

GNU Unifont

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# Chapter 1

## GNU Unifont

### 1.1 GNU Unifont C Utilities

This documentation covers C utility programs for creating GNU Unifont glyphs and fonts.

### 1.2 LICENSE

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### 1.3 Introduction

Unifont is the creation of Roman Czyborra, who created Perl utilities for generating a dual-width Bitmap Distribution Format (BDF) font 16 pixels tall, `unifont.bdf`, from an input file named `unifont.hex`. The `unifont.hex` file contained two fields separated by a colon: a Unicode code point as four hexadecimal digits, and a hexadecimal string of 32 or 64 characters representing the glyph bitmap pattern. Roman also wrote other Perl scripts for manipulating `unifont.hex` files.

Jungshik Shin wrote a Perl script, `johab2ucs2`, to convert Hangul syllable glyph elements into Hangul Johab-encoded fonts. These glyph elements are compatible with Jaekyung "Jake" Song's Hanterm terminal emulator. Paul Hardy modified `johab2ucs2` and drew Hangul Syllables Unicode elements for compatibility with this Johab encoding and with Hanterm. These new glyphs were created to avoid licensing issues with the Hangul Syllables glyphs that were in the original `unifont.hex` file.

Over time, Unifont was extended to allow correct positioning of combining marks in a TrueType font, coverage beyond Unicode Plane 0, and the addition of Under-ConScript Unicode Registry (UCSUR) glyphs. There is also partial support for experimental quadruple-width glyphs.

Paul Hardy wrote the first pair of C programs, [unihex2bmp.c](#) and [unibmp2hex.c](#), to facilitate editing the bitmaps at their real aspect ratio. These programs allow conversion between the Unifont .hex format and a Windows Bitmap or Wireless Bitmap file for editing with a graphics editor. This was followed by make files, other C programs, Perl scripts, and shell scripts.

Luis Alejandro González Miranda wrote scripts for converting unifont.hex into a TrueType font using FontForge.

Andrew Miller wrote additional Perl programs for directly rendering unifont.hex files, for converting unifont.hex to and from Portable Network Graphics (PNG) files for editing based upon Paul Hardy's BMP conversion programs, and also wrote other Perl scripts.

David Corbett wrote a Perl script to rotate glyphs in a unifont.hex file and an awk script to substitute new glyphs for old glyphs of the same Unicode code point in a unifont.hex file.

何志翔 (He Zhixiang) wrote a program to convert Unifont files into OpenType fonts, [hex2otf.c](#).

Minseo Lee created new Hangul glyphs for the original Unifont Johab 10/3 or 4/4 encoding. This was followed immediately after by Ho-Seok Ee, who created Hangul glyphs for a new, simpler Johab 6/3/1 encoding that are now in Unifont.

## 1.4 The C Programs

This documentation only covers C programs and their header files. These programs are typically longer than the Unifont package's Perl scripts, which being much smaller are easier to understand. The C programs are, in alphabetical order:

Program	Description
<a href="#">hex2otf.c</a>	Convert a GNU Unifont .hex file to an OpenType font
<a href="#">johab2syl</a>	Generate Hangul Syllables range with simple
	positioning



Program	Description
<a href="#">unibdf2hex</a>	Convert a BDF file into a uni-font.↔ hex file
<a href="#">unibmp2font</a>	Turn a .bmp or .wbmp glyph matrix into a GNU Uni-font hex glyph set of 256 characters
<a href="#">unibmp2png</a>	Adjust a Microsoft bitmap (.bmp) file that was created by uni-hex2png but converted to .bmp

Program	Description
<a href="#">unicoverage</a>	Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file
<a href="#">unidup.c</a>	Check for duplicate code points in sorted unifont. <a href="#">↵</a> hex file
<a href="#">unifont1p</a>	Read a Unifont .hex file from standard input and produce one glyph per .bmp bitmap file as output

Program	Description
<a href="#">unifontpic</a>	See the "Big Picture"↔ : the entire Unifont in one BMP bitmap
<a href="#">unigen-ha</a>	Generate modern and ancient Hangul syllables with shifting of final consonants combined with diphthongs having two long vertical strokes on the right
<a href="#">unigencirc</a>	Superimpose dashed combining circles on combining glyphs

Program	Description
<a href="#">unigenwidths</a>	IEEE 1003.1-2008 setup to calculate wchar_t string widths
<a href="#">unihex2bitmap</a>	Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing
<a href="#">unihexgen</a>	Generate a series of glyphs containing hexadecimal code points

Program	Description
<a href="#">unihexpos</a>	Transpose Uni- font .hex glyph bitmaps to sim- plify send- ing to graph- ics dis- play con- troller chips that read bitmaps as a se- ries of columns 8 rows (one byte) high

Program	Description
<a href="#">unijohab2font.c</a>	a hangul- base.↔ hex file and pro- duce an HTML page as out- put show- ing jux- tapo- sition and over- lap- ping of all letter com- bina- tions in mod- ern and an- cient Hangul sylla- bles

Program	Description
unipagecount	Count the number of glyphs defined in each page of 256 code points

## 1.5 Perl Scripts

The very first program written for Unifont conversion was Roman Czyborra's hexdraw Perl script. That one script would convert a unifont.hex file into a text file with 16 lines per glyph (one for each glyph row) followed by a blank line after each glyph. That allowed editing unifont.hex glyphs with a text-based editor.

Combined with Roman's hex2bdf Perl script to convert a unifont.hex file into a BDF font, these two scripts formed a complete package for editing Unifont and generating the resulting BDF fonts.

There was no combining mark support initially, and the original unifont.hex file included combining circles with combining mark glyphs.

The list below gives a brief description of these and the other Perl scripts that are in the Unifont package src subdirectory.

Perl Script	Description
bdfimplode	Convert a BDF font into GNU Unifont .hex format

Perl Script	Description
hex2bdf	Convert a GNU Unifont .hex file into a BDF font
hex2sfd	Convert a GNU Unifont .hex file into a Font $\leftrightarrow$ Forge .sfd format
hexbraille	Algorithmically generate the Unicode Braille range (U+28xx)
hexdraw	Convert a GNU Unifont .hex file to and from an ASCII text file



Perl Script	Description
hexkinya	Create the Private Use Area Kinya syllables
hexmerge	Merge two or more GNU Unifont .hex font files into one
johab2uc2	Convert a Johab BDF font into GNU Unifont Hangul Syllables
unifont-viewer	View a .hex font file with a graphical user interface

Perl Script	Description
unifontch01.pl	Extract Hangul syllables that have no final consonant
unifontks1001.pl	Extract Hangul syllables that comprise KS X 1001↔:1992
unihex2png	GNU Unifont .hex file to Portable Network Graphics converter
unihexfill	Generate range of Unifont 4- or 6-digit hexadecimal glyph

Perl Script	Description
unihexrot	Rotate Uni-font hex glyphs in quarter turn increments
unipng2he	Portable Network Graphics to GNU Uni-font .hex file converter



# Chapter 2

## Data Structure Index

### 2.1 Data Structures

Here are the data structures with brief descriptions:

<a href="#">Buffer</a>	Generic data structure for a linked list of buffer elements . . . . .	19
<a href="#">Font</a>	Data structure to hold information for one font . . . . .	20
<a href="#">Glyph</a>	Data structure to hold data for one bitmap glyph . . . . .	22
<a href="#">NamePair</a>	Data structure for a font ID number and name character string . . . . .	24
<a href="#">Options</a>	Data structure to hold options for OpenType font output . . . . .	25
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# Chapter 3

## File Index

### 3.1 File List

Here is a list of all documented files with brief descriptions:

<a href="#">src/hangul.h</a>	Define constants and function prototypes for using Hangul glyphs . . . . .	33
<a href="#">src/hex2otf.c</a>	Hex2otf - Convert GNU Unifont .hex file to OpenType font . . . . .	78
<a href="#">src/hex2otf.h</a>	<a href="#">Hex2otf.h</a> - Header file for <a href="#">hex2otf.c</a> . . . . .	194
<a href="#">src/johab2syllables.c</a>	Create the Unicode Hangul Syllables block from component letters . . . . .	198
<a href="#">src/unibdf2hex.c</a>	Unibdf2hex - Convert a BDF file into a unifont.hex file . . . . .	204
<a href="#">src/unibmp2hex.c</a>	Unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters . . . . .	208
<a href="#">src/unibmpbump.c</a>	Unibmpbump - Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp . . . . .	229
<a href="#">src/unicoverage.c</a>	Unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file	246
<a href="#">src/unidup.c</a>	Unidup - Check for duplicate code points in sorted unifont.hex file . . . . .	255
<a href="#">src/unifont-support.c</a>	: Support functions for Unifont .hex files . . . . .	259
<a href="#">src/unifont1per.c</a>	Unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output . . . . .	271
<a href="#">src/unifontpic.c</a>	Unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap . . . . .	276
<a href="#">src/unifontpic.h</a>	<a href="#">Unifontpic.h</a> - Header file for <a href="#">unifontpic.c</a> . . . . .	304
<a href="#">src/unigen-hangul.c</a>	Generate arbitrary hangul syllables . . . . .	309

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src/ <a href="#">unigencircles.c</a>	Unigencircles - Superimpose dashed combining circles on combining glyphs . . . . .	320
src/ <a href="#">unigenwidth.c</a>	Unigenwidth - IEEE 1003.1-2008 setup to calculate wchar_t string widths . . . . .	330
src/ <a href="#">unihangul-support.c</a>	Functions for converting Hangul letters into syllables . . . . .	340
src/ <a href="#">unihex2bmp.c</a>	Unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing . . . . .	381
src/ <a href="#">unihexgen.c</a>	Unihexgen - Generate a series of glyphs containing hexadecimal code points . . . . .	398
src/ <a href="#">unihexpose.c</a>	. . . . .	408
src/ <a href="#">unijohab2html.c</a>	Display overlapped Hangul letter combinations in a grid . . . . .	409
src/ <a href="#">unipagecount.c</a>	Unipagecount - Count the number of glyphs defined in each page of 256 code points . . .	428



# Chapter 4

## Data Structure Documentation

### 4.1 Buffer Struct Reference

Generic data structure for a linked list of buffer elements.

#### Data Fields

- [size\\_t capacity](#)
- [byte \\* begin](#)
- [byte \\* next](#)
- [byte \\* end](#)

#### 4.1.1 Detailed Description

Generic data structure for a linked list of buffer elements.

A buffer can act as a vector (when filled with 'store\*' functions), or a temporary output area (when filled with 'cache\*' functions). The 'store\*' functions use native endian. The 'cache\*' functions use big endian or other formats in OpenType. Beware of memory alignment.

Definition at line [133](#) of file [hex2otf.c](#).

#### 4.1.2 Field Documentation

##### 4.1.2.1 begin

[byte\\*](#) Buffer::begin

Definition at line [136](#) of file [hex2otf.c](#).

#### 4.1.2.2 capacity

size\_t Buffer::capacity

Definition at line 135 of file [hex2otf.c](#).

#### 4.1.2.3 end

byte \* Buffer::end

Definition at line 136 of file [hex2otf.c](#).

#### 4.1.2.4 next

byte \* Buffer::next

Definition at line 136 of file [hex2otf.c](#).

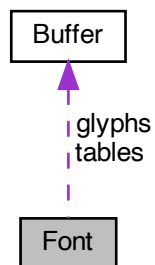
The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

## 4.2 Font Struct Reference

Data structure to hold information for one font.

Collaboration diagram for Font:



## Data Fields

- [Buffer \\* tables](#)
- [Buffer \\* glyphs](#)
- [uint\\_fast32\\_t glyphCount](#)
- [pixels\\_t maxWidth](#)

### 4.2.1 Detailed Description

Data structure to hold information for one font.

Definition at line [628](#) of file [hex2otf.c](#).

### 4.2.2 Field Documentation

#### 4.2.2.1 glyphCount

`uint_fast32_t Font::glyphCount`

Definition at line [632](#) of file [hex2otf.c](#).

#### 4.2.2.2 glyphs

`Buffer* Font::glyphs`

Definition at line [631](#) of file [hex2otf.c](#).

#### 4.2.2.3 maxWidth

`pixels_t Font::maxWidth`

Definition at line [633](#) of file [hex2otf.c](#).

#### 4.2.2.4 tables

[Buffer\\*](#) `Font::tables`

Definition at line [630](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

### 4.3 Glyph Struct Reference

Data structure to hold data for one bitmap glyph.

#### Data Fields

- `uint_least32_t` [codePoint](#)  
undefined for glyph 0
- `byte` [bitmap](#) [[GLYPH\\_MAX\\_BYTE\\_COUNT](#)]  
hexadecimal bitmap character array
- `uint_least8_t` [byteCount](#)  
length of bitmap data
- `bool` [combining](#)  
whether this is a combining glyph
- `pixels_t` [pos](#)
- `pixels_t` [lsb](#)  
left side bearing (x position of leftmost contour point)

#### 4.3.1 Detailed Description

Data structure to hold data for one bitmap glyph.

This data structure holds data to represent one Unifont bitmap glyph: Unicode code point, number of bytes in its bitmap array, whether or not it is a combining character, and an offset from the glyph origin to the start of the bitmap.

Definition at line [614](#) of file [hex2otf.c](#).

#### 4.3.2 Field Documentation

#### 4.3.2.1 bitmap

`byte` Glyph::bitmap[GLYPH\_MAX\_BYTE\_COUNT]

hexadecimal bitmap character array

Definition at line 617 of file [hex2otf.c](#).

#### 4.3.2.2 byteCount

`uint_least8_t` Glyph::byteCount

length of bitmap data

Definition at line 618 of file [hex2otf.c](#).

#### 4.3.2.3 codePoint

`uint_least32_t` Glyph::codePoint

undefined for glyph 0

Definition at line 616 of file [hex2otf.c](#).

#### 4.3.2.4 combining

`bool` Glyph::combining

whether this is a combining glyph

Definition at line 619 of file [hex2otf.c](#).

#### 4.3.2.5 lsb

`pixels_t` Glyph::lsb

left side bearing (x position of leftmost contour point)

Definition at line 622 of file [hex2otf.c](#).

#### 4.3.2.6 pos

`pixels_t Glyph::pos`

number of pixels the glyph should be moved to the right (negative number means moving to the left)

Definition at line [620](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

## 4.4 NamePair Struct Reference

Data structure for a font ID number and name character string.

```
#include <hex2otf.h>
```

### Data Fields

- `int id`
- `const char * str`

#### 4.4.1 Detailed Description

Data structure for a font ID number and name character string.

Definition at line [77](#) of file [hex2otf.h](#).

#### 4.4.2 Field Documentation

##### 4.4.2.1 id

`int NamePair::id`

Definition at line [79](#) of file [hex2otf.h](#).

#### 4.4.2.2 str

const char\* NamePair::str

Definition at line 80 of file [hex2otf.h](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.h](#)

## 4.5 Options Struct Reference

Data structure to hold options for OpenType font output.

### Data Fields

- bool [truetype](#)
- bool [blankOutline](#)
- bool [bitmap](#)
- bool [gpos](#)
- bool [gsub](#)
- int [cff](#)
- const char \* [hex](#)
- const char \* [pos](#)
- const char \* [out](#)
- [NameStrings](#) [nameStrings](#)

### 4.5.1 Detailed Description

Data structure to hold options for OpenType font output.

This data structure holds the status of options that can be specified as command line arguments for creating the output OpenType font file.

Definition at line 2453 of file [hex2otf.c](#).

### 4.5.2 Field Documentation

#### 4.5.2.1 bitmap

bool Options::bitmap

Definition at line 2455 of file [hex2otf.c](#).

#### 4.5.2.2 blankOutline

bool Options::blankOutline

Definition at line [2455](#) of file [hex2otf.c](#).

#### 4.5.2.3 cff

int Options::cff

Definition at line [2456](#) of file [hex2otf.c](#).

#### 4.5.2.4 gpos

bool Options::gpos

Definition at line [2455](#) of file [hex2otf.c](#).

#### 4.5.2.5 gsub

bool Options::gsub

Definition at line [2455](#) of file [hex2otf.c](#).

#### 4.5.2.6 hex

const char\* Options::hex

Definition at line [2457](#) of file [hex2otf.c](#).

#### 4.5.2.7 nameStrings

[NameStrings](#) Options::nameStrings

Definition at line [2458](#) of file [hex2otf.c](#).



#### 4.5.2.8 out

const char \* Options::out

Definition at line [2457](#) of file [hex2otf.c](#).

#### 4.5.2.9 pos

const char \* Options::pos

Definition at line [2457](#) of file [hex2otf.c](#).

#### 4.5.2.10 truetype

bool Options::truetype

Definition at line [2455](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)

## 4.6 PARAMS Struct Reference

### Data Fields

- unsigned [starting\\_codept](#)
- unsigned [cho\\_start](#)
- unsigned [cho\\_end](#)
- unsigned [jung\\_start](#)
- unsigned [jung\\_end](#)
- unsigned [jong\\_start](#)
- unsigned [jong\\_end](#)
- FILE \* [infp](#)
- FILE \* [outfp](#)

#### 4.6.1 Detailed Description

Definition at line [55](#) of file [unigen-hangul.c](#).

## 4.6.2 Field Documentation

### 4.6.2.1 cho\_end

unsigned PARAMS::cho\_end

Definition at line 57 of file [unigen-hangul.c](#).

### 4.6.2.2 cho\_start

unsigned PARAMS::cho\_start

Definition at line 57 of file [unigen-hangul.c](#).

### 4.6.2.3 infp

FILE\* PARAMS::infp

Definition at line 60 of file [unigen-hangul.c](#).

### 4.6.2.4 jong\_end

unsigned PARAMS::jong\_end

Definition at line 59 of file [unigen-hangul.c](#).

### 4.6.2.5 jong\_start

unsigned PARAMS::jong\_start

Definition at line 59 of file [unigen-hangul.c](#).

#### 4.6.2.6 jung\_end

unsigned PARAMS::jung\_end

Definition at line 58 of file [unigen-hangul.c](#).

#### 4.6.2.7 jung\_start

unsigned PARAMS::jung\_start

Definition at line 58 of file [unigen-hangul.c](#).

#### 4.6.2.8 outfp

FILE\* PARAMS::outfp

Definition at line 61 of file [unigen-hangul.c](#).

#### 4.6.2.9 starting\_codept

unsigned PARAMS::starting\_codept

Definition at line 56 of file [unigen-hangul.c](#).

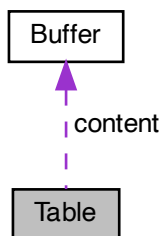
The documentation for this struct was generated from the following file:

- [src/unigen-hangul.c](#)

## 4.7 Table Struct Reference

Data structure for an OpenType table.

Collaboration diagram for Table:



## Data Fields

- `uint_fast32_t tag`
- `Buffer * content`

### 4.7.1 Detailed Description

Data structure for an OpenType table.

This data structure contains a table tag and a pointer to the start of the buffer that holds data for this OpenType table.

For information on the OpenType tables and their structure, see <https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables>.

Definition at line 645 of file `hex2otf.c`.

### 4.7.2 Field Documentation

#### 4.7.2.1 content

`Buffer* Table::content`

Definition at line 648 of file `hex2otf.c`.

#### 4.7.2.2 tag

`uint_fast32_t Table::tag`

Definition at line 647 of file `hex2otf.c`.

The documentation for this struct was generated from the following file:

- `src/hex2otf.c`

## 4.8 TableRecord Struct Reference

Data structure for data associated with one OpenType table.

## Data Fields

- `uint_least32_t` [tag](#)
- `uint_least32_t` [offset](#)
- `uint_least32_t` [length](#)
- `uint_least32_t` [checksum](#)

### 4.8.1 Detailed Description

Data structure for data associated with one OpenType table.

This data structure contains an OpenType table's tag, start within an OpenType font file, length in bytes, and checksum at the end of the table.

Definition at line [747](#) of file [hex2otf.c](#).

### 4.8.2 Field Documentation

#### 4.8.2.1 checksum

`uint_least32_t` `TableRecord::checksum`

Definition at line [749](#) of file [hex2otf.c](#).

#### 4.8.2.2 length

`uint_least32_t` `TableRecord::length`

Definition at line [749](#) of file [hex2otf.c](#).

#### 4.8.2.3 offset

`uint_least32_t` `TableRecord::offset`

Definition at line [749](#) of file [hex2otf.c](#).

#### 4.8.2.4 tag

`uint_least32_t` `TableRecord::tag`

Definition at line [749](#) of file [hex2otf.c](#).

The documentation for this struct was generated from the following file:

- [src/hex2otf.c](#)



# Chapter 5

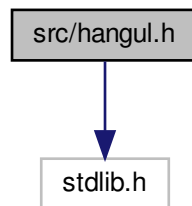
## File Documentation

### 5.1 src/hangul.h File Reference

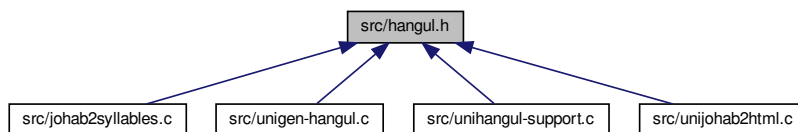
Define constants and function prototypes for using Hangul glyphs.

```
#include <stdlib.h>
```

Include dependency graph for hangul.h:



This graph shows which files directly or indirectly include this file:



## Macros

- #define `MAXLINE` 256  
Length of maximum file input line.
- #define `EXTENDED_HANGUL` /\* Use rare Hangul code points beyond U+1100 \*/
- #define `PUA_START` 0xE000
- #define `PUA_END` 0xE8FF
- #define `MAX_GLYPHS` (PUA\_END - PUA\_START + 1) /\* Maximum .hex file glyphs \*/
- #define `CHO_UNICODE_START` 0x1100  
Modern Hangul choseong start.
- #define `CHO_UNICODE_END` 0x115E  
Hangul Jamo choseong end.
- #define `CHO_EXTA_UNICODE_START` 0xA960  
Hangul Extended-A choseong start.
- #define `CHO_EXTA_UNICODE_END` 0xA97C  
Hangul Extended-A choseong end.
- #define `JUNG_UNICODE_START` 0x1161  
Modern Hangul jungseong start.
- #define `JUNG_UNICODE_END` 0x11A7  
Modern Hangul jungseong end.
- #define `JUNG_EXTB_UNICODE_START` 0xD7B0  
Hangul Extended-B jungseong start.
- #define `JUNG_EXTB_UNICODE_END` 0xD7C6  
Hangul Extended-B jungseong end.
- #define `JONG_UNICODE_START` 0x11A8  
Modern Hangul jongseong start.
- #define `JONG_UNICODE_END` 0x11FF  
Modern Hangul jongseong end.
- #define `JONG_EXTB_UNICODE_START` 0xD7CB  
Hangul Extended-B jongseong start.
- #define `JONG_EXTB_UNICODE_END` 0xD7FB  
Hangul Extended-B jongseong end.
- #define `NCHO_MODERN` 19  
19 modern Hangul Jamo choseong
- #define `NCHO_ANCIENT` 76  
ancient Hangul Jamo choseong
- #define `NCHO_EXTA` 29  
Hangul Extended-A choseong.
- #define `NCHO_EXTA_RSRVD` 3  
Reserved at end of Extended-A choseong.
- #define `NJUNG_MODERN` 21  
21 modern Hangul Jamo jungseong
- #define `NJUNG_ANCIENT` 50  
ancient Hangul Jamo jungseong
- #define `NJUNG_EXTB` 23  
Hangul Extended-B jungseong.
- #define `NJUNG_EXTB_RSRVD` 4



- Reserved at end of Extended-B junseong.
- #define `NJONG_MODERN` 27  
28 modern Hangul Jamo jongseong
- #define `NJONG_ANCIENT` 61  
ancient Hangul Jamo jongseong
- #define `NJONG_EXTB` 49  
Hangul Extended-B jongseong.
- #define `NJONG_EXTB_RSRVD` 4  
Reserved at end of Extended-B jonseong.
- #define `CHO_VARIATIONS` 6  
6 choseong variations
- #define `JUNG_VARIATIONS` 3  
3 jungseong variations
- #define `JONG_VARIATIONS` 1  
1 jongseong variation
- #define `CHO_HEX` 0x0001  
Location of first choseong (location 0x0000 is a blank glyph)
- #define `CHO_ANCIENT_HEX` (`CHO_HEX` + `CHO_VARIATIONS` \* `NCHO_MODERN`)  
Location of first ancient choseong.
- #define `CHO_EXTA_HEX` (`CHO_ANCIENT_HEX` + `CHO_VARIATIONS` \* `NCHO_ANCIENT`)  
U+A960 Extended-A choseong.
- #define `CHO_LAST_HEX` (`CHO_EXTA_HEX` + `CHO_VARIATIONS` \* (`NCHO_EXTA` + `NCHO_EXTA_RSRVD`) - 1)  
U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end.
- #define `JUNG_HEX` (`CHO_LAST_HEX` + 1)  
Location of first jungseong (will be 0x2FB)
- #define `JUNG_ANCIENT_HEX` (`JUNG_HEX` + `JUNG_VARIATIONS` \* `NJUNG_MODERN`)  
Location of first ancient jungseong.
- #define `JUNG_EXTB_HEX` (`JUNG_ANCIENT_HEX` + `JUNG_VARIATIONS` \* `NJUNG_ANCIENT`)  
U+D7B0 Extended-B jungseong.
- #define `JUNG_LAST_HEX` (`JUNG_EXTB_HEX` + `JUNG_VARIATIONS` \* (`NJUNG_EXTB` + `NJUNG_EXTB_RSRVD`) - 1)  
U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end.
- #define `JONG_HEX` (`JUNG_LAST_HEX` + 1)  
Location of first jongseong (will be 0x421)
- #define `JONG_ANCIENT_HEX` (`JONG_HEX` + `JONG_VARIATIONS` \* `NJONG_MODERN`)  
Location of first ancient jongseong.
- #define `JONG_EXTB_HEX` (`JONG_ANCIENT_HEX` + `JONG_VARIATIONS` \* `NJONG_ANCIENT`)  
U+D7CB Extended-B jongseong.
- #define `JONG_LAST_HEX` (`JONG_EXTB_HEX` + `JONG_VARIATIONS` \* (`NJONG_EXTB` + `NJONG_EXTB_RSRVD`) - 1)  
U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end.
- #define `JAMO_HEX` 0x0500  
Start of U+1100..U+11FF glyphs.
- #define `JAMO_END` 0x05FF  
End of U+1100..U+11FF glyphs.
- #define `JAMO_EXTA_HEX` 0x0600

- Start of U+A960..U+A97F glyphs.
- `#define JAMO_EXT_A_END 0x061F`  
End of U+A960..U+A97F glyphs.
- `#define JAMO_EXTB_HEX 0x0620`  
Start of U+D7B0..U+D7FF glyphs.
- `#define JAMO_EXTB_END 0x066F`  
End of U+D7B0..U+D7FF glyphs.
- `#define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT + NCHO_EXT_A )`
- `#define TOTAL_JUNG (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)`
- `#define TOTAL_JONG (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)`

## Functions

- unsigned `hangul_read_base8` (FILE \*infp, unsigned char base[][32])  
Read hangul-base.hex file into a unsigned char array.
- unsigned `hangul_read_base16` (FILE \*infp, unsigned base[][16])  
Read hangul-base.hex file into a unsigned array.
- void `hangul_decompose` (unsigned codept, int \*initial, int \*medial, int \*final)  
Decompose a Hangul Syllables code point into three letters.
- unsigned `hangul_compose` (int initial, int medial, int final)  
Compose a Hangul syllable into a code point, or 0 if none exists.
- void `hangul_hex_indices` (int choseong, int jungseong, int jongseong, int \*cho\_index, int \*jung\_index, int \*jong\_index)  
Determine index values to the bitmaps for a syllable's components.
- void `hangul_variations` (int choseong, int jungseong, int jongseong, int \*cho\_var, int \*jung\_var, int \*jong\_var)  
Determine the variations of each letter in a Hangul syllable.
- int `is_wide_vowel` (int vowel)  
Whether vowel has rightmost vertical stroke to the right.
- int `cho_variation` (int choseong, int jungseong, int jongseong)  
Return the Johab 6/3/1 choseong variation for a syllable.
- int `jung_variation` (int choseong, int jungseong, int jongseong)  
Return the Johab 6/3/1 jungseong variation.
- int `jong_variation` (int choseong, int jungseong, int jongseong)  
Return the Johab 6/3/1 jongseong variation.
- void `hangul_syllable` (int choseong, int jungseong, int jongseong, unsigned char hangul\_base[][32], unsigned char \*syllable)  
Given letters in a Hangul syllable, return a glyph.
- int `glyph_overlap` (unsigned \*glyph1, unsigned \*glyph2)  
See if two glyphs overlap.
- void `combine_glyphs` (unsigned \*glyph1, unsigned \*glyph2, unsigned \*combined\_glyph)  
Combine two glyphs into one glyph.
- void `one_jamo` (unsigned glyph\_table[MAX\_GLYPHS][16], unsigned jamo, unsigned \*jamo\_glyph)  
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
- void `combined_jamo` (unsigned glyph\_table[MAX\_GLYPHS][16], unsigned cho, unsigned jung, unsigned jong, unsigned \*combined\_glyph)  
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
- void `print_glyph_txt` (FILE \*fp, unsigned codept, unsigned \*this\_glyph)  
Print one glyph in Unifont hexdraw plain text style.
- void `print_glyph_hex` (FILE \*fp, unsigned codept, unsigned \*this\_glyph)  
Print one glyph in Unifont hexdraw hexadecimal string style.

### 5.1.1 Detailed Description

Define constants and function prototypes for using Hangul glyphs.

Author

Paul Hardy

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Definition in file [hangul.h](#).

### 5.1.2 Macro Definition Documentation

#### 5.1.2.1 CHO\_ANCIENT\_HEX

```
#define CHO_ANCIENT_HEX (CHO_HEX + CHO_VARIATIONS * NCHO_MODERN)
```

Location of first ancient choseong.

Definition at line 99 of file [hangul.h](#).

#### 5.1.2.2 CHO\_EXT\_A\_HEX

```
#define CHO_EXT_A_HEX (CHO_ANCIENT_HEX + CHO_VARIATIONS * NCHO_ANCIENT)
```

U+A960 Extended-A choseong.

Definition at line 102 of file [hangul.h](#).

#### 5.1.2.3 CHO\_EXT\_A\_UNICODE\_END

```
#define CHO_EXT_A_UNICODE_END 0xA97C
```

Hangul Extended-A choseong end.

Definition at line 53 of file [hangul.h](#).

#### 5.1.2.4 CHO\_EXTA\_UNICODE\_START

```
#define CHO_EXTA_UNICODE_START 0xA960
```

Hangul Extended-A choseong start.

Definition at line [52](#) of file [hangul.h](#).

#### 5.1.2.5 CHO\_HEX

```
#define CHO_HEX 0x0001
```

Location of first choseong (location 0x0000 is a blank glyph)

Definition at line [96](#) of file [hangul.h](#).

#### 5.1.2.6 CHO\_LAST\_HEX

```
#define CHO_LAST_HEX (CHO_EXTA_HEX + CHO_VARIATIONS * (NCHO_EXTA + NCHO_EXTA_RSRVD) - 1)
```

U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end.

Definition at line [105](#) of file [hangul.h](#).

#### 5.1.2.7 CHO\_UNICODE\_END

```
#define CHO_UNICODE_END 0x115E
```

Hangul Jamo choseong end.

Definition at line [51](#) of file [hangul.h](#).

#### 5.1.2.8 CHO\_UNICODE\_START

```
#define CHO_UNICODE_START 0x1100
```

Modern Hangul choseong start.

Definition at line [50](#) of file [hangul.h](#).

### 5.1.2.9 CHO\_VARIATIONS

```
#define CHO_VARIATIONS 6
```

6 choseong variations

Definition at line 88 of file [hangul.h](#).

### 5.1.2.10 EXTENDED\_HANGUL

```
#define EXTENDED_HANGUL /* Use rare Hangul code points beyond U+1100 */
```

Definition at line 35 of file [hangul.h](#).

### 5.1.2.11 JAMO\_END

```
#define JAMO_END 0x05FF
```

End of U+1100..U+11FF glyphs.

Definition at line 133 of file [hangul.h](#).

### 5.1.2.12 JAMO\_EXTA\_END

```
#define JAMO_EXTA_END 0x061F
```

End of U+A960..U+A97F glyphs.

Definition at line 137 of file [hangul.h](#).

### 5.1.2.13 JAMO\_EXTA\_HEX

```
#define JAMO_EXTA_HEX 0x0600
```

Start of U+A960..U+A97F glyphs.

Definition at line 136 of file [hangul.h](#).

#### 5.1.2.14 JAMO\_EXTB\_END

```
#define JAMO_EXTB_END 0x066F
```

End of U+D7B0..U+D7FF glyphs.

Definition at line [141](#) of file [hangul.h](#).

#### 5.1.2.15 JAMO\_EXTB\_HEX

```
#define JAMO_EXTB_HEX 0x0620
```

Start of U+D7B0..U+D7FF glyphs.

Definition at line [140](#) of file [hangul.h](#).

#### 5.1.2.16 JAMO\_HEX

```
#define JAMO_HEX 0x0500
```

Start of U+1100..U+11FF glyphs.

Definition at line [132](#) of file [hangul.h](#).

#### 5.1.2.17 JONG\_ANCIENT\_HEX

```
#define JONG_ANCIENT_HEX (JONG_HEX + JONG_VARIATIONS * NJONG_MODERN)
```

Location of first ancient jongseong.

Definition at line [123](#) of file [hangul.h](#).

#### 5.1.2.18 JONG\_EXTB\_HEX

```
#define JONG_EXTB_HEX (JONG_ANCIENT_HEX + JONG_VARIATIONS * NJONG_ANCIENT)
```

U+D7CB Extended-B jongseong.

Definition at line [126](#) of file [hangul.h](#).

#### 5.1.2.19 JONG\_EXTB\_UNICODE\_END

```
#define JONG_EXTB_UNICODE_END 0xD7FB
```

Hangul Extended-B jongseong end.

Definition at line [63](#) of file [hangul.h](#).

#### 5.1.2.20 JONG\_EXTB\_UNICODE\_START

```
#define JONG_EXTB_UNICODE_START 0xD7CB
```

Hangul Extended-B jongseong start.

Definition at line [62](#) of file [hangul.h](#).

#### 5.1.2.21 JONG\_HEX

```
#define JONG_HEX (JONG_LAST_HEX + 1)
```

Location of first jongseong (will be 0x421)

Definition at line [120](#) of file [hangul.h](#).

#### 5.1.2.22 JONG\_LAST\_HEX

```
#define JONG_LAST_HEX (JONG_EXTB_HEX + JONG_VARIATIONS * (NJONG_EXTB + NJONG_EXTB_RSRVD) - 1)
```

U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end.

Definition at line [129](#) of file [hangul.h](#).

#### 5.1.2.23 JONG\_UNICODE\_END

```
#define JONG_UNICODE_END 0x11FF
```

Modern Hangul jongseong end.

Definition at line [61](#) of file [hangul.h](#).

#### 5.1.2.24 JONG\_UNICODE\_START

```
#define JONG_UNICODE_START 0x11A8
```

Modern Hangul jongseong start.

Definition at line [60](#) of file [hangul.h](#).

#### 5.1.2.25 JONG\_VARIATIONS

```
#define JONG_VARIATIONS 1
```

1 jongseong variation

Definition at line [90](#) of file [hangul.h](#).

#### 5.1.2.26 JUNG\_ANCIENT\_HEX

```
#define JUNG_ANCIENT_HEX (JUNG_HEX + JONG_VARIATIONS * NJUNG_MODERN)
```

Location of first ancient jungseong.

Definition at line [111](#) of file [hangul.h](#).

#### 5.1.2.27 JUNG\_EXTB\_HEX

```
#define JUNG_EXTB_HEX (JUNG_ANCIENT_HEX + JONG_VARIATIONS * NJUNG_ANCIENT)
```

U+D7B0 Extended-B jungseong.

Definition at line [114](#) of file [hangul.h](#).

#### 5.1.2.28 JUNG\_EXTB\_UNICODE\_END

```
#define JUNG_EXTB_UNICODE_END 0xD7C6
```

Hangul Extended-B jungseong end.

Definition at line [58](#) of file [hangul.h](#).



#### 5.1.2.29 JUNG\_EXTB\_UNICODE\_START

```
#define JUNG_EXTB_UNICODE_START 0xD7B0
```

Hangul Extended-B jungseong start.

Definition at line 57 of file [hangul.h](#).

#### 5.1.2.30 JUNG\_HEX

```
#define JUNG_HEX (CHO_LAST_HEX + 1)
```

Location of first jungseong (will be 0x2FB)

Definition at line 108 of file [hangul.h](#).

#### 5.1.2.31 JUNG\_LAST\_HEX

```
#define JUNG_LAST_HEX (JUNG_EXTB_HEX + JUNG_VARIATIONS * (NJUNG_EXTB + NJUNG_EXTB_RSRVD) - 1)
```

U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end.

Definition at line 117 of file [hangul.h](#).

#### 5.1.2.32 JUNG\_UNICODE\_END

```
#define JUNG_UNICODE_END 0x11A7
```

Modern Hangul jungseong end.

Definition at line 56 of file [hangul.h](#).

#### 5.1.2.33 JUNG\_UNICODE\_START

```
#define JUNG_UNICODE_START 0x1161
```

Modern Hangul jungseong start.

Definition at line 55 of file [hangul.h](#).

#### 5.1.2.34 JUNG\_VARIATIONS

```
#define JUNG_VARIATIONS 3
```

3 jungseong variations

Definition at line [89](#) of file [hangul.h](#).

#### 5.1.2.35 MAX\_GLYPHS

```
#define MAX_GLYPHS (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
```

Definition at line [40](#) of file [hangul.h](#).

#### 5.1.2.36 MAXLINE

```
#define MAXLINE 256
```

Length of maximum file input line.

Definition at line [33](#) of file [hangul.h](#).

#### 5.1.2.37 NCHO\_ANCIENT

```
#define NCHO_ANCIENT 76
```

ancient Hangul Jamo choseong

Definition at line [70](#) of file [hangul.h](#).

#### 5.1.2.38 NCHO\_EXT\_A

```
#define NCHO_EXT_A 29
```

Hangul Extended-A choseong.

Definition at line [71](#) of file [hangul.h](#).

#### 5.1.2.39 NCHO\_EXTA\_RSRVD

```
#define NCHO_EXTA_RSRVD 3
```

Reserved at end of Extended-A choseong.

Definition at line 72 of file [hangul.h](#).

#### 5.1.2.40 NCHO\_MODERN

```
#define NCHO_MODERN 19
```

19 modern Hangul Jamo choseong

Definition at line 69 of file [hangul.h](#).

#### 5.1.2.41 NJONG\_ANCIENT

```
#define NJONG_ANCIENT 61
```

ancient Hangul Jamo jongseong

Definition at line 80 of file [hangul.h](#).

#### 5.1.2.42 NJONG\_EXTB

```
#define NJONG_EXTB 49
```

Hangul Extended-B jongseong.

Definition at line 81 of file [hangul.h](#).

#### 5.1.2.43 NJONG\_EXTB\_RSRVD

```
#define NJONG_EXTB_RSRVD 4
```

Reserved at end of Extended-B jonseong.

Definition at line 82 of file [hangul.h](#).

#### 5.1.2.44 NJONG\_MODERN

```
#define NJONG_MODERN 27
```

28 modern Hangul Jamo jongseong

Definition at line [79](#) of file [hangul.h](#).

#### 5.1.2.45 NJUNG\_ANCIENT

```
#define NJUNG_ANCIENT 50
```

ancient Hangul Jamo jungseong

Definition at line [75](#) of file [hangul.h](#).

#### 5.1.2.46 NJUNG\_EXTB

```
#define NJUNG_EXTB 23
```

Hangul Extended-B jungseong.

Definition at line [76](#) of file [hangul.h](#).

#### 5.1.2.47 NJUNG\_EXTB\_RSRVD

```
#define NJUNG_EXTB_RSRVD 4
```

Reserved at end of Extended-B junseong.

Definition at line [77](#) of file [hangul.h](#).

#### 5.1.2.48 NJUNG\_MODERN

```
#define NJUNG_MODERN 21
```

21 modern Hangul Jamo jungseong

Definition at line [74](#) of file [hangul.h](#).

#### 5.1.2.49 PUA\_END

```
#define PUA_END 0xE8FF
```

Definition at line [39](#) of file [hangul.h](#).

#### 5.1.2.50 PUA\_START

```
#define PUA_START 0xE000
```

Definition at line [38](#) of file [hangul.h](#).

#### 5.1.2.51 TOTAL\_CHO

```
#define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT + NCHO_EXT_A )
```

Definition at line [150](#) of file [hangul.h](#).

#### 5.1.2.52 TOTAL\_JONG

```
#define TOTAL_JONG (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)
```

Definition at line [152](#) of file [hangul.h](#).

#### 5.1.2.53 TOTAL\_JUNG

```
#define TOTAL_JUNG (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)
```

Definition at line [151](#) of file [hangul.h](#).

### 5.1.3 Function Documentation

### 5.1.3.1 cho\_variation()

```
int cho_variation (
    int choseong,
    int jungseong,
    int jongseong )
```

Return the Johab 6/3/1 choseong variation for a syllable.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the initial consonant (choseong).

Each choseong has 6 variations:

#### Variation Occurrence

0 Choseong with a vertical vowel such as "A". 1 Choseong with a horizontal vowel such as "O". 2 Choseong with a vertical and horizontal vowel such as "WA". 3 Same as variation 0, but with jongseong (final consonant). 4 Same as variation 1, but with jongseong (final consonant). Also a horizontal vowel pointing down, such as U and YU. 5 Same as variation 2, but with jongseong (final consonant). Also a horizontal vowel pointing down with vertical element, such as WEO, WE, and WI.

In addition, if the vowel is horizontal and a downward-pointing stroke as in the modern letters U, WEO, WE, WI, and YU, and in archaic letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added to the initial variation of 0 to 2, resulting in a choseong variation of 3 to 5, respectively.

#### Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

#### Returns

The choseong variation, 0 to 5.

Definition at line 350 of file [unihangul-support.c](#).

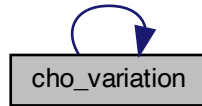
```
00350 {
00351     int cho_variation; /* Return value */
00352
00353     /*
00354     The Choseong cho_var is determined by the
00355     21 modern + 50 ancient Jungseong, and whether
```

```

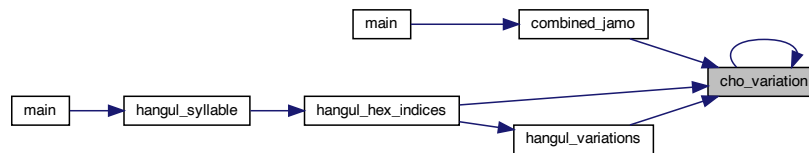
00356 or not the syllable contains a final consonant
00357 (Jongseong).
00358 */
00359 static int choseong_var [TOTAL_JUNG + 1] = {
00360     /*
00361 Modern Jungseong in positions 0..20.
00362 */
00363 /* Location Variations Unicode Range Vowel # Vowel Names */
00364 /* ----- */
00365 /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00366 /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00367 /* 0x30D */ 0, 0, 0, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00368 /* 0x313 */ 1, // U+1169 -->[ 8] O
00369 /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00370 /* 0x31F */ 1, 4, // U+116D..U+116E-->[12..13] YO, U
00371 /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16] WEO, WE, WI
00372 /* 0x32E */ 4, 1, // U+1172..U+1173-->[17..18] YU, EU
00373 /* 0x334 */ 2, // U+1174 -->[19] YI
00374 /* 0x337 */ 0, // U+1175 -->[20] I
00375     /*
00376 Ancient Jungseong in positions 21..70.
00377 */
00378 /* Location Variations Unicode Range Vowel # Vowel Names */
00379 /* ----- */
00380 /* 0x33A: */ 2, 5, 2, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00381 /* 0x343: */ 2, 2, 5, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00382 /* 0x34C: */ 2, 2, 5, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00383 /* 0x355: */ 2, 5, 5, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00384 /* 0x35E: */ 4, 4, 2, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00385 /* 0x367: */ 2, 2, 5, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00386 /* 0x370: */ 2, 5, 5, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00387 /* 0x379: */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00388 /* 0x382: */ 5, 5, 5, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00389 /* 0x38B: */ 5, 5, 2, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00390 /* 0x394: */ 5, 2, 2, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00391 /* 0x39D: */ 2, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00392 /* 0x3A6: */ 2, 5, 2, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00393 /* 0x3AF: */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00394 /* 0x3B8: */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00395 /* 0x3C1: */ 2, 5, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00396 /* 0x3CA: */ 2, 2, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE,
00397 #ifdef EXTENDED_HANGUL
00398 /* 0x3D0: */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00399 /* 0x3D9: */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00400 /* 0x3E2: */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00401 /* 0x3EB: */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00405 /* 0x40F: */ 2, 2, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1 // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1 // Mark end of list of vowels.
00409 #endif
00410 };
00411
00412
00413 if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415 }
00416 else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jungseong >= 0 && cho_variation < 3)
00419         cho_variation += 3;
00420 }
00421
00422
00423 return cho_variation;
00424 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.1.3.2 combine\_glyphs()

```

void combine_glyphs (
    unsigned * glyph1,
    unsigned * glyph2,
    unsigned * combined_glyph )
  
```

Combine two glyphs into one glyph.

Parameters

in	glyph1	The first glyph to overlap.
in	glyph2	The second glyph to overlap.



## Parameters

out	combined_glyph	The re-returned combination glyph.
-----	----------------	------------------------------------

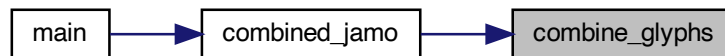
Definition at line 637 of file [unihangul-support.c](#).

```

00638     {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642         combined_glyph [i] = glyph1 [i] | glyph2 [i];
00643
00644     return;
00645 }

```

Here is the caller graph for this function:



## 5.1.3.3 combined\_jamo()

```

void combined_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned cho,
    unsigned jung,
    unsigned jong,
    unsigned * combined_glyph )

```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

This function converts input Hangul choseong, jungseong, and jongseong Unicode code triplets into a Hangul syllable. Any of those with an out of range code point are assigned a blank glyph for combining. This function performs the following steps:

- 1) Determine the sequence number of choseong, jungseong, and jongseong, from 0 to the total number of choseong, jungseong, or jongseong, respectively, minus one. The sequence for each is as follows:
  - a) Choseong: Unicode code points of U+1100..U+115E and then U+A960..U+A97C.
  - b) Jungseong: Unicode code points of U+1161..U+11A7 and then U+D7B0..U+D7C6.
  - c) Jongseong: Unicode code points of U+11A8..U+11FF and then U+D7CB..U+D7FB.

- 2) From the choseong, jungseong, and jongseong sequence number, determine the variation of choseong and jungseong (there is only one jongseong variation, although it is shifted right by one column for some vowels with a pair of long vertical strokes on the right side).
- 3) Convert the variation numbers for the three syllable components to index locations in the glyph array.
- 4) Combine the glyph array glyphs into a syllable.

#### Parameters

in	glyph_table	The collection of all jamo glyphs.
in	cho	The choseong Unicode code point, 0 or 0x1100..0x115F.
in	jung	The jungseong Unicode code point, 0 or 0x1160..0x11A7.
in	jong	The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
out	combined_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 787 of file `unihangul-support.c`.

```

00789     {
00790
00791     int i; /* Loop variable. */
00792     int cho_num, jung_num, jong_num;
00793     int cho_group, jung_group, jong_group;
00794     int cho_index, jung_index, jong_index;
00795
00796     unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00797
00798     int cho_variation (int choseong, int jungseong, int jongseong);
00799
00800     void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00801                        unsigned *combined_glyph);
00802
00803
00804     /* Choose a blank glyph for each syllalbe by default. */
00805     cho_index = jung_index = jong_index = 0x000;
00806
00807     /*
00808     Convert Unicode code points to jamo sequence number
00809     of each letter, or -1 if letter is not in valid range.
00810     */
00811     if (cho >= 0x1100 && cho <= 0x115E)
00812         cho_num = cho - CHO_UNICODE_START;
00813     else if (cho >= CHO_EXTB_UNICODE_START &&
00814            cho < (CHO_EXTB_UNICODE_START + NCHO_EXTB))
00815         cho_num = cho - CHO_EXTB_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816     else
00817         cho_num = -1;
00818
00819     if (jung >= 0x1161 && jung <= 0x11A7)
00820         jung_num = jung - JUNG_UNICODE_START;
00821     else if (jung >= JUNG_EXTB_UNICODE_START &&
00822            jung < (JUNG_EXTB_UNICODE_START + NJUNG_EXTB))
00823         jung_num = jung - JUNG_EXTB_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824     else
00825         jung_num = -1;
00826
00827     if (jong >= 0x11A8 && jong <= 0x11FF)
00828         jong_num = jong - JONG_UNICODE_START;
00829     else if (jong >= JONG_EXTB_UNICODE_START &&
00830            jong < (JONG_EXTB_UNICODE_START + NJONG_EXTB))
00831         jong_num = jong - JONG_EXTB_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832     else
00833         jong_num = -1;
00834
00835     /*
00836     Choose initial consonant (choseong) variation based upon
00837     the vowel (jungseong) if both are specified.
00838     */
00839     if (cho_num < 0) {
00840         cho_index = cho_group = 0; /* Use blank glyph for choseong. */
00841     }
00842     else {
00843         if (jung_num < 0 && jong_num < 0) { /* Choseong is by itself. */
00844             cho_group = 0;
00845             if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846                 cho_index = cho_num + JAMO_HEX;
00847             else /* Choseong is in Hangul Jamo Extended-A range. */
00848                 cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                     + JAMO_EXTB_HEX;
00850         }
00851         else {
00852             if (jung_num >= 0) { /* Valid jungseong with choseong. */
00853                 cho_group = cho_variation (cho_num, jung_num, jong_num);
00854             }
00855             else { /* Invalid vowel; see if final consonant is valid. */
00856                 /*
00857                 If initial consonant and final consonant are specified,
00858                 set cho_group to 4, which is the group tha would apply
00859                 to a horizontal-only vowel such as Hangul "O", so the
00860                 consonant appears full-width.
00861                 */
00862                 cho_group = 0;
00863                 if (jong_num >= 0) {
00864                     cho_group = 4;
00865                 }
00866             }
00867             cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868                 cho_group;

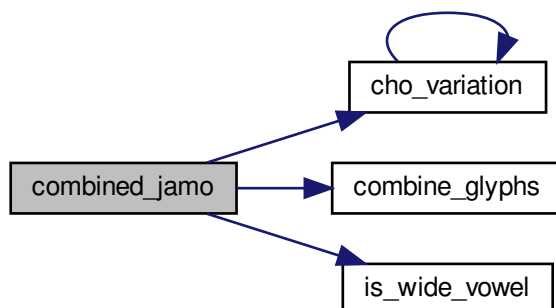
```

```

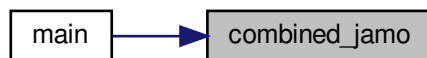
00869     } /* Choseong combined with jungseong and/or jongseong. */
00870 } /* Valid choseong. */
00871
00872 /*
00873 Choose vowel (jungseong) variation based upon the choseong
00874 and jungseong.
00875 */
00876 jung_index = jung_group = 0; /* Use blank glyph for jungseong. */
00877
00878 if (jung_num >= 0) {
00879     if (cho_num < 0 && jong_num < 0) { /* Jungseong is by itself. */
00880         jung_group = 0;
00881         jung_index = jung_num + JUNG_UNICODE_START;
00882     }
00883     else {
00884         if (jong_num >= 0) { /* If there is a final consonant. */
00885             if (jong_num == 3) /* Nieun; choose variation 3. */
00886                 jung_group = 2;
00887             else
00888                 jung_group = 1;
00889         } /* Valid jongseong. */
00890         /* If valid choseong but no jongseong, choose jungseong variation 0. */
00891         else if (cho_num >= 0)
00892             jung_group = 0;
00893     }
00894     jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895 }
00896
00897 /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jungseong are present.
00900 */
00901 if (jong_num < 0) {
00902     jung_index = jung_group = 0; /* Use blank glyph for jongseong. */
00903 }
00904 else { /* Valid jongseong. */
00905     if (cho_num < 0 && jung_num < 0) { /* Jongseong is by itself. */
00906         jong_group = 0;
00907         jong_index = jung_num + 0x4A8;
00908     }
00909     else { /* There is only one jongseong variation if combined. */
00910         jong_group = 0;
00911         jong_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912             jung_group;
00913     }
00914 }
00915
00916 /*
00917 Now that we know the index locations for choseong, jungseong, and
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920 combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921     combined_glyph);
00922
00923 if (jong_index > 0) {
00924     /*
00925     If the vowel has a vertical stroke that is one column
00926     away from the right border, shift this jongseung right
00927     by one column to line up with the rightmost vertical
00928     stroke in the vowel.
00929     */
00930     if (is_wide_vowel (jung_num)) {
00931         for (i = 0; i < 16; i++) {
00932             tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933         }
00934         combine_glyphs (combined_glyph, tmp_glyph,
00935             combined_glyph);
00936     }
00937     else {
00938         combine_glyphs (combined_glyph, glyph_table [jong_index],
00939             combined_glyph);
00940     }
00941 }
00942
00943 return;
00944 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.1.3.4 glyph\_overlap()

```
int glyph_overlap (
    unsigned * glyph1,
    unsigned * glyph2 )
```

See if two glyphs overlap.

Parameters

in	glyph1	The first glyph, as a 16-row bitmap.
----	--------	--------------------------------------

## Parameters

in	glyph2	The second glyph, as a 16-row bitmap.
----	--------	---------------------------------------

## Returns

0 if no overlaps between glyphs, 1 otherwise.

Definition at line 613 of file unihangul-support.c.

```

00613     {
00614     int overlaps; /* Return value; 0 if no overlaps, -1 if overlaps. */
00615     int i;
00616
00617     /* Check for overlaps between the two glyphs. */
00618
00619     i = 0;
00620     do {
00621         overlaps = (glyph1[i] & glyph2[i]) != 0;
00622         i++;
00623     } while (i < 16 && overlaps == 0);
00624
00625     return overlaps;
00626 }

```

## 5.1.3.5 hangul\_compose()

```

unsigned hangul_compose (
    int initial,
    int medial,
    int final )

```

Compose a Hangul syllable into a code point, or 0 if none exists.

This function takes three letters that can form a modern Hangul syllable and returns the corresponding Unicode Hangul Syllables code point in the range 0xAC00 to 0xD7A3.

If a three-letter combination includes one or more archaic letters, it will not map into the Hangul Syllables range. In that case, the returned code point will be 0 to indicate that no valid Hangul Syllables code point exists.

## Parameters

in	initial	The first letter (choseong), 0 to 18.
in	medial	The second letter (jungseong), 0 to 20.

## Parameters

in	final	The third letter (jongseong), 0 to 26 or -1 if none.
----	-------	--

## Returns

The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.

Definition at line 201 of file [unihangul-support.c](#).

```

00201     {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial >= 0 && medial <= 20 &&
00207         final >= 0 && final <= 26) {
00208
00209         codept = 0xAC00;
00210         codept += initial * 21 * 28;
00211         codept += medial * 28;
00212         codept += final + 1;
00213     }
00214     else {
00215         codept = 0;
00216     }
00217
00218     return codept;
00219 }

```

## 5.1.3.6 hangul\_decompose()

```

void hangul_decompose (
    unsigned codept,
    int * initial,
    int * medial,
    int * final )

```

Decompose a Hangul Syllables code point into three letters.

Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:

- Choseong 0-19
- Jungseong 0-20
- Jongseong 0-27 or -1 if no jongseong

All letter values are set to -1 if the letters do not form a syllable in the Hangul Syllables range. This function only handles modern Hangul, because that is all that is in the Hangul Syllables range.

## Parameters

in	codept	The Unicode code point to decode, from 0x↵AC00 to 0x↵D7A3.
out	initial	The 1st letter (choseong) in the syllable.
out	initial	The 2nd letter (jungseong) in the syllable.
out	initial	The 3rd letter (jongseong) in the syllable.

Definition at line 167 of file [unihangul-support.c](#).

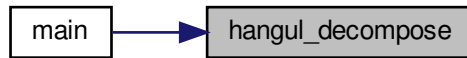
```

00167 {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept -= 0xAC00;
00174         *initial = codept / (28 * 21);
00175         *medial = (codept / 28) % 21;
00176         *final = codept % 28 - 1;
00177     }
00178
00179     return;
00180 }

```



Here is the caller graph for this function:



### 5.1.3.7 hangul\_hex\_indices()

```

void hangul_hex_indices (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_index,
    int * jung_index,
    int * jong_index )
  
```

Determine index values to the bitmaps for a syllable's components.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

These variations are then converted into index locations within the glyph array that was read in from the hangul-base.hex file. Those index locations can then be used to form a composite syllable.

There is no restriction to only use the modern Hangul letters.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.

## Parameters

in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_index	Index location to the 1st letter variation from the hangul-base.↔ hex file.
out	jung_index	Index location to the 2nd letter variation from the hangul-base.↔ hex file.
out	jong_index	Index location to the 3rd letter variation from the hangul-base.↔ hex file.

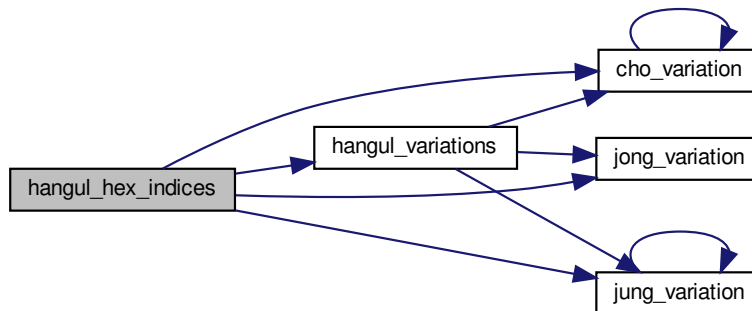
Definition at line [249](#) of file [unihangul-support.c](#).

```

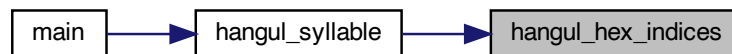
00250                                     {
00251
00252   int cho_variation, jung_variation, jong_variation; /* Letter variations */
00253
00254   void hangul_variations (int choseong, int jungseong, int jongseong,
00255                          int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257   hangul_variations (choseong, jungseong, jongseong,
00258                     &cho_variation, &jung_variation, &jong_variation);
00260
00261   *cho_index = CHO_HEX + choseong * CHO_VARIATIONS + cho_variation;
00262   *jung_index = JUNG_HEX + jungseong * JUNG_VARIATIONS + jung_variation;
00263   *jong_index = jongseong < 0 ? 0x0000 :
00264                 JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266   return;
00267 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.1.3.8 hangul\_read\_base16()

```

unsigned hangul_read_base16 (
    FILE * infp,
    unsigned base[][16] )

```

Read hangul-base.hex file into a unsigned array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation.

The order is:

- Empty glyph in 0x0000 position.

- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

#### Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 16 16-bit values per letter.

#### Returns

The maximum code point value read in the file.

Definition at line 116 of file [unihangul-support.c](#).

```

00116     {
00117     unsigned codept;
00118     unsigned max_codept;
00119     int     i, j;
00120     char   instring[MAXLINE];
00121
00122
00123     max_codept = 0;
00124
00125     while (fgets (instring, MAXLINE, infp) != NULL) {
00126         sscanf (instring, "%X", &codept);
00127         codept -= PUA_START;
00128         /* If code point is within range, add it */
00129         if (codept < MAX_GLYPHS) {
00130             /* Find the start of the glyph bitmap. */
00131             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132             if (instring[i] == ':') {
00133                 i++; /* Skip over ':' to get to start of bitmap. */
00134                 for (j = 0; j < 16; j++) {
00135                     sscanf (&instring[i], "%4X", &base[codept][j]);
00136                     i += 4;
00137                 }
00138                 if (codept > max_codept) max_codept = codept;
00139             }
00140         }
00141     }
00142
00143     return max_codept;
00144 }

```

Here is the caller graph for this function:



### 5.1.3.9 hangul\_read\_base8()

```

unsigned hangul_read_base8 (
    FILE * infp,
    unsigned char base[][32] )
  
```

Read hangul-base.hex file into a unsigned char array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 32 8-bit values per letter.

## Returns

The maximum code point value read in the file.

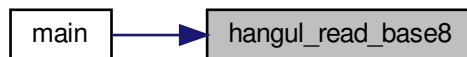
Definition at line 63 of file `unihangul-support.c`.

```

00063     {
00064     unsigned codept;
00065     unsigned max_codept;
00066     int    i, j;
00067     char   instring[MAXLINE];
00068
00069
00070     max_codept = 0;
00071
00072     while (fgets (instring, MAXLINE, infp) != NULL) {
00073         sscanf (instring, "%X", &codept);
00074         codept -= PUA_START;
00075         /* If code point is within range, add it */
00076         if (codept < MAX_GLYPHS) {
00077             /* Find the start of the glyph bitmap. */
00078             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079             if (instring[i] == ':') {
00080                 i++; /* Skip over ':' to get to start of bitmap. */
00081                 for (j = 0; j < 32; j++) {
00082                     sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083                     i += 2;
00084                 }
00085                 if (codept > max_codept) max_codept = codept;
00086             }
00087         }
00088     }
00089     return max_codept;
00090 }
00091 }

```

Here is the caller graph for this function:



### 5.1.3.10 hangul\_syllable()

```

void hangul_syllable (
    int choseong,
    int jungseong,
    int jongseong,
    unsigned char hangul_base[][32],
    unsigned char * syllable )

```

Given letters in a Hangul syllable, return a glyph.

This function returns a glyph bitmap comprising up to three Hangul letters that form a syllable. It reads the three component letters (choseong, jungseong, and jongseong), then calls a function that determines the appropriate variation of each letter, returning the letter bitmap locations in the glyph array. Then these letter bitmaps are combined with a logical OR operation to produce a final bitmap, which forms a 16 row by 16 column bitmap glyph.

## Parameters

in	choseong	The 1st letter in the composite glyph.
in	jungseong	The 2nd letter in the composite glyph.
in	jongseong	The 3rd letter in the composite glyph.
in	hangul_base	The glyphs read from the "hangul_base.hex" file.

## Returns

syllable The composite syllable, as a 16 by 16 pixel bitmap.

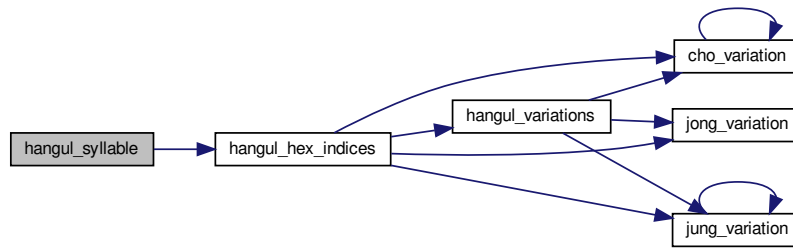
Definition at line 583 of file [unihangul-support.c](#).

```

00584                                     {
00585
00586     int     i; /* loop variable */
00587     int     cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                        &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595         glyph_byte = hangul_base [cho_hex][i];
00596         glyph_byte |= hangul_base [jung_hex][i];
00597         if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598         syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.1.3.11 hangul\_variations()

```

void hangul_variations (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_var,
    int * jung_var,
    int * jong_var )
  
```

Determine the variations of each letter in a Hangul syllable.

Given the three letters that will form a syllable, return the variation of each letter used to form the composite glyph.

This function can determine variations for both modern and archaic Hangul letters; it is not limited to only the letters combinations that comprise the Unicode Hangul Syllables range.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).



## Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_var	Variation of the 1st letter from the hangul-base.↔ hex file.
out	jung_var	Variation of the 2nd letter from the hangul-base.↔ hex file.
out	jong_var	Variation of the 3rd letter from the hangul-base.↔ hex file.

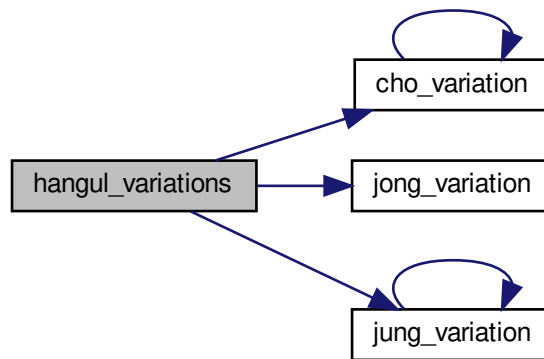
Definition at line 298 of file [unihangul-support.c](#).

```

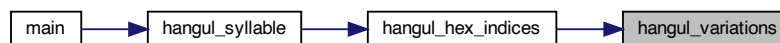
00299                                     {
00300
00301   int cho_variation (int choseong, int jungseong, int jongseong);
00302   int jung_variation (int choseong, int jungseong, int jongseong);
00303   int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305   /*
00306   Find the variation for each letter component.
00307   */
00308   *cho_var = cho_variation (choseong, jungseong, jongseong);
00309   *jung_var = jung_variation (choseong, jungseong, jongseong);
00310   *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313   return;
00314 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.1.3.12 is\_wide\_vowel()

```

int is_wide_vowel (
    int vowel )

```

Whether vowel has rightmost vertical stroke to the right.

## Parameters

in	vowel	Vowel number, from 0 to TOTAL_JUNG ← ← JUNG - 1.
----	-------	--

## Returns

1 if this vowel's vertical stroke is wide on the right side; else 0.

Definition at line 434 of file [unihangul-support.c](#).

```

00434 {
00435     int retval; /* Return value. */
00436
00437     static int wide_vowel [TOTAL_JUNG + 1] = {
00438         /*
00439         Modern Jungseong in positions 0..20.
00440         */
00441         /* Location Variations Unicode Range Vowel # Vowel Names */
00442         /* ----- */
00443         /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00444         /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00445         /* 0x30D */ 0, 1, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00446         /* 0x313 */ 0, // U+1169 -->[ 8] O
00447         /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00448         /* 0x31F */ 0, 0, // U+116D..U+116E-->[12..13] YO, U
00449         /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16] WEO, WE, WI
00450         /* 0x32E */ 0, 0, // U+1172..U+1173-->[17..18] YU, EU
00451         /* 0x334 */ 0, // U+1174 -->[19] YI
00452         /* 0x337 */ 0, // U+1175 -->[20] I
00453         /*
00454         Ancient Jungseong in positions 21..70.
00455         */
00456         /* Location Variations Unicode Range Vowel # Vowel Names */
00457         /* ----- */
00458         /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00459         /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00460         /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00461         /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00462         /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00463         /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00464         /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00465         /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00466         /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00467         /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00468         /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00469         /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00470         /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00471         /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00472         /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00473         /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00474         /* 0x3CA: */ 0, 1, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE
00475         #ifndef EXTENDED_HANGUL
00476         /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00477         /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00478         /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00479         /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00480         /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00481         /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00482         /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00483         /* 0x40F: */ 0, 1, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484         /* 0x415: */ -1 // Mark end of list of vowels.
00485         #else
00486         /* 0x310: */ -1 // Mark end of list of vowels.
00487         #endif
00488     };

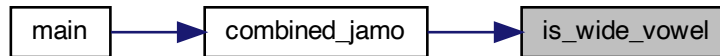
```

```

00489
00490
00491  if (vowel >= 0 && vowel < TOTAL_JUNG) {
00492      retval = wide_vowel [vowel];
00493  }
00494  else {
00495      retval = 0;
00496  }
00497
00498
00499  return retval;
00500 }

```

Here is the caller graph for this function:



### 5.1.3.13 jong\_variation()

```

int jong_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]

```

Return the Johab 6/3/1 jongseong variation.

There is only one jongseong variation, so this function always returns 0. It is a placeholder function for possible future adaptation to other johab encodings.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

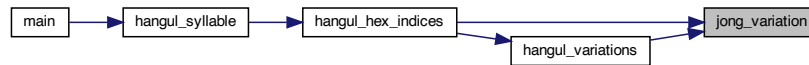
## Returns

The jongseong variation, always 0.

Definition at line 558 of file [unihangul-support.c](#).

```
00558     {
00559
00560     return 0; /* There is only one Jongseong variation. */
00561 }
```

Here is the caller graph for this function:



## 5.1.3.14 jung\_variation()

```
int jung_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]
```

Return the Johab 6/3/1 jungseong variation.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the vowel (jungseong).

Each jungseong has 3 variations:

Variation Occurrence

0 Jungseong with only chungseong (no jungseong). 1 Jungseong with chungseong and jungseong (except nieun). 2 Jungseong with chungseong and jungseong nieun.

## Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

## Returns

The jungseong variation, 0 to 2.

Definition at line 524 of file unihangul-support.c.

```

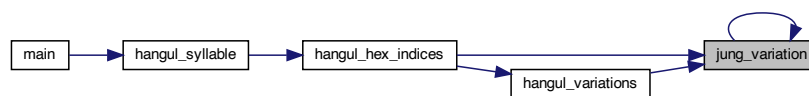
00524     {
00525     int jung_variation; /* Return value */
00526
00527     if (jungseong < 0) {
00528         jung_variation = -1;
00529     }
00530     else {
00531         jung_variation = 0;
00532         if (jongseong >= 0) {
00533             if (jongseong == 3)
00534                 jung_variation = 2; /* Vowel for final Nieun. */
00535             else
00536                 jung_variation = 1;
00537         }
00538     }
00539
00540
00541     return jung_variation;
00542 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.1.3.15 one\_jamo()

```

void one_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned jamo,
    unsigned * jamo_glyph )

```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

## Parameters

in	glyph_table	The collection of all jamo glyphs.
in	jamo	The Unicode code point, 0 or 0x1100..0x115F.
out	jamo_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 717 of file [unihangul-support.c](#).

```

00718     {
00719
00720     int i; /* Loop variable */
00721     int glyph_index; /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724     /* If jamo is invalid range, use blank glyph, */
00725     if (jamo >= 0x1100 && jamo <= 0x11FF) {
00726         glyph_index = jamo - 0x1100 + JAMO_HEX;
00727     }
00728     else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729         glyph_index = jamo - 0xA960 + JAMO_EXTA_HEX;
00730     }
00731     else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732         glyph_index = jamo - 0x1100 + JAMO_EXTB_HEX;
00733     }
00734     else {
00735         glyph_index = 0;
00736     }
00737
00738     for (i = 0; i < 16; i++) {
00739         jamo_glyph [i] = glyph_table [glyph_index] [i];
00740     }
00741
00742     return;
00743 }

```

### 5.1.3.16 print\_glyph\_hex()

```

void print_glyph_hex (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )

```

Print one glyph in Unifont hexdraw hexadecimal string style.

## Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 692 of file [unihangul-support.c](#).

```

00692                                     {
00693
00694     int i;
00695
00696     fprintf (fp, "%04X:", codept);
00697
00698     /* for each this_glyph row */
00699     for (i = 0; i < 16; i++) {
00700         fprintf (fp, "%04X", this_glyph[i]);
00701     }
00702     fputc ('\n', fp);
00703
00704     return;
00705 }
00706 }

```

Here is the caller graph for this function:





## 5.1.3.17 print\_glyph\_txt()

```
void print_glyph_txt (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw plain text style.

## Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 656 of file [unihangul-support.c](#).

```
00656                                     {
00657     int i;
00658     unsigned mask;
00659
00660     fprintf (fp, "%04X:", codept);
00661
00662     /* for each this_glyph row */
00663     for (i = 0; i < 16; i++) {
00664         mask = 0x8000;
00665         fputc ('\t', fp);
00666         while (mask != 0x0000) {
00667             if (mask & this_glyph [i]) {
00668                 fputc ('#', fp);
00669             }
00670             else {
00671                 fputc ('.', fp);
00672             }
00673             mask »= 1; /* shift to next bit in this_glyph row */
00674         }
00675         fputc ('\n', fp);
00676     }
00677     fputc ('\n', fp);
00678     return;
00679 }
00680
00681 }
```

## 5.2 hangul.h

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file hangul.h
00003
00004 @brief Define constants and function prototypes for using Hangul glyphs.
00005
00006 @author Paul Hardy
00007
00008 @copyright Copyright © 2023 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program. If not, see <http://www.gnu.org/licenses/>.
00025 */
00026
00027 #ifndef _HANGUL_H_
00028 #define _HANGUL_H_
00029
00030 #include <stdlib.h>
00031
00032
00033 #define MAXLINE 256 ///< Length of maximum file input line.
00034
00035 #define EXTENDED_HANGUL /* Use rare Hangul code points beyond U+1100 */
00036
00037 /* Definitions to move Hangul .hex file contents into the Private Use Area. */
00038 #define PUA_START 0xE000
00039 #define PUA_END 0xE8FF
00040 #define MAX_GLYPHS (PUA_END - PUA_START + 1) /* Maximum .hex file glyphs */
00041
00042 /*
00043 Unicode ranges for Hangul choseong, jungseong, and jongseong.
00044
00045 U+1100..U+11FF is the main range of modern and ancient Hangul jamo.
00046 U+A960..U+A97C is the range for extended Hangul choseong.
00047 U+D7B0..U+D7C6 is the range for extended Hangul jungseong.
00048 U+D7CB..U+D7FB is the range for extended Hangul jongseong.
00049 */
00050 #define CHO_UNICODE_START 0x1100 ///< Modern Hangul choseong start
00051 #define CHO_UNICODE_END 0x115E ///< Hangul Jamo choseong end
00052 #define CHO_EXT_A_UNICODE_START 0xA960 ///< Hangul Extended-A choseong start
00053 #define CHO_EXT_A_UNICODE_END 0xA97C ///< Hangul Extended-A choseong end
00054
00055 #define JUNG_UNICODE_START 0x1161 ///< Modern Hangul jungseong start
00056 #define JUNG_UNICODE_END 0x11A7 ///< Modern Hangul jungseong end
00057 #define JUNG_EXT_B_UNICODE_START 0xD7B0 ///< Hangul Extended-B jungseong start
00058 #define JUNG_EXT_B_UNICODE_END 0xD7C6 ///< Hangul Extended-B jungseong end
00059
00060 #define JONG_UNICODE_START 0x11A8 ///< Modern Hangul jongseong start
00061 #define JONG_UNICODE_END 0x11FF ///< Modern Hangul jongseong end
00062 #define JONG_EXT_B_UNICODE_START 0xD7CB ///< Hangul Extended-B jongseong start
00063 #define JONG_EXT_B_UNICODE_END 0xD7FB ///< Hangul Extended-B jongseong end
00064
00065
00066 /*
00067 Number of modern and ancient letters in hangul-base.hex file.
00068 */
00069 #define NCHO_MODERN 19 ///< 19 modern Hangul Jamo choseong
00070 #define NCHO_ANCIENT 76 ///< ancient Hangul Jamo choseong
00071 #define NCHO_EXT_A 29 ///< Hangul Extended-A choseong
00072 #define NCHO_EXT_A_RSRVD 3 ///< Reserved at end of Extended-A choseong
00073
00074 #define NJUNG_MODERN 21 ///< 21 modern Hangul Jamo jungseong
00075 #define NJUNG_ANCIENT 50 ///< ancient Hangul Jamo jungseong
00076 #define NJUNG_EXT_B 23 ///< Hangul Extended-B jungseong
00077 #define NJUNG_EXT_B_RSRVD 4 ///< Reserved at end of Extended-B junseong

```

```

00078
00079 #define NJONG_MODERN    27 ///< 28 modern Hangul Jamo jongseong
00080 #define NJONG_ANCIENT   61 ///< 62 ancient Hangul Jamo jongseong
00081 #define NJONG_EXTB     49 ///< Hangul Extended-B jongseong
00082 #define NJONG_EXTB_RSRVD 4 ///< Reserved at end of Extended-B jongseong
00083
00084
00085 /*
00086 Number of variations of each component in a Johab 6/3/1 arrangement.
00087 */
00088 #define CHO_VARIATIONS  6 ///< 6 choseong variations
00089 #define JUNG_VARIATIONS 3 ///< 3 jungseong variations
00090 #define JONG_VARIATIONS 1 ///< 1 jongseong variation
00091
00092 /*
00093 Starting positions in the hangul-base.hex file for each component.
00094 */
00095 ///< Location of first choseong (location 0x0000 is a blank glyph)
00096 #define CHO_HEX        0x0001
00097
00098 ///< Location of first ancient choseong
00099 #define CHO_ANCIENT_HEX (CHO_HEX      + CHO_VARIATIONS * NCHO_MODERN)
00100
00101 ///< U+A960 Extended-A choseong
00102 #define CHO_EXT_A_HEX  (CHO_ANCIENT_HEX + CHO_VARIATIONS * NCHO_ANCIENT)
00103
00104 ///< U+A97F Extended-A last location in .hex file, including reserved Unicode code points at end
00105 #define CHO_LAST_HEX  (CHO_EXT_A_HEX  + CHO_VARIATIONS * (NCHO_EXT_A + NCHO_EXT_A_RSRVD) - 1)
00106
00107 ///< Location of first jungseong (will be 0x2FB)
00108 #define JUNG_HEX      (CHO_LAST_HEX + 1)
00109
00110 ///< Location of first ancient jungseong
00111 #define JUNG_ANCIENT_HEX (JUNG_HEX      + JUNG_VARIATIONS * NJUNG_MODERN)
00112
00113 ///< U+D7B0 Extended-B jungseong
00114 #define JUNG_EXTB_HEX  (JUNG_ANCIENT_HEX + JUNG_VARIATIONS * NJUNG_ANCIENT)
00115
00116 ///< U+D7CA Extended-B last location in .hex file, including reserved Unicode code points at end
00117 #define JUNG_LAST_HEX (JUNG_EXTB_HEX  + JUNG_VARIATIONS * (NJUNG_EXTB +
NJUNG_EXTB_RSRVD) - 1)
00118
00119 ///< Location of first jongseong (will be 0x421)
00120 #define JONG_HEX      (JUNG_LAST_HEX + 1)
00121
00122 ///< Location of first ancient jongseong
00123 #define JONG_ANCIENT_HEX (JONG_HEX      + JONG_VARIATIONS * NJONG_MODERN)
00124
00125 ///< U+D7CB Extended-B jongseong
00126 #define JONG_EXTB_HEX  (JONG_ANCIENT_HEX + JONG_VARIATIONS * NJONG_ANCIENT)
00127
00128 ///< U+D7FF Extended-B last location in .hex file, including reserved Unicode code points at end
00129 #define JONG_LAST_HEX (JONG_EXTB_HEX  + JONG_VARIATIONS * (NJONG_EXTB +
NJONG_EXTB_RSRVD) - 1)
00130
00131 /* Common modern and ancient Hangul Jamo range */
00132 #define JAMO_HEX      0x0500 ///< Start of U+1100..U+11FF glyphs
00133 #define JAMO_END      0x05FF ///< End   of U+1100..U+11FF glyphs
00134
00135 /* Hangul Jamo Extended-A range */
00136 #define JAMO_EXT_A_HEX 0x0600 ///< Start of U+A960..U+A97F glyphs
00137 #define JAMO_EXT_A_END 0x061F ///< End   of U+A960..U+A97F glyphs
00138
00139 /* Hangul Jamo Extended-B range */
00140 #define JAMO_EXTB_HEX  0x0620 ///< Start of U+D7B0..U+D7FF glyphs
00141 #define JAMO_EXTB_END  0x066F ///< End   of U+D7B0..U+D7FF glyphs
00142
00143 /*
00144 These values allow enumeration of all modern and ancient letters.
00145
00146 If RARE_HANGUL is defined, include Hangul code points above U+11FF.
00147 */
00148 #ifdef EXTENDED_HANGUL
00149
00150 #define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT + NCHO_EXT_A )
00151 #define TOTAL_JUNG (NJUNG_MODERN + NJUNG_ANCIENT + NJUNG_EXTB)
00152 #define TOTAL_JONG (NJONG_MODERN + NJONG_ANCIENT + NJONG_EXTB)
00153
00154 #else
00155
00156 #define TOTAL_CHO (NCHO_MODERN + NCHO_ANCIENT )

```

```

00157 #define TOTAL_JUNG    (NJUNG_MODERN + NJUNG_ANCIENT)
00158 #define TOTAL_JONG    (NJONG_MODERN + NJONG_ANCIENT)
00159
00160 #endif
00161
00162
00163 /*
00164 Function Prototypes.
00165 */
00166
00167 unsigned hangul_read_base8 (FILE *infp, unsigned char base[][32]);
00168 unsigned hangul_read_base16 (FILE *infp, unsigned base[][16]);
00169
00170 void    hangul_decompose (unsigned codept,
00171                          int *initial, int *medial, int *final);
00172 unsigned hangul_compose  (int initial, int medial, int final);
00173
00174 void hangul_hex_indices (int choseong, int jungseong, int jongseong,
00175                          int *cho_index, int *jung_index, int *jong_index);
00176 void hangul_variations (int choseong, int jungseong, int jongseong,
00177                          int *cho_var, int *jung_var, int *jong_var);
00178 int is_wide_vowel (int vowel);
00179 int cho_variation (int choseong, int jungseong, int jongseong);
00180 int jung_variation (int choseong, int jungseong, int jongseong);
00181 int jong_variation (int choseong, int jungseong, int jongseong);
00182
00183 void hangul_syllable (int choseong, int jungseong, int jongseong,
00184                      unsigned char hangul_base[][32], unsigned char *syllable);
00185 int glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00186 void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00187                     unsigned *combined_glyph);
00188 void one_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00189               unsigned jamo, unsigned *jamo_glyph);
00190 void combined_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00191                    unsigned cho, unsigned jung, unsigned jong,
00192                    unsigned *combined_glyph);
00193 void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00194 void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00195
00196
00197 #endif

```

### 5.3 src/hex2otf.c File Reference

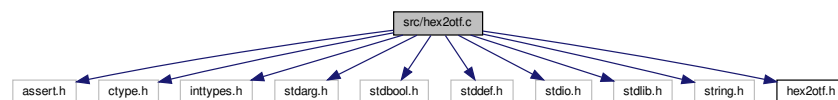
hex2otf - Convert GNU Unifont .hex file to OpenType font

```

#include <assert.h>
#include <ctype.h>
#include <inttypes.h>
#include <stdarg.h>
#include <stdbool.h>
#include <stddef.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hex2otf.h"

```

Include dependency graph for hex2otf.c:



## Data Structures

- struct [Buffer](#)  
Generic data structure for a linked list of buffer elements.
- struct [Glyph](#)  
Data structure to hold data for one bitmap glyph.
- struct [Font](#)  
Data structure to hold information for one font.
- struct [Table](#)  
Data structure for an OpenType table.
- struct [TableRecord](#)  
Data structure for data associated with one OpenType table.
- struct [Options](#)  
Data structure to hold options for OpenType font output.

## Macros

- `#define VERSION "1.0.1"`  
Program version, for "--version" option.
- `#define U16MAX 0xffff`  
Maximum UTF-16 code point value.
- `#define U32MAX 0xffffffff`  
Maximum UTF-32 code point value.
- `#define PRI\_CP "U+%.4"PRIxFAST32`  
Format string to print Unicode code point.
- `#define static\_assert(a, b) (assert(a))`  
If "a" is true, return string "b".
- `#define BX(shift, x) ((uintmax_t)(!(x)) << (shift))`  
Truncate & shift word.
- `#define B0(shift) BX((shift), 0)`  
Clear a given bit in a word.
- `#define B1(shift) BX((shift), 1)`  
Set a given bit in a word.
- `#define GLYPH\_MAX\_WIDTH 16`  
Maximum glyph width, in pixels.
- `#define GLYPH\_HEIGHT 16`  
Maximum glyph height, in pixels.
- `#define GLYPH\_MAX\_BYTE\_COUNT (GLYPH\_HEIGHT * GLYPH\_MAX\_WIDTH / 8)`  
Number of bytes to represent one bitmap glyph as a binary array.
- `#define DESCENDER 2`  
Count of pixels below baseline.
- `#define ASCENDER (GLYPH\_HEIGHT - DESCENDER)`  
Count of pixels above baseline.
- `#define FUPEM 64`  
[Font](#) units per em.
- `#define MAX\_GLYPHS 65536`  
An OpenType font has at most 65536 glyphs.
- `#define MAX\_NAME\_IDS 256`

- Name IDs 0-255 are used for standard names.
- `#define FU(x) ((x) * FUPEM / GLYPH_HEIGHT)`  
Convert pixels to font units.
- `#define PW(x) ((x) / (GLYPH_HEIGHT / 8))`  
Convert glyph byte count to pixel width.
- `#define defineStore(name, type)`  
Temporary define to look up an element in an array of given type.
- `#define addByte(shift)`
- `#define getRowBit(rows, x, y) ((rows)[(y)] & x0 >> (x))`
- `#define flipRowBit(rows, x, y) ((rows)[(y)] ^ x0 >> (x))`
- `#define stringCount (sizeof strings / sizeof *strings)`
- `#define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))`

## Typedefs

- typedef unsigned char `byte`  
Definition of "byte" type as an unsigned char.
- typedef int\_least8\_t `pixels_t`  
This type must be able to represent max(GLYPH\_MAX\_WIDTH, GLYPH\_HEIGHT).
- typedef struct `Buffer Buffer`  
Generic data structure for a linked list of buffer elements.
- typedef const char \* `NameStrings[MAX_NAME_IDS]`  
Array of OpenType names indexed directly by Name IDs.
- typedef struct `Glyph Glyph`  
Data structure to hold data for one bitmap glyph.
- typedef struct `Font Font`  
Data structure to hold information for one font.
- typedef struct `Table Table`  
Data structure for an OpenType table.
- typedef struct `Options Options`  
Data structure to hold options for OpenType font output.

## Enumerations

- enum `LocaFormat` { `LOCA_OFFSET16 = 0` , `LOCA_OFFSET32 = 1` }
  - enum `ContourOp` { `OP_CLOSE` , `OP_POINT` }
  - enum `FillSide` { `FILL_LEFT` , `FILL_RIGHT` }
- Fill to the left side (CFF) or right side (TrueType) of a contour.

## Functions

- void `fail` (const char \*reason,...)  
Print an error message on stderr, then exit.
- void `initBuffers` (size\_t count)  
Initialize an array of buffer pointers to all zeroes.
- void `cleanBuffers` ()  
Free all allocated buffer pointers.

- `Buffer * newBuffer (size_t initialCapacity)`  
Create a new buffer.
- `void ensureBuffer (Buffer *buf, size_t needed)`  
Ensure that the buffer has at least the specified minimum size.
- `void freeBuffer (Buffer *buf)`  
Free the memory previously allocated for a buffer.
- `defineStore (storeU8, uint_least8_t)`
- `void cacheU8 (Buffer *buf, uint_fast8_t value)`  
Append one unsigned byte to the end of a byte array.
- `void cacheU16 (Buffer *buf, uint_fast16_t value)`  
Append two unsigned bytes to the end of a byte array.
- `void cacheU32 (Buffer *buf, uint_fast32_t value)`  
Append four unsigned bytes to the end of a byte array.
- `void cacheCFFOperand (Buffer *buf, int_fast32_t value)`  
Cache charstring number encoding in a CFF buffer.
- `void cacheZeros (Buffer *buf, size_t count)`  
Append 1 to 4 bytes of zeroes to a buffer, for padding.
- `void cacheBytes (Buffer *restrict buf, const void *restrict src, size_t count)`  
Append a string of bytes to a buffer.
- `void cacheBuffer (Buffer *restrict bufDest, const Buffer *restrict bufSrc)`  
Append bytes of a table to a byte buffer.
- `void writeBytes (const byte bytes[], size_t count, FILE *file)`  
Write an array of bytes to an output file.
- `void writeU16 (uint_fast16_t value, FILE *file)`  
Write an unsigned 16-bit value to an output file.
- `void writeU32 (uint_fast32_t value, FILE *file)`  
Write an unsigned 32-bit value to an output file.
- `void addTable (Font *font, const char tag[static 4], Buffer *content)`  
Add a TrueType or OpenType table to the font.
- `void organizeTables (Font *font, bool isCFF)`  
Sort tables according to OpenType recommendations.
- `int byTableTag (const void *a, const void *b)`  
Compare tables by 4-byte unsigned table tag value.
- `void writeFont (Font *font, bool isCFF, const char *fileName)`  
Write OpenType font to output file.
- `bool readCodePoint (uint_fast32_t *codePoint, const char *fileName, FILE *file)`  
Read up to 6 hexadecimal digits and a colon from file.
- `void readGlyphs (Font *font, const char *fileName)`  
Read glyph definitions from a Unifont .hex format file.
- `int byCodePoint (const void *a, const void *b)`  
Compare two Unicode code points to determine which is greater.
- `void positionGlyphs (Font *font, const char *fileName, pixels_t *xMin)`  
Position a glyph within a 16-by-16 pixel bounding box.
- `void sortGlyphs (Font *font)`  
Sort the glyphs in a font by Unicode code point.
- `void buildOutline (Buffer *result, const byte bitmap[], const size_t byteCount, const enum FillSide fillSide)`

- Build a glyph outline.
- void `prepareOffsets` (`size_t *sizes`)
  - Prepare 32-bit glyph offsets in a font table.
- `Buffer * prepareStringIndex` (`const NameStrings names`)
  - Prepare a font name string index.
- void `fillCFF` (`Font *font`, `int version`, `const NameStrings names`)
  - Add a CFF table to a font.
- void `fillTrueType` (`Font *font`, `enum LocaFormat *format`, `uint_fast16_t *maxPoints`, `uint_fast16_t *maxContours`)
  - Add a TrueType table to a font.
- void `fillBlankOutline` (`Font *font`)
  - Create a dummy blank outline in a font table.
- void `fillBitmap` (`Font *font`)
  - Fill OpenType bitmap data and location tables.
- void `fillHeadTable` (`Font *font`, `enum LocaFormat locaFormat`, `pixels_t xMin`)
  - Fill a "head" font table.
- void `fillHheaTable` (`Font *font`, `pixels_t xMin`)
  - Fill a "hhea" font table.
- void `fillMaxpTable` (`Font *font`, `bool isCFF`, `uint_fast16_t maxPoints`, `uint_fast16_t maxContours`)
  - Fill a "maxp" font table.
- void `fillOS2Table` (`Font *font`)
  - Fill an "OS/2" font table.
- void `fillHmtxTable` (`Font *font`)
  - Fill an "hmtx" font table.
- void `fillCmapTable` (`Font *font`)
  - Fill a "cmap" font table.
- void `fillPostTable` (`Font *font`)
  - Fill a "post" font table.
- void `fillGposTable` (`Font *font`)
  - Fill a "GPOS" font table.
- void `fillGsubTable` (`Font *font`)
  - Fill a "GSUB" font table.
- void `cacheStringAsUTF16BE` (`Buffer *buf`, `const char *str`)
  - Cache a string as a big-ending UTF-16 surrogate pair.
- void `fillNameTable` (`Font *font`, `NameStrings nameStrings`)
  - Fill a "name" font table.
- void `printVersion` ()
  - Print program version string on stdout.
- void `printHelp` ()
  - Print help message to stdout and then exit.
- `const char * matchToken` (`const char *operand`, `const char *key`, `char delimiter`)
  - Match a command line option with its key for enabling.
- `Options parseOptions` (`char *const argv[const]`)
  - Parse command line options.
- `int main` (`int argc`, `char *argv[]`)
  - The main function.



## Variables

- [Buffer \\* allBuffers](#)  
Initial allocation of empty array of buffer pointers.
- `size_t` [bufferCount](#)  
Number of buffers in a [Buffer \\* array](#).
- `size_t` [nextBufferIndex](#)  
Index number to tail element of [Buffer \\* array](#).

### 5.3.1 Detailed Description

hex2otf - Convert GNU Unifont .hex file to OpenType font

This program reads a Unifont .hex format file and a file containing combining mark offset information, and produces an OpenType font file.

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Author

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Definition in file [hex2otf.c](#).

### 5.3.2 Macro Definition Documentation

#### 5.3.2.1 addByte

```
#define addByte(  
                shift )
```

Value:

```
if (p == end) \  
    break; \  
record->checksum += (uint_fast32_t)*p++ « (shift);
```

#### 5.3.2.2 ASCENDER

```
#define ASCENDER (GLYPH\_HEIGHT - DESCENDER)
```

Count of pixels above baseline.

Definition at line [79](#) of file [hex2otf.c](#).

#### 5.3.2.3 B0

```
#define B0(  
        shift ) BX((shift), 0)
```

Clear a given bit in a word.

Definition at line [66](#) of file [hex2otf.c](#).

## 5.3.2.4 B1

```
#define B1(
    shift ) BX((shift), 1)
```

Set a given bit in a word.

Definition at line 67 of file [hex2otf.c](#).

## 5.3.2.5 BX

```
#define BX(
    shift,
    x ) ((uintmax_t)(!(x)) << (shift))
```

Truncate & shift word.

Definition at line 65 of file [hex2otf.c](#).

## 5.3.2.6 defineStore

```
#define defineStore(
    name,
    type )
```

Value:

```
void name (Buffer *buf, type value) \
{ \
    type *slot = getBufferSlot (buf, sizeof value); \
    *slot = value; \
}
```

Temporary define to look up an element in an array of given type.

This definition is used to create lookup functions to return a given element in unsigned arrays of size 8, 16, and 32 bytes, and in an array of pixels.

Definition at line 350 of file [hex2otf.c](#).

## 5.3.2.7 DESCENDER

```
#define DESCENDER 2
```

Count of pixels below baseline.

Definition at line 76 of file [hex2otf.c](#).

## 5.3.2.8 FU

```
#define FU(
    x ) ((x) * FUPEM / GLYPH_HEIGHT)
```

Convert pixels to font units.

Definition at line 91 of file [hex2otf.c](#).

## 5.3.2.9 FUPEM

```
#define FUPEM 64
```

Font units per em.

Definition at line 82 of file [hex2otf.c](#).

### 5.3.2.10 GLYPH\_HEIGHT

```
#define GLYPH_HEIGHT 16
```

Maximum glyph height, in pixels.  
Definition at line 70 of file [hex2otf.c](#).

### 5.3.2.11 GLYPH\_MAX\_BYTE\_COUNT

```
#define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)
```

Number of bytes to represent one bitmap glyph as a binary array.  
Definition at line 73 of file [hex2otf.c](#).

### 5.3.2.12 GLYPH\_MAX\_WIDTH

```
#define GLYPH_MAX_WIDTH 16
```

Maximum glyph width, in pixels.  
Definition at line 69 of file [hex2otf.c](#).

### 5.3.2.13 MAX\_GLYPHS

```
#define MAX_GLYPHS 65536
```

An OpenType font has at most 65536 glyphs.  
Definition at line 85 of file [hex2otf.c](#).

### 5.3.2.14 MAX\_NAME\_IDS

```
#define MAX_NAME_IDS 256
```

Name IDs 0-255 are used for standard names.  
Definition at line 88 of file [hex2otf.c](#).

### 5.3.2.15 PRI\_CP

```
#define PRI_CP "U+%.4"PRIFAST32
```

Format string to print Unicode code point.  
Definition at line 58 of file [hex2otf.c](#).

### 5.3.2.16 PW

```
#define PW(  
    x ) ((x) / (GLYPH_HEIGHT / 8))
```

Convert glyph byte count to pixel width.  
Definition at line 94 of file [hex2otf.c](#).

### 5.3.2.17 static\_assert

```
#define static_assert(  
    a,  
    b ) (assert(a))
```

If "a" is true, return string "b".  
Definition at line 61 of file [hex2otf.c](#).

#### 5.3.2.18 U16MAX

```
#define U16MAX 0xffff
```

Maximum UTF-16 code point value.  
Definition at line [55](#) of file [hex2otf.c](#).

#### 5.3.2.19 U32MAX

```
#define U32MAX 0xffffffff
```

Maximum UTF-32 code point value.  
Definition at line [56](#) of file [hex2otf.c](#).

#### 5.3.2.20 VERSION

```
#define VERSION "1.0.1"
```

Program version, for "--version" option.  
Definition at line [51](#) of file [hex2otf.c](#).

### 5.3.3 Typedef Documentation

#### 5.3.3.1 Buffer

```
typedef struct Buffer Buffer
```

Generic data structure for a linked list of buffer elements.

A buffer can act as a vector (when filled with 'store\*' functions), or a temporary output area (when filled with 'cache\*' functions). The 'store\*' functions use native endian. The 'cache\*' functions use big endian or other formats in OpenType. Beware of memory alignment.

#### 5.3.3.2 byte

```
typedef unsigned char byte
```

Definition of "byte" type as an unsigned char.  
Definition at line [97](#) of file [hex2otf.c](#).

#### 5.3.3.3 Glyph

```
typedef struct Glyph Glyph
```

Data structure to hold data for one bitmap glyph.

This data structure holds data to represent one Unifont bitmap glyph: Unicode code point, number of bytes in its bitmap array, whether or not it is a combining character, and an offset from the glyph origin to the start of the bitmap.

#### 5.3.3.4 NameStrings

```
typedef const char* NameStrings[MAX\_NAME\_IDS]
```

Array of OpenType names indexed directly by Name IDs.  
Definition at line [604](#) of file [hex2otf.c](#).

### 5.3.3.5 Options

typedef struct [Options](#) [Options](#)

Data structure to hold options for OpenType font output.

This data structure holds the status of options that can be specified as command line arguments for creating the output OpenType font file.

### 5.3.3.6 pixels\_t

typedef int\_least8\_t [pixels\\_t](#)

This type must be able to represent  $\max(\text{GLYPH\_MAX\_WIDTH}, \text{GLYPH\_HEIGHT})$ .

Definition at line 100 of file [hex2otf.c](#).

### 5.3.3.7 Table

typedef struct [Table](#) [Table](#)

Data structure for an OpenType table.

This data structure contains a table tag and a pointer to the start of the buffer that holds data for this OpenType table.

For information on the OpenType tables and their structure, see <https://docs.microsoft.com/en-us/Typography/opentype/spec/otff#font-tables>.

## 5.3.4 Enumeration Type Documentation

### 5.3.4.1 ContourOp

enum [ContourOp](#)

Specify the current contour drawing operation.

Enumerator

OP_CLOSE	Close the current contour path that was being drawn.
OP_POINT	Add one more (x,y) point to the contour being drawn.

Definition at line 1136 of file `hex2otf.c`.

```
01136 {
01137     OP_CLOSE,    ///< Close the current contour path that was being drawn.
01138     OP_POINT    ///< Add one more (x,y) point to the contor being drawn.
01139 };
```

#### 5.3.4.2 FillSide

enum `FillSide`

Fill to the left side (CFF) or right side (TrueType) of a contour.

Enumerator

FILL_LEFT	Draw out-line counter-clockwise (CFF, PostScript).
FILL_RIGHT	Draw out-line clockwise (TrueType).

Definition at line 1144 of file `hex2otf.c`.

```
01144 {
01145     FILL_LEFT,    ///< Draw outline counter-clockwise (CFF, PostScript).
01146     FILL_RIGHT    ///< Draw outline clockwise (TrueType).
01147 };
```

#### 5.3.4.3 LocaFormat

enum `LocaFormat`

Index to Location ("loca") offset information.

This enumerated type encodes the type of offset to locations in a table. It denotes Offset16 (16-bit) and Offset32 (32-bit) offset types.

Enumerator

LOCA_OFFSET16	Offset to location is a 16-bit Offset16 value.
---------------	--

## Enumerator

LOCA_OFFSET32	Offset to location is a 32-bit Offset32 value.
---------------	--

Definition at line 658 of file [hex2otf.c](#).

```
00658     {
00659     LOCA_OFFSET16 = 0,    ///< Offset to location is a 16-bit Offset16 value
00660     LOCA_OFFSET32 = 1    ///< Offset to location is a 32-bit Offset32 value
00661 };
```

### 5.3.5 Function Documentation

#### 5.3.5.1 addTable()

```
void addTable (
    Font * font,
    const char tag[static 4],
    Buffer * content )
```

Add a TrueType or OpenType table to the font.

This function adds a TrueType or OpenType table to a font. The 4-byte table tag is passed as an unsigned 32-bit integer in big-endian format.

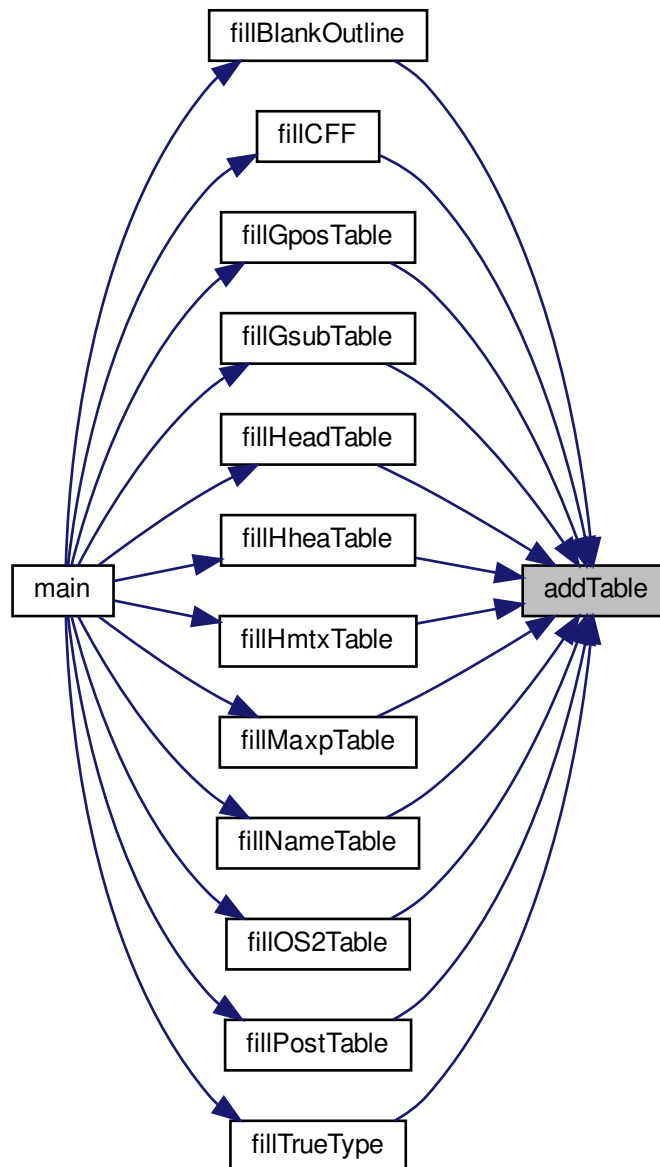
#### Parameters

in,out	font	The font to which a font table will be added.
in	tag	The 4-byte table name.
in	content	The table bytes to add, of type <a href="#">Buffer</a> *.

Definition at line 694 of file [hex2otf.c](#).

```
00695 {  
00696     Table *table = getBufferSlot (font->tables, sizeof (Table));  
00697     table->tag = tagAsU32 (tag);  
00698     table->content = content;  
00699 }
```

Here is the caller graph for this function:





## 5.3.5.2 buildOutline()

```
void buildOutline (
    Buffer * result,
    const byte bitmap[],
    const size_t byteCount,
    const enum FillSide fillSide )
```

Build a glyph outline.

This function builds a glyph outline from a Unifont glyph bitmap.

Parameters

out	result	The resulting glyph outline.
in	bitmap	A bitmap array.
in	byteCount	the number of bytes in the input bitmap array.
in	fillSide	Enumerated indicator to fill left or right side.

Get the value of a given bit that is in a given row.

Invert the value of a given bit that is in a given row.

Definition at line 1160 of file [hex2otf.c](#).

```
01162 {
01163     enum Direction {RIGHT, LEFT, DOWN, UP}; // order is significant
01164
01165     // respective coordinate deltas
01166     const pixels_t dx[] = {1, -1, 0, 0}, dy[] = {0, 0, -1, 1};
01167
01168     assert (byteCount % GLYPH_HEIGHT == 0);
01169     const uint_fast8_t bytesPerRow = byteCount / GLYPH_HEIGHT;
01170     const pixels_t glyphWidth = bytesPerRow * 8;
01171     assert (glyphWidth <= GLYPH_MAX_WIDTH);
01172
01173     #if GLYPH_MAX_WIDTH < 32
01174         typedef uint_fast32_t row_t;
01175     #elif GLYPH_MAX_WIDTH < 64
01176         typedef uint_fast64_t row_t;
01177     #else
01178     #error GLYPH_MAX_WIDTH is too large.
01179     #endif
01180
01181     row_t pixels[GLYPH_HEIGHT + 2] = {0};
01182     for (pixels_t row = GLYPH_HEIGHT; row > 0; row--)
```

```

01183     for (pixels_t b = 0; b < bytesPerRow; b++)
01184         pixels[row] = pixels[row] « 8 | *bitmap++;
01185 typedef row_t graph_t[GLYPH_HEIGHT + 1];
01186 graph_t vectors[4];
01187 const row_t *lower = pixels, *upper = pixels + 1;
01188 for (pixels_t row = 0; row <= GLYPH_HEIGHT; row++)
01189 {
01190     const row_t m = (fillSide == FILL_RIGHT) - 1;
01191     vectors[RIGHT][row] = (m ^ (*lower « 1)) & (~m ^ (*upper « 1));
01192     vectors[LEFT][row] = (m ^ (*upper )) & (~m ^ (*lower ));
01193     vectors[DOWN][row] = (m ^ (*lower )) & (~m ^ (*lower « 1));
01194     vectors[UP][row] = (m ^ (*upper « 1)) & (~m ^ (*upper ));
01195     lower++;
01196     upper++;
01197 }
01198 graph_t selection = {0};
01199 const row_t x0 = (row_t)1 « glyphWidth;
01200
01201 /// Get the value of a given bit that is in a given row.
01202 #define getRowBit(rows, x, y) ((rows)[(y)] & x0 » (x))
01203
01204 /// Invert the value of a given bit that is in a given row.
01205 #define flipRowBit(rows, x, y) ((rows)[(y)] ^ x0 » (x))
01206
01207 for (pixels_t y = GLYPH_HEIGHT; y >= 0; y--)
01208 {
01209     for (pixels_t x = 0; x <= glyphWidth; x++)
01210     {
01211         assert (!getRowBit (vectors[LEFT], x, y));
01212         assert (!getRowBit (vectors[UP], x, y));
01213         enum Direction initial;
01214
01215         if (getRowBit (vectors[RIGHT], x, y))
01216             initial = RIGHT;
01217         else if (getRowBit (vectors[DOWN], x, y))
01218             initial = DOWN;
01219         else
01220             continue;
01221
01222         static_assert ((GLYPH_MAX_WIDTH + 1) * (GLYPH_HEIGHT + 1) * 2 <=
01223             U16MAX, "potential overflow");
01224
01225         uint_fast16_t lastPointCount = 0;
01226         for (bool converged = false;;)
01227         {
01228             uint_fast16_t pointCount = 0;
01229             enum Direction heading = initial;
01230             for (pixels_t tx = x, ty = y;;)
01231             {
01232                 if (converged)
01233                 {
01234                     storePixels (result, OP_POINT);
01235                     storePixels (result, tx);
01236                     storePixels (result, ty);
01237                 }
01238                 do
01239                 {
01240                     if (converged)
01241                         flipRowBit (vectors[heading], tx, ty);
01242                     tx += dx[heading];
01243                     ty += dy[heading];
01244                 } while (getRowBit (vectors[heading], tx, ty));
01245                 if (tx == x && ty == y)
01246                     break;
01247                 static_assert ((UP ^ DOWN) == 1 && (LEFT ^ RIGHT) == 1,
01248                     "wrong enums");
01249                 heading = (heading & 2) ^ 2;
01250                 heading |= !getRowBit (selection, tx, ty);
01251                 heading ^= !getRowBit (vectors[heading], tx, ty);
01252                 assert (getRowBit (vectors[heading], tx, ty));
01253                 flipRowBit (selection, tx, ty);
01254                 pointCount++;
01255             }
01256             if (converged)
01257                 break;
01258             converged = pointCount == lastPointCount;
01259             lastPointCount = pointCount;
01260         }
01261
01262         storePixels (result, OP_CLOSE);
01263     }

```

```

01264 }
01265 #undef getRowBit
01266 #undef flipRowBit
01267 }

```

### 5.3.5.3 byCodePoint()

```

int byCodePoint (
    const void * a,
    const void * b )

```

Compare two Unicode code points to determine which is greater.

This function compares the Unicode code points contained within two [Glyph](#) data structures. The function returns 1 if the first code point is greater, and -1 if the second is greater.

#### Parameters

in	a	A <a href="#">Glyph</a> data structure containing the first code point.
in	b	A <a href="#">Glyph</a> data structure containing the second code point.

#### Returns

1 if the code point a is greater, -1 if less, 0 if equal.

Definition at line 1040 of file [hex2otf.c](#).

```

01041 {
01042     const Glyph *const ga = a, *const gb = b;
01043     int gt = ga->codePoint > gb->codePoint;
01044     int lt = ga->codePoint < gb->codePoint;
01045     return gt - lt;
01046 }

```

#### 5.3.5.4 byTableTag()

```
int byTableTag (
    const void * a,
    const void * b )
```

Compare tables by 4-byte unsigned table tag value.

This function takes two pointers to a [TableRecord](#) data structure and extracts the four-byte tag structure element for each. The two 32-bit numbers are then compared. If the first tag is greater than the first, then  $gt = 1$  and  $lt = 0$ , and so  $1 - 0 = 1$  is returned. If the first is less than the second, then  $gt = 0$  and  $lt = 1$ , and so  $0 - 1 = -1$  is returned.

Parameters

in	a	Pointer to the first <a href="#">TableRecord</a> structure.
in	b	Pointer to the second <a href="#">TableRecord</a> structure.

Returns

1 if the tag in "a" is greater, -1 if less, 0 if equal.

Definition at line 767 of file [hex2otf.c](#).

```
00768 {
00769     const struct TableRecord *const ra = a, *const rb = b;
00770     int gt = ra->tag > rb->tag;
00771     int lt = ra->tag < rb->tag;
00772     return gt - lt;
00773 }
```

#### 5.3.5.5 cacheBuffer()

```
void cacheBuffer (
    Buffer *restrict bufDest,
    const Buffer *restrict bufSrc )
```

Append bytes of a table to a byte buffer.

## Parameters

in,out	bufDest	The buffer to which the new bytes are appended.
in	bufSrc	The bytes to append to the buffer array.

Definition at line 523 of file [hex2otf.c](#).

```
00524 {
00525     size_t length = countBufferedBytes (bufSrc);
00526     ensureBuffer (bufDest, length);
00527     memcpy (bufDest->next, bufSrc->begin, length);
00528     bufDest->next += length;
00529 }
```

## 5.3.5.6 cacheBytes()

```
void cacheBytes (
    Buffer *restrict buf,
    const void *restrict src,
    size_t count )
```

Append a string of bytes to a buffer.

This function appends an array of 1 to 4 bytes to the end of a buffer.

## Parameters

in,out	buf	The buffer to which the bytes are appended.
--------	-----	---

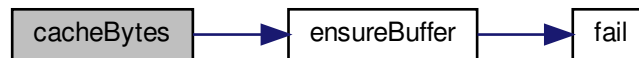
## Parameters

in	src	The array of bytes to append to the buffer.
in	count	The number of bytes containing zeroes to append.

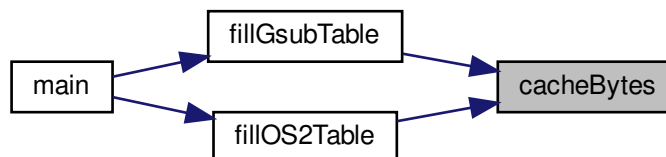
Definition at line 509 of file [hex2otf.c](#).

```
00510 {
00511     ensureBuffer (buf, count);
00512     memcpy (buf->next, src, count);
00513     buf->next += count;
00514 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



## 5.3.5.7 cacheCFFOperand()

```
void cacheCFFOperand (
    Buffer * buf,
    int_fast32_t value )
```

Cache charstring number encoding in a CFF buffer.

This function caches two's complement 8-, 16-, and 32-bit words as per Adobe's Type 2 Charstring encoding for operands. These operands are used in Compact [Font](#) Format data structures.

Byte values can have offsets, for which this function compensates, optionally followed by additional bytes:

Byte Range	Offset	Bytes	Adjusted Range
0 to 11	0	1	0 to 11 (operators)
12	0	2	Next byte is 8-bit op code
13 to 18	0	1	13 to 18 (operators)
19 to 20	0	2+	hintmask and cntrmask operators
21 to 27	0	1	21 to 27 (operators)
28	0	3	16-bit 2's complement number
29 to 31	0	1	29 to 31 (operators)
32 to 246	-139	1	-107 to +107
247 to 250	+108	2	+108 to +1131
251 to 254	-108	2	-108 to -1131
255	0	5	16-bit integer and 16-bit fraction

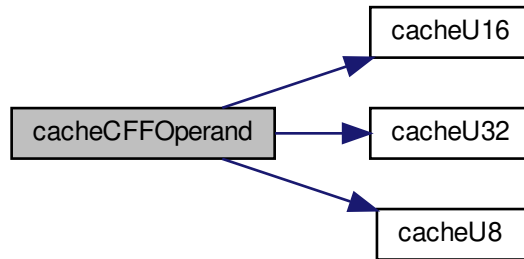
## Parameters

in,out	buf	The buffer to which the operand value is appended.
in	value	The operand value.

Definition at line 460 of file [hex2otf.c](#).

```
00461 {
00462     if (-107 <= value && value <= 107)
00463         cacheU8 (buf, value + 139);
00464     else if (108 <= value && value <= 1131)
00465     {
00466         cacheU8 (buf, (value - 108) / 256 + 247);
00467         cacheU8 (buf, (value - 108) % 256);
00468     }
00469     else if (-32768 <= value && value <= 32767)
00470     {
00471         cacheU8 (buf, 28);
00472         cacheU16 (buf, value);
00473     }
00474     else if (-2147483647 <= value && value <= 2147483647)
00475     {
00476         cacheU8 (buf, 29);
00477         cacheU32 (buf, value);
00478     }
00479     else
00480         assert (false); // other encodings are not used and omitted
00481     static_assert (GLYPH_MAX_WIDTH <= 107, "More encodings are needed.");
00482 }
```

Here is the call graph for this function:



### 5.3.5.8 cacheStringAsUTF16BE()

```
void cacheStringAsUTF16BE (
    Buffer * buf,
    const char * str )
```

Cache a string as a big-ending UTF-16 surrogate pair.

This function encodes a UTF-8 string as a big-endian UTF-16 surrogate pair.

Parameters

in,out	buf	Pointer to a Buffer struct to update.
in	str	The character array to encode.

Definition at line 2316 of file [hex2otf.c](#).

```
02317 {
02318     for (const char *p = str; *p; p++)
02319     {
02320         byte c = *p;
02321         if (c < 0x80)
02322         {
02323             cacheU16 (buf, c);
02324             continue;
02325         }
02326         int length = 1;
02327         byte mask = 0x40;
02328         for (; c & mask; mask »= 1)
02329             length++;
02330         if (length == 1 || length > 4)
02331             fail ("Ill-formed UTF-8 sequence.");
```

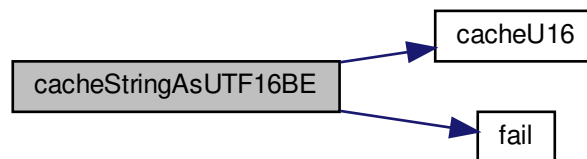


```

02332     uint_fast32_t codePoint = c & (mask - 1);
02333     for (int i = 1; i < length; i++)
02334     {
02335         c = *++p;
02336         if ((c & 0xc0) != 0x80) // NUL checked here
02337             fail ("Ill-formed UTF-8 sequence.");
02338         codePoint = (codePoint « 6) | (c & 0x3f);
02339     }
02340     const int lowerBits = length==2 ? 7 : length==3 ? 11 : 16;
02341     if (codePoint » lowerBits == 0)
02342         fail ("Ill-formed UTF-8 sequence."); // sequence should be shorter
02343     if (codePoint >= 0xd800 && codePoint <= 0xdfff)
02344         fail ("Ill-formed UTF-8 sequence.");
02345     if (codePoint > 0x10ffff)
02346         fail ("Ill-formed UTF-8 sequence.");
02347     if (codePoint > 0xffff)
02348     {
02349         cacheU16 (buf, 0xd800 | (codePoint - 0x10000) » 10);
02350         cacheU16 (buf, 0xdc00 | (codePoint & 0x3ff));
02351     }
02352     else
02353         cacheU16 (buf, codePoint);
02354 }
02355 }

```

Here is the call graph for this function:



### 5.3.5.9 cacheU16()

```

void cacheU16 (
    Buffer * buf,
    uint_fast16_t value )

```

Append two unsigned bytes to the end of a byte array.

This function adds two bytes to the end of a byte array. The buffer is updated to account for the newly-added bytes.

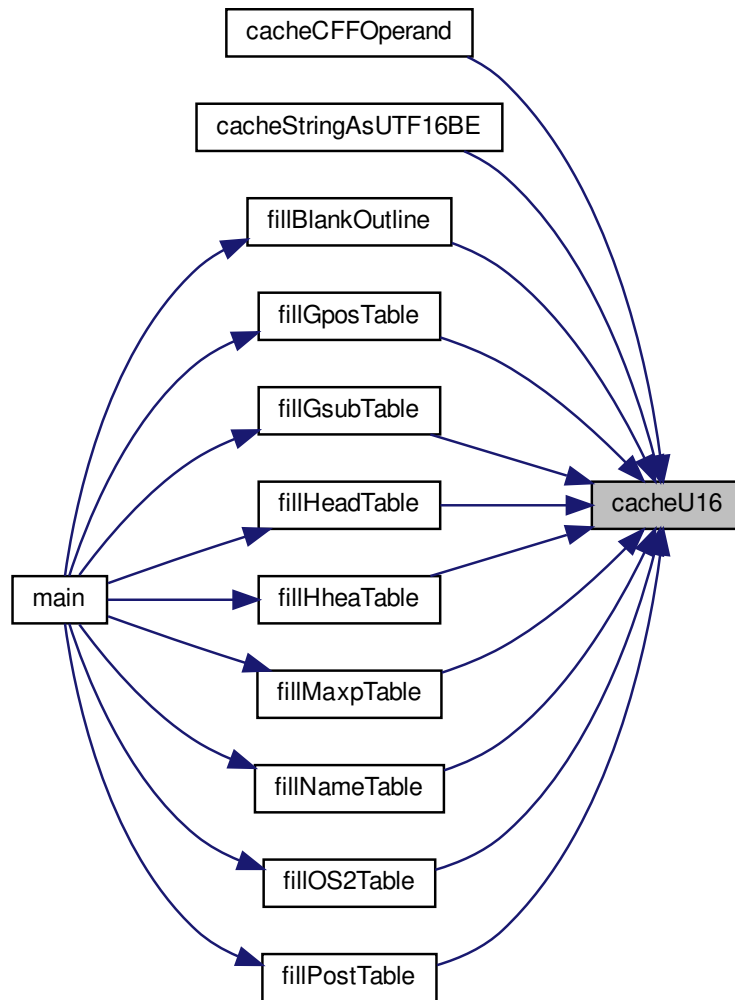
## Parameters

in,out	buf	The array of bytes to which to append two new bytes.
in	value	The 16-bit unsigned value to append to the buf array.

Definition at line [412](#) of file [hex2otf.c](#).

```
00413 {  
00414     cacheU (buf, value, 2);  
00415 }
```

Here is the caller graph for this function:



#### 5.3.5.10 `cacheU32()`

```
void cacheU32 (  
    Buffer * buf,  
    uint_fast32_t value )
```

Append four unsigned bytes to the end of a byte array.

This function adds four bytes to the end of a byte array. The buffer is updated to account for the newly-added bytes.

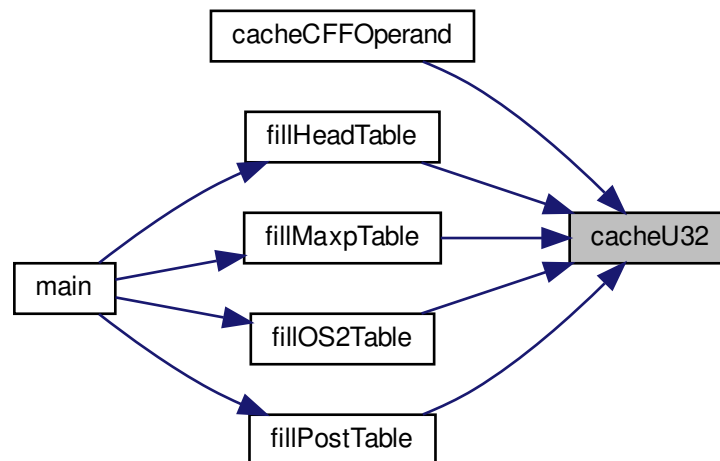
## Parameters

in,out	buf	The array of bytes to which to append four new bytes.
in	value	The 32-bit unsigned value to append to the buf array.

Definition at line [427](#) of file [hex2otf.c](#).

```
00428 {
00429     cacheU (buf, value, 4);
00430 }
```

Here is the caller graph for this function:



## 5.3.5.11 cacheU8()

```
void cacheU8 (
    Buffer * buf,
    uint_fast8_t value )
```

Append one unsigned byte to the end of a byte array.

This function adds one byte to the end of a byte array. The buffer is updated to account for the newly-added byte.

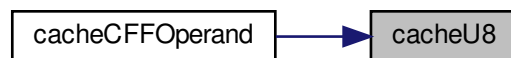
## Parameters

in,out	buf	The array of bytes to which to append a new byte.
in	value	The 8-bit unsigned value to append to the buf array.

Definition at line [397](#) of file [hex2otf.c](#).

```
00398 {
00399     storeU8 (buf, value & 0xff);
00400 }
```

Here is the caller graph for this function:



## 5.3.5.12 cacheZeros()

```
void cacheZeros (
    Buffer * buf,
    size_t count )
```

Append 1 to 4 bytes of zeroes to a buffer, for padding.

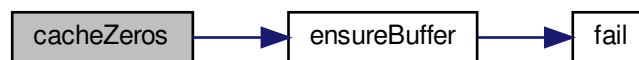
Parameters

in,out	buf	The buffer to which the operand value is appended.
in	count	The number of bytes containing zeroes to append.

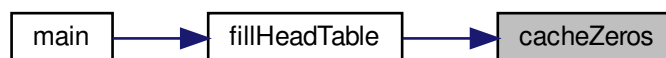
Definition at line 491 of file [hex2otf.c](#).

```
00492 {
00493     ensureBuffer (buf, count);
00494     memset (buf->next, 0, count);
00495     buf->next += count;
00496 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



## 5.3.5.13 cleanBuffers()

```
void cleanBuffers ( )
```

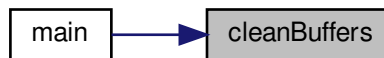
Free all allocated buffer pointers.

This function frees all buffer pointers previously allocated in the `initBuffers` function.

Definition at line 170 of file `hex2otf.c`.

```
00171 {
00172     for (size_t i = 0; i < bufferCount; i++)
00173         if (allBuffers[i].capacity)
00174             free (allBuffers[i].begin);
00175     free (allBuffers);
00176     bufferCount = 0;
00177 }
```

Here is the caller graph for this function:



## 5.3.5.14 defineStore()

```
defineStore (
    storeU8 ,
    uint_least8_t )
```

Definition at line 356 of file `hex2otf.c`.

```
00375 {
00376     assert (1 <= bytes && bytes <= 4);
00377     ensureBuffer (buf, bytes);
00378     switch (bytes)
00379     {
00380     case 4: *buf->next++ = value » 24 & 0xff; // fall through
00381     case 3: *buf->next++ = value » 16 & 0xff; // fall through
00382     case 2: *buf->next++ = value » 8 & 0xff; // fall through
00383     case 1: *buf->next++ = value & 0xff;
00384     }
00385 }
```

## 5.3.5.15 ensureBuffer()

```
void ensureBuffer (
    Buffer * buf,
    size_t needed )
```

Ensure that the buffer has at least the specified minimum size.

This function takes a buffer array of type `Buffer` and the necessary minimum number of elements as inputs, and attempts to increase the size of the buffer if it must be larger.

If the buffer is too small and cannot be resized, the program will terminate with an error message and an exit status of `EXIT_FAILURE`.

## Parameters

in,out	buf	The buffer to check.
in	needed	The required minimum number of elements in the buffer.

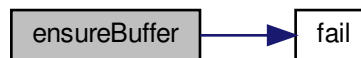
Definition at line 239 of file `hex2otf.c`.

```

00240 {
00241     if (buf->end - buf->next >= needed)
00242         return;
00243     ptrdiff_t occupied = buf->next - buf->begin;
00244     size_t required = occupied + needed;
00245     if (required < needed) // overflow
00246         fail ("Cannot allocate %zu + %zu bytes of memory.", occupied, needed);
00247     if (required > SIZE_MAX / 2)
00248         buf->capacity = required;
00249     else while (buf->capacity < required)
00250         buf->capacity *= 2;
00251     void *extended = realloc (buf->begin, buf->capacity);
00252     if (!extended)
00253         fail ("Failed to allocate %zu bytes of memory.", buf->capacity);
00254     buf->begin = extended;
00255     buf->next = buf->begin + occupied;
00256     buf->end = buf->begin + buf->capacity;
00257 }

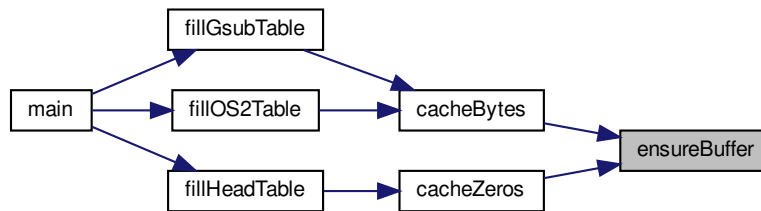
```

Here is the call graph for this function:





Here is the caller graph for this function:



#### 5.3.5.16 fail()

```
void fail (
    const char * reason,
    ... )
```

Print an error message on stderr, then exit.

This function prints the provided error string and optional following arguments to stderr, and then exits with a status of EXIT\_FAILURE.

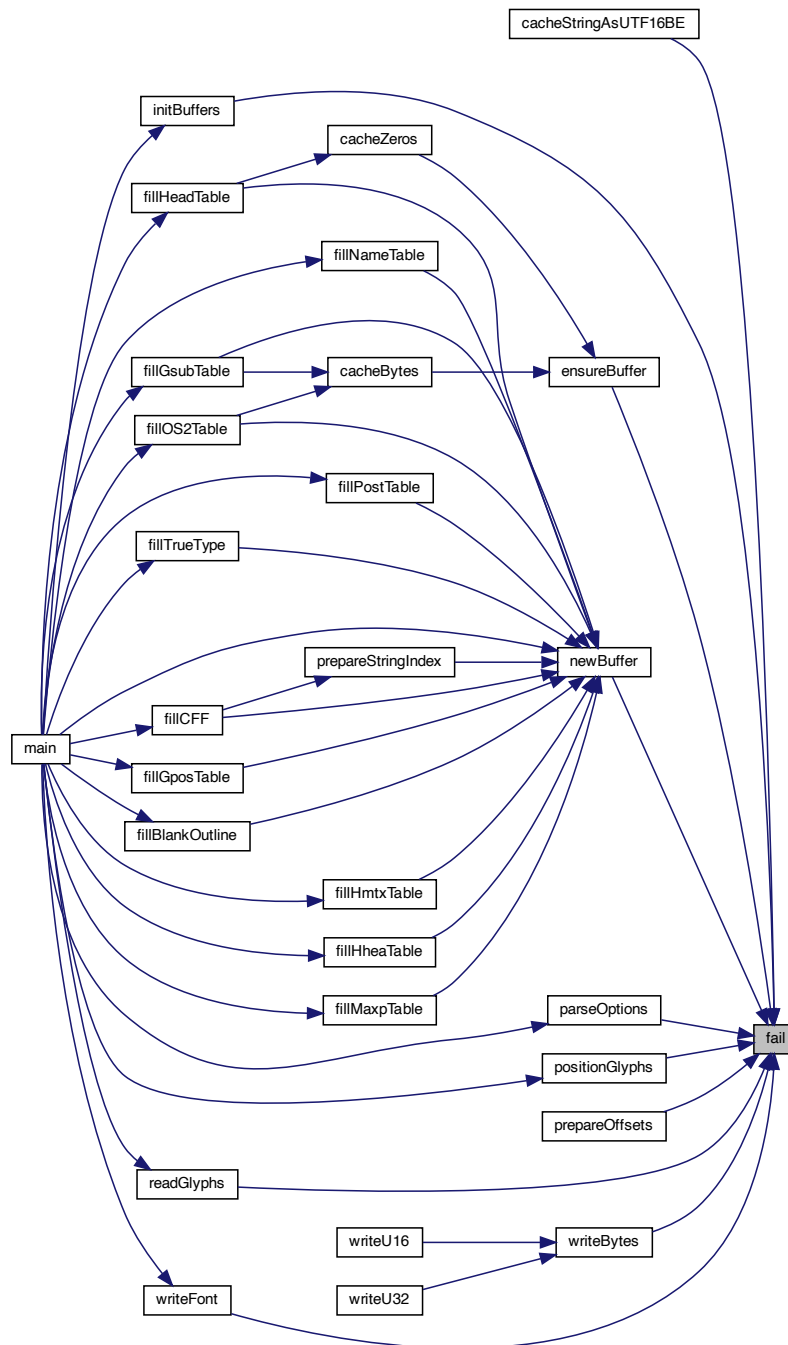
Parameters

in	reason	The output string to describe the error.
in	...	Optional following arguments to output.

Definition at line 113 of file [hex2otf.c](#).

```
00114 {
00115     fputs ("ERROR: ", stderr);
00116     va_list args;
00117     va_start (args, reason);
00118     vfprintf (stderr, reason, args);
00119     va_end (args);
00120     putc ('\n', stderr);
00121     exit (EXIT_FAILURE);
00122 }
```

Here is the caller graph for this function:



### 5.3.5.17 fillBitmap()

```
void fillBitmap (
```

Font \* font )

Fill OpenType bitmap data and location tables.

This function fills an Embedded Bitmap Data (EBDT) [Table](#) and an Embedded Bitmap Location (EBLC) [Table](#) with glyph bitmap information. These tables enable embedding bitmaps in OpenType fonts. No Embedded Bitmap Scaling (EBSC) table is used for the bitmap glyphs, only EBDT and EBLC.

Parameters

in,out	font	Pointer to a <a href="#">Font</a> struct in which to add bitmaps.
--------	------	---

Definition at line 1728 of file [hex2otf.c](#).

```

1729 {
1730     const Glyph *const glyphs = getBufferHead (font->glyphs);
1731     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
1732     size_t bitmapsSize = 0;
1733     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
1734         bitmapsSize += glyph->byteCount;
1735     Buffer *ebdt = newBuffer (4 + bitmapsSize);
1736     addTable (font, "EBDT", ebdt);
1737     cacheU16 (ebdt, 2); // majorVersion
1738     cacheU16 (ebdt, 0); // minorVersion
1739     uint_fast8_t byteCount = 0; // unequal to any glyph
1740     pixels_t pos = 0;
1741     bool combining = false;
1742     Buffer *rangeHeads = newBuffer (32);
1743     Buffer *offsets = newBuffer (64);
1744     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
1745     {
1746         if (glyph->byteCount != byteCount || glyph->pos != pos ||
1747             glyph->combining != combining)
1748         {
1749             storeU16 (rangeHeads, glyph - glyphs);
1750             storeU32 (offsets, countBufferedBytes (ebdt));
1751             byteCount = glyph->byteCount;
1752             pos = glyph->pos;
1753             combining = glyph->combining;
1754         }
1755         cacheBytes (ebdt, glyph->bitmap, byteCount);
1756     }
1757     const uint_least16_t *ranges = getBufferHead (rangeHeads);
1758     const uint_least16_t *rangesEnd = getBufferTail (rangeHeads);
1759     uint_fast32_t rangeCount = rangesEnd - ranges;
1760     storeU16 (rangeHeads, font->glyphCount);
1761     Buffer *eblc = newBuffer (4096);
1762     addTable (font, "EBLC", eblc);
1763     cacheU16 (eblc, 2); // majorVersion
1764     cacheU16 (eblc, 0); // minorVersion
1765     cacheU32 (eblc, 1); // numSizes
1766     { // bitmapSizes[0]
1767         cacheU32 (eblc, 56); // indexSubTableArrayOffset
1768         cacheU32 (eblc, (8 + 20) * rangeCount); // indexTablesSize
1769         cacheU32 (eblc, rangeCount); // numberOfIndexSubTables
1770         cacheU32 (eblc, 0); // colorRef
1771         { // hori
1772             cacheU8 (eblc, ASCENDER); // ascender
1773             cacheU8 (eblc, -DESCENDER); // descender
1774             cacheU8 (eblc, font->maxWidth); // widthMax
1775             cacheU8 (eblc, 1); // caretSlopeNumerator
1776             cacheU8 (eblc, 0); // caretSlopeDenominator
1777             cacheU8 (eblc, 0); // caretOffset
1778             cacheU8 (eblc, 0); // minOriginSB
1779             cacheU8 (eblc, 0); // minAdvanceSB
1780             cacheU8 (eblc, ASCENDER); // maxBeforeBL
1781             cacheU8 (eblc, -DESCENDER); // minAfterBL
1782             cacheU8 (eblc, 0); // pad1

```

```

01783     cacheU8 (eblc, 0); // pad2
01784 }
01785 { // vert
01786     cacheU8 (eblc, ASCENDER); // ascender
01787     cacheU8 (eblc, -DESCENDER); // descender
01788     cacheU8 (eblc, font->maxWidth); // widthMax
01789     cacheU8 (eblc, 1); // caretSlopeNumerator
01790     cacheU8 (eblc, 0); // caretSlopeDenominator
01791     cacheU8 (eblc, 0); // caretOffset
01792     cacheU8 (eblc, 0); // minOriginSB
01793     cacheU8 (eblc, 0); // minAdvanceSB
01794     cacheU8 (eblc, ASCENDER); // maxBeforeBL
01795     cacheU8 (eblc, -DESCENDER); // minAfterBL
01796     cacheU8 (eblc, 0); // pad1
01797     cacheU8 (eblc, 0); // pad2
01798 }
01799 cacheU16 (eblc, 0); // startGlyphIndex
01800 cacheU16 (eblc, font->glyphCount - 1); // endGlyphIndex
01801 cacheU8 (eblc, 16); // ppemX
01802 cacheU8 (eblc, 16); // ppemY
01803 cacheU8 (eblc, 1); // bitDepth
01804 cacheU8 (eblc, 1); // flags = Horizontal
01805 }
01806 { // IndexSubTableArray
01807     uint_fast32_t offset = rangeCount * 8;
01808     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01809     {
01810         cacheU16 (eblc, *p); // firstGlyphIndex
01811         cacheU16 (eblc, p[1] - 1); // lastGlyphIndex
01812         cacheU32 (eblc, offset); // additionalOffsetToIndexSubtable
01813         offset += 20;
01814     }
01815 }
01816 { // IndexSubTables
01817     const uint_least32_t *offset = getBufferHead (offsets);
01818     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01819     {
01820         const Glyph *glyph = &glyphs[*p];
01821         cacheU16 (eblc, 2); // indexFormat
01822         cacheU16 (eblc, 5); // imageFormat
01823         cacheU32 (eblc, *offset++); // imageDataOffset
01824         cacheU32 (eblc, glyph->byteCount); // imageSize
01825         { // bigMetrics
01826             cacheU8 (eblc, GLYPH_HEIGHT); // height
01827             const uint_fast8_t width = PW (glyph->byteCount);
01828             cacheU8 (eblc, width); // width
01829             cacheU8 (eblc, glyph->pos); // horiBearingX
01830             cacheU8 (eblc, ASCENDER); // horiBearingY
01831             cacheU8 (eblc, glyph->combining ? 0 : width); // horiAdvance
01832             cacheU8 (eblc, 0); // vertBearingX
01833             cacheU8 (eblc, 0); // vertBearingY
01834             cacheU8 (eblc, GLYPH_HEIGHT); // vertAdvance
01835         }
01836     }
01837 }
01838 freeBuffer (rangeHeads);
01839 freeBuffer (offsets);
01840 }

```

Here is the caller graph for this function:



## 5.3.5.18 fillBlankOutline()

```
void fillBlankOutline (
    Font * font )
```

Create a dummy blank outline in a font table.

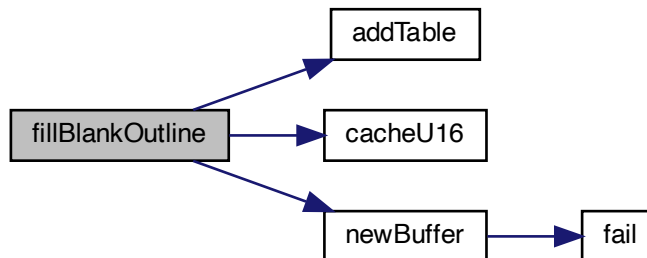
Parameters

in,out	font	Pointer to a <a href="#">Font</a> struct to insert a blank outline.
--------	------	---

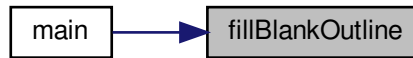
Definition at line 1697 of file [hex2otf.c](#).

```
01698 {
01699     Buffer *glyph = newBuffer (12);
01700     addTable (font, "glyph", glyph);
01701     // Empty table is not allowed, but an empty outline for glyph 0 suffices.
01702     cacheU16 (glyph, 0); // numberOfContours
01703     cacheU16 (glyph, FU (0)); // xMin
01704     cacheU16 (glyph, FU (0)); // yMin
01705     cacheU16 (glyph, FU (0)); // xMax
01706     cacheU16 (glyph, FU (0)); // yMax
01707     cacheU16 (glyph, 0); // instructionLength
01708     Buffer *loca = newBuffer (2 * (font->glyphCount + 1));
01709     addTable (font, "loca", loca);
01710     cacheU16 (loca, 0); // offsets[0]
01711     assert (countBufferedBytes (glyph) % 2 == 0);
01712     for (uint_fast32_t i = 1; i <= font->glyphCount; i++)
01713         cacheU16 (loca, countBufferedBytes (glyph) / 2); // offsets[i]
01714 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.19 fillCFF()

```

void fillCFF (
    Font * font,
    int version,
    const NameStrings names )
  
```

Add a CFF table to a font.

Parameters

in,out	font	Pointer to a <a href="#">Font</a> struct to contain the CFF table.
in	version	Version of CFF table, with value 1 or 2.
in	names	List of NameStrings.

Use fixed width integer for variables to simplify offset calculation.

Definition at line 1329 of file [hex2otf.c](#).

```

01330 {
01331     // HACK: For convenience, CFF data structures are hard coded.
01332     assert (0 < version && version <= 2);
01333     Buffer *cff = newBuffer (65536);
01334     addTable (font, version == 1 ? "CFF " : "CFF2", cff);
01335
01336     /// Use fixed width integer for variables to simplify offset calculation.
01337     #define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))
01338
01339     // In Unifont, 16px glyphs are more common. This is used by CFF1 only.
  
```

```

01340 const pixels_t defaultWidth = 16, nominalWidth = 8;
01341 if (version == 1)
01342 {
01343     Buffer *strings = prepareStringIndex (names);
01344     size_t stringsSize = countBufferedBytes (strings);
01345     const char *cffName = names[6];
01346     assert (cffName);
01347     size_t nameLength = strlen (cffName);
01348     size_t namesSize = nameLength + 5;
01349     // These sizes must be updated together with the data below.
01350     size_t offsets[] = {4, namesSize, 45, stringsSize, 2, 5, 8, 32, 4, 0};
01351     prepareOffsets (offsets);
01352     { // Header
01353         cacheU8 (cff, 1); // major
01354         cacheU8 (cff, 0); // minor
01355         cacheU8 (cff, 4); // hdrSize
01356         cacheU8 (cff, 1); // offSize
01357     }
01358     assert (countBufferedBytes (cff) == offsets[0]);
01359     { // Name INDEX (should not be used by OpenType readers)
01360         cacheU16 (cff, 1); // count
01361         cacheU8 (cff, 1); // offSize
01362         cacheU8 (cff, 1); // offset[0]
01363         if (nameLength + 1 > 255) // must be too long; spec limit is 63
01364             fail ("PostScript name is too long.");
01365         cacheU8 (cff, nameLength + 1); // offset[1]
01366         cacheBytes (cff, cffName, nameLength);
01367     }
01368     assert (countBufferedBytes (cff) == offsets[1]);
01369     { // Top DICT INDEX
01370         cacheU16 (cff, 1); // count
01371         cacheU8 (cff, 1); // offSize
01372         cacheU8 (cff, 1); // offset[0]
01373         cacheU8 (cff, 41); // offset[1]
01374         cacheCFFOperand (cff, 391); // "Adobe"
01375         cacheCFFOperand (cff, 392); // "Identity"
01376         cacheCFFOperand (cff, 0);
01377         cacheBytes (cff, (byte[]){12, 30}, 2); // ROS
01378         cacheCFF32 (cff, font->glyphCount);
01379         cacheBytes (cff, (byte[]){12, 34}, 2); // CIDCount
01380         cacheCFF32 (cff, offsets[6]);
01381         cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01382         cacheCFF32 (cff, offsets[5]);
01383         cacheBytes (cff, (byte[]){12, 37}, 2); // FDSelect
01384         cacheCFF32 (cff, offsets[4]);
01385         cacheU8 (cff, 15); // charset
01386         cacheCFF32 (cff, offsets[8]);
01387         cacheU8 (cff, 17); // CharStrings
01388     }
01389     assert (countBufferedBytes (cff) == offsets[2]);
01390     { // String INDEX
01391         cacheBuffer (cff, strings);
01392         freeBuffer (strings);
01393     }
01394     assert (countBufferedBytes (cff) == offsets[3]);
01395     cacheU16 (cff, 0); // Global Subr INDEX
01396     assert (countBufferedBytes (cff) == offsets[4]);
01397     { // Charsets
01398         cacheU8 (cff, 2); // format
01399         { // Range2[0]
01400             cacheU16 (cff, 1); // first
01401             cacheU16 (cff, font->glyphCount - 2); // nLeft
01402         }
01403     }
01404     assert (countBufferedBytes (cff) == offsets[5]);
01405     { // FDSelect
01406         cacheU8 (cff, 3); // format
01407         cacheU16 (cff, 1); // nRanges
01408         cacheU16 (cff, 0); // first
01409         cacheU8 (cff, 0); // fd
01410         cacheU16 (cff, font->glyphCount); // sentinel
01411     }
01412     assert (countBufferedBytes (cff) == offsets[6]);
01413     { // FDArray
01414         cacheU16 (cff, 1); // count
01415         cacheU8 (cff, 1); // offSize
01416         cacheU8 (cff, 1); // offset[0]
01417         cacheU8 (cff, 28); // offset[1]
01418         cacheCFFOperand (cff, 393);
01419         cacheBytes (cff, (byte[]){12, 38}, 2); // FontName
01420         // Windows requires FontMatrix in Font DICT.

```

```

01421     const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01422     cacheBytes (cff, unit, sizeof unit);
01423     cacheCFFOperand (cff, 0);
01424     cacheCFFOperand (cff, 0);
01425     cacheBytes (cff, unit, sizeof unit);
01426     cacheCFFOperand (cff, 0);
01427     cacheCFFOperand (cff, 0);
01428     cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01429     cacheCFFOperand (cff, offsets[8] - offsets[7]); // size
01430     cacheCFF32 (cff, offsets[7]); // offset
01431     cacheU8 (cff, 18); // Private
01432 }
01433 assert (countBufferedBytes (cff) == offsets[7]);
01434 { // Private
01435     cacheCFFOperand (cff, FU (defaultWidth));
01436     cacheU8 (cff, 20); // defaultWidthX
01437     cacheCFFOperand (cff, FU (nominalWidth));
01438     cacheU8 (cff, 21); // nominalWidthX
01439 }
01440 assert (countBufferedBytes (cff) == offsets[8]);
01441 }
01442 else
01443 {
01444     assert (version == 2);
01445     // These sizes must be updated together with the data below.
01446     size_t offsets[] = {5, 21, 4, 10, 0};
01447     prepareOffsets (offsets);
01448     { // Header
01449         cacheU8 (cff, 2); // majorVersion
01450         cacheU8 (cff, 0); // minorVersion
01451         cacheU8 (cff, 5); // headerSize
01452         cacheU16 (cff, offsets[1] - offsets[0]); // topDictLength
01453     }
01454     assert (countBufferedBytes (cff) == offsets[0]);
01455     { // Top DICT
01456         const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01457         cacheBytes (cff, unit, sizeof unit);
01458         cacheCFFOperand (cff, 0);
01459         cacheCFFOperand (cff, 0);
01460         cacheBytes (cff, unit, sizeof unit);
01461         cacheCFFOperand (cff, 0);
01462         cacheCFFOperand (cff, 0);
01463         cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01464         cacheCFFOperand (cff, offsets[2]);
01465         cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01466         cacheCFFOperand (cff, offsets[3]);
01467         cacheU8 (cff, 17); // CharStrings
01468     }
01469     assert (countBufferedBytes (cff) == offsets[1]);
01470     cacheU32 (cff, 0); // Global Subr INDEX
01471     assert (countBufferedBytes (cff) == offsets[2]);
01472     { // Font DICT INDEX
01473         cacheU32 (cff, 1); // count
01474         cacheU8 (cff, 1); // offSize
01475         cacheU8 (cff, 1); // offset[0]
01476         cacheU8 (cff, 4); // offset[1]
01477         cacheCFFOperand (cff, 0);
01478         cacheCFFOperand (cff, 0);
01479         cacheU8 (cff, 18); // Private
01480     }
01481     assert (countBufferedBytes (cff) == offsets[3]);
01482 }
01483 { // CharStrings INDEX
01484     Buffer *offsets = newBuffer (4096);
01485     Buffer *charstrings = newBuffer (4096);
01486     Buffer *outline = newBuffer (1024);
01487     const Glyph *glyph = getBufferHead (font->glyphs);
01488     const Glyph *const endGlyph = glyph + font->glyphCount;
01489     for (; glyph < endGlyph; glyph++)
01490     {
01491         // CFF offsets start at 1
01492         storeU32 (offsets, countBufferedBytes (charstrings) + 1);
01493
01494         pixels_t rx = -glyph->pos;
01495         pixels_t ry = DESCENDER;
01496         resetBuffer (outline);
01497         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_LEFT);
01498         enum CFFOp {rmoveto=21, hmoveto=22, vmoveto=4, hlineto=6,
01499                 vlineto=7, endchar=14};
01500         enum CFFOp pendingOp = 0;
01501         const int STACK_LIMIT = version == 1 ? 48 : 513;

```



```

01502     int stackSize = 0;
01503     bool isDrawing = false;
01504     pixels_t width = glyph->combining ? 0 : PW (glyph->byteCount);
01505     if (version == 1 && width != defaultWidth)
01506     {
01507         cacheCFFOperand (charstrings, FU (width - nominalWidth));
01508         stackSize++;
01509     }
01510     for (const pixels_t *p = getBufferHead (outline),
01511          *const end = getBufferTail (outline); p < end;)
01512     {
01513         int s = 0;
01514         const enum ContourOp op = *p++;
01515         if (op == OP_POINT)
01516         {
01517             const pixels_t x = *p++, y = *p++;
01518             if (x != rx)
01519             {
01520                 cacheCFFOperand (charstrings, FU (x - rx));
01521                 rx = x;
01522                 stackSize++;
01523                 s |= 1;
01524             }
01525             if (y != ry)
01526             {
01527                 cacheCFFOperand (charstrings, FU (y - ry));
01528                 ry = y;
01529                 stackSize++;
01530                 s |= 2;
01531             }
01532             assert (!(isDrawing && s == 3));
01533         }
01534         if (s)
01535         {
01536             if (lisDrawing)
01537             {
01538                 const enum CFFOp moves[] = {0, hmoveto, vmoveto,
01539                                             rmoveto};
01540                 cacheU8 (charstrings, moves[s]);
01541                 stackSize = 0;
01542             }
01543             else if (!pendingOp)
01544                 pendingOp = (enum CFFOp[]){0, hlineto, vlineto}[s];
01545         }
01546         else if (!isDrawing)
01547         {
01548             // only when the first point happens to be (0, 0)
01549             cacheCFFOperand (charstrings, FU (0));
01550             cacheU8 (charstrings, hmoveto);
01551             stackSize = 0;
01552         }
01553         if (op == OP_CLOSE || stackSize >= STACK_LIMIT)
01554         {
01555             assert (stackSize <= STACK_LIMIT);
01556             cacheU8 (charstrings, pendingOp);
01557             pendingOp = 0;
01558             stackSize = 0;
01559         }
01560         isDrawing = op != OP_CLOSE;
01561     }
01562     if (version == 1)
01563         cacheU8 (charstrings, endchar);
01564 }
01565 size_t lastOffset = countBufferedBytes (charstrings) + 1;
01566 #if SIZE_MAX > U32MAX
01567     if (lastOffset > U32MAX)
01568         fail ("CFF data exceeded size limit.");
01569 #endif
01570 storeU32 (offsets, lastOffset);
01571 int offsetSize = 1 + (lastOffset > 0xff)
01572     + (lastOffset > 0xffff)
01573     + (lastOffset > 0xfffff);
01574 // count (must match 'numGlyphs' in 'maxp' table)
01575 cacheU (cff, font->glyphCount, version * 2);
01576 cacheU8 (cff, offsetSize); // offsetSize
01577 const uint_least32_t *p = getBufferHead (offsets);
01578 const uint_least32_t *const end = getBufferTail (offsets);
01579 for (; p < end; p++)
01580     cacheU (cff, *p, offsetSize); // offsets
01581 cacheBuffer (cff, charstrings); // data
01582 freeBuffer (offsets);

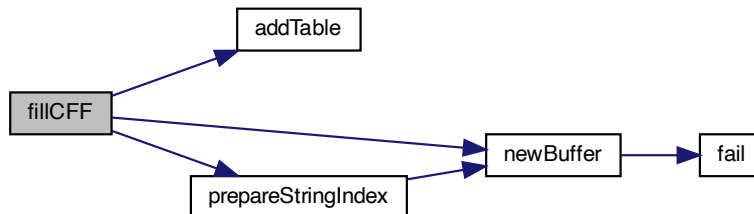
```

```

01583     freeBuffer (charstrings);
01584     freeBuffer (outline);
01585 }
01586 #undef cacheCFF32
01587 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.20 fillCmapTable()

```

void fillCmapTable (
    Font * font )

```

Fill a "cmap" font table.

The "cmap" table contains character to glyph index mapping information.

Parameters

in,out	font	The <code>Font</code> struct to which to add the table.
--------	------	---

Definition at line 2109 of file `hex2otf.c`.

```

02110 {
02111     Glyph *const glyphs = getBufferHead (font->glyphs);

```

```

02112 Buffer *rangeHeads = newBuffer (16);
02113 uint_fast32_t rangeCount = 0;
02114 uint_fast32_t bmpRangeCount = 1; // 1 for the last 0xffff-0xffff range
02115 glyphs[0].codePoint = glyphs[1].codePoint; // to start a range at glyph 1
02116 for (uint_fast16_t i = 1; i < font->glyphCount; i++)
02117 {
02118     if (glyphs[i].codePoint != glyphs[i - 1].codePoint + 1)
02119     {
02120         storeU16 (rangeHeads, i);
02121         rangeCount++;
02122         bmpRangeCount += glyphs[i].codePoint < 0xffff;
02123     }
02124 }
02125 Buffer *cmap = newBuffer (256);
02126 addTable (font, "cmap", cmap);
02127 // Format 4 table is always generated for compatibility.
02128 bool hasFormat12 = glyphs[font->glyphCount - 1].codePoint > 0xffff;
02129 cacheU16 (cmap, 0); // version
02130 cacheU16 (cmap, 1 + hasFormat12); // numTables
02131 { // encodingRecords[]
02132     cacheU16 (cmap, 3); // platformID
02133     cacheU16 (cmap, 1); // encodingID
02134     cacheU32 (cmap, 12 + 8 * hasFormat12); // subtableOffset
02135 }
02136 if (hasFormat12) // encodingRecords[1]
02137 {
02138     cacheU16 (cmap, 3); // platformID
02139     cacheU16 (cmap, 10); // encodingID
02140     cacheU32 (cmap, 36 + 8 * bmpRangeCount); // subtableOffset
02141 }
02142 const uint_least16_t *ranges = getBufferHead (rangeHeads);
02143 const uint_least16_t *const rangesEnd = getBufferTail (rangeHeads);
02144 storeU16 (rangeHeads, font->glyphCount);
02145 { // format 4 table
02146     cacheU16 (cmap, 4); // format
02147     cacheU16 (cmap, 16 + 8 * bmpRangeCount); // length
02148     cacheU16 (cmap, 0); // language
02149     if (bmpRangeCount * 2 > U16MAX)
02150         fail ("Too many ranges in 'cmap' table.");
02151     cacheU16 (cmap, bmpRangeCount * 2); // segCountX2
02152     uint_fast16_t searchRange = 1, entrySelector = -1;
02153     while (searchRange <= bmpRangeCount)
02154     {
02155         searchRange <<= 1;
02156         entrySelector++;
02157     }
02158     cacheU16 (cmap, searchRange); // searchRange
02159     cacheU16 (cmap, entrySelector); // entrySelector
02160     cacheU16 (cmap, bmpRangeCount * 2 - searchRange); // rangeShift
02161     { // endCode[]
02162         const uint_least16_t *p = ranges;
02163         for (p++; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02164             cacheU16 (cmap, glyphs[*p - 1].codePoint);
02165         uint_fast32_t cp = glyphs[*p - 1].codePoint;
02166         if (cp > 0xffff)
02167             cp = 0xffff;
02168         cacheU16 (cmap, cp);
02169         cacheU16 (cmap, 0xffff);
02170     }
02171     cacheU16 (cmap, 0); // reservedPad
02172     { // startCode[]
02173         for (uint_fast32_t i = 0; i < bmpRangeCount - 1; i++)
02174             cacheU16 (cmap, glyphs[ranges[i]].codePoint);
02175         cacheU16 (cmap, 0xffff);
02176     }
02177     { // idDelta[]
02178         const uint_least16_t *p = ranges;
02179         for (; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02180             cacheU16 (cmap, *p - glyphs[*p].codePoint);
02181         uint_fast16_t delta = 1;
02182         if (p < rangesEnd && *p == 0xffff)
02183             delta = *p - glyphs[*p].codePoint;
02184         cacheU16 (cmap, delta);
02185     }
02186     { // idRangeOffsets[]
02187         for (uint_least16_t i = 0; i < bmpRangeCount; i++)
02188             cacheU16 (cmap, 0);
02189     }
02190 }
02191 if (hasFormat12) // format 12 table
02192 {

```

```

02193     cacheU16 (cmap, 12); // format
02194     cacheU16 (cmap, 0); // reserved
02195     cacheU32 (cmap, 16 + 12 * rangeCount); // length
02196     cacheU32 (cmap, 0); // language
02197     cacheU32 (cmap, rangeCount); // numGroups
02198
02199     // groups[]
02200     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
02201     {
02202         cacheU32 (cmap, glyphs[*p].codePoint); // startCharCode
02203         cacheU32 (cmap, glyphs[p[1] - 1].codePoint); // endCharCode
02204         cacheU32 (cmap, *p); // startGlyphID
02205     }
02206 }
02207 freeBuffer (rangeHeads);
02208 }

```

Here is the caller graph for this function:



### 5.3.5.21 fillGposTable()

```

void fillGposTable (
    Font * font )

```

Fill a "GPOS" font table.

The "GPOS" table contains information for glyph positioning.

Parameters

in,out	font	The <b>Font</b> struct to which to add the table.
--------	------	---

Definition at line 2241 of file [hex2otf.c](#).

```

02242 {
02243     Buffer *gpos = newBuffer (16);
02244     addTable (font, "GPOS", gpos);
02245     cacheU16 (gpos, 1); // majorVersion
02246     cacheU16 (gpos, 0); // minorVersion
02247     cacheU16 (gpos, 10); // scriptListOffset
02248     cacheU16 (gpos, 12); // featureListOffset
02249     cacheU16 (gpos, 14); // lookupListOffset
02250     { // ScriptList table
02251         cacheU16 (gpos, 0); // scriptCount
02252     }
02253     { // Feature List table
02254         cacheU16 (gpos, 0); // featureCount
02255     }
02256     { // Lookup List Table

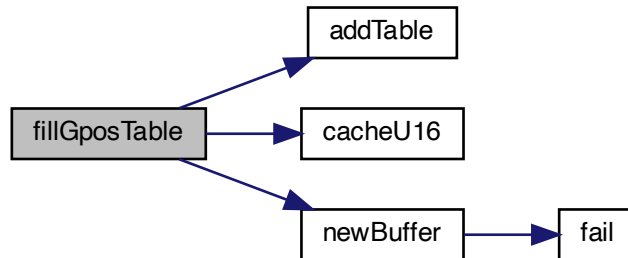
```

```

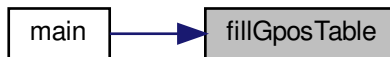
02257     cacheU16 (gpos, 0); // lookupCount
02258 }
02259 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.22 fillGsubTable()

```

void fillGsubTable (
    Font * font )

```

Fill a "GSUB" font table.

The "GSUB" table contains information for glyph substitution.

Parameters

in,out	font	The <code>Font</code> struct to which to add the table.
--------	------	---

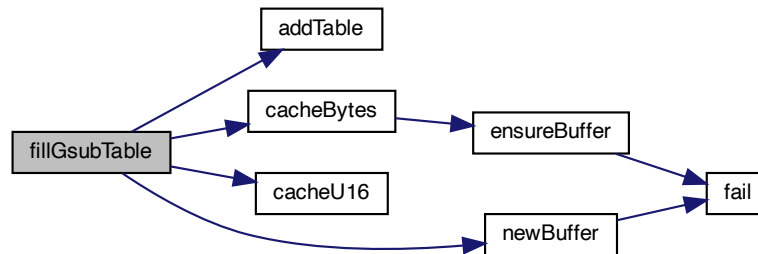
Definition at line [2269](#) of file [hex2otf.c](#).

```

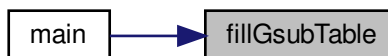
02270 {
02271   Buffer *gsub = newBuffer (38);
02272   addTable (font, "GSUB", gsub);
02273   cacheU16 (gsub, 1); // majorVersion
02274   cacheU16 (gsub, 0); // minorVersion
02275   cacheU16 (gsub, 10); // scriptListOffset
02276   cacheU16 (gsub, 34); // featureListOffset
02277   cacheU16 (gsub, 36); // lookupListOffset
02278   { // ScriptList table
02279     cacheU16 (gsub, 2); // scriptCount
02280     { // scriptRecords[0]
02281       cacheBytes (gsub, "DFLT", 4); // scriptTag
02282       cacheU16 (gsub, 14); // scriptOffset
02283     }
02284     { // scriptRecords[1]
02285       cacheBytes (gsub, "thai", 4); // scriptTag
02286       cacheU16 (gsub, 14); // scriptOffset
02287     }
02288     { // Script table
02289       cacheU16 (gsub, 4); // defaultLangSysOffset
02290       cacheU16 (gsub, 0); // langSysCount
02291       { // Default Language System table
02292         cacheU16 (gsub, 0); // lookupOrderOffset
02293         cacheU16 (gsub, 0); // requiredFeatureIndex
02294         cacheU16 (gsub, 0); // featureIndexCount
02295       }
02296     }
02297   }
02298   { // Feature List table
02299     cacheU16 (gsub, 0); // featureCount
02300   }
02301   { // Lookup List Table
02302     cacheU16 (gsub, 0); // lookupCount
02303   }
02304 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



## 5.3.5.23 fillHeadTable()

```
void fillHeadTable (
    Font * font,
    enum LocaFormat locaFormat,
    pixels_t xMin )
```

Fill a "head" font table.

The "head" table contains font header information common to the whole font.

Parameters

in,out	font	The <a href="#">Font</a> struct to which to add the table.
in	locaFormat	The "loca" offset index location table.
in	xMin	The minimum x-coordinate for a glyph.

Definition at line 1853 of file [hex2otf.c](#).

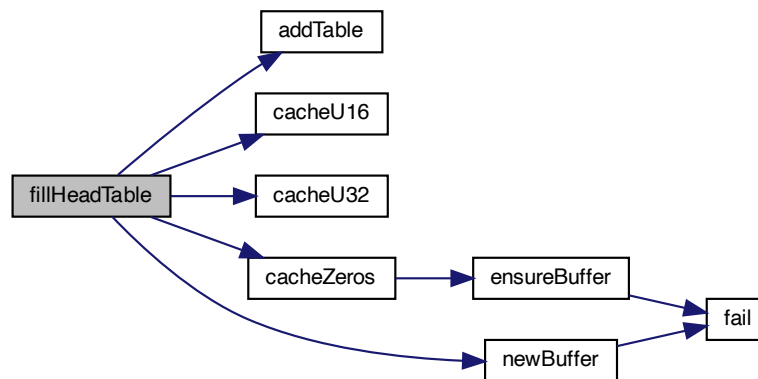
```
01854 {
01855     Buffer *head = newBuffer (56);
01856     addTable (font, "head", head);
01857     cacheU16 (head, 1); // majorVersion
01858     cacheU16 (head, 0); // minorVersion
01859     cacheZeros (head, 4); // fontRevision (unused)
01860     // The 'checksumAdjustment' field is a checksum of the entire file.
01861     // It is later calculated and written directly in the 'writeFont' function.
01862     cacheU32 (head, 0); // checksumAdjustment (placeholder)
01863     cacheU32 (head, 0x5f0f3cf5); // magicNumber
01864     const uint_fast16_t flags =
01865         + B1 (0) // baseline at y=0
01866         + B1 (1) // LSB at x=0 (doubtful; probably should be LSB=xMin)
01867         + B0 (2) // instructions may depend on point size
01868         + B0 (3) // force internal ppem to integers
01869         + B0 (4) // instructions may alter advance width
01870         + B0 (5) // not used in OpenType
01871         + B0 (6) // not used in OpenType
01872         + B0 (7) // not used in OpenType
01873         + B0 (8) // not used in OpenType
01874         + B0 (9) // not used in OpenType
01875         + B0 (10) // not used in OpenType
01876         + B0 (11) // font transformed
01877         + B0 (12) // font converted
01878         + B0 (13) // font optimized for ClearType
01879         + B0 (14) // last resort font
01880         + B0 (15) // reserved
01881     ;
01882     cacheU16 (head, flags); // flags
```

```

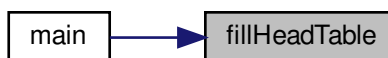
01883 cacheU16 (head, FUPEM); // unitsPerEm
01884 cacheZeros (head, 8); // created (unused)
01885 cacheZeros (head, 8); // modified (unused)
01886 cacheU16 (head, FU (xMin)); // xMin
01887 cacheU16 (head, FU (-DESCENDER)); // yMin
01888 cacheU16 (head, FU (font->maxWidth)); // xMax
01889 cacheU16 (head, FU (ASCENDER)); // yMax
01890 // macStyle (must agree with 'fsSelection' in 'OS/2' table)
01891 const uint_fast16_t macStyle =
01892     + B0 (0) // bold
01893     + B0 (1) // italic
01894     + B0 (2) // underline
01895     + B0 (3) // outline
01896     + B0 (4) // shadow
01897     + B0 (5) // condensed
01898     + B0 (6) // extended
01899     // 7-15 reserved
01900 ;
01901 cacheU16 (head, macStyle);
01902 cacheU16 (head, GLYPH_HEIGHT); // lowestRecPPEM
01903 cacheU16 (head, 2); // fontDirectionHint
01904 cacheU16 (head, locaFormat); // indexToLocFormat
01905 cacheU16 (head, 0); // glyphDataFormat
01906 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.3.5.24 fillHheaTable()

```
void fillHheaTable (
```



```

    Font * font,
    pixels_t xMin )

```

Fill a "hhea" font table.

The "hhea" table contains horizontal header information, for example left and right side bearings.

Parameters

in,out	font	The <code>Font</code> struct to which to add the table.
in	xMin	The minimum x-coordinate for a glyph.

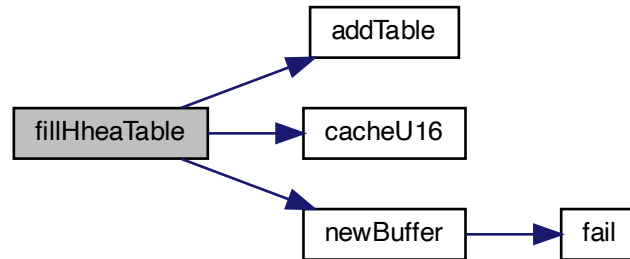
Definition at line 1918 of file `hex2otf.c`.

```

01919 {
01920     Buffer *hhea = newBuffer (36);
01921     addTable (font, "hhea", hhea);
01922     cacheU16 (hhea, 1); // majorVersion
01923     cacheU16 (hhea, 0); // minorVersion
01924     cacheU16 (hhea, FU (ASCENDER)); // ascender
01925     cacheU16 (hhea, FU (-DESCENDER)); // descender
01926     cacheU16 (hhea, FU (0)); // lineGap
01927     cacheU16 (hhea, FU (font->maxWidth)); // advanceWidthMax
01928     cacheU16 (hhea, FU (xMin)); // minLeftSideBearing
01929     cacheU16 (hhea, FU (0)); // minRightSideBearing (unused)
01930     cacheU16 (hhea, FU (font->maxWidth)); // xMaxExtent
01931     cacheU16 (hhea, 1); // caretSlopeRise
01932     cacheU16 (hhea, 0); // caretSlopeRun
01933     cacheU16 (hhea, 0); // caretOffset
01934     cacheU16 (hhea, 0); // reserved
01935     cacheU16 (hhea, 0); // reserved
01936     cacheU16 (hhea, 0); // reserved
01937     cacheU16 (hhea, 0); // reserved
01938     cacheU16 (hhea, 0); // metricDataFormat
01939     cacheU16 (hhea, font->glyphCount); // numberOfHMetrics
01940 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.25 fillHmtxTable()

```
void fillHmtxTable (
```

```
    Font * font )
```

Fill an "hmtx" font table.

The "hmtx" table contains horizontal metrics information.

Parameters

in,out	font	The <a href="#">Font</a> struct to which to add the table.
--------	------	--

Definition at line [2087](#) of file [hex2otf.c](#).

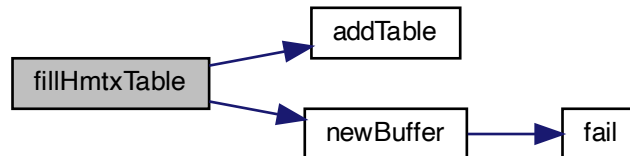
```
02088 {
02089     Buffer *hmtx = newBuffer (4 * font->glyphCount);
02090     addTable (font, "hmtx", hmtx);
02091     const Glyph *const glyphs = getBufferHead (font->glyphs);
```

```

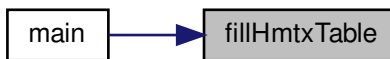
02092  const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
02093  for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
02094  {
02095      int_fast16_t aw = glyph->combining ? 0 : PW (glyph->byteCount);
02096      cacheU16 (hmtx, FU (aw)); // advanceWidth
02097      cacheU16 (hmtx, FU (glyph->lsb)); // lsb
02098  }
02099  }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.26 fillMaxpTable()

```

void fillMaxpTable (
    Font * font,
    bool isCFF,
    uint_fast16_t maxPoints,
    uint_fast16_t maxContours )

```

Fill a "maxp" font table.

The "maxp" table contains maximum profile information, such as the memory required to contain the font.

Parameters

in,out	font	The <a href="#">Font</a> struct to which to add the table.
--------	------	--

## Parameters

in	isCFF	true if a CFF font is included, false otherwise.
in	maxPoints	Maximum points in a non-composite glyph.
in	maxContours	Maximum contours in a non-composite glyph.

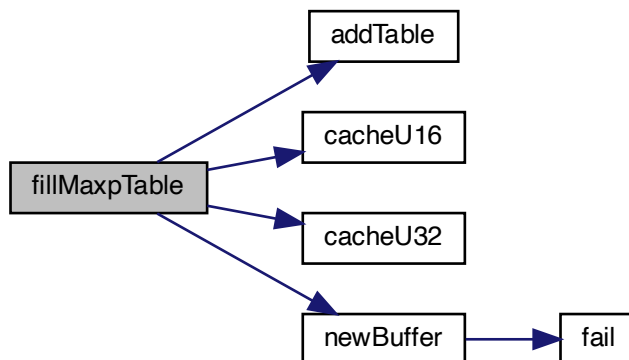
Definition at line 1954 of file [hex2otf.c](#).

```

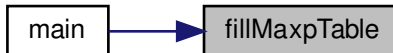
01956 {
01957     Buffer *maxp = newBuffer (32);
01958     addTable (font, "maxp", maxp);
01959     cacheU32 (maxp, isCFF ? 0x00005000 : 0x00010000); // version
01960     cacheU16 (maxp, font->glyphCount); // numGlyphs
01961     if (isCFF)
01962         return;
01963     cacheU16 (maxp, maxPoints); // maxPoints
01964     cacheU16 (maxp, maxContours); // maxContours
01965     cacheU16 (maxp, 0); // maxCompositePoints
01966     cacheU16 (maxp, 0); // maxCompositeContours
01967     cacheU16 (maxp, 0); // maxZones
01968     cacheU16 (maxp, 0); // maxTwilightPoints
01969     cacheU16 (maxp, 0); // maxStorage
01970     cacheU16 (maxp, 0); // maxFunctionDefs
01971     cacheU16 (maxp, 0); // maxInstructionDefs
01972     cacheU16 (maxp, 0); // maxStackElements
01973     cacheU16 (maxp, 0); // maxSizeOfInstructions
01974     cacheU16 (maxp, 0); // maxComponentElements
01975     cacheU16 (maxp, 0); // maxComponentDepth
01976 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.27 fillNameTable()

```

void fillNameTable (
    Font * font,
    NameStrings nameStrings )
  
```

Fill a "name" font table.

The "name" table contains name information, for example for Name IDs.

Parameters

in,out	font	The <code>Font</code> struct to which to add the table.
--------	------	---

## Parameters

in	names	List of Name Strings.
----	-------	-----------------------

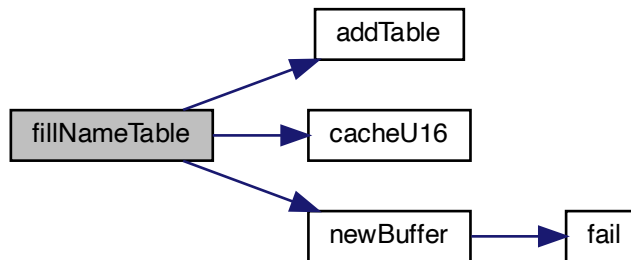
Definition at line 2366 of file [hex2otf.c](#).

```

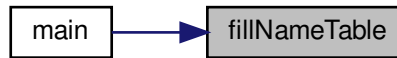
02367 {
02368     Buffer *name = newBuffer (2048);
02369     addTable (font, "name", name);
02370     size_t nameStringCount = 0;
02371     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02372         nameStringCount += !nameStrings[i];
02373     cacheU16 (name, 0); // version
02374     cacheU16 (name, nameStringCount); // count
02375     cacheU16 (name, 2 * 3 + 12 * nameStringCount); // storageOffset
02376     Buffer *stringData = newBuffer (1024);
02377     // nameRecord[]
02378     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02379     {
02380         if (!nameStrings[i])
02381             continue;
02382         size_t offset = countBufferedBytes (stringData);
02383         cacheStringAsUTF16BE (stringData, nameStrings[i]);
02384         size_t length = countBufferedBytes (stringData) - offset;
02385         if (offset > U16MAX || length > U16MAX)
02386             fail ("Name strings are too long.");
02387         // Platform ID 0 (Unicode) is not well supported.
02388         // ID 3 (Windows) seems to be the best for compatibility.
02389         cacheU16 (name, 3); // platformID = Windows
02390         cacheU16 (name, 1); // encodingID = Unicode BMP
02391         cacheU16 (name, 0x0409); // languageID = en-US
02392         cacheU16 (name, i); // nameID
02393         cacheU16 (name, length); // length
02394         cacheU16 (name, offset); // stringOffset
02395     }
02396     cacheBuffer (name, stringData);
02397     freeBuffer (stringData);
02398 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.28 fillOS2Table()

```
void fillOS2Table (
    Font * font )
```

Fill an "OS/2" font table.

The "OS/2" table contains OS/2 and Windows font metrics information.

Parameters

in,out	font	The <b>Font</b> struct to which to add the table.
--------	------	---

Definition at line 1986 of file `hex2otf.c`.

```

1987 {
1988     Buffer *os2 = newBuffer (100);
1989     addTable (font, "OS/2", os2);
1990     cacheU16 (os2, 5); // version
1991     // HACK: Average glyph width is not actually calculated.
1992     cacheU16 (os2, FU (font->maxWidth)); // xAvgCharWidth
1993     cacheU16 (os2, 400); // usWeightClass = Normal
1994     cacheU16 (os2, 5); // usWidthClass = Medium
1995     const uint_fast16_t typeFlags =
1996         + B0 (0) // reserved
1997         // usage permissions, one of:
1998         // Default: Installable embedding
1999         + B0 (1) // Restricted License embedding
2000         + B0 (2) // Preview & Print embedding
2001         + B0 (3) // Editable embedding
2002         // 4-7 reserved
2003         + B0 (8) // no subsetting
2004         + B0 (9) // bitmap embedding only
2005         // 10-15 reserved
2006     ;
2007     cacheU16 (os2, typeFlags); // fsType
2008     cacheU16 (os2, FU (5)); // ySubscriptXSize
2009     cacheU16 (os2, FU (7)); // ySubscriptYSize
2010     cacheU16 (os2, FU (0)); // ySubscriptXOffset
2011     cacheU16 (os2, FU (1)); // ySubscriptYOffset
2012     cacheU16 (os2, FU (5)); // ySuperscriptXSize
2013     cacheU16 (os2, FU (7)); // ySuperscriptYSize
2014     cacheU16 (os2, FU (0)); // ySuperscriptXOffset
2015     cacheU16 (os2, FU (4)); // ySuperscriptYOffset
2016     cacheU16 (os2, FU (1)); // yStrikeoutSize
2017     cacheU16 (os2, FU (5)); // yStrikeoutPosition
2018     cacheU16 (os2, 0x080a); // sFamilyClass = Sans Serif, Matrix
  
```

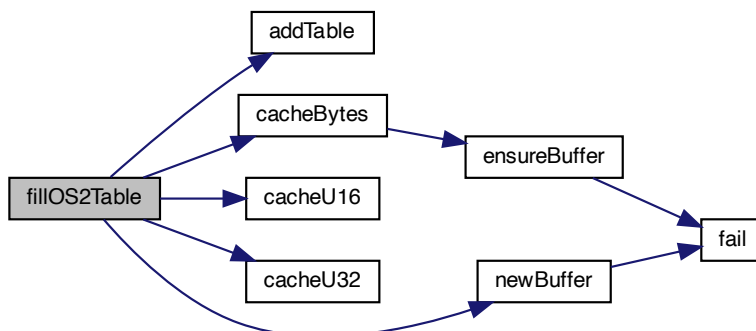
```

02019  const byte panose[] =
02020  {
02021      2, // Family Kind = Latin Text
02022      11, // Serif Style = Normal Sans
02023      4, // Weight = Thin
02024      // Windows would render all glyphs to the same width,
02025      // if 'Proportion' is set to 'Monospaced' (as Unifont should be).
02026      // 'Condensed' is the best alternative according to metrics.
02027      6, // Proportion = Condensed
02028      2, // Contrast = None
02029      2, // Stroke = No Variation
02030      2, // Arm Style = Straight Arms
02031      8, // Letterform = Normal/Square
02032      2, // Midline = Standard/Trimmed
02033      4, // X-height = Constant/Large
02034  };
02035  cacheBytes (os2, panose, sizeof panose); // panose
02036  // HACK: All defined Unicode ranges are marked functional for convenience.
02037  cacheU32 (os2, 0xffffffff); // ulUnicodeRange1
02038  cacheU32 (os2, 0xffffffff); // ulUnicodeRange2
02039  cacheU32 (os2, 0xffffffff); // ulUnicodeRange3
02040  cacheU32 (os2, 0x0effffff); // ulUnicodeRange4
02041  cacheBytes (os2, "GNU ", 4); // achVendID
02042  // fsSelection (must agree with 'macStyle' in 'head' table)
02043  const uint_fast16_t selection =
02044      + B0 (0) // italic
02045      + B0 (1) // underscored
02046      + B0 (2) // negative
02047      + B0 (3) // outlined
02048      + B0 (4) // strikeout
02049      + B0 (5) // bold
02050      + B1 (6) // regular
02051      + B1 (7) // use sTypo* metrics in this table
02052      + B1 (8) // font name conforms to WWS model
02053      + B0 (9) // oblique
02054      // 10-15 reserved
02055  ;
02056  cacheU16 (os2, selection);
02057  const Glyph *glyphs = getBufferHead (font->glyphs);
02058  uint_fast32_t first = glyphs[1].codePoint;
02059  uint_fast32_t last = glyphs[font->glyphCount - 1].codePoint;
02060  cacheU16 (os2, first < U16MAX ? first : U16MAX); // usFirstCharIndex
02061  cacheU16 (os2, last < U16MAX ? last : U16MAX); // usLastCharIndex
02062  cacheU16 (os2, FU (ASCENDER)); // sTypoAscender
02063  cacheU16 (os2, FU (-DESCENDER)); // sTypoDescender
02064  cacheU16 (os2, FU (0)); // sTypoLineGap
02065  cacheU16 (os2, FU (ASCENDER)); // usWinAscent
02066  cacheU16 (os2, FU (DESCENDER)); // usWinDescent
02067  // HACK: All reasonable code pages are marked functional for convenience.
02068  cacheU32 (os2, 0x603f01ff); // ulCodePageRange1
02069  cacheU32 (os2, 0xffff0000); // ulCodePageRange2
02070  cacheU16 (os2, FU (8)); // sxHeight
02071  cacheU16 (os2, FU (10)); // sCapHeight
02072  cacheU16 (os2, 0); // usDefaultChar
02073  cacheU16 (os2, 0x20); // usBreakChar
02074  cacheU16 (os2, 0); // usMaxContext
02075  cacheU16 (os2, 0); // usLowerOpticalPointSize
02076  cacheU16 (os2, 0xffff); // usUpperOpticalPointSize
02077  }

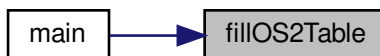
```



Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.3.5.29 fillPostTable()

```
void fillPostTable (
    Font * font )
```

Fill a "post" font table.

The "post" table contains information for PostScript printers.

Parameters

in,out	font	The <a href="#">Font</a> struct to which to add the table.
--------	------	--

Definition at line [2218](#) of file [hex2otf.c](#).

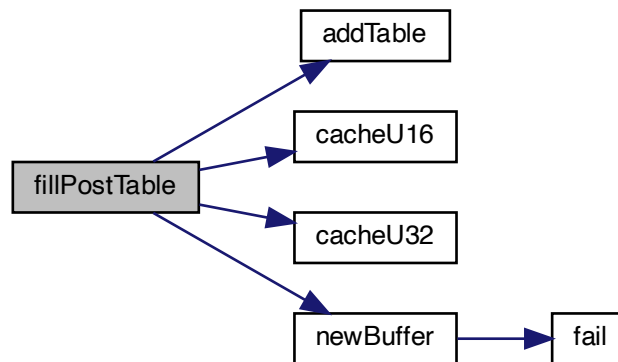
```
02219 {
02220     Buffer *post = newBuffer (32);
```

```

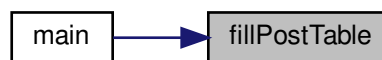
02221  addTable (font, "post", post);
02222  cacheU32 (post, 0x00030000); // version = 3.0
02223  cacheU32 (post, 0); // italicAngle
02224  cacheU16 (post, 0); // underlinePosition
02225  cacheU16 (post, 1); // underlineThickness
02226  cacheU32 (post, 1); // isFixedPitch
02227  cacheU32 (post, 0); // minMemType42
02228  cacheU32 (post, 0); // maxMemType42
02229  cacheU32 (post, 0); // minMemType1
02230  cacheU32 (post, 0); // maxMemType1
02231  }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.30 fillTrueType()

```

void fillTrueType (
    Font * font,
    enum LocaFormat * format,
    uint_fast16_t * maxPoints,
    uint_fast16_t * maxContours )

```

Add a TrueType table to a font.

## Parameters

in,out	font	Pointer to a <a href="#">Font</a> struct to contain the TrueType table.
in	format	The TrueType "loca" table format, Offset16 or Offset32.
in	names	List of Name Strings.

Definition at line 1597 of file [hex2otf.c](#).

```

01599 {
01600     Buffer *glyph = newBuffer (65536);
01601     addTable (font, "glyph", glyph);
01602     Buffer *loca = newBuffer (4 * (font->glyphCount + 1));
01603     addTable (font, "loca", loca);
01604     *format = LOCA_OFFSET32;
01605     Buffer *endPoints = newBuffer (256);
01606     Buffer *flags = newBuffer (256);
01607     Buffer *xs = newBuffer (256);
01608     Buffer *ys = newBuffer (256);
01609     Buffer *outline = newBuffer (1024);
01610     Glyph *const glyphs = getBufferHead (font->glyphs);
01611     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01612     for (Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01613     {
01614         cacheU32 (loca, countBufferedBytes (glyph));
01615         pixels_t rx = -glyph->pos;
01616         pixels_t ry = DESCENDER;
01617         pixels_t xMin = GLYPH_MAX_WIDTH, xMax = 0;
01618         pixels_t yMin = ASCENDER, yMax = -DESCENDER;
01619         resetBuffer (endPoints);
01620         resetBuffer (flags);
01621         resetBuffer (xs);
01622         resetBuffer (ys);
01623         resetBuffer (outline);
01624         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_RIGHT);
01625         uint_fast32_t pointCount = 0, contourCount = 0;
01626         for (const pixels_t *p = getBufferHead (outline),
01627              *const end = getBufferTail (outline); p < end;)
01628         {
01629             const enum ContourOp op = *p++;
01630             if (op == OP_CLOSE)
01631             {
01632                 contourCount++;
01633                 assert (contourCount <= U16MAX);
01634                 cacheU16 (endPoints, pointCount - 1);
01635                 continue;

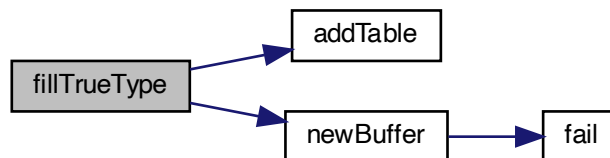
```

```

01636     }
01637     assert (op == OP_POINT);
01638     pointCount++;
01639     assert (pointCount <= U16MAX);
01640     const pixels_t x = *p++, y = *p++;
01641     uint_fast8_t pointFlags =
01642         + B1 (0) // point is on curve
01643         + BX (1, x != rx) // x coordinate is 1 byte instead of 2
01644         + BX (2, y != ry) // y coordinate is 1 byte instead of 2
01645         + B0 (3) // repeat
01646         + BX (4, x >= rx) // when x is 1 byte: x is positive;
01647           // when x is 2 bytes: x unchanged and omitted
01648         + BX (5, y >= ry) // when y is 1 byte: y is positive;
01649           // when y is 2 bytes: y unchanged and omitted
01650         + B1 (6) // contours may overlap
01651         + B0 (7) // reserved
01652     ;
01653     cacheU8 (flags, pointFlags);
01654     if (x != rx)
01655         cacheU8 (xs, FU (x > rx ? x - rx : rx - x));
01656     if (y != ry)
01657         cacheU8 (ys, FU (y > ry ? y - ry : ry - y));
01658     if (x < xMin) xMin = x;
01659     if (y < yMin) yMin = y;
01660     if (x > xMax) xMax = x;
01661     if (y > yMax) yMax = y;
01662     rx = x;
01663     ry = y;
01664 }
01665 if (contourCount == 0)
01666     continue; // blank glyph is indicated by the 'loca' table
01667 glyph->lsb = glyph->pos + xMin;
01668 cacheU16 (glyf, contourCount); // numberOfContours
01669 cacheU16 (glyf, FU (glyph->pos + xMin)); // xMin
01670 cacheU16 (glyf, FU (yMin)); // yMin
01671 cacheU16 (glyf, FU (glyph->pos + xMax)); // xMax
01672 cacheU16 (glyf, FU (yMax)); // yMax
01673 cacheBuffer (glyf, endPoints); // endPtsOfContours[]
01674 cacheU16 (glyf, 0); // instructionLength
01675 cacheBuffer (glyf, flags); // flags[]
01676 cacheBuffer (glyf, xs); // xCoordinates[]
01677 cacheBuffer (glyf, ys); // yCoordinates[]
01678 if (pointCount > *maxPoints)
01679     *maxPoints = pointCount;
01680 if (contourCount > *maxContours)
01681     *maxContours = contourCount;
01682 }
01683 cacheU32 (loca, countBufferedBytes (glyf));
01684 freeBuffer (endPoints);
01685 freeBuffer (flags);
01686 freeBuffer (xs);
01687 freeBuffer (ys);
01688 freeBuffer (outline);
01689 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.3.5.31 freeBuffer()

```
void freeBuffer (  
    Buffer * buf )
```

Free the memory previously allocated for a buffer.

This function frees the memory allocated to an array of type `Buffer *`.

Parameters

in	buf	The pointer to an array of type <code>Buffer *</code> .

Definition at line 337 of file `hex2otf.c`.

```
00338 {  
00339     free (buf->begin);  
00340     buf->capacity = 0;  
00341 }
```

#### 5.3.5.32 initBuffers()

```
void initBuffers (  
    size_t count )
```

Initialize an array of buffer pointers to all zeroes.

This function initializes the "allBuffers" array of buffer pointers to all zeroes.

## Parameters

in	count	The number of buffer array pointers to allocate.
----	-------	--

Definition at line 152 of file [hex2otf.c](#).

```
00153 {
00154     assert (count > 0);
00155     assert (bufferCount == 0); // uninitialized
00156     allBuffers = calloc (count, sizeof *allBuffers);
00157     if (!allBuffers)
00158         fail ("Failed to initialize buffers.");
00159     bufferCount = count;
00160     nextBufferIndex = 0;
00161 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.33 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

## Parameters

in	argc	The number of command-line arguments.
in	argv	The array of command-line arguments.

## Returns

EXIT\_FAILURE upon fatal error, EXIT\_SUCCESS otherwise.

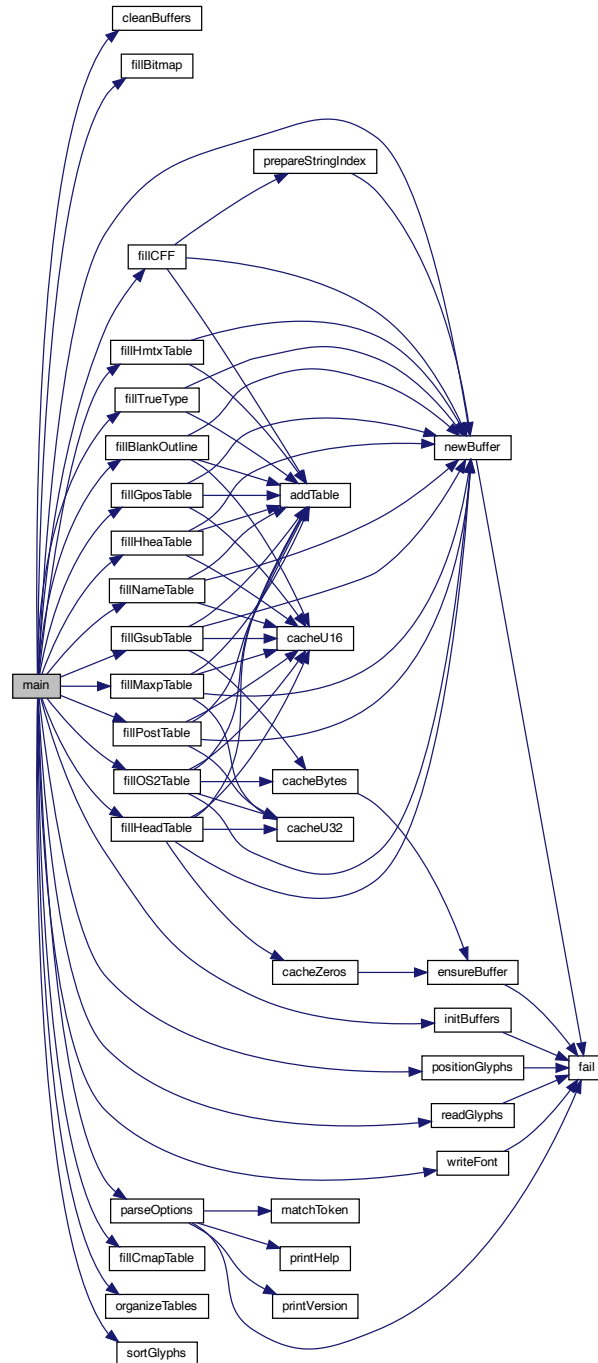
Definition at line 2603 of file [hex2otf.c](#).

```

02604 {
02605     initBuffers (16);
02606     atexit (cleanBuffers);
02607     Options opt = parseOptions (argv);
02608     Font font;
02609     font.tables = newBuffer (sizeof (Table) * 16);
02610     font.glyphs = newBuffer (sizeof (Glyph) * MAX_GLYPHS);
02611     readGlyphs (&font, opt.hex);
02612     sortGlyphs (&font);
02613     enum LocaFormat loca = LOCA_OFFSET16;
02614     uint\_fast16\_t maxPoints = 0, maxContours = 0;
02615     pixels\_t xMin = 0;
02616     if (opt.pos)
02617         positionGlyphs (&font, opt.pos, &xMin);
02618     if (opt.gpos)
02619         fillGposTable (&font);
02620     if (opt.gsub)
02621         fillGsubTable (&font);
02622     if (opt.cff)
02623         fillCFF (&font, opt.cff, opt.nameStrings);
02624     if (opt.trueType)
02625         fillTrueType (&font, &loca, &maxPoints, &maxContours);
02626     if (opt.blankOutline)
02627         fillBlankOutline (&font);
02628     if (opt.bitmap)
02629         fillBitmap (&font);
02630     fillHeadTable (&font, loca, xMin);
02631     fillHheaTable (&font, xMin);
02632     fillMaxpTable (&font, opt.cff, maxPoints, maxContours);
02633     fillOS2Table (&font);
02634     fillNameTable (&font, opt.nameStrings);
02635     fillHmtxTable (&font);
02636     fillCmapTable (&font);
02637     fillPostTable (&font);
02638     organizeTables (&font, opt.cff);
02639     writeFont (&font, opt.cff, opt.out);
02640     return EXIT_SUCCESS;
02641 }

```

Here is the call graph for this function:



### 5.3.5.34 matchToken()

```
const char * matchToken (
```



```

    const char * operand,
    const char * key,
    char delimiter )

```

Match a command line option with its key for enabling.

Parameters

in	operand	A pointer to the specified operand.
in	key	Pointer to the option structure.
in	delimiter	The delimiter to end searching.

Returns

Pointer to the first character of the desired option.

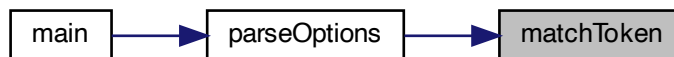
Definition at line 2470 of file [hex2otf.c](#).

```

02471 {
02472     while (*key)
02473         if (*operand++ != *key++)
02474             return NULL;
02475     if (!*operand || *operand++ == delimiter)
02476         return operand;
02477     return NULL;
02478 }

```

Here is the caller graph for this function:



### 5.3.5.35 newBuffer()

```

Buffer * newBuffer (
    size_t initialCapacity )

```

Create a new buffer.

This function creates a new buffer array of type [Buffer](#), with an initial size of `initialCapacity` elements.

## Parameters

in	initialCapacity	The initial number of elements in the buffer.
----	-----------------	---

Definition at line 188 of file [hex2otf.c](#).

```

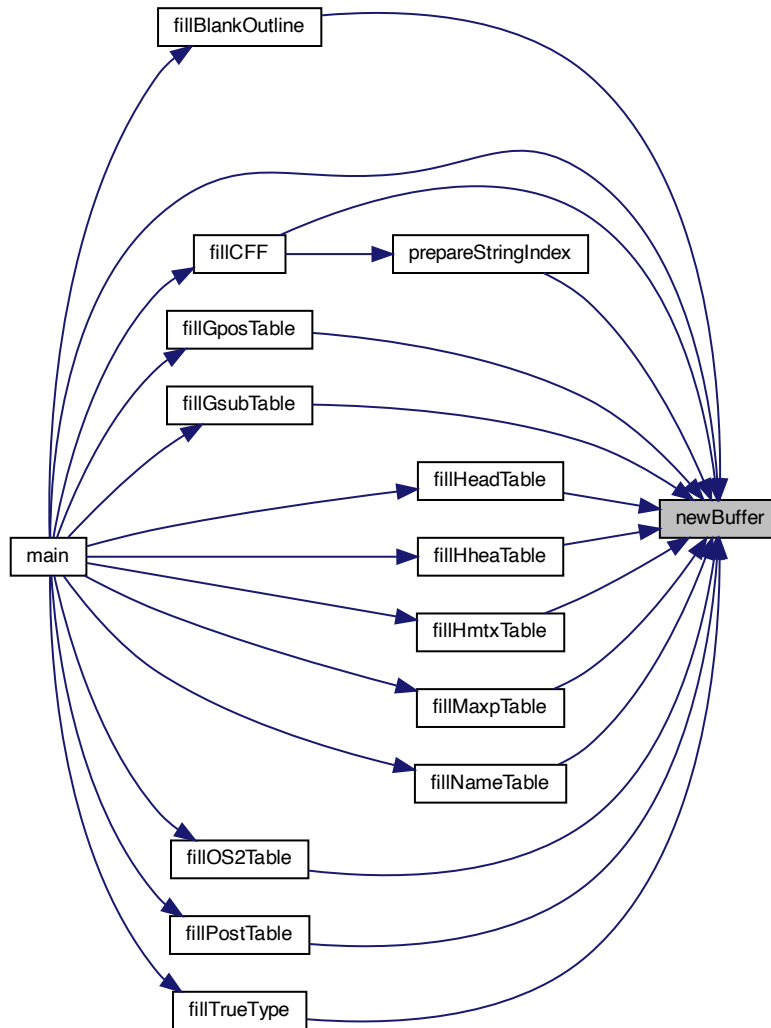
00189 {
00190     assert (initialCapacity > 0);
00191     Buffer *buf = NULL;
00192     size_t sentinel = nextBufferIndex;
00193     do
00194     {
00195         if (nextBufferIndex == bufferCount)
00196             nextBufferIndex = 0;
00197         if (allBuffers[nextBufferIndex].capacity == 0)
00198         {
00199             buf = &allBuffers[nextBufferIndex++];
00200             break;
00201         }
00202     } while (++nextBufferIndex != sentinel);
00203     if (!buf) // no existing buffer available
00204     {
00205         size_t newSize = sizeof (Buffer) * bufferCount * 2;
00206         void *extended = realloc (allBuffers, newSize);
00207         if (!extended)
00208             fail ("Failed to create new buffers.");
00209         allBuffers = extended;
00210         memset (allBuffers + bufferCount, 0, sizeof (Buffer) * bufferCount);
00211         buf = &allBuffers[bufferCount];
00212         nextBufferIndex = bufferCount + 1;
00213         bufferCount *= 2;
00214     }
00215     buf->begin = malloc (initialCapacity);
00216     if (!buf->begin)
00217         fail ("Failed to allocate %zu bytes of memory.", initialCapacity);
00218     buf->capacity = initialCapacity;
00219     buf->next = buf->begin;
00220     buf->end = buf->begin + initialCapacity;
00221     return buf;
00222 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.36 organizeTables()

```

void organizeTables (
    Font * font,
    bool isCFF )
  
```

Sort tables according to OpenType recommendations.

The various tables in a font are sorted in an order recommended for TrueType font files.

## Parameters

in,out	font	The font in which to sort tables.
in	isCFF	True iff Compact Font Format (CFF) is being used.

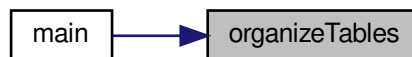
Definition at line 711 of file `hex2otf.c`.

```

00712 {
00713     const char *const cffOrder[] = {"head","hhea","maxp","OS/2","name",
00714         "cmap","post","CFF ",NULL};
00715     const char *const truetypeOrder[] = {"head","hhea","maxp","OS/2",
00716         "hmtx","LTSH","VDMX","hdmx","cmap","fpgm","prep","cvt ","loca",
00717         "glyf","kern","name","post","gasp","PCLT","DSIG",NULL};
00718     const char *const *const order = isCFF ? cffOrder : truetypeOrder;
00719     Table *unordered = getBufferHead (font->tables);
00720     const Table *const tablesEnd = getBufferTail (font->tables);
00721     for (const char *const *p = order; *p; p++)
00722     {
00723         uint_fast32_t tag = tagAsU32 (*p);
00724         for (Table *t = unordered; t < tablesEnd; t++)
00725         {
00726             if (t->tag != tag)
00727                 continue;
00728             if (t != unordered)
00729             {
00730                 Table temp = *unordered;
00731                 *unordered = *t;
00732                 *t = temp;
00733             }
00734             unordered++;
00735             break;
00736         }
00737     }
00738 }

```

Here is the caller graph for this function:



## 5.3.5.37 parseOptions()

**Options** parseOptions (   
 char \*const argv[const ] )

Parse command line options.

Option	Data Type	Description
truetype	bool	Generate TrueType outlines
blankOutline	bool	Generate blank outlines
bitmap	bool	Generate embedded bitmap
gpos	bool	Generate a dummy GPOS table
gsub	bool	Generate a dummy GSUB table
cff	int	Generate CFF 1 or CFF 2 outlines
hex	const char *	Name of Unifont .hex file
pos	const char *	Name of Unifont combining data file
out	const char *	Name of output font file
nameStrings	NameStrings	Array of TrueType font Name IDs

## Parameters

in	argv	Pointer to array of command line options.
----	------	---

## Returns

Data structure to hold requested command line options.

Definition at line 2500 of file [hex2otf.c](#).

```

02501 {
02502     Options opt = {0}; // all options default to 0, false and NULL
02503     const char *format = NULL;
02504     struct StringArg
02505     {
02506         const char *const key;
02507         const char **const value;
02508     } strArgs[] =
02509     {
02510         {"hex", &opt.hex},
02511         {"pos", &opt.pos},
02512         {"out", &opt.out},
02513         {"format", &format},
02514         {NULL, NULL} // sentinel
02515     };
02516     for (char *const *argp = argv + 1; *argp; argp++)
02517     {
02518         const char *const arg = *argp;
02519         struct StringArg *p;
02520         const char *value = NULL;
02521         if (strcmp (arg, "--help") == 0)
02522             printHelp ();
02523         if (strcmp (arg, "--version") == 0)
02524             printVersion ();
02525         for (p = strArgs; p->key; p++)
02526             if ((value = matchToken (arg, p->key, '=')))
02527                 break;
02528         if (p->key)
02529         {
02530             if (!*value)
02531                 fail ("Empty argument: '%s'", p->key);
02532             if (*p->value)
02533                 fail ("Duplicate argument: '%s'", p->key);

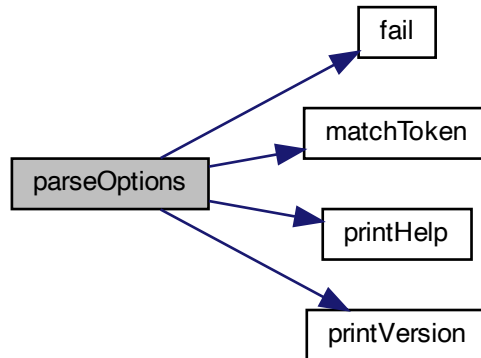
```

```

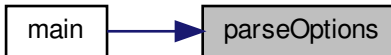
02534     *p->value = value;
02535 }
02536 else // shall be a name string
02537 {
02538     char *endptr;
02539     unsigned long id = strtoul (arg, &endptr, 10);
02540     if (endptr == arg || id >= MAX_NAME_IDS || *endptr != '=')
02541         fail ("Invalid argument: '%s'", arg);
02542     endptr++; // skip '='
02543     if (opt.nameStrings[id])
02544         fail ("Duplicate name ID: %lu.", id);
02545     opt.nameStrings[id] = endptr;
02546 }
02547 }
02548 if (!opt.hex)
02549     fail ("Hex file is not specified.");
02550 if (opt.pos && opt.pos[0] == '\0')
02551     opt.pos = NULL; // Position file is optional. Empty path means none.
02552 if (!opt.out)
02553     fail ("Output file is not specified.");
02554 if (!format)
02555     fail ("Format is not specified.");
02556 for (const NamePair *p = defaultNames; p->str; p++)
02557     if (!opt.nameStrings[p->id])
02558         opt.nameStrings[p->id] = p->str;
02559 bool cff = false, cff2 = false;
02560 struct Symbol
02561 {
02562     const char *const key;
02563     bool *const found;
02564 } symbols[] =
02565 {
02566     {"cff", &cff},
02567     {"cff2", &cff2},
02568     {"truetype", &opt.truetype},
02569     {"blank", &opt.blankOutline},
02570     {"bitmap", &opt.bitmap},
02571     {"gpos", &opt.gpos},
02572     {"gsub", &opt.gsub},
02573     {NULL, NULL} // sentinel
02574 };
02575 while (*format)
02576 {
02577     const struct Symbol *p;
02578     const char *next = NULL;
02579     for (p = symbols; p->key; p++)
02580         if ((next = matchToken (format, p->key, ',')))
02581             break;
02582     if (!p->key)
02583         fail ("Invalid format.");
02584     *p->found = true;
02585     format = next;
02586 }
02587 if (cff + cff2 + opt.truetype + opt.blankOutline > 1)
02588     fail ("At most one outline format can be accepted.");
02589 if (!(cff || cff2 || opt.truetype || opt.bitmap))
02590     fail ("Invalid format.");
02591 opt.cff = cff + cff2 * 2;
02592 return opt;
02593 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.38 positionGlyphs()

```
void positionGlyphs (  
    Font * font,  
    const char * fileName,  
    pixels_t * xMin )
```

Position a glyph within a 16-by-16 pixel bounding box.

Position a glyph within the 16-by-16 pixel drawing area and note whether or not the glyph is a combining character.

N.B.: Glyphs must be sorted by code point before calling this function.



## Parameters

in,out	font	Font data structure pointer to store glyphs.
in	fileName	Name of glyph file to read.
in	xMin	Minimum x-axis value (for left side bearing).

Definition at line 1061 of file [hex2otf.c](#).

```

01062 {
01063     *xMin = 0;
01064     FILE *file = fopen (fileName, "r");
01065     if (!file)
01066         fail ("Failed to open file '%s'", fileName);
01067     Glyph *glyphs = getBufferHead (font->glyphs);
01068     const Glyph *const endGlyph = glyphs + font->glyphCount;
01069     Glyph *nextGlyph = &glyphs[1]; // predict and avoid search
01070     for (;;)
01071     {
01072         uint_fast32_t codePoint;
01073         if (readCodePoint (&codePoint, fileName, file))
01074             break;
01075         Glyph *glyph = nextGlyph;
01076         if (glyph == endGlyph || glyph->codePoint != codePoint)
01077         {
01078             // Prediction failed. Search.
01079             const Glyph key = { .codePoint = codePoint };
01080             glyph = bsearch (&key, glyphs + 1, font->glyphCount - 1,
01081                             sizeof key, byCodePoint);
01082             if (!glyph)
01083                 fail ("Glyph 'PRI_CP' is positioned but not defined.",
01084                     codePoint);
01085         }
01086         nextGlyph = glyph + 1;
01087         char s[8];
01088         if (!fgets (s, sizeof s, file))
01089             fail ("%s: Read error.", fileName);
01090         char *end;
01091         const long value = strtol (s, &end, 10);
01092         if (*end != '\n' && *end != '\0')
01093             fail ("Position of glyph 'PRI_CP' is invalid.", codePoint);
01094         // Currently no glyph is moved to the right,
01095         // so positive position is considered out of range.
01096         // If this limit is to be lifted,
01097         // 'xMax' of bounding box in 'head' table shall also be updated.
01098         if (value < -GLYPH_MAX_WIDTH || value > 0)
01099             fail ("Position of glyph 'PRI_CP' is out of range.", codePoint);
01100         glyph->combining = true;
01101         glyph->pos = value;
01102         glyph->lsb = value; // updated during outline generation
01103         if (value < *xMin)
01104             *xMin = value;

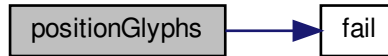
```

```

01105     }
01106     fclose (file);
01107 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.39 prepareOffsets()

```

void prepareOffsets (
    size_t * sizes )

```

Prepare 32-bit glyph offsets in a font table.

Parameters

in	sizes	Array of glyph sizes, for offset calculations.
----	-------	--

Definition at line [1275](#) of file [hex2otf.c](#).

```

01276 {
01277     size_t *p = sizes;
01278     for (size_t *i = sizes + 1; *i; i++)
01279         *i += *p++;
01280     if (*p > 2147483647U) // offset not representable
01281         fail ("CFF table is too large.");
01282 }

```

Here is the call graph for this function:



#### 5.3.5.40 prepareStringIndex()

`Buffer * prepareStringIndex (`  
     const `NameStrings` names )

Prepare a font name string index.

Parameters

in	names	List of name strings.
----	-------	-----------------------

Returns

Pointer to a `Buffer` struct containing the string names.

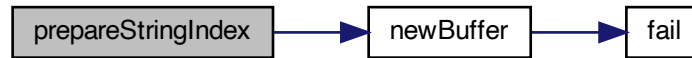
Get the number of elements in array `char *strings[]`.

Definition at line 1291 of file `hex2otf.c`.

```

01292 {
01293     Buffer *buf = newBuffer (256);
01294     assert (names[6]);
01295     const char *strings[] = {"Adobe", "Identity", names[6]};
01296     /// Get the number of elements in array char *strings[].
01297     #define stringCount (sizeof strings / sizeof *strings)
01298     static_assert (stringCount <= U16MAX, "too many strings");
01299     size_t offset = 1;
01300     size_t lengths[stringCount];
01301     for (size_t i = 0; i < stringCount; i++)
01302     {
01303         assert (strings[i]);
01304         lengths[i] = strlen (strings[i]);
01305         offset += lengths[i];
01306     }
01307     int offsetSize = 1 + (offset > 0xff)
01308                   + (offset > 0xffff)
01309                   + (offset > 0xfffff);
01310     cacheU16 (buf, stringCount); // count
01311     cacheU8 (buf, offsetSize); // offsetSize
01312     cacheU (buf, offset = 1, offsetSize); // offset[0]
01313     for (size_t i = 0; i < stringCount; i++)
01314         cacheU (buf, offset += lengths[i], offsetSize); // offset[i + 1]
01315     for (size_t i = 0; i < stringCount; i++)
01316         cacheBytes (buf, strings[i], lengths[i]);
01317     #undef stringCount
01318     return buf;
01319 }
  
```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.3.5.41 `printHelp()`

```
void printHelp ( )
```

Print help message to stdout and then exit.

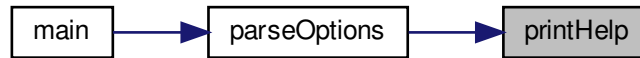
Print help message if invoked with the "--help" option, and then exit successfully.

Definition at line 2426 of file [hex2otf.c](#).

```

02426     {
02427     printf ("Synopsis: hex2otf <options>:\n\n");
02428     printf ("  hex=<filename>      Specify Unifont .hex input file.\n");
02429     printf ("  pos=<filename>      Specify combining file. (Optional)\n");
02430     printf ("  out=<filename>     Specify output font file.\n");
02431     printf ("  format=<f1>,<f2>,... Specify font format(s); values:\n");
02432     printf ("                    cff\n");
02433     printf ("                    cff2\n");
02434     printf ("                    truetype\n");
02435     printf ("                    blank\n");
02436     printf ("                    bitmap\n");
02437     printf ("                    gpos\n");
02438     printf ("                    gsub\n");
02439     printf ("\nExample:\n\n");
02440     printf ("  hex2otf hex=Myfont.hex out=Myfont.otf format=cff\n");
02441     printf ("For more information, consult the hex2otf(1) man page.\n\n");
02442
02443     exit (EXIT_SUCCESS);
02444 }
  
```

Here is the caller graph for this function:



#### 5.3.5.42 printVersion()

```
void printVersion ( )
```

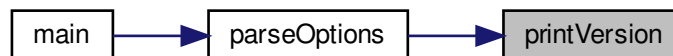
Print program version string on stdout.

Print program version if invoked with the "--version" option, and then exit successfully.

Definition at line 2407 of file [hex2otf.c](#).

```
02407     {
02408     printf ("hex2otf (GNU Unifont) %s\n", VERSION);
02409     printf ("Copyright \u00A9 2022 \u4F55\u5FD7\u7FD4 (He Zhixiang)\n");
02410     printf ("License GPLv2+: GNU GPL version 2 or later\n");
02411     printf ("<https://gnu.org/licenses/gpl.html>\n");
02412     printf ("This is free software: you are free to change and\n");
02413     printf ("redistribute it.  There is NO WARRANTY, to the extent\n");
02414     printf ("permitted by law.\n");
02415
02416     exit (EXIT_SUCCESS);
02417 }
```

Here is the caller graph for this function:



#### 5.3.5.43 readCodePoint()

```
bool readCodePoint (
    uint_fast32_t * codePoint,
    const char * fileName,
    FILE * file )
```

Read up to 6 hexadecimal digits and a colon from file.

This function reads up to 6 hexadecimal digits followed by a colon from a file.

If the end of the file is reached, the function returns true. The file name is provided to include in an error message if the end of file was reached unexpectedly.

## Parameters

out	codePoint	The Uni-code code point.
in	fileName	The name of the input file.
in	file	Pointer to the input file stream.

## Returns

true if at end of file, false otherwise.

Definition at line 919 of file [hex2otf.c](#).

```

00920 {
00921     *codePoint = 0;
00922     uint_fast8_t digitCount = 0;
00923     for (;;)
00924     {
00925         int c = getc (file);
00926         if (isdigit (c) && ++digitCount <= 6)
00927         {
00928             *codePoint = (*codePoint « 4) | nibbleValue (c);
00929             continue;
00930         }
00931         if (c == '?' && digitCount > 0)
00932             return false;
00933         if (c == EOF)
00934         {
00935             if (digitCount == 0)
00936                 return true;
00937             if (feof (file))
00938                 fail ("%s: Unexpected end of file.", fileName);
00939             else
00940                 fail ("%s: Read error.", fileName);
00941         }
00942         fail ("%s: Unexpected character: %#.2x.", fileName, (unsigned)c);
00943     }
00944 }
```

## 5.3.5.44 readGlyphs()

```

void readGlyphs (
    Font * font,
    const char * fileName )
```

Read glyph definitions from a Unifont .hex format file.

This function reads in the glyph bitmaps contained in a Unifont .hex format file. These input files contain one glyph bitmap per line. Each line is of the form

```
<hexadecimal code point> '?' <hexadecimal bitmap sequence>
```

The code point field typically consists of 4 hexadecimal digits for a code point in Unicode Plane 0, and 6 hexadecimal digits for code points above Plane 0. The hexadecimal bitmap sequence is 32 hexadecimal digits long for a glyph that is 8 pixels wide by 16 pixels high, and 64 hexadecimal digits long for a glyph that is 16 pixels wide by 16 pixels high.

## Parameters

in,out	font	The font data structure to update with new glyphs.
in	fileName	The name of the Unifont .hex format input file.

Definition at line 966 of file `hex2otf.c`.

```

00967 {
00968     FILE *file = fopen (fileName, "r");
00969     if (!file)
00970         fail ("Failed to open file '%s'", fileName);
00971     uint_fast32_t glyphCount = 1; // for glyph 0
00972     uint_fast8_t maxByteCount = 0;
00973     { // Hard code the .notdef glyph.
00974         const byte bitmap[] = "\0\0\0-fZZzvv-vv-\0\0"; // same as U+FFFD
00975         const size_t byteCount = sizeof bitmap - 1;
00976         assert (byteCount <= GLYPH_MAX_BYTE_COUNT);
00977         assert (byteCount % GLYPH_HEIGHT == 0);
00978         Glyph *notdef = getBufferSlot (font->glyphs, sizeof (Glyph));
00979         memcpy (notdef->bitmap, bitmap, byteCount);
00980         notdef->byteCount = maxByteCount = byteCount;
00981         notdef->combining = false;
00982         notdef->pos = 0;
00983         notdef->lsb = 0;
00984     }
00985     for (;;)
00986     {
00987         uint_fast32_t codePoint;
00988         if (readCodePoint (&codePoint, fileName, file))
00989             break;
00990         if (++glyphCount > MAX_GLYPHS)
00991             fail ("OpenType does not support more than %lu glyphs.",
00992                 MAX_GLYPHS);
00993         Glyph *glyph = getBufferSlot (font->glyphs, sizeof (Glyph));
00994         glyph->codePoint = codePoint;
00995         glyph->byteCount = 0;
00996         glyph->combining = false;
00997         glyph->pos = 0;
00998         glyph->lsb = 0;
00999         for (byte *p = glyph->bitmap;; p++)
01000         {
01001             int h, l;
01002             if (isxdigit (h = getc (file)) && isxdigit (l = getc (file)))
01003                 {
01004                     if (++glyph->byteCount > GLYPH_MAX_BYTE_COUNT)
01005                         fail ("Hex stream of 'PRI_CP' is too long.", codePoint);
01006                     *p = nibbleValue (h) « 4 | nibbleValue (l);
01007                 }
01008             else if (h == '\n' || (h == EOF && feof (file)))
01009                 break;
01010             else if (ferror (file))
01011                 fail ("%s: Read error.", fileName);

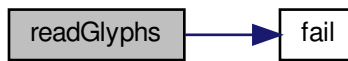
```

```

01012         else
01013             fail ("Hex stream of "PRI_CP" is invalid.", codePoint);
01014     }
01015     if (glyph->byteCount % GLYPH_HEIGHT != 0)
01016         fail ("Hex length of "PRI_CP" is indivisible by glyph height %d.",
01017             codePoint, GLYPH_HEIGHT);
01018     if (glyph->byteCount > maxByteCount)
01019         maxByteCount = glyph->byteCount;
01020 }
01021 if (glyphCount == 1)
01022     fail ("No glyph is specified.");
01023 font->glyphCount = glyphCount;
01024 font->maxWidth = PW (maxByteCount);
01025 fclose (file);
01026 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.3.5.45 sortGlyphs()

```

void sortGlyphs (
    Font * font )

```

Sort the glyphs in a font by Unicode code point.

This function reads in an array of glyphs and sorts them by Unicode code point. If a duplicate code point is encountered, that will result in a fatal error with an error message to `stderr`.



## Parameters

in,out	font	Pointer to a <a href="#">Font</a> structure with glyphs to sort.
--------	------	--

Definition at line 1119 of file [hex2otf.c](#).

```

01120 {
01121     Glyph *glyphs = getBufferHead (font->glyphs);
01122     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01123     glyphs++; // glyph 0 does not need sorting
01124     qsort (glyphs, glyphsEnd - glyphs, sizeof *glyphs, byCodePoint);
01125     for (const Glyph *glyph = glyphs; glyph < glyphsEnd - 1; glyph++)
01126     {
01127         if (glyph[0].codePoint == glyph[1].codePoint)
01128             fail ("Duplicate code point: "PRI_CP", glyph[0].codePoint);
01129         assert (glyph[0].codePoint < glyph[1].codePoint);
01130     }
01131 }

```

Here is the caller graph for this function:



## 5.3.5.46 writeBytes()

```

void writeBytes (
    const byte bytes[],
    size\_t count,
    FILE * file )

```

Write an array of bytes to an output file.

## Parameters

in	bytes	An array of unsigned bytes to write.
----	-------	--------------------------------------

## Parameters

in	file	The file pointer for writing, of type FILE*.
----	------	--

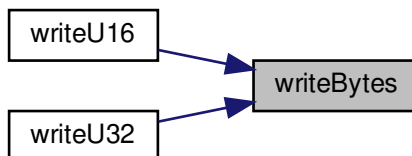
Definition at line 538 of file [hex2otf.c](#).

```
00539 {
00540     if (fwrite (bytes, count, 1, file) != 1 && count != 0)
00541         fail ("Failed to write %zu bytes to output file.", count);
00542 }
```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.3.5.47 writeFont()

```
void writeFont (
    Font * font,
    bool isCFF,
    const char * fileName )
```

Write OpenType font to output file.

This function writes the constructed OpenType font to the output file named "filename".

## Parameters

in	font	Pointer to the font, of type <a href="#">Font</a> *.
in	isCFF	Boolean indicating whether the font has CFF data.
in	filename	The name of the font file to create.

Add a byte shifted by 24, 16, 8, or 0 bits.

Definition at line 786 of file [hex2otf.c](#).

```

00787 {
00788     FILE *file = fopen (fileName, "wb");
00789     if (!file)
00790         fail ("Failed to open file '%s'", fileName);
00791     const Table *const tables = getBufferHead (font->tables);
00792     const Table *const tablesEnd = getBufferTail (font->tables);
00793     size_t tableCount = tablesEnd - tables;
00794     assert (0 < tableCount && tableCount <= U16MAX);
00795     size_t offset = 12 + 16 * tableCount;
00796     uint_fast32_t totalChecksum = 0;
00797     Buffer *tableRecords =
00798         newBuffer (sizeof (struct TableRecord) * tableCount);
00799     for (size_t i = 0; i < tableCount; i++)
00800     {
00801         struct TableRecord *record =
00802             getBufferSlot (tableRecords, sizeof *record);
00803         record->tag = tables[i].tag;
00804         size_t length = countBufferedBytes (tables[i].content);
00805         #if SIZE_MAX > U32MAX
00806             if (offset > U32MAX)
00807                 fail ("Table offset exceeded 4 GiB.");
00808             if (length > U32MAX)
00809                 fail ("Table size exceeded 4 GiB.");
00810         #endif
00811         record->length = length;
00812         record->checksum = 0;
00813         const byte *p = getBufferHead (tables[i].content);
00814         const byte *const end = getBufferTail (tables[i].content);
00815
00816         /// Add a byte shifted by 24, 16, 8, or 0 bits.
00817         #define addByte(shift) \
00818             if (p == end) \
00819                 break; \
00820             record->checksum += (uint_fast32_t)*p++ « (shift);
00821
00822         for (;;)
00823         {
00824             addByte (24)
00825             addByte (16)

```

```

00826     addByte (8)
00827     addByte (0)
00828 }
00829 #undef addByte
00830 cacheZeros (tables[i].content, (~length + 1U) & 3U);
00831 record->offset = offset;
00832 offset += countBufferedBytes (tables[i].content);
00833 totalChecksum += record->checksum;
00834 }
00835 struct TableRecord *records = getBufferHead (tableRecords);
00836 qsort (records, tableCount, sizeof *records, byTableTag);
00837 // Offset Table
00838 uint_fast32_t sfntVersion = isCFF ? 0x4f54544f : 0x00010000;
00839 writeU32 (sfntVersion, file); // sfntVersion
00840 totalChecksum += sfntVersion;
00841 uint_fast16_t entrySelector = 0;
00842 for (size_t k = tableCount; k != 1; k >= 1)
00843     entrySelector++;
00844 uint_fast16_t searchRange = 1 << (entrySelector + 4);
00845 uint_fast16_t rangeShift = (tableCount - (1 << entrySelector)) << 4;
00846 writeU16 (tableCount, file); // numTables
00847 writeU16 (searchRange, file); // searchRange
00848 writeU16 (entrySelector, file); // entrySelector
00849 writeU16 (rangeShift, file); // rangeShift
00850 totalChecksum += (uint_fast32_t)tableCount << 16;
00851 totalChecksum += searchRange;
00852 totalChecksum += (uint_fast32_t)entrySelector << 16;
00853 totalChecksum += rangeShift;
00854 // Table Records (always sorted by table tags)
00855 for (size_t i = 0; i < tableCount; i++)
00856 {
00857     // Table Record
00858     writeU32 (records[i].tag, file); // tableTag
00859     writeU32 (records[i].checksum, file); // checksum
00860     writeU32 (records[i].offset, file); // offset
00861     writeU32 (records[i].length, file); // length
00862     totalChecksum += records[i].tag;
00863     totalChecksum += records[i].checksum;
00864     totalChecksum += records[i].offset;
00865     totalChecksum += records[i].length;
00866 }
00867 freeBuffer (tableRecords);
00868 for (const Table *table = tables; table < tablesEnd; table++)
00869 {
00870     if (table->tag == 0x68656164) // 'head' table
00871     {
00872         byte *begin = getBufferHead (table->content);
00873         byte *end = getBufferTail (table->content);
00874         writeBytes (begin, 8, file);
00875         writeU32 (0xb1b0afb0 - totalChecksum, file); // checksumAdjustment
00876         writeBytes (begin + 12, end - (begin + 12), file);
00877         continue;
00878     }
00879     writeBuffer (table->content, file);
00880 }
00881 fclose (file);
00882 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.3.5.48 writeU16()

```
void writeU16 (  
    uint_fast16_t value,  
    FILE * file )
```

Write an unsigned 16-bit value to an output file.

This function writes a 16-bit unsigned value in big-endian order to an output file specified with a file pointer.

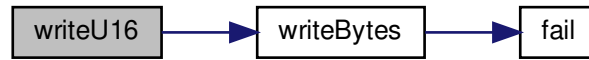
#### Parameters

in	value	The 16-bit value to write.
in	file	The file pointer for writing, of type FILE*.

Definition at line 554 of file [hex2otf.c](#).

```
00555 {  
00556     byte bytes[] =  
00557     {  
00558         (value » 8) & 0xff,  
00559         (value ) & 0xff,  
00560     };  
00561     writeBytes (bytes, sizeof bytes, file);  
00562 }
```

Here is the call graph for this function:



### 5.3.5.49 writeU32()

```
void writeU32 (
    uint_fast32_t value,
    FILE * file )
```

Write an unsigned 32-bit value to an output file.

This function writes a 32-bit unsigned value in big-endian order to an output file specified with a file pointer.

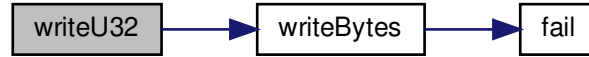
Parameters

in	value	The 32-bit value to write.
in	file	The file pointer for writing, of type FILE*.

Definition at line 574 of file [hex2otf.c](#).

```
00575 {
00576     byte bytes[] =
00577     {
00578         (value » 24) & 0xff,
00579         (value » 16) & 0xff,
00580         (value » 8) & 0xff,
00581         (value ) & 0xff,
00582     };
00583     writeBytes (bytes, sizeof bytes, file);
00584 }
```

Here is the call graph for this function:



## 5.3.6 Variable Documentation

### 5.3.6.1 allBuffers

**Buffer\*** allBuffers

Initial allocation of empty array of buffer pointers.

Definition at line 139 of file [hex2otf.c](#).

### 5.3.6.2 bufferCount

size\_t bufferCount

Number of buffers in a **Buffer** \* array.

Definition at line 140 of file [hex2otf.c](#).

### 5.3.6.3 nextBufferIndex

size\_t nextBufferIndex

Index number to tail element of **Buffer** \* array.

Definition at line 141 of file [hex2otf.c](#).

## 5.4 hex2otf.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file hex2otf.c
00003
00004  @brief hex2otf - Convert GNU Unifont .hex file to OpenType font
00005
00006  This program reads a Unifont .hex format file and a file containing
00007  combining mark offset information, and produces an OpenType font file.
00008
00009  @copyright Copyright © 2022 何志翔 (He Zhixiang)
00010
00011  @author 何志翔 (He Zhixiang)
00012  */
00013
00014  /*
00015  LICENSE:
00016
00017  This program is free software; you can redistribute it and/or
00018  modify it under the terms of the GNU General Public License
00019  as published by the Free Software Foundation; either version 2
00020  of the License, or (at your option) any later version.
00021
00022  This program is distributed in the hope that it will be useful,
00023  but WITHOUT ANY WARRANTY; without even the implied warranty of
  
```

```

00024 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00025 GNU General Public License for more details.
00026
00027 You should have received a copy of the GNU General Public License
00028 along with this program; if not, write to the Free Software
00029 Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA
00030 02110-1301, USA.
00031
00032 NOTE: It is a violation of the license terms of this software
00033 to delete or override license and copyright information contained
00034 in the hex2otf.h file if creating a font derived from Unifont glyphs.
00035 Fonts derived from Unifont can add names to the copyright notice
00036 for creators of new or modified glyphs.
00037 */
00038
00039 #include <assert.h>
00040 #include <ctype.h>
00041 #include <inttypes.h>
00042 #include <stdarg.h>
00043 #include <stdbool.h>
00044 #include <stddef.h>
00045 #include <stdio.h>
00046 #include <stdlib.h>
00047 #include <string.h>
00048
00049 #include "hex2otf.h"
00050
00051 #define VERSION "1.0.1" ///< Program version, for "--version" option.
00052
00053 // This program assumes the execution character set is compatible with ASCII.
00054
00055 #define U16MAX 0xffff ///< Maximum UTF-16 code point value.
00056 #define U32MAX 0xffffffff ///< Maximum UTF-32 code point value.
00057
00058 #define PRI_CP "U+%.*"PRIFAST32 ///< Format string to print Unicode code point.
00059
00060 #ifndef static_assert
00061 #define static_assert(a, b) (assert(a)) ///< If "a" is true, return string "b".
00062 #endif
00063
00064 // Set or clear a particular bit.
00065 #define BX(shift, x) ((uintmax_t)(!(x)) « (shift)) ///< Truncate & shift word.
00066 #define B0(shift) BX((shift), 0) ///< Clear a given bit in a word.
00067 #define B1(shift) BX((shift), 1) ///< Set a given bit in a word.
00068
00069 #define GLYPH_MAX_WIDTH 16 ///< Maximum glyph width, in pixels.
00070 #define GLYPH_HEIGHT 16 ///< Maximum glyph height, in pixels.
00071
00072 /// Number of bytes to represent one bitmap glyph as a binary array.
00073 #define GLYPH_MAX_BYTE_COUNT (GLYPH_HEIGHT * GLYPH_MAX_WIDTH / 8)
00074
00075 /// Count of pixels below baseline.
00076 #define DESCENDER 2
00077
00078 /// Count of pixels above baseline.
00079 #define ASCENDER (GLYPH_HEIGHT - DESCENDER)
00080
00081 /// Font units per em.
00082 #define FUPEM 64
00083
00084 /// An OpenType font has at most 65536 glyphs.
00085 #define MAX_GLYPHS 65536
00086
00087 /// Name IDs 0-255 are used for standard names.
00088 #define MAX_NAME_IDS 256
00089
00090 /// Convert pixels to font units.
00091 #define FU(x) ((x) * FUPEM / GLYPH_HEIGHT)
00092
00093 /// Convert glyph byte count to pixel width.
00094 #define PW(x) ((x) / (GLYPH_HEIGHT / 8))
00095
00096 /// Definition of "byte" type as an unsigned char.
00097 typedef unsigned char byte;
00098
00099 /// This type must be able to represent max(GLYPH_MAX_WIDTH, GLYPH_HEIGHT).
00100 typedef int_least8_t pixels_t;
00101
00102 /**
00103 @brief Print an error message on stderr, then exit.
00104

```



```

00105 This function prints the provided error string and optional
00106 following arguments to stderr, and then exits with a status
00107 of EXIT_FAILURE.
00108
00109 @param[in] reason The output string to describe the error.
00110 @param[in] ... Optional following arguments to output.
00111 */
00112 void
00113 fail (const char *reason, ...)
00114 {
00115     fputs ("ERROR: ", stderr);
00116     va_list args;
00117     va_start (args, reason);
00118     vfprintf (stderr, reason, args);
00119     va_end (args);
00120     putc ('\n', stderr);
00121     exit (EXIT_FAILURE);
00122 }
00123
00124 /**
00125 @brief Generic data structure for a linked list of buffer elements.
00126
00127 A buffer can act as a vector (when filled with 'store*' functions),
00128 or a temporary output area (when filled with 'cache*' functions).
00129 The 'store*' functions use native endian.
00130 The 'cache*' functions use big endian or other formats in OpenType.
00131 Beware of memory alignment.
00132 */
00133 typedef struct Buffer
00134 {
00135     size_t capacity; // = 0 iff this buffer is free
00136     byte *begin, *next, *end;
00137 } Buffer;
00138
00139 Buffer *allBuffers; ///< Initial allocation of empty array of buffer pointers.
00140 size_t bufferCount; ///< Number of buffers in a Buffer * array.
00141 size_t nextBufferIndex; ///< Index number to tail element of Buffer * array.
00142
00143 /**
00144 @brief Initialize an array of buffer pointers to all zeroes.
00145
00146 This function initializes the "allBuffers" array of buffer
00147 pointers to all zeroes.
00148
00149 @param[in] count The number of buffer array pointers to allocate.
00150 */
00151 void
00152 initBuffers (size_t count)
00153 {
00154     assert (count > 0);
00155     assert (bufferCount == 0); // uninitialized
00156     allBuffers = calloc (count, sizeof *allBuffers);
00157     if (!allBuffers)
00158         fail ("Failed to initialize buffers.");
00159     bufferCount = count;
00160     nextBufferIndex = 0;
00161 }
00162
00163 /**
00164 @brief Free all allocated buffer pointers.
00165
00166 This function frees all buffer pointers previously allocated
00167 in the initBuffers function.
00168 */
00169 void
00170 cleanBuffers ()
00171 {
00172     for (size_t i = 0; i < bufferCount; i++)
00173         if (allBuffers[i].capacity)
00174             free (allBuffers[i].begin);
00175     free (allBuffers);
00176     bufferCount = 0;
00177 }
00178
00179 /**
00180 @brief Create a new buffer.
00181
00182 This function creates a new buffer array of type Buffer,
00183 with an initial size of initialCapacity elements.
00184
00185 @param[in] initialCapacity The initial number of elements in the buffer.

```

```

00186 */
00187 Buffer *
00188 newBuffer (size_t initialCapacity)
00189 {
00190     assert (initialCapacity > 0);
00191     Buffer *buf = NULL;
00192     size_t sentinel = nextBufferIndex;
00193     do
00194     {
00195         if (nextBufferIndex == bufferCount)
00196             nextBufferIndex = 0;
00197         if (allBuffers[nextBufferIndex].capacity == 0)
00198         {
00199             buf = &allBuffers[nextBufferIndex++];
00200             break;
00201         }
00202     } while (++nextBufferIndex != sentinel);
00203     if (!buf) // no existing buffer available
00204     {
00205         size_t newSize = sizeof (Buffer) * bufferCount * 2;
00206         void *extended = realloc (allBuffers, newSize);
00207         if (!extended)
00208             fail ("Failed to create new buffers.");
00209         allBuffers = extended;
00210         memset (allBuffers + bufferCount, 0, sizeof (Buffer) * bufferCount);
00211         buf = &allBuffers[bufferCount];
00212         nextBufferIndex = bufferCount + 1;
00213         bufferCount *= 2;
00214     }
00215     buf->begin = malloc (initialCapacity);
00216     if (!buf->begin)
00217         fail ("Failed to allocate %zu bytes of memory.", initialCapacity);
00218     buf->capacity = initialCapacity;
00219     buf->next = buf->begin;
00220     buf->end = buf->begin + initialCapacity;
00221     return buf;
00222 }
00223
00224 /**
00225 @brief Ensure that the buffer has at least the specified minimum size.
00226
00227 This function takes a buffer array of type Buffer and the
00228 necessary minimum number of elements as inputs, and attempts
00229 to increase the size of the buffer if it must be larger.
00230
00231 If the buffer is too small and cannot be resized, the program
00232 will terminate with an error message and an exit status of
00233 EXIT_FAILURE.
00234
00235 @param[in,out] buf The buffer to check.
00236 @param[in] needed The required minimum number of elements in the buffer.
00237 */
00238 void
00239 ensureBuffer (Buffer *buf, size_t needed)
00240 {
00241     if (buf->end - buf->next >= needed)
00242         return;
00243     ptrdiff_t occupied = buf->next - buf->begin;
00244     size_t required = occupied + needed;
00245     if (required < needed) // overflow
00246         fail ("Cannot allocate %zu + %zu bytes of memory.", occupied, needed);
00247     if (required > SIZE_MAX / 2)
00248         buf->capacity = required;
00249     else while (buf->capacity < required)
00250         buf->capacity *= 2;
00251     void *extended = realloc (buf->begin, buf->capacity);
00252     if (!extended)
00253         fail ("Failed to allocate %zu bytes of memory.", buf->capacity);
00254     buf->begin = extended;
00255     buf->next = buf->begin + occupied;
00256     buf->end = buf->begin + buf->capacity;
00257 }
00258
00259 /**
00260 @brief Count the number of elements in a buffer.
00261
00262 @param[in] buf The buffer to be examined.
00263 @return The number of elements in the buffer.
00264 */
00265 static inline size_t
00266 countBufferedBytes (const Buffer *buf)

```

```
00267 {
00268     return buf->next - buf->begin;
00269 }
00270
00271 /**
00272 @brief Get the start of the buffer array.
00273
00274 @param[in] buf The buffer to be examined.
00275 @return A pointer of type Buffer * to the start of the buffer.
00276 */
00277 static inline void *
00278 getBufferHead (const Buffer *buf)
00279 {
00280     return buf->begin;
00281 }
00282
00283 /**
00284 @brief Get the end of the buffer array.
00285
00286 @param[in] buf The buffer to be examined.
00287 @return A pointer of type Buffer * to the end of the buffer.
00288 */
00289 static inline void *
00290 getBufferTail (const Buffer *buf)
00291 {
00292     return buf->next;
00293 }
00294
00295 /**
00296 @brief Add a slot to the end of a buffer.
00297
00298 This function ensures that the buffer can grow by one slot,
00299 and then returns a pointer to the new slot within the buffer.
00300
00301 @param[in] buf The pointer to an array of type Buffer *.
00302 @param[in] slotSize The new slot number.
00303 @return A pointer to the new slot within the buffer.
00304 */
00305 static inline void *
00306 getBufferSlot (Buffer *buf, size_t slotSize)
00307 {
00308     ensureBuffer (buf, slotSize);
00309     void *slot = buf->next;
00310     buf->next += slotSize;
00311     return slot;
00312 }
00313
00314 /**
00315 @brief Reset a buffer pointer to the buffer's beginning.
00316
00317 This function resets an array of type Buffer * to point
00318 its tail to the start of the array.
00319
00320 @param[in] buf The pointer to an array of type Buffer *.
00321 */
00322 static inline void
00323 resetBuffer (Buffer *buf)
00324 {
00325     buf->next = buf->begin;
00326 }
00327
00328 /**
00329 @brief Free the memory previously allocated for a buffer.
00330
00331 This function frees the memory allocated to an array
00332 of type Buffer *.
00333
00334 @param[in] buf The pointer to an array of type Buffer *.
00335 */
00336 void
00337 freeBuffer (Buffer *buf)
00338 {
00339     free (buf->begin);
00340     buf->capacity = 0;
00341 }
00342
00343 /**
00344 @brief Temporary define to look up an element in an array of given type.
00345
00346 This definition is used to create lookup functions to return
00347 a given element in unsigned arrays of size 8, 16, and 32 bytes,
```

```

00348 and in an array of pixels.
00349 */
00350 #define defineStore(name, type) \
00351 void name (Buffer *buf, type value) \
00352 { \
00353     type *slot = getBufferSlot (buf, sizeof value); \
00354     *slot = value; \
00355 }
00356 #defineStore (storeU8, uint_least8_t)
00357 #defineStore (storeU16, uint_least16_t)
00358 #defineStore (storeU32, uint_least32_t)
00359 #defineStore (storePixels, pixels_t)
00360 #undef defineStore
00361
00362 /**
00363 @brief Cache bytes in a big-endian format.
00364
00365 This function adds from 1, 2, 3, or 4 bytes to the end of
00366 a byte array in big-endian order. The buffer is updated
00367 to account for the newly-added bytes.
00368
00369 @param[in,out] buf The array of bytes to which to append new bytes.
00370 @param[in] value The bytes to add, passed as a 32-bit unsigned word.
00371 @param[in] bytes The number of bytes to append to the buffer.
00372 */
00373 void
00374 cacheU (Buffer *buf, uint_fast32_t value, int bytes)
00375 {
00376     assert (1 <= bytes && bytes <= 4);
00377     ensureBuffer (buf, bytes);
00378     switch (bytes)
00379     {
00380         case 4: *buf->next++ = value » 24 & 0xff; // fall through
00381         case 3: *buf->next++ = value » 16 & 0xff; // fall through
00382         case 2: *buf->next++ = value » 8 & 0xff; // fall through
00383         case 1: *buf->next++ = value & 0xff;
00384     }
00385 }
00386
00387 /**
00388 @brief Append one unsigned byte to the end of a byte array.
00389
00390 This function adds one byte to the end of a byte array.
00391 The buffer is updated to account for the newly-added byte.
00392
00393 @param[in,out] buf The array of bytes to which to append a new byte.
00394 @param[in] value The 8-bit unsigned value to append to the buf array.
00395 */
00396 void
00397 cacheU8 (Buffer *buf, uint_fast8_t value)
00398 {
00399     storeU8 (buf, value & 0xff);
00400 }
00401
00402 /**
00403 @brief Append two unsigned bytes to the end of a byte array.
00404
00405 This function adds two bytes to the end of a byte array.
00406 The buffer is updated to account for the newly-added bytes.
00407
00408 @param[in,out] buf The array of bytes to which to append two new bytes.
00409 @param[in] value The 16-bit unsigned value to append to the buf array.
00410 */
00411 void
00412 cacheU16 (Buffer *buf, uint_fast16_t value)
00413 {
00414     cacheU (buf, value, 2);
00415 }
00416
00417 /**
00418 @brief Append four unsigned bytes to the end of a byte array.
00419
00420 This function adds four bytes to the end of a byte array.
00421 The buffer is updated to account for the newly-added bytes.
00422
00423 @param[in,out] buf The array of bytes to which to append four new bytes.
00424 @param[in] value The 32-bit unsigned value to append to the buf array.
00425 */
00426 void
00427 cacheU32 (Buffer *buf, uint_fast32_t value)
00428 {

```

```

00429     cacheU (buf, value, 4);
00430 }
00431
00432 /**
00433 @brief Cache charstring number encoding in a CFF buffer.
00434
00435 This function caches two's complement 8-, 16-, and 32-bit
00436 words as per Adobe's Type 2 Charstring encoding for operands.
00437 These operands are used in Compact Font Format data structures.
00438
00439 Byte values can have offsets, for which this function
00440 compensates, optionally followed by additional bytes:
00441
00442 Byte Range  Offset  Bytes  Adjusted Range
00443 -----  -
00444 0 to 11      0    1    0 to 11 (operators)
00445 12           0    2    Next byte is 8-bit op code
00446 13 to 18    0    1    13 to 18 (operators)
00447 19 to 20    0    2+   hintmask and cntrmask operators
00448 21 to 27    0    1    21 to 27 (operators)
00449 28          0    3    16-bit 2's complement number
00450 29 to 31    0    1    29 to 31 (operators)
00451 32 to 246  -139  1    -107 to +107
00452 247 to 250 +108  2    +108 to +1131
00453 251 to 254 -108  2    -108 to -1131
00454 255        0    5    16-bit integer and 16-bit fraction
00455
00456 @param[in,out] buf The buffer to which the operand value is appended.
00457 @param[in] value The operand value.
00458 */
00459 void
00460 cacheCFFOperand (Buffer *buf, int_fast32_t value)
00461 {
00462     if (-107 <= value && value <= 107)
00463         cacheU8 (buf, value + 139);
00464     else if (108 <= value && value <= 1131)
00465     {
00466         cacheU8 (buf, (value - 108) / 256 + 247);
00467         cacheU8 (buf, (value - 108) % 256);
00468     }
00469     else if (-32768 <= value && value <= 32767)
00470     {
00471         cacheU8 (buf, 28);
00472         cacheU16 (buf, value);
00473     }
00474     else if (-2147483647 <= value && value <= 2147483647)
00475     {
00476         cacheU8 (buf, 29);
00477         cacheU32 (buf, value);
00478     }
00479     else
00480         assert (false); // other encodings are not used and omitted
00481     static_assert (GLYPH_MAX_WIDTH <= 107, "More encodings are needed.");
00482 }
00483
00484 /**
00485 @brief Append 1 to 4 bytes of zeroes to a buffer, for padding.
00486
00487 @param[in,out] buf The buffer to which the operand value is appended.
00488 @param[in] count The number of bytes containing zeroes to append.
00489 */
00490 void
00491 cacheZeros (Buffer *buf, size_t count)
00492 {
00493     ensureBuffer (buf, count);
00494     memset (buf->next, 0, count);
00495     buf->next += count;
00496 }
00497
00498 /**
00499 @brief Append a string of bytes to a buffer.
00500
00501 This function appends an array of 1 to 4 bytes to the end of
00502 a buffer.
00503
00504 @param[in,out] buf The buffer to which the bytes are appended.
00505 @param[in] src The array of bytes to append to the buffer.
00506 @param[in] count The number of bytes containing zeroes to append.
00507 */
00508 void
00509 cacheBytes (Buffer *restrict buf, const void *restrict src, size_t count)

```

```

00510 {
00511     ensureBuffer (buf, count);
00512     memcpy (buf->next, src, count);
00513     buf->next += count;
00514 }
00515
00516 /**
00517 @brief Append bytes of a table to a byte buffer.
00518
00519 @param[in,out] bufDest The buffer to which the new bytes are appended.
00520 @param[in] bufSrc The bytes to append to the buffer array.
00521 */
00522 void
00523 cacheBuffer (Buffer *restrict bufDest, const Buffer *restrict bufSrc)
00524 {
00525     size_t length = countBufferedBytes (bufSrc);
00526     ensureBuffer (bufDest, length);
00527     memcpy (bufDest->next, bufSrc->begin, length);
00528     bufDest->next += length;
00529 }
00530
00531 /**
00532 @brief Write an array of bytes to an output file.
00533
00534 @param[in] bytes An array of unsigned bytes to write.
00535 @param[in] file The file pointer for writing, of type FILE *.
00536 */
00537 void
00538 writeBytes (const byte bytes[], size_t count, FILE *file)
00539 {
00540     if (fwrite (bytes, count, 1, file) != 1 && count != 0)
00541         fail ("Failed to write %zu bytes to output file.", count);
00542 }
00543
00544 /**
00545 @brief Write an unsigned 16-bit value to an output file.
00546
00547 This function writes a 16-bit unsigned value in big-endian order
00548 to an output file specified with a file pointer.
00549
00550 @param[in] value The 16-bit value to write.
00551 @param[in] file The file pointer for writing, of type FILE *.
00552 */
00553 void
00554 writeU16 (uint_fast16_t value, FILE *file)
00555 {
00556     byte bytes[] =
00557     {
00558         (value » 8) & 0xff,
00559         (value ) & 0xff,
00560     };
00561     writeBytes (bytes, sizeof bytes, file);
00562 }
00563
00564 /**
00565 @brief Write an unsigned 32-bit value to an output file.
00566
00567 This function writes a 32-bit unsigned value in big-endian order
00568 to an output file specified with a file pointer.
00569
00570 @param[in] value The 32-bit value to write.
00571 @param[in] file The file pointer for writing, of type FILE *.
00572 */
00573 void
00574 writeU32 (uint_fast32_t value, FILE *file)
00575 {
00576     byte bytes[] =
00577     {
00578         (value » 24) & 0xff,
00579         (value » 16) & 0xff,
00580         (value » 8) & 0xff,
00581         (value ) & 0xff,
00582     };
00583     writeBytes (bytes, sizeof bytes, file);
00584 }
00585
00586 /**
00587 @brief Write an entire buffer array of bytes to an output file.
00588
00589 This function determines the size of a buffer of bytes and
00590 writes that number of bytes to an output file specified with

```

```

00591 a file pointer. The number of bytes is determined from the
00592 length information stored as part of the Buffer * data structure.
00593
00594 @param[in] buf An array containing unsigned bytes to write.
00595 @param[in] file The file pointer for writing, of type FILE *.
00596 */
00597 static inline void
00598 writeBuffer (const Buffer *buf, FILE *file)
00599 {
00600     writeBytes (getBufferHead (buf), countBufferedBytes (buf), file);
00601 }
00602
00603 /// Array of OpenType names indexed directly by Name IDs.
00604 typedef const char *NameStrings[MAX_NAME_IDS];
00605
00606 /**
00607 @brief Data structure to hold data for one bitmap glyph.
00608
00609 This data structure holds data to represent one Unifont bitmap
00610 glyph: Unicode code point, number of bytes in its bitmap array,
00611 whether or not it is a combining character, and an offset from
00612 the glyph origin to the start of the bitmap.
00613 */
00614 typedef struct Glyph
00615 {
00616     uint_least32_t codePoint; ///< undefined for glyph 0
00617     byte bitmap[GLYPH_MAX_BYTE_COUNT]; ///< hexadecimal bitmap character array
00618     uint_least8_t byteCount; ///< length of bitmap data
00619     bool combining; ///< whether this is a combining glyph
00620     pixels_t pos; ///< number of pixels the glyph should be moved to the right
00621     ///< (negative number means moving to the left)
00622     pixels_t lsb; ///< left side bearing (x position of leftmost contour point)
00623 } Glyph;
00624
00625 /**
00626 @brief Data structure to hold information for one font.
00627 */
00628 typedef struct Font
00629 {
00630     Buffer *tables;
00631     Buffer *glyphs;
00632     uint_fast32_t glyphCount;
00633     pixels_t maxWidth;
00634 } Font;
00635
00636 /**
00637 @brief Data structure for an OpenType table.
00638
00639 This data structure contains a table tag and a pointer to the
00640 start of the buffer that holds data for this OpenType table.
00641
00642 For information on the OpenType tables and their structure, see
00643 https://docs.microsoft.com/en-us/typography/opentype/spec/otff#font-tables.
00644 */
00645 typedef struct Table
00646 {
00647     uint_fast32_t tag;
00648     Buffer *content;
00649 } Table;
00650
00651 /**
00652 @brief Index to Location ("loca") offset information.
00653
00654 This enumerated type encodes the type of offset to locations
00655 in a table. It denotes Offset16 (16-bit) and Offset32 (32-bit)
00656 offset types.
00657 */
00658 enum LocaFormat {
00659     LOCA_OFFSET16 = 0,    ///< Offset to location is a 16-bit Offset16 value
00660     LOCA_OFFSET32 = 1,   ///< Offset to location is a 32-bit Offset32 value
00661 };
00662
00663 /**
00664 @brief Convert a 4-byte array to the machine's native 32-bit endian order.
00665
00666 This function takes an array of 4 bytes in big-endian order and
00667 converts it to a 32-bit word in the endian order of the native machine.
00668
00669 @param[in] tag The array of 4 bytes in big-endian order.
00670 @return The 32-bit unsigned word in a machine's native endian order.
00671 */

```

```

00672 static inline uint_fast32_t tagAsU32 (const char tag[static 4])
00673 {
00674     uint_fast32_t r = 0;
00675     r |= (tag[0] & 0xff) << 24;
00676     r |= (tag[1] & 0xff) << 16;
00677     r |= (tag[2] & 0xff) << 8;
00678     r |= (tag[3] & 0xff);
00679     return r;
00680 }
00681
00682 /**
00683 @brief Add a TrueType or OpenType table to the font.
00684
00685 This function adds a TrueType or OpenType table to a font.
00686 The 4-byte table tag is passed as an unsigned 32-bit integer
00687 in big-endian format.
00688
00689 @param[in,out] font The font to which a font table will be added.
00690 @param[in] tag The 4-byte table name.
00691 @param[in] content The table bytes to add, of type Buffer *.
00692 */
00693 void
00694 addTable (Font *font, const char tag[static 4], Buffer *content)
00695 {
00696     Table *table = getBufferSlot (font->tables, sizeof (Table));
00697     table->tag = tagAsU32 (tag);
00698     table->content = content;
00699 }
00700
00701 /**
00702 @brief Sort tables according to OpenType recommendations.
00703
00704 The various tables in a font are sorted in an order recommended
00705 for TrueType font files.
00706
00707 @param[in,out] font The font in which to sort tables.
00708 @param[in] isCFF True iff Compact Font Format (CFF) is being used.
00709 */
00710 void
00711 organizeTables (Font *font, bool isCFF)
00712 {
00713     const char *const cffOrder[] = {"head", "hhea", "maxp", "OS/2", "name",
00714                                     "cmap", "post", "CFF ", NULL};
00715     const char *const truetypeOrder[] = {"head", "hhea", "maxp", "OS/2",
00716                                         "hmtx", "LTSH", "VDMX", "hdmx", "cmap", "fpgm", "prep", "cvt ", "loca",
00717                                         "glyf", "kern", "name", "post", "gasp", "PCLT", "DSIG", NULL};
00718     const char *const order = isCFF ? cffOrder : truetypeOrder;
00719     Table *unordered = getBufferHead (font->tables);
00720     const Table *const tablesEnd = getBufferTail (font->tables);
00721     for (const char *const *p = order; *p; p++)
00722     {
00723         uint_fast32_t tag = tagAsU32 (*p);
00724         for (Table *t = unordered; t < tablesEnd; t++)
00725         {
00726             if (t->tag != tag)
00727                 continue;
00728             if (t != unordered)
00729             {
00730                 Table temp = *unordered;
00731                 *unordered = *t;
00732                 *t = temp;
00733             }
00734             unordered++;
00735             break;
00736         }
00737     }
00738 }
00739
00740 /**
00741 @brief Data structure for data associated with one OpenType table.
00742
00743 This data structure contains an OpenType table's tag, start within
00744 an OpenType font file, length in bytes, and checksum at the end of
00745 the table.
00746 */
00747 struct TableRecord
00748 {
00749     uint_least32_t tag, offset, length, checksum;
00750 };
00751
00752 /**

```



```

00753 @brief Compare tables by 4-byte unsigned table tag value.
00754
00755 This function takes two pointers to a TableRecord data structure
00756 and extracts the four-byte tag structure element for each. The
00757 two 32-bit numbers are then compared. If the first tag is greater
00758 than the first, then gt = 1 and lt = 0, and so 1 - 0 = 1 is
00759 returned. If the first is less than the second, then gt = 0 and
00760 lt = 1, and so 0 - 1 = -1 is returned.
00761
00762 @param[in] a Pointer to the first TableRecord structure.
00763 @param[in] b Pointer to the second TableRecord structure.
00764 @return 1 if the tag in "a" is greater, -1 if less, 0 if equal.
00765 */
00766 int
00767 byTableTag (const void *a, const void *b)
00768 {
00769     const struct TableRecord *const ra = a, *const rb = b;
00770     int gt = ra->tag > rb->tag;
00771     int lt = ra->tag < rb->tag;
00772     return gt - lt;
00773 }
00774
00775 /**
00776 @brief Write OpenType font to output file.
00777
00778 This function writes the constructed OpenType font to the
00779 output file named "filename".
00780
00781 @param[in] font Pointer to the font, of type Font *.
00782 @param[in] isCFF Boolean indicating whether the font has CFF data.
00783 @param[in] filename The name of the font file to create.
00784 */
00785 void
00786 writeFont (Font *font, bool isCFF, const char *fileName)
00787 {
00788     FILE *file = fopen (fileName, "wb");
00789     if (!file)
00790         fail ("Failed to open file '%s'", fileName);
00791     const Table *const tables = getBufferHead (font->tables);
00792     const Table *const tablesEnd = getBufferTail (font->tables);
00793     size_t tableCount = tablesEnd - tables;
00794     assert (0 < tableCount && tableCount <= UI64MAX);
00795     size_t offset = 12 + 16 * tableCount;
00796     uint_fast32_t totalChecksum = 0;
00797     Buffer *tableRecords =
00798         newBuffer (sizeof (struct TableRecord) * tableCount);
00799     for (size_t i = 0; i < tableCount; i++)
00800     {
00801         struct TableRecord *record =
00802             getBufferSlot (tableRecords, sizeof *record);
00803         record->tag = tables[i].tag;
00804         size_t length = countBufferedBytes (tables[i].content);
00805         #if SIZE_MAX > U32MAX
00806             if (offset > U32MAX)
00807                 fail ("Table offset exceeded 4 GiB.");
00808             if (length > U32MAX)
00809                 fail ("Table size exceeded 4 GiB.");
00810         #endif
00811         record->length = length;
00812         record->checksum = 0;
00813         const byte *p = getBufferHead (tables[i].content);
00814         const byte *const end = getBufferTail (tables[i].content);
00815
00816         /// Add a byte shifted by 24, 16, 8, or 0 bits.
00817         #define addByte(shift) \
00818         if (p == end) \
00819         break; \
00820         record->checksum += (uint_fast32_t)*p++ « (shift);
00821
00822         for (;;)
00823         {
00824             addByte (24)
00825             addByte (16)
00826             addByte (8)
00827             addByte (0)
00828         }
00829         #undef addByte
00830         cacheZeros (tables[i].content, (~length + 1U) & 3U);
00831         record->offset = offset;
00832         offset += countBufferedBytes (tables[i].content);
00833         totalChecksum += record->checksum;

```

```

00834 }
00835 struct TableRecord *records = getBufferHead (tableRecords);
00836 qsort (records, tableCount, sizeof *records, byTableTag);
00837 // Offset Table
00838 uint_fast32_t sfntVersion = isCFF ? 0x4f54544f : 0x00010000;
00839 writeU32 (sfntVersion, file); // sfntVersion
00840 totalChecksum += sfntVersion;
00841 uint_fast16_t entrySelector = 0;
00842 for (size_t k = tableCount; k != 1; k >>= 1)
00843     entrySelector++;
00844 uint_fast16_t searchRange = 1 << (entrySelector + 4);
00845 uint_fast16_t rangeShift = (tableCount - (1 << entrySelector)) << 4;
00846 writeU16 (tableCount, file); // numTables
00847 writeU16 (searchRange, file); // searchRange
00848 writeU16 (entrySelector, file); // entrySelector
00849 writeU16 (rangeShift, file); // rangeShift
00850 totalChecksum += (uint_fast32_t)tableCount << 16;
00851 totalChecksum += searchRange;
00852 totalChecksum += (uint_fast32_t)entrySelector << 16;
00853 totalChecksum += rangeShift;
00854 // Table Records (always sorted by table tags)
00855 for (size_t i = 0; i < tableCount; i++)
00856 {
00857     // Table Record
00858     writeU32 (records[i].tag, file); // tableTag
00859     writeU32 (records[i].checksum, file); // checksum
00860     writeU32 (records[i].offset, file); // offset
00861     writeU32 (records[i].length, file); // length
00862     totalChecksum += records[i].tag;
00863     totalChecksum += records[i].checksum;
00864     totalChecksum += records[i].offset;
00865     totalChecksum += records[i].length;
00866 }
00867 freeBuffer (tableRecords);
00868 for (const Table *table = tables; table < tablesEnd; table++)
00869 {
00870     if (table->tag == 0x68656164) // 'head' table
00871     {
00872         byte *begin = getBufferHead (table->content);
00873         byte *end = getBufferTail (table->content);
00874         writeBytes (begin, 8, file);
00875         writeU32 (0xb1b0afbaU - totalChecksum, file); // checksumAdjustment
00876         writeBytes (begin + 12, end - (begin + 12), file);
00877         continue;
00878     }
00879     writeBuffer (table->content, file);
00880 }
00881 fclose (file);
00882 }
00883
00884 /**
00885 @brief Convert a hexadecimal digit character to a 4-bit number.
00886
00887 This function takes a character that contains one hexadecimal digit
00888 and returns the 4-bit value (as an unsigned 8-bit value) corresponding
00889 to the hexadecimal digit.
00890
00891 @param[in] nibble The character containing one hexadecimal digit.
00892 @return The hexadecimal digit value, 0 through 15, inclusive.
00893 */
00894 static inline byte
00895 nibbleValue (char nibble)
00896 {
00897     if (isdigit (nibble))
00898         return nibble - '0';
00899     nibble = toupper (nibble);
00900     return nibble - 'A' + 10;
00901 }
00902
00903 /**
00904 @brief Read up to 6 hexadecimal digits and a colon from file.
00905
00906 This function reads up to 6 hexadecimal digits followed by
00907 a colon from a file.
00908
00909 If the end of the file is reached, the function returns true.
00910 The file name is provided to include in an error message if
00911 the end of file was reached unexpectedly.
00912
00913 @param[out] codePoint The Unicode code point.
00914 @param[in] fileName The name of the input file.

```

```

00915 @param[in] file Pointer to the input file stream.
00916 @return true if at end of file, false otherwise.
00917 */
00918 bool
00919 readCodePoint (uint_fast32_t *codePoint, const char *fileName, FILE *file)
00920 {
00921     *codePoint = 0;
00922     uint_fast8_t digitCount = 0;
00923     for (;;)
00924     {
00925         int c = getc (file);
00926         if (isxdigit (c) && ++digitCount <= 6)
00927         {
00928             *codePoint = (*codePoint « 4) | nibbleValue (c);
00929             continue;
00930         }
00931         if (c == ':' && digitCount > 0)
00932             return false;
00933         if (c == EOF)
00934         {
00935             if (digitCount == 0)
00936                 return true;
00937             if (feof (file))
00938                 fail ("%s: Unexpected end of file.", fileName);
00939             else
00940                 fail ("%s: Read error.", fileName);
00941         }
00942         fail ("%s: Unexpected character: %#.2x.", fileName, (unsigned)c);
00943     }
00944 }
00945 /**
00946 @brief Read glyph definitions from a Unifont .hex format file.
00947 This function reads in the glyph bitmaps contained in a Unifont
00948 .hex format file. These input files contain one glyph bitmap
00949 per line. Each line is of the form
00950 <hexadecimal code point> ':' <hexadecimal bitmap sequence>
00951 The code point field typically consists of 4 hexadecimal digits
00952 for a code point in Unicode Plane 0, and 6 hexadecimal digits for
00953 code points above Plane 0. The hexadecimal bitmap sequence is
00954 32 hexadecimal digits long for a glyph that is 8 pixels wide by
00955 16 pixels high, and 64 hexadecimal digits long for a glyph that
00956 is 16 pixels wide by 16 pixels high.
00957 @param[in,out] font The font data structure to update with new glyphs.
00958 @param[in] fileName The name of the Unifont .hex format input file.
00959 */
00960 void
00961 readGlyphs (Font *font, const char *fileName)
00962 {
00963     FILE *file = fopen (fileName, "r");
00964     if (!file)
00965         fail ("Failed to open file '%s'", fileName);
00966     uint_fast32_t glyphCount = 1; // for glyph 0
00967     uint_fast8_t maxByteCount = 0;
00968     { // Hard code the .notdef glyph.
00969         const byte bitmap[] = "\0\0\0-fZZzvv-vv-\0\0"; // same as U+FFFF
00970         const size_t byteCount = sizeof bitmap - 1;
00971         assert (byteCount <= GLYPH_MAX_BYTE_COUNT);
00972         assert (byteCount % GLYPH_HEIGHT == 0);
00973         Glyph *notdef = getBufferSlot (font->glyphs, sizeof (Glyph));
00974         memcpy (notdef->bitmap, bitmap, byteCount);
00975         notdef->byteCount = maxByteCount = byteCount;
00976         notdef->combining = false;
00977         notdef->pos = 0;
00978         notdef->lsb = 0;
00979     }
00980     for (;;)
00981     {
00982         uint_fast32_t codePoint;
00983         if (readCodePoint (&codePoint, fileName, file))
00984             break;
00985         if (++glyphCount > MAX_GLYPHS)
00986             fail ("OpenType does not support more than %lu glyphs.",
00987                 MAX_GLYPHS);
00988         Glyph *glyph = getBufferSlot (font->glyphs, sizeof (Glyph));
00989         glyph->codePoint = codePoint;
00990         glyph->byteCount = 0;

```

```

00996     glyph->combining = false;
00997     glyph->pos = 0;
00998     glyph->lsb = 0;
00999     for (byte *p = glyph->bitmap;; p++)
01000     {
01001         int h, l;
01002         if (isxdigit (h = getc (file)) && isxdigit (l = getc (file)))
01003         {
01004             if (++glyph->byteCount > GLYPH_MAX_BYTE_COUNT)
01005                 fail ("Hex stream of "PRI_CP" is too long.", codePoint);
01006             *p = nibbleValue (h) « 4 | nibbleValue (l);
01007         }
01008         else if (h == '\n' || (h == EOF && feof (file)))
01009             break;
01010         else if (ferror (file))
01011             fail ("%s: Read error.", fileName);
01012         else
01013             fail ("Hex stream of "PRI_CP" is invalid.", codePoint);
01014     }
01015     if (glyph->byteCount % GLYPH_HEIGHT != 0)
01016         fail ("Hex length of "PRI_CP" is indivisible by glyph height %d.",
01017             codePoint, GLYPH_HEIGHT);
01018     if (glyph->byteCount > maxByteCount)
01019         maxByteCount = glyph->byteCount;
01020 }
01021 if (glyphCount == 1)
01022     fail ("No glyph is specified.");
01023 font->glyphCount = glyphCount;
01024 font->maxWidth = PW (maxByteCount);
01025 fclose (file);
01026 }
01027
01028 /**
01029 @brief Compare two Unicode code points to determine which is greater.
01030
01031 This function compares the Unicode code points contained within
01032 two Glyph data structures. The function returns 1 if the first
01033 code point is greater, and -1 if the second is greater.
01034
01035 @param[in] a A Glyph data structure containing the first code point.
01036 @param[in] b A Glyph data structure containing the second code point.
01037 @return 1 if the code point a is greater, -1 if less, 0 if equal.
01038 */
01039 int
01040 byCodePoint (const void *a, const void *b)
01041 {
01042     const Glyph *const ga = a, *const gb = b;
01043     int gt = ga->codePoint > gb->codePoint;
01044     int lt = ga->codePoint < gb->codePoint;
01045     return gt - lt;
01046 }
01047
01048 /**
01049 @brief Position a glyph within a 16-by-16 pixel bounding box.
01050
01051 Position a glyph within the 16-by-16 pixel drawing area and
01052 note whether or not the glyph is a combining character.
01053
01054 N.B.: Glyphs must be sorted by code point before calling this function.
01055
01056 @param[in,out] font Font data structure pointer to store glyphs.
01057 @param[in] fileName Name of glyph file to read.
01058 @param[in] xMin Minimum x-axis value (for left side bearing).
01059 */
01060 void
01061 positionGlyphs (Font *font, const char *fileName, pixels_t *xMin)
01062 {
01063     *xMin = 0;
01064     FILE *file = fopen (fileName, "r");
01065     if (!file)
01066         fail ("Failed to open file '%s'", fileName);
01067     Glyph *glyphs = getBufferHead (font->glyphs);
01068     const Glyph *const endGlyph = glyphs + font->glyphCount;
01069     Glyph *nextGlyph = &glyphs[1]; // predict and avoid search
01070     for (;;)
01071     {
01072         uint_fast32_t codePoint;
01073         if (readCodePoint (&codePoint, fileName, file))
01074             break;
01075         Glyph *glyph = nextGlyph;
01076         if (glyph == endGlyph || glyph->codePoint != codePoint)

```

```

01077     {
01078         // Prediction failed. Search.
01079         const Glyph key = { .codePoint = codePoint };
01080         glyph = bsearch (&key, glyphs + 1, font->glyphCount - 1,
01081             sizeof key, byCodePoint);
01082         if (!glyph)
01083             fail ("Glyph "PRI_CP" is positioned but not defined.",
01084                 codePoint);
01085     }
01086     nextGlyph = glyph + 1;
01087     char s[8];
01088     if (!fgets (s, sizeof s, file))
01089         fail ("%s: Read error.", fileName);
01090     char *end;
01091     const long value = strtol (s, &end, 10);
01092     if (*end != '\n' && *end != '\0')
01093         fail ("Position of glyph "PRI_CP" is invalid.", codePoint);
01094     // Currently no glyph is moved to the right,
01095     // so positive position is considered out of range.
01096     // If this limit is to be lifted,
01097     // 'xMax' of bounding box in 'head' table shall also be updated.
01098     if (value < -GLYPH_MAX_WIDTH || value > 0)
01099         fail ("Position of glyph "PRI_CP" is out of range.", codePoint);
01100     glyph->combining = true;
01101     glyph->pos = value;
01102     glyph->lsb = value; // updated during outline generation
01103     if (value < *xMin)
01104         *xMin = value;
01105 }
01106 fclose (file);
01107 }
01108
01109 /**
01110 @brief Sort the glyphs in a font by Unicode code point.
01111
01112 This function reads in an array of glyphs and sorts them
01113 by Unicode code point. If a duplicate code point is encountered,
01114 that will result in a fatal error with an error message to stderr.
01115
01116 @param[in,out] font Pointer to a Font structure with glyphs to sort.
01117 */
01118 void
01119 sortGlyphs (Font *font)
01120 {
01121     Glyph *glyphs = getBufferHead (font->glyphs);
01122     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01123     glyphs++; // glyph 0 does not need sorting
01124     qsort (glyphs, glyphsEnd - glyphs, sizeof *glyphs, byCodePoint);
01125     for (const Glyph *glyph = glyphs; glyph < glyphsEnd - 1; glyph++)
01126     {
01127         if (glyph[0].codePoint == glyph[1].codePoint)
01128             fail ("Duplicate code point: "PRI_CP", glyph[0].codePoint);
01129         assert (glyph[0].codePoint < glyph[1].codePoint);
01130     }
01131 }
01132
01133 /**
01134 @brief Specify the current contour drawing operation.
01135 */
01136 enum ContourOp {
01137     OP_CLOSE, ///< Close the current contour path that was being drawn.
01138     OP_POINT  ///< Add one more (x,y) point to the contor being drawn.
01139 };
01140
01141 /**
01142 @brief Fill to the left side (CFF) or right side (TrueType) of a contour.
01143 */
01144 enum FillSide {
01145     FILL_LEFT,  ///< Draw outline counter-clockwise (CFF, PostScript).
01146     FILL_RIGHT  ///< Draw outline clockwise (TrueType).
01147 };
01148
01149 /**
01150 @brief Build a glyph outline.
01151
01152 This function builds a glyph outline from a Unifont glyph bitmap.
01153
01154 @param[out] result The resulting glyph outline.
01155 @param[in] bitmap A bitmap array.
01156 @param[in] byteCount the number of bytes in the input bitmap array.
01157 @param[in] fillSide Enumerated indicator to fill left or right side.

```

```

01158 */
01159 void
01160 buildOutline (Buffer *result, const byte bitmap[], const size_t byteCount,
01161             const enum FillSide fillSide)
01162 {
01163     enum Direction {RIGHT, LEFT, DOWN, UP}; // order is significant
01164
01165     // respective coordinate deltas
01166     const pixels_t dx[] = {1, -1, 0, 0}, dy[] = {0, 0, -1, 1};
01167
01168     assert (byteCount % GLYPH_HEIGHT == 0);
01169     const uint_fast8_t bytesPerRow = byteCount / GLYPH_HEIGHT;
01170     const pixels_t glyphWidth = bytesPerRow * 8;
01171     assert (glyphWidth <= GLYPH_MAX_WIDTH);
01172
01173     #if GLYPH_MAX_WIDTH < 32
01174         typedef uint_fast32_t row_t;
01175     #elif GLYPH_MAX_WIDTH < 64
01176         typedef uint_fast64_t row_t;
01177     #else
01178     #error GLYPH_MAX_WIDTH is too large.
01179     #endif
01180
01181     row_t pixels[GLYPH_HEIGHT + 2] = {0};
01182     for (pixels_t row = GLYPH_HEIGHT; row > 0; row--)
01183         for (pixels_t b = 0; b < bytesPerRow; b++)
01184             pixels[row] = pixels[row] « 8 | *bitmap++;
01185     typedef row_t graph_t[GLYPH_HEIGHT + 1];
01186     graph_t vectors[4];
01187     const row_t *lower = pixels, *upper = pixels + 1;
01188     for (pixels_t row = 0; row <= GLYPH_HEIGHT; row++)
01189     {
01190         const row_t m = (fillSide == FILL_RIGHT) - 1;
01191         vectors[RIGHT][row] = (m ^ (*lower « 1) & (~m ^ (*upper « 1)));
01192         vectors[LEFT][row] = (m ^ (*upper      ) & (~m ^ (*lower      )));
01193         vectors[DOWN][row] = (m ^ (*lower      ) & (~m ^ (*lower « 1)));
01194         vectors[UP][row] = (m ^ (*upper « 1) & (~m ^ (*upper      )));
01195         lower++;
01196         upper++;
01197     }
01198     graph_t selection = {0};
01199     const row_t x0 = (row_t)1 « glyphWidth;
01200
01201     /// Get the value of a given bit that is in a given row.
01202     #define getRowBit(rows, x, y) ((rows)[(y)] & x0 « (x))
01203
01204     /// Invert the value of a given bit that is in a given row.
01205     #define flipRowBit(rows, x, y) ((rows)[(y)] ^ x0 « (x))
01206
01207     for (pixels_t y = GLYPH_HEIGHT; y >= 0; y--)
01208     {
01209         for (pixels_t x = 0; x <= glyphWidth; x++)
01210         {
01211             assert (!getRowBit (vectors[LEFT], x, y));
01212             assert (!getRowBit (vectors[UP], x, y));
01213             enum Direction initial;
01214
01215             if (getRowBit (vectors[RIGHT], x, y))
01216                 initial = RIGHT;
01217             else if (getRowBit (vectors[DOWN], x, y))
01218                 initial = DOWN;
01219             else
01220                 continue;
01221
01222             static_assert (((GLYPH_MAX_WIDTH + 1) * (GLYPH_HEIGHT + 1) * 2 <=
01223                          U16MAX, "potential overflow");
01224
01225             uint_fast16_t lastPointCount = 0;
01226             for (bool converged = false;;)
01227             {
01228                 uint_fast16_t pointCount = 0;
01229                 enum Direction heading = initial;
01230                 for (pixels_t tx = x, ty = y;;)
01231                 {
01232                     if (converged)
01233                     {
01234                         storePixels (result, OP_POINT);
01235                         storePixels (result, tx);
01236                         storePixels (result, ty);
01237                     }
01238                     do

```

```

01239     {
01240         if (converged)
01241             flipRowBit (vectors[heading], tx, ty);
01242         tx += dx[heading];
01243         ty += dy[heading];
01244     } while (getRowBit (vectors[heading], tx, ty));
01245     if (tx == x && ty == y)
01246         break;
01247     static_assert ((UP ^ DOWN) == 1 && (LEFT ^ RIGHT) == 1,
01248         "wrong enums");
01249     heading = (heading & 2) ^ 2;
01250     heading |= !getRowBit (selection, tx, ty);
01251     heading ^= !getRowBit (vectors[heading], tx, ty);
01252     assert (getRowBit (vectors[heading], tx, ty));
01253     flipRowBit (selection, tx, ty);
01254     pointCount++;
01255 }
01256 if (converged)
01257     break;
01258 converged = pointCount == lastPointCount;
01259 lastPointCount = pointCount;
01260 }
01261
01262 storePixels (result, OP_CLOSE);
01263 }
01264 }
01265 #undef getRowBit
01266 #undef flipRowBit
01267 }
01268
01269 /**
01270 @brief Prepare 32-bit glyph offsets in a font table.
01271
01272 @param[in] sizes Array of glyph sizes, for offset calculations.
01273 */
01274 void
01275 prepareOffsets (size_t *sizes)
01276 {
01277     size_t *p = sizes;
01278     for (size_t *i = sizes + 1; *i; i++)
01279         *i += *p++;
01280     if (*p > 2147483647U) // offset not representable
01281         fail ("CFF table is too large.");
01282 }
01283
01284 /**
01285 @brief Prepare a font name string index.
01286
01287 @param[in] names List of name strings.
01288 @return Pointer to a Buffer struct containing the string names.
01289 */
01290 Buffer *
01291 prepareStringIndex (const NameStrings names)
01292 {
01293     Buffer *buf = newBuffer (256);
01294     assert (names[6]);
01295     const char *strings[] = {"Adobe", "Identity", names[6]};
01296     /// Get the number of elements in array char *strings[].
01297     #define stringCount (sizeof strings / sizeof *strings)
01298     static_assert (stringCount <= U16MAX, "too many strings");
01299     size_t offset = 1;
01300     size_t lengths[stringCount];
01301     for (size_t i = 0; i < stringCount; i++)
01302     {
01303         assert (strings[i]);
01304         lengths[i] = strlen (strings[i]);
01305         offset += lengths[i];
01306     }
01307     int offsetSize = 1 + (offset > 0xff)
01308         + (offset > 0xffff)
01309         + (offset > 0xffffffff);
01310     cacheU16 (buf, stringCount); // count
01311     cacheU8 (buf, offsetSize); // offSize
01312     cacheU (buf, offset = 1, offsetSize); // offset[0]
01313     for (size_t i = 0; i < stringCount; i++)
01314         cacheU (buf, offset += lengths[i], offsetSize); // offset[i + 1]
01315     for (size_t i = 0; i < stringCount; i++)
01316         cacheBytes (buf, strings[i], lengths[i]);
01317     #undef stringCount
01318     return buf;
01319 }

```

```

01320
01321 /**
01322 @brief Add a CFF table to a font.
01323
01324 @param[in,out] font Pointer to a Font struct to contain the CFF table.
01325 @param[in] version Version of CFF table, with value 1 or 2.
01326 @param[in] names List of NameStrings.
01327 */
01328 void
01329 fillCFF (Font *font, int version, const NameStrings names)
01330 {
01331     // HACK: For convenience, CFF data structures are hard coded.
01332     assert (0 < version && version <= 2);
01333     Buffer *cff = newBuffer (65536);
01334     addTable (font, version == 1 ? "CFF " : "CFF2", cff);
01335
01336     /// Use fixed width integer for variables to simplify offset calculation.
01337     #define cacheCFF32(buf, x) (cacheU8 ((buf), 29), cacheU32 ((buf), (x)))
01338
01339     // In Unifont, 16px glyphs are more common. This is used by CFF1 only.
01340     const pixels_t defaultWidth = 16, nominalWidth = 8;
01341     if (version == 1)
01342     {
01343         Buffer *strings = prepareStringIndex (names);
01344         size_t stringsSize = countBufferedBytes (strings);
01345         const char *cffName = names[6];
01346         assert (cffName);
01347         size_t nameLength = strlen (cffName);
01348         size_t namesSize = nameLength + 5;
01349         // These sizes must be updated together with the data below.
01350         size_t offsets[] = {4, namesSize, 45, stringsSize, 2, 5, 8, 32, 4, 0};
01351         prepareOffsets (offsets);
01352         { // Header
01353             cacheU8 (cff, 1); // major
01354             cacheU8 (cff, 0); // minor
01355             cacheU8 (cff, 4); // hdrSize
01356             cacheU8 (cff, 1); // offSize
01357         }
01358         assert (countBufferedBytes (cff) == offsets[0]);
01359         { // Name INDEX (should not be used by OpenType readers)
01360             cacheU16 (cff, 1); // count
01361             cacheU8 (cff, 1); // offSize
01362             cacheU8 (cff, 1); // offset[0]
01363             if (nameLength + 1 > 255) // must be too long; spec limit is 63
01364                 fail ("PostScript name is too long.");
01365             cacheU8 (cff, nameLength + 1); // offset[1]
01366             cacheBytes (cff, cffName, nameLength);
01367         }
01368         assert (countBufferedBytes (cff) == offsets[1]);
01369         { // Top DICT INDEX
01370             cacheU16 (cff, 1); // count
01371             cacheU8 (cff, 1); // offSize
01372             cacheU8 (cff, 1); // offset[0]
01373             cacheU8 (cff, 41); // offset[1]
01374             cacheCFFOperand (cff, 391); // "Adobe"
01375             cacheCFFOperand (cff, 392); // "Identity"
01376             cacheCFFOperand (cff, 0);
01377             cacheBytes (cff, (byte[]){12, 30}, 2); // ROS
01378             cacheCFF32 (cff, font->glyphCount);
01379             cacheBytes (cff, (byte[]){12, 34}, 2); // CIDCount
01380             cacheCFF32 (cff, offsets[6]);
01381             cacheBytes (cff, (byte[]){12, 36}, 2); // FDArray
01382             cacheCFF32 (cff, offsets[5]);
01383             cacheBytes (cff, (byte[]){12, 37}, 2); // FDSelect
01384             cacheCFF32 (cff, offsets[4]);
01385             cacheU8 (cff, 15); // charset
01386             cacheCFF32 (cff, offsets[8]);
01387             cacheU8 (cff, 17); // CharStrings
01388         }
01389         assert (countBufferedBytes (cff) == offsets[2]);
01390         { // String INDEX
01391             cacheBuffer (cff, strings);
01392             freeBuffer (strings);
01393         }
01394         assert (countBufferedBytes (cff) == offsets[3]);
01395         cacheU16 (cff, 0); // Global Subr INDEX
01396         assert (countBufferedBytes (cff) == offsets[4]);
01397         { // Charsets
01398             cacheU8 (cff, 2); // format
01399             { // Range2[0]
01400                 cacheU16 (cff, 1); // first

```



```

01401     cacheU16 (cff, font->glyphCount - 2); // nLeft
01402     }
01403     }
01404     assert (countBufferedBytes (cff) == offsets[5]);
01405     { // FDSelect
01406         cacheU8 (cff, 3); // format
01407         cacheU16 (cff, 1); // nRanges
01408         cacheU16 (cff, 0); // first
01409         cacheU8 (cff, 0); // fd
01410         cacheU16 (cff, font->glyphCount); // sentinel
01411     }
01412     assert (countBufferedBytes (cff) == offsets[6]);
01413     { // FDDict
01414         cacheU16 (cff, 1); // count
01415         cacheU8 (cff, 1); // offSize
01416         cacheU8 (cff, 1); // offset[0]
01417         cacheU8 (cff, 28); // offset[1]
01418         cacheCFFOperand (cff, 393);
01419         cacheBytes (cff, (byte[]){12, 38}, 2); // FontName
01420         // Windows requires FontMatrix in Font DICT.
01421         const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01422         cacheBytes (cff, unit, sizeof unit);
01423         cacheCFFOperand (cff, 0);
01424         cacheCFFOperand (cff, 0);
01425         cacheBytes (cff, unit, sizeof unit);
01426         cacheCFFOperand (cff, 0);
01427         cacheCFFOperand (cff, 0);
01428         cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01429         cacheCFFOperand (cff, offsets[8] - offsets[7]); // size
01430         cacheCFF32 (cff, offsets[7]); // offset
01431         cacheU8 (cff, 18); // Private
01432     }
01433     assert (countBufferedBytes (cff) == offsets[7]);
01434     { // Private
01435         cacheCFFOperand (cff, FU (defaultWidth));
01436         cacheU8 (cff, 20); // defaultWidthX
01437         cacheCFFOperand (cff, FU (nominalWidth));
01438         cacheU8 (cff, 21); // nominalWidthX
01439     }
01440     assert (countBufferedBytes (cff) == offsets[8]);
01441     }
01442     else
01443     {
01444         assert (version == 2);
01445         // These sizes must be updated together with the data below.
01446         size_t offsets[] = {5, 21, 4, 10, 0};
01447         prepareOffsets (offsets);
01448         { // Header
01449             cacheU8 (cff, 2); // majorVersion
01450             cacheU8 (cff, 0); // minorVersion
01451             cacheU8 (cff, 5); // headerSize
01452             cacheU16 (cff, offsets[1] - offsets[0]); // topDictLength
01453         }
01454         assert (countBufferedBytes (cff) == offsets[0]);
01455         { // Top DICT
01456             const byte unit[] = {0x1e,0x15,0x62,0x5c,0x6f}; // 1/64 (0.015625)
01457             cacheBytes (cff, unit, sizeof unit);
01458             cacheCFFOperand (cff, 0);
01459             cacheCFFOperand (cff, 0);
01460             cacheBytes (cff, unit, sizeof unit);
01461             cacheCFFOperand (cff, 0);
01462             cacheCFFOperand (cff, 0);
01463             cacheBytes (cff, (byte[]){12, 7}, 2); // FontMatrix
01464             cacheCFFOperand (cff, offsets[2]);
01465             cacheBytes (cff, (byte[]){12, 36}, 2); // FDDict
01466             cacheCFFOperand (cff, offsets[3]);
01467             cacheU8 (cff, 17); // CharStrings
01468         }
01469         assert (countBufferedBytes (cff) == offsets[1]);
01470         cacheU32 (cff, 0); // Global Subr INDEX
01471         assert (countBufferedBytes (cff) == offsets[2]);
01472         { // Font DICT INDEX
01473             cacheU32 (cff, 1); // count
01474             cacheU8 (cff, 1); // offSize
01475             cacheU8 (cff, 1); // offset[0]
01476             cacheU8 (cff, 4); // offset[1]
01477             cacheCFFOperand (cff, 0);
01478             cacheCFFOperand (cff, 0);
01479             cacheU8 (cff, 18); // Private
01480         }
01481         assert (countBufferedBytes (cff) == offsets[3]);

```

```

01482 }
01483 { // CharStrings INDEX
01484   Buffer *offsets = newBuffer (4096);
01485   Buffer *charstrings = newBuffer (4096);
01486   Buffer *outline = newBuffer (1024);
01487   const Glyph *glyph = getBufferHead (font->glyphs);
01488   const Glyph *const endGlyph = glyph + font->glyphCount;
01489   for (; glyph < endGlyph; glyph++)
01490   {
01491     // CFF offsets start at 1
01492     storeU32 (offsets, countBufferedBytes (charstrings) + 1);
01493
01494     pixels_t rx = -glyph->pos;
01495     pixels_t ry = DESCENDER;
01496     resetBuffer (outline);
01497     buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_LEFT);
01498     enum CFFOp {rmoveto=21, hmoveto=22, vmoveto=4, hlineto=6,
01499               vlineto=7, endchar=14};
01500     enum CFFOp pendingOp = 0;
01501     const int STACK_LIMIT = version == 1 ? 48 : 513;
01502     int stackSize = 0;
01503     bool isDrawing = false;
01504     pixels_t width = glyph->combining ? 0 : PW (glyph->byteCount);
01505     if (version == 1 && width != defaultWidth)
01506     {
01507       cacheCFFOperand (charstrings, FU (width - nominalWidth));
01508       stackSize++;
01509     }
01510     for (const pixels_t *p = getBufferHead (outline),
01511          *const end = getBufferTail (outline); p < end;)
01512     {
01513       int s = 0;
01514       const enum ContourOp op = *p++;
01515       if (op == OP_POINT)
01516       {
01517         const pixels_t x = *p++, y = *p++;
01518         if (x != rx)
01519         {
01520           cacheCFFOperand (charstrings, FU (x - rx));
01521           rx = x;
01522           stackSize++;
01523           s |= 1;
01524         }
01525         if (y != ry)
01526         {
01527           cacheCFFOperand (charstrings, FU (y - ry));
01528           ry = y;
01529           stackSize++;
01530           s |= 2;
01531         }
01532         assert (!(isDrawing && s == 3));
01533       }
01534       if (s)
01535       {
01536         if (!isDrawing)
01537         {
01538           const enum CFFOp moves[] = {0, hmoveto, vmoveto,
01539                                     rmoveto};
01540           cacheU8 (charstrings, moves[s]);
01541           stackSize = 0;
01542         }
01543         else if (!pendingOp)
01544           pendingOp = (enum CFFOp[]){0, hlineto, vlineto}[s];
01545       }
01546       else if (!isDrawing)
01547       {
01548         // only when the first point happens to be (0, 0)
01549         cacheCFFOperand (charstrings, FU (0));
01550         cacheU8 (charstrings, hmoveto);
01551         stackSize = 0;
01552       }
01553       if (op == OP_CLOSE || stackSize >= STACK_LIMIT)
01554       {
01555         assert (stackSize <= STACK_LIMIT);
01556         cacheU8 (charstrings, pendingOp);
01557         pendingOp = 0;
01558         stackSize = 0;
01559       }
01560       isDrawing = op != OP_CLOSE;
01561     }
01562     if (version == 1)

```

```

01563         cacheU8 (charstrings, endchar);
01564     }
01565     size_t lastOffset = countBufferedBytes (charstrings) + 1;
01566     #if SIZE_MAX > U32MAX
01567     if (lastOffset > U32MAX)
01568         fail ("CFF data exceeded size limit.");
01569     #endif
01570     storeU32 (offsets, lastOffset);
01571     int offsetSize = 1 + (lastOffset > 0xff)
01572         + (lastOffset > 0xffff)
01573         + (lastOffset > 0xfffff);
01574     // count (must match 'numGlyphs' in 'maxp' table)
01575     cacheU (cff, font->glyphCount, version * 2);
01576     cacheU8 (cff, offsetSize); // offsetSize
01577     const uint_least32_t *p = getBufferHead (offsets);
01578     const uint_least32_t *const end = getBufferTail (offsets);
01579     for (; p < end; p++)
01580         cacheU (cff, *p, offsetSize); // offsets
01581     cacheBuffer (cff, charstrings); // data
01582     freeBuffer (offsets);
01583     freeBuffer (charstrings);
01584     freeBuffer (outline);
01585 }
01586 #undef cacheCFF32
01587 }
01588
01589 /**
01590 @brief Add a TrueType table to a font.
01591
01592 @param[in,out] font Pointer to a Font struct to contain the TrueType table.
01593 @param[in] format The TrueType "loca" table format, Offset16 or Offset32.
01594 @param[in] names List of NameStrings.
01595 */
01596 void
01597 fillTrueType (Font *font, enum LocaFormat *format,
01598              uint_fast16_t *maxPoints, uint_fast16_t *maxContours)
01599 {
01600     Buffer *glyf = newBuffer (65536);
01601     addTable (font, "glyf", glyf);
01602     Buffer *loca = newBuffer (4 * (font->glyphCount + 1));
01603     addTable (font, "loca", loca);
01604     *format = LOCA_OFFSET32;
01605     Buffer *endPoints = newBuffer (256);
01606     Buffer *flags = newBuffer (256);
01607     Buffer *xs = newBuffer (256);
01608     Buffer *ys = newBuffer (256);
01609     Buffer *outline = newBuffer (1024);
01610     Glyph *const glyphs = getBufferHead (font->glyphs);
01611     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01612     for (Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01613     {
01614         cacheU32 (loca, countBufferedBytes (glyf));
01615         pixels_t rx = -glyph->pos;
01616         pixels_t ry = DESCENDER;
01617         pixels_t xMin = GLYPH_MAX_WIDTH, xMax = 0;
01618         pixels_t yMin = ASCENDER, yMax = -DESCENDER;
01619         resetBuffer (endPoints);
01620         resetBuffer (flags);
01621         resetBuffer (xs);
01622         resetBuffer (ys);
01623         resetBuffer (outline);
01624         buildOutline (outline, glyph->bitmap, glyph->byteCount, FILL_RIGHT);
01625         uint_fast32_t pointCount = 0, contourCount = 0;
01626         for (const pixels_t *p = getBufferHead (outline),
01627              *const end = getBufferTail (outline); p < end;
01628              )
01629         {
01630             const enum ContourOp op = *p++;
01631             if (op == OP_CLOSE)
01632             {
01633                 contourCount++;
01634                 assert (contourCount <= U16MAX);
01635                 cacheU16 (endPoints, pointCount - 1);
01636                 continue;
01637             }
01638             assert (op == OP_POINT);
01639             pointCount++;
01640             assert (pointCount <= U16MAX);
01641             const pixels_t x = *p++, y = *p++;
01642             uint_fast8_t pointFlags =
01643                 + B1 (0) // point is on curve
01644                 + BX (1, x != rx) // x coordinate is 1 byte instead of 2

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```

01644     + BX (2, y != ry) // y coordinate is 1 byte instead of 2
01645     + B0 (3) // repeat
01646     + BX (4, x >= rx) // when x is 1 byte: x is positive;
01647           // when x is 2 bytes: x unchanged and omitted
01648     + BX (5, y >= ry) // when y is 1 byte: y is positive;
01649           // when y is 2 bytes: y unchanged and omitted
01650     + B1 (6) // contours may overlap
01651     + B0 (7) // reserved
01652     ;
01653     cacheU8 (flags, pointFlags);
01654     if (x != rx)
01655         cacheU8 (xs, FU (x > rx ? x - rx : rx - x));
01656     if (y != ry)
01657         cacheU8 (ys, FU (y > ry ? y - ry : ry - y));
01658     if (x < xMin) xMin = x;
01659     if (y < yMin) yMin = y;
01660     if (x > xMax) xMax = x;
01661     if (y > yMax) yMax = y;
01662     rx = x;
01663     ry = y;
01664 }
01665 if (contourCount == 0)
01666     continue; // blank glyph is indicated by the 'loca' table
01667 glyph->lsb = glyph->pos + xMin;
01668 cacheU16 (glyph, contourCount); // numberOfContours
01669 cacheU16 (glyph, FU (glyph->pos + xMin)); // xMin
01670 cacheU16 (glyph, FU (yMin)); // yMin
01671 cacheU16 (glyph, FU (glyph->pos + xMax)); // xMax
01672 cacheU16 (glyph, FU (yMax)); // yMax
01673 cacheBuffer (glyph, endPoints); // endPtsOfContours[]
01674 cacheU16 (glyph, 0); // instructionLength
01675 cacheBuffer (glyph, flags); // flags[]
01676 cacheBuffer (glyph, xs); // xCoordinates[]
01677 cacheBuffer (glyph, ys); // yCoordinates[]
01678 if (pointCount > *maxPoints)
01679     *maxPoints = pointCount;
01680 if (contourCount > *maxContours)
01681     *maxContours = contourCount;
01682 }
01683 cacheU32 (loca, countBufferedBytes (glyph));
01684 freeBuffer (endPoints);
01685 freeBuffer (flags);
01686 freeBuffer (xs);
01687 freeBuffer (ys);
01688 freeBuffer (outline);
01689 }
01690
01691 /**
01692 @brief Create a dummy blank outline in a font table.
01693
01694 @param[in,out] font Pointer to a Font struct to insert a blank outline.
01695 */
01696 void
01697 fillBlankOutline (Font *font)
01698 {
01699     Buffer *glyph = newBuffer (12);
01700     addTable (font, "glyf", glyph);
01701     // Empty table is not allowed, but an empty outline for glyph 0 suffices.
01702     cacheU16 (glyph, 0); // numberOfContours
01703     cacheU16 (glyph, FU (0)); // xMin
01704     cacheU16 (glyph, FU (0)); // yMin
01705     cacheU16 (glyph, FU (0)); // xMax
01706     cacheU16 (glyph, FU (0)); // yMax
01707     cacheU16 (glyph, 0); // instructionLength
01708     Buffer *loca = newBuffer (2 * (font->glyphCount + 1));
01709     addTable (font, "loca", loca);
01710     cacheU16 (loca, 0); // offsets[0]
01711     assert (countBufferedBytes (glyph) % 2 == 0);
01712     for (uint_fast32_t i = 1; i <= font->glyphCount; i++)
01713         cacheU16 (loca, countBufferedBytes (glyph) / 2); // offsets[i]
01714 }
01715
01716 /**
01717 @brief Fill OpenType bitmap data and location tables.
01718
01719 This function fills an Embedded Bitmap Data (EBDT) Table
01720 and an Embedded Bitmap Location (EBLC) Table with glyph
01721 bitmap information. These tables enable embedding bitmaps
01722 in OpenType fonts. No Embedded Bitmap Scaling (EBSC) table
01723 is used for the bitmap glyphs, only EBDT and EBLC.
01724

```

```

01725 @param[in,out] font Pointer to a Font struct in which to add bitmaps.
01726 */
01727 void
01728 fillBitmap (Font *font)
01729 {
01730     const Glyph *const glyphs = getBufferHead (font->glyphs);
01731     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
01732     size_t bitmapsSize = 0;
01733     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01734         bitmapsSize += glyph->byteCount;
01735     Buffer *ebdt = newBuffer (4 + bitmapsSize);
01736     addTable (font, "EBDT", ebdt);
01737     cacheU16 (ebdt, 2); // majorVersion
01738     cacheU16 (ebdt, 0); // minorVersion
01739     uint_fast8_t byteCount = 0; // unequal to any glyph
01740     pixels_t pos = 0;
01741     bool combining = false;
01742     Buffer *rangeHeads = newBuffer (32);
01743     Buffer *offsets = newBuffer (64);
01744     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
01745     {
01746         if (glyph->byteCount != byteCount || glyph->pos != pos ||
01747             glyph->combining != combining)
01748         {
01749             storeU16 (rangeHeads, glyph - glyphs);
01750             storeU32 (offsets, countBufferedBytes (ebdt));
01751             byteCount = glyph->byteCount;
01752             pos = glyph->pos;
01753             combining = glyph->combining;
01754         }
01755         cacheBytes (ebdt, glyph->bitmap, byteCount);
01756     }
01757     const uint_least16_t *ranges = getBufferHead (rangeHeads);
01758     const uint_least16_t *rangesEnd = getBufferTail (rangeHeads);
01759     uint_fast32_t rangeCount = rangesEnd - ranges;
01760     storeU16 (rangeHeads, font->glyphCount);
01761     Buffer *eblc = newBuffer (4096);
01762     addTable (font, "EBLC", eblc);
01763     cacheU16 (eblc, 2); // majorVersion
01764     cacheU16 (eblc, 0); // minorVersion
01765     cacheU32 (eblc, 1); // numSizes
01766     { // bitmapSizes[0]
01767         cacheU32 (eblc, 56); // indexSubTableArrayOffset
01768         cacheU32 (eblc, (8 + 20) * rangeCount); // indexTablesSize
01769         cacheU32 (eblc, rangeCount); // numberOfIndexSubTables
01770         cacheU32 (eblc, 0); // colorRef
01771         { // hori
01772             cacheU8 (eblc, ASCENDER); // ascender
01773             cacheU8 (eblc, -DESCENDER); // descender
01774             cacheU8 (eblc, font->maxWidth); // widthMax
01775             cacheU8 (eblc, 1); // caretSlopeNumerator
01776             cacheU8 (eblc, 0); // caretSlopeDenominator
01777             cacheU8 (eblc, 0); // caretOffset
01778             cacheU8 (eblc, 0); // minOriginSB
01779             cacheU8 (eblc, 0); // minAdvanceSB
01780             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01781             cacheU8 (eblc, -DESCENDER); // minAfterBL
01782             cacheU8 (eblc, 0); // pad1
01783             cacheU8 (eblc, 0); // pad2
01784         }
01785         { // vert
01786             cacheU8 (eblc, ASCENDER); // ascender
01787             cacheU8 (eblc, -DESCENDER); // descender
01788             cacheU8 (eblc, font->maxWidth); // widthMax
01789             cacheU8 (eblc, 1); // caretSlopeNumerator
01790             cacheU8 (eblc, 0); // caretSlopeDenominator
01791             cacheU8 (eblc, 0); // caretOffset
01792             cacheU8 (eblc, 0); // minOriginSB
01793             cacheU8 (eblc, 0); // minAdvanceSB
01794             cacheU8 (eblc, ASCENDER); // maxBeforeBL
01795             cacheU8 (eblc, -DESCENDER); // minAfterBL
01796             cacheU8 (eblc, 0); // pad1
01797             cacheU8 (eblc, 0); // pad2
01798         }
01799         cacheU16 (eblc, 0); // startGlyphIndex
01800         cacheU16 (eblc, font->glyphCount - 1); // endGlyphIndex
01801         cacheU8 (eblc, 16); // ppemX
01802         cacheU8 (eblc, 16); // ppemY
01803         cacheU8 (eblc, 1); // bitDepth
01804         cacheU8 (eblc, 1); // flags = Horizontal
01805     }

```

```

01806 { // IndexSubTableArray
01807     uint_fast32_t offset = rangeCount * 8;
01808     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01809     {
01810         cacheU16 (ebcl, *p); // firstGlyphIndex
01811         cacheU16 (ebcl, p[1] - 1); // lastGlyphIndex
01812         cacheU32 (ebcl, offset); // additionalOffsetToIndexSubtable
01813         offset += 20;
01814     }
01815 }
01816 { // IndexSubTables
01817     const uint_least32_t *offset = getBufferHead (offsets);
01818     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
01819     {
01820         const Glyph *glyph = &glyphs[*p];
01821         cacheU16 (ebcl, 2); // indexFormat
01822         cacheU16 (ebcl, 5); // imageFormat
01823         cacheU32 (ebcl, *offset++); // imageDataOffset
01824         cacheU32 (ebcl, glyph->byteCount); // imageSize
01825         { // bigMetrics
01826             cacheU8 (ebcl, GLYPH_HEIGHT); // height
01827             const uint_fast8_t width = PW (glyph->byteCount);
01828             cacheU8 (ebcl, width); // width
01829             cacheU8 (ebcl, glyph->pos); // horiBearingX
01830             cacheU8 (ebcl, ASCENDER); // horiBearingY
01831             cacheU8 (ebcl, glyph->combining ? 0 : width); // horiAdvance
01832             cacheU8 (ebcl, 0); // vertBearingX
01833             cacheU8 (ebcl, 0); // vertBearingY
01834             cacheU8 (ebcl, GLYPH_HEIGHT); // vertAdvance
01835         }
01836     }
01837 }
01838 freeBuffer (rangeHeads);
01839 freeBuffer (offsets);
01840 }
01841
01842 /**
01843 @brief Fill a "head" font table.
01844
01845 The "head" table contains font header information common to the
01846 whole font.
01847
01848 @param[in,out] font The Font struct to which to add the table.
01849 @param[in] locaFormat The "loca" offset index location table.
01850 @param[in] xMin The minimum x-coordinate for a glyph.
01851 */
01852 void
01853 fillHeadTable (Font *font, enum LocaFormat locaFormat, pixels_t xMin)
01854 {
01855     Buffer *head = newBuffer (56);
01856     addTable (font, "head", head);
01857     cacheU16 (head, 1); // majorVersion
01858     cacheU16 (head, 0); // minorVersion
01859     cacheZeros (head, 4); // fontRevision (unused)
01860     // The 'checksumAdjustment' field is a checksum of the entire file.
01861     // It is later calculated and written directly in the 'writeFont' function.
01862     cacheU32 (head, 0); // checksumAdjustment (placeholder)
01863     cacheU32 (head, 0x5f0f3cf5); // magicNumber
01864     const uint_fast16_t flags =
01865         + B1 (0) // baseline at y=0
01866         + B1 (1) // LSB at x=0 (doubtful; probably should be LSB=xMin)
01867         + B0 (2) // instructions may depend on point size
01868         + B0 (3) // force internal ppem to integers
01869         + B0 (4) // instructions may alter advance width
01870         + B0 (5) // not used in OpenType
01871         + B0 (6) // not used in OpenType
01872         + B0 (7) // not used in OpenType
01873         + B0 (8) // not used in OpenType
01874         + B0 (9) // not used in OpenType
01875         + B0 (10) // not used in OpenType
01876         + B0 (11) // font transformed
01877         + B0 (12) // font converted
01878         + B0 (13) // font optimized for ClearType
01879         + B0 (14) // last resort font
01880         + B0 (15) // reserved
01881     ;
01882     cacheU16 (head, flags); // flags
01883     cacheU16 (head, FUPEM); // unitsPerEm
01884     cacheZeros (head, 8); // created (unused)
01885     cacheZeros (head, 8); // modified (unused)
01886     cacheU16 (head, FU (xMin)); // xMin

```

```

01887 cacheU16 (head, FU (-DESCENDER)); // yMin
01888 cacheU16 (head, FU (font->maxWidth)); // xMax
01889 cacheU16 (head, FU (ASCENDER)); // yMax
01890 // macStyle (must agree with 'fsSelection' in 'OS/2' table)
01891 const uint_fast16_t macStyle =
01892     + B0 (0) // bold
01893     + B0 (1) // italic
01894     + B0 (2) // underline
01895     + B0 (3) // outline
01896     + B0 (4) // shadow
01897     + B0 (5) // condensed
01898     + B0 (6) // extended
01899     // 7-15 reserved
01900 ;
01901 cacheU16 (head, macStyle);
01902 cacheU16 (head, GLYPH_HEIGHT); // lowestRecPPEM
01903 cacheU16 (head, 2); // fontDirectionHint
01904 cacheU16 (head, locaFormat); // indexToLocFormat
01905 cacheU16 (head, 0); // glyphDataFormat
01906 }
01907
01908 /**
01909 @brief Fill a "hhea" font table.
01910
01911 The "hhea" table contains horizontal header information,
01912 for example left and right side bearings.
01913
01914 @param[in,out] font The Font struct to which to add the table.
01915 @param[in] xMin The minimum x-coordinate for a glyph.
01916 */
01917 void
01918 fillHheaTable (Font *font, pixels_t xMin)
01919 {
01920     Buffer *hhea = newBuffer (36);
01921     addTable (font, "hhea", hhea);
01922     cacheU16 (hhea, 1); // majorVersion
01923     cacheU16 (hhea, 0); // minorVersion
01924     cacheU16 (hhea, FU (ASCENDER)); // ascender
01925     cacheU16 (hhea, FU (-DESCENDER)); // descender
01926     cacheU16 (hhea, FU (0)); // lineGap
01927     cacheU16 (hhea, FU (font->maxWidth)); // advanceWidthMax
01928     cacheU16 (hhea, FU (xMin)); // minLeftSideBearing
01929     cacheU16 (hhea, FU (0)); // minRightSideBearing (unused)
01930     cacheU16 (hhea, FU (font->maxWidth)); // xMaxExtent
01931     cacheU16 (hhea, 1); // caretSlopeRise
01932     cacheU16 (hhea, 0); // caretSlopeRun
01933     cacheU16 (hhea, 0); // caretOffset
01934     cacheU16 (hhea, 0); // reserved
01935     cacheU16 (hhea, 0); // reserved
01936     cacheU16 (hhea, 0); // reserved
01937     cacheU16 (hhea, 0); // reserved
01938     cacheU16 (hhea, 0); // metricDataFormat
01939     cacheU16 (hhea, font->glyphCount); // numberOfMetrics
01940 }
01941
01942 /**
01943 @brief Fill a "maxp" font table.
01944
01945 The "maxp" table contains maximum profile information,
01946 such as the memory required to contain the font.
01947
01948 @param[in,out] font The Font struct to which to add the table.
01949 @param[in] isCFF true if a CFF font is included, false otherwise.
01950 @param[in] maxPoints Maximum points in a non-composite glyph.
01951 @param[in] maxContours Maximum contours in a non-composite glyph.
01952 */
01953 void
01954 fillMaxpTable (Font *font, bool isCFF, uint_fast16_t maxPoints,
01955               uint_fast16_t maxContours)
01956 {
01957     Buffer *maxp = newBuffer (32);
01958     addTable (font, "maxp", maxp);
01959     cacheU32 (maxp, isCFF ? 0x00005000 : 0x00010000); // version
01960     cacheU16 (maxp, font->glyphCount); // numGlyphs
01961     if (isCFF)
01962         return;
01963     cacheU16 (maxp, maxPoints); // maxPoints
01964     cacheU16 (maxp, maxContours); // maxContours
01965     cacheU16 (maxp, 0); // maxCompositePoints
01966     cacheU16 (maxp, 0); // maxCompositeContours
01967     cacheU16 (maxp, 0); // maxZones

```



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01968 cacheU16 (maxp, 0); // maxTwilightPoints
01969 cacheU16 (maxp, 0); // maxStorage
01970 cacheU16 (maxp, 0); // maxFunctionDefs
01971 cacheU16 (maxp, 0); // maxInstructionDefs
01972 cacheU16 (maxp, 0); // maxStackElements
01973 cacheU16 (maxp, 0); // maxSizeOfInstructions
01974 cacheU16 (maxp, 0); // maxComponentElements
01975 cacheU16 (maxp, 0); // maxComponentDepth
01976 }
01977
01978 /**
01979 @brief Fill an "OS/2" font table.
01980
01981 The "OS/2" table contains OS/2 and Windows font metrics information.
01982
01983 @param[in,out] font The Font struct to which to add the table.
01984 */
01985 void
01986 fillOS2Table (Font *font)
01987 {
01988     Buffer *os2 = newBuffer (100);
01989     addTable (font, "OS/2", os2);
01990     cacheU16 (os2, 5); // version
01991     // HACK: Average glyph width is not actually calculated.
01992     cacheU16 (os2, FU (font->maxWidth)); // xAvgCharWidth
01993     cacheU16 (os2, 400); // usWeightClass = Normal
01994     cacheU16 (os2, 5); // usWidthClass = Medium
01995     const uint_fast16_t typeFlags =
01996         + B0 (0) // reserved
01997         // usage permissions, one of:
01998         // Default: Installable embedding
01999         + B0 (1) // Restricted License embedding
02000         + B0 (2) // Preview & Print embedding
02001         + B0 (3) // Editable embedding
02002         // 4-7 reserved
02003         + B0 (8) // no subsetting
02004         + B0 (9) // bitmap embedding only
02005         // 10-15 reserved
02006     ;
02007     cacheU16 (os2, typeFlags); // fsType
02008     cacheU16 (os2, FU (5)); // ySubscriptXSize
02009     cacheU16 (os2, FU (7)); // ySubscriptYSize
02010     cacheU16 (os2, FU (0)); // ySubscriptXOffset
02011     cacheU16 (os2, FU (1)); // ySubscriptYOffset
02012     cacheU16 (os2, FU (5)); // ySuperscriptXSize
02013     cacheU16 (os2, FU (7)); // ySuperscriptYSize
02014     cacheU16 (os2, FU (0)); // ySuperscriptXOffset
02015     cacheU16 (os2, FU (4)); // ySuperscriptYOffset
02016     cacheU16 (os2, FU (1)); // yStrikeoutSize
02017     cacheU16 (os2, FU (5)); // yStrikeoutPosition
02018     cacheU16 (os2, 0x080a); // sFamilyClass = Sans Serif, Matrix
02019     const byte panose[] =
02020     {
02021         2, // Family Kind = Latin Text
02022         11, // Serif Style = Normal Sans
02023         4, // Weight = Thin
02024         // Windows would render all glyphs to the same width,
02025         // if 'Proportion' is set to 'Monospaced' (as Unifont should be).
02026         // 'Condensed' is the best alternative according to metrics.
02027         6, // Proportion = Condensed
02028         2, // Contrast = None
02029         2, // Stroke = No Variation
02030         2, // Arm Style = Straight Arms
02031         8, // Letterform = Normal/Square
02032         2, // Midline = Standard/Trimmed
02033         4, // X-height = Constant/Large
02034     };
02035     cacheBytes (os2, panose, sizeof panose); // panose
02036     // HACK: All defined Unicode ranges are marked functional for convenience.
02037     cacheU32 (os2, 0xffffffff); // ulUnicodeRange1
02038     cacheU32 (os2, 0xffffffff); // ulUnicodeRange2
02039     cacheU32 (os2, 0xffffffff); // ulUnicodeRange3
02040     cacheU32 (os2, 0x0effffff); // ulUnicodeRange4
02041     cacheBytes (os2, "GNU ", 4); // achVendID
02042     // fsSelection (must agree with 'macStyle' in 'head' table)
02043     const uint_fast16_t selection =
02044         + B0 (0) // italic
02045         + B0 (1) // underscored
02046         + B0 (2) // negative
02047         + B0 (3) // outlined
02048         + B0 (4) // strikeout

```



```

02049     + B0 (5) // bold
02050     + B1 (6) // regular
02051     + B1 (7) // use sTypo* metrics in this table
02052     + B1 (8) // font name conforms to WWS model
02053     + B0 (9) // oblique
02054     // 10-15 reserved
02055 ;
02056 cacheU16 (os2, selection);
02057 const Glyph *glyphs = getBufferHead (font->glyphs);
02058 uint_fast32_t first = glyphs[1].codePoint;
02059 uint_fast32_t last = glyphs[font->glyphCount - 1].codePoint;
02060 cacheU16 (os2, first < U16MAX ? first : U16MAX); // usFirstCharIndex
02061 cacheU16 (os2, last < U16MAX ? last : U16MAX); // usLastCharIndex
02062 cacheU16 (os2, FU (ASCENDER)); // sTypoAscender
02063 cacheU16 (os2, FU (-DESCENDER)); // sTypoDescender
02064 cacheU16 (os2, FU (0)); // sTypoLineGap
02065 cacheU16 (os2, FU (ASCENDER)); // usWinAscent
02066 cacheU16 (os2, FU (DESCENDER)); // usWinDescent
02067 // HACK: All reasonable code pages are marked functional for convenience.
02068 cacheU32 (os2, 0x603f01ff); // ulCodePageRange1
02069 cacheU32 (os2, 0xffff0000); // ulCodePageRange2
02070 cacheU16 (os2, FU (8)); // sxHeight
02071 cacheU16 (os2, FU (10)); // sCapHeight
02072 cacheU16 (os2, 0); // usDefaultChar
02073 cacheU16 (os2, 0x20); // usBreakChar
02074 cacheU16 (os2, 0); // usMaxContext
02075 cacheU16 (os2, 0); // usLowerOpticalPointSize
02076 cacheU16 (os2, 0xffff); // usUpperOpticalPointSize
02077 }
02078
02079 /**
02080 @brief Fill an "hmtx" font table.
02081
02082 The "hmtx" table contains horizontal metrics information.
02083
02084 @param[in,out] font The Font struct to which to add the table.
02085 */
02086 void
02087 fillHmtxTable (Font *font)
02088 {
02089     Buffer *hmtx = newBuffer (4 * font->glyphCount);
02090     addTable (font, "hmtx", hmtx);
02091     const Glyph *const glyphs = getBufferHead (font->glyphs);
02092     const Glyph *const glyphsEnd = getBufferTail (font->glyphs);
02093     for (const Glyph *glyph = glyphs; glyph < glyphsEnd; glyph++)
02094     {
02095         int_fast16_t aw = glyph->combining ? 0 : PW (glyph->byteCount);
02096         cacheU16 (hmtx, FU (aw)); // advanceWidth
02097         cacheU16 (hmtx, FU (glyph->lsb)); // lsb
02098     }
02099 }
02100
02101 /**
02102 @brief Fill a "cmap" font table.
02103
02104 The "cmap" table contains character to glyph index mapping information.
02105
02106 @param[in,out] font The Font struct to which to add the table.
02107 */
02108 void
02109 fillCmapTable (Font *font)
02110 {
02111     Glyph *const glyphs = getBufferHead (font->glyphs);
02112     Buffer *rangeHeads = newBuffer (16);
02113     uint_fast32_t rangeCount = 0;
02114     uint_fast32_t bmpRangeCount = 1; // 1 for the last 0xffff-0xffff range
02115     glyphs[0].codePoint = glyphs[1].codePoint; // to start a range at glyph 1
02116     for (uint_fast16_t i = 1; i < font->glyphCount; i++)
02117     {
02118         if (glyphs[i].codePoint != glyphs[i - 1].codePoint + 1)
02119         {
02120             storeU16 (rangeHeads, i);
02121             rangeCount++;
02122             bmpRangeCount += glyphs[i].codePoint < 0xffff;
02123         }
02124     }
02125     Buffer *cmap = newBuffer (256);
02126     addTable (font, "cmap", cmap);
02127     // Format 4 table is always generated for compatibility.
02128     bool hasFormat12 = glyphs[font->glyphCount - 1].codePoint > 0xffff;
02129     cacheU16 (cmap, 0); // version

```

```

02130 cacheU16 (cmap, 1 + hasFormat12); // numTables
02131 { // encodingRecords[0]
02132     cacheU16 (cmap, 3); // platformID
02133     cacheU16 (cmap, 1); // encodingID
02134     cacheU32 (cmap, 12 + 8 * hasFormat12); // subtableOffset
02135 }
02136 if (hasFormat12) // encodingRecords[1]
02137 {
02138     cacheU16 (cmap, 3); // platformID
02139     cacheU16 (cmap, 10); // encodingID
02140     cacheU32 (cmap, 36 + 8 * bmpRangeCount); // subtableOffset
02141 }
02142 const uint_least16_t *ranges = getBufferHead (rangeHeads);
02143 const uint_least16_t *const rangesEnd = getBufferTail (rangeHeads);
02144 storeU16 (rangeHeads, font->glyphCount);
02145 { // format 4 table
02146     cacheU16 (cmap, 4); // format
02147     cacheU16 (cmap, 16 + 8 * bmpRangeCount); // length
02148     cacheU16 (cmap, 0); // language
02149     if (bmpRangeCount * 2 > U16MAX)
02150         fail ("Too many ranges in 'cmap' table.");
02151     cacheU16 (cmap, bmpRangeCount * 2); // segCountX2
02152     uint_fast16_t searchRange = 1, entrySelector = -1;
02153     while (searchRange <= bmpRangeCount)
02154     {
02155         searchRange <<= 1;
02156         entrySelector++;
02157     }
02158     cacheU16 (cmap, searchRange); // searchRange
02159     cacheU16 (cmap, entrySelector); // entrySelector
02160     cacheU16 (cmap, bmpRangeCount * 2 - searchRange); // rangeShift
02161     { // endCode[]
02162         const uint_least16_t *p = ranges;
02163         for (p++; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02164             cacheU16 (cmap, glyphs[*p - 1].codePoint);
02165         uint_fast32_t cp = glyphs[*p - 1].codePoint;
02166         if (cp > 0xffffe)
02167             cp = 0xffff;
02168         cacheU16 (cmap, cp);
02169         cacheU16 (cmap, 0xffff);
02170     }
02171     cacheU16 (cmap, 0); // reservedPad
02172     { // startCode[]
02173         for (uint_fast32_t i = 0; i < bmpRangeCount - 1; i++)
02174             cacheU16 (cmap, glyphs[ranges[i]].codePoint);
02175         cacheU16 (cmap, 0xffff);
02176     }
02177     { // idDelta[]
02178         const uint_least16_t *p = ranges;
02179         for (; p < rangesEnd && glyphs[*p].codePoint < 0xffff; p++)
02180             cacheU16 (cmap, *p - glyphs[*p].codePoint);
02181         uint_fast16_t delta = 1;
02182         if (p < rangesEnd && *p == 0xffff)
02183             delta = *p - glyphs[*p].codePoint;
02184         cacheU16 (cmap, delta);
02185     }
02186     { // idRangeOffsets[]
02187         for (uint_least16_t i = 0; i < bmpRangeCount; i++)
02188             cacheU16 (cmap, 0);
02189     }
02190 }
02191 if (hasFormat12) // format 12 table
02192 {
02193     cacheU16 (cmap, 12); // format
02194     cacheU16 (cmap, 0); // reserved
02195     cacheU32 (cmap, 16 + 12 * rangeCount); // length
02196     cacheU32 (cmap, 0); // language
02197     cacheU32 (cmap, rangeCount); // numGroups
02198
02199     // groups[]
02200     for (const uint_least16_t *p = ranges; p < rangesEnd; p++)
02201     {
02202         cacheU32 (cmap, glyphs[*p].codePoint); // startCharCode
02203         cacheU32 (cmap, glyphs[p[1] - 1].codePoint); // endCharCode
02204         cacheU32 (cmap, *p); // startGlyphID
02205     }
02206 }
02207 freeBuffer (rangeHeads);
02208 }
02209
02210 /**

```

```

02211 @brief Fill a "post" font table.
02212
02213 The "post" table contains information for PostScript printers.
02214
02215 @param[in,out] font The Font struct to which to add the table.
02216 */
02217 void
02218 fillPostTable (Font *font)
02219 {
02220     Buffer *post = newBuffer (32);
02221     addTable (font, "post", post);
02222     cacheU32 (post, 0x00030000); // version = 3.0
02223     cacheU32 (post, 0); // italicAngle
02224     cacheU16 (post, 0); // underlinePosition
02225     cacheU16 (post, 1); // underlineThickness
02226     cacheU32 (post, 1); // isFixedPitch
02227     cacheU32 (post, 0); // minMemType42
02228     cacheU32 (post, 0); // maxMemType42
02229     cacheU32 (post, 0); // minMemType1
02230     cacheU32 (post, 0); // maxMemType1
02231 }
02232
02233 /**
02234 @brief Fill a "GPOS" font table.
02235
02236 The "GPOS" table contains information for glyph positioning.
02237
02238 @param[in,out] font The Font struct to which to add the table.
02239 */
02240 void
02241 fillGposTable (Font *font)
02242 {
02243     Buffer *gpos = newBuffer (16);
02244     addTable (font, "GPOS", gpos);
02245     cacheU16 (gpos, 1); // majorVersion
02246     cacheU16 (gpos, 0); // minorVersion
02247     cacheU16 (gpos, 10); // scriptListOffset
02248     cacheU16 (gpos, 12); // featureListOffset
02249     cacheU16 (gpos, 14); // lookupListOffset
02250     { // ScriptList table
02251         cacheU16 (gpos, 0); // scriptCount
02252     }
02253     { // Feature List table
02254         cacheU16 (gpos, 0); // featureCount
02255     }
02256     { // Lookup List Table
02257         cacheU16 (gpos, 0); // lookupCount
02258     }
02259 }
02260
02261 /**
02262 @brief Fill a "GSUB" font table.
02263
02264 The "GSUB" table contains information for glyph substitution.
02265
02266 @param[in,out] font The Font struct to which to add the table.
02267 */
02268 void
02269 fillGsubTable (Font *font)
02270 {
02271     Buffer *gsub = newBuffer (38);
02272     addTable (font, "GSUB", gsub);
02273     cacheU16 (gsub, 1); // majorVersion
02274     cacheU16 (gsub, 0); // minorVersion
02275     cacheU16 (gsub, 10); // scriptListOffset
02276     cacheU16 (gsub, 34); // featureListOffset
02277     cacheU16 (gsub, 36); // lookupListOffset
02278     { // ScriptList table
02279         cacheU16 (gsub, 2); // scriptCount
02280         { // scriptRecords[0]
02281             cacheBytes (gsub, "DFLT", 4); // scriptTag
02282             cacheU16 (gsub, 14); // scriptOffset
02283         }
02284         { // scriptRecords[1]
02285             cacheBytes (gsub, "thai", 4); // scriptTag
02286             cacheU16 (gsub, 14); // scriptOffset
02287         }
02288     }
02289     { // Script table
02290         cacheU16 (gsub, 4); // defaultLangSysOffset
02291         cacheU16 (gsub, 0); // langSysCount
02292     }
02293     { // Default Language System table

```

```

02292         cacheU16 (gsub, 0); // lookupOrderOffset
02293         cacheU16 (gsub, 0); // requiredFeatureIndex
02294         cacheU16 (gsub, 0); // featureIndexCount
02295     }
02296 }
02297 }
02298 { // Feature List table
02299     cacheU16 (gsub, 0); // featureCount
02300 }
02301 { // Lookup List Table
02302     cacheU16 (gsub, 0); // lookupCount
02303 }
02304 }
02305
02306 /**
02307 @brief Cache a string as a big-ending UTF-16 surrogate pair.
02308
02309 This function encodes a UTF-8 string as a big-endian UTF-16
02310 surrogate pair.
02311
02312 @param[in,out] buf Pointer to a Buffer struct to update.
02313 @param[in] str The character array to encode.
02314 */
02315 void
02316 cacheStringAsUTF16BE (Buffer *buf, const char *str)
02317 {
02318     for (const char *p = str; *p; p++)
02319     {
02320         byte c = *p;
02321         if (c < 0x80)
02322         {
02323             cacheU16 (buf, c);
02324             continue;
02325         }
02326         int length = 1;
02327         byte mask = 0x40;
02328         for (; c & mask; mask »= 1)
02329             length++;
02330         if (length == 1 || length > 4)
02331             fail ("Ill-formed UTF-8 sequence.");
02332         uint_fast32_t codePoint = c & (mask - 1);
02333         for (int i = 1; i < length; i++)
02334         {
02335             c = *++p;
02336             if ((c & 0xc0) != 0x80) // NUL checked here
02337                 fail ("Ill-formed UTF-8 sequence.");
02338             codePoint = (codePoint « 6) | (c & 0x3f);
02339         }
02340         const int lowerBits = length==2 ? 7 : length==3 ? 11 : 16;
02341         if (codePoint » lowerBits == 0)
02342             fail ("Ill-formed UTF-8 sequence."); // sequence should be shorter
02343         if (codePoint >= 0xd800 && codePoint <= 0xdfff)
02344             fail ("Ill-formed UTF-8 sequence.");
02345         if (codePoint > 0x10fff)
02346             fail ("Ill-formed UTF-8 sequence.");
02347         if (codePoint > 0xffff)
02348         {
02349             cacheU16 (buf, 0xd800 | (codePoint - 0x10000) » 10);
02350             cacheU16 (buf, 0xdc00 | (codePoint & 0x3ff));
02351         }
02352         else
02353             cacheU16 (buf, codePoint);
02354     }
02355 }
02356
02357 /**
02358 @brief Fill a "name" font table.
02359
02360 The "name" table contains name information, for example for Name IDs.
02361
02362 @param[in,out] font The Font struct to which to add the table.
02363 @param[in] names List of NameStrings.
02364 */
02365 void
02366 fillNameTable (Font *font, NameStrings nameStrings)
02367 {
02368     Buffer *name = newBuffer (2048);
02369     addTable (font, "name", name);
02370     size_t nameStringCount = 0;
02371     for (size_t i = 0; i < MAX_NAME_IDS; i++)
02372         nameStringCount += !nameStrings[i];

```

```

02373 cacheU16 (name, 0); // version
02374 cacheU16 (name, nameStringCount); // count
02375 cacheU16 (name, 2 * 3 + 12 * nameStringCount); // storageOffset
02376 Buffer *stringData = newBuffer (1024);
02377 // nameRecord[]
02378 for (size_t i = 0; i < MAX_NAME_IDS; i++)
02379 {
02380     if (!nameStrings[i])
02381         continue;
02382     size_t offset = countBufferedBytes (stringData);
02383     cacheStringAsUTF16BE (stringData, nameStrings[i]);
02384     size_t length = countBufferedBytes (stringData) - offset;
02385     if (offset > U16MAX || length > U16MAX)
02386         fail ("Name strings are too long.");
02387     // Platform ID 0 (Unicode) is not well supported.
02388     // ID 3 (Windows) seems to be the best for compatibility.
02389     cacheU16 (name, 3); // platformID = Windows
02390     cacheU16 (name, 1); // encodingID = Unicode BMP
02391     cacheU16 (name, 0x0409); // languageID = en-US
02392     cacheU16 (name, i); // nameID
02393     cacheU16 (name, length); // length
02394     cacheU16 (name, offset); // stringOffset
02395 }
02396 cacheBuffer (name, stringData);
02397 freeBuffer (stringData);
02398 }
02399
02400 /**
02401 @brief Print program version string on stdout.
02402
02403 Print program version if invoked with the "--version" option,
02404 and then exit successfully.
02405 */
02406 void
02407 printVersion () {
02408     printf ("hex2otf (GNU Unifont) %s\n", VERSION);
02409     printf ("Copyright \u00A9 2022 \u4F55\u5FD7\u7FD4 (He Zhixiang)\n");
02410     printf ("License GPLv2+: GNU GPL version 2 or later\n");
02411     printf ("<https://gnu.org/licenses/gpl.html>\n");
02412     printf ("This is free software: you are free to change and\n");
02413     printf ("redistribute it. There is NO WARRANTY, to the extent\n");
02414     printf ("permitted by law.\n");
02415
02416     exit (EXIT_SUCCESS);
02417 }
02418
02419 /**
02420 @brief Print help message to stdout and then exit.
02421
02422 Print help message if invoked with the "--help" option,
02423 and then exit successfully.
02424 */
02425 void
02426 printHelp () {
02427     printf ("Synopsis: hex2otf <options>:\n\n");
02428     printf ("  hex=<filename>      Specify Unifont .hex input file.\n");
02429     printf ("  pos=<filename>      Specify combining file. (Optional)\n");
02430     printf ("  out=<filename>      Specify output font file.\n");
02431     printf ("  format=<f1>,<f2>,... Specify font format(s); values:\n");
02432     printf ("      cff\n");
02433     printf ("      cff2\n");
02434     printf ("      truetype\n");
02435     printf ("      blank\n");
02436     printf ("      bitmap\n");
02437     printf ("      gpos\n");
02438     printf ("      gsub\n");
02439     printf ("\nExample:\n\n");
02440     printf ("  hex2otf hex=Myfont.hex out=Myfont.otf format=cff\n");
02441     printf ("For more information, consult the hex2otf(1) man page.\n\n");
02442
02443     exit (EXIT_SUCCESS);
02444 }
02445
02446 /**
02447 @brief Data structure to hold options for OpenType font output.
02448
02449 This data structure holds the status of options that can be
02450 specified as command line arguments for creating the output
02451 OpenType font file.
02452 */
02453 typedef struct Options

```

```

02454 {
02455     bool truetype, blankOutline, bitmap, gpos, gsub;
02456     int cff; // 0 = no CFF outline; 1 = use 'CFF' table; 2 = use 'CFF2' table
02457     const char *hex, *pos, *out; // file names
02458     NameStrings nameStrings; // indexed directly by Name IDs
02459 } Options;
02460
02461 /**
02462 @brief Match a command line option with its key for enabling.
02463
02464 @param[in] operand A pointer to the specified operand.
02465 @param[in] key Pointer to the option structure.
02466 @param[in] delimiter The delimiter to end searching.
02467 @return Pointer to the first character of the desired option.
02468 */
02469 const char *
02470 matchToken (const char *operand, const char *key, char delimiter)
02471 {
02472     while (*key)
02473         if (*operand++ != *key++)
02474             return NULL;
02475     if (!*operand || *operand++ == delimiter)
02476         return operand;
02477     return NULL;
02478 }
02479
02480 /**
02481 @brief Parse command line options.
02482
02483 Option      Data Type      Description
02484 -----
02485 truetype    bool            Generate TrueType outlines
02486 blankOutline bool          Generate blank outlines
02487 bitmap      bool            Generate embedded bitmap
02488 gpos        bool            Generate a dummy GPOS table
02489 gsub        bool            Generate a dummy GSUB table
02490 cff         int             Generate CFF 1 or CFF 2 outlines
02491 hex         const char *   Name of Unifont .hex file
02492 pos         const char *   Name of Unifont combining data file
02493 out         const char *   Name of output font file
02494 nameStrings NameStrings   Array of TrueType font Name IDs
02495
02496 @param[in] argv Pointer to array of command line options.
02497 @return Data structure to hold requested command line options.
02498 */
02499 Options
02500 parseOptions (char *const argv[const])
02501 {
02502     Options opt = {0}; // all options default to 0, false and NULL
02503     const char *format = NULL;
02504     struct StringArg
02505     {
02506         const char *const key;
02507         const char **const value;
02508     } strArgs[] =
02509     {
02510         {"hex", &opt.hex},
02511         {"pos", &opt.pos},
02512         {"out", &opt.out},
02513         {"format", &format},
02514         {NULL, NULL} // sentinel
02515     };
02516     for (char *const *argp = argv + 1; *argp; argp++)
02517     {
02518         const char *const arg = *argp;
02519         struct StringArg *p;
02520         const char *value = NULL;
02521         if (strcmp (arg, "--help") == 0)
02522             printHelp ();
02523         if (strcmp (arg, "--version") == 0)
02524             printVersion ();
02525         for (p = strArgs; p->key; p++)
02526             if ((value = matchToken (arg, p->key, '=')))
02527                 break;
02528         if (p->key)
02529             {
02530                 if (!*value)
02531                     fail ("Empty argument: '%s'", p->key);
02532                 if (*p->value)
02533                     fail ("Duplicate argument: '%s'", p->key);
02534                 *p->value = value;

```

```

02535     }
02536     else // shall be a name string
02537     {
02538         char *endptr;
02539         unsigned long id = strtoul (arg, &endptr, 10);
02540         if (endptr == arg || id >= MAX_NAME_IDS || *endptr != '=')
02541             fail ("Invalid argument: '%s'", arg);
02542         endptr++; // skip '='
02543         if (opt.nameStrings[id])
02544             fail ("Duplicate name ID: %lu.", id);
02545         opt.nameStrings[id] = endptr;
02546     }
02547 }
02548 if (!opt.hex)
02549     fail ("Hex file is not specified.");
02550 if (opt.pos && opt.pos[0] == '\0')
02551     opt.pos = NULL; // Position file is optional. Empty path means none.
02552 if (!opt.out)
02553     fail ("Output file is not specified.");
02554 if (!format)
02555     fail ("Format is not specified.");
02556 for (const NamePair *p = defaultNames; p->str; p++)
02557     if (!opt.nameStrings[p->id])
02558         opt.nameStrings[p->id] = p->str;
02559 bool cff = false, cff2 = false;
02560 struct Symbol
02561 {
02562     const char *const key;
02563     bool *const found;
02564 } symbols[] =
02565 {
02566     {"cff", &cff},
02567     {"cff2", &cff2},
02568     {"truetype", &opt.truetype},
02569     {"blank", &opt.blankOutline},
02570     {"bitmap", &opt.bitmap},
02571     {"gpos", &opt.gpos},
02572     {"gsub", &opt.gsub},
02573     {NULL, NULL} // sentinel
02574 };
02575 while (*format)
02576 {
02577     const struct Symbol *p;
02578     const char *next = NULL;
02579     for (p = symbols; p->key; p++)
02580         if ((next = matchToken (format, p->key, ',')))
02581             break;
02582     if (!p->key)
02583         fail ("Invalid format.");
02584     *p->found = true;
02585     format = next;
02586 }
02587 if (cff + cff2 + opt.truetype + opt.blankOutline > 1)
02588     fail ("At most one outline format can be accepted.");
02589 if (!(cff || cff2 || opt.truetype || opt.bitmap))
02590     fail ("Invalid format.");
02591 opt.cff = cff + cff2 * 2;
02592 return opt;
02593 }
02594 /**
02595  * @brief The main function.
02596  */
02597
02598 @param[in] argc The number of command-line arguments.
02599 @param[in] argv The array of command-line arguments.
02600 @return EXIT_FAILURE upon fatal error, EXIT_SUCCESS otherwise.
02601 */
02602 int
02603 main (int argc, char *argv[])
02604 {
02605     initBuffers (16);
02606     atexit (cleanBuffers);
02607     Options opt = parseOptions (argv);
02608     Font font;
02609     font.tables = newBuffer (sizeof (Table) * 16);
02610     font.glyphs = newBuffer (sizeof (Glyph) * MAX_GLYPHS);
02611     readGlyphs (&font, opt.hex);
02612     sortGlyphs (&font);
02613     enum LocaFormat loca = LOCA_OFFSET16;
02614     uint_fast16_t maxPoints = 0, maxContours = 0;
02615     pixels_t xMin = 0;

```

```

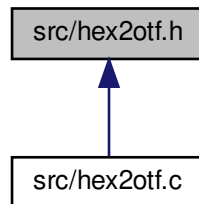
02616     if (opt.pos)
02617         positionGlyphs (&font, opt.pos, &xMin);
02618     if (opt.gpos)
02619         fillGposTable (&font);
02620     if (opt.gsub)
02621         fillGsubTable (&font);
02622     if (opt.cff)
02623         fillCFF (&font, opt.cff, opt.nameStrings);
02624     if (opt.trueType)
02625         fillTrueType (&font, &loca, &maxPoints, &maxContours);
02626     if (opt.blankOutline)
02627         fillBlankOutline (&font);
02628     if (opt.bitmap)
02629         fillBitmap (&font);
02630     fillHeadTable (&font, loca, xMin);
02631     fillHheaTable (&font, xMin);
02632     fillMaxpTable (&font, opt.cff, maxPoints, maxContours);
02633     fillOS2Table (&font);
02634     fillNameTable (&font, opt.nameStrings);
02635     fillHmtxTable (&font);
02636     fillCmapTable (&font);
02637     fillPostTable (&font);
02638     organizeTables (&font, opt.cff);
02639     writeFont (&font, opt.cff, opt.out);
02640     return EXIT_SUCCESS;
02641 }

```

## 5.5 src/hex2otf.h File Reference

[hex2otf.h](#) - Header file for [hex2otf.c](#)

This graph shows which files directly or indirectly include this file:



### Data Structures

- struct [NamePair](#)  
Data structure for a font ID number and name character string.

### Macros

- `#define UNIFONT_VERSION "15.0.06"`  
Current Unifont version.
- `#define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \Nils Moskopp, Rebecca Bettencourt, et al."`
- `#define DEFAULT_ID1 "Unifont"`  
Default NameID 1 string ([Font Family](#))
- `#define DEFAULT_ID2 "Regular"`



- Default NameID 2 string ([Font Subfamily](#))
- `#define DEFAULT_ID5 "Version "UNIFONT_VERSION`  
Default NameID 5 string (Version of the Name [Table](#))
- `#define DEFAULT_ID11 "https://unifoundry.com/unifont/"`  
Default NameID 11 string ([Font Vendor URL](#))
- `#define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \and GNU GPL version 2 or later with the GNU Font Embedding Exception."`  
Default NameID 13 string (License Description)
- `#define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \https://scripts.sil.org/OFL"`  
Default NameID 14 string (License Information URLs)
- `#define NAMEPAIR(n) {(n), DEFAULT_ID##n}`  
Macro to initialize name identifier codes to default values defined above.

## Typedefs

- typedef struct [NamePair](#) NamePair  
Data structure for a font ID number and name character string.

## Variables

- const [NamePair](#) defaultNames []  
Allocate array of NameID codes with default values.

### 5.5.1 Detailed Description

[hex2otf.h](#) - Header file for [hex2otf.c](#)

Copyright

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Author

[何志翔](#) (He Zhixiang)

Definition in file [hex2otf.h](#).

### 5.5.2 Macro Definition Documentation

#### 5.5.2.1 DEFAULT\_ID0

`#define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \Nils Moskopp, Rebecca Bettencourt, et al."`  
Define default strings for some TrueType font NameID strings.

NameID Description

NameID	Description
0	Copyright Notice
1	Font Family
2	Font Subfamily
5	Version of the Name Table
11	URL of the Font Vendor
13	License Description
14	License Information URL

Default NameID 0 string (Copyright Notice)

Definition at line [53](#) of file [hex2otf.h](#).

### 5.5.2.2 DEFAULT\_ID1

```
#define DEFAULT_ID1 "Unifont"
Default NameID 1 string (Font Family)
Definition at line 57 of file hex2otf.h.
```

### 5.5.2.3 DEFAULT\_ID11

```
#define DEFAULT_ID11 "https://unifoundry.com/unifont/"
Default NameID 11 string (Font Vendor URL)
Definition at line 64 of file hex2otf.h.
```

### 5.5.2.4 DEFAULT\_ID13

```
#define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \
and GNU GPL version 2 or later with the GNU Font Embedding Exception."
Default NameID 13 string (License Description)
Definition at line 67 of file hex2otf.h.
```

### 5.5.2.5 DEFAULT\_ID14

```
#define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \
https://scripts.sil.org/OFL"
Default NameID 14 string (License Information URLs)
Definition at line 71 of file hex2otf.h.
```

### 5.5.2.6 DEFAULT\_ID2

```
#define DEFAULT_ID2 "Regular"
Default NameID 2 string (Font Subfamily)
Definition at line 58 of file hex2otf.h.
```

### 5.5.2.7 DEFAULT\_ID5

```
#define DEFAULT_ID5 "Version "UNIFONT_VERSION
Default NameID 5 string (Version of the Name Table)
Definition at line 61 of file hex2otf.h.
```

### 5.5.2.8 NAMEPAIR

```
#define NAMEPAIR(
    n ) {(n), DEFAULT_ID##n}
Macro to initialize name identifier codes to default values defined above.
Definition at line 84 of file hex2otf.h.
```

### 5.5.2.9 UNIFONT\_VERSION

```
#define UNIFONT_VERSION "15.0.06"
Current Unifont version.
Definition at line 36 of file hex2otf.h.
```

### 5.5.3 Variable Documentation

#### 5.5.3.1 defaultNames

const `NamePair` defaultNames[]

Initial value:

```
=
{
  NAMEPAIR (0),
  NAMEPAIR (1),
  NAMEPAIR (2),
  NAMEPAIR (5),
  NAMEPAIR (11),
  NAMEPAIR (13),
  NAMEPAIR (14),
  {0, NULL}
}
```

Allocate array of NameID codes with default values.

This array contains the default values for several TrueType NameID strings, as defined above in this file. Strings are assigned using the NAMEPAIR macro defined above.

Definition at line 93 of file `hex2otf.h`.

## 5.6 hex2otf.h

[Go to the documentation of this file.](#)

```
00001 /**
00002  @file hex2otf.h
00003
00004  @brief hex2otf.h - Header file for hex2otf.c
00005
00006  @copyright Copyright © 2022 何志翔 (He Zhixiang)
00007
00008  @author 何志翔 (He Zhixiang)
00009  */
00010
00011  /*
00012  LICENSE:
00013
00014  This program is free software; you can redistribute it and/or
00015  modify it under the terms of the GNU General Public License
00016  as published by the Free Software Foundation; either version 2
00017  of the License, or (at your option) any later version.
00018
00019  This program is distributed in the hope that it will be useful,
00020  but WITHOUT ANY WARRANTY; without even the implied warranty of
00021  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00022  GNU General Public License for more details.
00023
00024  You should have received a copy of the GNU General Public License
00025  along with this program; if not, write to the Free Software
00026  Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA
00027  02110-1301, USA.
00028
00029  NOTE: It is a violation of the license terms of this software
00030  to delete license and copyright information below if creating
00031  a font derived from Unifont glyphs.
00032  */
00033  #ifndef __HEX2OTF_H__
00034  #define __HEX2OTF_H__
00035
00036  #define UNIFONT_VERSION "15.0.06" ///< Current Unifont version.
00037
00038  /**
00039  Define default strings for some TrueType font NameID strings.
00040
00041  NameID  Description
00042  -----  -----
00043  0      Copyright Notice
00044  1      Font Family
00045  2      Font Subfamily
00046  5      Version of the Name Table
00047  11     URL of the Font Vendor
```

```

00048 13    License Description
00049 14    License Information URL
00050
00051 Default NameID 0 string (Copyright Notice)
00052 */
00053 #define DEFAULT_ID0 "Copyright © 1998-2022 Roman Czyborra, Paul Hardy, \
00054 Qianqian Fang, Andrew Miller, Johnnie Weaver, David Corbett, \
00055 Nils Moskopp, Rebecca Bettencourt, et al."
00056
00057 #define DEFAULT_ID1 "Unifont"    ///< Default NameID 1 string (Font Family)
00058 #define DEFAULT_ID2 "Regular"    ///< Default NameID 2 string (Font Subfamily)
00059
00060 ///< Default NameID 5 string (Version of the Name Table)
00061 #define DEFAULT_ID5 "Version" UNIFONT_VERSION
00062
00063 ///< Default NameID 11 string (Font Vendor URL)
00064 #define DEFAULT_ID11 "https://unifoundry.com/unifont/"
00065
00066 ///< Default NameID 13 string (License Description)
00067 #define DEFAULT_ID13 "Dual license: SIL Open Font License version 1.1, \
00068 and GNU GPL version 2 or later with the GNU Font Embedding Exception."
00069
00070 ///< Default NameID 14 string (License Information URLs)
00071 #define DEFAULT_ID14 "http://unifoundry.com/LICENSE.txt, \
00072 https://scripts.sil.org/OFL"
00073
00074 /**
00075 @brief Data structure for a font ID number and name character string.
00076 */
00077 typedef struct NamePair
00078 {
00079     int id;
00080     const char *str;
00081 } NamePair;
00082
00083 ///< Macro to initialize name identifier codes to default values defined above.
00084 #define NAMEPAIR(n) {(n), DEFAULT_ID##n}
00085
00086 /**
00087 @brief Allocate array of NameID codes with default values.
00088
00089 This array contains the default values for several TrueType NameID
00090 strings, as defined above in this file. Strings are assigned using
00091 the NAMEPAIR macro defined above.
00092 */
00093 const NamePair defaultNames[] =
00094 {
00095     NAMEPAIR (0), // Copyright notice; required (used in CFF)
00096     NAMEPAIR (1), // Font family; required (used in CFF)
00097     NAMEPAIR (2), // Font subfamily
00098     NAMEPAIR (5), // Version of the name table
00099     NAMEPAIR (11), // URL of font vendor
00100     NAMEPAIR (13), // License description
00101     NAMEPAIR (14), // License information URL
00102     {0, NULL} // Sentinel
00103 };
00104
00105 #undef NAMEPAIR
00106
00107 #endif

```

## 5.7 src/johab2syllables.c File Reference

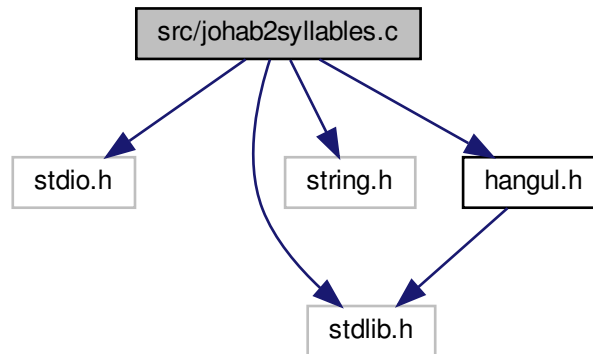
Create the Unicode Hangul Syllables block from component letters.

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hangul.h"

```

Include dependency graph for johab2syllables.c:



## Functions

- `int main (int argc, char *argv[])`  
The main function.
- `void print_help ()`  
Print a help message.

### 5.7.1 Detailed Description

Create the Unicode Hangul Syllables block from component letters.

This program reads in a "hangul-base.hex" file containing Hangul letters in Johab 6/3/1 format and outputs a Unifont .hex format file covering the Unicode Hangul Syllables range of U+AC00..U+D7A3.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [johab2syllables.c](#).

### 5.7.2 Function Documentation

#### 5.7.2.1 main()

```
int main (  
    int argc,  
    char * argv[] )
```

The main function.

Definition at line 42 of file [johab2syllables.c](#).

```

00042     {
00043 int     i;          /* Loop variables */
00044 int     arg_count; /* index into *argv[] */
00045 unsigned codept;
00046 unsigned max_codept;
00047 unsigned char hangul_base[MAX_GLYPHS][32];
00048 int     initial, medial, final; /* Base glyphs for a syllable. */
00049 unsigned char syllable[32]; /* Syllable glyph built for output. */
00050
00051 FILE *infp = stdin; /* Input Hangul Johab 6/3/1 file */
00052 FILE *outfp = stdout; /* Output Hangul Syllables file */
00053
00054 /* Print a help message */
00055 void print_help ();
00056
00057 /* Read the file containing Hangul base glyphs. */
00058 unsigned hangul_read_base8 (FILE *infp, unsigned char hangul_base[][32]);
00059
00060 /* Given a Hangul Syllables code point, determine component glyphs. */
00061 void hangul_decompose (unsigned codept, int *, int *, int *);
00062
00063 /* Given letters in a Hangul syllable, return a glyph. */
00064 void hangul_syllable (int choseong, int jungseong, int jongseong,
00065                     unsigned char hangul_base[][32],
00066                     unsigned char *syllable);
00067
00068
00069 /*
00070 If there are command line arguments, parse them.
00071 */
00072 arg_count = 1;
00073
00074 while (arg_count < argc) {
00075     /* If input file is specified, open it for read access. */
00076     if (strcmp (argv [arg_count], "-i", 2) == 0) {
00077         arg_count++;
00078         if (arg_count < argc) {
00079             infp = fopen (argv [arg_count], "r");
00080             if (infp == NULL) {
00081                 fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00082                         argv [arg_count]);
00083                 exit (EXIT_FAILURE);
00084             }
00085         }
00086     }
00087     /* If output file is specified, open it for write access. */
00088     else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00089         arg_count++;
00090         if (arg_count < argc) {
00091             outfp = fopen (argv [arg_count], "w");
00092             if (outfp == NULL) {
00093                 fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00094                         argv [arg_count]);
00095                 exit (EXIT_FAILURE);
00096             }
00097         }
00098     }
00099     /* If help is requested, print help message and exit. */
00100     else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00101             strcmp (argv [arg_count], "--help", 6) == 0) {
00102         print_help ();
00103         exit (EXIT_SUCCESS);
00104     }
00105     arg_count++;
00106 }
00107
00108
00109
00110 /*
00111 Initialize entire glyph array to zeroes in case the input
00112 file skips over some code points.
00113 */
00114 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00115     for (i = 0; i < 32; i++) hangul_base[codept][i] = 0;
00116 }
00117
00118 /*
00119 Read the entire "hangul-base.hex" file into an array
00120 organized as hangul_base [code_point][glyph_byte].
00121 The Hangul glyphs are 16 columns wide, which is
00122 two bytes, by 16 rows, for a total of 2 * 16 = 32 bytes.

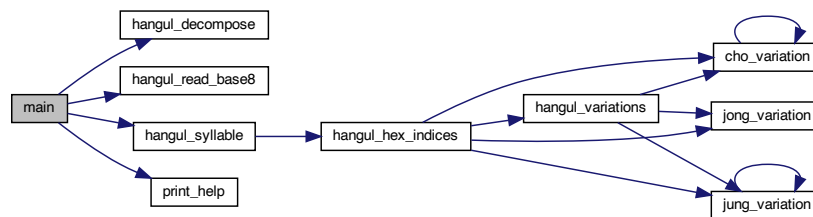
```

```

00123 */
00124 max_codept = hangul_read_base8 (infp, hangul_base);
00125 if (max_codept > 0x8FFF) {
00126     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00127 }
00128
00129 /*
00130 For each glyph in the Unicode Hangul Syllables block,
00131 form a composite glyph of choseong + jungseong +
00132 optional jongseong and output it in Unifont .hex format.
00133 */
00134 for (codept = 0xAC00; codept < 0xAC00 + 19 * 21 * 28; codept++) {
00135     hangul_decompose (codept, &initial, &medial, &final);
00136
00137     hangul_syllable (initial, medial, final, hangul_base, syllable);
00138
00139     fprintf (outfp, "%04X:", codept);
00140
00141     for (i = 0; i < 32; i++) {
00142         fprintf (outfp, "%02X", syllable[i]);
00143     }
00144     fputc ('\n', outfp);
00145 }
00146
00147 exit (EXIT_SUCCESS);
00148 }

```

Here is the call graph for this function:



### 5.7.2.2 print\_help()

```
void print_help ( )
```

Print a help message.

Definition at line 155 of file [johab2syllables.c](#).

```

00155     {
00156
00157     printf ("\ngen-hangul [options]\n\n");
00158     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00159     printf ("    in Johab 6/3/1 format.  The output is the Unicode Hangul Syllables\n");
00160     printf ("    range, U+AC00..U+D7A3.\n\n");
00161     printf ("    This program demonstrates forming Hangul syllables without shifting\n");
00162     printf ("    the final consonant (jongseong) when combined with a vowel having\n");
00163     printf ("    a long double vertical stroke.  For a program that demonstrtrtes\n");
00164     printf ("    shifting jongseong in those cases, see unigen-hangul, which is what\n");
00165     printf ("    creates the Unifont Hangul Syllables block.\n\n");
00166
00167     printf ("    This program may be invoked with the following command line options:\n\n");
00168
00169     printf ("    Option  Parameters  Function\n");
00170     printf ("    ----  - - - - - - - - - -\n");
00171     printf ("    -h, --help          Print this message and exit.\n\n");
00172     printf ("    -i      input_file  Unifont hangul-base.hex formatted input file.\n\n");
00173     printf ("    -o      output_file Unifont .hex format output file.\n\n");
00174     printf ("    Example:\n\n");
00175     printf ("    johab2syllables -i hangul-base.hex -o hangul-syllables.hex\n\n");
00176
00177     return;
00178 }

```

Here is the caller graph for this function:



## 5.8 johab2syllables.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file johab2syllables.c
00003
00004 @brief Create the Unicode Hangul Syllables block from component letters.
00005
00006 This program reads in a "hangul-base.hex" file containing Hangul
00007 letters in Johab 6/3/1 format and outputs a Unifont .hex format
00008 file covering the Unicode Hangul Syllables range of U+AC00..U+D7A3.
00009
00010 @author Paul Hardy
00011
00012 @copyright Copyright © 2023 Paul Hardy
00013 */
00014 /*
00015 LICENSE:
00016
00017 This program is free software: you can redistribute it and/or modify
00018 it under the terms of the GNU General Public License as published by
00019 the Free Software Foundation, either version 2 of the License, or
00020 (at your option) any later version.
00021
00022 This program is distributed in the hope that it will be useful,
00023 but WITHOUT ANY WARRANTY; without even the implied warranty of
00024 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00025 GNU General Public License for more details.
00026
00027 You should have received a copy of the GNU General Public License
00028 along with this program. If not, see <http://www.gnu.org/licenses/>.
00029 */
00030
00031 #include <stdio.h>
00032 #include <stdlib.h>
00033 #include <string.h>
00034
00035 #include "hangul.h"
00036
00037
00038 /**
00039 @brief The main function.
00040 */
00041 int
00042 main (int argc, char *argv[]) {
00043     int i; /* Loop variables */
00044     int arg_count; /* index into *argv[] */
00045     unsigned codept;
00046     unsigned max_codept;
00047     unsigned char hangul_base[MAX_GLYPHS][32];
00048     int initial, medial, final; /* Base glyphs for a syllable. */
00049     unsigned char syllable[32]; /* Syllable glyph built for output. */
00050
00051     FILE *infp = stdin; /* Input Hangul Johab 6/3/1 file */
00052     FILE *outfp = stdout; /* Output Hangul Syllables file */
00053
00054     /* Print a help message */
00055     void print_help ();
00056
00057     /* Read the file containing Hangul base glyphs. */
00058     unsigned hangul_read_base8 (FILE *infp, unsigned char hangul_base[][32]);
  
```



```

00059
00060 /* Given a Hangul Syllables code point, determine component glyphs. */
00061 void hangul_decompose (unsigned codept, int *, int *, int *);
00062
00063 /* Given letters in a Hangul syllable, return a glyph. */
00064 void hangul_syllable (int choseong, int jungseong, int jongseong,
00065                     unsigned char hangul_base[][32],
00066                     unsigned char *syllable);
00067
00068
00069 /*
00070 If there are command line arguments, parse them.
00071 */
00072 arg_count = 1;
00073
00074 while (arg_count < argc) {
00075     /* If input file is specified, open it for read access. */
00076     if (strcmp (argv [arg_count], "-i", 2) == 0) {
00077         arg_count++;
00078         if (arg_count < argc) {
00079             infp = fopen (argv [arg_count], "r");
00080             if (infp == NULL) {
00081                 fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00082                         argv [arg_count]);
00083                 exit (EXIT_FAILURE);
00084             }
00085         }
00086     }
00087     /* If output file is specified, open it for write access. */
00088     else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00089         arg_count++;
00090         if (arg_count < argc) {
00091             outfp = fopen (argv [arg_count], "w");
00092             if (outfp == NULL) {
00093                 fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00094                         argv [arg_count]);
00095                 exit (EXIT_FAILURE);
00096             }
00097         }
00098     }
00099     /* If help is requested, print help message and exit. */
00100     else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00101             strcmp (argv [arg_count], "--help", 6) == 0) {
00102         print_help ();
00103         exit (EXIT_SUCCESS);
00104     }
00105     arg_count++;
00106 }
00107 }
00108
00109
00110 /*
00111 Initialize entire glyph array to zeroes in case the input
00112 file skips over some code points.
00113 */
00114 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00115     for (i = 0; i < 32; i++) hangul_base[codept][i] = 0;
00116 }
00117
00118 /*
00119 Read the entire "hangul-base.hex" file into an array
00120 organized as hangul_base [code_point][glyph_byte].
00121 The Hangul glyphs are 16 columns wide, which is
00122 two bytes, by 16 rows, for a total of 2 * 16 = 32 bytes.
00123 */
00124 max_codept = hangul_read_base8 (infp, hangul_base);
00125 if (max_codept > 0x8FFF) {
00126     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00127 }
00128
00129 /*
00130 For each glyph in the Unicode Hangul Syllables block,
00131 form a composite glyph of choseong + jungseong +
00132 optional jongseong and output it in Unifont .hex format.
00133 */
00134 for (codept = 0xAC00; codept < 0xAC00 + 19 * 21 * 28; codept++) {
00135     hangul_decompose (codept, &initial, &medial, &final);
00136
00137     hangul_syllable (initial, medial, final, hangul_base, syllable);
00138
00139     fprintf (outfp, "%04X:", codept);

```

```

00140
00141     for (i = 0; i < 32; i++) {
00142         fprintf (outfp, "%02X", syllable[i]);
00143     }
00144     fputc ('\n', outfp);
00145 }
00146
00147 exit (EXIT_SUCCESS);
00148 }
00149
00150
00151 /**
00152 @brief Print a help message.
00153 */
00154 void
00155 print_help () {
00156     printf ("\ngen-hangul [options]\n\n");
00157     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00158     printf ("    in Johab 6/3/1 format.  The output is the Unicode Hangul Syllables\n");
00160     printf ("    range, U+AC00..U+D7A3.\n\n");
00161     printf ("    This program demonstrates forming Hangul syllables without shifting\n");
00162     printf ("    the final consonant (jongseong) when combined with a vowel having\n");
00163     printf ("    a long double vertical stroke.  For a program that demonstrtes\n");
00164     printf ("    shifting jongseong in those cases, see unigen-hangul, which is what\n");
00165     printf ("    creates the Unifont Hangul Syllables block.\n\n");
00166
00167     printf ("    This program may be invoked with the following command line options:\n\n");
00168
00169     printf ("    Option  Parameters  Function\n");
00170     printf ("    -----  -\n");
00171     printf ("    -h, --help          Print this message and exit.\n\n");
00172     printf ("    -i      input_file  Unifont hangul-base.hex formatted input file.\n\n");
00173     printf ("    -o      output_file Unifont .hex format output file.\n\n");
00174     printf ("    Example:\n\n");
00175     printf ("    johab2syllables -i hangul-base.hex -o hangul-syllables.hex\n\n");
00176
00177     return;
00178 }
00179

```

## 5.9 src/unibdf2hex.c File Reference

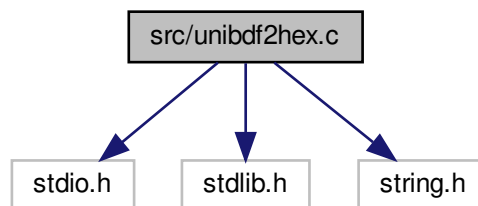
unibdf2hex - Convert a BDF file into a unifont.hex file

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unibdf2hex.c:



### Macros

- #define UNISTART 0x3400

- First Unicode code point to examine.
- `#define UNISTOP 0x4DBF`  
Last Unicode code point to examine.
- `#define MAXBUF 256`  
Maximum allowable input file line length - 1.

## Functions

- `int main ()`  
The main function.

### 5.9.1 Detailed Description

unibdf2hex - Convert a BDF file into a unifont.hex file

Author

Paul Hardy, January 2008

Copyright

Copyright (C) 2008, 2013 Paul Hardy

Note: currently this has hard-coded code points for glyphs extracted from Wen Quan Yi to create the Unifont source file "wqy.hex".

Definition in file [unibdf2hex.c](#).

### 5.9.2 Macro Definition Documentation

#### 5.9.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum allowable input file line length - 1.

Definition at line [37](#) of file [unibdf2hex.c](#).

#### 5.9.2.2 UNISTART

```
#define UNISTART 0x3400
```

First Unicode code point to examine.

Definition at line [34](#) of file [unibdf2hex.c](#).

#### 5.9.2.3 UNISTOP

```
#define UNISTOP 0x4DBF
```

Last Unicode code point to examine.

Definition at line [35](#) of file [unibdf2hex.c](#).

### 5.9.3 Function Documentation

## 5.9.3.1 main()

```
int main ( )
```

The main function.

Returns

Exit status is always 0 (successful termination).

Definition at line 46 of file [unibdf2hex.c](#).

```
00047 {
00048     int i;
00049     int digitsout; /* how many hex digits we output in a bitmap */
00050     int thispoint;
00051     char inbuf[MAXBUF];
00052     int bbxx, bbxy, bbxxoff, bbxyoff;
00053
00054     int descent=4; /* font descent wrt baseline */
00055     int startrow; /* row to start glyph */
00056     unsigned rowout;
00057
00058     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL) {
00059         if (strcmp (inbuf, "ENCODING ", 9) == 0) {
00060             sscanf (&inbuf[9], "%d", &thispoint); /* get code point */
00061             /*
00062             If we want this code point, get the BBX (bounding box) and
00063             BITMAP information.
00064             */
00065             if ((thispoint >= 0x2E80 && thispoint <= 0x2EFF) || /* CJK Radicals Supplement
00066                 (thispoint >= 0x2F00 && thispoint <= 0x2FDF) || /* Kangxi Radicals
00067                 (thispoint >= 0x2FF0 && thispoint <= 0x2FFF) || /* Ideographic Description Characters
00068                 (thispoint >= 0x3001 && thispoint <= 0x303F) || /* CJK Symbols and Punctuation (U+3000 is a space)
00069                 (thispoint >= 0x3100 && thispoint <= 0x312F) || /* Bopomofo
00070                 (thispoint >= 0x31A0 && thispoint <= 0x31BF) || /* Bopomofo extend
00071                 (thispoint >= 0x31C0 && thispoint <= 0x31EF) || /* CJK Strokes
00072                 (thispoint >= 0x3400 && thispoint <= 0x4DBF) || /* CJK Unified Ideographs Extension A
00073                 (thispoint >= 0x4E00 && thispoint <= 0x9FCF) || /* CJK Unified Ideographs
00074                 (thispoint >= 0xF900 && thispoint <= 0xFAFF)) /* CJK Compatibility Ideographs
00075             {
00076                 while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00077                     strcmp (inbuf, "BBX ", 4) != 0); /* find bounding box */
00078
00079                 sscanf (&inbuf[4], "%d %d %d %d", &bbxx, &bbxy, &bbxxoff, &bbxyoff);
00080                 while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00081                     strcmp (inbuf, "BITMAP", 6) != 0); /* find bitmap start */
00082                 fprintf (stdout, "%04X:", thispoint);
00083                 digitsout = 0;
00084                 /* Print initial blank rows */
00085                 startrow = descent + bbxyoff + bbxy;
00086
00087                 /* Force everything to 16 pixels wide */
00088                 for (i = 16; i > startrow; i--) {
00089                     fprintf (stdout, "0000");
00090                     digitsout += 4;
00091                 }
00092                 while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00093                     strcmp (inbuf, "END", 3) != 0) { /* copy bitmap until END */
00094                     sscanf (inbuf, "%X", &rowout);
00095                     /* Now force glyph to a 16x16 grid even if they'd fit in 8x16 */
00096                     if (bbxx <= 8) rowout <= 8; /* shift left for 16x16 glyph */
00097                     rowout >= bbxxoff;
00098                     fprintf (stdout, "%04X", rowout);
00099                     digitsout += 4;
00100                 }
00101
00102                 /* Pad for 16x16 glyph */
00103                 while (digitsout < 64) {
00104                     fprintf (stdout, "0000");
00105                     digitsout += 4;
00106                 }
00107                 fprintf (stdout, "\n");
00108             }
00109         }
00110     }
00111     exit (0);
00112 }
```

## 5.10 unibdf2hex.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unibdf2hex.c
00003
00004 @brief unibdf2hex - Convert a BDF file into a unifont.hex file
00005
00006 @author Paul Hardy, January 2008
00007
00008 @copyright Copyright (C) 2008, 2013 Paul Hardy
00009
00010 Note: currently this has hard-coded code points for glyphs extracted
00011 from Wen Quan Yi to create the Unifont source file "wqy.hex".
00012 */
00013 /*
00014 LICENSE:
00015
00016 This program is free software: you can redistribute it and/or modify
00017 it under the terms of the GNU General Public License as published by
00018 the Free Software Foundation, either version 2 of the License, or
00019 (at your option) any later version.
00020
00021 This program is distributed in the hope that it will be useful,
00022 but WITHOUT ANY WARRANTY; without even the implied warranty of
00023 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00024 GNU General Public License for more details.
00025
00026 You should have received a copy of the GNU General Public License
00027 along with this program. If not, see <http://www.gnu.org/licenses/>.
00028 */
00029
00030 #include <stdio.h>
00031 #include <stdlib.h>
00032 #include <string.h>
00033
00034 #define UNISTART 0x3400 ///< First Unicode code point to examine
00035 #define UNISTOP 0x4DBF ///< Last Unicode code point to examine
00036
00037 #define MAXBUF 256 ///< Maximum allowable input file line length - 1
00038
00039
00040 /**
00041 @brief The main function.
00042
00043 @return Exit status is always 0 (successful termination).
00044 */
00045 int
00046 main()
00047 {
00048     int i;
00049     int digitsout; /* how many hex digits we output in a bitmap */
00050     int thispoint;
00051     char inbuf[MAXBUF];
00052     int bbxx, bbxy, bbxxoff, bbxyoff;
00053
00054     int descent=4; /* font descent wrt baseline */
00055     int startrow; /* row to start glyph */
00056     unsigned rowout;
00057
00058     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL) {
00059         if (strcmp (inbuf, "ENCODING ", 9) == 0) {
00060             sscanf (&inbuf[9], "%d", &thispoint); /* get code point */
00061             /*
00062 If we want this code point, get the BBX (bounding box) and
00063 BITMAP information.
00064 */
00065             if ((thispoint >= 0x2E80 && thispoint <= 0x2EFF) || // CJK Radicals Supplement
00066                 (thispoint >= 0x2F00 && thispoint <= 0x2FDF) || // Kangxi Radicals
00067                 (thispoint >= 0x2FF0 && thispoint <= 0x2FFF) || // Ideographic Description Characters
00068                 (thispoint >= 0x3001 && thispoint <= 0x303F) || // CJK Symbols and Punctuation (U+3000 is a space)
00069                 (thispoint >= 0x3100 && thispoint <= 0x312F) || // Bopomofo
00070                 (thispoint >= 0x31A0 && thispoint <= 0x31BF) || // Bopomofo extend
00071                 (thispoint >= 0x31C0 && thispoint <= 0x31EF) || // CJK Strokes
00072                 (thispoint >= 0x3400 && thispoint <= 0x4DBF) || // CJK Unified Ideographs Extension A
00073                 (thispoint >= 0x4E00 && thispoint <= 0x9FCF) || // CJK Unified Ideographs
00074                 (thispoint >= 0xF900 && thispoint <= 0xFAFF)) // CJK Compatibility Ideographs
00075             {
00076                 while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00077                     strcmp (inbuf, "BBX ", 4) != 0); /* find bounding box */

```

```

00078
00079     sscanf (&inbuf[4], "%d %d %d %d", &bbxx, &bbxy, &bbxxoff, &bbxyoff);
00080     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00081             strcmp (inbuf, "BITMAP", 6) != 0); /* find bitmap start */
00082     fprintf (stdout, "%04X:", thispoint);
00083     digitsout = 0;
00084     /* Print initial blank rows */
00085     startrow = descent + bbxyoff + bbxy;
00086
00087     /* Force everything to 16 pixels wide */
00088     for (i = 16; i > startrow; i--) {
00089         fprintf (stdout, "0000");
00090         digitsout += 4;
00091     }
00092     while (fgets (inbuf, MAXBUF - 1, stdin) != NULL &&
00093             strcmp (inbuf, "END", 3) != 0) { /* copy bitmap until END */
00094         sscanf (inbuf, "%cX", &rowout);
00095         /* Now force glyph to a 16x16 grid even if they'd fit in 8x16 */
00096         if (bbxx <= 8) rowout <= 8; /* shift left for 16x16 glyph */
00097         rowout >= bbxxoff;
00098         fprintf (stdout, "%04X", rowout);
00099         digitsout += 4;
00100     }
00101
00102     /* Pad for 16x16 glyph */
00103     while (digitsout < 64) {
00104         fprintf (stdout, "0000");
00105         digitsout += 4;
00106     }
00107     fprintf (stdout, "\n");
00108 }
00109 }
00110 }
00111 exit (0);
00112 }

```

## 5.11 src/unibmp2hex.c File Reference

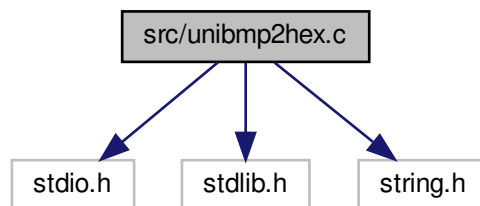
unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unibmp2hex.c:



## Macros

- `#define MAXBUF 256`  
Maximum input file line length - 1.

## Functions

- int `main` (int argc, char \*argv[])  
The main function.

## Variables

- unsigned `hexdigit` [16][4]  
32 bit representation of 16x8 0..F bitmap
- unsigned `uniplane` =0  
Unicode plane number, 0..0xff ff ff.
- unsigned `planeset` =0  
=1: use plane specified with -p parameter
- unsigned `flip` =0  
=1 if we're transposing glyph matrix
- unsigned `forcewide` =0  
=1 to set each glyph to 16 pixels wide
- unsigned `unidigit` [6][4]
- struct {  
  char `filetype` [2]  
  int `file_size`  
  int `image_offset`  
  int `info_size`  
  int `width`  
  int `height`  
  int `nplanes`  
  int `bits_per_pixel`  
  int `compression`  
  int `image_size`  
  int `x_ppm`  
  int `y_ppm`  
  int `ncolors`  
  int `important_colors`  
} `bmp_header`
- unsigned char `color_table` [256][4]

### 5.11.1 Detailed Description

unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a GNU Unifont hex glyph set of 256 characters

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Synopsis: unibmp2hex [-iin\_file.bmp] [-oout\_file.hex] [-phex\_page\_num] [-w]  
Definition in file [unibmp2hex.c](#).

### 5.11.2 Macro Definition Documentation

### 5.11.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum input file line length - 1.

Definition at line 104 of file [unibmp2hex.c](#).

## 5.11.3 Function Documentation

### 5.11.3.1 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 149 of file [unibmp2hex.c](#).

```
00150 {
00151
00152     int i, j, k; /* loop variables */
00153     unsigned char inchar; /* temporary input character */
00154     char header[MAXBUF]; /* input buffer for bitmap file header */
00155     int wbmp=0; /* =0 for Windows Bitmap (.bmp); 1 for Wireless Bitmap (.wbmp) */
00156     int fatal; /* =1 if a fatal error occurred */
00157     int match; /* =1 if we're still matching a pattern, 0 if no match */
00158     int empty1, empty2; /* =1 if bytes tested are all zeroes */
00159     unsigned char thischar1[16], thischar2[16]; /* bytes of hex char */
00160     unsigned char thischar0[16], thischar3[16]; /* bytes for quadruple-width */
00161     int thisrow; /* index to point into thischar1[] and thischar2[] */
00162     int tmpsum; /* temporary sum to see if a character is blank */
00163     unsigned this_pixel; /* color of one pixel, if > 1 bit per pixel */
00164     unsigned next_pixels; /* pending group of 8 pixels being read */
00165     unsigned color_mask = 0x00; /* to invert monochrome bitmap, set to 0xFF */
00166
00167     unsigned char bitmap[17*32][18*32/8]; /* final bitmap */
00168     /* For wide array:
00169     0 = don't force glyph to double-width;
00170     1 = force glyph to double-width;
00171     4 = force glyph to quadruple-width.
```



```

00172 */
00173 char wide[0x200000]={0x200000 * 0};
00174
00175 char *infile="", *outfile=""; /* names of input and output files */
00176 FILE *infp, *outfp; /* file pointers of input and output files */
00177
00178 if (argc > 1) {
00179     for (i = 1; i < argc; i++) {
00180         if (argv[i][0] == '-') { /* this is an option argument */
00181             switch (argv[i][1]) {
00182                 case 'i': /* name of input file */
00183                     infile = &argv[i][2];
00184                     break;
00185                 case 'o': /* name of output file */
00186                     outfile = &argv[i][2];
00187                     break;
00188                 case 'p': /* specify a Unicode plane */
00189                     sscanf (&argv[i][2], "%x", &uniplane); /* Get Unicode plane */
00190                     planeset = 1; /* Use specified range, not what's in bitmap */
00191                     break;
00192                 case 'w': /* force wide (16 pixels) for each glyph */
00193                     forcewide = 1;
00194                     break;
00195                 default: /* if unrecognized option, print list and exit */
00196                     fprintf (stderr, "\nSyntax:\n\n");
00197                     fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00198                     fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00199                     fprintf (stderr, " -w specifies .wbmp output instead of ");
00200                     fprintf (stderr, "default Windows .bmp output.\n\n");
00201                     fprintf (stderr, " -p is followed by 1 to 6 ");
00202                     fprintf (stderr, "Unicode plane hex digits ");
00203                     fprintf (stderr, "(default is Page 0).\n\n");
00204                     fprintf (stderr, "\nExample:\n\n");
00205                     fprintf (stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n\n",
00206                             argv[0]);
00207                     exit (1);
00208             }
00209         }
00210     }
00211 }
00212 /*
00213 Make sure we can open any I/O files that were specified before
00214 doing anything else.
00215 */
00216 if (strlen (infile) > 0) {
00217     if ((infp = fopen (infile, "r")) == NULL) {
00218         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00219         exit (1);
00220     }
00221 }
00222 else {
00223     infp = stdin;
00224 }
00225 if (strlen (outfile) > 0) {
00226     if ((outfp = fopen (outfile, "w")) == NULL) {
00227         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00228         exit (1);
00229     }
00230 }
00231 else {
00232     outfp = stdout;
00233 }
00234 /*
00235 Initialize selected code points for double width (16x16).
00236 Double-width is forced in cases where a glyph (usually a combining
00237 glyph) only occupies the left-hand side of a 16x16 grid, but must
00238 be rendered as double-width to appear properly with other glyphs
00239 in a given script. If additions were made to a script after
00240 Unicode 5.0, the Unicode version is given in parentheses after
00241 the script name.
00242 */
00243 for (i = 0x0700; i <= 0x074F; i++) wide[i] = 1; /* Syriac */
00244 for (i = 0x0800; i <= 0x083F; i++) wide[i] = 1; /* Samaritan (5.2) */
00245 for (i = 0x0900; i <= 0x0DFF; i++) wide[i] = 1; /* Indic */
00246 for (i = 0x1000; i <= 0x109F; i++) wide[i] = 1; /* Myanmar */
00247 for (i = 0x1100; i <= 0x11FF; i++) wide[i] = 1; /* Hangul Jamo */
00248 for (i = 0x1400; i <= 0x167F; i++) wide[i] = 1; /* Canadian Aboriginal */
00249 for (i = 0x1700; i <= 0x171F; i++) wide[i] = 1; /* Tagalog */
00250 for (i = 0x1720; i <= 0x173F; i++) wide[i] = 1; /* Hanunoo */
00251 for (i = 0x1740; i <= 0x175F; i++) wide[i] = 1; /* Buhid */
00252 for (i = 0x1760; i <= 0x177F; i++) wide[i] = 1; /* Tagbanwa */

```

```

00253 for (i = 0x1780; i <= 0x17FF; i++) wide[i] = 1; /* Khmer */
00254 for (i = 0x18B0; i <= 0x18FF; i++) wide[i] = 1; /* Ext. Can. Aboriginal */
00255 for (i = 0x1800; i <= 0x18AF; i++) wide[i] = 1; /* Mongolian */
00256 for (i = 0x1900; i <= 0x194F; i++) wide[i] = 1; /* Limbu */
00257 // for (i = 0x1980; i <= 0x19DF; i++) wide[i] = 1; /* New Tai Lue */
00258 for (i = 0x1A00; i <= 0x1A1F; i++) wide[i] = 1; /* Buginese */
00259 for (i = 0x1A20; i <= 0x1AAF; i++) wide[i] = 1; /* Tai Tham (5.2) */
00260 for (i = 0x1B00; i <= 0x1B7F; i++) wide[i] = 1; /* Balinese */
00261 for (i = 0x1B80; i <= 0x1BBF; i++) wide[i] = 1; /* Sundanese (5.1) */
00262 for (i = 0x1BC0; i <= 0x1BFF; i++) wide[i] = 1; /* Batak (6.0) */
00263 for (i = 0x1C00; i <= 0x1C4F; i++) wide[i] = 1; /* Lepcha (5.1) */
00264 for (i = 0x1CC0; i <= 0x1CCF; i++) wide[i] = 1; /* Sundanese Supplement */
00265 for (i = 0x1CD0; i <= 0x1CFF; i++) wide[i] = 1; /* Vedic Extensions (5.2) */
00266 wide[0x2329] = wide[0x232A] = 1; /* Left- & Right-pointing Angle Brackets */
00267 for (i = 0x2E80; i <= 0xA4CF; i++) wide[i] = 1; /* CJK */
00268 // for (i = 0x9FD8; i <= 0x9FE9; i++) wide[i] = 4; /* CJK quadruple-width */
00269 for (i = 0xA900; i <= 0xA92F; i++) wide[i] = 1; /* Kayah Li (5.1) */
00270 for (i = 0xA930; i <= 0xA95F; i++) wide[i] = 1; /* Rejang (5.1) */
00271 for (i = 0xA960; i <= 0xA97F; i++) wide[i] = 1; /* Hangul Jamo Extended-A */
00272 for (i = 0xA980; i <= 0xA9DF; i++) wide[i] = 1; /* Javanese (5.2) */
00273 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham (5.1) */
00274 for (i = 0xA9E0; i <= 0xA9FF; i++) wide[i] = 1; /* Myanmar Extended-B */
00275 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham */
00276 for (i = 0xAA60; i <= 0xAA7F; i++) wide[i] = 1; /* Myanmar Extended-A */
00277 for (i = 0xAAE0; i <= 0xA AFF; i++) wide[i] = 1; /* Meetei Mayek Ext (6.0) */
00278 for (i = 0xABC0; i <= 0xABFF; i++) wide[i] = 1; /* Meetei Mayek (5.2) */
00279 for (i = 0xAC00; i <= 0xD7AF; i++) wide[i] = 1; /* Hangul Syllables */
00280 for (i = 0xD7B0; i <= 0xD7FF; i++) wide[i] = 1; /* Hangul Jamo Extended-B */
00281 for (i = 0xF900; i <= 0xFAFF; i++) wide[i] = 1; /* CJK Compatibility */
00282 for (i = 0xFE10; i <= 0xFE1F; i++) wide[i] = 1; /* Vertical Forms */
00283 for (i = 0xFE30; i <= 0xFE60; i++) wide[i] = 1; /* CJK Compatibility Forms */
00284 for (i = 0xFFE0; i <= 0xFFE6; i++) wide[i] = 1; /* CJK Compatibility Forms */
00285
00286 wide[0x303F] = 0; /* CJK half-space fill */
00287
00288 /* Supplemental Multilingual Plane (Plane 01) */
00289 for (i = 0x010A00; i <= 0x010A5F; i++) wide[i] = 1; /* Kharoshthi */
00290 for (i = 0x011000; i <= 0x01107F; i++) wide[i] = 1; /* Brahmi */
00291 for (i = 0x011080; i <= 0x0110CF; i++) wide[i] = 1; /* Kaithi */
00292 for (i = 0x011100; i <= 0x01114F; i++) wide[i] = 1; /* Chakma */
00293 for (i = 0x011180; i <= 0x0111DF; i++) wide[i] = 1; /* Sharada */
00294 for (i = 0x011200; i <= 0x01124F; i++) wide[i] = 1; /* Khojki */
00295 for (i = 0x0112B0; i <= 0x0112FF; i++) wide[i] = 1; /* Khudawadi */
00296 for (i = 0x011300; i <= 0x01137F; i++) wide[i] = 1; /* Grantha */
00297 for (i = 0x011400; i <= 0x01147F; i++) wide[i] = 1; /* Newa */
00298 for (i = 0x011480; i <= 0x0114DF; i++) wide[i] = 1; /* Tirhuta */
00299 for (i = 0x011580; i <= 0x0115FF; i++) wide[i] = 1; /* Siddham */
00300 for (i = 0x011600; i <= 0x01165F; i++) wide[i] = 1; /* Modi */
00301 for (i = 0x011660; i <= 0x01167F; i++) wide[i] = 1; /* Mongolian Suppl. */
00302 for (i = 0x011680; i <= 0x0116CF; i++) wide[i] = 1; /* Takri */
00303 for (i = 0x011700; i <= 0x01173F; i++) wide[i] = 1; /* Ahom */
00304 for (i = 0x011800; i <= 0x01184F; i++) wide[i] = 1; /* Dogra */
00305 for (i = 0x011900; i <= 0x01195F; i++) wide[i] = 1; /* Dives Akuru */
00306 for (i = 0x0119A0; i <= 0x0119FF; i++) wide[i] = 1; /* Nandinagari */
00307 for (i = 0x011A00; i <= 0x011A4F; i++) wide[i] = 1; /* Zanabazar Square */
00308 for (i = 0x011A50; i <= 0x011AAF; i++) wide[i] = 1; /* Soyombo */
00309 for (i = 0x011B00; i <= 0x011B5F; i++) wide[i] = 1; /* Devanagari Extended-A */
00310 for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi */
00311 for (i = 0x011C00; i <= 0x011C6F; i++) wide[i] = 1; /* Bhaiksuki */
00312 for (i = 0x011C70; i <= 0x011CBF; i++) wide[i] = 1; /* Marchen */
00313 for (i = 0x011D00; i <= 0x011D5F; i++) wide[i] = 1; /* Masaram Gondi */
00314 for (i = 0x011EE0; i <= 0x011EFF; i++) wide[i] = 1; /* Makasar */
00315 for (i = 0x012F90; i <= 0x012FFF; i++) wide[i] = 1; /* Cypro-Minoan */
00316 /* Make Bassa Vah all single width or all double width */
00317 for (i = 0x016AD0; i <= 0x016AFF; i++) wide[i] = 1; /* Bassa Vah */
00318 for (i = 0x016B00; i <= 0x016B8F; i++) wide[i] = 1; /* Pahawh Hmong */
00319 for (i = 0x016F00; i <= 0x016F9F; i++) wide[i] = 1; /* Miao */
00320 for (i = 0x016FE0; i <= 0x016FFF; i++) wide[i] = 1; /* Ideograph Sym/Punct */
00321 for (i = 0x017000; i <= 0x0187FF; i++) wide[i] = 1; /* Tangut */
00322 for (i = 0x018800; i <= 0x018AFF; i++) wide[i] = 1; /* Tangut Components */
00323 for (i = 0x01AFF0; i <= 0x01AFFF; i++) wide[i] = 1; /* Kana Extended-B */
00324 for (i = 0x01B000; i <= 0x01B0FF; i++) wide[i] = 1; /* Kana Supplement */
00325 for (i = 0x01B100; i <= 0x01B12F; i++) wide[i] = 1; /* Kana Extended-A */
00326 for (i = 0x01B170; i <= 0x01B2FF; i++) wide[i] = 1; /* Nushu */
00327 for (i = 0x01CF00; i <= 0x01CFCF; i++) wide[i] = 1; /* Znamenny Musical */
00328 for (i = 0x01D100; i <= 0x01D1FF; i++) wide[i] = 1; /* Musical Symbols */
00329 for (i = 0x01D800; i <= 0x01DAAF; i++) wide[i] = 1; /* Sutton SignWriting */
00330 for (i = 0x01E2C0; i <= 0x01E2FF; i++) wide[i] = 1; /* Wancho */
00331 for (i = 0x01E800; i <= 0x01E8DF; i++) wide[i] = 1; /* Mende Kikakui */
00332 for (i = 0x01F200; i <= 0x01F2FF; i++) wide[i] = 1; /* Encl Ideograp Suppl */
00333 wide[0x01F5E7] = 1; /* Three Rays Right */

```

```

00334
00335  /*
00336 Determine whether or not the file is a Microsoft Windows Bitmap file.
00337 If it starts with 'B', 'M', assume it's a Windows Bitmap file.
00338 Otherwise, assume it's a Wireless Bitmap file.
00339
00340 WARNING: There isn't much in the way of error checking here --
00341 if you give it a file that wasn't first created by hex2bmp.c,
00342 all bets are off.
00343 */
00344 fatal = 0; /* assume everything is okay with reading input file */
00345 if ((header[0] = fgetc (infp)) != EOF) {
00346     if ((header[1] = fgetc (infp)) != EOF) {
00347         if (header[0] == 'B' && header[1] == 'M') {
00348             wbmp = 0; /* Not a Wireless Bitmap -- it's a Windows Bitmap */
00349         }
00350         else {
00351             wbmp = 1; /* Assume it's a Wireless Bitmap */
00352         }
00353     }
00354     else
00355         fatal = 1;
00356 }
00357 else
00358     fatal = 1;
00359
00360 if (fatal) {
00361     fprintf (stderr, "Fatal error; end of input file.\n\n");
00362     exit (1);
00363 }
00364 /*
00365 If this is a Wireless Bitmap (.wbmp) format file,
00366 skip the header and point to the start of the bitmap itself.
00367 */
00368 if (wbmp) {
00369     for (i=2; i<6; i++)
00370         header[i] = fgetc (infp);
00371     /*
00372 Now read the bitmap.
00373 */
00374     for (i=0; i < 32*17; i++) {
00375         for (j=0; j < 32*18/8; j++) {
00376             inchar = fgetc (infp);
00377             bitmap[i][j] = ~inchar; /* invert bits for proper color */
00378         }
00379     }
00380 }
00381 /*
00382 Otherwise, treat this as a Windows Bitmap file, because we checked
00383 that it began with "BM". Save the header contents for future use.
00384 Expect a 14 byte standard BITMAPFILEHEADER format header followed
00385 by a 40 byte standard BITMAPINFOHEADER Device Independent Bitmap
00386 header, with data stored in little-endian format.
00387 */
00388 else {
00389     for (i = 2; i < 54; i++)
00390         header[i] = fgetc (infp);
00391
00392     bmp_header.filetype[0] = 'B';
00393     bmp_header.filetype[1] = 'M';
00394
00395     bmp_header.file_size =
00396         (header[2] & 0xFF) | ((header[3] & 0xFF) << 8) |
00397         ((header[4] & 0xFF) << 16) | ((header[5] & 0xFF) << 24);
00398
00399     /* header bytes 6..9 are reserved */
00400
00401     bmp_header.image_offset =
00402         (header[10] & 0xFF) | ((header[11] & 0xFF) << 8) |
00403         ((header[12] & 0xFF) << 16) | ((header[13] & 0xFF) << 24);
00404
00405     bmp_header.info_size =
00406         (header[14] & 0xFF) | ((header[15] & 0xFF) << 8) |
00407         ((header[16] & 0xFF) << 16) | ((header[17] & 0xFF) << 24);
00408
00409     bmp_header.width =
00410         (header[18] & 0xFF) | ((header[19] & 0xFF) << 8) |
00411         ((header[20] & 0xFF) << 16) | ((header[21] & 0xFF) << 24);
00412
00413     bmp_header.height =
00414         (header[22] & 0xFF) | ((header[23] & 0xFF) << 8) |

```

```

00415     ((header[24] & 0xFF) << 16) | ((header[25] & 0xFF) << 24);
00416
00417     bmp_header.nplanes =
00418     (header[26] & 0xFF) | ((header[27] & 0xFF) << 8);
00419
00420     bmp_header.bits_per_pixel =
00421     (header[28] & 0xFF) | ((header[29] & 0xFF) << 8);
00422
00423     bmp_header.compression =
00424     (header[30] & 0xFF) | ((header[31] & 0xFF) << 8) |
00425     ((header[32] & 0xFF) << 16) | ((header[33] & 0xFF) << 24);
00426
00427     bmp_header.image_size =
00428     (header[34] & 0xFF) | ((header[35] & 0xFF) << 8) |
00429     ((header[36] & 0xFF) << 16) | ((header[37] & 0xFF) << 24);
00430
00431     bmp_header.x_ppm =
00432     (header[38] & 0xFF) | ((header[39] & 0xFF) << 8) |
00433     ((header[40] & 0xFF) << 16) | ((header[41] & 0xFF) << 24);
00434
00435     bmp_header.y_ppm =
00436     (header[42] & 0xFF) | ((header[43] & 0xFF) << 8) |
00437     ((header[44] & 0xFF) << 16) | ((header[45] & 0xFF) << 24);
00438
00439     bmp_header.ncolors =
00440     (header[46] & 0xFF) | ((header[47] & 0xFF) << 8) |
00441     ((header[48] & 0xFF) << 16) | ((header[49] & 0xFF) << 24);
00442
00443     bmp_header.important_colors =
00444     (header[50] & 0xFF) | ((header[51] & 0xFF) << 8) |
00445     ((header[52] & 0xFF) << 16) | ((header[53] & 0xFF) << 24);
00446
00447     if (bmp_header.ncolors == 0)
00448         bmp_header.ncolors = 1 << bmp_header.bits_per_pixel;
00449
00450     /* If a Color Table exists, read it */
00451     if (bmp_header.ncolors > 0 && bmp_header.bits_per_pixel <= 8) {
00452         for (i = 0; i < bmp_header.ncolors; i++) {
00453             color_table[i][0] = fgetc (infp); /* Red */
00454             color_table[i][1] = fgetc (infp); /* Green */
00455             color_table[i][2] = fgetc (infp); /* Blue */
00456             color_table[i][3] = fgetc (infp); /* Alpha */
00457         }
00458     }
00459     /* Determine from the first color table entry whether we
00460     are inverting the resulting bitmap image.
00461     */
00462     if ( ( color_table[0][0] + color_table[0][1] + color_table[0][2] )
00463         < ( 3 * 128 ) ) {
00464         color_mask = 0xFF;
00465     }
00466 }
00467
00468 #ifdef DEBUG
00469
00470     /*
00471     Print header info for possibly adding support for
00472     additional file formats in the future, to determine
00473     how the bitmap is encoded.
00474     */
00475     fprintf (stderr, "Filetype: '%c%c'\n",
00476             bmp_header.filetype[0], bmp_header.filetype[1]);
00477     fprintf (stderr, "File Size: %d\n", bmp_header.file_size);
00478     fprintf (stderr, "Image Offset: %d\n", bmp_header.image_offset);
00479     fprintf (stderr, "Info Header Size: %d\n", bmp_header.info_size);
00480     fprintf (stderr, "Image Width: %d\n", bmp_header.width);
00481     fprintf (stderr, "Image Height: %d\n", bmp_header.height);
00482     fprintf (stderr, "Number of Planes: %d\n", bmp_header.nplanes);
00483     fprintf (stderr, "Bits per Pixel: %d\n", bmp_header.bits_per_pixel);
00484     fprintf (stderr, "Compression Method: %d\n", bmp_header.compression);
00485     fprintf (stderr, "Image Size: %d\n", bmp_header.image_size);
00486     fprintf (stderr, "X Pixels per Meter: %d\n", bmp_header.x_ppm);
00487     fprintf (stderr, "Y Pixels per Meter: %d\n", bmp_header.y_ppm);
00488     fprintf (stderr, "Number of Colors: %d\n", bmp_header.ncolors);
00489     fprintf (stderr, "Important Colors: %d\n", bmp_header.important_colors);
00490
00491 #endif
00492
00493     /*
00494     Now read the bitmap.
00495     */

```

```

00496     for (i = 32*17-1; i >= 0; i--) {
00497         for (j=0; j < 32*18/8; j++) {
00498             next_pixels = 0x00; /* initialize next group of 8 pixels */
00499             /* Read a monochrome image -- the original case */
00500             if (bmp_header.bits_per_pixel == 1) {
00501                 next_pixels = fgetc (infp);
00502             }
00503             /* Read a 32 bit per pixel RGB image; convert to monochrome */
00504             else if ( bmp_header.bits_per_pixel == 24 ||
00505                      bmp_header.bits_per_pixel == 32) {
00506                 next_pixels = 0;
00507                 for (k = 0; k < 8; k++) { /* get next 8 pixels */
00508                     this_pixel = (fgetc (infp) & 0xFF) +
00509                                 (fgetc (infp) & 0xFF) +
00510                                 (fgetc (infp) & 0xFF);
00511
00512                     if (bmp_header.bits_per_pixel == 32) {
00513                         (void) fgetc (infp); /* ignore alpha value */
00514                     }
00515
00516                     /* convert RGB color space to monochrome */
00517                     if (this_pixel >= (128 * 3))
00518                         this_pixel = 0;
00519                     else
00520                         this_pixel = 1;
00521
00522                     /* shift next pixel color into place for 8 pixels total */
00523                     next_pixels = (next_pixels << 1) | this_pixel;
00524                 }
00525             }
00526             if (bmp_header.height < 0) { /* Bitmap drawn top to bottom */
00527                 bitmap [(32*17-1) - i][j] = next_pixels;
00528             }
00529             else { /* Bitmap drawn bottom to top */
00530                 bitmap [i][j] = next_pixels;
00531             }
00532         }
00533     }
00534
00535     /*
00536     If any bits are set in color_mask, apply it to
00537     entire bitmap to invert black <--> white.
00538     */
00539     if (color_mask != 0x00) {
00540         for (i = 32*17-1; i >= 0; i--) {
00541             for (j=0; j < 32*18/8; j++) {
00542                 bitmap [i][j] ^= color_mask;
00543             }
00544         }
00545     }
00546
00547 }
00548
00549 /*
00550 We've read the entire file. Now close the input file pointer.
00551 */
00552 fclose (infp);
00553 /*
00554 We now have the header portion in the header[] array,
00555 and have the bitmap portion from top-to-bottom in the bitmap[] array.
00556 */
00557 /*
00558 If no Unicode range (U+nnnnnn00 through U+nnnnnnFF) was specified
00559 with a -p parameter, determine the range from the digits in the
00560 bitmap itself.
00561
00562 Store bitmaps for the hex digit patterns that this file uses.
00563 */
00564 if (!planeset) { /* If Unicode range not specified with -p parameter */
00565     for (i = 0x0; i <= 0xF; i++) { /* hex digit pattern we're storing */
00566         for (j = 0; j < 4; j++) {
00567             hexdigit[i][j] =
00568                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 ] [6] << 24 ) |
00569                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 1] [6] << 16 ) |
00570                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 2] [6] << 8 ) |
00571                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 3] [6] );
00572         }
00573     }
00574     /*
00575     Read the Unicode plane digits into arrays for comparison, to
00576     determine the upper four hex digits of the glyph addresses.

```

```

00577 */
00578 for (i = 0; i < 4; i++) {
00579     for (j = 0; j < 4; j++) {
00580         unidigit[i][j] =
00581             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 1][i + 3] << 24 ) |
00582             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 2][i + 3] << 16 ) |
00583             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 3][i + 3] << 8 ) |
00584             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 4][i + 3] );
00585     }
00586 }
00587
00588 tmpsum = 0;
00589 for (i = 4; i < 6; i++) {
00590     for (j = 0; j < 4; j++) {
00591         unidigit[i][j] =
00592             ((unsigned)bitmap[32 * 1 + 4 * j + 8 ][i] << 24 ) |
00593             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 1][i] << 16 ) |
00594             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 2][i] << 8 ) |
00595             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 3][i] );
00596         tmpsum |= unidigit[i][j];
00597     }
00598 }
00599 if (tmpsum == 0) { /* the glyph matrix is transposed */
00600     flip = 1; /* note transposed order for processing glyphs in matrix */
00601     /*
00602     Get 5th and 6th hex digits by shifting first column header left by
00603     1.5 columns, thereby shifting the hex digit right after the leading
00604     "U+nnnn" page number.
00605     */
00606     for (i = 0x08; i < 0x18; i++) {
00607         bitmap[i][7] = (bitmap[i][8] << 4) | ((bitmap[i][9] >> 4) & 0xf);
00608         bitmap[i][8] = (bitmap[i][9] << 4) | ((bitmap[i][10] >> 4) & 0xf);
00609     }
00610     for (i = 4; i < 6; i++) {
00611         for (j = 0; j < 4; j++) {
00612             unidigit[i][j] =
00613                 ((unsigned)bitmap[4 * j + 8 + 1][i + 3] << 24 ) |
00614                 ((unsigned)bitmap[4 * j + 8 + 2][i + 3] << 16 ) |
00615                 ((unsigned)bitmap[4 * j + 8 + 3][i + 3] << 8 ) |
00616                 ((unsigned)bitmap[4 * j + 8 + 4][i + 3] );
00617         }
00618     }
00619 }
00620
00621 /*
00622 Now determine the Unicode plane by comparing unidigit[0..5] to
00623 the hexdigit[0x0..0xF] array.
00624 */
00625 uniplane = 0;
00626 for (i=0; i<6; i++) { /* go through one bitmap digit at a time */
00627     match = 0; /* haven't found pattern yet */
00628     for (j = 0x0; !match && j <= 0xF; j++) {
00629         if (unidigit[i][0] == hexdigit[j][0] &&
00630             unidigit[i][1] == hexdigit[j][1] &&
00631             unidigit[i][2] == hexdigit[j][2] &&
00632             unidigit[i][3] == hexdigit[j][3]) { /* we found the digit */
00633             uniplane |= j;
00634             match = 1;
00635         }
00636     }
00637     uniplane <<= 4;
00638 }
00639 uniplane >= 4;
00640 }
00641 /*
00642 Now read each glyph and print it as hex.
00643 */
00644 for (i = 0x0; i <= 0xf; i++) {
00645     for (j = 0x0; j <= 0xf; j++) {
00646         for (k = 0; k < 16; k++) {
00647             if (flip) { /* transpose glyph matrix */
00648                 thischar0[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) ];
00649                 thischar1[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 1];
00650                 thischar2[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 2];
00651                 thischar3[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 3];
00652             }
00653             else {
00654                 thischar0[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) ];
00655                 thischar1[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 1];
00656                 thischar2[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 2];
00657                 thischar3[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 3];

```

```

00658     }
00659   }
00660   /*
00661   If the second half of the 16*16 character is all zeroes, this
00662   character is only 8 bits wide, so print a half-width character.
00663   */
00664   empty1 = empty2 = 1;
00665   for (k=0; (empty1 || empty2) && k < 16; k++) {
00666     if (thischar1[k] != 0) empty1 = 0;
00667     if (thischar2[k] != 0) empty2 = 0;
00668   }
00669   /*
00670   Only print this glyph if it isn't blank.
00671   */
00672   if (!empty1 || !empty2) {
00673     /*
00674     If the second half is empty, this is a half-width character.
00675     Only print the first half.
00676     */
00677     /*
00678     Original GNU Unifont format is four hexadecimal digit character
00679     code followed by a colon followed by a hex string. Add support
00680     for codes beyond the Basic Multilingual Plane.
00681
00682     Unicode ranges from U+0000 to U+10FFFF, so print either a
00683     4-digit or a 6-digit code point. Note that this software
00684     should support up to an 8-digit code point, extending beyond
00685     the normal Unicode range, but this has not been fully tested.
00686     */
00687     if (uniplane > 0xff)
00688       fprintf (outfp, "%04X%X%X:", uniplane, i, j); // 6 digit code pt.
00689     else
00690       fprintf (outfp, "%02X%X%X:", uniplane, i, j); // 4 digit code pt.
00691     for (thisrow=0; thisrow<16; thisrow++) {
00692       /*
00693       If second half is empty and we're not forcing this
00694       code point to double width, print as single width.
00695       */
00696       if (!forcewide &&
00697         empty2 && !wide[(uniplane « 8) | (i « 4) | j]) {
00698         fprintf (outfp,
00699           "%02X",
00700           thischar1[thisrow]);
00701       }
00702       else if (wide[(uniplane « 8) | (i « 4) | j] == 4) {
00703         /* quadruple-width; force 32nd pixel to zero */
00704         fprintf (outfp,
00705           "%02X%02X%02X%02X",
00706           thischar0[thisrow], thischar1[thisrow],
00707           thischar2[thisrow], thischar3[thisrow] & 0xFE);
00708       }
00709       else { /* treat as double-width */
00710         fprintf (outfp,
00711           "%02X%02X",
00712           thischar1[thisrow], thischar2[thisrow]);
00713       }
00714     }
00715     fprintf (outfp, "\n");
00716   }
00717 }
00718 }
00719 exit (0);
00720 }

```

## 5.11.4 Variable Documentation

### 5.11.4.1 bits\_per\_pixel

int bits\_per\_pixel

Definition at line 127 of file [unibmp2hex.c](#).

## 5.11.4.2

struct { ... } bmp\_header  
Bitmap Header parameters

## 5.11.4.3 color\_table

unsigned char color\_table[256][4]  
Bitmap Color [Table](#) – maximum of 256 colors in a BMP file  
Definition at line [137](#) of file [unibmp2hex.c](#).

## 5.11.4.4 compression

int compression  
Definition at line [128](#) of file [unibmp2hex.c](#).

## 5.11.4.5 file\_size

int file\_size  
Definition at line [121](#) of file [unibmp2hex.c](#).

## 5.11.4.6 filetype

char filetype[2]  
Definition at line [120](#) of file [unibmp2hex.c](#).

## 5.11.4.7 flip

unsigned flip =0  
=1 if we're transposing glyph matrix  
Definition at line [111](#) of file [unibmp2hex.c](#).

## 5.11.4.8 forcewide

unsigned forcewide =0  
=1 to set each glyph to 16 pixels wide  
Definition at line [112](#) of file [unibmp2hex.c](#).

## 5.11.4.9 height

int height  
Definition at line [125](#) of file [unibmp2hex.c](#).

## 5.11.4.10 hexdigit

unsigned hexdigit[16][4]  
32 bit representation of 16x8 0..F bitmap  
Definition at line [107](#) of file [unibmp2hex.c](#).



#### 5.11.4.11 image\_offset

int image\_offset

Definition at line 122 of file [unibmp2hex.c](#).

#### 5.11.4.12 image\_size

int image\_size

Definition at line 129 of file [unibmp2hex.c](#).

#### 5.11.4.13 important\_colors

int important\_colors

Definition at line 133 of file [unibmp2hex.c](#).

#### 5.11.4.14 info\_size

int info\_size

Definition at line 123 of file [unibmp2hex.c](#).

#### 5.11.4.15 ncolors

int ncolors

Definition at line 132 of file [unibmp2hex.c](#).

#### 5.11.4.16 nplanes

int nplanes

Definition at line 126 of file [unibmp2hex.c](#).

#### 5.11.4.17 planeset

unsigned planeset =0

=1: use plane specified with -p parameter

Definition at line 110 of file [unibmp2hex.c](#).

#### 5.11.4.18 unidigit

unsigned unidigit[6][4]

The six Unicode plane digits, from left-most (0) to right-most (5)

Definition at line 115 of file [unibmp2hex.c](#).

#### 5.11.4.19 uniplane

unsigned uniplane =0

Unicode plane number, 0..0xff ff ff.

Definition at line 109 of file [unibmp2hex.c](#).

## 5.11.4.20 width

int width

Definition at line 124 of file [unibmp2hex.c](#).

## 5.11.4.21 x\_ppm

int x\_ppm

Definition at line 130 of file [unibmp2hex.c](#).

## 5.11.4.22 y\_ppm

int y\_ppm

Definition at line 131 of file [unibmp2hex.c](#).

## 5.12 unibmp2hex.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unibmp2hex.c
00003
00004 @brief unibmp2hex - Turn a .bmp or .wbmp glyph matrix into a
00005 GNU Unifont hex glyph set of 256 characters
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009 @copyright Copyright (C) 2007, 2008, 2013, 2017, 2019, 2022 Paul Hardy
00010
00011 Synopsis: unibmp2hex [-iin_file.bmp] [-oout_file.hex] [-phex_page_num] [-w]
00012 */
00013 /*
00014
00015 LICENSE:
00016
00017 This program is free software: you can redistribute it and/or modify
00018 it under the terms of the GNU General Public License as published by
00019 the Free Software Foundation, either version 2 of the License, or
00020 (at your option) any later version.
00021
00022 This program is distributed in the hope that it will be useful,
00023 but WITHOUT ANY WARRANTY; without even the implied warranty of
00024 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00025 GNU General Public License for more details.
00026
00027 You should have received a copy of the GNU General Public License
00028 along with this program. If not, see <http://www.gnu.org/licenses/>.
00029 */
00030
00031 /*
00032 6 September 2021 [Paul Hardy]:
00033 - Set U+12F90..U+12FFF (Cypro-Minoan) to be double width.
00034 - Set U+1CF00..U+1CFCF (Znamenny Musical Notation) to be double width.
00035 - Set U+1AFF0..U+1AFFF (Kana Extended-B) to be double width.
00036
00037 20 June 2017 [Paul Hardy]:
00038 - Modify to allow hard-coding of quadruple-width hex glyphs.
00039 The 32nd column (rightmost column) is cleared to zero, because
00040 that column contains the vertical cell border.
00041 - Set U+9FD8..U+9FE9 (complex CJK) to be quadruple-width.
00042 - Set U+011A00..U+011A4F (Masaram Gondi, non-digits) to be wide.
00043 - Set U+011A50..U+011AAF (Soyombo) to be wide.
00044
00045 8 July 2017 [Paul Hardy]:
00046 - All CJK glyphs in the range U+4E00..u+9FFF are double width
00047 again; commented out the line that sets U+9FD8..U+9FE9 to be
00048 quadruple width.
00049
00050 6 August 2017 [Paul Hardy]:
00051 - Remove hard-coding of U+01D200..U+01D24F Ancient Greek Musical
00052 Notation to double-width; allow range to be dual-width.

```

```

00053
00054 12 August 2017 [Paul Hardy]:
00055 - Remove Miao script from list of wide scripts, so it can contain
00056 single-width glyphs.
00057
00058 26 December 2017 Paul Hardy:
00059 - Removed Tibetan from list of wide scripts, so it can contain
00060 single-width glyphs.
00061 - Added a number of scripts to be explicitly double-width in case
00062 they are redrawn.
00063 - Added Miao script back as wide, because combining glyphs are
00064 added back to font/plane01/plane01-combining.txt.
00065
00066 05 June 2018 Paul Hardy:
00067 - Made U+2329] and U+232A wide.
00068 - Added to wide settings for CJK Compatibility Forms over entire range.
00069 - Made Kayah Li script double-width.
00070 - Made U+232A (Right-pointing Angle Bracket) double-width.
00071 - Made U+01F5E7 (Three Rays Right) double-width.
00072
00073 July 2018 Paul Hardy:
00074 - Changed 2017 to 2018 in previous change entry.
00075 - Added Dogra (U+011800..U+01184F) as double width.
00076 - Added Makasar (U+011EE0..U+011EFF) as double width.
00077
00078 23 February 2019 [Paul Hardy]:
00079 - Set U+119A0..U+119FF (Nandinagari) to be wide.
00080 - Set U+1E2C0..U+1E2FF (Wancho) to be wide.
00081
00082 25 May 2019 [Paul Hardy]:
00083 - Added support for the case when the original .bmp monochrome
00084 file has been converted to a 32 bit per pixel RGB file.
00085 - Added support for bitmap images stored from either top to bottom
00086 or bottom to top.
00087 - Add DEBUG compile flag to print header information, to ease
00088 adding support for additional bitmap formats in the future.
00089
00090 13 March 2022 [Paul Hardy]:
00091 - Added support for 24 bits per pixel RGB file.
00092
00093 12 June 2022 [Paul Hardy]:
00094 - Set U+11B00..U+11B5F (Devanagari Extended-A) to be wide.
00095 - Set U+11F00..U+11F5F (Kawi) to be wide.
00096
00097
00098 */
00099
00100 #include <stdio.h>
00101 #include <stdlib.h>
00102 #include <string.h>
00103
00104 #define MAXBUF 256 ///< Maximum input file line length - 1
00105
00106
00107 unsigned hexdigit[16][4]; ///< 32 bit representation of 16x8 0..F bitmap
00108
00109 unsigned uniplane=0; ///< Unicode plane number, 0..0xff ff
00110 unsigned planeset=0; ///< =1: use plane specified with -p parameter
00111 unsigned flip=0; ///< =1 if we're transposing glyph matrix
00112 unsigned forcewidth=0; ///< =1 to set each glyph to 16 pixels wide
00113
00114 /** The six Unicode plane digits, from left-most (0) to right-most (5) */
00115 unsigned unidigit[6][4];
00116
00117
00118 /** Bitmap Header parameters */
00119 struct {
00120 char filetype[2];
00121 int file_size;
00122 int image_offset;
00123 int info_size;
00124 int width;
00125 int height;
00126 int nplanes;
00127 int bits_per_pixel;
00128 int compression;
00129 int image_size;
00130 int x_ppm;
00131 int y_ppm;
00132 int ncolors;
00133 int important_colors;

```

```

00134 } bmp_header;
00135
00136 /** Bitmap Color Table -- maximum of 256 colors in a BMP file */
00137 unsigned char color_table[256][4]; /* R, G, B, alpha for up to 256 colors */
00138
00139 // #define DEBUG
00140
00141 /**
00142 @brief The main function.
00143
00144 @param[in] argc The count of command line arguments.
00145 @param[in] argv Pointer to array of command line arguments.
00146 @return This program exits with status 0.
00147 */
00148 int
00149 main (int argc, char *argv[])
00150 {
00151
00152     int i, j, k; /* loop variables */
00153     unsigned char inchar; /* temporary input character */
00154     char header[MAXBUF]; /* input buffer for bitmap file header */
00155     int wbmp=0; /* =0 for Windows Bitmap (.bmp); 1 for Wireless Bitmap (.wbmp) */
00156     int fatal; /* =1 if a fatal error occurred */
00157     int match; /* =1 if we're still matching a pattern, 0 if no match */
00158     int empty1, empty2; /* =1 if bytes tested are all zeroes */
00159     unsigned char thischar1[16], thischar2[16]; /* bytes of hex char */
00160     unsigned char thischar0[16], thischar3[16]; /* bytes for quadruple-width */
00161     int thisrow; /* index to point into thischar1[] and thischar2[] */
00162     int tmpsum; /* temporary sum to see if a character is blank */
00163     unsigned this_pixel; /* color of one pixel, if > 1 bit per pixel */
00164     unsigned next_pixels; /* pending group of 8 pixels being read */
00165     unsigned color_mask = 0x00; /* to invert monochrome bitmap, set to 0xFF */
00166
00167     unsigned char bitmap[17*32][18*32/8]; /* final bitmap */
00168     /* For wide array:
00169     0 = don't force glyph to double-width;
00170     1 = force glyph to double-width;
00171     4 = force glyph to quadruple-width.
00172     */
00173     char wide[0x200000]={0x200000 * 0};
00174
00175     char *infile="", *outfile=""; /* names of input and output files */
00176     FILE *infp, *outfp; /* file pointers of input and output files */
00177
00178     if (argc > 1) {
00179         for (i = 1; i < argc; i++) {
00180             if (argv[i][0] == '-') { /* this is an option argument */
00181                 switch (argv[i][1]) {
00182                     case 'i': /* name of input file */
00183                         infile = &argv[i][2];
00184                         break;
00185                     case 'o': /* name of output file */
00186                         outfile = &argv[i][2];
00187                         break;
00188                     case 'p': /* specify a Unicode plane */
00189                         sscanf (&argv[i][2], "%x", &uniplane); /* Get Unicode plane */
00190                         planeset = 1; /* Use specified range, not what's in bitmap */
00191                         break;
00192                     case 'w': /* force wide (16 pixels) for each glyph */
00193                         forcewide = 1;
00194                         break;
00195                     default: /* if unrecognized option, print list and exit */
00196                         fprintf (stderr, "\nSyntax:\n\n");
00197                         fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00198                         fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00199                         fprintf (stderr, " -w specifies .wbmp output instead of ");
00200                         fprintf (stderr, "default Windows .bmp output.\n\n");
00201                         fprintf (stderr, " -p is followed by 1 to 6 ");
00202                         fprintf (stderr, "Unicode plane hex digits ");
00203                         fprintf (stderr, "(default is Page 0).\n\n");
00204                         fprintf (stderr, "\nExample:\n\n");
00205                         fprintf (stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n\n",
00206                                 argv[0]);
00207                         exit (1);
00208                 }
00209             }
00210         }
00211     }
00212     /*
00213     Make sure we can open any I/O files that were specified before
00214     doing anything else.

```

```

00215 */
00216 if (strlen (infile) > 0) {
00217     if ((infp = fopen (infile, "r")) == NULL) {
00218         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00219         exit (1);
00220     }
00221 }
00222 else {
00223     infp = stdin;
00224 }
00225 if (strlen (outfile) > 0) {
00226     if ((outfp = fopen (outfile, "w")) == NULL) {
00227         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00228         exit (1);
00229     }
00230 }
00231 else {
00232     outfp = stdout;
00233 }
00234 /*
00235 Initialize selected code points for double width (16x16).
00236 Double-width is forced in cases where a glyph (usually a combining
00237 glyph) only occupies the left-hand side of a 16x16 grid, but must
00238 be rendered as double-width to appear properly with other glyphs
00239 in a given script.  If additions were made to a script after
00240 Unicode 5.0, the Unicode version is given in parentheses after
00241 the script name.
00242 */
00243 for (i = 0x0700; i <= 0x074F; i++) wide[i] = 1; /* Syriac */
00244 for (i = 0x0800; i <= 0x083F; i++) wide[i] = 1; /* Samaritan (5.2) */
00245 for (i = 0x0900; i <= 0x0DFF; i++) wide[i] = 1; /* Indic */
00246 for (i = 0x1000; i <= 0x109F; i++) wide[i] = 1; /* Myanmar */
00247 for (i = 0x1100; i <= 0x11FF; i++) wide[i] = 1; /* Hangul Jamo */
00248 for (i = 0x1400; i <= 0x167F; i++) wide[i] = 1; /* Canadian Aboriginal */
00249 for (i = 0x1700; i <= 0x171F; i++) wide[i] = 1; /* Tagalog */
00250 for (i = 0x1720; i <= 0x173F; i++) wide[i] = 1; /* Hanunoo */
00251 for (i = 0x1740; i <= 0x175F; i++) wide[i] = 1; /* Buhid */
00252 for (i = 0x1760; i <= 0x177F; i++) wide[i] = 1; /* Tagbanwa */
00253 for (i = 0x1780; i <= 0x17FF; i++) wide[i] = 1; /* Khmer */
00254 for (i = 0x18B0; i <= 0x18FF; i++) wide[i] = 1; /* Ext. Can. Aboriginal */
00255 for (i = 0x1800; i <= 0x18AF; i++) wide[i] = 1; /* Mongolian */
00256 for (i = 0x1900; i <= 0x194F; i++) wide[i] = 1; /* Limbu */
00257 // for (i = 0x1980; i <= 0x19DF; i++) wide[i] = 1; /* New Tai Lue */
00258 for (i = 0x1A00; i <= 0x1A1F; i++) wide[i] = 1; /* Buginese */
00259 for (i = 0x1A20; i <= 0x1AAF; i++) wide[i] = 1; /* Tai Tham (5.2) */
00260 for (i = 0x1B00; i <= 0x1B7F; i++) wide[i] = 1; /* Balinese */
00261 for (i = 0x1B80; i <= 0x1BBF; i++) wide[i] = 1; /* Sundanese (5.1) */
00262 for (i = 0x1BC0; i <= 0x1BFF; i++) wide[i] = 1; /* Batak (6.0) */
00263 for (i = 0x1C00; i <= 0x1C4F; i++) wide[i] = 1; /* Lepcha (5.1) */
00264 for (i = 0x1CC0; i <= 0x1CCF; i++) wide[i] = 1; /* Sundanese Supplement */
00265 for (i = 0x1CD0; i <= 0x1CFF; i++) wide[i] = 1; /* Vedic Extensions (5.2) */
00266 wide[0x2329] = wide[0x232A] = 1; /* Left- & Right-pointing Angle Brackets */
00267 for (i = 0x2E80; i <= 0xA4CF; i++) wide[i] = 1; /* CJK */
00268 // for (i = 0x9FD8; i <= 0x9FE9; i++) wide[i] = 4; /* CJK quadruple-width */
00269 for (i = 0xA900; i <= 0xA92F; i++) wide[i] = 1; /* Kayah Li (5.1) */
00270 for (i = 0xA930; i <= 0xA95F; i++) wide[i] = 1; /* Rejang (5.1) */
00271 for (i = 0xA960; i <= 0xA97F; i++) wide[i] = 1; /* Hangul Jamo Extended-A */
00272 for (i = 0xA980; i <= 0xA9DF; i++) wide[i] = 1; /* Javanese (5.2) */
00273 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham (5.1) */
00274 for (i = 0xA9E0; i <= 0xA9FF; i++) wide[i] = 1; /* Myanmar Extended-B */
00275 for (i = 0xAA00; i <= 0xAA5F; i++) wide[i] = 1; /* Cham */
00276 for (i = 0xAA60; i <= 0xAA7F; i++) wide[i] = 1; /* Myanmar Extended-A */
00277 for (i = 0xAAE0; i <= 0xA AFF; i++) wide[i] = 1; /* Meetei Mayek Ext (6.0) */
00278 for (i = 0xABC0; i <= 0xABFF; i++) wide[i] = 1; /* Meetei Mayek (5.2) */
00279 for (i = 0xAC00; i <= 0xD7AF; i++) wide[i] = 1; /* Hangul Syllables */
00280 for (i = 0xD7B0; i <= 0xD7FF; i++) wide[i] = 1; /* Hangul Jamo Extended-B */
00281 for (i = 0xF900; i <= 0xFAFF; i++) wide[i] = 1; /* CJK Compatibility */
00282 for (i = 0xFE10; i <= 0xFE1F; i++) wide[i] = 1; /* Vertical Forms */
00283 for (i = 0xFE30; i <= 0xFE60; i++) wide[i] = 1; /* CJK Compatibility Forms */
00284 for (i = 0xFFE0; i <= 0xFFE6; i++) wide[i] = 1; /* CJK Compatibility Forms */
00285
00286 wide[0x303F] = 0; /* CJK half-space fill */
00287
00288 /* Supplemental Multilingual Plane (Plane 01) */
00289 for (i = 0x010A00; i <= 0x010A5F; i++) wide[i] = 1; /* Kharoshthi */
00290 for (i = 0x011000; i <= 0x01107F; i++) wide[i] = 1; /* Brahmi */
00291 for (i = 0x011080; i <= 0x0110CF; i++) wide[i] = 1; /* Kaithi */
00292 for (i = 0x011100; i <= 0x01114F; i++) wide[i] = 1; /* Chakma */
00293 for (i = 0x011180; i <= 0x0111DF; i++) wide[i] = 1; /* Sharada */
00294 for (i = 0x011200; i <= 0x01124F; i++) wide[i] = 1; /* Khojki */
00295 for (i = 0x0112B0; i <= 0x0112FF; i++) wide[i] = 1; /* Khudawadi */

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00296 for (i = 0x011300; i <= 0x01137F; i++) wide[i] = 1; /* Grantha */
00297 for (i = 0x011400; i <= 0x01147F; i++) wide[i] = 1; /* Newa */
00298 for (i = 0x011480; i <= 0x0114DF; i++) wide[i] = 1; /* Tirhuta */
00299 for (i = 0x011580; i <= 0x0115FF; i++) wide[i] = 1; /* Siddham */
00300 for (i = 0x011600; i <= 0x01165F; i++) wide[i] = 1; /* Modi */
00301 for (i = 0x011660; i <= 0x01167F; i++) wide[i] = 1; /* Mongolian Suppl. */
00302 for (i = 0x011680; i <= 0x0116CF; i++) wide[i] = 1; /* Takri */
00303 for (i = 0x011700; i <= 0x01173F; i++) wide[i] = 1; /* Ahom */
00304 for (i = 0x011800; i <= 0x01184F; i++) wide[i] = 1; /* Dogra */
00305 for (i = 0x011900; i <= 0x01195F; i++) wide[i] = 1; /* Dives Akuru */
00306 for (i = 0x0119A0; i <= 0x0119FF; i++) wide[i] = 1; /* Nandinagari */
00307 for (i = 0x011A00; i <= 0x011A4F; i++) wide[i] = 1; /* Zanabazar Square */
00308 for (i = 0x011A50; i <= 0x011AAF; i++) wide[i] = 1; /* Soyombo */
00309 for (i = 0x011B00; i <= 0x011B5F; i++) wide[i] = 1; /* Devanagari Extended-A */
00310 for (i = 0x011F00; i <= 0x011F5F; i++) wide[i] = 1; /* Kawi */
00311 for (i = 0x011C00; i <= 0x011C6F; i++) wide[i] = 1; /* Bhaiksuki */
00312 for (i = 0x011C70; i <= 0x011CBF; i++) wide[i] = 1; /* Marchen */
00313 for (i = 0x011D00; i <= 0x011D5F; i++) wide[i] = 1; /* Masaram Gondi */
00314 for (i = 0x011EE0; i <= 0x011EFF; i++) wide[i] = 1; /* Makasar */
00315 for (i = 0x012F90; i <= 0x012FFF; i++) wide[i] = 1; /* Cypro-Minoan */
00316 /* Make Bassa Vah all single width or all double width */
00317 for (i = 0x016AD0; i <= 0x016AFF; i++) wide[i] = 1; /* Bassa Vah */
00318 for (i = 0x016B00; i <= 0x016B8F; i++) wide[i] = 1; /* Pahawh Hmong */
00319 for (i = 0x016F00; i <= 0x016F9F; i++) wide[i] = 1; /* Miao */
00320 for (i = 0x016FE0; i <= 0x016FFF; i++) wide[i] = 1; /* Ideograph Sym/Punct */
00321 for (i = 0x017000; i <= 0x0187FF; i++) wide[i] = 1; /* Tangut */
00322 for (i = 0x018800; i <= 0x018AFF; i++) wide[i] = 1; /* Tangut Components */
00323 for (i = 0x01AFF0; i <= 0x01AFFF; i++) wide[i] = 1; /* Kana Extended-B */
00324 for (i = 0x01B000; i <= 0x01B0FF; i++) wide[i] = 1; /* Kana Supplement */
00325 for (i = 0x01B100; i <= 0x01B12F; i++) wide[i] = 1; /* Kana Extended-A */
00326 for (i = 0x01B170; i <= 0x01B2FF; i++) wide[i] = 1; /* Nushu */
00327 for (i = 0x01CF00; i <= 0x01CFCF; i++) wide[i] = 1; /* Znamenny Musical */
00328 for (i = 0x01D100; i <= 0x01D1FF; i++) wide[i] = 1; /* Musical Symbols */
00329 for (i = 0x01D800; i <= 0x01DAAF; i++) wide[i] = 1; /* Sutton SignWriting */
00330 for (i = 0x01E2C0; i <= 0x01E2FF; i++) wide[i] = 1; /* Wancho */
00331 for (i = 0x01E800; i <= 0x01E8DF; i++) wide[i] = 1; /* Mende Kikakui */
00332 for (i = 0x01F200; i <= 0x01F2FF; i++) wide[i] = 1; /* Encl Ideograp Suppl */
00333 wide[0x01F5E7] = 1; /* Three Rays Right */
00334
00335 /*
00336 Determine whether or not the file is a Microsoft Windows Bitmap file.
00337 If it starts with 'B', 'M', assume it's a Windows Bitmap file.
00338 Otherwise, assume it's a Wireless Bitmap file.
00339
00340 WARNING: There isn't much in the way of error checking here --
00341 if you give it a file that wasn't first created by hex2bmp.c,
00342 all bets are off.
00343 */
00344 fatal = 0; /* assume everything is okay with reading input file */
00345 if ((header[0] = fgetc (infp)) != EOF) {
00346     if ((header[1] = fgetc (infp)) != EOF) {
00347         if (header[0] == 'B' && header[1] == 'M') {
00348             wbmp = 0; /* Not a Wireless Bitmap -- it's a Windows Bitmap */
00349         }
00350         else {
00351             wbmp = 1; /* Assume it's a Wireless Bitmap */
00352         }
00353     }
00354     else
00355         fatal = 1;
00356 }
00357 else
00358     fatal = 1;
00359
00360 if (fatal) {
00361     fprintf (stderr, "Fatal error; end of input file.\n\n");
00362     exit (1);
00363 }
00364 /*
00365 If this is a Wireless Bitmap (.wbmp) format file,
00366 skip the header and point to the start of the bitmap itself.
00367 */
00368 if (wbmp) {
00369     for (i=2; i<6; i++)
00370         header[i] = fgetc (infp);
00371     /*
00372 Now read the bitmap.
00373 */
00374     for (i=0; i < 32*17; i++) {
00375         for (j=0; j < 32*18/8; j++) {
00376             inchar = fgetc (infp);

```

```

00377         bitmap[i][j] = ~inchar; /* invert bits for proper color */
00378     }
00379 }
00380 }
00381 /*
00382 Otherwise, treat this as a Windows Bitmap file, because we checked
00383 that it began with "BM". Save the header contents for future use.
00384 Expect a 14 byte standard BITMAPFILEHEADER format header followed
00385 by a 40 byte standard BITMAPINFOHEADER Device Independent Bitmap
00386 header, with data stored in little-endian format.
00387 */
00388 else {
00389     for (i = 2; i < 54; i++)
00390         header[i] = fgetc (infp);
00391
00392     bmp_header.filetype[0] = 'B';
00393     bmp_header.filetype[1] = 'M';
00394
00395     bmp_header.file_size =
00396         (header[2] & 0xFF) | ((header[3] & 0xFF) << 8) |
00397         ((header[4] & 0xFF) << 16) | ((header[5] & 0xFF) << 24);
00398
00399     /* header bytes 6..9 are reserved */
00400
00401     bmp_header.image_offset =
00402         (header[10] & 0xFF) | ((header[11] & 0xFF) << 8) |
00403         ((header[12] & 0xFF) << 16) | ((header[13] & 0xFF) << 24);
00404
00405     bmp_header.info_size =
00406         (header[14] & 0xFF) | ((header[15] & 0xFF) << 8) |
00407         ((header[16] & 0xFF) << 16) | ((header[17] & 0xFF) << 24);
00408
00409     bmp_header.width =
00410         (header[18] & 0xFF) | ((header[19] & 0xFF) << 8) |
00411         ((header[20] & 0xFF) << 16) | ((header[21] & 0xFF) << 24);
00412
00413     bmp_header.height =
00414         (header[22] & 0xFF) | ((header[23] & 0xFF) << 8) |
00415         ((header[24] & 0xFF) << 16) | ((header[25] & 0xFF) << 24);
00416
00417     bmp_header.nplanes =
00418         (header[26] & 0xFF) | ((header[27] & 0xFF) << 8);
00419
00420     bmp_header.bits_per_pixel =
00421         (header[28] & 0xFF) | ((header[29] & 0xFF) << 8);
00422
00423     bmp_header.compression =
00424         (header[30] & 0xFF) | ((header[31] & 0xFF) << 8) |
00425         ((header[32] & 0xFF) << 16) | ((header[33] & 0xFF) << 24);
00426
00427     bmp_header.image_size =
00428         (header[34] & 0xFF) | ((header[35] & 0xFF) << 8) |
00429         ((header[36] & 0xFF) << 16) | ((header[37] & 0xFF) << 24);
00430
00431     bmp_header.x_ppm =
00432         (header[38] & 0xFF) | ((header[39] & 0xFF) << 8) |
00433         ((header[40] & 0xFF) << 16) | ((header[41] & 0xFF) << 24);
00434
00435     bmp_header.y_ppm =
00436         (header[42] & 0xFF) | ((header[43] & 0xFF) << 8) |
00437         ((header[44] & 0xFF) << 16) | ((header[45] & 0xFF) << 24);
00438
00439     bmp_header.ncolors =
00440         (header[46] & 0xFF) | ((header[47] & 0xFF) << 8) |
00441         ((header[48] & 0xFF) << 16) | ((header[49] & 0xFF) << 24);
00442
00443     bmp_header.important_colors =
00444         (header[50] & 0xFF) | ((header[51] & 0xFF) << 8) |
00445         ((header[52] & 0xFF) << 16) | ((header[53] & 0xFF) << 24);
00446
00447     if (bmp_header.ncolors == 0)
00448         bmp_header.ncolors = 1 << bmp_header.bits_per_pixel;
00449
00450     /* If a Color Table exists, read it */
00451     if (bmp_header.ncolors > 0 && bmp_header.bits_per_pixel <= 8) {
00452         for (i = 0; i < bmp_header.ncolors; i++) {
00453             color_table[i][0] = fgetc (infp); /* Red */
00454             color_table[i][1] = fgetc (infp); /* Green */
00455             color_table[i][2] = fgetc (infp); /* Blue */
00456             color_table[i][3] = fgetc (infp); /* Alpha */
00457         }

```

```

00458     /*
00459 Determine from the first color table entry whether we
00460 are inverting the resulting bitmap image.
00461 */
00462     if ( ( color_table[0][0] + color_table[0][1] + color_table[0][2])
00463         < ( 3 * 128 ) ) {
00464         color_mask = 0xFF;
00465     }
00466 }
00467
00468 #ifndef DEBUG
00469
00470     /*
00471 Print header info for possibly adding support for
00472 additional file formats in the future, to determine
00473 how the bitmap is encoded.
00474 */
00475     fprintf (stderr, "Filetype: '%c%c'\n",
00476             bmp_header.filetype[0], bmp_header.filetype[1]);
00477     fprintf (stderr, "File Size: %d\n", bmp_header.file_size);
00478     fprintf (stderr, "Image Offset: %d\n", bmp_header.image_offset);
00479     fprintf (stderr, "Info Header Size: %d\n", bmp_header.info_size);
00480     fprintf (stderr, "Image Width: %d\n", bmp_header.width);
00481     fprintf (stderr, "Image Height: %d\n", bmp_header.height);
00482     fprintf (stderr, "Number of Planes: %d\n", bmp_header.nplanes);
00483     fprintf (stderr, "Bits per Pixel: %d\n", bmp_header.bits_per_pixel);
00484     fprintf (stderr, "Compression Method: %d\n", bmp_header.compression);
00485     fprintf (stderr, "Image Size: %d\n", bmp_header.image_size);
00486     fprintf (stderr, "X Pixels per Meter: %d\n", bmp_header.x_ppm);
00487     fprintf (stderr, "Y Pixels per Meter: %d\n", bmp_header.y_ppm);
00488     fprintf (stderr, "Number of Colors: %d\n", bmp_header.ncolors);
00489     fprintf (stderr, "Important Colors: %d\n", bmp_header.important_colors);
00490
00491 #endif
00492
00493     /*
00494 Now read the bitmap.
00495 */
00496     for (i = 32*17-1; i >= 0; i--) {
00497         for (j=0; j < 32*18/8; j++) {
00498             next_pixels = 0x00; /* initialize next group of 8 pixels */
00499             /* Read a monochrome image -- the original case */
00500             if (bmp_header.bits_per_pixel == 1) {
00501                 next_pixels = fgetc (infp);
00502             }
00503             /* Read a 32 bit per pixel RGB image; convert to monochrome */
00504             else if ( bmp_header.bits_per_pixel == 24 ||
00505                    bmp_header.bits_per_pixel == 32) {
00506                 next_pixels = 0;
00507                 for (k = 0; k < 8; k++) { /* get next 8 pixels */
00508                     this_pixel = (fgetc (infp) & 0xFF) +
00509                                 (fgetc (infp) & 0xFF) +
00510                                 (fgetc (infp) & 0xFF);
00511
00512                     if (bmp_header.bits_per_pixel == 32) {
00513                         (void) fgetc (infp); /* ignore alpha value */
00514                     }
00515
00516                     /* convert RGB color space to monochrome */
00517                     if (this_pixel >= (128 * 3))
00518                         this_pixel = 0;
00519                     else
00520                         this_pixel = 1;
00521
00522                     /* shift next pixel color into place for 8 pixels total */
00523                     next_pixels = (next_pixels « 1) | this_pixel;
00524                 }
00525             }
00526             if (bmp_header.height < 0) { /* Bitmap drawn top to bottom */
00527                 bitmap [(32*17-1) - i] [j] = next_pixels;
00528             }
00529             else { /* Bitmap drawn bottom to top */
00530                 bitmap [i][j] = next_pixels;
00531             }
00532         }
00533     }
00534
00535     /*
00536 If any bits are set in color_mask, apply it to
00537 entire bitmap to invert black <--> white.
00538 */

```



```

00539     if (color_mask != 0x00) {
00540         for (i = 32*17-1; i >= 0; i--) {
00541             for (j=0; j < 32*18/8; j++) {
00542                 bitmap [i][j] ^= color_mask;
00543             }
00544         }
00545     }
00546 }
00547 }
00548
00549 /*
00550 We've read the entire file.  Now close the input file pointer.
00551 */
00552 fclose (infp);
00553 /*
00554 We now have the header portion in the header[] array,
00555 and have the bitmap portion from top-to-bottom in the bitmap[] array.
00556 */
00557 /*
00558 If no Unicode range (U+nnnnnn00 through U+nnnnnnFF) was specified
00559 with a -p parameter, determine the range from the digits in the
00560 bitmap itself.
00561
00562 Store bitmaps for the hex digit patterns that this file uses.
00563 */
00564 if (!planeset) { /* If Unicode range not specified with -p parameter */
00565     for (i = 0x0; i <= 0xF; i++) { /* hex digit pattern we're storing */
00566         for (j = 0; j < 4; j++) {
00567             hexdigit[i][j] =
00568                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 ][6] << 24 ) |
00569                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 1][6] << 16 ) |
00570                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 2][6] << 8 ) |
00571                 ((unsigned)bitmap[32 * (i+1) + 4 * j + 8 + 3][6] );
00572         }
00573     }
00574 } /*
00575 Read the Unicode plane digits into arrays for comparison, to
00576 determine the upper four hex digits of the glyph addresses.
00577 */
00578 for (i = 0; i < 4; i++) {
00579     for (j = 0; j < 4; j++) {
00580         unidigit[i][j] =
00581             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 1][i + 3] << 24 ) |
00582             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 2][i + 3] << 16 ) |
00583             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 3][i + 3] << 8 ) |
00584             ((unsigned)bitmap[32 * 0 + 4 * j + 8 + 4][i + 3] );
00585     }
00586 }
00587
00588 tmpsum = 0;
00589 for (i = 4; i < 6; i++) {
00590     for (j = 0; j < 4; j++) {
00591         unidigit[i][j] =
00592             ((unsigned)bitmap[32 * 1 + 4 * j + 8 ][i] << 24 ) |
00593             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 1][i] << 16 ) |
00594             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 2][i] << 8 ) |
00595             ((unsigned)bitmap[32 * 1 + 4 * j + 8 + 3][i] );
00596         tmpsum |= unidigit[i][j];
00597     }
00598 }
00599 if (tmpsum == 0) { /* the glyph matrix is transposed */
00600     flip = 1; /* note transposed order for processing glyphs in matrix */
00601 } /*
00602 Get 5th and 6th hex digits by shifting first column header left by
00603 1.5 columns, thereby shifting the hex digit right after the leading
00604 "U+nnnn" page number.
00605 */
00606 for (i = 0x08; i < 0x18; i++) {
00607     bitmap[i][7] = (bitmap[i][8] << 4) | ((bitmap[i][9] >> 4) & 0xf);
00608     bitmap[i][8] = (bitmap[i][9] << 4) | ((bitmap[i][10] >> 4) & 0xf);
00609 }
00610 for (i = 4; i < 6; i++) {
00611     for (j = 0; j < 4; j++) {
00612         unidigit[i][j] =
00613             ((unsigned)bitmap[4 * j + 8 + 1][i + 3] << 24 ) |
00614             ((unsigned)bitmap[4 * j + 8 + 2][i + 3] << 16 ) |
00615             ((unsigned)bitmap[4 * j + 8 + 3][i + 3] << 8 ) |
00616             ((unsigned)bitmap[4 * j + 8 + 4][i + 3] );
00617     }
00618 }
00619 }

```

```

00620
00621 /*
00622 Now determine the Unicode plane by comparing unidigit[0..5] to
00623 the hexdigit[0x0..0xF] array.
00624 */
00625     uniplane = 0;
00626     for (i=0; i<6; i++) { /* go through one bitmap digit at a time */
00627         match = 0; /* haven't found pattern yet */
00628         for (j = 0x0; !match && j <= 0xF; j++) {
00629             if (unidigit[i][0] == hexdigit[j][0] &&
00630                 unidigit[i][1] == hexdigit[j][1] &&
00631                 unidigit[i][2] == hexdigit[j][2] &&
00632                 unidigit[i][3] == hexdigit[j][3]) { /* we found the digit */
00633                 uniplane |= j;
00634                 match = 1;
00635             }
00636         }
00637         uniplane <<= 4;
00638     }
00639     uniplane >>= 4;
00640 }
00641 /*
00642 Now read each glyph and print it as hex.
00643 */
00644     for (i = 0x0; i <= 0xf; i++) {
00645         for (j = 0x0; j <= 0xf; j++) {
00646             for (k = 0; k < 16; k++) {
00647                 if (flip) { /* transpose glyph matrix */
00648                     thischar0[k] = bitmap[32*(j+1) + k + 7][4 * (i+2)  ];
00649                     thischar1[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 1];
00650                     thischar2[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 2];
00651                     thischar3[k] = bitmap[32*(j+1) + k + 7][4 * (i+2) + 3];
00652                 }
00653                 else {
00654                     thischar0[k] = bitmap[32*(i+1) + k + 7][4 * (j+2)  ];
00655                     thischar1[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 1];
00656                     thischar2[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 2];
00657                     thischar3[k] = bitmap[32*(i+1) + k + 7][4 * (j+2) + 3];
00658                 }
00659             }
00660         }
00661         /*
00662         If the second half of the 16*16 character is all zeroes, this
00663         character is only 8 bits wide, so print a half-width character.
00664         */
00664         empty1 = empty2 = 1;
00665         for (k=0; (empty1 || empty2) && k < 16; k++) {
00666             if (thischar1[k] != 0) empty1 = 0;
00667             if (thischar2[k] != 0) empty2 = 0;
00668         }
00669         /*
00670         Only print this glyph if it isn't blank.
00671         */
00672         if (!empty1 || !empty2) {
00673             /*
00674             If the second half is empty, this is a half-width character.
00675             Only print the first half.
00676             */
00677             /*
00678             Original GNU Unifont format is four hexadecimal digit character
00679             code followed by a colon followed by a hex string.  Add support
00680             for codes beyond the Basic Multilingual Plane.
00681             */
00682             Unicode ranges from U+0000 to U+10FFFF, so print either a
00683             4-digit or a 6-digit code point.  Note that this software
00684             should support up to an 8-digit code point, extending beyond
00685             the normal Unicode range, but this has not been fully tested.
00686             */
00687             if (uniplane > 0xff)
00688                 fprintf (outfp, "%04X%X%X:", uniplane, i, j); // 6 digit code pt.
00689             else
00690                 fprintf (outfp, "%02X%X%X:", uniplane, i, j); // 4 digit code pt.
00691             for (thisrow=0; thisrow<16; thisrow++) {
00692                 /*
00693                 If second half is empty and we're not forcing this
00694                 code point to double width, print as single width.
00695                 */
00696                 if (!forcewide &&
00697                     empty2 && !wide[(uniplane << 8) | (i << 4) | j]) {
00698                     fprintf (outfp,
00699                             "%02X",
00700                             thischar1[thisrow]);

```

```

00701     }
00702     else if (wide[(uniplane << 8) | (i << 4) | j] == 4) {
00703         /* quadruple-width; force 32nd pixel to zero */
00704         fprintf (outfp,
00705                 "%02X%02X%02X%02X",
00706                 thischar0[thisrow], thischar1[thisrow],
00707                 thischar2[thisrow], thischar3[thisrow] & 0xFE);
00708     }
00709     else { /* treat as double-width */
00710         fprintf (outfp,
00711                 "%02X%02X",
00712                 thischar1[thisrow], thischar2[thisrow]);
00713     }
00714     }
00715     fprintf (outfp, "\n");
00716 }
00717 }
00718 }
00719 exit (0);
00720 }

```

## 5.13 src/unibmpbump.c File Reference

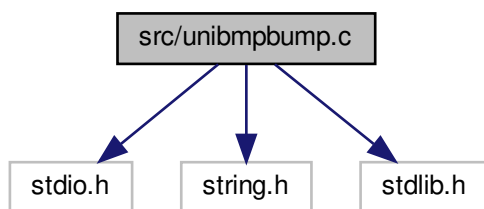
unibmpbump - Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp

```
#include <stdio.h>
```

```
#include <string.h>
```

```
#include <stdlib.h>
```

Include dependency graph for unibmpbump.c:



### Macros

- `#define VERSION "1.0"`  
Version of this program.
- `#define MAX_COMPRESSION_METHOD 13`  
Maximum supported compression method.

### Functions

- `int main (int argc, char *argv[])`  
The main function.
- `unsigned get_bytes (FILE *infp, int nbytes)`  
Get from 1 to 4 bytes, inclusive, from input file.
- `void regrid (unsigned *image_bytes)`  
After reading in the image, shift it.

### 5.13.1 Detailed Description

unibmpbump - Adjust a Microsoft bitmap (.bmp) file that was created by unihex2png but converted to .bmp

Author

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Copyright

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This program shifts the glyphs in a bitmap file to adjust an original PNG file that was saved in BMP format. This is so the result matches the format of a unihex2bmp image. This conversion then lets unibmp2hex decode the result.

Synopsis: unibmpbump [-iin\_file.bmp] [-oout\_file.bmp]

Definition in file [unibmpbump.c](#).

### 5.13.2 Macro Definition Documentation

#### 5.13.2.1 MAX\_COMPRESSION\_METHOD

```
#define MAX_COMPRESSION_METHOD 13
```

Maximum supported compression method.  
Definition at line [40](#) of file [unibmpbump.c](#).

#### 5.13.2.2 VERSION

```
#define VERSION "1.0"
```

Version of this program.  
Definition at line [38](#) of file [unibmpbump.c](#).

### 5.13.3 Function Documentation

#### 5.13.3.1 get\_bytes()

```
unsigned get_bytes (
    FILE * infp,
    int nbytes )
```

Get from 1 to 4 bytes, inclusive, from input file.

Parameters

in	infp	Pointer to input file.
----	------	------------------------

## Parameters

in	nbytes	Number of bytes to read, from 1 to 4, inclusive.
----	--------	--

## Returns

The unsigned 1 to 4 bytes in machine native endian format.

Definition at line 487 of file [unibmpbump.c](#).

```

00487     {
00488     int i;
00489     unsigned char inchar[4];
00490     unsigned inword;
00491
00492     for (i = 0; i < nbytes; i++) {
00493         if (fread (&inchar[i], 1, 1, infp) != 1) {
00494             inchar[i] = 0;
00495         }
00496     }
00497     for (i = nbytes; i < 4; i++) inchar[i] = 0;
00498
00499     inword = ((inchar[3] & 0xFF) << 24) | ((inchar[2] & 0xFF) << 16) |
00500             ((inchar[1] & 0xFF) << 8) | (inchar[0] & 0xFF);
00501
00502     return inword;
00503 }

```

## 5.13.3.2 main()

```

int main (
    int argc,
    char * argv[] )

```

The main function.

## Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

## Returns

This program exits with status `EXIT_SUCCESS`.

Definition at line 50 of file [unibmpbump.c](#).

```

00050     {
00051
00052     /*
00053     Values preserved from file header (first 14 bytes).
00054     */
00055     char file_format[3];      /* "BM" for original Windows format */
00056     unsigned filesize;      /* size of file in bytes */
00057     unsigned char rsvd_hdr[4]; /* 4 reserved bytes */
00058     unsigned image_start;    /* byte offset of image in file */
00059
00060     /*
00061     Values preserved from Device Independent Bitmap (DIB) Header.
00062
00063     The DIB fields below are in the standard 40-byte header. Version
00064     4 and version 5 headers have more information, mainly for color
00065     information. That is skipped over, because a valid glyph image
00066     is just monochrome.
00067     */
00068     int dib_length;          /* in bytes, for parsing by header version */
00069     int image_width = 0;     /* Signed image width */
00070     int image_height = 0;    /* Signed image height */
00071     int num_planes = 0;      /* number of planes; must be 1 */
00072     int bits_per_pixel = 0;  /* for palletized color maps (< 2^16 colors) */
00073     /*
00074     The following fields are not in the original spec, so initialize
00075     them to 0 so we can correctly parse an original file format.
00076     */
00077     int compression_method=0; /* 0 --> uncompressed RGB/monochrome */
00078     int image_size = 0;       /* 0 is a valid size if no compression */
00079     int hres = 0;             /* image horizontal resolution */
00080     int vres = 0;            /* image vertical resolution */
00081     int num_colors = 0;      /* Number of colors for palletized images */
00082     int important_colors = 0; /* Number of significant colors (0 or 2) */
00083
00084     int true_colors = 0;     /* interpret num_colors, which can equal 0 */
00085
00086     /*
00087     Color map. This should be a monochrome file, so only two
00088     colors are stored.
00089     */
00090     unsigned char color_map[2][4]; /* two of R, G, B, and possibly alpha */
00091
00092     /*
00093     The monochrome image bitmap, stored as a vector 544 rows by
00094     72*8 columns.
00095     */
00096     unsigned image_bytes[544*72];
00097
00098     /*
00099     Flags for conversion & I/O.
00100     */
00101     int verbose = 0;         /* Whether to print file info on stderr */
00102     unsigned image_xor = 0x00; /* Invert (= 0xFF) if color 0 is not black */
00103
00104     /*
00105     Temporary variables.
00106     */
00107     int i, j, k;            /* loop variables */
00108
00109     /* Compression type, for parsing file */
00110     char *compression_type[MAX_COMPRESSION_METHOD + 1] = {
00111         "BI_RGB",           /* 0 */
00112         "BI_RLE8",         /* 1 */
00113         "BI_RLE4",         /* 2 */
00114         "BI_BITFIELDS",    /* 3 */
00115         "BI_JPEG",         /* 4 */
00116         "BI_PNG",          /* 5 */
00117         "BI_ALPHABITFIELDS", /* 6 */
00118         "", "", "", "",    /* 7 - 10 */
00119         "BI_CMYK",         /* 11 */
00120         "BI_CMYKRLE8",     /* 12 */
00121         "BI_CMYKRLE4",     /* 13 */
00122     };
00123
00124     /* Standard unihex2bmp.c header for BMP image */
00125     unsigned standard_header [62] = {

```

```

00126     /* 0 */ 0x42, 0x4d, 0x3e, 0x99, 0x00, 0x00, 0x00, 0x00,
00127     /* 8 */ 0x00, 0x00, 0x3e, 0x00, 0x00, 0x00, 0x28, 0x00,
00128     /* 16 */ 0x00, 0x00, 0x40, 0x02, 0x00, 0x00, 0x20, 0x02,
00129     /* 24 */ 0x00, 0x00, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00,
00130     /* 32 */ 0x00, 0x00, 0x00, 0x99, 0x00, 0x00, 0xc4, 0x0e,
00131     /* 40 */ 0x00, 0x00, 0xc4, 0x0e, 0x00, 0x00, 0x00, 0x00,
00132     /* 48 */ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
00133     /* 56 */ 0x00, 0x00, 0xff, 0xff, 0xff, 0x00
00134 };
00135
00136 unsigned get_bytes (FILE *, int);
00137 void regrid (unsigned *);
00138
00139 char *infile="", *outfile=""; /* names of input and output files */
00140 FILE *infp, *outfp; /* file pointers of input and output files */
00141
00142 /*
00143 Process command line arguments.
00144 */
00145 if (argc > 1) {
00146     for (i = 1; i < argc; i++) {
00147         if (argv[i][0] == '-') { /* this is an option argument */
00148             switch (argv[i][1]) {
00149                 case 'i': /* name of input file */
00150                     infile = &argv[i][2];
00151                     break;
00152                 case 'o': /* name of output file */
00153                     outfile = &argv[i][2];
00154                     break;
00155                 case 'v': /* verbose output */
00156                     verbose = 1;
00157                     break;
00158                 case 'V': /* print version & quit */
00159                     fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00160                     exit (EXIT_SUCCESS);
00161                     break;
00162                 case '-': /* see if "--verbose" */
00163                     if (strcmp (argv[i], "--verbose") == 0) {
00164                         verbose = 1;
00165                     }
00166                     else if (strcmp (argv[i], "--version") == 0) {
00167                         fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00168                         exit (EXIT_SUCCESS);
00169                     }
00170                     break;
00171                 default: /* if unrecognized option, print list and exit */
00172                     fprintf (stderr, "\nSyntax:\n\n");
00173                     fprintf (stderr, " unibmpbump ");
00174                     fprintf (stderr, "-i<Input_File> -o<Output_File>\n\n");
00175                     fprintf (stderr, "-v or --verbose gives verbose output");
00176                     fprintf (stderr, " on stderr\n\n");
00177                     fprintf (stderr, "-V or --version prints version");
00178                     fprintf (stderr, " on stderr and exits\n\n");
00179                     fprintf (stderr, "\nExample:\n\n");
00180                     fprintf (stderr, " unibmpbump -iuni0101.bmp");
00181                     fprintf (stderr, " -onew-uni0101.bmp\n\n");
00182                     exit (EXIT_SUCCESS);
00183             }
00184         }
00185     }
00186 }
00187
00188 /*
00189 Make sure we can open any I/O files that were specified before
00190 doing anything else.
00191 */
00192 if (strlen (infile) > 0) {
00193     if ((infp = fopen (infile, "r")) == NULL) {
00194         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00195         exit (EXIT_FAILURE);
00196     }
00197 }
00198 else {
00199     infp = stdin;
00200 }
00201 if (strlen (outfile) > 0) {
00202     if ((outfp = fopen (outfile, "w")) == NULL) {
00203         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00204         exit (EXIT_FAILURE);
00205     }
00206 }

```

```

00207 else {
00208     outfp = stdout;
00209 }
00210
00211
00212 /* Read bitmap file header */
00213 file_format[0] = get_bytes (infp, 1);
00214 file_format[1] = get_bytes (infp, 1);
00215 file_format[2] = '\0'; /* Terminate string with null */
00216
00217 /* Read file size */
00218 filesize = get_bytes (infp, 4);
00219
00220 /* Read Reserved bytes */
00221 rsvd_hdr[0] = get_bytes (infp, 1);
00222 rsvd_hdr[1] = get_bytes (infp, 1);
00223 rsvd_hdr[2] = get_bytes (infp, 1);
00224 rsvd_hdr[3] = get_bytes (infp, 1);
00225
00226 /* Read Image Offset Address within file */
00227 image_start = get_bytes (infp, 4);
00228
00229 /*
00230 See if this looks like a valid image file based on
00231 the file header first two bytes.
00232 */
00233 if (strncmp (file_format, "BM", 2) != 0) {
00234     fprintf (stderr, "\nInvalid file format: not file type \"BM\".\n\n");
00235     exit (EXIT_FAILURE);
00236 }
00237
00238 if (verbose) {
00239     fprintf (stderr, "\nFile Header:\n");
00240     fprintf (stderr, "  File Type:  \"%s\"\n", file_format);
00241     fprintf (stderr, "  File Size:   %d bytes\n", filesize);
00242     fprintf (stderr, "  Reserved:   ");
00243     for (i = 0; i < 4; i++) fprintf (stderr, " 0x%02X", rsvd_hdr[i]);
00244     fputc ('\n', stderr);
00245     fprintf (stderr, "  Image Start: %d. = 0x%02X = 0%05o\n\n",
00246             image_start, image_start, image_start);
00247 } /* if (verbose) */
00248
00249 /*
00250 Device Independent Bitmap (DIB) Header: bitmap information header
00251 ("BM" format file DIB Header is 12 bytes long).
00252 */
00253 dib_length = get_bytes (infp, 4);
00254
00255 /*
00256 Parse one of three versions of Device Independent Bitmap (DIB) format:
00257
00258 Length Format
00259 -----
00260 12  BITMAPCOREHEADER
00261 40  BITMAPINFOHEADER
00262 108 BITMAPV4HEADER
00263 124 BITMAPV5HEADER
00264 */
00265 if (dib_length == 12) { /* BITMAPCOREHEADER format -- UNTESTED */
00266     image_width  = get_bytes (infp, 2);
00267     image_height = get_bytes (infp, 2);
00268     num_planes   = get_bytes (infp, 2);
00269     bits_per_pixel = get_bytes (infp, 2);
00270 }
00271 else if (dib_length >= 40) { /* BITMAPINFOHEADER format or later */
00272     image_width = get_bytes (infp, 4);
00273     image_height = get_bytes (infp, 4);
00274     num_planes   = get_bytes (infp, 2);
00275     bits_per_pixel = get_bytes (infp, 2);
00276     compression_method = get_bytes (infp, 4); /* BI_BITFIELDS */
00277     image_size         = get_bytes (infp, 4);
00278     hres               = get_bytes (infp, 4);
00279     vres               = get_bytes (infp, 4);
00280     num_colors         = get_bytes (infp, 4);
00281     important_colors   = get_bytes (infp, 4);
00282
00283     /* true_colors is true number of colors in image */
00284     if (num_colors == 0)
00285         true_colors = 1 « bits_per_pixel;
00286     else
00287         true_colors = num_colors;

```



```

00288
00289 /*
00290 If dib_length > 40, the format is BITMAPV4HEADER or
00291 BITMAPV5HEADER. As this program is only designed
00292 to handle a monochrome image, we can ignore the rest
00293 of the header but must read past the remaining bytes.
00294 */
00295     for (i = 40; i < dib_length; i++) (void)get_bytes (infp, 1);
00296 }
00297
00298 if (verbose) {
00299     fprintf (stderr, "Device Independent Bitmap (DIB) Header:\n");
00300     fprintf (stderr, "  DIB Length:  %9d bytes (version = ", dib_length);
00301
00302     if (dib_length == 12) fprintf (stderr, "\"BITMAPCOREHEADER\"\n");
00303     else if (dib_length == 40) fprintf (stderr, "\"BITMAPINFOHEADER\"\n");
00304     else if (dib_length == 108) fprintf (stderr, "\"BITMAPV4HEADER\"\n");
00305     else if (dib_length == 124) fprintf (stderr, "\"BITMAPV5HEADER\"\n");
00306     else fprintf (stderr, "unknown");
00307     fprintf (stderr, "  Bitmap Width:  %6d pixels\n", image_width);
00308     fprintf (stderr, "  Bitmap Height: %6d pixels\n", image_height);
00309     fprintf (stderr, "  Color Planes:  %6d\n", num_planes);
00310     fprintf (stderr, "  Bits per Pixel: %6d\n", bits_per_pixel);
00311     fprintf (stderr, "  Compression Method: %2d --> ", compression_method);
00312     if (compression_method <= MAX_COMPRESSION_METHOD) {
00313         fprintf (stderr, "%s", compression_type [compression_method]);
00314     }
00315     /*
00316 Supported compression method values:
00317 0 --> uncompressed RGB
00318 11 --> uncompressed CMYK
00319 */
00320     if (compression_method == 0 || compression_method == 11) {
00321         fprintf (stderr, " (no compression)");
00322     }
00323     else {
00324         fprintf (stderr, "Image uses compression; this is unsupported.\n\n");
00325         exit (EXIT_FAILURE);
00326     }
00327     fprintf (stderr, "\n");
00328     fprintf (stderr, "  Image Size:          %5d bytes\n", image_size);
00329     fprintf (stderr, "  Horizontal Resolution: %5d pixels/meter\n", hres);
00330     fprintf (stderr, "  Vertical Resolution:  %5d pixels/meter\n", vres);
00331     fprintf (stderr, "  Number of Colors:     %5d", num_colors);
00332     if (num_colors != true_colors) {
00333         fprintf (stderr, " --> %d", true_colors);
00334     }
00335     fputc ('\n', stderr);
00336     fprintf (stderr, "  Important Colors:     %5d", important_colors);
00337     if (important_colors == 0)
00338         fprintf (stderr, " (all colors are important)");
00339     fprintf (stderr, "\n\n");
00340 } /* if (verbose) */
00341
00342 /*
00343 Print Color Table information for images with pallettized colors.
00344 */
00345 if (bits_per_pixel <= 8) {
00346     for (i = 0; i < 2; i++) {
00347         color_map [i][0] = get_bytes (infp, 1);
00348         color_map [i][1] = get_bytes (infp, 1);
00349         color_map [i][2] = get_bytes (infp, 1);
00350         color_map [i][3] = get_bytes (infp, 1);
00351     }
00352     /* Skip remaining color table entries if more than 2 */
00353     while (i < true_colors) {
00354         (void) get_bytes (infp, 4);
00355         i++;
00356     }
00357
00358     if (color_map [0][0] >= 128) image_xor = 0xFF; /* Invert colors */
00359 }
00360
00361 if (verbose) {
00362     fprintf (stderr, "Color Palette [R, G, B, %s] Values:\n",
00363             (dib_length <= 40) ? "reserved" : "Alpha");
00364     for (i = 0; i < 2; i++) {
00365         fprintf (stderr, "%7d: [", i);
00366         fprintf (stderr, "%3d,", color_map [i][0] & 0xFF);
00367         fprintf (stderr, "%3d,", color_map [i][1] & 0xFF);
00368         fprintf (stderr, "%3d,", color_map [i][2] & 0xFF);

```

```

00369     fprintf(stderr, "%3d]\n", color_map [i][3] & 0xFF);
00370     }
00371     if (image_xor == 0xFF) fprintf(stderr, "Will Invert Colors.\n");
00372     fputc ('\n', stderr);
00373
00374 } /* if (verbose) */
00375
00376
00377 /*
00378 Check format before writing output file.
00379 */
00380 if (image_width != 560 && image_width != 576) {
00381     fprintf(stderr, "\nUnsupported image width: %d\n", image_width);
00382     fprintf(stderr, "Width should be 560 or 576 pixels.\n\n");
00383     exit (EXIT_FAILURE);
00384 }
00385
00386 if (image_height != 544) {
00387     fprintf(stderr, "\nUnsupported image height: %d\n", image_height);
00388     fprintf(stderr, "Height should be 544 pixels.\n\n");
00389     exit (EXIT_FAILURE);
00390 }
00391
00392 if (num_planes != 1) {
00393     fprintf(stderr, "\nUnsupported number of planes: %d\n", num_planes);
00394     fprintf(stderr, "Number of planes should be 1.\n\n");
00395     exit (EXIT_FAILURE);
00396 }
00397
00398 if (bits_per_pixel != 1) {
00399     fprintf(stderr, "\nUnsupported number of bits per pixel: %d\n",
00400             bits_per_pixel);
00401     fprintf(stderr, "Bits per pixel should be 1.\n\n");
00402     exit (EXIT_FAILURE);
00403 }
00404
00405 if (compression_method != 0 && compression_method != 11) {
00406     fprintf(stderr, "\nUnsupported compression method: %d\n",
00407             compression_method);
00408     fprintf(stderr, "Compression method should be 1 or 11.\n\n");
00409     exit (EXIT_FAILURE);
00410 }
00411
00412 if (true_colors != 2) {
00413     fprintf(stderr, "\nUnsupported number of colors: %d\n", true_colors);
00414     fprintf(stderr, "Number of colors should be 2.\n\n");
00415     exit (EXIT_FAILURE);
00416 }
00417
00418
00419 /*
00420 If we made it this far, things look okay, so write out
00421 the standard header for image conversion.
00422 */
00423 for (i = 0; i < 62; i++) fputc (standard_header[i], outfp);
00424
00425
00426 /*
00427 Image Data. Each row must be a multiple of 4 bytes, with
00428 padding at the end of each row if necessary.
00429 */
00430 k = 0; /* byte number within the binary image */
00431 for (i = 0; i < 544; i++) {
00432     /*
00433 If original image is 560 pixels wide (not 576), add
00434 2 white bytes at beginning of row.
00435 */
00436     if (image_width == 560) { /* Insert 2 white bytes */
00437         image_bytes[k++] = 0xFF;
00438         image_bytes[k++] = 0xFF;
00439     }
00440     for (j = 0; j < 70; j++) { /* Copy next 70 bytes */
00441         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00442     }
00443     /*
00444 If original image is 560 pixels wide (not 576), skip
00445 2 padding bytes at end of row in file because we inserted
00446 2 white bytes at the beginning of the row.
00447 */
00448     if (image_width == 560) {
00449         (void) get_bytes (infp, 2);

```

```

00450     }
00451     else { /* otherwise, next 2 bytes are part of the image so copy them */
00452         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00453         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00454     }
00455 }
00456
00457
00458 /*
00459 Change the image to match the unihex2bmp.c format if original wasn't
00460 */
00461 if (image_width == 560) {
00462     regrid (image_bytes);
00463 }
00464
00465 for (i = 0; i < 544 * 576 / 8; i++) {
00466     fputc (image_bytes[i], outfp);
00467 }
00468
00469
00470 /*
00471 Wrap up.
00472 */
00473 fclose (infp);
00474 fclose (outfp);
00475
00476 exit (EXIT_SUCCESS);
00477 }

```

### 5.13.3.3 regrid()

```
void regrid (
    unsigned * image_bytes )
```

After reading in the image, shift it.

This function adjusts the input image from an original PNG file to match [unihex2bmp.c](#) format.

Parameters

in,out	image_bytes	The pixels in an image.
--------	-------------	-------------------------

Definition at line 514 of file [unibmpbump.c](#).

```

00514     {
00515     int i, j, k; /* loop variables */
00516     int offset;
00517     unsigned glyph_row; /* one grid row of 32 pixels */
00518     unsigned last_pixel; /* last pixel in a byte, to preserve */
00519
00520     /* To insert "00" after "U+" at top of image */
00521     char zero_pattern[16] = {
00522         0x00, 0x00, 0x00, 0x00, 0x18, 0x24, 0x42, 0x42,
00523         0x42, 0x42, 0x42, 0x42, 0x24, 0x18, 0x00, 0x00
00524     };
00525
00526     /* This is the horizontal grid pattern on glyph boundaries */
00527     unsigned hgrid[72] = {
00528         /* 0 */ 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff,
00529         /* 8 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00530         /* 16 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00531         /* 24 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00532         /* 32 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00533         /* 40 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00534         /* 48 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00535         /* 56 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00536         /* 64 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00
00537     };
00538
00539
00540     /*
00541     First move "U+" left and insert "00" after it.

```

```

00542 */
00543 j = 15; /* rows are written bottom to top, so we'll decrement j */
00544 for (i = 543 - 8; i > 544 - 24; i--) {
00545     offset = 72 * i;
00546     image_bytes[offset + 0] = image_bytes[offset + 2];
00547     image_bytes[offset + 1] = image_bytes[offset + 3];
00548     image_bytes[offset + 2] = image_bytes[offset + 4];
00549     image_bytes[offset + 3] = image_bytes[offset + 4] =
00550     ~zero_pattern[15 - j--] & 0xFF;
00551 }
00552
00553 /*
00554 Now move glyph bitmaps to the right by 8 pixels.
00555 */
00556 for (i = 0; i < 16; i++) { /* for each glyph row */
00557     for (j = 0; j < 16; j++) { /* for each glyph column */
00558         /* set offset to lower left-hand byte of next glyph */
00559         offset = (32 * 72 * i) + (9 * 72) + (4 * j) + 8;
00560         for (k = 0; k < 16; k++) { /* for each glyph row */
00561             glyph_row = (image_bytes[offset + 0] << 24) |
00562             (image_bytes[offset + 1] << 16) |
00563             (image_bytes[offset + 2] << 8) |
00564             (image_bytes[offset + 3]);
00565             last_pixel = glyph_row & 1; /* preserve border */
00566             glyph_row >>= 4;
00567             glyph_row &= 0x0FFFFFFE;
00568             /* Set left 4 pixels to white and preserve last pixel */
00569             glyph_row |= 0xF0000000 | last_pixel;
00570             image_bytes[offset + 3] = glyph_row & 0xFF;
00571             glyph_row >>= 8;
00572             image_bytes[offset + 2] = glyph_row & 0xFF;
00573             glyph_row >>= 8;
00574             image_bytes[offset + 1] = glyph_row & 0xFF;
00575             glyph_row >>= 8;
00576             image_bytes[offset + 0] = glyph_row & 0xFF;
00577             offset += 72; /* move up to next row in current glyph */
00578         }
00579     }
00580 }
00581
00582 /* Replace horizontal grid with unihex2bmp.c grid */
00583 for (i = 0; i <= 16; i++) {
00584     offset = 32 * 72 * i;
00585     for (j = 0; j < 72; j++) {
00586         image_bytes[offset + j] = hgrid[j];
00587     }
00588 }
00589
00590 return;
00591 }

```

## 5.14 unibmpbump.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unibmpbump.c
00003
00004 @brief unibmpbump - Adjust a Microsoft bitmap (.bmp) file that
00005 was created by unihex2png but converted to .bmp
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com
00008
00009 @copyright Copyright (C) 2019 Paul Hardy
00010
00011 This program shifts the glyphs in a bitmap file to adjust an
00012 original PNG file that was saved in BMP format. This is so the
00013 result matches the format of a unihex2bmp image. This conversion
00014 then lets unibmp2hex decode the result.
00015
00016 Synopsis: unibmpbump [-iin_file.bmp] [-out_file.bmp]
00017 */
00018 /*
00019 LICENSE:
00020
00021 This program is free software: you can redistribute it and/or modify
00022 it under the terms of the GNU General Public License as published by
00023 the Free Software Foundation, either version 2 of the License, or
00024 (at your option) any later version.

```

```

00025
00026 This program is distributed in the hope that it will be useful,
00027 but WITHOUT ANY WARRANTY; without even the implied warranty of
00028 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00029 GNU General Public License for more details.
00030
00031 You should have received a copy of the GNU General Public License
00032 along with this program. If not, see <http://www.gnu.org/licenses/>.
00033 */
00034 #include <stdio.h>
00035 #include <string.h>
00036 #include <stdlib.h>
00037
00038 #define VERSION "1.0" ///< Version of this program
00039
00040 #define MAX_COMPRESSION_METHOD 13 ///< Maximum supported compression method
00041
00042
00043 /**
00044 @brief The main function.
00045
00046 @param[in] argc The count of command line arguments.
00047 @param[in] argv Pointer to array of command line arguments.
00048 @return This program exits with status EXIT_SUCCESS.
00049 */
00050 int main (int argc, char *argv[]) {
00051
00052     /*
00053     Values preserved from file header (first 14 bytes).
00054     */
00055     char file_format[3]; /* "BM" for original Windows format */
00056     unsigned filesize; /* size of file in bytes */
00057     unsigned char rsvd_hdr[4]; /* 4 reserved bytes */
00058     unsigned image_start; /* byte offset of image in file */
00059
00060     /*
00061     Values preserved from Device Independent Bitmap (DIB) Header.
00062
00063     The DIB fields below are in the standard 40-byte header. Version
00064     4 and version 5 headers have more information, mainly for color
00065     information. That is skipped over, because a valid glyph image
00066     is just monochrome.
00067     */
00068     int dib_length; /* in bytes, for parsing by header version */
00069     int image_width = 0; /* Signed image width */
00070     int image_height = 0; /* Signed image height */
00071     int num_planes = 0; /* number of planes; must be 1 */
00072     int bits_per_pixel = 0; /* for palletized color maps (< 2^16 colors) */
00073
00074     /*
00075     The following fields are not in the original spec, so initialize
00076     them to 0 so we can correctly parse an original file format.
00077     */
00077     int compression_method=0; /* 0 --> uncompressed RGB/monochrome */
00078     int image_size = 0; /* 0 is a valid size if no compression */
00079     int hres = 0; /* image horizontal resolution */
00080     int vres = 0; /* image vertical resolution */
00081     int num_colors = 0; /* Number of colors for palletized images */
00082     int important_colors = 0; /* Number of significant colors (0 or 2) */
00083
00084     int true_colors = 0; /* interpret num_colors, which can equal 0 */
00085
00086     /*
00087     Color map. This should be a monochrome file, so only two
00088     colors are stored.
00089     */
00090     unsigned char color_map[2][4]; /* two of R, G, B, and possibly alpha */
00091
00092     /*
00093     The monochrome image bitmap, stored as a vector 544 rows by
00094     72*8 columns.
00095     */
00096     unsigned image_bytes[544*72];
00097
00098     /*
00099     Flags for conversion & I/O.
00100     */
00101     int verbose = 0; /* Whether to print file info on stderr */
00102     unsigned image_xor = 0x00; /* Invert (= 0xFF) if color 0 is not black */
00103
00104     /*
00105     Temporary variables.

```

```

00106 */
00107 int i, j, k;          /* loop variables */
00108
00109 /* Compression type, for parsing file */
00110 char *compression_type[MAX_COMPRESSION_METHOD + 1] = {
00111     "BI_RGB",          /* 0 */
00112     "BI_RLE8",        /* 1 */
00113     "BI_RLE4",        /* 2 */
00114     "BI_BITFIELDS",   /* 3 */
00115     "BI_JPEG",        /* 4 */
00116     "BI_PNG",         /* 5 */
00117     "BI_ALPHABITFIELDS", /* 6 */
00118     "", "", "", "",   /* 7 - 10 */
00119     "BI_CMYK",        /* 11 */
00120     "BI_CMYKRLE8",    /* 12 */
00121     "BI_CMYKRLE4",    /* 13 */
00122 };
00123
00124 /* Standard unihex2bmp.c header for BMP image */
00125 unsigned standard_header [62] = {
00126     /* 0 */ 0x42, 0x4d, 0x3e, 0x99, 0x00, 0x00, 0x00, 0x00,
00127     /* 8 */ 0x00, 0x00, 0x3e, 0x00, 0x00, 0x00, 0x28, 0x00,
00128     /* 16 */ 0x00, 0x00, 0x40, 0x02, 0x00, 0x00, 0x20, 0x02,
00129     /* 24 */ 0x00, 0x00, 0x01, 0x00, 0x01, 0x00, 0x00, 0x00,
00130     /* 32 */ 0x00, 0x00, 0x00, 0x99, 0x00, 0x00, 0xc4, 0x0e,
00131     /* 40 */ 0x00, 0x00, 0xc4, 0x0e, 0x00, 0x00, 0x00, 0x00,
00132     /* 48 */ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
00133     /* 56 */ 0x00, 0x00, 0xff, 0xff, 0xff, 0x00
00134 };
00135
00136 unsigned get_bytes (FILE *, int);
00137 void regrid (unsigned *);
00138
00139 char *infile="", *outfile=""; /* names of input and output files */
00140 FILE *infp, *outfp;          /* file pointers of input and output files */
00141
00142 /*
00143 Process command line arguments.
00144 */
00145 if (argc > 1) {
00146     for (i = 1; i < argc; i++) {
00147         if (argv[i][0] == '-') { /* this is an option argument */
00148             switch (argv[i][1]) {
00149                 case 'i': /* name of input file */
00150                     infile = &argv[i][2];
00151                     break;
00152                 case 'o': /* name of output file */
00153                     outfile = &argv[i][2];
00154                     break;
00155                 case 'v': /* verbose output */
00156                     verbose = 1;
00157                     break;
00158                 case 'V': /* print version & quit */
00159                     fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00160                     exit (EXIT_SUCCESS);
00161                     break;
00162                 case '-': /* see if "--verbose" */
00163                     if (strcmp (argv[i], "--verbose") == 0) {
00164                         verbose = 1;
00165                     }
00166                     else if (strcmp (argv[i], "--version") == 0) {
00167                         fprintf (stderr, "unibmpbump version %s\n\n", VERSION);
00168                         exit (EXIT_SUCCESS);
00169                     }
00170                     break;
00171                 default: /* if unrecognized option, print list and exit */
00172                     fprintf (stderr, "\nSyntax:\n\n");
00173                     fprintf (stderr, "    unibmpbump ");
00174                     fprintf (stderr, "-i<Input_File> -o<Output_File>\n\n");
00175                     fprintf (stderr, "-v or --verbose gives verbose output");
00176                     fprintf (stderr, " on stderr\n\n");
00177                     fprintf (stderr, "-V or --version prints version");
00178                     fprintf (stderr, " on stderr and exits\n\n");
00179                     fprintf (stderr, "\nExample:\n\n");
00180                     fprintf (stderr, "    unibmpbump -iuni0101.bmp");
00181                     fprintf (stderr, " -onew-uni0101.bmp\n\n");
00182                     exit (EXIT_SUCCESS);
00183             }
00184         }
00185     }
00186 }

```

```

00187
00188 /*
00189 Make sure we can open any I/O files that were specified before
00190 doing anything else.
00191 */
00192 if (strlen (infile) > 0) {
00193     if ((infp = fopen (infile, "r")) == NULL) {
00194         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00195         exit (EXIT_FAILURE);
00196     }
00197 }
00198 else {
00199     infp = stdin;
00200 }
00201 if (strlen (outfile) > 0) {
00202     if ((outfp = fopen (outfile, "w")) == NULL) {
00203         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00204         exit (EXIT_FAILURE);
00205     }
00206 }
00207 else {
00208     outfp = stdout;
00209 }
00210
00211
00212 /* Read bitmap file header */
00213 file_format[0] = get_bytes (infp, 1);
00214 file_format[1] = get_bytes (infp, 1);
00215 file_format[2] = '\0'; /* Terminate string with null */
00216
00217 /* Read file size */
00218 filesize = get_bytes (infp, 4);
00219
00220 /* Read Reserved bytes */
00221 rsvd_hdr[0] = get_bytes (infp, 1);
00222 rsvd_hdr[1] = get_bytes (infp, 1);
00223 rsvd_hdr[2] = get_bytes (infp, 1);
00224 rsvd_hdr[3] = get_bytes (infp, 1);
00225
00226 /* Read Image Offset Address within file */
00227 image_start = get_bytes (infp, 4);
00228
00229 /*
00230 See if this looks like a valid image file based on
00231 the file header first two bytes.
00232 */
00233 if (strncmp (file_format, "BM", 2) != 0) {
00234     fprintf (stderr, "\nInvalid file format: not file type \"BM\".\n\n");
00235     exit (EXIT_FAILURE);
00236 }
00237
00238 if (verbose) {
00239     fprintf (stderr, "\nFile Header:\n");
00240     fprintf (stderr, "  File Type:  \\\n%s\\n", file_format);
00241     fprintf (stderr, "  File Size:  %d bytes\n", filesize);
00242     fprintf (stderr, "  Reserved:  ");
00243     for (i = 0; i < 4; i++) fprintf (stderr, " 0x%02X", rsvd_hdr[i]);
00244     fputc ('\n', stderr);
00245     fprintf (stderr, "  Image Start: %d. = 0x%02X = 0%05o\n\n",
00246             image_start, image_start, image_start);
00247 } /* if (verbose) */
00248
00249 /*
00250 Device Independent Bitmap (DIB) Header: bitmap information header
00251 ("BM" format file DIB Header is 12 bytes long).
00252 */
00253 dib_length = get_bytes (infp, 4);
00254
00255 /*
00256 Parse one of three versions of Device Independent Bitmap (DIB) format:
00257 Length Format
00258 -----
00259 12  BITMAPCOREHEADER
00260 40  BITMAPINFOHEADER
00261 108 BITMAPV4HEADER
00262 124 BITMAPV5HEADER
00263 */
00264 /*
00265 if (dib_length == 12) { /* BITMAPCOREHEADER format -- UNTESTED */
00266     image_width  = get_bytes (infp, 2);
00267     image_height = get_bytes (infp, 2);

```

```

00268     num_planes    = get_bytes (infp, 2);
00269     bits_per_pixel = get_bytes (infp, 2);
00270 }
00271 else if (dib_length >= 40) { /* BITMAPINFOHEADER format or later */
00272     image_width = get_bytes (infp, 4);
00273     image_height = get_bytes (infp, 4);
00274     num_planes    = get_bytes (infp, 2);
00275     bits_per_pixel = get_bytes (infp, 2);
00276     compression_method = get_bytes (infp, 4); /* BI_BITFIELDS */
00277     image_size    = get_bytes (infp, 4);
00278     hres          = get_bytes (infp, 4);
00279     vres          = get_bytes (infp, 4);
00280     num_colors    = get_bytes (infp, 4);
00281     important_colors = get_bytes (infp, 4);
00282
00283     /* true_colors is true number of colors in image */
00284     if (num_colors == 0)
00285         true_colors = 1 « bits_per_pixel;
00286     else
00287         true_colors = num_colors;
00288
00289     /*
00290 If dib_length > 40, the format is BITMAPV4HEADER or
00291 BITMAPV5HEADER. As this program is only designed
00292 to handle a monochrome image, we can ignore the rest
00293 of the header but must read past the remaining bytes.
00294 */
00295     for (i = 40; i < dib_length; i++) (void)get_bytes (infp, 1);
00296 }
00297
00298 if (verbose) {
00299     fprintf (stderr, "Device Independent Bitmap (DIB) Header:\n");
00300     fprintf (stderr, "  DIB Length:  %9d bytes (version = ", dib_length);
00301
00302     if (dib_length == 12) fprintf (stderr, "\"BITMAPCOREHEADER\"\n");
00303     else if (dib_length == 40) fprintf (stderr, "\"BITMAPINFOHEADER\"\n");
00304     else if (dib_length == 108) fprintf (stderr, "\"BITMAPV4HEADER\"\n");
00305     else if (dib_length == 124) fprintf (stderr, "\"BITMAPV5HEADER\"\n");
00306     else fprintf (stderr, "unknown");
00307     fprintf (stderr, "  Bitmap Width:  %6d pixels\n", image_width);
00308     fprintf (stderr, "  Bitmap Height: %6d pixels\n", image_height);
00309     fprintf (stderr, "  Color Planes:  %6d\n", num_planes);
00310     fprintf (stderr, "  Bits per Pixel: %6d\n", bits_per_pixel);
00311     fprintf (stderr, "  Compression Method: %2d --> ", compression_method);
00312     if (compression_method <= MAX_COMPRESSION_METHOD) {
00313         fprintf (stderr, "%s", compression_type [compression_method]);
00314     }
00315     /*
00316 Supported compression method values:
00317 0 --> uncompressed RGB
00318 11 --> uncompressed CMYK
00319 */
00320     if (compression_method == 0 || compression_method == 11) {
00321         fprintf (stderr, " (no compression)");
00322     }
00323     else {
00324         fprintf (stderr, "Image uses compression; this is unsupported.\n\n");
00325         exit (EXIT_FAILURE);
00326     }
00327     fprintf (stderr, "\n");
00328     fprintf (stderr, "  Image Size:          %5d bytes\n", image_size);
00329     fprintf (stderr, "  Horizontal Resolution: %5d pixels/meter\n", hres);
00330     fprintf (stderr, "  Vertical Resolution:  %5d pixels/meter\n", vres);
00331     fprintf (stderr, "  Number of Colors:    %5d", num_colors);
00332     if (num_colors != true_colors) {
00333         fprintf (stderr, " --> %d", true_colors);
00334     }
00335     fputc ('\n', stderr);
00336     fprintf (stderr, "  Important Colors:    %5d", important_colors);
00337     if (important_colors == 0)
00338         fprintf (stderr, " (all colors are important)");
00339     fprintf (stderr, "\n\n");
00340 } /* if (verbose) */
00341
00342 /*
00343 Print Color Table information for images with pallettized colors.
00344 */
00345 if (bits_per_pixel <= 8) {
00346     for (i = 0; i < 2; i++) {
00347         color_map [i][0] = get_bytes (infp, 1);
00348         color_map [i][1] = get_bytes (infp, 1);

```



```

00349     color_map [i][2] = get_bytes (infp, 1);
00350     color_map [i][3] = get_bytes (infp, 1);
00351 }
00352 /* Skip remaining color table entries if more than 2 */
00353 while (i < true_colors) {
00354     (void) get_bytes (infp, 4);
00355     i++;
00356 }
00357
00358 if (color_map [0][0] >= 128) image_xor = 0xFF; /* Invert colors */
00359 }
00360
00361 if (verbose) {
00362     fprintf (stderr, "Color Palette [R, G, B, %s] Values:\n",
00363             (dib_length <= 40) ? "reserved" : "Alpha");
00364     for (i = 0; i < 2; i++) {
00365         fprintf (stderr, "%7d: [", i);
00366         fprintf (stderr, "%3d,", color_map [i][0] & 0xFF);
00367         fprintf (stderr, "%3d,", color_map [i][1] & 0xFF);
00368         fprintf (stderr, "%3d,", color_map [i][2] & 0xFF);
00369         fprintf (stderr, "%3d\n", color_map [i][3] & 0xFF);
00370     }
00371     if (image_xor == 0xFF) fprintf (stderr, "Will Invert Colors.\n");
00372     fputc ('\n', stderr);
00373 } /* if (verbose) */
00374 }
00375
00376 /*
00377 Check format before writing output file.
00378 */
00379 if (image_width != 560 && image_width != 576) {
00380     fprintf (stderr, "\nUnsupported image width: %d\n", image_width);
00381     fprintf (stderr, "Width should be 560 or 576 pixels.\n\n");
00382     exit (EXIT_FAILURE);
00383 }
00384
00385 if (image_height != 544) {
00386     fprintf (stderr, "\nUnsupported image height: %d\n", image_height);
00387     fprintf (stderr, "Height should be 544 pixels.\n\n");
00388     exit (EXIT_FAILURE);
00389 }
00390
00391 if (num_planes != 1) {
00392     fprintf (stderr, "\nUnsupported number of planes: %d\n", num_planes);
00393     fprintf (stderr, "Number of planes should be 1.\n\n");
00394     exit (EXIT_FAILURE);
00395 }
00396
00397 if (bits_per_pixel != 1) {
00398     fprintf (stderr, "\nUnsupported number of bits per pixel: %d\n",
00399             bits_per_pixel);
00400     fprintf (stderr, "Bits per pixel should be 1.\n\n");
00401     exit (EXIT_FAILURE);
00402 }
00403
00404 if (compression_method != 0 && compression_method != 11) {
00405     fprintf (stderr, "\nUnsupported compression method: %d\n",
00406             compression_method);
00407     fprintf (stderr, "Compression method should be 1 or 11.\n\n");
00408     exit (EXIT_FAILURE);
00409 }
00410
00411 if (true_colors != 2) {
00412     fprintf (stderr, "\nUnsupported number of colors: %d\n", true_colors);
00413     fprintf (stderr, "Number of colors should be 2.\n\n");
00414     exit (EXIT_FAILURE);
00415 }
00416 }
00417
00418 /*
00419 If we made it this far, things look okay, so write out
00420 the standard header for image conversion.
00421 */
00422 for (i = 0; i < 62; i++) fputc (standard_header[i], outfp);
00423
00424 /*
00425 Image Data. Each row must be a multiple of 4 bytes, with
00426 padding at the end of each row if necessary.
00427 */

```

```

00430 k = 0; /* byte number within the binary image */
00431 for (i = 0; i < 544; i++) {
00432     /*
00433     If original image is 560 pixels wide (not 576), add
00434     2 white bytes at beginning of row.
00435     */
00436     if (image_width == 560) { /* Insert 2 white bytes */
00437         image_bytes[k++] = 0xFF;
00438         image_bytes[k++] = 0xFF;
00439     }
00440     for (j = 0; j < 70; j++) { /* Copy next 70 bytes */
00441         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00442     }
00443     /*
00444     If original image is 560 pixels wide (not 576), skip
00445     2 padding bytes at end of row in file because we inserted
00446     2 white bytes at the beginning of the row.
00447     */
00448     if (image_width == 560) {
00449         (void) get_bytes (infp, 2);
00450     }
00451     else { /* otherwise, next 2 bytes are part of the image so copy them */
00452         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00453         image_bytes[k++] = (get_bytes (infp, 1) & 0xFF) ^ image_xor;
00454     }
00455 }
00456
00457
00458 /*
00459 Change the image to match the unihex2bmp.c format if original wasn't
00460 */
00461 if (image_width == 560) {
00462     regrid (image_bytes);
00463 }
00464
00465 for (i = 0; i < 544 * 576 / 8; i++) {
00466     fputc (image_bytes[i], outfp);
00467 }
00468
00469
00470 /*
00471 Wrap up.
00472 */
00473 fclose (infp);
00474 fclose (outfp);
00475
00476 exit (EXIT_SUCCESS);
00477 }
00478
00479
00480 /**
00481 @brief Get from 1 to 4 bytes, inclusive, from input file.
00482
00483 @param[in] infp Pointer to input file.
00484 @param[in] nbytes Number of bytes to read, from 1 to 4, inclusive.
00485 @return The unsigned 1 to 4 bytes in machine native endian format.
00486 */
00487 unsigned get_bytes (FILE *infp, int nbytes) {
00488     int i;
00489     unsigned char inchar[4];
00490     unsigned inword;
00491
00492     for (i = 0; i < nbytes; i++) {
00493         if (fread (&inchar[i], 1, 1, infp) != 1) {
00494             inchar[i] = 0;
00495         }
00496     }
00497     for (i = nbytes; i < 4; i++) inchar[i] = 0;
00498
00499     inword = ((inchar[3] & 0xFF) « 24) | ((inchar[2] & 0xFF) « 16) |
00500             ((inchar[1] & 0xFF) « 8) | (inchar[0] & 0xFF);
00501
00502     return inword;
00503 }
00504
00505
00506 /**
00507 @brief After reading in the image, shift it.
00508
00509 This function adjusts the input image from an original PNG file
00510 to match unihex2bmp.c format.

```

```

00511
00512 @param[in,out] image_bytes The pixels in an image.
00513 */
00514 void regrid (unsigned *image_bytes) {
00515     int i, j, k; /* loop variables */
00516     int offset;
00517     unsigned glyph_row; /* one grid row of 32 pixels */
00518     unsigned last_pixel; /* last pixel in a byte, to preserve */
00519
00520     /* To insert "00" after "U+" at top of image */
00521     char zero_pattern[16] = {
00522         0x00, 0x00, 0x00, 0x00, 0x18, 0x24, 0x42, 0x42,
00523         0x42, 0x42, 0x42, 0x42, 0x24, 0x18, 0x00, 0x00
00524     };
00525
00526     /* This is the horizontal grid pattern on glyph boundaries */
00527     unsigned hgrid[72] = {
00528         /* 0 */ 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff,
00529         /* 8 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00530         /* 16 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00531         /* 24 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00532         /* 32 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00533         /* 40 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00534         /* 48 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00535         /* 56 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00,
00536         /* 64 */ 0x00, 0x81, 0x81, 0x00, 0x00, 0x81, 0x81, 0x00
00537     };
00538
00539     /*
00540     First move "U+" left and insert "00" after it.
00541     */
00542     j = 15; /* rows are written bottom to top, so we'll decrement j */
00543     for (i = 543 - 8; i > 544 - 24; i--) {
00544         offset = 72 * i;
00545         image_bytes [offset + 0] = image_bytes [offset + 2];
00546         image_bytes [offset + 1] = image_bytes [offset + 3];
00547         image_bytes [offset + 2] = image_bytes [offset + 4];
00548         image_bytes [offset + 3] = image_bytes [offset + 4] =
00549             ~zero_pattern[15 - j--] & 0xFF;
00550     }
00551 }
00552
00553 /*
00554 Now move glyph bitmaps to the right by 8 pixels.
00555 */
00556 for (i = 0; i < 16; i++) { /* for each glyph row */
00557     for (j = 0; j < 16; j++) { /* for each glyph column */
00558         /* set offset to lower left-hand byte of next glyph */
00559         offset = (32 * 72 * i) + (9 * 72) + (4 * j) + 8;
00560         for (k = 0; k < 16; k++) { /* for each glyph row */
00561             glyph_row = (image_bytes [offset + 0] << 24) |
00562                 (image_bytes [offset + 1] << 16) |
00563                 (image_bytes [offset + 2] << 8) |
00564                 (image_bytes [offset + 3]);
00565             last_pixel = glyph_row & 1; /* preserve border */
00566             glyph_row >>= 4;
00567             glyph_row &= 0x0FFFFFFE;
00568             /* Set left 4 pixels to white and preserve last pixel */
00569             glyph_row |= 0xF0000000 | last_pixel;
00570             image_bytes [offset + 3] = glyph_row & 0xFF;
00571             glyph_row >>= 8;
00572             image_bytes [offset + 2] = glyph_row & 0xFF;
00573             glyph_row >>= 8;
00574             image_bytes [offset + 1] = glyph_row & 0xFF;
00575             glyph_row >>= 8;
00576             image_bytes [offset + 0] = glyph_row & 0xFF;
00577             offset += 72; /* move up to next row in current glyph */
00578         }
00579     }
00580 }
00581
00582 /* Replace horizontal grid with unihex2bmp.c grid */
00583 for (i = 0; i <= 16; i++) {
00584     offset = 32 * 72 * i;
00585     for (j = 0; j < 72; j++) {
00586         image_bytes [offset + j] = hgrid [j];
00587     }
00588 }
00589
00590 return;
00591 }

```

## 5.15 src/unicoverage.c File Reference

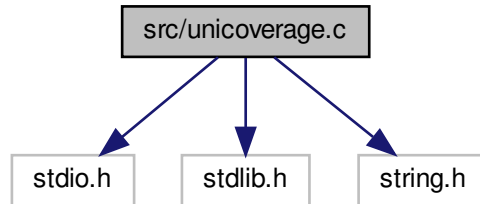
unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unicoverage.c:



### Macros

- `#define MAXBUF 256`  
Maximum input line length - 1.

### Functions

- `int main (int argc, char *argv[])`  
The main function.
- `int nextrange (FILE *coveragefp, int *cstart, int *cend, char *coverstring)`  
Get next Unicode range.
- `void print_subtotal (FILE *outfp, int print_n, int nglyphs, int cstart, int cend, char *coverstring)`  
Print the subtotal for one Unicode script range.

#### 5.15.1 Detailed Description

unicoverage - Show the coverage of Unicode plane scripts for a GNU Unifont hex glyph file

Author

Paul Hardy, unifoundry <at> unifoundry.com, 6 January 2008

Copyright

Copyright (C) 2008, 2013 Paul Hardy

Synopsis: `unicoverage [-ifont_file.hex] [-ocoverage_file.txt]`

This program requires the file "coverage.dat" to be present in the directory from which it is run.

Definition in file [unicoverage.c](#).

#### 5.15.2 Macro Definition Documentation

## 5.15.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum input line length - 1.

Definition at line 57 of file [unicoverage.c](#).

## 5.15.3 Function Documentation

## 5.15.3.1 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 68 of file [unicoverage.c](#).

```
00069 {
00070
00071     int    print_n=0;        /* print # of glyphs, not percentage */
00072     unsigned i;            /* loop variable */
00073     unsigned slen;        /* string length of coverage file line */
00074     char    inbuf[256];    /* input buffer */
00075     unsigned thischar;    /* the current character */
00076
00077     char *infile="", *outfile=""; /* names of input and output files */
00078     FILE *infp, *outfp;    /* file pointers of input and output files */
00079     FILE *coveragefp;    /* file pointer to coverage.dat file */
00080     int cstart, cend;    /* current coverage start and end code points */
00081     char coverstring[MAXBUF]; /* description of current coverage range */
00082     int nglyphs;        /* number of glyphs in this section */
00083     int nextrange();    /* to get next range & name of Unicode glyphs */
00084
00085     void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00086                        int cstart, int cend, char *coverstring);
00087
00088     if ((coveragefp = fopen ("coverage.dat", "r")) == NULL) {
00089         fprintf (stderr, "\nError: data file \"coverage.dat\" not found.\n\n");
00090         exit (0);
00091     }
```

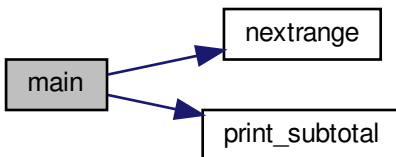
```

00091 }
00092
00093 if (argc > 1) {
00094     for (i = 1; i < argc; i++) {
00095         if (argv[i][0] == '-') { /* this is an option argument */
00096             switch (argv[i][1]) {
00097                 case 'i': /* name of input file */
00098                     infile = &argv[i][2];
00099                     break;
00100                 case 'n': /* print number of glyphs instead of percentage */
00101                     print_n = 1;
00102                 case 'o': /* name of output file */
00103                     outfile = &argv[i][2];
00104                     break;
00105                 default: /* if unrecognized option, print list and exit */
00106                     fprintf (stderr, "\nSyntax:\n\n");
00107                     fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00108                     fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00109                     exit (1);
00110             }
00111         }
00112     }
00113 }
00114 /*
00115 Make sure we can open any I/O files that were specified before
00116 doing anything else.
00117 */
00118 if (strlen (infile) > 0) {
00119     if ((infp = fopen (infile, "r")) == NULL) {
00120         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00121         exit (1);
00122     }
00123 }
00124 else {
00125     infp = stdin;
00126 }
00127 if (strlen (outfile) > 0) {
00128     if ((outfp = fopen (outfile, "w")) == NULL) {
00129         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00130         exit (1);
00131     }
00132 }
00133 else {
00134     outfp = stdout;
00135 }
00136
00137 /*
00138 Print header row.
00139 */
00140 if (print_n) {
00141     fprintf (outfp, "# Glyphs      Range      Script\n");
00142     fprintf (outfp, "-----      ----      ----- \n");
00143 }
00144 else {
00145     fprintf (outfp, "Covered      Range      Script\n");
00146     fprintf (outfp, "-----      ----      ----- \n");
00147 }
00148
00149 slen = nextrange (coveragefp, &cstart, &chend, coverstring);
00150 nglyphs = 0;
00151
00152 /*
00153 Read in the glyphs in the file
00154 */
00155 while (slen != 0 && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00156     sscanf (inbuf, "%x", &thischar);
00157
00158     /* Read a character beyond end of current script. */
00159     while (cend < thischar && slen != 0) {
00160         print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00161
00162         /* start new range total */
00163         slen = nextrange (coveragefp, &cstart, &chend, coverstring);
00164         nglyphs = 0;
00165     }
00166     nglyphs++;
00167 }
00168
00169 print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00170
00171 exit (0);

```

```
00172 }
```

Here is the call graph for this function:



### 5.15.3.2 nextrange()

```
int nextrange (
    FILE * coveragefp,
    int * cstart,
    int * cend,
    char * coverstring )
```

Get next Unicode range.

This function reads the next Unicode script range to count its glyph coverage.

Parameters

in	coveragefp	File pointer to Unicode script range data file.
in	cstart	Starting code point in current Unicode script range.

## Parameters

in	cend	Ending code point in current Unicode script range.
out	coverstring	String containing <code>&lt;start&gt;</code> - <code>&lt;end&gt;</code> substring.

## Returns

Length of the last string read, or 0 for end of file.

Definition at line 187 of file `unicoverage.c`.

```

00190 {
00191     int i;
00192     static char inbuf[MAXBUF];
00193     int retval; /* the return value */
00194
00195     retval = 0;
00196
00197     do {
00198         if (fgets (inbuf, MAXBUF-1, coveragefp) != NULL) {
00199             retval = strlen (inbuf);
00200             if ((inbuf[0] >= '0' && inbuf[0] <= '9') ||
00201                 (inbuf[0] >= 'A' && inbuf[0] <= 'F') ||
00202                 (inbuf[0] >= 'a' && inbuf[0] <= 'f')) {
00203                 sscanf (inbuf, "%x-%x", cstart, cend);
00204                 i = 0;
00205                 while (inbuf[i] != ' ') i++; /* find first blank */
00206                 while (inbuf[i] == ' ') i++; /* find next non-blank */
00207                 strncpy (coverstring, &inbuf[i], MAXBUF);
00208             }
00209             else retval = 0;
00210         }
00211         else retval = 0;
00212     } while (retval == 0 && !feof (coveragefp));
00213
00214     return (retval);
00215 }

```

Here is the caller graph for this function:





### 5.15.3.3 print\_subtotal()

```
void print_subtotal (
    FILE * outfp,
    int print_n,
    int nglyphs,
    int cstart,
    int cend,
    char * coverstring )
```

Print the subtotal for one Unicode script range.

#### Parameters

in	outfp	Pointer to output file.
in	print_n	1 = print number of glyphs, 0 = print percentage.
in	nglyphs	Number of glyphs in current range.
in	cstart	Starting code point for current range.
in	cend	Ending code point for current range.

## Parameters

in	coverstring	Character string of " <code>&lt;cstart&gt;</code> - <code>&lt;end&gt;</code> ".
----	-------------	---

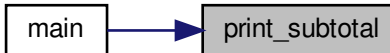
Definition at line 228 of file `unicoverage.c`.

```

00229 {
00230
00231 /* print old range total */
00232 if (print_n) { /* Print number of glyphs, not percentage */
00233     fprintf (outfp, " %6d ", nglyphs);
00234 }
00235 else {
00236     fprintf (outfp, " %5.1f%%", 100.0*nglyphs/(1+cend-cstart));
00237 }
00238
00239 if (cend < 0x10000)
00240     fprintf (outfp, " U+%04X..U+%04X  %s",
00241             cstart, cend, coverstring);
00242 else
00243     fprintf (outfp, " U+%05X..U+%05X  %s",
00244             cstart, cend, coverstring);
00245
00246 return;
00247 }

```

Here is the caller graph for this function:



## 5.16 unicoverage.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unicoverage.c
00003
00004  @brief unicoverage - Show the coverage of Unicode plane scripts
00005  for a GNU Unifont hex glyph file
00006
00007  @author Paul Hardy, unifoundry <at> unifoundry.com, 6 January 2008
00008
00009  @copyright Copyright (C) 2008, 2013 Paul Hardy
00010
00011  Synopsis: unicoverage [-ifont_file.hex] [-ocoverage_file.txt]
00012
00013  This program requires the file "coverage.dat" to be present
00014  in the directory from which it is run.
00015  */
00016  /*
00017  LICENSE:
00018
00019  This program is free software: you can redistribute it and/or modify
00020  it under the terms of the GNU General Public License as published by
00021  the Free Software Foundation, either version 2 of the License, or
00022  (at your option) any later version.
00023
00024  This program is distributed in the hope that it will be useful,
00025  but WITHOUT ANY WARRANTY; without even the implied warranty of

```

```

00026 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00027 GNU General Public License for more details.
00028
00029 You should have received a copy of the GNU General Public License
00030 along with this program. If not, see <http://www.gnu.org/licenses/>.
00031 */
00032
00033 /*
00034 2016 (Paul Hardy): Modified in Unifont 9.0.01 release to remove non-existent
00035 "-p" option and empty example from help printout.
00036
00037 2018 (Paul Hardy): Modified to cover entire Unicode range, not just Plane 0.
00038
00039 11 May 2019: [Paul Hardy] changed strcpy function call to strncpy
00040 for better error handling.
00041
00042 31 May 2019: [Paul Hardy] replaced strcpy call with strncpy
00043 for compilation on more systems.
00044
00045 4 June 2022: [Paul Hardy] Adjusted column spacing for better alignment
00046 of Unicode Plane 1-15 scripts. Added "-n" option to print number of
00047 glyphs in each range instead of percent coverage.
00048
00049 18 September 2022: [Paul Hardy] in nextrange function, initialize retval.
00050 */
00051
00052 #include <stdio.h>
00053 #include <stdlib.h>
00054 #include <string.h>
00055
00056
00057 #define MAXBUF 256 ///< Maximum input line length - 1
00058
00059
00060 /**
00061 @brief The main function.
00062
00063 @param[in] argc The count of command line arguments.
00064 @param[in] argv Pointer to array of command line arguments.
00065 @return This program exits with status 0.
00066 */
00067 int
00068 main (int argc, char *argv[])
00069 {
00070
00071     int    print_n=0;    /* print # of glyphs, not percentage */
00072     unsigned i;        /* loop variable */
00073     unsigned slen;     /* string length of coverage file line */
00074     char    inbuf[256]; /* input buffer */
00075     unsigned thischar; /* the current character */
00076
00077     char *infile="", *outfile=""; /* names of input and output files */
00078     FILE *infp, *outfp; /* file pointers of input and output files */
00079     FILE *coveragefp; /* file pointer to coverage.dat file */
00080     int cstart, cend; /* current coverage start and end code points */
00081     char coverstring[MAXBUF]; /* description of current coverage range */
00082     int nglyphs; /* number of glyphs in this section */
00083     int nextrange(); /* to get next range & name of Unicode glyphs */
00084
00085     void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00086                         int cstart, int cend, char *coverstring);
00087
00088     if ((coveragefp = fopen ("coverage.dat", "r")) == NULL) {
00089         fprintf (stderr, "\nError: data file \"coverage.dat\" not found.\n\n");
00090         exit (0);
00091     }
00092
00093     if (argc > 1) {
00094         for (i = 1; i < argc; i++) {
00095             if (argv[i][0] == '-') { /* this is an option argument */
00096                 switch (argv[i][1]) {
00097                     case 'i': /* name of input file */
00098                         infile = &argv[i][2];
00099                         break;
00100                     case 'n': /* print number of glyphs instead of percentage */
00101                         print_n = 1;
00102                     case 'o': /* name of output file */
00103                         outfile = &argv[i][2];
00104                         break;
00105                     default: /* if unrecognized option, print list and exit */
00106                         fprintf (stderr, "\nSyntax:\n\n");

```

```

00107         fprintf (stderr, "  %s -p<Unicode_Page> ", argv[0]);
00108         fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00109         exit (1);
00110     }
00111 }
00112 }
00113 }
00114 /*
00115 Make sure we can open any I/O files that were specified before
00116 doing anything else.
00117 */
00118 if (strlen (infile) > 0) {
00119     if ((infp = fopen (infile, "r")) == NULL) {
00120         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00121         exit (1);
00122     }
00123 }
00124 else {
00125     infp = stdin;
00126 }
00127 if (strlen (outfile) > 0) {
00128     if ((outfp = fopen (outfile, "w")) == NULL) {
00129         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00130         exit (1);
00131     }
00132 }
00133 else {
00134     outfp = stdout;
00135 }
00136
00137 /*
00138 Print header row.
00139 */
00140 if (print_n) {
00141     fprintf (outfp, "# Glyphs      Range      Script\n");
00142     fprintf (outfp, "-----      ----      ----- \n");
00143 }
00144 else {
00145     fprintf (outfp, "Covered      Range      Script\n");
00146     fprintf (outfp, "-----      ----      ----- \n\n");
00147 }
00148
00149 slen = nextrange (coveragefp, &cstart, &chend, coverstring);
00150 nglyphs = 0;
00151
00152 /*
00153 Read in the glyphs in the file
00154 */
00155 while (slen != 0 && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00156     sscanf (inbuf, "%cx", &thischar);
00157
00158     /* Read a character beyond end of current script. */
00159     while (cend < thischar && slen != 0) {
00160         print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00161
00162         /* start new range total */
00163         slen = nextrange (coveragefp, &cstart, &chend, coverstring);
00164         nglyphs = 0;
00165     }
00166     nglyphs++;
00167 }
00168
00169 print_subtotal (outfp, print_n, nglyphs, cstart, cend, coverstring);
00170
00171 exit (0);
00172 }
00173
00174 /**
00175 @brief Get next Unicode range.
00176
00177 This function reads the next Unicode script range to count its
00178 glyph coverage.
00179
00180 @param[in] coveragefp File pointer to Unicode script range data file.
00181 @param[in] cstart Starting code point in current Unicode script range.
00182 @param[in] cend Ending code point in current Unicode script range.
00183 @param[out] coverstring String containing <cstart>-<cend> substring.
00184 @return Length of the last string read, or 0 for end of file.
00185 */
00186 int
00187 nextrange (FILE *coveragefp,

```

```

00188         int *cstart, int *cend,
00189         char *coverstring)
00190 {
00191     int i;
00192     static char inbuf[MAXBUF];
00193     int retval;          /* the return value */
00194
00195     retval = 0;
00196
00197     do {
00198         if (fgets (inbuf, MAXBUF-1, coveragefp) != NULL) {
00199             retval = strlen (inbuf);
00200             if ((inbuf[0] >= '0' && inbuf[0] <= '9') ||
00201                 (inbuf[0] >= 'A' && inbuf[0] <= 'F') ||
00202                 (inbuf[0] >= 'a' && inbuf[0] <= 'f')) {
00203                 sscanf (inbuf, "%x-%x", cstart, cend);
00204                 i = 0;
00205                 while (inbuf[i] != ' ') i++; /* find first blank */
00206                 while (inbuf[i] == ' ') i++; /* find next non-blank */
00207                 strncpy (coverstring, &inbuf[i], MAXBUF);
00208             }
00209             else retval = 0;
00210         }
00211         else retval = 0;
00212     } while (retval == 0 && !feof (coveragefp));
00213
00214     return (retval);
00215 }
00216
00217
00218 /**
00219 @brief Print the subtotal for one Unicode script range.
00220
00221 @param[in] outfp Pointer to output file.
00222 @param[in] print_n 1 = print number of glyphs, 0 = print percentage.
00223 @param[in] nglyphs Number of glyphs in current range.
00224 @param[in] cstart Starting code point for current range.
00225 @param[in] cend Ending code point for current range.
00226 @param[in] coverstring Character string of "<cstart>-<cend>".
00227 */
00228 void print_subtotal (FILE *outfp, int print_n, int nglyphs,
00229                    int cstart, int cend, char *coverstring) {
00230
00231     /* print old range total */
00232     if (print_n) { /* Print number of glyphs, not percentage */
00233         fprintf (outfp, " %6d ", nglyphs);
00234     }
00235     else {
00236         fprintf (outfp, " %5.1f%%", 100.0*nglyphs/(1+cend-cstart));
00237     }
00238
00239     if (cend < 0x10000)
00240         fprintf (outfp, " U+%04X..U+%04X  %s",
00241                 cstart, cend, coverstring);
00242     else
00243         fprintf (outfp, " U+%05X..U+%05X  %s",
00244                 cstart, cend, coverstring);
00245
00246     return;
00247 }

```

## 5.17 src/unidup.c File Reference

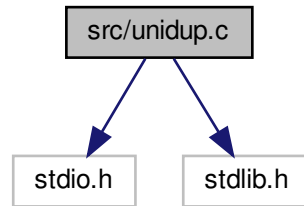
unidup - Check for duplicate code points in sorted unifont.hex file

```

#include <stdio.h>
#include <stdlib.h>

```

Include dependency graph for `unidup.c`:



## Macros

- `#define MAXBUF 256`  
Maximum input line length - 1.

## Functions

- `int main (int argc, char **argv)`  
The main function.

### 5.17.1 Detailed Description

`unidup` - Check for duplicate code points in sorted `unifont.hex` file

#### Author

Paul Hardy, `unifoundry <at> unifoundry.com`, December 2007

#### Copyright

Copyright (C) 2007, 2008, 2013 Paul Hardy

This program reads a sorted list of glyphs in Unifont `.hex` format and prints duplicate code points on `stderr` if any were detected.

Synopsis: `unidup < unifont_file.hex`

[Hopefully there won't be any output!]

Definition in file `unidup.c`.

### 5.17.2 Macro Definition Documentation

#### 5.17.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum input line length - 1.

Definition at line 37 of file `unidup.c`.

### 5.17.3 Function Documentation

#### 5.17.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 48 of file `unidup.c`.

```
00049 {
00050
00051     int ix, iy;
00052     char inbuf[MAXBUF];
00053     char *infile; /* the input file name */
00054     FILE *infilep; /* file pointer to input file */
00055
00056     if (argc > 1) {
00057         infile = argv[1];
00058         if ((infilep = fopen (infile, "r")) == NULL) {
00059             fprintf (stderr, "\nERROR: Can't open file %s\n\n", infile);
00060             exit (EXIT_FAILURE);
00061         }
00062     }
00063     else {
00064         infilep = stdin;
00065     }
00066
00067     ix = -1;
00068
00069     while (fgets (inbuf, MAXBUF-1, infilep) != NULL) {
00070         sscanf (inbuf, "%X", &iy);
00071         if (ix == iy) fprintf (stderr, "Duplicate code point: %04X\n", ix);
00072         else ix = iy;
00073     }
00074     exit (0);
00075 }
```

## 5.18 unidup.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unidup.c
00003
00004 @brief unidup - Check for duplicate code points in sorted unifont.hex file
00005
00006 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00007
00008 @copyright Copyright (C) 2007, 2008, 2013 Paul Hardy
00009
00010 This program reads a sorted list of glyphs in Unifont .hex format
00011 and prints duplicate code points on stderr if any were detected.
00012
00013 Synopsis: unidup < unifont_file.hex
00014
00015 [Hopefully there won't be any output!]
00016 */
00017 /*
00018 LICENSE:
00019
00020 This program is free software: you can redistribute it and/or modify
00021 it under the terms of the GNU General Public License as published by
00022 the Free Software Foundation, either version 2 of the License, or
00023 (at your option) any later version.
00024
00025 This program is distributed in the hope that it will be useful,
00026 but WITHOUT ANY WARRANTY; without even the implied warranty of
00027 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00028 GNU General Public License for more details.
00029
00030 You should have received a copy of the GNU General Public License
00031 along with this program. If not, see <http://www.gnu.org/licenses/>.
00032 */
00033
00034 #include <stdio.h>
00035 #include <stdlib.h>
00036
00037 #define MAXBUF 256 ///< Maximum input line length - 1
00038
00039
00040 /**
00041 @brief The main function.
00042
00043 @param[in] argc The count of command line arguments.
00044 @param[in] argv Pointer to array of command line arguments.
00045 @return This program exits with status 0.
00046 */
00047 int
00048 main (int argc, char **argv)
00049 {
00050
00051     int ix, iy;
00052     char inbuf[MAXBUF];
00053     char *infile; /* the input file name */
00054     FILE *infilefp; /* file pointer to input file */
00055
00056     if (argc > 1) {
00057         infile = argv[1];
00058         if ((infilefp = fopen (infile, "r")) == NULL) {
00059             fprintf (stderr, "\nERROR: Can't open file %s\n\n", infile);
00060             exit (EXIT_FAILURE);
00061         }
00062     }
00063     else {
00064         infilefp = stdin;
00065     }
00066
00067     ix = -1;
00068
00069     while (fgets (inbuf, MAXBUF-1, infilefp) != NULL) {
00070         sscanf (inbuf, "%X", &iy);
00071         if (ix == iy) fprintf (stderr, "Duplicate code point: %04X\n", ix);
00072         else ix = iy;
00073     }
00074     exit (0);
00075 }

```



## 5.19 src/unifont-support.c File Reference

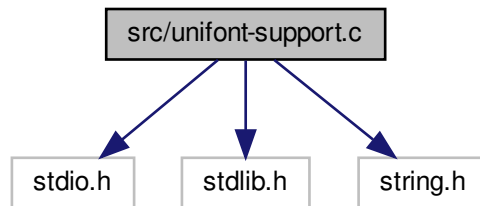
: Support functions for Unifont .hex files.

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unifont-support.c:



### Functions

- void [parse\\_hex](#) (char \*hexstring, int \*width, unsigned \*codept, unsigned char glyph[16][2])  
Decode a Unifont .hex file into Unioctde code point and glyph.
- void [glyph2bits](#) (int width, unsigned char glyph[16][2], unsigned char glyphbits[16][16])  
Convert a Unifont binary glyph into a binary glyph array of bits.
- void [hexpose](#) (int width, unsigned char glyphbits[16][16], unsigned char transpose[2][16])  
Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.
- void [glyph2string](#) (int width, unsigned codept, unsigned char glyph[16][2], char \*outstring)  
Convert a glyph code point and byte array into a Unifont .hex string.
- void [xglyph2string](#) (int width, unsigned codept, unsigned char transpose[2][16], char \*outstring)  
Convert a code point and transposed glyph into a Unifont .hex string.

#### 5.19.1 Detailed Description

: Support functions for Unifont .hex files.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [unifont-support.c](#).

#### 5.19.2 Function Documentation

## 5.19.2.1 glyph2bits()

```
void glyph2bits (
    int width,
    unsigned char glyph[16][2],
    unsigned char glyphbits[16][16] )
```

Convert a Unifont binary glyph into a binary glyph array of bits.

This function takes a Unifont 16-row by 1- or 2-byte wide binary glyph and returns an array of 16 rows by 16 columns. For each output array element, a 1 indicates the corresponding bit was set in the binary glyph, and a 0 indicates the corresponding bit was not set.

## Parameters

in	width	The number of columns in the glyph.
in	glyph	The binary glyph, as a 16-row by 2-byte array.
out	glyphbits	The converted glyph, as a 16-row, 16-column array.

Definition at line 91 of file [unifont-support.c](#).

```
00093     {
00094
00095     unsigned char tmp_byte;
00096     unsigned char mask;
00097     int row, column;
00098
00099     for (row = 0; row < 16; row++) {
00100         tmp_byte = glyph [row][0];
00101         mask = 0x80;
00102         for (column = 0; column < 8; column++) {
00103             glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00104             mask »= 1;
00105         }
00106
00107         if (width > 8)
00108             tmp_byte = glyph [row][1];
00109         else
00110             tmp_byte = 0x00;
00111
00112         mask = 0x80;
00113         for (column = 8; column < 16; column++) {
```

```

00114     glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00115     mask »= 1;
00116     }
00117 }
00118
00119
00120     return;
00121 }

```

### 5.19.2.2 glyph2string()

```

void glyph2string (
    int width,
    unsigned codept,
    unsigned char glyph[16][2],
    char * outstring )

```

Convert a glyph code point and byte array into a Unifont .hex string.

This function takes a code point and a 16-row by 1- or 2-byte binary glyph, and converts it into a Unifont .hex format character array.

#### Parameters

in	width	The number of columns in the glyph.
in	codept	The code point to appear in the output .hex string.
in	glyph	The glyph, with each of 16 rows 1 or 2 bytes wide.

## Parameters

out	outstring	The output string, in Unifont .hex format.
-----	-----------	--

Definition at line 221 of file [unifont-support.c](#).

```

00223     {
00224
00225     int i;           /* index into outstring array */
00226     int row;
00227
00228     if (codept <= 0xFFFF) {
00229         sprintf (outstring, "%04X:", codept);
00230         i = 5;
00231     }
00232     else {
00233         sprintf (outstring, "%06X:", codept);
00234         i = 7;
00235     }
00236
00237     for (row = 0; row < 16; row++) {
00238         sprintf (&outstring[i], "%02X", glyph [row][0]);
00239         i += 2;
00240
00241         if (width > 8) {
00242             sprintf (&outstring[i], "%02X", glyph [row][1]);
00243             i += 2;
00244         }
00245     }
00246
00247     outstring[i] = '\0'; /* terminate output string */
00248
00249
00250     return;
00251 }

```

### 5.19.2.3 hexpose()

```

void hexpose (
    int width,
    unsigned char glyphbits[16][16],
    unsigned char transpose[2][16] )

```

Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.

This function takes a 16-by-16 cell bit array made from a Unifont glyph (as created by the `glyph2bits` function) and outputs a transposed array of 2 sets of 8 or 16 columns, depending on the glyph width. This format simplifies outputting these bit patterns on a graphics display with a controller chip designed to output a column of 8 pixels at a time.

For a line of text with Unifont output, first all glyphs can have their first 8 rows of pixels displayed on a line. Then the second 8 rows of all glyphs on the line can be displayed. This simplifies code for such controller chips that are designed to automatically increment input bytes of column data by one column at a time for each successive byte.

The `glyphbits` array contains a '1' in each cell where the corresponding non-transposed glyph has a pixel set, and 0 in each cell where a pixel is not set.

## Parameters

in	width	The number of columns in the glyph.
in	glyphbits	The 16-by-16 pixel glyph bits.
out	transpose	The array of 2 sets of 8 or 16 columns of 8 pixels.

Definition at line 150 of file [unifont-support.c](#).

```

00152                                     {
00153
00154     int column;
00155
00156
00157     for (column = 0; column < 8; column++) {
00158         transpose [0][column] =
00159             (glyphbits [ 0][column] << 7) |
00160             (glyphbits [ 1][column] << 6) |
00161             (glyphbits [ 2][column] << 5) |
00162             (glyphbits [ 3][column] << 4) |
00163             (glyphbits [ 4][column] << 3) |
00164             (glyphbits [ 5][column] << 2) |
00165             (glyphbits [ 6][column] << 1) |
00166             (glyphbits [ 7][column] );
00167         transpose [1][column] =
00168             (glyphbits [ 8][column] << 7) |
00169             (glyphbits [ 9][column] << 6) |
00170             (glyphbits [10][column] << 5) |
00171             (glyphbits [11][column] << 4) |
00172             (glyphbits [12][column] << 3) |
00173             (glyphbits [13][column] << 2) |
00174             (glyphbits [14][column] << 1) |
00175             (glyphbits [15][column] );
00176     }
00177     if (width > 8) {
00178         for (column = 8; column < width; column++) {
00179             transpose [0][column] =
00180                 (glyphbits [0][column] << 7) |
00181                 (glyphbits [1][column] << 6) |
00182                 (glyphbits [2][column] << 5) |
00183                 (glyphbits [3][column] << 4) |
00184                 (glyphbits [4][column] << 3) |
00185                 (glyphbits [5][column] << 2) |
00186                 (glyphbits [6][column] << 1) |
00187                 (glyphbits [7][column] );
00188             transpose [1][column] =
00189                 (glyphbits [ 8][column] << 7) |
00190                 (glyphbits [ 9][column] << 6) |
00191                 (glyphbits [10][column] << 5) |
00192                 (glyphbits [11][column] << 4) |
00193                 (glyphbits [12][column] << 3) |
00194                 (glyphbits [13][column] << 2) |
00195                 (glyphbits [14][column] << 1) |
00196                 (glyphbits [15][column] );

```

```

00197     }
00198   }
00199   else {
00200     for (column = 8; column < width; column++)
00201       transpose [0][column] = transpose [1][column] = 0x00;
00202   }
00203 }
00204 }
00205 return;
00206 }

```

#### 5.19.2.4 parse\_hex()

```

void parse_hex (
    char * hexstring,
    int * width,
    unsigned * codept,
    unsigned char glyph[16][2] )

```

Decode a Unifont .hex file into Unicode code point and glyph.

This function takes one line from a Unifont .hex file and decodes it into a code point followed by a 16-row glyph array. The glyph array can be one byte (8 columns) or two bytes (16 columns).

##### Parameters

in	hexstring	The Unicode .hex string for one code point.
out	width	The number of columns in a glyph with 16 rows.
out	codept	The code point, contained in the first .hex file field.

## Parameters

out	glyph	The Unifont glyph, as 16 rows by 1 or 2 bytes wide.
-----	-------	---

Definition at line 44 of file [unifont-support.c](#).

```

00047         {
00048
00049     int i;
00050     int row;
00051     int length;
00052
00053     sscanf (hexstring, "%X", codept);
00054     length = strlen (hexstring);
00055     for (i = length - 1; i > 0 && hexstring[i] != '\n'; i--);
00056     hexstring[i] = '\0';
00057     for (i = 0; i < 9 && hexstring[i] != ':'; i++);
00058     i++; /* Skip over ':' */
00059     *width = (length - i) * 4 / 16; /* 16 rows per glyphbits */
00060
00061     for (row = 0; row < 16; row++) {
00062         sscanf (&hexstring[i], "%2hhX", &glyph [row][0]);
00063         i += 2;
00064         if (*width > 8) {
00065             sscanf (&hexstring[i], "%2hhX", &glyph [row][1]);
00066             i += 2;
00067         }
00068         else {
00069             glyph [row][1] = 0x00;
00070         }
00071     }
00072
00073
00074     return;
00075 }

```

## 5.19.2.5 xglyph2string()

```

void xglyph2string (
    int width,
    unsigned codept,
    unsigned char transpose[2][16],
    char * outstring )

```

Convert a code point and transposed glyph into a Unifont .hex string.

This function takes a code point and a transposed Unifont glyph of 2 rows of 8 pixels in a column, and converts it into a Unifont .hex format character array.

## Parameters

in	width	The number of columns in the glyph.
----	-------	-------------------------------------

## Parameters

in	codept	The code point to appear in the output .hex string.
in	transpose	The transposed glyph, with 2 sets of 8-row data.
out	outstring	The output string, in Unifont .hex format.

Definition at line 267 of file [unifont-support.c](#).

```

00269     {
00270
00271     int i;          /* index into outstring array */
00272     int column;
00273
00274     if (codept <= 0xFFFF) {
00275         sprintf (outstring, "%04X:", codept);
00276         i = 5;
00277     }
00278     else {
00279         sprintf (outstring, "%06X:", codept);
00280         i = 7;
00281     }
00282
00283     for (column = 0; column < 8; column++) {
00284         sprintf (&outstring[i], "%02X", transpose [0][column]);
00285         i += 2;
00286     }
00287     if (width > 8) {
00288         for (column = 8; column < 16; column++) {
00289             sprintf (&outstring[i], "%02X", transpose [0][column]);
00290             i += 2;
00291         }
00292     }
00293     for (column = 0; column < 8; column++) {
00294         sprintf (&outstring[i], "%02X", transpose [1][column]);
00295         i += 2;
00296     }
00297     if (width > 8) {
00298         for (column = 8; column < 16; column++) {
00299             sprintf (&outstring[i], "%02X", transpose [1][column]);
00300             i += 2;
00301         }

```



```

00302 }
00303
00304 outstring[i] = '\0'; /* terminate output string */
00305
00306
00307 return;
00308 }

```

## 5.20 unifont-support.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file: unifont-support.c
00003
00004 @brief: Support functions for Unifont .hex files.
00005
00006 @author Paul Hardy
00007
00008 @copyright Copyright © 2023 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program. If not, see <http://www.gnu.org/licenses/>.
00025 */
00026 #include <stdio.h>
00027 #include <stdlib.h>
00028 #include <string.h>
00029
00030
00031 /**
00032 @brief Decode a Unifont .hex file into Unioctode code point and glyph.
00033
00034 This function takes one line from a Unifont .hex file and decodes
00035 it into a code point followed by a 16-row glyph array. The glyph
00036 array can be one byte (8 columns) or two bytes (16 columns).
00037
00038 @param[in] hexstring The Unicode .hex string for one code point.
00039 @param[out] width The number of columns in a glyph with 16 rows.
00040 @param[out] codept The code point, contained in the first .hex file field.
00041 @param[out] glyph The Unifont glyph, as 16 rows by 1 or 2 bytes wide.
00042 */
00043 void
00044 parse_hex (char *hexstring,
00045            int *width,
00046            unsigned *codept,
00047            unsigned char glyph[16][2]) {
00048
00049     int i;
00050     int row;
00051     int length;
00052
00053     sscanf (hexstring, "%X", codept);
00054     length = strlen (hexstring);
00055     for (i = length - 1; i > 0 && hexstring[i] != '\n'; i--);
00056     hexstring[i] = '\0';
00057     for (i = 0; i < 9 && hexstring[i] != ':'; i++);
00058     i++; /* Skip over ':' */
00059     *width = (length - i) * 4 / 16; /* 16 rows per glyphbits */
00060
00061     for (row = 0; row < 16; row++) {
00062         sscanf (&hexstring[i], "%2hhX", &glyph [row][0]);
00063         i += 2;
00064         if (*width > 8) {
00065             sscanf (&hexstring[i], "%2hhX", &glyph [row][1]);
00066             i += 2;
00067         }

```

```

00068     else {
00069         glyph [row][1] = 0x00;
00070     }
00071 }
00072
00073
00074 return;
00075 }
00076
00077
00078 /**
00079 @brief Convert a Unifont binary glyph into a binary glyph array of bits.
00080
00081 This function takes a Unifont 16-row by 1- or 2-byte wide binary glyph
00082 and returns an array of 16 rows by 16 columns. For each output array
00083 element, a 1 indicates the corresponding bit was set in the binary
00084 glyph, and a 0 indicates the corresponding bit was not set.
00085
00086 @param[in] width The number of columns in the glyph.
00087 @param[in] glyph The binary glyph, as a 16-row by 2-byte array.
00088 @param[out] glyphbits The converted glyph, as a 16-row, 16-column array.
00089 */
00090 void
00091 glyph2bits (int width,
00092             unsigned char glyph[16][2],
00093             unsigned char glyphbits [16][16]) {
00094
00095     unsigned char tmp_byte;
00096     unsigned char mask;
00097     int row, column;
00098
00099     for (row = 0; row < 16; row++) {
00100         tmp_byte = glyph [row][0];
00101         mask = 0x80;
00102         for (column = 0; column < 8; column++) {
00103             glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00104             mask »= 1;
00105         }
00106
00107         if (width > 8)
00108             tmp_byte = glyph [row][1];
00109         else
00110             tmp_byte = 0x00;
00111
00112         mask = 0x80;
00113         for (column = 8; column < 16; column++) {
00114             glyphbits [row][column] = tmp_byte & mask ? 1 : 0;
00115             mask »= 1;
00116         }
00117     }
00118
00119
00120     return;
00121 }
00122
00123
00124 /**
00125 @brief Transpose a Unifont .hex format glyph into 2 column-major sub-arrays.
00126
00127 This function takes a 16-by-16 cell bit array made from a Unifont
00128 glyph (as created by the glyph2bits function) and outputs a transposed
00129 array of 2 sets of 8 or 16 columns, depending on the glyph width.
00130 This format simplifies outputting these bit patterns on a graphics
00131 display with a controller chip designed to output a column of 8 pixels
00132 at a time.
00133
00134 For a line of text with Unifont output, first all glyphs can have
00135 their first 8 rows of pixels displayed on a line. Then the second
00136 8 rows of all glyphs on the line can be displayed. This simplifies
00137 code for such controller chips that are designed to automatically
00138 increment input bytes of column data by one column at a time for
00139 each successive byte.
00140
00141 The glyphbits array contains a '1' in each cell where the corresponding
00142 non-transposed glyph has a pixel set, and 0 in each cell where a pixel
00143 is not set.
00144
00145 @param[in] width The number of columns in the glyph.
00146 @param[in] glyphbits The 16-by-16 pixel glyph bits.
00147 @param[out] transpose The array of 2 sets of 8 or 16 columns of 8 pixels.
00148 */

```

```

00149 void
00150 hexpose (int width,
00151          unsigned char glyphbits [16][16],
00152          unsigned char transpose [2][16]) {
00153
00154     int column;
00155
00156     for (column = 0; column < 8; column++) {
00157         transpose [0][column] =
00158             (glyphbits [ 0][column] << 7) |
00159             (glyphbits [ 1][column] << 6) |
00160             (glyphbits [ 2][column] << 5) |
00161             (glyphbits [ 3][column] << 4) |
00162             (glyphbits [ 4][column] << 3) |
00163             (glyphbits [ 5][column] << 2) |
00164             (glyphbits [ 6][column] << 1) |
00165             (glyphbits [ 7][column] );
00166         transpose [1][column] =
00167             (glyphbits [ 8][column] << 7) |
00168             (glyphbits [ 9][column] << 6) |
00169             (glyphbits [10][column] << 5) |
00170             (glyphbits [11][column] << 4) |
00171             (glyphbits [12][column] << 3) |
00172             (glyphbits [13][column] << 2) |
00173             (glyphbits [14][column] << 1) |
00174             (glyphbits [15][column] );
00175     }
00176 }
00177 if (width > 8) {
00178     for (column = 8; column < width; column++) {
00179         transpose [0][column] =
00180             (glyphbits [0][column] << 7) |
00181             (glyphbits [1][column] << 6) |
00182             (glyphbits [2][column] << 5) |
00183             (glyphbits [3][column] << 4) |
00184             (glyphbits [4][column] << 3) |
00185             (glyphbits [5][column] << 2) |
00186             (glyphbits [6][column] << 1) |
00187             (glyphbits [7][column] );
00188         transpose [1][column] =
00189             (glyphbits [8][column] << 7) |
00190             (glyphbits [9][column] << 6) |
00191             (glyphbits [10][column] << 5) |
00192             (glyphbits [11][column] << 4) |
00193             (glyphbits [12][column] << 3) |
00194             (glyphbits [13][column] << 2) |
00195             (glyphbits [14][column] << 1) |
00196             (glyphbits [15][column] );
00197     }
00198 }
00199 else {
00200     for (column = 8; column < width; column++)
00201         transpose [0][column] = transpose [1][column] = 0x00;
00202 }
00203
00204     return;
00205 }
00206
00207
00208 /**
00209 @brief Convert a glyph code point and byte array into a Unifont .hex string.
00210
00211 This function takes a code point and a 16-row by 1- or 2-byte binary
00212 glyph, and converts it into a Unifont .hex format character array.
00213
00214 @param[in] width The number of columns in the glyph.
00215 @param[in] codept The code point to appear in the output .hex string.
00216 @param[in] glyph The glyph, with each of 16 rows 1 or 2 bytes wide.
00217 @param[out] outstring The output string, in Unifont .hex format.
00218 */
00219 void
00220 glyph2string (int width, unsigned codept,
00221              unsigned char glyph [16][2],
00222              char *outstring) {
00223
00224     int i;          /* index into outstring array */
00225     int row;
00226
00227     if (codept <= 0xFFFF) {
00228         sprintf (outstring, "%04X:", codept);
00229     }

```

```

00230     i = 5;
00231 }
00232 else {
00233     sprintf (outstring, "%06X:", codept);
00234     i = 7;
00235 }
00236
00237 for (row = 0; row < 16; row++) {
00238     sprintf (&outstring[i], "%02X", glyph [row][0]);
00239     i += 2;
00240
00241     if (width > 8) {
00242         sprintf (&outstring[i], "%02X", glyph [row][1]);
00243         i += 2;
00244     }
00245 }
00246
00247 outstring[i] = '\\0'; /* terminate output string */
00248
00249
00250 return;
00251 }
00252
00253
00254 /**
00255 @brief Convert a code point and transposed glyph into a Unifont .hex string.
00256
00257 This function takes a code point and a transposed Unifont glyph
00258 of 2 rows of 8 pixels in a column, and converts it into a Unifont
00259 .hex format character array.
00260
00261 @param[in] width The number of columns in the glyph.
00262 @param[in] codept The code point to appear in the output .hex string.
00263 @param[in] transpose The transposed glyph, with 2 sets of 8-row data.
00264 @param[out] outstring The output string, in Unifont .hex format.
00265 */
00266 void
00267 xglyph2string (int width, unsigned codept,
00268               unsigned char transpose [2][16],
00269               char *outstring) {
00270
00271     int i;          /* index into outstring array */
00272     int column;
00273
00274     if (codept <= 0xFFFF) {
00275         sprintf (outstring, "%04X:", codept);
00276         i = 5;
00277     }
00278     else {
00279         sprintf (outstring, "%06X:", codept);
00280         i = 7;
00281     }
00282
00283     for (column = 0; column < 8; column++) {
00284         sprintf (&outstring[i], "%02X", transpose [0][column]);
00285         i += 2;
00286     }
00287     if (width > 8) {
00288         for (column = 8; column < 16; column++) {
00289             sprintf (&outstring[i], "%02X", transpose [0][column]);
00290             i += 2;
00291         }
00292     }
00293     for (column = 0; column < 8; column++) {
00294         sprintf (&outstring[i], "%02X", transpose [1][column]);
00295         i += 2;
00296     }
00297     if (width > 8) {
00298         for (column = 8; column < 16; column++) {
00299             sprintf (&outstring[i], "%02X", transpose [1][column]);
00300             i += 2;
00301         }
00302     }
00303
00304     outstring[i] = '\\0'; /* terminate output string */
00305
00306     return;
00307 }
00308 }
00309

```

## 5.21 src/unifont1per.c File Reference

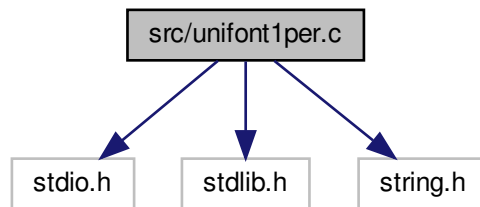
unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unifont1per.c:



### Macros

- #define [MAXSTRING](#) 266
- #define [MAXFILENAME](#) 20

### Functions

- int [main](#) ()  
The main function.

#### 5.21.1 Detailed Description

unifont1per - Read a Unifont .hex file from standard input and produce one glyph per ".bmp" bitmap file as output

#### Author

Paul Hardy, unifoundry <at> unifoundry.com, December 2016

#### Copyright

Copyright (C) 2016, 2017 Paul Hardy

Each glyph is 16 pixels tall, and can be 8, 16, 24, or 32 pixels wide. The width of each output graphic file is determined automatically by the width of each Unifont hex representation.

This program creates files of the form "U+<codepoint>.bmp", 1 per glyph.

Synopsis: unifont1per < unifont.hex

Definition in file [unifont1per.c](#).

#### 5.21.2 Macro Definition Documentation

### 5.21.2.1 MAXFILENAME

```
#define MAXFILENAME 20
```

Maximum size of a filename of the form "U+%06X.bmp".

Definition at line 60 of file [unifont1per.c](#).

### 5.21.2.2 MAXSTRING

```
#define MAXSTRING 266
```

Maximum size of an input line in a Unifont .hex file - 1.

Definition at line 57 of file [unifont1per.c](#).

## 5.21.3 Function Documentation

### 5.21.3.1 main()

```
int main ( )
```

The main function.

Returns

This program exits with status EXIT\_SUCCESS.

Definition at line 69 of file [unifont1per.c](#).

```
00069     {
00070
00071     int i; /* loop variable */
00072
00073     /*
00074     Define bitmap header bytes
00075     */
00076     unsigned char header [62] = {
00077     /*
00078     Bitmap File Header -- 14 bytes
00079     */
00080     'B', 'M', /* Signature */
00081     0x7E, 0, 0, 0, /* File Size */
00082     0, 0, 0, 0, /* Reserved */
00083     0x3E, 0, 0, 0, /* Pixel Array Offset */
00084
00085     /*
00086     Device Independent Bitmap Header -- 40 bytes
00087
00088     Image Width and Image Height are assigned final values
00089     based on the dimensions of each glyph.
00090     */
00091     0x28, 0, 0, 0, /* DIB Header Size */
00092     0x10, 0, 0, 0, /* Image Width = 16 pixels */
00093     0xF0, 0xFF, 0xFF, 0xFF, /* Image Height = -16 pixels */
00094     0x01, 0, /* Planes */
00095     0x01, 0, /* Bits Per Pixel */
00096     0, 0, 0, 0, /* Compression */
00097     0x40, 0, 0, 0, /* Image Size */
00098     0x14, 0x0B, 0, 0, /* X Pixels Per Meter = 72 dpi */
00099     0x14, 0x0B, 0, 0, /* Y Pixels Per Meter = 72 dpi */
00100     0x02, 0, 0, 0, /* Colors In Color Table */
00101     0, 0, 0, 0, /* Important Colors */
00102
00103     /*
00104     Color Palette -- 8 bytes
00105     */
00106     0xFF, 0xFF, 0xFF, 0, /* White */
00107     0, 0, 0, 0 /* Black */
00108     };
00109
00110     char instring[MAXSTRING]; /* input string */
00111     int code_point; /* current Unicode code point */
00112     char glyph[MAXSTRING]; /* bitmap string for this glyph */
00113     int glyph_height=16; /* for now, fixed at 16 pixels high */
```

```

00114 int glyph_width; /* 8, 16, 24, or 32 pixels wide */
00115 char filename[MAXFILENAME]; /* name of current output file */
00116 FILE *outfp; /* file pointer to current output file */
00117
00118 int string_index; /* pointer into hexadecimal glyph string */
00119 int nextbyte; /* next set of 8 bits to print out */
00120
00121 /* Repeat for each line in the input stream */
00122 while (fgets (instring, MAXSTRING - 1, stdin) != NULL) {
00123 /* Read next Unifont ASCII hexadecimal format glyph description */
00124 sscanf (instring, "%X:%s", &code_point, glyph);
00125 /* Calculate width of a glyph in pixels; 4 bits per ASCII hex digit */
00126 glyph_width = strlen (glyph) / (glyph_height / 4);
00127 snprintf (filename, MAXFILENAME, "U+%06X.bmp", code_point);
00128 header [18] = glyph_width; /* bitmap width */
00129 header [22] = -glyph_height; /* negative height --> draw top to bottom */
00130 if ((outfp = fopen (filename, "w")) != NULL) {
00131 for (i = 0; i < 62; i++) fputc (header[i], outfp);
00132 /*
00133 Bitmap, with each row padded with zeroes if necessary
00134 so each row is four bytes wide. (Each row must end
00135 on a four-byte boundary, and four bytes is the maximum
00136 possible row length for up to 32 pixels in a row.)
00137 */
00138 string_index = 0;
00139 for (i = 0; i < glyph_height; i++) {
00140 /* Read 2 ASCII hexadecimal digits (1 byte of output pixels) */
00141 sscanf (&glyph[string_index], "%2X", &nextbyte);
00142 string_index += 2;
00143 fputc (nextbyte, outfp); /* write out the 8 pixels */
00144 if (glyph_width <= 8) { /* pad row with 3 zero bytes */
00145 fputc (0x00, outfp); fputc (0x00, outfp); fputc (0x00, outfp);
00146 }
00147 else { /* get 8 more pixels */
00148 sscanf (&glyph[string_index], "%2X", &nextbyte);
00149 string_index += 2;
00150 fputc (nextbyte, outfp); /* write out the 8 pixels */
00151 if (glyph_width <= 16) { /* pad row with 2 zero bytes */
00152 fputc (0x00, outfp); fputc (0x00, outfp);
00153 }
00154 else { /* get 8 more pixels */
00155 sscanf (&glyph[string_index], "%2X", &nextbyte);
00156 string_index += 2;
00157 fputc (nextbyte, outfp); /* write out the 8 pixels */
00158 if (glyph_width <= 24) { /* pad row with 1 zero byte */
00159 fputc (0x00, outfp);
00160 }
00161 else { /* get 8 more pixels */
00162 sscanf (&glyph[string_index], "%2X", &nextbyte);
00163 string_index += 2;
00164 fputc (nextbyte, outfp); /* write out the 8 pixels */
00165 } /* glyph is 32 pixels wide */
00166 } /* glyph is 24 pixels wide */
00167 } /* glyph is 16 pixels wide */
00168 } /* glyph is 8 pixels wide */
00169
00170 fclose (outfp);
00171 }
00172 }
00173
00174 exit (EXIT_SUCCESS);
00175 }

```

## 5.22 unifont1per.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unifont1per.c
00003
00004 @brief unifont1per - Read a Unifont .hex file from standard input and
00005 produce one glyph per ".bmp" bitmap file as output
00006
00007 @author Paul Hardy, unifoundry <at> unifoundry.com, December 2016
00008
00009 @copyright Copyright (C) 2016, 2017 Paul Hardy
00010
00011 Each glyph is 16 pixels tall, and can be 8, 16, 24,
00012 or 32 pixels wide. The width of each output graphic

```

```

00013 file is determined automatically by the width of each
00014 Unifont hex representation.
00015
00016 This program creates files of the form "U+<codepoint>.bmp", 1 per glyph.
00017
00018 Synopsis: unifont1per < unifont.hex
00019 */
00020 /*
00021 LICENSE:
00022
00023 This program is free software: you can redistribute it and/or modify
00024 it under the terms of the GNU General Public License as published by
00025 the Free Software Foundation, either version 2 of the License, or
00026 (at your option) any later version.
00027
00028 This program is distributed in the hope that it will be useful,
00029 but WITHOUT ANY WARRANTY; without even the implied warranty of
00030 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00031 GNU General Public License for more details.
00032
00033 You should have received a copy of the GNU General Public License
00034 along with this program. If not, see <http://www.gnu.org/licenses/>.
00035
00036 Example:
00037
00038 mkdir my-bmp
00039 cd my-bmp
00040 unifont1per < ../glyphs.hex
00041
00042 */
00043 /*
00044 /*
00045 11 May 2019 [Paul Hardy]:
00046 - Changed sprintf function call to snprintf for writing
00047 "filename" character string.
00048 - Defined MAXFILENAME to hold size of "filename" array
00049 for snprintf function call.
00050 */
00051
00052 #include <stdio.h>
00053 #include <stdlib.h>
00054 #include <string.h>
00055
00056 /** Maximum size of an input line in a Unifont .hex file - 1. */
00057 #define MAXSTRING 266
00058
00059 /** Maximum size of a filename of the form "U+%06X.bmp". */
00060 #define MAXFILENAME 20
00061
00062
00063 /**
00064 @brief The main function.
00065
00066 @return This program exits with status EXIT_SUCCESS.
00067 */
00068 int
00069 main () {
00070
00071     int i; /* loop variable */
00072
00073     /*
00074     Define bitmap header bytes
00075     */
00076     unsigned char header [62] = {
00077         /*
00078         Bitmap File Header -- 14 bytes
00079         */
00080         'B', 'M', /* Signature */
00081         0x7E, 0, 0, 0, /* File Size */
00082         0, 0, 0, 0, /* Reserved */
00083         0x3E, 0, 0, 0, /* Pixel Array Offset */
00084
00085         /*
00086         Device Independent Bitmap Header -- 40 bytes
00087
00088         Image Width and Image Height are assigned final values
00089         based on the dimensions of each glyph.
00090         */
00091         0x28, 0, 0, 0, /* DIB Header Size */
00092         0x10, 0, 0, 0, /* Image Width = 16 pixels */
00093         0xF0, 0xFF, 0xFF, 0xFF, /* Image Height = -16 pixels */

```



```

00094     0x01,  0,          /* Planes                */
00095     0x01,  0,          /* Bits Per Pixel        */
00096     0,  0,  0,  0,    /* Compression           */
00097     0x40,  0,  0,  0,  /* Image Size            */
00098     0x14, 0x0B,  0,  0, /* X Pixels Per Meter = 72 dpi */
00099     0x14, 0x0B,  0,  0, /* Y Pixels Per Meter = 72 dpi */
00100     0x02,  0,  0,  0,  /* Colors In Color Table */
00101     0,  0,  0,  0,    /* Important Colors      */
00102
00103     /*
00104     Color Palette -- 8 bytes
00105     */
00106     0xFF, 0xFF, 0xFF, 0, /* White */
00107     0,  0,  0,  0, /* Black */
00108 };
00109
00110 char instring[MAXSTRING]; /* input string */
00111 int code_point; /* current Unicode code point */
00112 char glyph[MAXSTRING]; /* bitmap string for this glyph */
00113 int glyph_height=16; /* for now, fixed at 16 pixels high */
00114 int glyph_width; /* 8, 16, 24, or 32 pixels wide */
00115 char filename[MAXFILENAME]; /* name of current output file */
00116 FILE *outfp; /* file pointer to current output file */
00117
00118 int string_index; /* pointer into hexadecimal glyph string */
00119 int nextbyte; /* next set of 8 bits to print */
00120
00121 /* Repeat for each line in the input stream */
00122 while (fgets (instring, MAXSTRING - 1, stdin) != NULL) {
00123     /* Read next Unifont ASCII hexadecimal format glyph description */
00124     sscanf (instring, "%X:%s", &code_point, glyph);
00125     /* Calculate width of a glyph in pixels; 4 bits per ASCII hex digit */
00126     glyph_width = strlen (glyph) / (glyph_height / 4);
00127     sprintf (filename, MAXFILENAME, "U+%06X.bmp", code_point);
00128     header [18] = glyph_width; /* bitmap width */
00129     header [22] = -glyph_height; /* negative height --> draw top to bottom */
00130     if ((outfp = fopen (filename, "w")) != NULL) {
00131         for (i = 0; i < 62; i++) fputc (header[i], outfp);
00132         /*
00133         Bitmap, with each row padded with zeroes if necessary
00134         so each row is four bytes wide. (Each row must end
00135         on a four-byte boundary, and four bytes is the maximum
00136         possible row length for up to 32 pixels in a row.)
00137         */
00138         string_index = 0;
00139         for (i = 0; i < glyph_height; i++) {
00140             /* Read 2 ASCII hexadecimal digits (1 byte of output pixels) */
00141             sscanf (&glyph[string_index], "%2X", &nextbyte);
00142             string_index += 2;
00143             fputc (nextbyte, outfp); /* write out the 8 pixels */
00144             if (glyph_width <= 8) { /* pad row with 3 zero bytes */
00145                 fputc (0x00, outfp); fputc (0x00, outfp); fputc (0x00, outfp);
00146             }
00147             else { /* get 8 more pixels */
00148                 sscanf (&glyph[string_index], "%2X", &nextbyte);
00149                 string_index += 2;
00150                 fputc (nextbyte, outfp); /* write out the 8 pixels */
00151                 if (glyph_width <= 16) { /* pad row with 2 zero bytes */
00152                     fputc (0x00, outfp); fputc (0x00, outfp);
00153                 }
00154                 else { /* get 8 more pixels */
00155                     sscanf (&glyph[string_index], "%2X", &nextbyte);
00156                     string_index += 2;
00157                     fputc (nextbyte, outfp); /* write out the 8 pixels */
00158                     if (glyph_width <= 24) { /* pad row with 1 zero byte */
00159                         fputc (0x00, outfp);
00160                     }
00161                 }
00162                 else { /* get 8 more pixels */
00163                     sscanf (&glyph[string_index], "%2X", &nextbyte);
00164                     string_index += 2;
00165                     fputc (nextbyte, outfp); /* write out the 8 pixels */
00166                 } /* glyph is 32 pixels wide */
00167             } /* glyph is 24 pixels wide */
00168         } /* glyph is 16 pixels wide */
00169     } /* glyph is 8 pixels wide */
00170     fclose (outfp);
00171 }
00172 }
00173
00174 exit (EXIT_SUCCESS);

```

```
00175 }
```

## 5.23 src/unifontpic.c File Reference

unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap

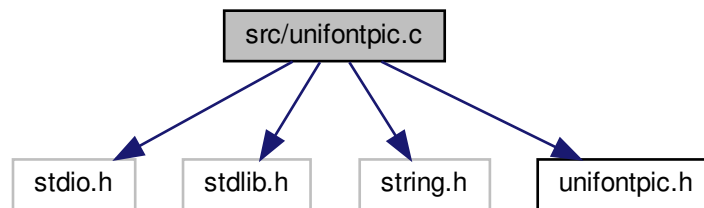
```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

```
#include "unifontpic.h"
```

Include dependency graph for unifontpic.c:



### Macros

- #define [HDR\\_LEN](#) 33

### Functions

- int [main](#) (int argc, char \*\*argv)  
The main function.
- void [output4](#) (int thisword)  
Output a 4-byte integer in little-endian order.
- void [output2](#) (int thisword)  
Output a 2-byte integer in little-endian order.
- void [gethex](#) (char \*instring, int plane\_array[0x10000][16], int plane)  
Read a Unifont .hex-format input file from stdin.
- void [genlongbmp](#) (int plane\_array[0x10000][16], int dpi, int tinynum, int plane)  
Generate the BMP output file in long format.
- void [genwidebmp](#) (int plane\_array[0x10000][16], int dpi, int tinynum, int plane)  
Generate the BMP output file in wide format.

#### 5.23.1 Detailed Description

unifontpic - See the "Big Picture": the entire Unifont in one BMP bitmap

Author

Paul Hardy, 2013

Copyright

Copyright (C) 2013, 2017 Paul Hardy

Definition in file [unifontpic.c](#).

## 5.23.2 Macro Definition Documentation

### 5.23.2.1 HDR\_LEN

```
#define HDR_LEN 33
```

Define length of header string for top of chart.

Definition at line [67](#) of file [unifontpic.c](#).

## 5.23.3 Function Documentation

### 5.23.3.1 genlongbmp()

```
void genlongbmp (
    int plane_array[0x10000][16],
    int dpi,
    int tinynum,
    int plane )
```

Generate the BMP output file in long format.

This function generates the BMP output file from a bitmap parameter. This is a long bitmap, 16 glyphs wide by 4,096 glyphs tall.

Parameters

in	plane_array	The array of glyph bitmaps for a plane.
in	dpi	Dots per inch, for encoding in the BMP output file header.

## Parameters

in	tinynum	Whether to generate tiny numbers in wide grid (unused).
in	plane	The Unicode plane, 0..17.

Definition at line 294 of file `unifontpic.c`.

```

00295 {
00296
00297 char header_string[HDR_LEN]; /* centered header */
00298 char raw_header[HDR_LEN]; /* left-aligned header */
00299 int header[16][16]; /* header row, for chart title */
00300 int hdrlen; /* length of HEADER_STRING */
00301 int startcol; /* column to start printing header, for centering */
00302
00303 unsigned leftcol[0x1000][16]; /* code point legend on left side of chart */
00304 int d1, d2, d3, d4; /* digits for filling leftcol[][] legend */
00305 int codept; /* current starting code point for legend */
00306 int thisrow; /* glyph row currently being rendered */
00307 unsigned toprow[16][16]; /* code point legend on top of chart */
00308 int digitrow; /* row we're in (0..4) for the above hexdigit digits */
00309
00310 /*
00311 DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00312 */
00313 int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00314 int ImageSize;
00315 int FileSize;
00316 int Width, Height; /* bitmap image width and height in pixels */
00317 int ppm; /* integer pixels per meter */
00318
00319 int i, j, k;
00320
00321 unsigned bytesout;
00322
00323 void output4(int), output2(int);
00324
00325 /*
00326 Image width and height, in pixels.
00327
00328 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00329 */
00330 Width = 18 * 16; /* (2 legend + 16 glyphs) * 16 pixels/glyph */
00331 Height = 4099 * 16; /* (1 header + 4096 glyphs) * 16 rows/glyph */
00332
00333 ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00334
00335 FileSize = DataOffset + ImageSize;
00336
00337 /* convert dots/inch to pixels/meter */
00338 if (dpi == 0) dpi = 96;
00339 ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00340
00341 /*
00342 Generate the BMP Header
00343 */

```

```

00344 putchar ('B');
00345 putchar ('M');
00346
00347 /*
00348 Calculate file size:
00349
00350 BMP Header + InfoHeader + Color Table + Raster Data
00351 */
00352 output4 (FileSize); /* FileSize */
00353 output4 (0x0000); /* reserved */
00354
00355 /* Calculate DataOffset */
00356 output4 (DataOffset);
00357
00358 /*
00359 InfoHeader
00360 */
00361 output4 (40); /* Size of InfoHeader */
00362 output4 (Width); /* Width of bitmap in pixels */
00363 output4 (Height); /* Height of bitmap in pixels */
00364 output2 (1); /* Planes (1 plane) */
00365 output2 (1); /* BitCount (1 = monochrome) */
00366 output4 (0); /* Compression (0 = none) */
00367 output4 (ImageSize); /* ImageSize, in bytes */
00368 output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00369 output4 (ppm); /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00370 output4 (2); /* ColorsUsed (= 2) */
00371 output4 (2); /* ColorsImportant (= 2) */
00372 output4 (0x00000000); /* black (reserved, B, G, R) */
00373 output4 (0x00FFFFFF); /* white (reserved, B, G, R) */
00374
00375 /*
00376 Create header row bits.
00377 */
00378 snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00379 memset ((void *)header, 0, 16 * 16 * sizeof (int)); /* fill with white */
00380 memset ((void *)header_string, ' ', 32 * sizeof (char)); /* 32 spaces */
00381 header_string[32] = '\0'; /* null-terminated */
00382
00383 hdrlen = strlen (raw_header);
00384 if (hdrlen > 32) hdrlen = 32; /* only 32 columns to print header */
00385 startcol = 16 - ((hdrlen + 1) » 1); /* to center header */
00386 /* center up to 32 chars */
00387 memcpy (&header_string[startcol], raw_header, hdrlen);
00388
00389 /* Copy each letter's bitmap from the plane_array[] we constructed. */
00390 /* Each glyph must be single-width, to fit two glyphs in 16 pixels */
00391 for (j = 0; j < 16; j++) {
00392     for (i = 0; i < 16; i++) {
00393         header[i][j] =
00394             (ascii_bits[header_string[j+j ] & 0x7F][i] & 0xFF00) |
00395             (ascii_bits[header_string[j+j+1] & 0x7F][i] » 8);
00396     }
00397 }
00398
00399 /*
00400 Create the left column legend.
00401 */
00402 memset ((void *)leftcol, 0, 4096 * 16 * sizeof (unsigned));
00403
00404 for (codept = 0x0000; codept < 0x10000; codept += 0x10) {
00405     d1 = (codept » 12) & 0xF; /* most significant hex digit */
00406     d2 = (codept » 8) & 0xF;
00407     d3 = (codept » 4) & 0xF;
00408
00409     thisrow = codept » 4; /* rows of 16 glyphs */
00410
00411     /* fill in first and second digits */
00412     for (digitrow = 0; digitrow < 5; digitrow++) {
00413         leftcol[thisrow][2 + digitrow] =
00414             (hexdigit[d1][digitrow] « 10) |
00415             (hexdigit[d2][digitrow] « 4);
00416     }
00417
00418     /* fill in third digit */
00419     for (digitrow = 0; digitrow < 5; digitrow++) {
00420         leftcol[thisrow][9 + digitrow] = hexdigit[d3][digitrow] « 10;
00421     }
00422     leftcol[thisrow][9 + 4] |= 0xF « 4; /* underscore as 4th digit */
00423
00424     for (i = 0; i < 15; i++) {

```

```

00425     leftcol[thisrow][i] |= 0x00000002;    /* right border */
00426     }
00427
00428     leftcol[thisrow][15] = 0x0000FFFE;      /* bottom border */
00429
00430     if (d3 == 0xF) {                        /* 256-point boundary */
00431         leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00432     }
00433
00434     if ((thisrow % 0x40) == 0x3F) {         /* 1024-point boundary */
00435         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00436     }
00437     }
00438
00439     /*
00440     Create the top row legend.
00441     */
00442     memset ((void *)toprow, 0, 16 * 16 * sizeof (unsigned));
00443
00444     for (codept = 0x0; codept <= 0xF; codept++) {
00445         d1 = (codept » 12) & 0xF; /* most significant hex digit */
00446         d2 = (codept » 8) & 0xF;
00447         d3 = (codept » 4) & 0xF;
00448         d4 = codept      & 0xF; /* least significant hex digit */
00449
00450         /* fill in last digit */
00451         for (digitrow = 0; digitrow < 5; digitrow++) {
00452             toprow[6 + digitrow][codept] = hexdigit[d4][digitrow] « 6;
00453         }
00454     }
00455
00456     for (j = 0; j < 16; j++) {
00457         /* force bottom pixel row to be white, for separation from glyphs */
00458         toprow[15][j] = 0x0000;
00459     }
00460
00461     /* 1 pixel row with left-hand legend line */
00462     for (j = 0; j < 16; j++) {
00463         toprow[14][j] |= 0xFFFF;
00464     }
00465
00466     /* 14 rows with line on left to fill out this character row */
00467     for (i = 13; i >= 0; i--) {
00468         for (j = 0; j < 16; j++) {
00469             toprow[i][j] |= 0x0001;
00470         }
00471     }
00472
00473     /*
00474     Now write the raster image.
00475     */
00476     XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00477     */
00478
00479     /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00480     for (i = 0xFFF0; i >= 0; i -= 0x10) {
00481         thisrow = i » 4; /* 16 glyphs per row */
00482         for (j = 15; j >= 0; j--) {
00483             /* left-hand legend */
00484             putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00485             putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00486             putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00487             putchar (~leftcol[thisrow][j]      & 0xFF);
00488             /* Unifont glyph */
00489             for (k = 0; k < 16; k++) {
00490                 bytesout = ~plane_array[i+k][j] & 0xFFFF;
00491                 putchar ((bytesout » 8) & 0xFF);
00492                 putchar ( bytesout      & 0xFF);
00493             }
00494         }
00495     }
00496
00497     /*
00498     Write the top legend.
00499     */
00500     /* i == 15: bottom pixel row of header is output here */
00501     /* left-hand legend: solid black line except for right-most pixel */
00502     putchar (0x00);
00503     putchar (0x00);
00504     putchar (0x00);
00505     putchar (0x01);

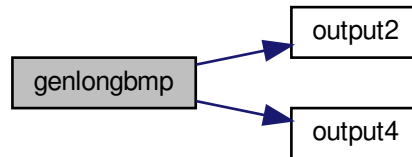
```

```

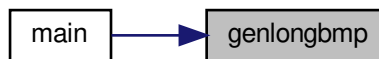
00506     for (j = 0; j < 16; j++) {
00507         putchar ((~toprow[15][j] » 8) & 0xFF);
00508         putchar ( ~toprow[15][j]      & 0xFF);
00509     }
00510
00511     putchar (0xFF);
00512     putchar (0xFF);
00513     putchar (0xFF);
00514     putchar (0xFC);
00515     for (j = 0; j < 16; j++) {
00516         putchar ((~toprow[14][j] » 8) & 0xFF);
00517         putchar ( ~toprow[14][j]      & 0xFF);
00518     }
00519
00520     for (i = 13; i >= 0; i--) {
00521         putchar (0xFF);
00522         putchar (0xFF);
00523         putchar (0xFF);
00524         putchar (0xFD);
00525         for (j = 0; j < 16; j++) {
00526             putchar ((~toprow[i][j] » 8) & 0xFF);
00527             putchar ( ~toprow[i][j]      & 0xFF);
00528         }
00529     }
00530
00531     /*
00532     Write the header.
00533     */
00534
00535     /* 7 completely white rows */
00536     for (i = 7; i >= 0; i--) {
00537         for (j = 0; j < 18; j++) {
00538             putchar (0xFF);
00539             putchar (0xFF);
00540         }
00541     }
00542
00543     for (i = 15; i >= 0; i--) {
00544         /* left-hand legend */
00545         putchar (0xFF);
00546         putchar (0xFF);
00547         putchar (0xFF);
00548         putchar (0xFF);
00549         /* header glyph */
00550         for (j = 0; j < 16; j++) {
00551             bytesout = ~header[i][j] & 0xFFFF;
00552             putchar ((bytesout » 8) & 0xFF);
00553             putchar ( bytesout      & 0xFF);
00554         }
00555     }
00556
00557     /* 8 completely white rows at very top */
00558     for (i = 7; i >= 0; i--) {
00559         for (j = 0; j < 18; j++) {
00560             putchar (0xFF);
00561             putchar (0xFF);
00562         }
00563     }
00564
00565     return;
00566 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.23.3.2 genwidebmp()

```

void genwidebmp (
    int plane_array[0x10000][16],
    int dpi,
    int tinynum,
    int plane )
  
```

Generate the BMP output file in wide format.

This function generates the BMP output file from a bitmap parameter. This is a wide bitmap, 256 glyphs wide by 256 glyphs tall.

#### Parameters

in	plane_array	The array of glyph bitmaps for a plane.
----	-------------	---



## Parameters

in	dpi	Dots per inch, for encoding in the BMP output file header.
in	tinynum	Whether to generate tiny numbers in 256x256 grid.
in	plane	The Unicode plane, 0..17.

Definition at line 581 of file `unifontpic.c`.

```

00582 {
00583
00584 char header_string[257];
00585 char raw_header[HDR_LEN];
00586 int header[16][256]; /* header row, for chart title */
00587 int hdrlen;          /* length of HEADER_STRING */
00588 int startcol;       /* column to start printing header, for centering */
00589
00590 unsigned leftcol[0x100][16]; /* code point legend on left side of chart */
00591 int d1, d2, d3, d4;          /* digits for filling leftcol[][] legend */
00592 int codept;                 /* current starting code point for legend */
00593 int thisrow;                /* glyph row currently being rendered */
00594 unsigned toprow[32][256];   /* code point legend on top of chart */
00595 int digitrow;               /* row we're in (0..4) for the above hexdigit digits */
00596 int hexalpha1, hexalpha2;   /* to convert hex digits to ASCII */
00597
00598 /*
00599 DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00600 */
00601 int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00602 int ImageSize;
00603 int FileSize;
00604 int Width, Height; /* bitmap image width and height in pixels */
00605 int ppm;           /* integer pixels per meter */
00606
00607 int i, j, k;
00608
00609 unsigned bytesout;
00610
00611 void output4(int), output2(int);
00612
00613 /*
00614 Image width and height, in pixels.
00615

```

```

00616 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00617 */
00618 Width = 258 * 16; /* (          2 legend + 256 glyphs) * 16 pixels/glyph */
00619 Height = 260 * 16; /* (2 header + 2 legend + 256 glyphs) * 16 rows/glyph */
00620
00621 ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00622
00623 FileSize = DataOffset + ImageSize;
00624
00625 /* convert dots/inch to pixels/meter */
00626 if (dpi == 0) dpi = 96;
00627 ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00628
00629 /*
00630 Generate the BMP Header
00631 */
00632 putchar ('B');
00633 putchar ('M');
00634 /*
00635 Calculate file size:
00636
00637 BMP Header + InfoHeader + Color Table + Raster Data
00638 */
00639 output4 (FileSize); /* FileSize */
00640 output4 (0x0000); /* reserved */
00641 /* Calculate DataOffset */
00642 output4 (DataOffset);
00643
00644 /*
00645 InfoHeader
00646 */
00647 output4 (40); /* Size of InfoHeader */
00648 output4 (Width); /* Width of bitmap in pixels */
00649 output4 (Height); /* Height of bitmap in pixels */
00650 output2 (1); /* Planes (1 plane) */
00651 output2 (1); /* BitCount (1 = monochrome) */
00652 output4 (0); /* Compression (0 = none) */
00653 output4 (ImageSize); /* ImageSize, in bytes */
00654 output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00655 output4 (ppm); /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00656 output4 (2); /* ColorsUsed (= 2) */
00657 output4 (2); /* ColorsImportant (= 2) */
00658 output4 (0x00000000); /* black (reserved, B, G, R) */
00659 output4 (0x00FFFFFF); /* white (reserved, B, G, R) */
00660
00661 /*
00662 Create header row bits.
00663 */
00664 sprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00665 memset ((void *)header, 0, 256 * 16 * sizeof (int)); /* fill with white */
00666 memset ((void *)header_string, ' ', 256 * sizeof (char)); /* 256 spaces */
00667 header_string[256] = '\0'; /* null-terminated */
00668
00669 hdrlen = strlen (raw_header);
00670 /* Wide bitmap can print 256 columns, but limit to 32 columns for long bitmap. */
00671 if (hdrlen > 32) hdrlen = 32;
00672 startcol = 127 - ((hdrlen - 1) » 1); /* to center header */
00673 /* center up to 32 chars */
00674 memcpy (&header_string[startcol], raw_header, hdrlen);
00675
00676 /* Copy each letter's bitmap from the plane_array[] we constructed. */
00677 for (j = 0; j < 256; j++) {
00678     for (i = 0; i < 16; i++) {
00679         header[i][j] = ascii_bits[header_string[j] & 0x7F][i];
00680     }
00681 }
00682
00683 /*
00684 Create the left column legend.
00685 */
00686 memset ((void *)leftcol, 0, 256 * 16 * sizeof (unsigned));
00687
00688 for (codept = 0x0000; codept < 0x10000; codept += 0x100) {
00689     d1 = (codept » 12) & 0xF; /* most significant hex digit */
00690     d2 = (codept » 8) & 0xF;
00691
00692     thisrow = codept » 8; /* rows of 256 glyphs */
00693
00694     /* fill in first and second digits */
00695
00696     if (tinynum) { /* use 4x5 pixel glyphs */

```

```

00697     for (digitrow = 0; digitrow < 5; digitrow++) {
00698         leftcol[thisrow][6 + digitrow] =
00699             (hexdigit[d1][digitrow] « 10) |
00700             (hexdigit[d2][digitrow] « 4);
00701     }
00702 }
00703 else { /* bigger numbers -- use glyphs from Unifont itself */
00704     /* convert hexadecimal digits to ASCII equivalent */
00705     hexalpha1 = d1 < 0xA ? '0' + d1 : 'A' + d1 - 0xA;
00706     hexalpha2 = d2 < 0xA ? '0' + d2 : 'A' + d2 - 0xA;
00707
00708     for (i = 0 ; i < 16; i++) {
00709         leftcol[thisrow][i] =
00710             (ascii_bits[hexalpha1][i] « 2) |
00711             (ascii_bits[hexalpha2][i] » 6);
00712     }
00713 }
00714
00715 for (i = 0; i < 15; i++) {
00716     leftcol[thisrow][i] |= 0x00000002; /* right border */
00717 }
00718
00719 leftcol[thisrow][15] = 0x0000FFFE; /* bottom border */
00720
00721 if (d2 == 0xF) { /* 4096-point boundary */
00722     leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00723 }
00724
00725 if ((thisrow % 0x40) == 0x3F) { /* 16,384-point boundary */
00726     leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00727 }
00728 }
00729
00730 /*
00731 Create the top row legend.
00732 */
00733 memset((void *)toprow, 0, 32 * 256 * sizeof(unsigned));
00734
00735 for (codept = 0x00; codept <= 0xFF; codept++) {
00736     d3 = (codept » 4) & 0xF;
00737     d4 = codept & 0xF; /* least significant hex digit */
00738
00739     if (tinynum) {
00740         for (digitrow = 0; digitrow < 5; digitrow++) {
00741             toprow[16 + 6 + digitrow][codept] =
00742                 (hexdigit[d3][digitrow] « 10) |
00743                 (hexdigit[d4][digitrow] « 4);
00744         }
00745     }
00746     else {
00747         /* convert hexadecimal digits to ASCII equivalent */
00748         hexalpha1 = d3 < 0xA ? '0' + d3 : 'A' + d3 - 0xA;
00749         hexalpha2 = d4 < 0xA ? '0' + d4 : 'A' + d4 - 0xA;
00750         for (i = 0 ; i < 16; i++) {
00751             toprow[14 + i][codept] =
00752                 (ascii_bits[hexalpha1][i] ) |
00753                 (ascii_bits[hexalpha2][i] » 7);
00754         }
00755     }
00756 }
00757
00758 for (j = 0; j < 256; j++) {
00759     /* force bottom pixel row to be white, for separation from glyphs */
00760     toprow[16 + 15][j] = 0x0000;
00761 }
00762
00763 /* 1 pixel row with left-hand legend line */
00764 for (j = 0; j < 256; j++) {
00765     toprow[16 + 14][j] |= 0xFFFF;
00766 }
00767
00768 /* 14 rows with line on left to fill out this character row */
00769 for (i = 13; i >= 0; i--) {
00770     for (j = 0; j < 256; j++) {
00771         toprow[16 + i][j] |= 0x0001;
00772     }
00773 }
00774
00775 /* Form the longer tic marks in top legend */
00776 for (i = 8; i < 16; i++) {
00777     for (j = 0x0F; j < 0x100; j += 0x10) {

```

```

00778     toprow[i][j] |= 0x0001;
00779     }
00780 }
00781
00782 /*
00783 Now write the raster image.
00784
00785 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00786 */
00787
00788 /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00789 for (i = 0xFF00; i >= 0; i -= 0x100) {
00790     thisrow = i » 8; /* 256 glyphs per row */
00791     for (j = 15; j >= 0; j--) {
00792         /* left-hand legend */
00793         putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00794         putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00795         putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00796         putchar (~leftcol[thisrow][j] & 0xFF);
00797         /* Unifont glyph */
00798         for (k = 0x00; k < 0x100; k++) {
00799             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00800             putchar ((bytesout » 8) & 0xFF);
00801             putchar ( bytesout      & 0xFF);
00802         }
00803     }
00804 }
00805
00806 /*
00807 Write the top legend.
00808 */
00809 /* i == 15: bottom pixel row of header is output here */
00810 /* left-hand legend: solid black line except for right-most pixel */
00811 putchar (0x00);
00812 putchar (0x00);
00813 putchar (0x00);
00814 putchar (0x01);
00815 for (j = 0; j < 256; j++) {
00816     putchar ((~toprow[16 + 15][j] » 8) & 0xFF);
00817     putchar (~toprow[16 + 15][j] & 0xFF);
00818 }
00819
00820 putchar (0xFF);
00821 putchar (0xFF);
00822 putchar (0xFF);
00823 putchar (0xFC);
00824 for (j = 0; j < 256; j++) {
00825     putchar ((~toprow[16 + 14][j] » 8) & 0xFF);
00826     putchar (~toprow[16 + 14][j] & 0xFF);
00827 }
00828
00829 for (i = 16 + 13; i >= 0; i--) {
00830     if (i >= 8) { /* make vertical stroke on right */
00831         putchar (0xFF);
00832         putchar (0xFF);
00833         putchar (0xFF);
00834         putchar (0xFD);
00835     }
00836     else { /* all white */
00837         putchar (0xFF);
00838         putchar (0xFF);
00839         putchar (0xFF);
00840         putchar (0xFF);
00841     }
00842     for (j = 0; j < 256; j++) {
00843         putchar ((~toprow[i][j] » 8) & 0xFF);
00844         putchar (~toprow[i][j] & 0xFF);
00845     }
00846 }
00847
00848 /*
00849 Write the header.
00850 */
00851
00852 /* 8 completely white rows */
00853 for (i = 7; i >= 0; i--) {
00854     for (j = 0; j < 258; j++) {
00855         putchar (0xFF);
00856         putchar (0xFF);
00857     }
00858 }

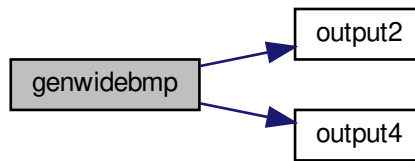
```

```

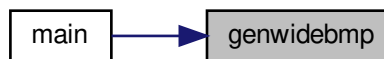
00859
00860 for (i = 15; i >= 0; i--) {
00861     /* left-hand legend */
00862     putchar (0xFF);
00863     putchar (0xFF);
00864     putchar (0xFF);
00865     putchar (0xFF);
00866     /* header glyph */
00867     for (j = 0; j < 256; j++) {
00868         bytesout = ~header[i][j] & 0xFFFF;
00869         putchar ((bytesout » 8) & 0xFF);
00870         putchar ( bytesout      & 0xFF);
00871     }
00872 }
00873
00874 /* 8 completely white rows at very top */
00875 for (i = 7; i >= 0; i--) {
00876     for (j = 0; j < 258; j++) {
00877         putchar (0xFF);
00878         putchar (0xFF);
00879     }
00880 }
00881
00882 return;
00883 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.23.3.3 gethex()

```

void gethex (
    char * instring,
    int plane_array[0x10000][16],
    int plane )

```

Read a Unifont .hex-format input file from stdin.

Each glyph can be 2, 4, 6, or 8 ASCII hexadecimal digits wide. [Glyph](#) height is fixed at 16 pixels.

## Parameters

in	instring	One line from a Uni-font .hex-format file.
in,out	plane_array	Bitmap for this plane, one bitmap row per element.
in	plane	The Unicode plane, 0..17.

Definition at line 215 of file `unifontpic.c`.

```

00216 {
00217     char *bitstring; /* pointer into instring for glyph bitmap */
00218     int i; /* loop variable */
00219     int codept; /* the Unicode code point of the current glyph */
00220     int glyph_plane; /* Unicode plane of current glyph */
00221     int ndigits; /* number of ASCII hexadecimal digits in glyph */
00222     int bytespl; /* bytes per line of pixels in a glyph */
00223     int temprow; /* 1 row of a quadruple-width glyph */
00224     int newrow; /* 1 row of double-width output pixels */
00225     unsigned bitmask; /* to mask off 2 bits of long width glyph */
00226
00227     /*
00228     Read each input line and place its glyph into the bit array.
00229     */
00230     sscanf (instring, "%X", &codept);
00231     glyph_plane = codept » 16;
00232     if (glyph_plane == plane) {
00233         codept &= 0xFFFF; /* array index will only have 16 bit address */
00234         /* find the colon separator */
00235         for (i = 0; (i < 9) && (instring[i] != ':'); i++);
00236         i++; /* position past it */
00237         bitstring = &instring[i];
00238         ndigits = strlen (bitstring);
00239         /* don't count '\n' at end of line if present */
00240         if (bitstring[ndigits - 1] == '\n') ndigits--;
00241         bytespl = ndigits » 5; /* 16 rows per line, 2 digits per byte */
00242
00243         if (bytespl >= 1 && bytespl <= 4) {
00244             for (i = 0; i < 16; i++) { /* 16 rows per glyph */
00245                 /* Read correct number of hexadecimal digits given glyph width */
00246                 switch (bytespl) {
00247                     case 1: sscanf (bitstring, "%2X", &temprow);
00248                             bitstring += 2;
00249                             temprow «= 8; /* left-justify single-width glyph */
00250                             break;
00251                     case 2: sscanf (bitstring, "%4X", &temprow);
00252                             bitstring += 4;
00253                             break;
00254                     /* cases 3 and 4 widths will be compressed by 50% (see below) */
00255                     case 3: sscanf (bitstring, "%6X", &temprow);
00256                             bitstring += 6;

```

```

00257         temprow «= 8; /* left-justify */
00258         break;
00259     case 4: sscanf (bitstring, "%8X", &temprow);
00260         bitstring += 8;
00261         break;
00262     } /* switch on number of bytes per row */
00263     /* compress glyph width by 50% if greater than double-width */
00264     if (bytespl > 2) {
00265         newrow = 0x0000;
00266         /* mask off 2 bits at a time to convert each pair to 1 bit out */
00267         for (bitmask = 0xC0000000; bitmask != 0; bitmask »= 2) {
00268             newrow «= 1;
00269             if ((temprow & bitmask) != 0) newrow |= 1;
00270         }
00271         temprow = newrow;
00272     } /* done conditioning glyphs beyond double-width */
00273     plane_array[codept][i] = temprow; /* store glyph bitmap for output */
00274 } /* for each row */
00275 } /* if 1 to 4 bytes per row/line */
00276 } /* if this is the plane we are seeking */
00277
00278 return;
00279 }

```

Here is the caller graph for this function:



#### 5.23.3.4 main()

```

int main (
    int argc,
    char ** argv )

```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

## Returns

This program exits with status `EXIT_SUCCESS`.

Definition at line 87 of file `unifontpic.c`.

```

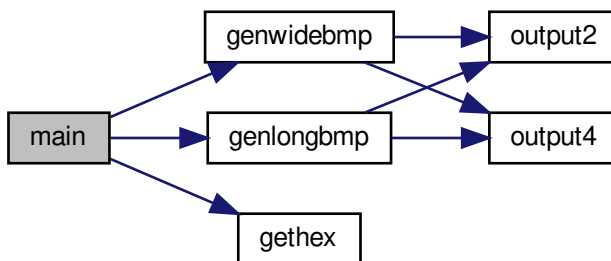
00088 {
00089     /* Input line buffer */
00090     char instring[MAXSTRING];
00091
00092     /* long and dpi are set from command-line options */
00093     int wide=1; /* =1 for a 256x256 grid, =0 for a 16x4096 grid */
00094     int dpi=96; /* change for 256x256 grid to fit paper if desired */
00095     int tinynum=0; /* whether to use tiny labels for 256x256 grid */
00096
00097     int i, j; /* loop variables */
00098
00099     int plane=0; /* Unicode plane, 0..17; Plane 0 is default */
00100     /* 16 pixel rows for each of 65,536 glyphs in a Unicode plane */
00101     int plane_array[0x10000][16];
00102
00103     void gethex();
00104     void genlongbmp();
00105     void genwidebmp();
00106
00107     if (argc > 1) {
00108         for (i = 1; i < argc; i++) {
00109             if (strncmp (argv[i], "-l", 2) == 0) { /* long display */
00110                 wide = 0;
00111             }
00112             else if (strncmp (argv[i], "-d", 2) == 0) {
00113                 dpi = atoi (&argv[i][2]); /* dots/inch specified on command line */
00114             }
00115             else if (strncmp (argv[i], "-t", 2) == 0) {
00116                 tinynum = 1;
00117             }
00118             else if (strncmp (argv[i], "-P", 2) == 0) {
00119                 /* Get Unicode plane */
00120                 for (j = 2; argv[i][j] != '\0'; j++) {
00121                     if (argv[i][j] < '0' || argv[i][j] > '9') {
00122                         fprintf (stderr,
00123                                 "ERROR: Specify Unicode plane as decimal number.\n\n");
00124                         exit (EXIT_FAILURE);
00125                     }
00126                 }
00127                 plane = atoi (&argv[i][2]); /* Unicode plane, 0..17 */
00128                 if (plane < 0 || plane > 17) {
00129                     fprintf (stderr,
00130                             "ERROR: Plane out of Unicode range [0,17].\n\n");
00131                     exit (EXIT_FAILURE);
00132                 }
00133             }
00134         }
00135     }
00136
00137     /*
00138     Initialize the ASCII bitmap array for chart titles
00139     */
00140     for (i = 0; i < 128; i++) {
00141         gethex (ascii_hex[i], plane_array, 0); /* convert Unifont hexadecimal string to bitmap */
00142         for (j = 0; j < 16; j++) ascii_bits[i][j] = plane_array[i][j];
00143     }
00144
00145     /*
00146     Read in the Unifont hex file to render from standard input
00147     */
00148     memset ((void *)plane_array, 0, 0x10000 * 16 * sizeof (int));
00149     while (fgets (instring, MAXSTRING, stdin) != NULL) {
00150         gethex (instring, plane_array, plane); /* read .hex input file and fill plane_array with glyph data */
00151     } /* while not EOF */
00152
00153     /*
00154     Write plane_array glyph data to BMP file as wide or long bitmap.
00155     */
00156     if (wide) {
00157         genwidebmp (plane_array, dpi, tinynum, plane);
00158     }
00159     else {
00160         genlongbmp (plane_array, dpi, tinynum, plane);
00161     }
00162 }

```



```
00164 }
00165
00166 exit (EXIT_SUCCESS);
00167 }
```

Here is the call graph for this function:



### 5.23.3.5 output2()

```
void output2 (
    int thisword )
```

Output a 2-byte integer in little-endian order.

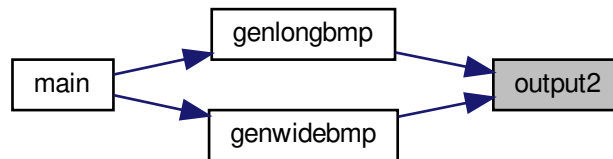
Parameters

in	thisword	The 2-byte integer to output as binary data.
----	----------	--

Definition at line 194 of file [unifontpic.c](#).

```
00195 {
00196
00197 putchar ( thisword & 0xFF);
00198 putchar ((thisword » 8) & 0xFF);
00199
00200 return;
00201 }
```

Here is the caller graph for this function:



### 5.23.3.6 `output4()`

```
void output4 (
    int thisword )
```

Output a 4-byte integer in little-endian order.

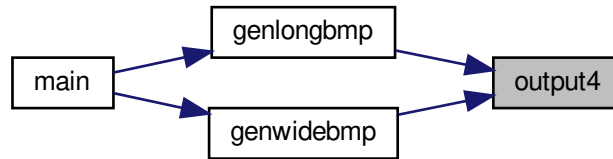
Parameters

in	thisword	The 4-byte integer to output as binary data.
----	----------	--

Definition at line 176 of file [unifontpic.c](#).

```
00177 {
00178
00179     putchar ( thisword      & 0xFF);
00180     putchar ((thisword » 8) & 0xFF);
00181     putchar ((thisword » 16) & 0xFF);
00182     putchar ((thisword » 24) & 0xFF);
00183
00184     return;
00185 }
```

Here is the caller graph for this function:



## 5.24 unifontpic.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unifontpic.c
00003
00004 @brief unifontpic - See the "Big Picture": the entire Unifont
00005 in one BMP bitmap
00006
00007 @author Paul Hardy, 2013
00008
00009 @copyright Copyright (C) 2013, 2017 Paul Hardy
00010 */
00011 /*
00012 LICENSE:
00013
00014 This program is free software: you can redistribute it and/or modify
00015 it under the terms of the GNU General Public License as published by
00016 the Free Software Foundation, either version 2 of the License, or
00017 (at your option) any later version.
00018
00019 This program is distributed in the hope that it will be useful,
00020 but WITHOUT ANY WARRANTY; without even the implied warranty of
00021 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00022 GNU General Public License for more details.
00023
00024 You should have received a copy of the GNU General Public License
00025 along with this program. If not, see <http://www.gnu.org/licenses/>.
00026 */
00027
00028 /*
00029 11 June 2017 [Paul Hardy]:
00030 - Modified to take glyphs that are 24 or 32 pixels wide and
00031 compress them horizontally by 50%.
00032
00033 8 July 2017 [Paul Hardy]:
00034 - Modified to print Unifont charts above Unicode Plane 0.
00035 - Adds "-P" option to specify Unicode plane in decimal,
00036 as "-P0" through "-P17". Omitting this argument uses
00037 plane 0 as the default.
00038 - Appends Unicode plane number to chart title.
00039 - Reads in "unifontpic.h", which was added mainly to
00040 store ASCII chart title glyphs in an embedded array
00041 rather than requiring these ASCII glyphs to be in
00042 the ".hex" file that is read in for the chart body
00043 (which was the case previously, when all that was
00044 able to print was Unicode place 0).
00045 - Fixes truncated header in long bitmap format, making
00046 the long chart title glyphs single-spaced. This leaves
00047 room for the Unicode plane to appear even in the narrow
00048 chart title of the "long" format chart. The wide chart
00049 title still has double-spaced ASCII glyphs.
00050 - Adjusts centering of title on long and wide charts.
00051
00052 11 May 2019 [Paul Hardy]:
00053 - Changed strncpy calls to memcpy.
  
```

```

00054 - Added "HDR_LEN" to define length of header string
00055 for use in sprintf function call.
00056 - Changed sprintf function calls to sprintf function
00057 calls for writing chart header string.
00058 */
00059
00060
00061 #include <stdio.h>
00062 #include <stdlib.h>
00063 #include <string.h>
00064 #include "unifontpic.h"
00065
00066 /** Define length of header string for top of chart. */
00067 #define HDR_LEN 33
00068
00069
00070 /*
00071 Stylistic Note:
00072
00073 Many variables in this program use multiple words scrunched
00074 together, with each word starting with an upper-case letter.
00075 This is only done to match the canonical field names in the
00076 Windows Bitmap Graphics spec.
00077 */
00078
00079 /**
00080 @brief The main function.
00081
00082 @param[in] argc The count of command line arguments.
00083 @param[in] argv Pointer to array of command line arguments.
00084 @return This program exits with status EXIT_SUCCESS.
00085 */
00086 int
00087 main (int argc, char **argv)
00088 {
00089     /* Input line buffer */
00090     char instring[MAXSTRING];
00091
00092     /* long and dpi are set from command-line options */
00093     int wide=1; /* =1 for a 256x256 grid, =0 for a 16x4096 grid */
00094     int dpi=96; /* change for 256x256 grid to fit paper if desired */
00095     int tinynum=0; /* whether to use tiny labels for 256x256 grid */
00096
00097     int i, j; /* loop variables */
00098
00099     int plane=0; /* Unicode plane, 0..17; Plane 0 is default */
00100     /* 16 pixel rows for each of 65,536 glyphs in a Unicode plane */
00101     int plane_array[0x10000][16];
00102
00103     void gethex();
00104     void genlongbmp();
00105     void genwidebmp();
00106
00107     if (argc > 1) {
00108         for (i = 1; i < argc; i++) {
00109             if (strncmp (argv[i], "-l", 2) == 0) { /* long display */
00110                 wide = 0;
00111             }
00112             else if (strncmp (argv[i], "-d", 2) == 0) {
00113                 dpi = atoi (&argv[i][2]); /* dots/inch specified on command line */
00114             }
00115             else if (strncmp (argv[i], "-t", 2) == 0) {
00116                 tinynum = 1;
00117             }
00118             else if (strncmp (argv[i], "-P", 2) == 0) {
00119                 /* Get Unicode plane */
00120                 for (j = 2; argv[i][j] != '\0'; j++) {
00121                     if (argv[i][j] < '0' || argv[i][j] > '9') {
00122                         fprintf (stderr,
00123                             "ERROR: Specify Unicode plane as decimal number.\n\n");
00124                         exit (EXIT_FAILURE);
00125                     }
00126                 }
00127                 plane = atoi (&argv[i][2]); /* Unicode plane, 0..17 */
00128                 if (plane < 0 || plane > 17) {
00129                     fprintf (stderr,
00130                         "ERROR: Plane out of Unicode range [0,17].\n\n");
00131                     exit (EXIT_FAILURE);
00132                 }
00133             }
00134         }
00135     }

```

```

00135 }
00136
00137
00138 /*
00139 Initialize the ASCII bitmap array for chart titles
00140 */
00141 for (i = 0; i < 128; i++) {
00142     gethex (ascii_hex[i], plane_array, 0); /* convert Unifont hexadecimal string to bitmap */
00143     for (j = 0; j < 16; j++) ascii_bits[i][j] = plane_array[i][j];
00144 }
00145
00146
00147 /*
00148 Read in the Unifont hex file to render from standard input
00149 */
00150 memset ((void *)plane_array, 0, 0x10000 * 16 * sizeof (int));
00151 while (fgets (instring, MAXSTRING, stdin) != NULL) {
00152     gethex (instring, plane_array, plane); /* read .hex input file and fill plane_array with glyph data */
00153 } /* while not EOF */
00154
00155
00156 /*
00157 Write plane_array glyph data to BMP file as wide or long bitmap.
00158 */
00159 if (wide) {
00160     genwidebmp (plane_array, dpi, tinynum, plane);
00161 }
00162 else {
00163     genlongbmp (plane_array, dpi, tinynum, plane);
00164 }
00165
00166 exit (EXIT_SUCCESS);
00167 }
00168
00169
00170 /**
00171 @brief Output a 4-byte integer in little-endian order.
00172
00173 @param[in] thisword The 4-byte integer to output as binary data.
00174 */
00175 void
00176 output4 (int thisword)
00177 {
00178
00179     putchar (thisword & 0xFF);
00180     putchar ((thisword » 8) & 0xFF);
00181     putchar ((thisword » 16) & 0xFF);
00182     putchar ((thisword » 24) & 0xFF);
00183
00184     return;
00185 }
00186
00187
00188 /**
00189 @brief Output a 2-byte integer in little-endian order.
00190
00191 @param[in] thisword The 2-byte integer to output as binary data.
00192 */
00193 void
00194 output2 (int thisword)
00195 {
00196
00197     putchar (thisword & 0xFF);
00198     putchar ((thisword » 8) & 0xFF);
00199
00200     return;
00201 }
00202
00203
00204 /**
00205 @brief Read a Unifont .hex-format input file from stdin.
00206
00207 Each glyph can be 2, 4, 6, or 8 ASCII hexadecimal digits wide.
00208 Glyph height is fixed at 16 pixels.
00209
00210 @param[in] instring One line from a Unifont .hex-format file.
00211 @param[in,out] plane_array Bitmap for this plane, one bitmap row per element.
00212 @param[in] plane The Unicode plane, 0..17.
00213 */
00214 void
00215 gethex (char *instring, int plane_array[0x10000][16], int plane)

```

```

00216 {
00217 char *bitstring; /* pointer into instring for glyph bitmap */
00218 int i; /* loop variable */
00219 int codept; /* the Unicode code point of the current glyph */
00220 int glyph_plane; /* Unicode plane of current glyph */
00221 int ndigits; /* number of ASCII hexadecimal digits in glyph */
00222 int bytespl; /* bytes per line of pixels in a glyph */
00223 int temprow; /* 1 row of a quadruple-width glyph */
00224 int newrow; /* 1 row of double-width output pixels */
00225 unsigned bitmask; /* to mask off 2 bits of long width glyph */
00226
00227 /*
00228 Read each input line and place its glyph into the bit array.
00229 */
00230 sscanf (instring, "%X", &codept);
00231 glyph_plane = codept » 16;
00232 if (glyph_plane == plane) {
00233     codept &= 0xFFFF; /* array index will only have 16 bit address */
00234     /* find the colon separator */
00235     for (i = 0; (i < 9) && (instring[i] != ':'); i++);
00236     i++; /* position past it */
00237     bitstring = &instring[i];
00238     ndigits = strlen (bitstring);
00239     /* don't count '\n' at end of line if present */
00240     if (bitstring[ndigits - 1] == '\n') ndigits--;
00241     bytespl = ndigits » 5; /* 16 rows per line, 2 digits per byte */
00242
00243     if (bytespl >= 1 && bytespl <= 4) {
00244         for (i = 0; i < 16; i++) { /* 16 rows per glyph */
00245             /* Read correct number of hexadecimal digits given glyph width */
00246             switch (bytespl) {
00247                 case 1: sscanf (bitstring, "%2X", &temprow);
00248                     bitstring += 2;
00249                     temprow «= 8; /* left-justify single-width glyph */
00250                     break;
00251                 case 2: sscanf (bitstring, "%4X", &temprow);
00252                     bitstring += 4;
00253                     break;
00254                 /* cases 3 and 4 widths will be compressed by 50% (see below) */
00255                 case 3: sscanf (bitstring, "%6X", &temprow);
00256                     bitstring += 6;
00257                     temprow «= 8; /* left-justify */
00258                     break;
00259                 case 4: sscanf (bitstring, "%8X", &temprow);
00260                     bitstring += 8;
00261                     break;
00262             } /* switch on number of bytes per row */
00263             /* compress glyph width by 50% if greater than double-width */
00264             if (bytespl > 2) {
00265                 newrow = 0x0000;
00266                 /* mask off 2 bits at a time to convert each pair to 1 bit out */
00267                 for (bitmask = 0xC0000000; bitmask != 0; bitmask »= 2) {
00268                     newrow «= 1;
00269                     if ((temprow & bitmask) != 0) newrow |= 1;
00270                 }
00271                 temprow = newrow;
00272             } /* done conditioning glyphs beyond double-width */
00273             plane_array[codept][i] = temprow; /* store glyph bitmap for output */
00274         } /* for each row */
00275     } /* if 1 to 4 bytes per row/line */
00276 } /* if this is the plane we are seeking */
00277
00278 return;
00279 }
00280
00281
00282 /**
00283 @brief Generate the BMP output file in long format.
00284
00285 This function generates the BMP output file from a bitmap parameter.
00286 This is a long bitmap, 16 glyphs wide by 4,096 glyphs tall.
00287
00288 @param[in] plane_array The array of glyph bitmaps for a plane.
00289 @param[in] dpi Dots per inch, for encoding in the BMP output file header.
00290 @param[in] tinynum Whether to generate tiny numbers in wide grid (unused).
00291 @param[in] plane The Unicode plane, 0..17.
00292 */
00293 void
00294 genlongbmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
00295 {
00296

```

```

00297 char header_string[HDR_LEN]; /* centered header */
00298 char raw_header[HDR_LEN]; /* left-aligned header */
00299 int header[16][16]; /* header row, for chart title */
00300 int hdrlen; /* length of HEADER_STRING */
00301 int startcol; /* column to start printing header, for centering */
00302
00303 unsigned leftcol[0x1000][16]; /* code point legend on left side of chart */
00304 int d1, d2, d3, d4; /* digits for filling leftcol[][] legend */
00305 int codept; /* current starting code point for legend */
00306 int thisrow; /* glyph row currently being rendered */
00307 unsigned toprow[16][16]; /* code point legend on top of chart */
00308 int digitrow; /* row we're in (0..4) for the above hexdigit digits */
00309
00310 /*
00311 DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00312 */
00313 int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00314 int ImageSize;
00315 int FileSize;
00316 int Width, Height; /* bitmap image width and height in pixels */
00317 int ppm; /* integer pixels per meter */
00318
00319 int i, j, k;
00320
00321 unsigned bytesout;
00322
00323 void output4(int), output2(int);
00324
00325 /*
00326 Image width and height, in pixels.
00327
00328 N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00329 */
00330 Width = 18 * 16; /* (2 legend + 16 glyphs) * 16 pixels/glyph */
00331 Height = 4099 * 16; /* (1 header + 4096 glyphs) * 16 rows/glyph */
00332
00333 ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00334
00335 FileSize = DataOffset + ImageSize;
00336
00337 /* convert dots/inch to pixels/meter */
00338 if (dpi == 0) dpi = 96;
00339 ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00340
00341 /*
00342 Generate the BMP Header
00343 */
00344 putchar ('B');
00345 putchar ('M');
00346
00347 /*
00348 Calculate file size:
00349
00350 BMP Header + InfoHeader + Color Table + Raster Data
00351 */
00352 output4 (FileSize); /* FileSize */
00353 output4 (0x0000); /* reserved */
00354
00355 /* Calculate DataOffset */
00356 output4 (DataOffset);
00357
00358 /*
00359 InfoHeader
00360 */
00361 output4 (40); /* Size of InfoHeader */
00362 output4 (Width); /* Width of bitmap in pixels */
00363 output4 (Height); /* Height of bitmap in pixels */
00364 output2 (1); /* Planes (1 plane) */
00365 output2 (1); /* BitCount (1 = monochrome) */
00366 output4 (0); /* Compression (0 = none) */
00367 output4 (ImageSize); /* ImageSize, in bytes */
00368 output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00369 output4 (ppm); /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00370 output4 (2); /* ColorsUsed (= 2) */
00371 output4 (2); /* ColorsImportant (= 2) */
00372 output4 (0x00000000); /* black (reserved, B, G, R) */
00373 output4 (0x00FFFFFF); /* white (reserved, B, G, R) */
00374
00375 /*
00376 Create header row bits.
00377 */

```

```

00378  snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00379  memset ((void *)header, 0, 16 * 16 * sizeof (int)); /* fill with white */
00380  memset ((void *)header_string, ' ', 32 * sizeof (char)); /* 32 spaces */
00381  header_string[32] = '\0'; /* null-terminated */
00382
00383  hdrlen = strlen (raw_header);
00384  if (hdrlen > 32) hdrlen = 32; /* only 32 columns to print header */
00385  startcol = 16 - ((hdrlen + 1) » 1); /* to center header */
00386  /* center up to 32 chars */
00387  memcpy (&header_string[startcol], raw_header, hdrlen);
00388
00389  /* Copy each letter's bitmap from the plane_array[][] we constructed. */
00390  /* Each glyph must be single-width, to fit two glyphs in 16 pixels */
00391  for (j = 0; j < 16; j++) {
00392      for (i = 0; i < 16; i++) {
00393          header[i][j] =
00394              (ascii_bits[header_string[j+i] ] & 0x7F)[i] & 0xFF00 |
00395              (ascii_bits[header_string[j+i+1] ] & 0x7F)[i] » 8);
00396      }
00397  }
00398
00399  /*
00400  Create the left column legend.
00401  */
00402  memset ((void *)leftcol, 0, 4096 * 16 * sizeof (unsigned));
00403
00404  for (codept = 0x0000; codept < 0x10000; codept += 0x10) {
00405      d1 = (codept » 12) & 0xF; /* most significant hex digit */
00406      d2 = (codept » 8) & 0xF;
00407      d3 = (codept » 4) & 0xF;
00408
00409      thisrow = codept » 4; /* rows of 16 glyphs */
00410
00411      /* fill in first and second digits */
00412      for (digitrow = 0; digitrow < 5; digitrow++) {
00413          leftcol[thisrow][2 + digitrow] =
00414              (hexdigit[d1][digitrow] « 10) |
00415              (hexdigit[d2][digitrow] « 4);
00416      }
00417
00418      /* fill in third digit */
00419      for (digitrow = 0; digitrow < 5; digitrow++) {
00420          leftcol[thisrow][9 + digitrow] = hexdigit[d3][digitrow] « 10;
00421      }
00422      leftcol[thisrow][9 + 4] |= 0xF « 4; /* underscore as 4th digit */
00423
00424      for (i = 0; i < 15; i++) {
00425          leftcol[thisrow][i] |= 0x00000002; /* right border */
00426      }
00427
00428      leftcol[thisrow][15] = 0x0000FFFE; /* bottom border */
00429
00430      if (d3 == 0xF) { /* 256-point boundary */
00431          leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00432      }
00433
00434      if ((thisrow % 0x40) == 0x3F) { /* 1024-point boundary */
00435          leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00436      }
00437  }
00438
00439  /*
00440  Create the top row legend.
00441  */
00442  memset ((void *)toprow, 0, 16 * 16 * sizeof (unsigned));
00443
00444  for (codept = 0x0; codept <= 0xF; codept++) {
00445      d1 = (codept » 12) & 0xF; /* most significant hex digit */
00446      d2 = (codept » 8) & 0xF;
00447      d3 = (codept » 4) & 0xF;
00448      d4 = codept & 0xF; /* least significant hex digit */
00449
00450      /* fill in last digit */
00451      for (digitrow = 0; digitrow < 5; digitrow++) {
00452          toprow[6 + digitrow][codept] = hexdigit[d4][digitrow] « 6;
00453      }
00454  }
00455
00456  for (j = 0; j < 16; j++) {
00457      /* force bottom pixel row to be white, for separation from glyphs */
00458      toprow[15][j] = 0x0000;

```



```

00459 }
00460
00461 /* 1 pixel row with left-hand legend line */
00462 for (j = 0; j < 16; j++) {
00463     toprow[14][j] |= 0xFFFF;
00464 }
00465
00466 /* 14 rows with line on left to fill out this character row */
00467 for (i = 13; i >= 0; i--) {
00468     for (j = 0; j < 16; j++) {
00469         toprow[i][j] |= 0x0001;
00470     }
00471 }
00472
00473 /*
00474 Now write the raster image.
00475
00476 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00477 */
00478
00479 /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00480 for (i = 0xFFFF0; i >= 0; i -= 0x10) {
00481     thisrow = i » 4; /* 16 glyphs per row */
00482     for (j = 15; j >= 0; j--) {
00483         /* left-hand legend */
00484         putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00485         putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00486         putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00487         putchar (~leftcol[thisrow][j] & 0xFF);
00488         /* Unifont glyph */
00489         for (k = 0; k < 16; k++) {
00490             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00491             putchar ((bytesout » 8) & 0xFF);
00492             putchar ( bytesout & 0xFF);
00493         }
00494     }
00495 }
00496
00497 /*
00498 Write the top legend.
00499 */
00500 /* i == 15: bottom pixel row of header is output here */
00501 /* left-hand legend: solid black line except for right-most pixel */
00502 putchar (0x00);
00503 putchar (0x00);
00504 putchar (0x00);
00505 putchar (0x01);
00506 for (j = 0; j < 16; j++) {
00507     putchar ((~toprow[15][j] » 8) & 0xFF);
00508     putchar (~toprow[15][j] & 0xFF);
00509 }
00510
00511 putchar (0xFF);
00512 putchar (0xFF);
00513 putchar (0xFF);
00514 putchar (0xFC);
00515 for (j = 0; j < 16; j++) {
00516     putchar ((~toprow[14][j] » 8) & 0xFF);
00517     putchar (~toprow[14][j] & 0xFF);
00518 }
00519
00520 for (i = 13; i >= 0; i--) {
00521     putchar (0xFF);
00522     putchar (0xFF);
00523     putchar (0xFF);
00524     putchar (0xFD);
00525     for (j = 0; j < 16; j++) {
00526         putchar ((~toprow[i][j] » 8) & 0xFF);
00527         putchar (~toprow[i][j] & 0xFF);
00528     }
00529 }
00530
00531 /*
00532 Write the header.
00533 */
00534
00535 /* 7 completely white rows */
00536 for (i = 7; i >= 0; i--) {
00537     for (j = 0; j < 18; j++) {
00538         putchar (0xFF);
00539         putchar (0xFF);

```

```

00540     }
00541   }
00542
00543   for (i = 15; i >= 0; i--) {
00544     /* left-hand legend */
00545     putchar (0xFF);
00546     putchar (0xFF);
00547     putchar (0xFF);
00548     putchar (0xFF);
00549     /* header glyph */
00550     for (j = 0; j < 16; j++) {
00551       bytesout = ~header[i][j] & 0xFFFF;
00552       putchar ((bytesout » 8) & 0xFF);
00553       putchar ( bytesout      & 0xFF);
00554     }
00555   }
00556
00557   /* 8 completely white rows at very top */
00558   for (i = 7; i >= 0; i--) {
00559     for (j = 0; j < 18; j++) {
00560       putchar (0xFF);
00561       putchar (0xFF);
00562     }
00563   }
00564
00565   return;
00566 }
00567
00568
00569 /**
00570 @brief Generate the BMP output file in wide format.
00571
00572 This function generates the BMP output file from a bitmap parameter.
00573 This is a wide bitmap, 256 glyphs wide by 256 glyphs tall.
00574
00575 @param[in] plane_array The array of glyph bitmaps for a plane.
00576 @param[in] dpi Dots per inch, for encoding in the BMP output file header.
00577 @param[in] tinynum Whether to generate tiny numbers in 256x256 grid.
00578 @param[in] plane The Unicode plane, 0..17.
00579 */
00580 void
00581 genwidebmp (int plane_array[0x10000][16], int dpi, int tinynum, int plane)
00582 {
00583   char header_string[257];
00584   char raw_header[HDR_LEN];
00585   int header[16][256]; /* header row, for chart title */
00586   int hdrlen; /* length of HEADER_STRING */
00587   int startcol; /* column to start printing header, for centering */
00588
00589   unsigned leftcol[0x100][16]; /* code point legend on left side of chart */
00590   int d1, d2, d3, d4; /* digits for filling leftcol[][] legend */
00591   int codept; /* current starting code point for legend */
00592   int thisrow; /* glyph row currently being rendered */
00593   unsigned toprow[32][256]; /* code point legend on top of chart */
00594   int digitrow; /* row we're in (0..4) for the above hexdigit digits */
00595   int hexalpha1, hexalpha2; /* to convert hex digits to ASCII */
00596
00597   /*
00598   DataOffset = BMP Header bytes + InfoHeader bytes + ColorTable bytes.
00599   */
00600   int DataOffset = 14 + 40 + 8; /* fixed size for monochrome BMP */
00601   int ImageSize;
00602   int FileSize;
00603   int Width, Height; /* bitmap image width and height in pixels */
00604   int ppm; /* integer pixels per meter */
00605
00606   int i, j, k;
00607
00608   unsigned bytesout;
00609
00610   void output4(int), output2(int);
00611
00612   /*
00613   Image width and height, in pixels.
00614
00615   N.B.: Width must be an even multiple of 32 pixels, or 4 bytes.
00616   */
00617   Width = 258 * 16; /* ( 2 legend + 256 glyphs) * 16 pixels/glyph */
00618   Height = 260 * 16; /* (2 header + 2 legend + 256 glyphs) * 16 rows/glyph */
00619
00620

```

```

00621 ImageSize = Height * (Width / 8); /* in bytes, calculated from pixels */
00622
00623 FileSize = DataOffset + ImageSize;
00624
00625 /* convert dots/inch to pixels/meter */
00626 if (dpi == 0) dpi = 96;
00627 ppm = (int)((double)dpi * 100.0 / 2.54 + 0.5);
00628
00629 /*
00630 Generate the BMP Header
00631 */
00632 putchar ('B');
00633 putchar ('M');
00634 /*
00635 Calculate file size:
00636
00637 BMP Header + InfoHeader + Color Table + Raster Data
00638 */
00639 output4 (FileSize); /* FileSize */
00640 output4 (0x0000); /* reserved */
00641 /* Calculate DataOffset */
00642 output4 (DataOffset);
00643
00644 /*
00645 InfoHeader
00646 */
00647 output4 (40); /* Size of InfoHeader */
00648 output4 (Width); /* Width of bitmap in pixels */
00649 output4 (Height); /* Height of bitmap in pixels */
00650 output2 (1); /* Planes (1 plane) */
00651 output2 (1); /* BitCount (1 = monochrome) */
00652 output4 (0); /* Compression (0 = none) */
00653 output4 (ImageSize); /* ImageSize, in bytes */
00654 output4 (ppm); /* XpixelsPerM (96 dpi = 3780 pixels/meter) */
00655 output4 (ppm); /* YpixelsPerM (96 dpi = 3780 pixels/meter) */
00656 output4 (2); /* ColorsUsed (= 2) */
00657 output4 (2); /* ColorsImportant (= 2) */
00658 output4 (0x00000000); /* black (reserved, B, G, R) */
00659 output4 (0x00FFFFFF); /* white (reserved, B, G, R) */
00660
00661 /*
00662 Create header row bits.
00663 */
00664 snprintf (raw_header, HDR_LEN, "%s Plane %d", HEADER_STRING, plane);
00665 memset ((void *)header, 0, 256 * 16 * sizeof (int)); /* fill with white */
00666 memset ((void *)header_string, ' ', 256 * sizeof (char)); /* 256 spaces */
00667 header_string[256] = '\0'; /* null-terminated */
00668
00669 hdrln = strlen (raw_header);
00670 /* Wide bitmap can print 256 columns, but limit to 32 columns for long bitmap. */
00671 if (hdrln > 32) hdrln = 32;
00672 startcol = 127 - ((hdrln - 1) » 1); /* to center header */
00673 /* center up to 32 chars */
00674 memcpy (&header_string[startcol], raw_header, hdrln);
00675
00676 /* Copy each letter's bitmap from the plane_array[] we constructed. */
00677 for (j = 0; j < 256; j++) {
00678     for (i = 0; i < 16; i++) {
00679         header[i][j] = ascii_bits[header_string[j] & 0x7F][i];
00680     }
00681 }
00682
00683 /*
00684 Create the left column legend.
00685 */
00686 memset ((void *)leftcol, 0, 256 * 16 * sizeof (unsigned));
00687
00688 for (codept = 0x0000; codept < 0x10000; codept += 0x100) {
00689     d1 = (codept » 12) & 0xF; /* most significant hex digit */
00690     d2 = (codept » 8) & 0xF;
00691
00692     thisrow = codept » 8; /* rows of 256 glyphs */
00693
00694     /* fill in first and second digits */
00695
00696     if (tinynum) { /* use 4x5 pixel glyphs */
00697         for (digitrow = 0; digitrow < 5; digitrow++) {
00698             leftcol[thisrow][6 + digitrow] =
00699                 (hexdigit[d1][digitrow] « 10) |
00700                 (hexdigit[d2][digitrow] « 4);
00701         }

```

```

00702     }
00703     else { /* bigger numbers -- use glyphs from Unifont itself */
00704         /* convert hexadecimal digits to ASCII equivalent */
00705         hexalpha1 = d1 < 0xA ? '0' + d1 : 'A' + d1 - 0xA;
00706         hexalpha2 = d2 < 0xA ? '0' + d2 : 'A' + d2 - 0xA;
00707
00708         for (i = 0 ; i < 16; i++) {
00709             leftcol[thisrow][i] =
00710                 (ascii_bits[hexalpha1][i] << 2) |
00711                 (ascii_bits[hexalpha2][i] >> 6);
00712         }
00713     }
00714
00715     for (i = 0; i < 15; i++) {
00716         leftcol[thisrow][i] |= 0x00000002; /* right border */
00717     }
00718
00719     leftcol[thisrow][15] = 0x0000FFFE; /* bottom border */
00720
00721     if (d2 == 0xF) { /* 4096-point boundary */
00722         leftcol[thisrow][15] |= 0x00FF0000; /* longer tic mark */
00723     }
00724
00725     if ((thisrow % 0x40) == 0x3F) { /* 16,384-point boundary */
00726         leftcol[thisrow][15] |= 0xFFFF0000; /* longest tic mark */
00727     }
00728 }
00729
00730 /*
00731 Create the top row legend.
00732 */
00733 memset ((void *)toprow, 0, 32 * 256 * sizeof (unsigned));
00734
00735 for (codept = 0x00; codept <= 0xFF; codept++) {
00736     d3 = (codept >> 4) & 0xF;
00737     d4 = codept & 0xF; /* least significant hex digit */
00738
00739     if (tinynum) {
00740         for (digitrow = 0; digitrow < 5; digitrow++) {
00741             toprow[16 + 6 + digitrow][codept] =
00742                 (hexdigit[d3][digitrow] << 10) |
00743                 (hexdigit[d4][digitrow] << 4);
00744         }
00745     }
00746     else {
00747         /* convert hexadecimal digits to ASCII equivalent */
00748         hexalpha1 = d3 < 0xA ? '0' + d3 : 'A' + d3 - 0xA;
00749         hexalpha2 = d4 < 0xA ? '0' + d4 : 'A' + d4 - 0xA;
00750         for (i = 0 ; i < 16; i++) {
00751             toprow[14 + i][codept] =
00752                 (ascii_bits[hexalpha1][i] << 2) |
00753                 (ascii_bits[hexalpha2][i] >> 7);
00754         }
00755     }
00756 }
00757
00758 for (j = 0; j < 256; j++) {
00759     /* force bottom pixel row to be white, for separation from glyphs */
00760     toprow[16 + 15][j] = 0x0000;
00761 }
00762
00763 /* 1 pixel row with left-hand legend line */
00764 for (j = 0; j < 256; j++) {
00765     toprow[16 + 14][j] |= 0xFFFF;
00766 }
00767
00768 /* 14 rows with line on left to fill out this character row */
00769 for (i = 13; i >= 0; i--) {
00770     for (j = 0; j < 256; j++) {
00771         toprow[16 + i][j] |= 0x0001;
00772     }
00773 }
00774
00775 /* Form the longer tic marks in top legend */
00776 for (i = 8; i < 16; i++) {
00777     for (j = 0x0F; j < 0x100; j += 0x10) {
00778         toprow[i][j] |= 0x0001;
00779     }
00780 }
00781
00782 /*

```

```

00783 Now write the raster image.
00784
00785 XOR each byte with 0xFF because black = 0, white = 1 in BMP.
00786 */
00787
00788 /* Write the glyphs, bottom-up, left-to-right, in rows of 16 (i.e., 0x10) */
00789 for (i = 0xFF00; i >= 0; i -= 0x100) {
00790     thisrow = i » 8; /* 256 glyphs per row */
00791     for (j = 15; j >= 0; j--) {
00792         /* left-hand legend */
00793         putchar ((~leftcol[thisrow][j] » 24) & 0xFF);
00794         putchar ((~leftcol[thisrow][j] » 16) & 0xFF);
00795         putchar ((~leftcol[thisrow][j] » 8) & 0xFF);
00796         putchar (~leftcol[thisrow][j] & 0xFF);
00797         /* Unifont glyph */
00798         for (k = 0x00; k < 0x100; k++) {
00799             bytesout = ~plane_array[i+k][j] & 0xFFFF;
00800             putchar ((bytesout » 8) & 0xFF);
00801             putchar (bytesout & 0xFF);
00802         }
00803     }
00804 }
00805
00806 /*
00807 Write the top legend.
00808 */
00809 /* i == 15: bottom pixel row of header is output here */
00810 /* left-hand legend: solid black line except for right-most pixel */
00811 putchar (0x00);
00812 putchar (0x00);
00813 putchar (0x00);
00814 putchar (0x01);
00815 for (j = 0; j < 256; j++) {
00816     putchar ((~toprow[16 + 15][j] » 8) & 0xFF);
00817     putchar (~toprow[16 + 15][j] & 0xFF);
00818 }
00819
00820 putchar (0xFF);
00821 putchar (0xFF);
00822 putchar (0xFF);
00823 putchar (0xFC);
00824 for (j = 0; j < 256; j++) {
00825     putchar ((~toprow[16 + 14][j] » 8) & 0xFF);
00826     putchar (~toprow[16 + 14][j] & 0xFF);
00827 }
00828
00829 for (i = 16 + 13; i >= 0; i--) {
00830     if (i >= 8) { /* make vertical stroke on right */
00831         putchar (0xFF);
00832         putchar (0xFF);
00833         putchar (0xFF);
00834         putchar (0xFD);
00835     }
00836     else { /* all white */
00837         putchar (0xFF);
00838         putchar (0xFF);
00839         putchar (0xFF);
00840         putchar (0xFF);
00841     }
00842     for (j = 0; j < 256; j++) {
00843         putchar ((~toprow[i][j] » 8) & 0xFF);
00844         putchar (~toprow[i][j] & 0xFF);
00845     }
00846 }
00847
00848 /*
00849 Write the header.
00850 */
00851
00852 /* 8 completely white rows */
00853 for (i = 7; i >= 0; i--) {
00854     for (j = 0; j < 258; j++) {
00855         putchar (0xFF);
00856         putchar (0xFF);
00857     }
00858 }
00859
00860 for (i = 15; i >= 0; i--) {
00861     /* left-hand legend */
00862     putchar (0xFF);
00863     putchar (0xFF);

```

```

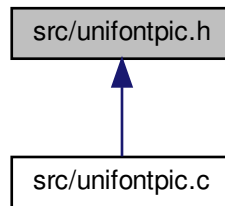
00864     putchar (0xFF);
00865     putchar (0xFF);
00866     /* header glyph */
00867     for (j = 0; j < 256; j++) {
00868         bytesout = ~header[i][j] & 0xFFFF;
00869         putchar ((bytesout » 8) & 0xFF);
00870         putchar ( bytesout      & 0xFF);
00871     }
00872 }
00873
00874 /* 8 completely white rows at very top */
00875 for (i = 7; i >= 0; i--) {
00876     for (j = 0; j < 256; j++) {
00877         putchar (0xFF);
00878         putchar (0xFF);
00879     }
00880 }
00881
00882 return;
00883 }
00884

```

## 5.25 src/unifontpic.h File Reference

[unifontpic.h](#) - Header file for [unifontpic.c](#)

This graph shows which files directly or indirectly include this file:



### Macros

- #define [MAXSTRING](#) 256  
Maximum input string allowed.
- #define [HEADER\\_STRING](#) "GNU Unifont 15.1.02"  
To be printed as chart title.

### Variables

- const char \* [ascii\\_hex](#) [128]  
Array of Unifont ASCII glyphs for chart row & column headings.
- int [ascii\\_bits](#) [128][16]  
Array to hold ASCII bitmaps for chart title.
- char [hexdigit](#) [16][5]  
Array of 4x5 hexadecimal digits for legend.

## 5.25.1 Detailed Description

[unifontpic.h](#) - Header file for [unifontpic.c](#)

Author

Paul Hardy, July 2017

Copyright

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Definition in file [unifontpic.h](#).

## 5.25.2 Macro Definition Documentation

### 5.25.2.1 HEADER\_STRING

```
#define HEADER_STRING "GNU Unifont 15.1.02"
```

To be printed as chart title.

Definition at line [32](#) of file [unifontpic.h](#).

### 5.25.2.2 MAXSTRING

```
#define MAXSTRING 256
```

Maximum input string allowed.

Definition at line [30](#) of file [unifontpic.h](#).

## 5.25.3 Variable Documentation

### 5.25.3.1 ascii\_bits

```
int ascii_bits[128][16]
```

Array to hold ASCII bitmaps for chart title.

This array will be created from the strings in `ascii_hex[]` above.

Definition at line [179](#) of file [unifontpic.h](#).

### 5.25.3.2 ascii\_hex

```
const char* ascii_hex[128]
```

Array of Unifont ASCII glyphs for chart row & column headings.

Define the array of Unifont ASCII glyphs, code points 0 through 127. This allows using `unifontpic` to print charts of glyphs above Unicode Plane 0. These were copied from `font/plane00/unifont-base.hex`, plus U+0020 (ASCII space character).

Definition at line [42](#) of file [unifontpic.h](#).

### 5.25.3.3 hexdigit

```
char hexdigit[16][5]
```

Initial value:

```
= {
  {0x6,0x9,0x9,0x9,0x6},
  {0x2,0x6,0x2,0x2,0x7},
  {0xF,0x1,0xF,0x8,0xF},
  {0xE,0x1,0x7,0x1,0xE},
  {0x9,0x9,0xF,0x1,0x1},
  {0xF,0x8,0xF,0x1,0xF},
  {0x6,0x8,0xE,0x9,0x6},
  {0xF,0x1,0x2,0x4,0x4},
  {0x6,0x9,0x6,0x9,0x6},
  {0x6,0x9,0x7,0x1,0x6},
  {0xF,0x9,0xF,0x9,0x9},
  {0xE,0x9,0xE,0x9,0xE},
  {0x7,0x8,0x8,0x8,0x7},
  {0xE,0x9,0x9,0x9,0xE},
  {0xF,0x8,0xE,0x8,0xF},
  {0xF,0x8,0xE,0x8,0x8}
}
```

Array of 4x5 hexadecimal digits for legend.

hexdigit contains 4x5 pixel arrays of tiny digits for the legend. See [unihexgen.c](#) for a more detailed description in the comments.

Definition at line 188 of file [unifontpic.h](#).

## 5.26 unifontpic.h

[Go to the documentation of this file.](#)

```
00001 /**
00002 @file unifontpic.h
00003
00004 @brief unifontpic.h - Header file for unifontpic.c
00005
00006 @author Paul Hardy, July 2017
00007
00008 @copyright Copyright (C) 2017 Paul Hardy
00009 */
00010 /*
00011 LICENSE:
00012
00013 This program is free software: you can redistribute it and/or modify
00014 it under the terms of the GNU General Public License as published by
00015 the Free Software Foundation, either version 2 of the License, or
00016 (at your option) any later version.
00017
00018 This program is distributed in the hope that it will be useful,
00019 but WITHOUT ANY WARRANTY; without even the implied warranty of
00020 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00021 GNU General Public License for more details.
00022
00023 You should have received a copy of the GNU General Public License
00024 along with this program. If not, see <http://www.gnu.org/licenses/>.
00025 */
00026
00027 #ifndef _UNIFONTPIC_H_
00028 #define _UNIFONTPIC_H_
00029
00030 #define MAXSTRING 256 ///< Maximum input string allowed.
00031
00032 #define HEADER_STRING "GNU Unifont 15.1.02" ///< To be printed as chart title.
00033
00034 /**
00035 @brief Array of Unifont ASCII glyphs for chart row & column headings.
00036
00037 Define the array of Unifont ASCII glyphs, code points 0 through 127.
00038 This allows using unifontpic to print charts of glyphs above Unicode
00039 Plane 0. These were copied from font/plane00/unifont-base.hex, plus
00040 U+0020 (ASCII space character).
00041 */
00042 const char *ascii_hex [128] = {
00043  "0000:AAA00018000000180004A51EA505A51C99E00018000000180005555",
00044  "0001:AAA00018000000180003993C252325F8A5271938000000180005555",
00045  "0002:AAA00018000000180003BA5C1243119892471258000000180005555",
```





```

00127 "0054:000000007F08080808080808080000",
00128 "0055:000000004242424242424242423C0000",
00129 "0056:00000000414141222222141408080000",
00130 "0057:00000000424242425A5A666642420000",
00131 "0058:00000000424242424181824242420000",
00132 "0059:000000004141222214080808080000",
00133 "005A:000000007E02020408102040407E0000",
00134 "005B:00000000E0808080808080808080E00",
00135 "005C:00000000404020101008080402020000",
00136 "005D:000000701010101010101010107000",
00137 "005E:000018244200000000000000000000",
00138 "005F:0000000000000000000000000000F00",
00139 "0060:002010080000000000000000000000",
00140 "0061:0000000000003C42023E4242463A0000",
00141 "0062:0000004040405C624242424242625C0000",
00142 "0063:000000000003C4240404040423C0000",
00143 "0064:000000202023A4642424242463A0000",
00144 "0065:000000000003C42427E4040423C0000",
00145 "0066:000000C1010107C101010101010000",
00146 "0067:000000000023A44444438203C42423C",
00147 "0068:0000004040405C624242424242420000",
00148 "0069:00000080800180808080808083E000",
00149 "006A:000000404000C040404040404044830",
00150 "006B:00000040404044485060504844420000",
00151 "006C:000000180808080808080808083E000",
00152 "006D:000000000000764949494949490000",
00153 "006E:0000000000005C624242424242420000",
00154 "006F:000000000003C4242424242423C0000",
00155 "0070:0000000000005C6242424242625C4040",
00156 "0071:000000000003A4642424242463A0202",
00157 "0072:000000000005C6242404040400000",
00158 "0073:000000000003C4240300C02423C0000",
00159 "0074:000000001010107C10101010100C0000",
00160 "0075:000000000004242424242463A0000",
00161 "0076:000000000004242424242418180000",
00162 "0077:00000000000414949494949360000",
00163 "0078:000000000004242418182442420000",
00164 "0079:000000000004242424242261A02023C",
00165 "007A:000000000007E0204081020407E0000",
00166 "007B:000000C10100808102010080810100C",
00167 "007C:000008080808080808080808080808",
00168 "007D:00000030080810100804081010080830",
00169 "007E:000000314946000000000000000000",
00170 "007F:AAA00018000001800073D1CA104BD1CA1073DF8000001800000180005555"
00171 };
00172
00173
00174 /**
00175 @brief Array to hold ASCII bitmaps for chart title.
00176
00177 This array will be created from the strings in ascii_hex[] above.
00178 */
00179 int ascii_bits[128][16];
00180
00181
00182 /**
00183 @brief Array of 4x5 hexadecimal digits for legend.
00184
00185 hexdigit contains 4x5 pixel arrays of tiny digits for the legend.
00186 See unihexgen.c for a more detailed description in the comments.
00187 */
00188 char hexdigit[16][5] = {
00189 {0x6,0x9,0x9,0x9,0x6}, /* 0x0 */
00190 {0x2,0x6,0x2,0x2,0x7}, /* 0x1 */
00191 {0xF,0x1,0xF,0x8,0xF}, /* 0x2 */
00192 {0xE,0x1,0x7,0x1,0xE}, /* 0x3 */
00193 {0x9,0x9,0xF,0x1,0x1}, /* 0x4 */
00194 {0xF,0x8,0xF,0x1,0xF}, /* 0x5 */
00195 {0x6,0x8,0xE,0x9,0x6}, /* 0x6 */
00196 {0xF,0x1,0x2,0x4,0x4}, /* 0x7 */
00197 {0x6,0x9,0x6,0x9,0x6}, /* 0x8 */
00198 {0x6,0x9,0x7,0x1,0x6}, /* 0x9 */
00199 {0xF,0x9,0xF,0x9,0x9}, /* 0xA */
00200 {0xE,0x9,0xE,0x9,0xE}, /* 0xB */
00201 {0x7,0x8,0x8,0x8,0x7}, /* 0xC */
00202 {0xE,0x9,0x9,0x9,0xE}, /* 0xD */
00203 {0xF,0x8,0xE,0x8,0xF}, /* 0xE */
00204 {0xF,0x8,0xE,0x8,0x8} /* 0xF */
00205 };
00206
00207 #endif

```

## 5.27 src/unigen-hangul.c File Reference

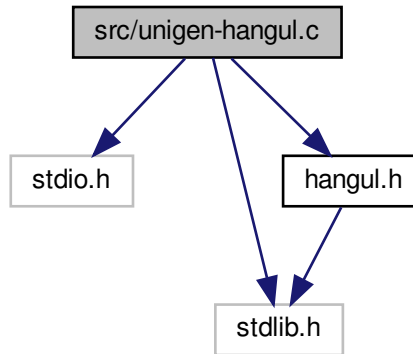
Generate arbitrary hangul syllables.

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include "hangul.h"
```

Include dependency graph for unigen-hangul.c:



### Data Structures

- struct [PARAMS](#)

### Functions

- int [main](#) (int argc, char \*argv[])  
Program entry point.
- void [parse\\_args](#) (int argc, char \*argv[], struct [PARAMS](#) \*params)  
Parse command line arguments.
- void [get\\_hex\\_range](#) (char \*instring, unsigned \*start, unsigned \*end)  
Scan a hexadecimal range from a character string.

#### 5.27.1 Detailed Description

Generate arbitrary hangul syllables.

Input is a Unifont .hex file such as the "hangul-base.hex" file that is included in the Unifont package.

The default program parameters will generate the Unicode Hangul Syllables range of U+AC00..U+D7A3.

The syllables will appear in this order:

```

For each modern choseong {
  For each modern jungseong {
    Output syllable of choseong and jungseong
    For each modern jongseong {
      Output syllable of choseong + jungseong + jongseong
    }
  }
}

```

By starting the jongseong code point at one before the first valid jongseong, the first inner loop iteration will add a blank glyph for the jongseong portion of the syllable, so only the current choseong and jungseong will be output first.

Author

Paul Hardy

Copyright

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Definition in file [unigen-hangul.c](#).

## 5.27.2 Function Documentation

### 5.27.2.1 `get_hex_range()`

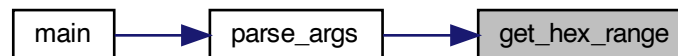
```
void get_hex_range (
    char * instring,
    unsigned * start,
    unsigned * end )
```

Scan a hexadecimal range from a character string.

Definition at line [354](#) of file [unigen-hangul.c](#).

```
00354     {
00355     int i; /* String index variable. */
00356     /* Get first number in range. */
00357     sscanf (instring, "%X", start);
00360     for (i = 0;
00361          instring [i] != '\0' && instring [i] != '-';
00362          i++);
00363     /* Get last number in range. */
00364     if (instring [i] == '-') {
00365         i++;
00366         sscanf (&instring [i], "%X", end);
00367     }
00368     else {
00369         *end = *start;
00370     }
00371     }
00372     return;
00373 }
```

Here is the caller graph for this function:



## 5.27.2.2 main()

```
int main (
    int argc,
    char * argv[] )
```

Program entry point.

Default parameters for Hangul syllable generation.

Definition at line 69 of file [unigen-hangul.c](#).

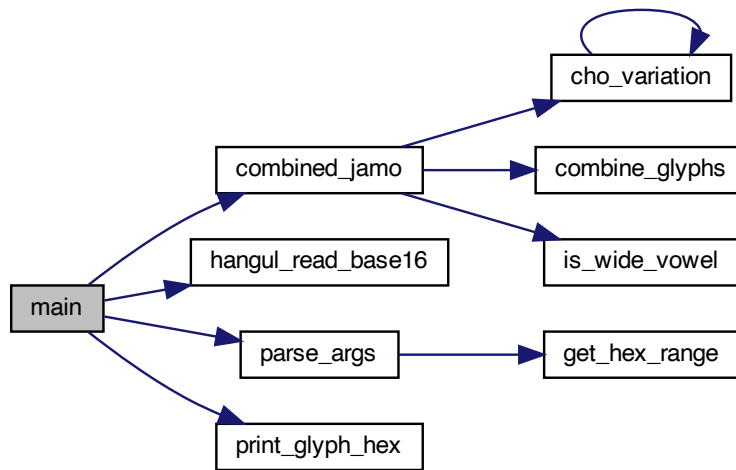
```
00069     {
00070
00071     int i; /* loop variable */
00072     unsigned codept;
00073     unsigned max_codept;
00074     unsigned glyph[MAX_GLYPHS][16];
00075     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00076     int cho, jung, jong; /* The 3 components in a Hangul syllable. */
00077
00078     /// Default parameters for Hangul syllable generation.
00079     struct PARAMS params = { 0xAC00, /* Starting output Unicode code point */
00080                             0x1100, /* First modern choseong */
00081                             0x1112, /* Last modern choseong */
00082                             0x1161, /* First modern jungseong */
00083                             0x1175, /* Last modern jungseong */
00084                             0x11A7, /* One before first modern jongseong */
00085                             0x11C2, /* Last modern jongseong */
00086                             stdin, /* Default input file pointer */
00087                             stdout /* Default output file pointer */
00088     };
00089
00090     void parse_args (int argc, char *argv[], struct PARAMS *params);
00091
00092     unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00093
00094     void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00095
00096     void combined_jamo (unsigned glyph [MAX_GLYPHS][16],
00097                       unsigned cho, unsigned jung, unsigned jong,
00098                       unsigned *combined_glyph);
00099
00100
00101     if (argc > 1) {
00102         parse_args (argc, argv, &params);
00103
00104     #ifdef DEBUG
00105         fprintf (stderr,
00106                 "Range: (U+%04X, U+%04X, U+%04X) to (U+%04X, U+%04X, U+%04X)\n",
00107                 params.cho_start, params.jung_start, params.jong_start,
00108                 params.cho_end, params.jung_end, params.jong_end);
00109     #endif
00110     }
00111
00112     /*
00113     Initialize glyph array to all zeroes.
00114     */
00115     for (codept = 0; codept < MAX_GLYPHS; codept++) {
00116         for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00117     }
00118
00119     /*
00120     Read Hangul base glyph file.
00121     */
00122     max_codept = hangul_read_base16 (params.infp, glyph);
00123     if (max_codept > 0x8FFF) {
00124         fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00125     }
00126
00127     codept = params.starting_codept; /* First code point to output */
00128
00129     for (cho = params.cho_start; cho <= params.cho_end; cho++) {
00130         for (jung = params.jung_start; jung <= params.jung_end; jung++) {
00131             for (jong = params.jong_start; jong <= params.jong_end; jong++) {
00132
00133     #ifdef DEBUG
00134                 fprintf (params.outfp,
00135                         "(U+%04X, U+%04X, U+%04X)\n",
00136                         cho, jung, jong);
00137     #endif
00138                 combined_jamo (glyph, cho, jung, jong, tmp_glyph);
```

```

00139     print_glyph_hex (params.outfp, codept, tmp_glyph);
00140     codept++;
00141     if (jong == JONG_UNICODE_END)
00142         jong = JONG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00143     }
00144     if (jung == JUNG_UNICODE_END)
00145         jung = JUNG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00146     }
00147     if (cho == CHO_UNICODE_END)
00148         cho = CHO_EXTA_UNICODE_START - 1; /* Start Extended-A range */
00149     }
00150
00151     if (params.infp != stdin) fclose (params.infp);
00152     if (params.outfp != stdout) fclose (params.outfp);
00153
00154     exit (EXIT_SUCCESS);
00155 }

```

Here is the call graph for this function:



### 5.27.2.3 parse\_args()

```

void parse_args (
    int argc,
    char * argv[],
    struct PARAMS * params )

```

Parse command line arguments.

Definition at line 163 of file unigen-hangul.c.

```

00163     {
00164     int arg_count; /* Current index into argv[] */
00165
00166     void get_hex_range (char *instring, unsigned *start, unsigned *end);
00167
00168     int strncmp (const char *s1, const char *s2, size_t n);
00169
00170
00171     arg_count = 1;
00172
00173     while (arg_count < argc) {
00174         /* If all 600,000+ Hangul syllables are requested. */
00175         if (strncmp (argv [arg_count], "-all", 4) == 0) {

```

```

00176     params->starting_codept = 0x0001;
00177     params->cho_start = CHO_UNICODE_START; /* First modern choseong */
00178     params->cho_end = CHO_EXTB_UNICODE_END; /* Last ancient choseong */
00179     params->jung_start = JUNG_UNICODE_START; /* First modern jungseong */
00180     params->jung_end = JUNG_EXTB_UNICODE_END; /* Last ancient jungseong */
00181     params->jong_start = JONG_UNICODE_START - 1; /* One before first modern jongseong */
00182     params->jong_end = JONG_EXTB_UNICODE_END; /* Last ancient jongseong */
00183 }
00184 /* If starting code point for output Unifont hex file is specified. */
00185 else if (strncmp (argv [arg_count], "-c", 2) == 0) {
00186     arg_count++;
00187     if (arg_count < argc) {
00188         sscanf (argv [arg_count], "%X", &params->starting_codept);
00189     }
00190 }
00191 /* If initial consonant (choseong) range, "jamo 1", get range. */
00192 else if (strncmp (argv [arg_count], "-j1", 3) == 0) {
00193     arg_count++;
00194     if (arg_count < argc) {
00195         get_hex_range (argv [arg_count],
00196                       &params->cho_start, &params->cho_end);
00197     }
00198     /* Allow one initial blank glyph at start of a loop, none at end. */
00199     if (params->cho_start < CHO_UNICODE_START) {
00200         params->cho_start = CHO_UNICODE_START - 1;
00201     }
00202     else if (params->cho_start > CHO_UNICODE_END &&
00203             params->cho_start < CHO_EXTB_UNICODE_START) {
00204         params->cho_start = CHO_EXTB_UNICODE_START - 1;
00205     }
00206 }
00207 /* Do not go past desired Hangul choseong range,
00208 Hangul Jamo or Hangul Jamo Extended-A choseong. */
00209 if (params->cho_end > CHO_EXTB_UNICODE_END) {
00210     params->cho_end = CHO_EXTB_UNICODE_END;
00211 }
00212 else if (params->cho_end > CHO_UNICODE_END &&
00213         params->cho_end < CHO_EXTB_UNICODE_START) {
00214     params->cho_end = CHO_UNICODE_END;
00215 }
00216 }
00217 }
00218 }
00219 }
00220 /* If medial vowel (jungseong) range, "jamo 2", get range. */
00221 else if (strncmp (argv [arg_count], "-j2", 3) == 0) {
00222     arg_count++;
00223     if (arg_count < argc) {
00224         get_hex_range (argv [arg_count],
00225                       &params->jung_start, &params->jung_end);
00226     }
00227     /* Allow one initial blank glyph at start of a loop, none at end. */
00228     if (params->jung_start < JUNG_UNICODE_START) {
00229         params->jung_start = JUNG_UNICODE_START - 1;
00230     }
00231     else if (params->jung_start > JUNG_UNICODE_END &&
00232             params->jung_start < JUNG_EXTB_UNICODE_START) {
00233         params->jung_start = JUNG_EXTB_UNICODE_START - 1;
00234     }
00235 }
00236 /* Do not go past desired Hangul jungseong range,
00237 Hangul Jamo or Hangul Jamo Extended-B jungseong. */
00238 if (params->jung_end > JUNG_EXTB_UNICODE_END) {
00239     params->jung_end = JUNG_EXTB_UNICODE_END;
00240 }
00241 else if (params->jung_end > JUNG_UNICODE_END &&
00242         params->jung_end < JUNG_EXTB_UNICODE_START) {
00243     params->jung_end = JUNG_UNICODE_END;
00244 }
00245 }
00246 }
00247 }
00248 }
00249 /* If final consonant (jongseong) range, "jamo 3", get range. */
00250 else if (strncmp (argv [arg_count], "-j3", 3) == 0) {
00251     arg_count++;
00252     if (arg_count < argc) {
00253         get_hex_range (argv [arg_count],
00254                       &params->jong_start, &params->jong_end);
00255     }
00256     /* Allow one initial blank glyph at start of a loop, none at end. */

```

```

00257 */
00258     if (params->jong_start < JONG_UNICODE_START) {
00259         params->jong_start = JONG_UNICODE_START - 1;
00260     }
00261     else if (params->jong_start > JONG_UNICODE_END &&
00262             params->jong_start < JONG_EXTB_UNICODE_START) {
00263         params->jong_start = JONG_EXTB_UNICODE_START - 1;
00264     }
00265     /*
00266     Do not go past desired Hangul jongseong range,
00267     Hangul Jamo or Hangul Jamo Extended-B jongseong.
00268     */
00269     if (params->jong_end > JONG_EXTB_UNICODE_END) {
00270         params->jong_end = JONG_EXTB_UNICODE_END;
00271     }
00272     else if (params->jong_end > JONG_UNICODE_END &&
00273             params->jong_end < JONG_EXTB_UNICODE_START) {
00274         params->jong_end = JONG_UNICODE_END;
00275     }
00276 }
00277 }
00278 /* If input file is specified, open it for read access. */
00279 else if (strcmp (argv [arg_count], "-i", 2) == 0) {
00280     arg_count++;
00281     if (arg_count < argc) {
00282         params->infp = fopen (argv [arg_count], "r");
00283         if (params->infp == NULL) {
00284             fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00285                     argv [arg_count]);
00286             exit (EXIT_FAILURE);
00287         }
00288     }
00289 }
00290 /* If output file is specified, open it for write access. */
00291 else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00292     arg_count++;
00293     if (arg_count < argc) {
00294         params->outfp = fopen (argv [arg_count], "w");
00295         if (params->outfp == NULL) {
00296             fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00297                     argv [arg_count]);
00298             exit (EXIT_FAILURE);
00299         }
00300     }
00301 }
00302 /* If help is requested, print help message and exit. */
00303 else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00304          strcmp (argv [arg_count], "--help", 6) == 0) {
00305     printf ("\nunigen-hangul [options]\n\n");
00306     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00307     printf ("    in Johab 6/3/1 format.  By default, the output is the Unicode Hangul\n");
00308     printf ("    Syllables range, U+AC00..U+D7A3.  Options allow the user to specify\n");
00309     printf ("    a starting code point for the output Unifont .hex file, and ranges\n");
00310     printf ("    in hexadecimal of the starting and ending Hangul Jamo code points:\n\n");
00311
00312     printf ("        * 1100-115E Initial consonants (choseong)\n");
00313     printf ("        * 1161-11A7 Medial vowels (jungseong)\n");
00314     printf ("        * 11A8-11FF Final consonants (jongseong).\n\n");
00315
00316     printf ("    A single code point or 0 to omit can be specified instead of a range.\n\n");
00317
00318     printf (" Option  Parameters  Function\n");
00319     printf (" ----  - - - - - - - - - - - - - - - \n");
00320     printf (" -h, --help          Print this message and exit.\n");
00321     printf (" -all                Generate all Hangul syllables, using all modern and\n");
00322     printf ("                    ancient Hangul in the Unicode range U+1100..U+11FF,\n");
00323     printf ("                    U+A960..U+A97C, and U+D7B0..U+D7FB.\n");
00324     printf ("                    WARNING: this will generate over 1,600,000 syllables\n");
00325     printf ("                    in a 115 megabyte Unifont .hex format file.  The\n");
00326     printf ("                    default is to only output modern Hangul syllables.\n");
00327     printf (" -c      code_point  Starting code point in hexadecimal for output file.\n");
00328     printf (" -j1    start-end    Choseong (jamo 1) start-end range in hexadecimal.\n");
00329     printf (" -j2    start-end    Jungseong (jamo 2) start-end range in hexadecimal.\n");
00330     printf (" -j3    start-end    Jongseong (jamo 3) start-end range in hexadecimal.\n");
00331     printf (" -i      input_file  Unifont hangul-base.hex formatted input file.\n");
00332     printf (" -o      output_file Unifont .hex format output file.\n");
00333     printf (" Example:\n");
00334     printf (" unigen-hangul -c 1 -j3 11AB-11AB -i hangul-base.hex -o nieun-only.hex\n");
00335     printf (" Generates Hangul syllables using all modern choseong and jungseong,\n");
00336     printf (" and only the jongseong nieun (Unicode code point U+11AB).  The output\n");
00337     printf (" Unifont .hex file will contain code points starting at 1.  Instead of\n");

```



```

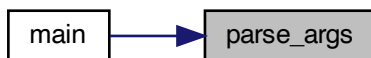
00338     printf ("    specifying \"-j3 11AB-11AB\", simply using \"-j3 11AB\" will also suffice.\n\n");
00339
00340     exit (EXIT_SUCCESS);
00341 }
00342
00343     arg_count++;
00344 }
00345
00346     return;
00347 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



## 5.28 unigen-hangul.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unigen-hangul.c
00003
00004  @brief Generate arbitrary hangul syllables.
00005
00006  Input is a Unifont .hex file such as the "hangul-base.hex" file that
00007  is included in the Unifont package.
00008
00009  The default program parameters will generate the Unicode
00010  Hangul Syllables range of U+AC00..U+D7A3. The syllables
00011  will appear in this order:
00012
00013  For each modern choseong {
00014  For each modern jungseong {
00015  Output syllable of choseong and jungseong
00016  For each modern jongseong {
00017  Output syllable of choseong + jungseong + jongseong
00018  }
00019  }
00020  }
00021
00022  By starting the jongseong code point at one before the first
00023  valid jongseong, the first inner loop iteration will add a
00024  blank glyph for the jongseong portion of the syllable, so
00025  only the current choseong and jungseong will be output first.
00026
00027  @author Paul Hardy
00028
00029  @copyright Copyright © 2023 Paul Hardy

```

```

00030 */
00031 /*
00032 LICENSE:
00033
00034 This program is free software: you can redistribute it and/or modify
00035 it under the terms of the GNU General Public License as published by
00036 the Free Software Foundation, either version 2 of the License, or
00037 (at your option) any later version.
00038
00039 This program is distributed in the hope that it will be useful,
00040 but WITHOUT ANY WARRANTY; without even the implied warranty of
00041 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00042 GNU General Public License for more details.
00043
00044 You should have received a copy of the GNU General Public License
00045 along with this program. If not, see <http://www.gnu.org/licenses/>.
00046 */
00047
00048 #include <stdio.h>
00049 #include <stdlib.h>
00050 #include "hangul.h"
00051
00052 // #define DEBUG
00053
00054
00055 struct PARAMS {
00056     unsigned starting_codept; /* First output Unicode code point. */
00057     unsigned cho_start, cho_end; /* Choseong start and end code points. */
00058     unsigned jung_start, jung_end; /* Jungseong start and end code points. */
00059     unsigned jong_start, jong_end; /* Jongseong start and end code points. */
00060     FILE *infp;
00061     FILE *outfp;
00062 };
00063
00064
00065 /**
00066 @brief Program entry point.
00067 */
00068 int
00069 main (int argc, char *argv[]) {
00070
00071     int i; /* loop variable */
00072     unsigned codept;
00073     unsigned max_codept;
00074     unsigned glyph[MAX_GLYPHS][16];
00075     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00076     int cho, jung, jong; /* The 3 components in a Hangul syllable. */
00077
00078     /// Default parameters for Hangul syllable generation.
00079     struct PARAMS params = { 0xAC00, /* Starting output Unicode code point */
00080                             0x1100, /* First modern choseong */
00081                             0x1112, /* Last modern choseong */
00082                             0x1161, /* First modern jungseong */
00083                             0x1175, /* Last modern jungseong */
00084                             0x11A7, /* One before first modern jongseong */
00085                             0x11C2, /* Last modern jongseong */
00086                             stdin, /* Default input file pointer */
00087                             stdout /* Default output file pointer */
00088     };
00089
00090     void parse_args (int argc, char *argv[], struct PARAMS *params);
00091
00092     unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00093
00094     void print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph);
00095
00096     void combined_jamo (unsigned glyph [MAX_GLYPHS][16],
00097                       unsigned cho, unsigned jung, unsigned jong,
00098                       unsigned *combined_glyph);
00099
00100
00101     if (argc > 1) {
00102         parse_args (argc, argv, &params);
00103
00104 #ifdef DEBUG
00105         fprintf (stderr,
00106                "Range: (U+%04X, U+%04X, U+%04X) to (U+%04X, U+%04X, U+%04X)\n",
00107                params.cho_start, params.jung_start, params.jong_start,
00108                params.cho_end, params.jung_end, params.jong_end);
00109 #endif
00110     }

```

```

00111
00112 /*
00113 Initialize glyph array to all zeroes.
00114 */
00115 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00116     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00117 }
00118
00119 /*
00120 Read Hangul base glyph file.
00121 */
00122 max_codept = hangul_read_base16 (params.infp, glyph);
00123 if (max_codept > 0x8FF) {
00124     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00125 }
00126
00127 codept = params.starting_codept; /* First code point to output */
00128
00129 for (cho = params.cho_start; cho <= params.cho_end; cho++) {
00130     for (jung = params.jung_start; jung <= params.jung_end; jung++) {
00131         for (jong = params.jong_start; jong <= params.jong_end; jong++) {
00132
00133 #ifdef DEBUG
00134             fprintf (params.outfp,
00135                 "(U+%04X, U+%04X, U+%04X)\n",
00136                 cho, jung, jong);
00137 #endif
00138             combined_jamo (glyph, cho, jung, jong, tmp_glyph);
00139             print_glyph_hex (params.outfp, codept, tmp_glyph);
00140             codept++;
00141             if (jong == JONG_UNICODE_END)
00142                 jong = JONG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00143         }
00144         if (jung == JUNG_UNICODE_END)
00145             jung = JUNG_EXTB_UNICODE_START - 1; /* Start Extended-B range */
00146     }
00147     if (cho == CHO_UNICODE_END)
00148         cho = CHO_EXTA_UNICODE_START - 1; /* Start Extended-A range */
00149 }
00150
00151 if (params.infp != stdin) fclose (params.infp);
00152 if (params.outfp != stdout) fclose (params.outfp);
00153
00154 exit (EXIT_SUCCESS);
00155 }
00156
00157
00158 /**
00159 @brief Parse command line arguments.
00160
00161 */
00162 void
00163 parse_args (int argc, char *argv[], struct PARAMS *params) {
00164     int arg_count; /* Current index into argv. */
00165
00166     void get_hex_range (char *instring, unsigned *start, unsigned *end);
00167
00168     int strncmp (const char *s1, const char *s2, size_t n);
00169
00170
00171     arg_count = 1;
00172
00173     while (arg_count < argc) {
00174         /* If all 600,000+ Hangul syllables are requested. */
00175         if (strcmp (argv [arg_count], "-all", 4) == 0) {
00176             params->starting_codept = 0x0001;
00177             params->cho_start = CHO_UNICODE_START; /* First modern choseong */
00178             params->cho_end = CHO_EXTA_UNICODE_END; /* Last ancient choseong */
00179             params->jung_start = JUNG_UNICODE_START; /* First modern jungseong */
00180             params->jung_end = JUNG_EXTB_UNICODE_END; /* Last ancient jungseong */
00181             params->jong_start = JONG_UNICODE_START - 1; /* One before first modern jongseong */
00182             params->jong_end = JONG_EXTB_UNICODE_END; /* Last ancient jongseong */
00183         }
00184         /* If starting code point for output Unifont hex file is specified. */
00185         else if (strcmp (argv [arg_count], "-c", 2) == 0) {
00186             arg_count++;
00187             if (arg_count < argc) {
00188                 sscanf (argv [arg_count], "%X", &params->starting_codept);
00189             }
00190         }
00191         /* If initial consonant (choseong) range, "jamo 1", get range. */

```

```

00192     else if (strncmp (argv [arg_count], "-j1", 3) == 0) {
00193         arg_count++;
00194         if (arg_count < argc) {
00195             get_hex_range (argv [arg_count],
00196                           &params->cho_start, &params->cho_end);
00197             /*
00198 Allow one initial blank glyph at start of a loop, none at end.
00199 */
00200             if (params->cho_start < CHO_UNICODE_START) {
00201                 params->cho_start = CHO_UNICODE_START - 1;
00202             }
00203             else if (params->cho_start > CHO_UNICODE_END &&
00204                    params->cho_start < CHO_EXTA_UNICODE_START) {
00205                 params->cho_start = CHO_EXTA_UNICODE_START - 1;
00206             }
00207             /*
00208 Do not go past desired Hangul choseong range,
00209 Hangul Jamo or Hangul Jamo Extended-A choseong.
00210 */
00211             if (params->cho_end > CHO_EXTA_UNICODE_END) {
00212                 params->cho_end = CHO_EXTA_UNICODE_END;
00213             }
00214             else if (params->cho_end > CHO_UNICODE_END &&
00215                    params->cho_end < CHO_EXTA_UNICODE_START) {
00216                 params->cho_end = CHO_UNICODE_END;
00217             }
00218         }
00219     }
00220     /* If medial vowel (jungseong) range, "jamo 2", get range. */
00221     else if (strncmp (argv [arg_count], "-j2", 3) == 0) {
00222         arg_count++;
00223         if (arg_count < argc) {
00224             get_hex_range (argv [arg_count],
00225                           &params->jung_start, &params->jung_end);
00226             /*
00227 Allow one initial blank glyph at start of a loop, none at end.
00228 */
00229             if (params->jung_start < JUNG_UNICODE_START) {
00230                 params->jung_start = JUNG_UNICODE_START - 1;
00231             }
00232             else if (params->jung_start > JUNG_UNICODE_END &&
00233                    params->jung_start < JUNG_EXTB_UNICODE_START) {
00234                 params->jung_start = JUNG_EXTB_UNICODE_START - 1;
00235             }
00236             /*
00237 Do not go past desired Hangul jungseong range,
00238 Hangul Jamo or Hangul Jamo Extended-B jungseong.
00239 */
00240             if (params->jung_end > JUNG_EXTB_UNICODE_END) {
00241                 params->jung_end = JUNG_EXTB_UNICODE_END;
00242             }
00243             else if (params->jung_end > JUNG_UNICODE_END &&
00244                    params->jung_end < JUNG_EXTB_UNICODE_START) {
00245                 params->jung_end = JUNG_UNICODE_END;
00246             }
00247         }
00248     }
00249     /* If final consonant (jongseong) range, "jamo 3", get range. */
00250     else if (strncmp (argv [arg_count], "-j3", 3) == 0) {
00251         arg_count++;
00252         if (arg_count < argc) {
00253             get_hex_range (argv [arg_count],
00254                           &params->jong_start, &params->jong_end);
00255             /*
00256 Allow one initial blank glyph at start of a loop, none at end.
00257 */
00258             if (params->jong_start < JONG_UNICODE_START) {
00259                 params->jong_start = JONG_UNICODE_START - 1;
00260             }
00261             else if (params->jong_start > JONG_UNICODE_END &&
00262                    params->jong_start < JONG_EXTB_UNICODE_START) {
00263                 params->jong_start = JONG_EXTB_UNICODE_START - 1;
00264             }
00265             /*
00266 Do not go past desired Hangul jongseong range,
00267 Hangul Jamo or Hangul Jamo Extended-B jongseong.
00268 */
00269             if (params->jong_end > JONG_EXTB_UNICODE_END) {
00270                 params->jong_end = JONG_EXTB_UNICODE_END;
00271             }
00272             else if (params->jong_end > JONG_UNICODE_END &&

```

```

00273     params->jong_end < JONG_EXTB_UNICODE_START) {
00274     params->jong_end = JONG_UNICODE_END;
00275     }
00276 }
00277 }
00278 /* If input file is specified, open it for read access. */
00279 else if (strncmp (argv [arg_count], "-i", 2) == 0) {
00280     arg_count++;
00281     if (arg_count < argc) {
00282         params->infp = fopen (argv [arg_count], "r");
00283         if (params->infp == NULL) {
00284             fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00285                     argv [arg_count]);
00286             exit (EXIT_FAILURE);
00287         }
00288     }
00289 }
00290 /* If output file is specified, open it for write access. */
00291 else if (strncmp (argv [arg_count], "-o", 2) == 0) {
00292     arg_count++;
00293     if (arg_count < argc) {
00294         params->outfp = fopen (argv [arg_count], "w");
00295         if (params->outfp == NULL) {
00296             fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00297                     argv [arg_count]);
00298             exit (EXIT_FAILURE);
00299         }
00300     }
00301 }
00302 /* If help is requested, print help message and exit. */
00303 else if (strncmp (argv [arg_count], "-h", 2) == 0 ||
00304          strncmp (argv [arg_count], "--help", 6) == 0) {
00305     printf ("\nunigen-hangul [options]\n\n");
00306     printf ("    Generates Hangul syllables from an input Unifont .hex file encoded\n");
00307     printf ("    in Johab 6/3/1 format.  By default, the output is the Unicode Hangul\n");
00308     printf ("    Syllables range, U+A960..U+A97C, and U+D7B0..U+D7FB.\n");
00309     printf ("    a starting code point for the output Unifont .hex file, and ranges\n");
00310     printf ("    in hexadecimal of the starting and ending Hangul Jamo code points:\n\n");
00311
00312     printf ("        * 1100-115E Initial consonants (choseong)\n");
00313     printf ("        * 1161-11A7 Medial vowels (jungseong)\n");
00314     printf ("        * 11A8-11FF Final consonants (jongseong).\n\n");
00315
00316     printf ("    A single code point or 0 to omit can be specified instead of a range.\n\n");
00317
00318     printf (" Option  Parameters  Function\n");
00319     printf (" -----  -\n");
00320     printf (" -h, --help          Print this message and exit.\n\n");
00321     printf (" -all                Generate all Hangul syllables, using all modern and\n");
00322     printf ("                    ancient Hangul in the Unicode range U+1100..U+11FF,\n");
00323     printf ("                    U+A960..U+A97C, and U+D7B0..U+D7FB.\n");
00324     printf ("                    WARNING: this will generate over 1,600,000 syllables\n");
00325     printf ("                    in a 115 megabyte Unifont .hex format file.  The\n");
00326     printf ("                    default is to only output modern Hangul syllables.\n\n");
00327     printf (" -c    code_point  Starting code point in hexadecimal for output file.\n\n");
00328     printf (" -j1   start-end   Choseong (jamo 1) start-end range in hexadecimal.\n\n");
00329     printf (" -j2   start-end   Jungseong (jamo 2) start-end range in hexadecimal.\n\n");
00330     printf (" -j3   start-end   Jongseong (jamo 3) start-end range in hexadecimal.\n\n");
00331     printf (" -i    input_file  Unifont hangul-base.hex formatted input file.\n\n");
00332     printf (" -o    output_file Unifont .hex format output file.\n\n");
00333     printf (" Example:\n\n");
00334     printf ("     unigen-hangul -c 1 -j3 11AB-11AB -i hangul-base.hex -o nieun-only.hex\n\n");
00335     printf ("     Generates Hangul syllables using all modern choseong and jungseong,\n");
00336     printf ("     and only the jongseong nieun (Unicode code point U+11AB).  The output\n");
00337     printf ("     Unifont .hex file will contain code points starting at 1.  Instead of\n");
00338     printf ("     specifying \"-j3 11AB-11AB\", simply using \"-j3 11AB\" will also suffice.\n\n");
00339
00340     exit (EXIT_SUCCESS);
00341 }
00342
00343 arg_count++;
00344 }
00345
00346 return;
00347 }
00348
00349
00350 /**
00351 @brief Scan a hexadecimal range from a character string.
00352 */
00353 void

```

```

00354 get_hex_range (char *instring, unsigned *start, unsigned *end) {
00355
00356     int i; /* String index variable. */
00357
00358     /* Get first number in range. */
00359     sscanf (instring, "%X", start);
00360     for (i = 0;
00361          instring [i] != '\0' && instring [i] != '-';
00362          i++);
00363     /* Get last number in range. */
00364     if (instring [i] == '-') {
00365         i++;
00366         sscanf (&instring [i], "%X", end);
00367     }
00368     else {
00369         *end = *start;
00370     }
00371
00372     return;
00373 }

```

## 5.29 src/unigencircles.c File Reference

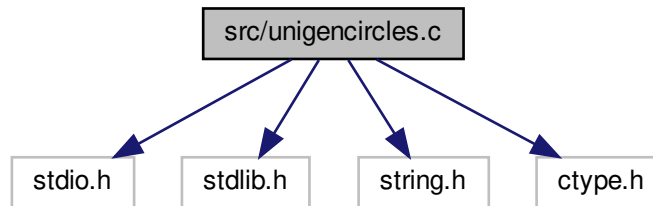
unigencircles - Superimpose dashed combining circles on combining glyphs

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>

```

Include dependency graph for unigencircles.c:



### Macros

- `#define` [MAXSTRING](#) 256  
Maximum input line length - 1.

### Functions

- `int` [main](#) (int argc, char \*\*argv)  
The main function.
- `void` [add\\_single\\_circle](#) (char \*glyphstring)  
Superimpose a single-width dashed combining circle on a glyph bitmap.
- `void` [add\\_double\\_circle](#) (char \*glyphstring, int offset)  
Superimpose a double-width dashed combining circle on a glyph bitmap.

## 5.29.1 Detailed Description

unigencircles - Superimpose dashed combining circles on combining glyphs

Author

Paul Hardy

Copyright

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Definition in file [unigencircles.c](#).

## 5.29.2 Macro Definition Documentation

### 5.29.2.1 MAXSTRING

```
#define MAXSTRING 256
```

Maximum input line length - 1.

Definition at line [62](#) of file [unigencircles.c](#).

## 5.29.3 Function Documentation

### 5.29.3.1 add\_double\_circle()

```
void add_double_circle (
    char * glyphstring,
    int offset )
```

Superimpose a double-width dashed combining circle on a glyph bitmap.

Parameters

in,out	glyphstring	A double-width glyph, 16x16 pixels.
--------	-------------	-------------------------------------

Definition at line [221](#) of file [unigencircles.c](#).

```
00222 {
00223
00224     char newstring[256];
00225     /* Circle hex string pattern is "00000008000024004200240000000000" */
00226
00227     /* For double diacritical glyphs (offset = -8) */
00228     /* Combining circle is left-justified. */
00229     char circle08[64]={0x0,0x0,0x0,0x0, /* row 1 */
00230                      0x0,0x0,0x0,0x0, /* row 2 */
00231                      0x0,0x0,0x0,0x0, /* row 3 */
00232                      0x0,0x0,0x0,0x0, /* row 4 */
00233                      0x0,0x0,0x0,0x0, /* row 5 */
00234                      0x0,0x0,0x0,0x0, /* row 6 */
00235                      0x2,0x4,0x0,0x0, /* row 7 */
00236                      0x0,0x0,0x0,0x0, /* row 8 */
00237                      0x4,0x2,0x0,0x0, /* row 9 */
00238                      0x0,0x0,0x0,0x0, /* row 10 */
```

```

00239         0x2,0x4,0x0,0x0, /* row 11 */
00240         0x0,0x0,0x0,0x0, /* row 12 */
00241         0x0,0x0,0x0,0x0, /* row 13 */
00242         0x0,0x0,0x0,0x0, /* row 14 */
00243         0x0,0x0,0x0,0x0, /* row 15 */
00244         0x0,0x0,0x0,0x0}; /* row 16 */
00245
00246 /* For all other combining glyphs (offset = -16) */
00247 /* Combining circle is centered in 16 columns. */
00248 char circle16[64]={0x0,0x0,0x0,0x0, /* row 1 */
00249                   0x0,0x0,0x0,0x0, /* row 2 */
00250                   0x0,0x0,0x0,0x0, /* row 3 */
00251                   0x0,0x0,0x0,0x0, /* row 4 */
00252                   0x0,0x0,0x0,0x0, /* row 5 */
00253                   0x0,0x0,0x0,0x0, /* row 6 */
00254                   0x0,0x2,0x4,0x0, /* row 7 */
00255                   0x0,0x0,0x0,0x0, /* row 8 */
00256                   0x0,0x4,0x2,0x0, /* row 9 */
00257                   0x0,0x0,0x0,0x0, /* row 10 */
00258                   0x0,0x2,0x4,0x0, /* row 11 */
00259                   0x0,0x0,0x0,0x0, /* row 12 */
00260                   0x0,0x0,0x0,0x0, /* row 13 */
00261                   0x0,0x0,0x0,0x0, /* row 14 */
00262                   0x0,0x0,0x0,0x0, /* row 15 */
00263                   0x0,0x0,0x0,0x0}; /* row 16 */
00264
00265 char *circle; /* points into circle16 or circle08 */
00266
00267 int digit1, digit2; /* corresponding digits in each string */
00268
00269 int i; /* index variables */
00270
00271
00272 /*
00273 Determine if combining circle is left-justified (offset = -8)
00274 or centered (offset = -16).
00275 */
00276 circle = (offset >= -8) ? circle08 : circle16;
00277
00278 /* for each character position, OR the corresponding circle glyph value */
00279 for (i = 0; i < 64; i++) {
00280     glyphstring[i] = toupper (glyphstring[i]);
00281
00282     /* Convert ASCII character to a hexadecimal integer */
00283     digit1 = (glyphstring[i] <= '9') ?
00284             (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00285
00286     /* Superimpose dashed circle */
00287     digit2 = digit1 | circle[i];
00288
00289     /* Convert hexadecimal integer to an ASCII character */
00290     newstring[i] = (digit2 <= 9) ?
00291                 ('0' + digit2) : ('A' + digit2 - 0xA);
00292 }
00293
00294 /* Terminate string for output */
00295 newstring[i++] = '\n';
00296 newstring[i++] = '\0';
00297
00298 memcpy (glyphstring, newstring, i);
00299
00300 return;
00301 }

```

Here is the caller graph for this function:





## 5.29.3.2 add\_single\_circle()

```
void add_single_circle (
    char * glyphstring )
```

Superimpose a single-width dashed combining circle on a glyph bitmap.

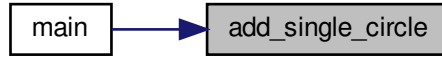
Parameters

in,out	glyphstring	A single- width glyph, 8x16 pixels.
--------	-------------	--

Definition at line 163 of file unigencircles.c.

```
00164 {
00165
00166     char newstring[256];
00167     /* Circle hex string pattern is "00000008000024004200240000000000" */
00168     char circle[32]={0x0,0x0, /* row 1 */
00169                     0x0,0x0, /* row 2 */
00170                     0x0,0x0, /* row 3 */
00171                     0x0,0x0, /* row 4 */
00172                     0x0,0x0, /* row 5 */
00173                     0x0,0x0, /* row 6 */
00174                     0x2,0x4, /* row 7 */
00175                     0x0,0x0, /* row 8 */
00176                     0x4,0x2, /* row 9 */
00177                     0x0,0x0, /* row 10 */
00178                     0x2,0x4, /* row 11 */
00179                     0x0,0x0, /* row 12 */
00180                     0x0,0x0, /* row 13 */
00181                     0x0,0x0, /* row 14 */
00182                     0x0,0x0, /* row 15 */
00183                     0x0,0x0}; /* row 16 */
00184
00185     int digit1, digit2; /* corresponding digits in each string */
00186
00187     int i; /* index variables */
00188
00189     /* for each character position, OR the corresponding circle glyph value */
00190     for (i = 0; i < 32; i++) {
00191         glyphstring[i] = toupper (glyphstring[i]);
00192
00193         /* Convert ASCII character to a hexadecimal integer */
00194         digit1 = (glyphstring[i] <= '9') ?
00195                 (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00196
00197         /* Superimpose dashed circle */
00198         digit2 = digit1 | circle[i];
00199
00200         /* Convert hexadecimal integer to an ASCII character */
00201         newstring[i] = (digit2 <= 9) ?
00202                 ('0' + digit2) : ('A' + digit2 - 0xA);
00203     }
00204
00205     /* Terminate string for output */
00206     newstring[i++] = '\n';
00207     newstring[i++] = '\0';
00208
00209     memcpy (glyphstring, newstring, i);
00210
00211     return;
00212 }
```

Here is the caller graph for this function:



### 5.29.3.3 main()

```
int main (
    int argc,
    char ** argv )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status `EXIT_SUCCESS`.

Definition at line 73 of file `unigencircles.c`.

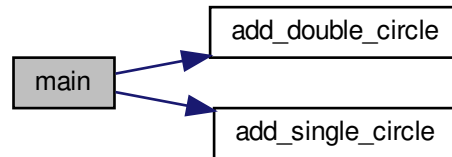
```
00074 {
00075
00076 char teststring[MAXSTRING]; /* current input line */
00077 int loc; /* Unicode code point of current input line */
00078 int offset; /* offset value of a combining character */
00079 char *gstart; /* glyph start, pointing into teststring */
00080
00081 char combining[0x110000]; /* 1 --> combining glyph; 0 --> non-combining */
00082 char x_offset [0x110000]; /* second value in *combining.txt files */
00083
00084 void add_single_circle(char *); /* add a single-width dashed circle */
00085 void add_double_circle(char *, int); /* add a double-width dashed circle */
00086
00087 FILE *infilefp;
```

```

00088
00089 /*
00090 if (argc != 3) {
00091 fprintf (stderr,
00092 "\n\nUsage: %s combining.txt nonprinting.hex < unifont.hex > unifontfull.hex\n\n");
00093 exit (EXIT_FAILURE);
00094 }
00095 */
00096
00097 /*
00098 Read the combining characters list.
00099 */
00100 /* Start with no combining code points flagged */
00101 memset (combining, 0, 0x110000 * sizeof (char));
00102 memset (x_offset , 0, 0x110000 * sizeof (char));
00103
00104 if ((infilep = fopen (argv[1], "r")) == NULL) {
00105     fprintf (stderr, "ERROR - combining characters file %s not found.\n\n",
00106             argv[1]);
00107     exit (EXIT_FAILURE);
00108 }
00109
00110 /* Flag list of combining characters to add a dashed circle. */
00111 while (fscanf (infilep, "%X:%d", &loc, &offset) != EOF) {
00112     /*
00113 U+01107F and U+01D1A0 are not defined as combining characters
00114 in Unicode; they were added in a combining.txt file as the
00115 only way to make them look acceptable in proximity to other
00116 glyphs in their script.
00117 */
00118     if (loc != 0x01107F && loc != 0x01D1A0) {
00119         combining[loc] = 1;
00120         x_offset [loc] = offset;
00121     }
00122 }
00123 fclose (infilep); /* all done reading combining.txt */
00124
00125 /* Now read the non-printing glyphs; they never have dashed circles */
00126 if ((infilep = fopen (argv[2], "r")) == NULL) {
00127     fprintf (stderr, "ERROR - nonprinting characters file %s not found.\n\n",
00128             argv[1]);
00129     exit (EXIT_FAILURE);
00130 }
00131
00132 /* Reset list of nonprinting characters to avoid adding a dashed circle. */
00133 while (fscanf (infilep, "%X:%s", &loc) != EOF) combining[loc] = 0;
00134
00135 fclose (infilep); /* all done reading nonprinting.hex */
00136
00137 /*
00138 Read the hex glyphs.
00139 */
00140 teststring[MAXSTRING - 1] = '\0'; /* so there's no chance we leave array */
00141 while (fgets (teststring, MAXSTRING-1, stdin) != NULL) {
00142     sscanf (teststring, "%X", &loc); /* loc == the Unicode code point */
00143     gstart = strchr (teststring, ':') + 1; /* start of glyph bitmap */
00144     if (combining[loc]) { /* if a combining character */
00145         if (strlen (gstart) < 35)
00146             add_single_circle (gstart); /* single-width */
00147         else
00148             add_double_circle (gstart, x_offset[loc]); /* double-width */
00149     }
00150     printf ("%s", teststring); /* output the new character .hex string */
00151 }
00152
00153 exit (EXIT_SUCCESS);
00154 }

```

Here is the call graph for this function:



### 5.30 unigencircles.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unigencircles.c
00003
00004 @brief unigencircles - Superimpose dashed combining circles
00005 on combining glyphs
00006
00007 @author Paul Hardy
00008
00009 @copyright Copyright (C) 2013, Paul Hardy.
00010 */
00011 /*
00012 LICENSE:
00013
00014 This program is free software: you can redistribute it and/or modify
00015 it under the terms of the GNU General Public License as published by
00016 the Free Software Foundation, either version 2 of the License, or
00017 (at your option) any later version.
00018
00019 This program is distributed in the hope that it will be useful,
00020 but WITHOUT ANY WARRANTY; without even the implied warranty of
00021 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00022 GNU General Public License for more details.
00023
00024 You should have received a copy of the GNU General Public License
00025 along with this program. If not, see <http://www.gnu.org/licenses/>.
00026 */
00027
00028 /*
00029 8 July 2017 [Paul Hardy]:
00030 - Reads new second field that contains an x-axis offset for
00031 each combining character in "**combining.txt" files.
00032 - Uses the above x-axis offset value for a combining character
00033 to print combining circle in the left half of a double
00034 diacritic combining character grid, or in the center for
00035 other combining characters.
00036 - Adds exceptions for U+01107F (Brahmi number joiner) and
00037 U+01D1A0 (vertical stroke musical ornament); they are in
00038 a combining.txt file for positioning, but are not actually
00039 Unicode combining characters.
00040 - Typo fix: "single-width"-->"double-width" in comment for
00041 add_double_circle function.
00042
00043 12 August 2017 [Paul Hardy]:
00044 - Hard-code Miao vowels to show combining circles after
00045 removing them from font/plane01/plane01-combining.txt.
00046
00047 26 December 2017 [Paul Hardy]:
00048 - Remove Miao hard-coding; they are back in unibmp2hex.c and
00049 in font/plane01/plane01-combining.txt.
00050
00051 11 May 2019 [Paul Hardy]:
00052 - Changed strncpy calls to memcpy calls to avoid a compiler
00053 warning.
  
```

```

00054 */
00055
00056
00057 #include <stdio.h>
00058 #include <stdlib.h>
00059 #include <string.h>
00060 #include <ctype.h>
00061
00062 #define MAXSTRING 256 ///< Maximum input line length - 1.
00063
00064
00065 /**
00066 @brief The main function.
00067
00068 @param[in] argc The count of command line arguments.
00069 @param[in] argv Pointer to array of command line arguments.
00070 @return This program exits with status EXIT_SUCCESS.
00071 */
00072 int
00073 main (int argc, char **argv)
00074 {
00075
00076     char teststring[MAXSTRING]; /* current input line */
00077     int loc; /* Unicode code point of current input line */
00078     int offset; /* offset value of a combining character */
00079     char *gstart; /* glyph start, pointing into teststring */
00080
00081     char combining[0x110000]; /* 1 --> combining glyph; 0 --> non-combining */
00082     char x_offset [0x110000]; /* second value in *combining.txt files */
00083
00084     void add_single_circle(char *); /* add a single-width dashed circle */
00085     void add_double_circle(char *, int); /* add a double-width dashed circle */
00086
00087     FILE *infilefp;
00088
00089     /*
00090     if (argc != 3) {
00091         fprintf (stderr,
00092             "\n\nUsage: %s combining.txt nonprinting.hex < unifont.hex > unifontfull.hex\n\n");
00093         exit (EXIT_FAILURE);
00094     }
00095     */
00096
00097     /*
00098     Read the combining characters list.
00099     */
00100     /* Start with no combining code points flagged */
00101     memset (combining, 0, 0x110000 * sizeof (char));
00102     memset (x_offset , 0, 0x110000 * sizeof (char));
00103
00104     if ((infilefp = fopen (argv[1], "r")) == NULL) {
00105         fprintf (stderr, "ERROR - combining characters file %s not found.\n\n",
00106             argv[1]);
00107         exit (EXIT_FAILURE);
00108     }
00109
00110     /* Flag list of combining characters to add a dashed circle. */
00111     while (fscanf (infilefp, "%X:%d", &loc, &offset) != EOF) {
00112         /*
00113         U+01107F and U+01D1A0 are not defined as combining characters
00114         in Unicode; they were added in a combining.txt file as the
00115         only way to make them look acceptable in proximity to other
00116         glyphs in their script.
00117         */
00118         if (loc != 0x01107F && loc != 0x01D1A0) {
00119             combining[loc] = 1;
00120             x_offset [loc] = offset;
00121         }
00122     }
00123     fclose (infilefp); /* all done reading combining.txt */
00124
00125     /* Now read the non-printing glyphs; they never have dashed circles */
00126     if ((infilefp = fopen (argv[2], "r")) == NULL) {
00127         fprintf (stderr, "ERROR - nonprinting characters file %s not found.\n\n",
00128             argv[1]);
00129         exit (EXIT_FAILURE);
00130     }
00131
00132     /* Reset list of nonprinting characters to avoid adding a dashed circle. */
00133     while (fscanf (infilefp, "%X:%s", &loc) != EOF) combining[loc] = 0;
00134

```

```

00135 fclose (infilep); /* all done reading nonprinting.hex */
00136
00137 /*
00138 Read the hex glyphs.
00139 */
00140 teststring[MAXSTRING - 1] = '\0'; /* so there's no chance we leave array */
00141 while (fgets (teststring, MAXSTRING-1, stdin) != NULL) {
00142     sscanf (teststring, "%X", &loc); /* loc == the Unicode code point */
00143     gstart = strchr (teststring, ':') + 1; /* start of glyph bitmap */
00144     if (combining[loc]) { /* if a combining character */
00145         if (strlen (gstart) < 35)
00146             add_single_circle (gstart); /* single-width */
00147         else
00148             add_double_circle (gstart, x_offset[loc]); /* double-width */
00149     }
00150     printf ("%s", teststring); /* output the new character .hex string */
00151 }
00152
00153 exit (EXIT_SUCCESS);
00154 }
00155
00156 /**
00157 @brief Superimpose a single-width dashed combining circle on a glyph bitmap.
00158 @param[in,out] glyphstring A single-width glyph, 8x16 pixels.
00159 */
00160 void
00161 add_single_circle (char *glyphstring)
00162 {
00163     char newstring[256];
00164     /* Circle hex string pattern is "00000008000024004200240000000000" */
00165     char circle[32]={0x0,0x0, /* row 1 */
00166                    0x0,0x0, /* row 2 */
00167                    0x0,0x0, /* row 3 */
00168                    0x0,0x0, /* row 4 */
00169                    0x0,0x0, /* row 5 */
00170                    0x0,0x0, /* row 6 */
00171                    0x2,0x4, /* row 7 */
00172                    0x0,0x0, /* row 8 */
00173                    0x4,0x2, /* row 9 */
00174                    0x0,0x0, /* row 10 */
00175                    0x2,0x4, /* row 11 */
00176                    0x0,0x0, /* row 12 */
00177                    0x0,0x0, /* row 13 */
00178                    0x0,0x0, /* row 14 */
00179                    0x0,0x0, /* row 15 */
00180                    0x0,0x0}; /* row 16 */
00181
00182     int digit1, digit2; /* corresponding digits in each string */
00183
00184     int i; /* index variables */
00185
00186     /* for each character position, OR the corresponding circle glyph value */
00187     for (i = 0; i < 32; i++) {
00188         glyphstring[i] = toupper (glyphstring[i]);
00189
00190         /* Convert ASCII character to a hexadecimal integer */
00191         digit1 = (glyphstring[i] <= '9') ?
00192                 (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00193
00194         /* Superimpose dashed circle */
00195         digit2 = digit1 | circle[i];
00196
00197         /* Convert hexadecimal integer to an ASCII character */
00198         newstring[i] = (digit2 <= 9) ?
00199                       ('0' + digit2) : ('A' + digit2 - 0xA);
00200     }
00201
00202     /* Terminate string for output */
00203     newstring[i++] = '\n';
00204     newstring[i++] = '\0';
00205
00206     memcpy (glyphstring, newstring, i);
00207
00208     return;
00209 }
00210
00211 /**
00212 */
00213
00214
00215

```

```

00216 @brief Superimpose a double-width dashed combining circle on a glyph bitmap.
00217
00218 @param[in,out] glyphstring A double-width glyph, 16x16 pixels.
00219 */
00220 void
00221 add_double_circle (char *glyphstring, int offset)
00222 {
00223     char newstring[256];
00224     /* Circle hex string pattern is "00000008000024004200240000000000" */
00225
00226     /* For double diacritical glyphs (offset = -8) */
00227     /* Combining circle is left-justified. */
00228     char circle08[64]={0x0,0x0,0x0,0x0, /* row 1 */
00229                        0x0,0x0,0x0,0x0, /* row 2 */
00230                        0x0,0x0,0x0,0x0, /* row 3 */
00231                        0x0,0x0,0x0,0x0, /* row 4 */
00232                        0x0,0x0,0x0,0x0, /* row 5 */
00233                        0x0,0x0,0x0,0x0, /* row 6 */
00234                        0x2,0x4,0x0,0x0, /* row 7 */
00235                        0x0,0x0,0x0,0x0, /* row 8 */
00236                        0x4,0x2,0x0,0x0, /* row 9 */
00237                        0x0,0x0,0x0,0x0, /* row 10 */
00238                        0x2,0x4,0x0,0x0, /* row 11 */
00239                        0x0,0x0,0x0,0x0, /* row 12 */
00240                        0x0,0x0,0x0,0x0, /* row 13 */
00241                        0x0,0x0,0x0,0x0, /* row 14 */
00242                        0x0,0x0,0x0,0x0, /* row 15 */
00243                        0x0,0x0,0x0,0x0}; /* row 16 */
00244
00245     /* For all other combining glyphs (offset = -16) */
00246     /* Combining circle is centered in 16 columns. */
00247     char circle16[64]={0x0,0x0,0x0,0x0, /* row 1 */
00248                        0x0,0x0,0x0,0x0, /* row 2 */
00249                        0x0,0x0,0x0,0x0, /* row 3 */
00250                        0x0,0x0,0x0,0x0, /* row 4 */
00251                        0x0,0x0,0x0,0x0, /* row 5 */
00252                        0x0,0x0,0x0,0x0, /* row 6 */
00253                        0x0,0x0,0x0,0x0, /* row 7 */
00254                        0x0,0x2,0x4,0x0, /* row 8 */
00255                        0x0,0x0,0x0,0x0, /* row 9 */
00256                        0x0,0x4,0x2,0x0, /* row 10 */
00257                        0x0,0x0,0x0,0x0, /* row 11 */
00258                        0x0,0x2,0x4,0x0, /* row 12 */
00259                        0x0,0x0,0x0,0x0, /* row 13 */
00260                        0x0,0x0,0x0,0x0, /* row 14 */
00261                        0x0,0x0,0x0,0x0, /* row 15 */
00262                        0x0,0x0,0x0,0x0}; /* row 16 */
00263
00264     char *circle; /* points into circle16 or circle08 */
00265
00266     int digit1, digit2; /* corresponding digits in each string */
00267
00268     int i; /* index variables */
00269
00270     /*
00271     Determine if combining circle is left-justified (offset = -8)
00272     or centered (offset = -16).
00273     */
00274     circle = (offset >= -8) ? circle08 : circle16;
00275
00276     /* for each character position, OR the corresponding circle glyph value */
00277     for (i = 0; i < 64; i++) {
00278         glyphstring[i] = toupper (glyphstring[i]);
00279
00280         /* Convert ASCII character to a hexadecimal integer */
00281         digit1 = (glyphstring[i] <= '9') ?
00282                 (glyphstring[i] - '0') : (glyphstring[i] - 'A' + 0xA);
00283
00284         /* Superimpose dashed circle */
00285         digit2 = digit1 | circle[i];
00286
00287         /* Convert hexadecimal integer to an ASCII character */
00288         newstring[i] = (digit2 <= 9) ?
00289                 ('0' + digit2) : ('A' + digit2 - 0xA);
00290     }
00291
00292     /* Terminate string for output */
00293     newstring[i++] = '\n';
00294     newstring[i++] = '\0';

```

```
00297
00298 memcpy (glyphstring, newstring, i);
00299
00300 return;
00301 }
00302
```

## 5.31 src/unigenwidth.c File Reference

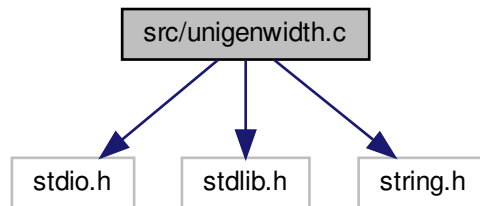
unigenwidth - IEEE 1003.1-2008 setup to calculate wchar\_t string widths

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

Include dependency graph for unigenwidth.c:



### Macros

- #define [MAXSTRING](#) 256  
Maximum input line length - 1.
- #define [PIKTO\\_START](#) 0x0F0E70  
Start of Pikto code point range.
- #define [PIKTO\\_END](#) 0x0F11EF  
End of Pikto code point range.
- #define [PIKTO\\_SIZE](#) ([PIKTO\\_END](#) - [PIKTO\\_START](#) + 1)

### Functions

- int [main](#) (int argc, char \*\*argv)  
The main function.

#### 5.31.1 Detailed Description

unigenwidth - IEEE 1003.1-2008 setup to calculate wchar\_t string widths

Author

Paul Hardy.



## Copyright

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All glyphs are treated as 16 pixels high, and can be 8, 16, 24, or 32 pixels wide (resulting in widths of 1, 2, 3, or 4, respectively).

Definition in file [unigenwidth.c](#).

## 5.31.2 Macro Definition Documentation

### 5.31.2.1 MAXSTRING

```
#define MAXSTRING 256
```

Maximum input line length - 1.

Definition at line [46](#) of file [unigenwidth.c](#).

### 5.31.2.2 PIKTO\_END

```
#define PIKTO_END 0x0F11EF
```

End of Pikto code point range.

Definition at line [50](#) of file [unigenwidth.c](#).

### 5.31.2.3 PIKTO\_SIZE

```
#define PIKTO_SIZE (PIKTO_END - PIKTO_START + 1)
```

Number of code points in Pikto range.

Definition at line [52](#) of file [unigenwidth.c](#).

### 5.31.2.4 PIKTO\_START

```
#define PIKTO_START 0x0F0E70
```

Start of Pikto code point range.

Definition at line [49](#) of file [unigenwidth.c](#).

## 5.31.3 Function Documentation

### 5.31.3.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

The main function.

## Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

## Returns

This program exits with status `EXIT_SUCCESS`.

Definition at line 63 of file `unigenwidth.c`.

```

00064 {
00065
00066     int i; /* loop variable */
00067
00068     char teststring[MAXSTRING];
00069     int loc;
00070     char *gstart;
00071
00072     char glyph_width[0x20000];
00073     char pikto_width[PIKTO_SIZE];
00074
00075     FILE *infilep;
00076
00077     if (argc != 3) {
00078         fprintf(stderr, "\n\nUsage: %s <unifont.hex> <combining.txt>\n\n", argv[0]);
00079         exit (EXIT_FAILURE);
00080     }
00081
00082     /*
00083     Read the collection of hex glyphs.
00084     */
00085     if ((infilep = fopen (argv[1], "r")) == NULL) {
00086         fprintf (stderr, "ERROR - hex input file %s not found.\n\n", argv[1]);
00087         exit (EXIT_FAILURE);
00088     }
00089
00090     /* Flag glyph as non-existent until found. */
00091     memset (glyph_width, -1, 0x20000 * sizeof (char));
00092     memset (pikto_width, -1, (PIKTO_SIZE) * sizeof (char));
00093
00094     teststring[MAXSTRING-1] = '\0';
00095     while (fgets (teststring, MAXSTRING-1, infilep) != NULL) {
00096         sscanf (teststring, "%X:%*s", &loc);
00097         if (loc < 0x20000) {
00098             gstart = strchr (teststring, ':') + 1;
00099             /*
00100             16 rows per glyph, 2 ASCII hexadecimal digits per byte,
00101             so divide number of digits by 32 (shift right 5 bits).
00102             */
00103             glyph_width[loc] = (strlen (gstart) - 1) » 5;
00104         }
00105         else if ((loc >= PIKTO_START) && (loc <= PIKTO_END)) {
00106             gstart = strchr (teststring, ':') + 1;
00107             pikto_width[loc - PIKTO_START] = strlen (gstart) <= 34 ? 1 : 2;
00108         }
00109     }

```

```

00110
00111     fclose (infilefp);
00112
00113     /*
00114     Now read the combining character code points.  These have width of 0.
00115     */
00116     if ((infilefp = fopen (argv[2], "r")) == NULL) {
00117         fprintf (stderr, "ERROR - combining characters file %s not found.\n\n", argv[2]);
00118         exit (EXIT_FAILURE);
00119     }
00120
00121     while (fgets (teststring, MAXSTRING-1, infilefp) != NULL) {
00122         sscanf (teststring, "%X:%*s", &loc);
00123         if (loc < 0x20000) glyph_width[loc] = 0;
00124     }
00125
00126     fclose (infilefp);
00127
00128     /*
00129     Code Points with Unusual Properties (Unicode Standard, Chapter 4).
00130
00131     As of Unifont 10.0.04, use the widths in the *-nonprinting.hex"
00132     files.  If an application is smart enough to know how to handle
00133     these special cases, it will not render the "nonprinting" glyph
00134     and will treat the code point as being zero-width.
00135     */
00136     // glyph_width[0]=0; /* NULL character */
00137     // for (i = 0x0001; i <= 0x001F; i++) glyph_width[i]=-1; /* Control Characters */
00138     // for (i = 0x007F; i <= 0x009F; i++) glyph_width[i]=-1; /* Control Characters */
00139
00140     // glyph_width[0x034F]=0; /* combining grapheme joiner */
00141     // glyph_width[0x180B]=0; /* Mongolian free variation selector one */
00142     // glyph_width[0x180C]=0; /* Mongolian free variation selector two */
00143     // glyph_width[0x180D]=0; /* Mongolian free variation selector three */
00144     // glyph_width[0x180E]=0; /* Mongolian vowel separator */
00145     // glyph_width[0x200B]=0; /* zero width space */
00146     // glyph_width[0x200C]=0; /* zero width non-joiner */
00147     // glyph_width[0x200D]=0; /* zero width joiner */
00148     // glyph_width[0x200E]=0; /* left-to-right mark */
00149     // glyph_width[0x200F]=0; /* right-to-left mark */
00150     // glyph_width[0x202A]=0; /* left-to-right embedding */
00151     // glyph_width[0x202B]=0; /* right-to-left embedding */
00152     // glyph_width[0x202C]=0; /* pop directional formatting */
00153     // glyph_width[0x202D]=0; /* left-to-right override */
00154     // glyph_width[0x202E]=0; /* right-to-left override */
00155     // glyph_width[0x2060]=0; /* word joiner */
00156     // glyph_width[0x2061]=0; /* function application */
00157     // glyph_width[0x2062]=0; /* invisible times */
00158     // glyph_width[0x2063]=0; /* invisible separator */
00159     // glyph_width[0x2064]=0; /* invisible plus */
00160     // glyph_width[0x206A]=0; /* inhibit symmetric swapping */
00161     // glyph_width[0x206B]=0; /* activate symmetric swapping */
00162     // glyph_width[0x206C]=0; /* inhibit arabic form shaping */
00163     // glyph_width[0x206D]=0; /* activate arabic form shaping */
00164     // glyph_width[0x206E]=0; /* national digit shapes */
00165     // glyph_width[0x206F]=0; /* nominal digit shapes */
00166
00167     // /* Variation Selector-1 to Variation Selector-16 */
00168     // for (i = 0xFE00; i <= 0xFE0F; i++) glyph_width[i] = 0;
00169
00170     // glyph_width[0xFEFF]=0; /* zero width no-break space */
00171     // glyph_width[0xFFFF9]=0; /* interlinear annotation anchor */
00172     // glyph_width[0xFFFFA]=0; /* interlinear annotation separator */
00173     // glyph_width[0xFFFFB]=0; /* interlinear annotation terminator */
00174     /*
00175     Let glyph widths represent 0xFFFC (object replacement character)
00176     and 0xFFFD (replacement character).
00177     */
00178
00179     /*
00180     Hangul Jamo:
00181
00182     Leading Consonant (Choseong): leave spacing as is.
00183
00184     Hangul Choseong Filler (U+115F): set width to 2.
00185
00186     Hangul Jungseong Filler, Hangul Vowel (Jungseong), and
00187     Final Consonant (Jongseong): set width to 0, because these
00188     combine with the leading consonant as one composite syllabic
00189     glyph.  As of Unicode 5.2, the Hangul Jamo block (U+1100..U+11FF)
00190     is completely filled.

```

```

00191 */
00192 // for (i = 0x1160; i <= 0x11FF; i++) glyph_width[i]=0; /* Vowels & Final Consonants */
00193
00194 /*
00195 Private Use Area -- the width is undefined, but likely
00196 to be 2 charcells wide either from a graphic glyph or
00197 from a four-digit hexadecimal glyph representing the
00198 code point. Therefore if any PUA glyph does not have
00199 a non-zero width yet, assign it a default width of 2.
00200 The Unicode Standard allows giving PUA characters
00201 default property values; see for example The Unicode
00202 Standard Version 5.0, p. 91. This same default is
00203 used for higher plane PUA code points below.
00204 */
00205 // for (i = 0xE000; i <= 0xF8FF; i++) {
00206 //   if (glyph_width[i] == 0) glyph_width[i]=2;
00207 // }
00208
00209 /*
00210 <not a character>
00211 */
00212 for (i = 0xFDD0; i <= 0xFDEF; i++) glyph_width[i] = -1;
00213 glyph_width[0xFFFFE] = -1; /* Byte Order Mark */
00214 glyph_width[0xFFFFF] = -1; /* Byte Order Mark */
00215
00216 /* Surrogate Code Points */
00217 for (i = 0xD800; i <= 0xDFFF; i++) glyph_width[i]=-1;
00218
00219 /* CJK Code Points */
00220 for (i = 0x4E00; i <= 0x9FFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00221 for (i = 0x3400; i <= 0x4DBF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00222 for (i = 0xF900; i <= 0xFAFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00223
00224 /*
00225 Now generate the output file.
00226 */
00227 printf ("/*\n");
00228 printf (" wewidth and wcswidth functions, as per IEEE 1003.1-2008\n");
00229 printf (" System Interfaces, pp. 2241 and 2251.\n\n");
00230 printf (" Author: Paul Hardy, 2013\n\n");
00231 printf (" Copyright (c) 2013 Paul Hardy\n\n");
00232 printf (" LICENSE:\n");
00233 printf ("\n");
00234 printf (" This program is free software: you can redistribute it and/or modify\n");
00235 printf (" it under the terms of the GNU General Public License as published by\n");
00236 printf (" the Free Software Foundation, either version 2 of the License, or\n");
00237 printf (" (at your option) any later version.\n");
00238 printf ("\n");
00239 printf (" This program is distributed in the hope that it will be useful,\n");
00240 printf (" but WITHOUT ANY WARRANTY; without even the implied warranty of\n");
00241 printf (" MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the\n");
00242 printf (" GNU General Public License for more details.\n");
00243 printf ("\n");
00244 printf (" You should have received a copy of the GNU General Public License\n");
00245 printf (" along with this program. If not, see <http://www.gnu.org/licenses/>.\n");
00246 printf ("*/\n\n");
00247
00248 printf ("#include <wchar.h>\n\n");
00249 printf ("/* Definitions for Picto CSUR Private Use Area glyphs */\n");
00250 printf ("#define PIKTO_START\t0x%06X\n", PIKTO_START);
00251 printf ("#define PIKTO_END\t0x%06X\n", PIKTO_END);
00252 printf ("#define PIKTO_SIZE\t(PIKTO_END - PIKTO_START + 1)\n");
00253 printf ("\n\n");
00254 printf ("/* wewidth -- return charcell positions of one code point */\n");
00255 printf ("inline int\ncwidth (wchar_t wc)\n{\n");
00256 printf ("  return (wcswidth (&wc, 1));\n");
00257 printf ("}\n");
00258 printf ("\n\n");
00259 printf ("int\ncwidth (const wchar_t *pwcs, size_t n)\n{\n\n");
00260 printf ("  int i; /* loop variable */\n");
00261 printf ("  unsigned codept; /* Unicode code point of current character */\n");
00262 printf ("  unsigned plane; /* Unicode plane, 0x00..0x10 */\n");
00263 printf ("  unsigned lower17; /* lower 17 bits of Unicode code point */\n");
00264 printf ("  unsigned lower16; /* lower 16 bits of Unicode code point */\n");
00265 printf ("  int lowpt, midpt, highpt; /* for binary searching in plane1zeroes[] */\n");
00266 printf ("  int found; /* for binary searching in plane1zeroes[] */\n");
00267 printf ("  int totalwidth; /* total width of string, in charcells (1 or 2/glyph) */\n");
00268 printf ("  int illegalchar; /* Whether or not this code point is illegal */\n");
00269 printf ("  putchar ('\n');\n");
00270
00271 /*

```

```

00272 Print the glyph_width[] array for glyphs widths in the
00273 Basic Multilingual Plane (Plane 0).
00274 */
00275 printf (" char glyph_width[0x20000] = {");
00276 for (i = 0; i < 0x10000; i++) {
00277     if ((i & 0x1F) == 0)
00278         printf ("\n /* U+%04X */ ", i);
00279     printf ("%d,", glyph_width[i]);
00280 }
00281 for (i = 0x10000; i < 0x20000; i++) {
00282     if ((i & 0x1F) == 0)
00283         printf ("\n /* U+%06X */ ", i);
00284     printf ("%d", glyph_width[i]);
00285     if (i < 0x1FFFF) putchar (',' );
00286 }
00287 printf ("\n }; \n\n");
00288
00289 /*
00290 Print the pikto_width[] array for Pikto glyph widths.
00291 */
00292 printf (" char pikto_width[PIKTO_SIZE] = {");
00293 for (i = 0; i < PIKTO_SIZE; i++) {
00294     if ((i & 0x1F) == 0)
00295         printf ("\n /* U+%06X */ ", PIKTO_START + i);
00296     printf ("%d", pikto_width[i]);
00297     if ((PIKTO_START + i) < PIKTO_END) putchar (',' );
00298 }
00299 printf ("\n }; \n\n");
00300
00301 /*
00302 Execution part of wcswidth.
00303 */
00304 printf ("\n");
00305 printf (" illegalchar = totalwidth = 0;\n");
00306 printf (" for (i = 0; !illegalchar && i < n; i++) {\n");
00307 printf ("     codept = pwcs[i];\n");
00308 printf ("     plane = codept » 16;\n");
00309 printf ("     lower17 = codept & 0x1FFFF;\n");
00310 printf ("     lower16 = codept & 0xFFFF;\n");
00311 printf ("     if (plane < 2) { /* the most common case */\n");
00312 printf ("         if (glyph_width[lower17] < 0) illegalchar = 1;\n");
00313 printf ("         else totalwidth += glyph_width[lower17];\n");
00314 printf ("     }\n");
00315 printf ("     else { /* a higher plane or beyond Unicode range */\n");
00316 printf ("         if ((lower16 == 0xFFFE) || (lower16 == 0xFFFF)) {\n");
00317 printf ("             illegalchar = 1;\n");
00318 printf ("         }\n");
00319 printf ("         else if (plane < 4) { /* Ideographic Plane */\n");
00320 printf ("             totalwidth += 2; /* Default ideographic width */\n");
00321 printf ("         }\n");
00322 printf ("         else if (plane == 0x0F) { /* CSUR Private Use Area */\n");
00323 printf ("             if (lower16 <= 0x0E6F) { /* Kinya */\n");
00324 printf ("                 totalwidth++; /* all Kinya syllables have width 1 */\n");
00325 printf ("             }\n");
00326 printf ("             else if (lower16 <= (PIKTO_END & 0xFFFF)) { /* Pikto */\n");
00327 printf ("                 if (pikto_width[lower16 - (PIKTO_START & 0xFFFF)] < 0) illegalchar = 1;\n");
00328 printf ("                 else totalwidth += pikto_width[lower16 - (PIKTO_START & 0xFFFF)];\n");
00329 printf ("             }\n");
00330 printf ("         }\n");
00331 printf ("         else if (plane > 0x10) {\n");
00332 printf ("             illegalchar = 1;\n");
00333 printf ("         }\n");
00334 printf ("         /* Other non-printing in higher planes; return -1 as per IEEE 1003.1-2008. */\n");
00335 printf ("         else if (/* language tags */\n");
00336 printf ("             codept == 0x0E0001 || (codept >= 0x0E0020 && codept <= 0x0E007F) ||\n");
00337 printf ("             /* variation selectors, 0x0E0100..0x0E01EF */\n");
00338 printf ("             (codept >= 0x0E0100 && codept <= 0x0E01EF)) {\n");
00339 printf ("                 illegalchar = 1;\n");
00340 printf ("             }\n");
00341 printf ("         /*\n");
00342 printf ("             Unicode plane 0x02..0x10 printing character\n");
00343 printf ("             */\n");
00344 printf ("         else {\n");
00345 printf ("             illegalchar = 1; /* code is not in font */\n");
00346 printf ("         }\n");
00347 printf ("     }\n");
00348 printf ("     }\n");
00349 printf (" }\n");
00350 printf (" if (illegalchar) totalwidth = -1;\n");
00351 printf ("\n");
00352 printf (" return (totalwidth);\n");

```

```

00353 printf ("\n");
00354 printf ("}\n");
00355
00356 exit (EXIT_SUCCESS);
00357 }

```

## 5.32 unigenwidth.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unigenwidth.c
00003
00004 @brief unigenwidth - IEEE 1003.1-2008 setup to calculate
00005 wchar_t string widths
00006
00007 @author Paul Hardy.
00008
00009 @copyright Copyright (C) 2013, 2017 Paul Hardy.
00010
00011 All glyphs are treated as 16 pixels high, and can be
00012 8, 16, 24, or 32 pixels wide (resulting in widths of
00013 1, 2, 3, or 4, respectively).
00014 */
00015 /*
00016 LICENSE:
00017
00018 This program is free software: you can redistribute it and/or modify
00019 it under the terms of the GNU General Public License as published by
00020 the Free Software Foundation, either version 2 of the License, or
00021 (at your option) any later version.
00022
00023 This program is distributed in the hope that it will be useful,
00024 but WITHOUT ANY WARRANTY; without even the implied warranty of
00025 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00026 GNU General Public License for more details.
00027
00028 You should have received a copy of the GNU General Public License
00029 along with this program. If not, see <http://www.gnu.org/licenses/>.
00030 */
00031
00032 /*
00033 20 June 2017 [Paul Hardy]:
00034 - Now handles glyphs that are 24 or 32 pixels wide.
00035
00036 8 July 2017 [Paul Hardy]:
00037 - Modifies sscanf format strings to ignore second field after
00038 the ":" field separator, newly added to "*"combining.txt" files
00039 and already present in "*.hex" files.
00040 */
00041
00042 #include <stdio.h>
00043 #include <stdlib.h>
00044 #include <string.h>
00045
00046 #define MAXSTRING 256 ///< Maximum input line length - 1.
00047
00048 /* Definitions for Pikto in Plane 15 */
00049 #define PIKTO_START 0x0F0E70 ///< Start of Pikto code point range.
00050 #define PIKTO_END 0x0F11EF ///< End of Pikto code point range.
00051 /** Number of code points in Pikto range. */
00052 #define PIKTO_SIZE (PIKTO_END - PIKTO_START + 1)
00053
00054
00055 /**
00056 @brief The main function.
00057
00058 @param[in] argc The count of command line arguments.
00059 @param[in] argv Pointer to array of command line arguments.
00060 @return This program exits with status EXIT_SUCCESS.
00061 */
00062 int
00063 main (int argc, char **argv)
00064 {
00065
00066     int i; /* loop variable */
00067
00068     char teststring[MAXSTRING];
00069     int loc;

```

```

00070 char *gstart;
00071
00072 char glyph_width[0x20000];
00073 char pikto_width[PIKTO_SIZE];
00074
00075 FILE *infilep;
00076
00077 if (argc != 3) {
00078     fprintf(stderr, "\n\nUsage: %s <unifont.hex> <combining.txt>\n\n", argv[0]);
00079     exit (EXIT_FAILURE);
00080 }
00081
00082 /*
00083 Read the collection of hex glyphs.
00084 */
00085 if ((infilep = fopen (argv[1], "r")) == NULL) {
00086     fprintf (stderr, "ERROR - hex input file %s not found.\n\n", argv[1]);
00087     exit (EXIT_FAILURE);
00088 }
00089
00090 /* Flag glyph as non-existent until found. */
00091 memset (glyph_width, -1, 0x20000 * sizeof (char));
00092 memset (pikto_width, -1, (PIKTO_SIZE) * sizeof (char));
00093
00094 teststring[MAXSTRING-1] = '\0';
00095 while (fgets (teststring, MAXSTRING-1, infilep) != NULL) {
00096     sscanf (teststring, "%X:%*s", &loc);
00097     if (loc < 0x20000) {
00098         gstart = strchr (teststring, ':') + 1;
00099         /*
00100 16 rows per glyph, 2 ASCII hexadecimal digits per byte,
00101 so divide number of digits by 32 (shift right 5 bits).
00102 */
00103         glyph_width[loc] = (strlen (gstart) - 1) » 5;
00104     }
00105     else if ((loc >= PIKTO_START) && (loc <= PIKTO_END)) {
00106         gstart = strchr (teststring, ':') + 1;
00107         pikto_width[loc - PIKTO_START] = strlen (gstart) <= 34 ? 1 : 2;
00108     }
00109 }
00110
00111 fclose (infilep);
00112
00113 /*
00114 Now read the combining character code points. These have width of 0.
00115 */
00116 if ((infilep = fopen (argv[2], "r")) == NULL) {
00117     fprintf (stderr, "ERROR - combining characters file %s not found.\n\n", argv[2]);
00118     exit (EXIT_FAILURE);
00119 }
00120
00121 while (fgets (teststring, MAXSTRING-1, infilep) != NULL) {
00122     sscanf (teststring, "%X:%*s", &loc);
00123     if (loc < 0x20000) glyph_width[loc] = 0;
00124 }
00125
00126 fclose (infilep);
00127
00128 /*
00129 Code Points with Unusual Properties (Unicode Standard, Chapter 4).
00130
00131 As of Unifont 10.0.04, use the widths in the "-nonprinting.hex"
00132 files. If an application is smart enough to know how to handle
00133 these special cases, it will not render the "nonprinting" glyph
00134 and will treat the code point as being zero-width.
00135 */
00136 // glyph_width[0]=0; /* NULL character */
00137 // for (i = 0x0001; i <= 0x001F; i++) glyph_width[i]=-1; /* Control Characters */
00138 // for (i = 0x007F; i <= 0x009F; i++) glyph_width[i]=-1; /* Control Characters */
00139
00140 // glyph_width[0x034F]=0; /* combining grapheme joiner */
00141 // glyph_width[0x180B]=0; /* Mongolian free variation selector one */
00142 // glyph_width[0x180C]=0; /* Mongolian free variation selector two */
00143 // glyph_width[0x180D]=0; /* Mongolian free variation selector three */
00144 // glyph_width[0x180E]=0; /* Mongolian vowel separator */
00145 // glyph_width[0x200B]=0; /* zero width space */
00146 // glyph_width[0x200C]=0; /* zero width non-joiner */
00147 // glyph_width[0x200D]=0; /* zero width joiner */
00148 // glyph_width[0x200E]=0; /* left-to-right mark */
00149 // glyph_width[0x200F]=0; /* right-to-left mark */
00150 // glyph_width[0x202A]=0; /* left-to-right embedding */

```

```

00151 // glyph_width[0x202B]=0; /* right-to-left embedding */
00152 // glyph_width[0x202C]=0; /* pop directional formatting */
00153 // glyph_width[0x202D]=0; /* left-to-right override */
00154 // glyph_width[0x202E]=0; /* right-to-left override */
00155 // glyph_width[0x2060]=0; /* word joiner */
00156 // glyph_width[0x2061]=0; /* function application */
00157 // glyph_width[0x2062]=0; /* invisible times */
00158 // glyph_width[0x2063]=0; /* invisible separator */
00159 // glyph_width[0x2064]=0; /* invisible plus */
00160 // glyph_width[0x206A]=0; /* inhibit symmetric swapping */
00161 // glyph_width[0x206B]=0; /* activate symmetric swapping */
00162 // glyph_width[0x206C]=0; /* inhibit arabic form shaping */
00163 // glyph_width[0x206D]=0; /* activate arabic form shaping */
00164 // glyph_width[0x206E]=0; /* national digit shapes */
00165 // glyph_width[0x206F]=0; /* nominal digit shapes */
00166
00167 // /* Variation Selector-1 to Variation Selector-16 */
00168 // for (i = 0xFE00; i <= 0xFE0F; i++) glyph_width[i] = 0;
00169
00170 // glyph_width[0xFEFF]=0; /* zero width no-break space */
00171 // glyph_width[0xFF9]=0; /* interlinear annotation anchor */
00172 // glyph_width[0xFFA]=0; /* interlinear annotation separator */
00173 // glyph_width[0xFFB]=0; /* interlinear annotation terminator */
00174 /*
00175 Let glyph widths represent 0xFFFC (object replacement character)
00176 and 0xFFFD (replacement character).
00177 */
00178
00179 /*
00180 Hangul Jamo:
00181
00182 Leading Consonant (Choseong): leave spacing as is.
00183
00184 Hangul Choseong Filler (U+115F): set width to 2.
00185
00186 Hangul Jungseong Filler, Hangul Vowel (Jungseong), and
00187 Final Consonant (Jongseong): set width to 0, because these
00188 combine with the leading consonant as one composite syllabic
00189 glyph. As of Unicode 5.2, the Hangul Jamo block (U+1100..U+11FF)
00190 is completely filled.
00191 */
00192 // for (i = 0x1160; i <= 0x11FF; i++) glyph_width[i]=0; /* Vowels & Final Consonants */
00193
00194 /*
00195 Private Use Area -- the width is undefined, but likely
00196 to be 2 charcells wide either from a graphic glyph or
00197 from a four-digit hexadecimal glyph representing the
00198 code point. Therefore if any PUA glyph does not have
00199 a non-zero width yet, assign it a default width of 2.
00200 The Unicode Standard allows giving PUA characters
00201 default property values; see for example The Unicode
00202 Standard Version 5.0, p. 91. This same default is
00203 used for higher plane PUA code points below.
00204 */
00205 // for (i = 0xE000; i <= 0xF8FF; i++) {
00206 // if (glyph_width[i] == 0) glyph_width[i]=2;
00207 // }
00208
00209 /*
00210 <not a character>
00211 */
00212 for (i = 0xFDD0; i <= 0xFDEF; i++) glyph_width[i] = -1;
00213 glyph_width[0xFFFE] = -1; /* Byte Order Mark */
00214 glyph_width[0xFFFF] = -1; /* Byte Order Mark */
00215
00216 /* Surrogate Code Points */
00217 for (i = 0xD800; i <= 0xDFFF; i++) glyph_width[i]=-1;
00218
00219 /* CJK Code Points */
00220 for (i = 0x4E00; i <= 0x9FFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00221 for (i = 0x3400; i <= 0x4DBF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00222 for (i = 0xF900; i <= 0xFAFF; i++) if (glyph_width[i] < 0) glyph_width[i] = 2;
00223
00224 /*
00225 Now generate the output file.
00226 */
00227 printf ("/*\n");
00228 printf (" wewidth and wcswidth functions, as per IEEE 1003.1-2008\n");
00229 printf (" System Interfaces, pp. 2241 and 2251.\n\n");
00230 printf (" Author: Paul Hardy, 2013\n\n");
00231 printf (" Copyright (c) 2013 Paul Hardy\n\n");

```



```

00232 printf (" LICENSE:\n");
00233 printf ("\n");
00234 printf (" This program is free software: you can redistribute it and/or modify\n");
00235 printf (" it under the terms of the GNU General Public License as published by\n");
00236 printf (" the Free Software Foundation, either version 2 of the License, or\n");
00237 printf (" (at your option) any later version.\n");
00238 printf ("\n");
00239 printf (" This program is distributed in the hope that it will be useful,\n");
00240 printf (" but WITHOUT ANY WARRANTY; without even the implied warranty of\n");
00241 printf (" MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the\n");
00242 printf (" GNU General Public License for more details.\n");
00243 printf ("\n");
00244 printf (" You should have received a copy of the GNU General Public License\n");
00245 printf (" along with this program. If not, see <http://www.gnu.org/licenses/>.\n");
00246 printf ("*\n\n");
00247
00248 printf ("#include <wchar.h>\n\n");
00249 printf ("/* Definitions for Pikto CSUR Private Use Area glyphs */\n");
00250 printf ("#define PIKTO_START\t0x%06X\n", PIKTO_START);
00251 printf ("#define PIKTO_END\t0x%06X\n", PIKTO_END);
00252 printf ("#define PIKTO_SIZE\t(PIKTO_END - PIKTO_START + 1)\n");
00253 printf ("\n\n");
00254 printf ("/* wwidth -- return charcell positions of one code point */\n");
00255 printf ("inline int\ncwidth (wchar_t wc)\n{\n");
00256 printf (" return (wcswidth (&wc, 1));\n");
00257 printf ("}\n");
00258 printf ("\n\n");
00259 printf ("int\ncwidth (const wchar_t *pwcs, size_t n)\n{\n\n");
00260 printf (" int i; /* loop variable */\n");
00261 printf (" unsigned codept; /* Unicode code point of current character */\n");
00262 printf (" unsigned plane; /* Unicode plane, 0x00..0x10 */\n");
00263 printf (" unsigned lower17; /* lower 17 bits of Unicode code point */\n");
00264 printf (" unsigned lower16; /* lower 16 bits of Unicode code point */\n");
00265 printf (" int lowpt, midpt, highpt; /* for binary searching in plane1zeroes[] */\n");
00266 printf (" int found; /* for binary searching in plane1zeroes[] */\n");
00267 printf (" int totalwidth; /* total width of string, in charcells (1 or 2/glyph) */\n");
00268 printf (" int illegalchar; /* Whether or not this code point is illegal */\n");
00269 putchar ('\n');
00270
00271 /*
00272 Print the glyph_width[] array for glyphs widths in the
00273 Basic Multilingual Plane (Plane 0).
00274 */
00275 printf (" char glyph_width[0x20000] = {}");
00276 for (i = 0; i < 0x10000; i++) {
00277 if ((i & 0x1F) == 0)
00278 printf ("\n /* U+%04X */ ", i);
00279 printf ("%d,", glyph_width[i]);
00280 }
00281 for (i = 0x10000; i < 0x20000; i++) {
00282 if ((i & 0x1F) == 0)
00283 printf ("\n /* U+%06X */ ", i);
00284 printf ("%d", glyph_width[i]);
00285 if (i < 0x1FFFF) putchar (',');
00286 }
00287 printf ("\n }; \n\n");
00288
00289 /*
00290 Print the pikto_width[] array for Pikto glyph widths.
00291 */
00292 printf (" char pikto_width[PIKTO_SIZE] = {}");
00293 for (i = 0; i < PIKTO_SIZE; i++) {
00294 if ((i & 0x1F) == 0)
00295 printf ("\n /* U+%06X */ ", PIKTO_START + i);
00296 printf ("%d", pikto_width[i]);
00297 if ((PIKTO_START + i) < PIKTO_END) putchar (',');
00298 }
00299 printf ("\n }; \n\n");
00300
00301 /*
00302 Execution part of wcswidth.
00303 */
00304 printf ("\n");
00305 printf (" illegalchar = totalwidth = 0;\n");
00306 printf (" for (i = 0; !illegalchar && i < n; i++) {\n");
00307 printf (" codept = pwcs[i];\n");
00308 printf (" plane = codept » 16;\n");
00309 printf (" lower17 = codept & 0x1FFFF;\n");
00310 printf (" lower16 = codept & 0xFFFF;\n");
00311 printf (" if (plane < 2) { /* the most common case */\n");
00312 printf (" if (glyph_width[lower17] < 0) illegalchar = 1;\n");

```

```

00313     printf ("        else totalwidth += glyph_width[lower17];\n");
00314     printf ("    }\n");
00315     printf ("    else { /* a higher plane or beyond Unicode range */\n");
00316     printf ("        if ((lower16 == 0xFFFE) || (lower16 == 0xFFFF)) {\n");
00317     printf ("            illegalchar = 1;\n");
00318     printf ("        }\n");
00319     printf ("        else if (plane < 4) { /* Ideographic Plane */\n");
00320     printf ("            totalwidth += 2; /* Default ideographic width */\n");
00321     printf ("        }\n");
00322     printf ("        else if (plane == 0x0F) { /* CSUR Private Use Area */\n");
00323     printf ("            if (lower16 <= 0x0E6F) { /* Kinya */\n");
00324     printf ("                totalwidth++; /* all Kinya syllables have width 1 */\n");
00325     printf ("            }\n");
00326     printf ("            else if (lower16 <= (PIKTO_END & 0xFFFF)) { /* Pikto */\n");
00327     printf ("                if (pikto_width[lower16 - (PIKTO_START & 0xFFFF)] < 0) illegalchar = 1;\n");
00328     printf ("                else totalwidth += pikto_width[lower16 - (PIKTO_START & 0xFFFF)];\n");
00329     printf ("            }\n");
00330     printf ("        }\n");
00331     printf ("        else if (plane > 0x10) {\n");
00332     printf ("            illegalchar = 1;\n");
00333     printf ("        }\n");
00334     printf ("        /* Other non-printing in higher planes; return -1 as per IEEE 1003.1-2008. */\n");
00335     printf ("        else if (/* language tags */\n");
00336     printf ("            codept == 0xE0001 || (codept >= 0xE0020 && codept <= 0xE007F) ||\n");
00337     printf ("            /* variation selectors, 0xE0100..0xE01EF */\n");
00338     printf ("            (codept >= 0xE0100 && codept <= 0xE01EF)) {\n");
00339     printf ("                illegalchar = 1;\n");
00340     printf ("            }\n");
00341     printf ("        /*\n");
00342     printf ("            Unicode plane 0x02..0x10 printing character\n");
00343     printf ("        */\n");
00344     printf ("        else {\n");
00345     printf ("            illegalchar = 1; /* code is not in font */\n");
00346     printf ("        }\n");
00347     printf ("    }\n");
00348     printf ("    }\n");
00349     printf ("    }\n");
00350     printf ("    if (illegalchar) totalwidth = -1;\n");
00351     printf ("    }\n");
00352     printf ("    return (totalwidth);\n");
00353     printf ("    }\n");
00354     printf ("    }\n");
00355
00356     exit (EXIT_SUCCESS);
00357 }

```

### 5.33 src/unihangul-support.c File Reference

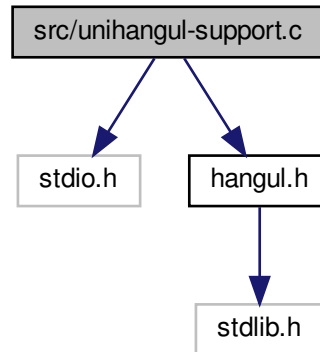
Functions for converting Hangul letters into syllables.

```

#include <stdio.h>
#include "hangul.h"

```

Include dependency graph for unihangul-support.c:



## Functions

- unsigned [hangul\\_read\\_base8](#) (FILE \*infp, unsigned char base[][32])  
Read hangul-base.hex file into a unsigned char array.
- unsigned [hangul\\_read\\_base16](#) (FILE \*infp, unsigned base[][16])  
Read hangul-base.hex file into a unsigned array.
- void [hangul\\_decompose](#) (unsigned codept, int \*initial, int \*medial, int \*final)  
Decompose a Hangul Syllables code point into three letters.
- unsigned [hangul\\_compose](#) (int initial, int medial, int final)  
Compose a Hangul syllable into a code point, or 0 if none exists.
- void [hangul\\_hex\\_indices](#) (int choseong, int jungseong, int jongseong, int \*cho\_index, int \*jung\_index, int \*jong\_index)  
Determine index values to the bitmaps for a syllable's components.
- void [hangul\\_variations](#) (int choseong, int jungseong, int jongseong, int \*cho\_var, int \*jung\_var, int \*jong\_var)  
Determine the variations of each letter in a Hangul syllable.
- int [cho\\_variation](#) (int choseong, int jungseong, int jongseong)  
Return the Johab 6/3/1 choseong variation for a syllable.
- int [is\\_wide\\_vowel](#) (int vowel)  
Whether vowel has rightmost vertical stroke to the right.
- int [jung\\_variation](#) (int choseong, int jungseong, int jongseong)  
Return the Johab 6/3/1 jungseong variation.
- int [jong\\_variation](#) (int choseong, int jungseong, int jongseong)  
Return the Johab 6/3/1 jongseong variation.
- void [hangul\\_syllable](#) (int choseong, int jungseong, int jongseong, unsigned char hangul\_base[][32], unsigned char \*syllable)  
Given letters in a Hangul syllable, return a glyph.
- int [glyph\\_overlap](#) (unsigned \*glyph1, unsigned \*glyph2)  
See if two glyphs overlap.

- void `combine_glyphs` (unsigned \*glyph1, unsigned \*glyph2, unsigned \*combined\_glyph)  
Combine two glyphs into one glyph.
- void `print_glyph_txt` (FILE \*fp, unsigned codept, unsigned \*this\_glyph)  
Print one glyph in Unifont hexdraw plain text style.
- void `print_glyph_hex` (FILE \*fp, unsigned codept, unsigned \*this\_glyph)  
Print one glyph in Unifont hexdraw hexadecimal string style.
- void `one_jamo` (unsigned glyph\_table[MAX\_GLYPHS][16], unsigned jamo, unsigned \*jamo\_glyph)  
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
- void `combined_jamo` (unsigned glyph\_table[MAX\_GLYPHS][16], unsigned cho, unsigned jung, unsigned jong, unsigned \*combined\_glyph)  
Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

### 5.33.1 Detailed Description

Functions for converting Hangul letters into syllables.

This file contains functions for reading in Hangul letters arranged in a Johab 6/3/1 pattern and composing syllables with them. One function maps an initial letter (choseong), medial letter (jungseong), and final letter (jongseong) into the Hangul Syllables Unicode block, U+AC00..U+D7A3. Other functions allow formation of glyphs that include the ancient Hangul letters that Hanterm supported. More can be added if desired, with appropriate changes to start positions and lengths defined in "hangul.h".

Author

Paul Hardy

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Definition in file [unihangul-support.c](#).

### 5.33.2 Function Documentation

#### 5.33.2.1 cho\_variation()

```
int cho_variation (
    int choseong,
    int jungseong,
    int jongseong )
```

Return the Johab 6/3/1 choseong variation for a syllable.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the initial consonant (choseong).

Each choseong has 6 variations:

#### Variation Occurrence

0 Choseong with a vertical vowel such as "A". 1 Choseong with a horizontal vowel such as "O". 2 Choseong with a vertical and horizontal vowel such as "WA". 3 Same as variation 0, but with jongseong (final consonant). 4 Same as variation 1, but with jongseong (final consonant). Also a horizontal vowel pointing down, such as U and YU. 5 Same as variation 2, but with jongseong (final consonant). Also a horizontal vowel pointing down with vertical element, such as WEO, WE, and WI.

In addition, if the vowel is horizontal and a downward-pointing stroke as in the modern letters U, WEO, WE, WI, and YU, and in archaic letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added to the initial variation of 0 to 2, resulting in a choseong variation of 3 to 5, respectively.

## Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

## Returns

The choseong variation, 0 to 5.

Definition at line 350 of file unihangul-support.c.

```

00350                                     {
00351     int cho_variation; /* Return value */
00352
00353     /*
00354     The Choseong cho_var is determined by the
00355     21 modern + 50 ancient Jungseong, and whether
00356     or not the syllable contains a final consonant
00357     (Jongseong).
00358     */
00359     static int choseong_var [TOTAL_JUNG + 1] = {
00360         /*
00361         Modern Jungseong in positions 0..20.
00362         */
00363         /* Location Variations Unicode Range Vowel # Vowel Names */
00364         /* ----- */
00365         /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00366         /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00367         /* 0x30D */ 0, 0, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00368         /* 0x313 */ 1, // U+1169 -->[ 8] O
00369         /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00370         /* 0x31F */ 1, 4, // U+116D..U+116E-->[12..13] YO, U
00371         /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16] WEO, WE, WI
00372         /* 0x32E */ 4, 1, // U+1172..U+1173-->[17..18] YU, EU
00373         /* 0x334 */ 2, // U+1174 -->[19] YI
00374         /* 0x337 */ 0, // U+1175 -->[20] I
00375         /*
00376         Ancient Jungseong in positions 21..70.
00377         */
00378         /* Location Variations Unicode Range Vowel # Vowel Names */
00379         /* ----- */
00380         /* 0x33A: */ 2, 5, 2, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00381         /* 0x343: */ 2, 2, 5, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00382         /* 0x34C: */ 2, 2, 5, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00383         /* 0x355: */ 2, 5, 5, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00384         /* 0x35E: */ 4, 4, 2, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00385         /* 0x367: */ 2, 2, 5, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00386         /* 0x370: */ 2, 5, 5, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00387         /* 0x379: */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00388         /* 0x382: */ 5, 5, 5, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00389         /* 0x38B: */ 5, 5, 2, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00390         /* 0x394: */ 5, 2, 2, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00391         /* 0x39D: */ 2, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,

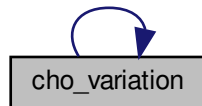
```

```

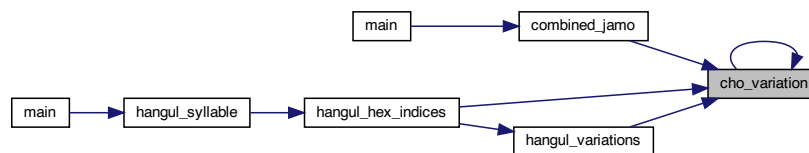
00392 /* 0x3A6: */ 2, 5, 2, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00393 /* 0x3AF: */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00394 /* 0x3B8: */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-ISSANGARAEA,
00395 /* 0x3C1: */ 2, 5, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00396 /* 0x3CA: */ 2, 2, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE,
00397 #ifdef EXTENDED_HANGUL
00398 /* 0x3D0: */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00399 /* 0x3D9: */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00400 /* 0x3E2: */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00401 /* 0x3EB: */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00405 /* 0x40F: */ 2, 2, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1 // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1 // Mark end of list of vowels.
00409 #endif
00410 };
00411
00412
00413 if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415 }
00416 else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jongseong >= 0 && cho_variation < 3)
00419         cho_variation += 3;
00420 }
00421
00422
00423 return cho_variation;
00424 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.33.2.2 combine\_glyphs()

```

void combine_glyphs (
    unsigned * glyph1,

```

```

    unsigned * glyph2,
    unsigned * combined_glyph )

```

Combine two glyphs into one glyph.

Parameters

in	glyph1	The first glyph to overlap.
in	glyph2	The second glyph to overlap.
out	combined_glyph	The returned combination glyph.

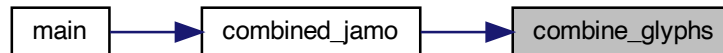
Definition at line 637 of file [unihangul-support.c](#).

```

00638     {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642         combined_glyph [i] = glyph1 [i] | glyph2 [i];
00643
00644     return;
00645 }

```

Here is the caller graph for this function:



### 5.33.2.3 combined\_jamo()

```

void combined_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned cho,
    unsigned jung,

```

```

    unsigned jong,
    unsigned * combined_glyph )

```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

This function converts input Hangul choseong, jungseong, and jongseong Unicode code triplets into a Hangul syllable. Any of those with an out of range code point are assigned a blank glyph for combining. This function performs the following steps:

- 1) Determine the sequence number of choseong, jungseong, and jongseong, from 0 to the total number of choseong, jungseong, or jongseong, respectively, minus one. The sequence for each is as follows:
  - a) Choseong: Unicode code points of U+1100..U+115E and then U+A960..U+A97C.
  - b) Jungseong: Unicode code points of U+1161..U+11A7 and then U+D7B0..U+D7C6.
  - c) Jongseong: Unicode code points of U+11A8..U+11FF and then U+D7CB..U+D7FB.
- 2) From the choseong, jungseong, and jongseong sequence number, determine the variation of choseong and jungseong (there is only one jongseong variation, although it is shifted right by one column for some vowels with a pair of long vertical strokes on the right side).
- 3) Convert the variation numbers for the three syllable components to index locations in the glyph array.
- 4) Combine the glyph array glyphs into a syllable.

#### Parameters

in	glyph_table	The collection of all jamo glyphs.
in	cho	The choseong Unicode code point, 0 or 0x1100..0x115F.
in	jung	The jungseong Unicode code point, 0 or 0x1160..0x11A7.



## Parameters

in	jong	The jongseong Unicode code point, 0 or 0x11← A8..0x11← FF.
out	combined_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 787 of file [unihangul-support.c](#).

```

00789     {
00790
00791     int i; /* Loop variable. */
00792     int cho_num, jung_num, jong_num;
00793     int cho_group, jung_group, jong_group;
00794     int cho_index, jung_index, jong_index;
00795
00796     unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00797
00798     int cho_variation (int choseong, int jungseong, int jongseong);
00799
00800     void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00801                        unsigned *combined_glyph);
00802
00803
00804     /* Choose a blank glyph for each syllalbe by default. */
00805     cho_index = jung_index = jong_index = 0x000;
00806
00807     /*
00808     Convert Unicode code points to jamo sequence number
00809     of each letter, or -1 if letter is not in valid range.
00810     */
00811     if (cho >= 0x1100 && cho <= 0x115E)
00812         cho_num = cho - CHO_UNICODE_START;
00813     else if (cho >= CHO_EXTA_UNICODE_START &&
00814            cho < (CHO_EXTA_UNICODE_START + NCHO_EXTA))
00815         cho_num = cho - CHO_EXTA_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816     else
00817         cho_num = -1;
00818
00819     if (jung >= 0x1161 && jung <= 0x11A7)
00820         jung_num = jung - JUNG_UNICODE_START;
00821     else if (jung >= JUNG_EXTB_UNICODE_START &&
00822            jung < (JUNG_EXTB_UNICODE_START + NJUNG_EXTB))
00823         jung_num = jung - JUNG_EXTB_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824     else
00825         jung_num = -1;
00826
00827     if (jong >= 0x11A8 && jong <= 0x11FF)
00828         jong_num = jong - JONG_UNICODE_START;
00829     else if (jong >= JONG_EXTB_UNICODE_START &&
00830            jong < (JONG_EXTB_UNICODE_START + NJONG_EXTB))
00831         jong_num = jong - JONG_EXTB_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832     else
00833         jong_num = -1;

```

```

00834
00835 /*
00836 Choose initial consonant (choseong) variation based upon
00837 the vowel (jungseong) if both are specified.
00838 */
00839 if (cho_num < 0) {
00840     cho_index = cho_group = 0; /* Use blank glyph for choseong. */
00841 }
00842 else {
00843     if (jung_num < 0 && jong_num < 0) { /* Choseong is by itself. */
00844         cho_group = 0;
00845         if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846             cho_index = cho_num + JAMO_HEX;
00847         else /* Choseong is in Hangul Jamo Extended-A range. */
00848             cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849                 + JAMO_EXT_A_HEX;
00850     }
00851     else {
00852         if (jung_num >= 0) { /* Valid jungseong with choseong. */
00853             cho_group = cho_variation (cho_num, jung_num, jong_num);
00854         }
00855         else { /* Invalid vowel; see if final consonant is valid. */
00856             /*
00857             If initial consonant and final consonant are specified,
00858             set cho_group to 4, which is the group tha would apply
00859             to a horizontal-only vowel such as Hangul "O", so the
00860             consonant appears full-width.
00861             */
00862             cho_group = 0;
00863             if (jong_num >= 0) {
00864                 cho_group = 4;
00865             }
00866         }
00867         cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868             cho_group;
00869     } /* Choseong combined with jungseong and/or jongseong. */
00870 } /* Valid choseong. */
00871
00872 /*
00873 Choose vowel (jungseong) variation based upon the choseong
00874 and jungseong.
00875 */
00876 jung_index = jung_group = 0; /* Use blank glyph for jungseong. */
00877
00878 if (jung_num >= 0) {
00879     if (cho_num < 0 && jong_num < 0) { /* Jungseong is by itself. */
00880         jung_group = 0;
00881         jung_index = jung_num + JUNG_UNICODE_START;
00882     }
00883     else {
00884         if (jong_num >= 0) { /* If there is a final consonant. */
00885             if (jong_num == 3) /* Nieun; choose variation 3. */
00886                 jung_group = 2;
00887             else
00888                 jung_group = 1;
00889         } /* Valid jongseong. */
00890         /* If valid choseong but no jongseong, choose jungseong variation 0. */
00891         else if (cho_num >= 0)
00892             jung_group = 0;
00893     }
00894     jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895 }
00896
00897 /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jungseong are present.
00900 */
00901 if (jong_num < 0) {
00902     jong_index = jong_group = 0; /* Use blank glyph for jongseong. */
00903 }
00904 else { /* Valid jongseong. */
00905     if (cho_num < 0 && jung_num < 0) { /* Jongseong is by itself. */
00906         jong_group = 0;
00907         jong_index = jung_num + 0x4A8;
00908     }
00909     else { /* There is only one jongseong variation if combined. */
00910         jong_group = 0;
00911         jong_index = JONG_HEX + JONG_VARIATIONS * jong_num +
00912             jong_group;
00913     }
00914 }

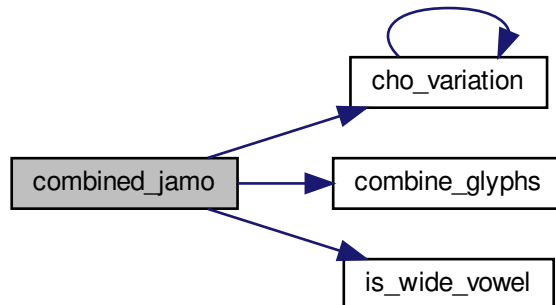
```

```

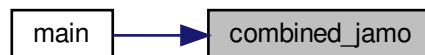
00915
00916  /*
00917  Now that we know the index locations for choseong, jungseong, and
00918  jongseong glyphs, combine them into one glyph.
00919  */
00920  combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921                combined_glyph);
00922
00923  if (jong_index > 0) {
00924    /*
00925    If the vowel has a vertical stroke that is one column
00926    away from the right border, shift this jongseung right
00927    by one column to line up with the rightmost vertical
00928    stroke in the vowel.
00929    */
00930    if (is_wide_vowel (jung_num)) {
00931      for (i = 0; i < 16; i++) {
00932        tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933      }
00934      combine_glyphs (combined_glyph, tmp_glyph,
00935                    combined_glyph);
00936    }
00937    else {
00938      combine_glyphs (combined_glyph, glyph_table [jong_index],
00939                    combined_glyph);
00940    }
00941  }
00942  return;
00943 }
00944 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.33.2.4 glyph\_overlap()

```
int glyph_overlap (
    unsigned * glyph1,
    unsigned * glyph2 )
```

See if two glyphs overlap.

Parameters

in	glyph1	The first glyph, as a 16-row bitmap.
in	glyph2	The second glyph, as a 16-row bitmap.

Returns

0 if no overlaps between glyphs, 1 otherwise.

Definition at line [613](#) of file [unihangul-support.c](#).

```
00613     {
00614     int overlaps; /* Return value; 0 if no overlaps, -1 if overlaps. */
00615     int i;
00616
00617     /* Check for overlaps between the two glyphs. */
00618
00619     i = 0;
00620     do {
00621         overlaps = (glyph1[i] & glyph2[i]) != 0;
00622         i++;
00623     } while (i < 16 && overlaps == 0);
00624
00625     return overlaps;
00626 }
```

### 5.33.2.5 hangul\_compose()

```
unsigned hangul_compose (
    int initial,
    int medial,
    int final )
```

Compose a Hangul syllable into a code point, or 0 if none exists.

This function takes three letters that can form a modern Hangul syllable and returns the corresponding Unicode Hangul Syllables code point in the range 0xAC00 to 0xD7A3.

If a three-letter combination includes one or more archaic letters, it will not map into the Hangul Syllables range. In that case, the returned code point will be 0 to indicate that no valid Hangul Syllables code point exists.

## Parameters

in	initial	The first letter (choseong), 0 to 18.
in	medial	The second letter (jungseong), 0 to 20.
in	final	The third letter (jongseong), 0 to 26 or -1 if none.

## Returns

The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.

Definition at line 201 of file unihangul-support.c.

```

00201     {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial >= 0 && medial <= 20 &&
00207         final >= 0 && final <= 26) {
00208
00209         codept = 0xAC00;
00210         codept += initial * 21 * 28;
00211         codept += medial * 28;
00212         codept += final + 1;
00213     }
00214     else {
00215         codept = 0;
00216     }
00217
00218     return codept;
00219 }
```

## 5.33.2.6 hangul\_decompose()

```

void hangul_decompose (
    unsigned codept,
    int * initial,
    int * medial,
    int * final )
```

Decompose a Hangul Syllables code point into three letters.

Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:

- Choseong 0-19

- Jungseong 0-20
- Jongseong 0-27 or -1 if no jongseong

All letter values are set to -1 if the letters do not form a syllable in the Hangul Syllables range. This function only handles modern Hangul, because that is all that is in the Hangul Syllables range.

#### Parameters

in	codept	The Unicode code point to decode, from 0x↔AC00 to 0x↔D7A3.
out	initial	The 1st letter (choseong) in the syllable.
out	initial	The 2nd letter (jungseong) in the syllable.
out	initial	The 3rd letter (jongseong) in the syllable.

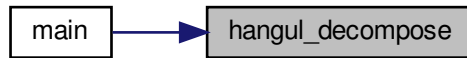
Definition at line 167 of file [unihangul-support.c](#).

```

00167 {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept -= 0xAC00;
00174         *initial = codept / (28 * 21);
00175         *medial = (codept / 28) % 21;
00176         *final = codept % 28 - 1;
00177     }
00178
00179     return;
00180 }

```

Here is the caller graph for this function:



### 5.33.2.7 hangul\_hex\_indices()

```

void hangul_hex_indices (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_index,
    int * jung_index,
    int * jong_index )
  
```

Determine index values to the bitmaps for a syllable's components.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

These variations are then converted into index locations within the glyph array that was read in from the hangul-base.hex file. Those index locations can then be used to form a composite syllable.

There is no restriction to only use the modern Hangul letters.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.

## Parameters

in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_index	Index location to the 1st letter variation from the hangul-base.↔ hex file.
out	jung_index	Index location to the 2nd letter variation from the hangul-base.↔ hex file.
out	jong_index	Index location to the 3rd letter variation from the hangul-base.↔ hex file.

Definition at line [249](#) of file [unihangul-support.c](#).

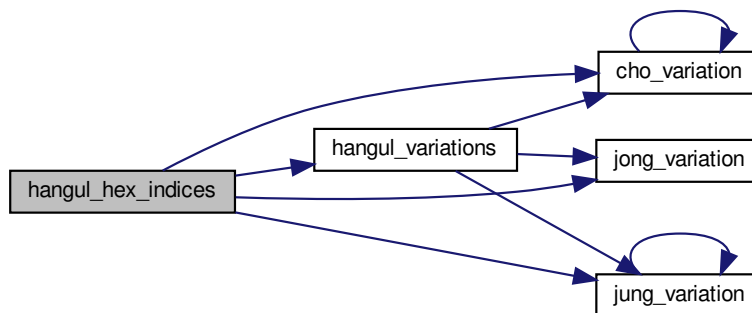


```

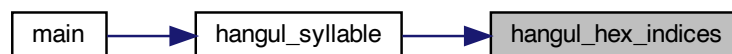
00250                                     {
00251
00252   int cho_variation, jung_variation, jong_variation; /* Letter variations */
00253
00254   void hangul_variations (int choseong, int jungseong, int jongseong,
00255                          int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257   hangul_variations (choseong, jungseong, jongseong,
00258                     &cho_variation, &jung_variation, &jong_variation);
00260
00261   *cho_index = CHO_HEX + choseong * CHO_VARIATIONS + cho_variation;
00262   *jung_index = JUNG_HEX + jungseong * JUNG_VARIATIONS + jung_variation;
00263   *jong_index = jongseong < 0 ? 0x0000 :
00264                 JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266   return;
00267 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.33.2.8 hangul\_read\_base16()

```

unsigned hangul_read_base16 (
    FILE * infp,
    unsigned base[][16] )

```

Read hangul-base.hex file into a unsigned array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation.

The order is:

- Empty glyph in 0x0000 position.

- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

#### Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 16 16-bit values per letter.

#### Returns

The maximum code point value read in the file.

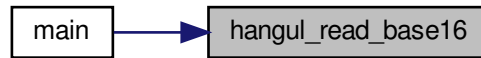
Definition at line 116 of file [unihangul-support.c](#).

```

00116     {
00117     unsigned codept;
00118     unsigned max_codept;
00119     int     i, j;
00120     char   instring[MAXLINE];
00121
00122
00123     max_codept = 0;
00124
00125     while (fgets (instring, MAXLINE, infp) != NULL) {
00126         sscanf (instring, "%X", &codept);
00127         codept -= PUA_START;
00128         /* If code point is within range, add it */
00129         if (codept < MAX_GLYPHS) {
00130             /* Find the start of the glyph bitmap. */
00131             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132             if (instring[i] == ':') {
00133                 i++; /* Skip over ':' to get to start of bitmap. */
00134                 for (j = 0; j < 16; j++) {
00135                     sscanf (&instring[i], "%4X", &base[codept][j]);
00136                     i += 4;
00137                 }
00138                 if (codept > max_codept) max_codept = codept;
00139             }
00140         }
00141     }
00142
00143     return max_codept;
00144 }

```

Here is the caller graph for this function:



### 5.33.2.9 hangul\_read\_base8()

```

unsigned hangul_read_base8 (
    FILE * infp,
    unsigned char base[][32] )
  
```

Read hangul-base.hex file into a unsigned char array.

Read a Hangul base .hex file with separate choseong, jungseong, and jongseong glyphs for syllable formation. The order is:

- Empty glyph in 0x0000 position.
- Initial consonants (choseong).
- Medial vowels and diphthongs (jungseong).
- Final consonants (jongseong).
- Individual letter forms in isolation, not for syllable formation.

The letters are arranged with all variations for one letter before continuing to the next letter. In the current encoding, there are 6 variations of choseong, 3 of jungseong, and 1 of jongseong per letter.

Parameters

in	Input	file pointer; can be stdin.
out	Array	of bit patterns, with 32 8-bit values per letter.

## Returns

The maximum code point value read in the file.

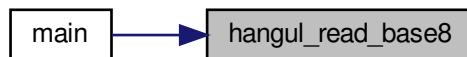
Definition at line 63 of file `unihangul-support.c`.

```

00063     {
00064     unsigned codept;
00065     unsigned max_codept;
00066     int    i, j;
00067     char   instring[MAXLINE];
00068
00069
00070     max_codept = 0;
00071
00072     while (fgets (instring, MAXLINE, infp) != NULL) {
00073         sscanf (instring, "%X", &codept);
00074         codept -= PUA_START;
00075         /* If code point is within range, add it */
00076         if (codept < MAX_GLYPHS) {
00077             /* Find the start of the glyph bitmap. */
00078             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079             if (instring[i] == ':') {
00080                 i++; /* Skip over ':' to get to start of bitmap. */
00081                 for (j = 0; j < 32; j++) {
00082                     sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083                     i += 2;
00084                 }
00085                 if (codept > max_codept) max_codept = codept;
00086             }
00087         }
00088     }
00089     return max_codept;
00090 }
00091 }

```

Here is the caller graph for this function:



### 5.33.2.10 `hangul_syllable()`

```

void hangul_syllable (
    int choseong,
    int jungseong,
    int jongseong,
    unsigned char hangul_base[][32],
    unsigned char * syllable )

```

Given letters in a Hangul syllable, return a glyph.

This function returns a glyph bitmap comprising up to three Hangul letters that form a syllable. It reads the three component letters (choseong, jungseong, and jongseong), then calls a function that determines the appropriate variation of each letter, returning the letter bitmap locations in the glyph array. Then these letter bitmaps are combined with a logical OR operation to produce a final bitmap, which forms a 16 row by 16 column bitmap glyph.

## Parameters

in	choseong	The 1st letter in the composite glyph.
in	jungseong	The 2nd letter in the composite glyph.
in	jongseong	The 3rd letter in the composite glyph.
in	hangul_base	The glyphs read from the "hangul_base.hex" file.

## Returns

syllable The composite syllable, as a 16 by 16 pixel bitmap.

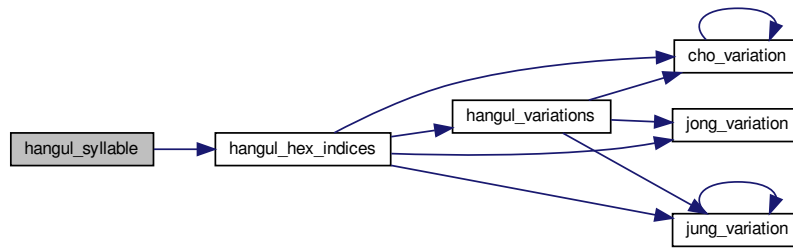
Definition at line 583 of file [unihangul-support.c](#).

```

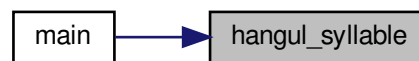
00584                                     {
00585
00586     int    i; /* loop variable */
00587     int    cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                        &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595         glyph_byte = hangul_base [cho_hex][i];
00596         glyph_byte |= hangul_base [jung_hex][i];
00597         if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598         syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



#### 5.33.2.11 hangul\_variations()

```

void hangul_variations (
    int choseong,
    int jungseong,
    int jongseong,
    int * cho_var,
    int * jung_var,
    int * jong_var )
  
```

Determine the variations of each letter in a Hangul syllable.

Given the three letters that will form a syllable, return the variation of each letter used to form the composite glyph.

This function can determine variations for both modern and archaic Hangul letters; it is not limited to only the letters combinations that comprise the Unicode Hangul Syllables range.

This function reads these input values for modern and ancient Hangul letters:

- Choseong number (0 to the number of modern and archaic choseong - 1).
- Jungseong number (0 to the number of modern and archaic jungseong - 1).
- Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none).

It then determines the variation of each letter given the combination with the other two letters (or just choseong and jungseong if the jongseong value is -1).

## Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable, or -1 if none.
out	cho_var	Variation of the 1st letter from the hangul-base.↔ hex file.
out	jung_var	Variation of the 2nd letter from the hangul-base.↔ hex file.
out	jong_var	Variation of the 3rd letter from the hangul-base.↔ hex file.

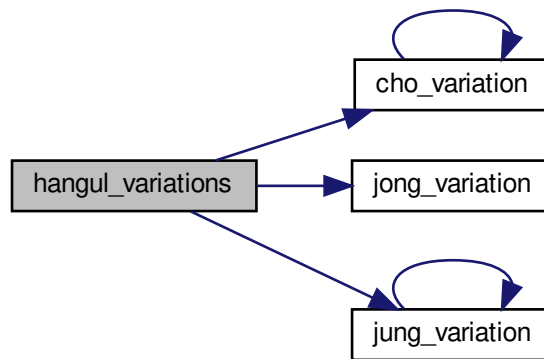
Definition at line 298 of file [unihangul-support.c](#).

```

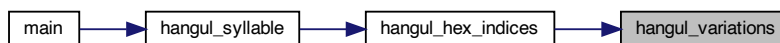
00299             {
00300
00301     int cho_variation (int choseong, int jungseong, int jongseong);
00302     int jung_variation (int choseong, int jungseong, int jongseong);
00303     int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305     /*
00306     Find the variation for each letter component.
00307     */
00308     *cho_var = cho_variation (choseong, jungseong, jongseong);
00309     *jung_var = jung_variation (choseong, jungseong, jongseong);
00310     *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313     return;
00314 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.33.2.12 is\_wide\_vowel()

```

int is_wide_vowel (
    int vowel )

```

Whether vowel has rightmost vertical stroke to the right.



## Parameters

in	vowel	Vowel number, from 0 to TOTAL_JUNG ← ← JUNG - 1.
----	-------	--

## Returns

1 if this vowel's vertical stroke is wide on the right side; else 0.

Definition at line 434 of file [unihangul-support.c](#).

```

00434 {
00435     int retval; /* Return value. */
00436
00437     static int wide_vowel [TOTAL_JUNG + 1] = {
00438         /*
00439         Modern Jungseong in positions 0..20.
00440         */
00441         /* Location Variations Unicode Range Vowel # Vowel Names */
00442         /* ----- */
00443         /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00444         /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00445         /* 0x30D */ 0, 1, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00446         /* 0x313 */ 0, // U+1169 -->[ 8] O
00447         /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00448         /* 0x31F */ 0, 0, // U+116D..U+116E-->[12..13] YO, U
00449         /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16] WEO, WE, WI
00450         /* 0x32E */ 0, 0, // U+1172..U+1173-->[17..18] YU, EU
00451         /* 0x334 */ 0, // U+1174 -->[19] YI
00452         /* 0x337 */ 0, // U+1175 -->[20] I
00453         /*
00454         Ancient Jungseong in positions 21..70.
00455         */
00456         /* Location Variations Unicode Range Vowel # Vowel Names */
00457         /* ----- */
00458         /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00459         /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00460         /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00461         /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00462         /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00463         /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00464         /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00465         /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00466         /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00467         /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00468         /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00469         /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00470         /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00471         /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00472         /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00473         /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00474         /* 0x3CA: */ 0, 1, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE
00475         #ifndef EXTENDED_HANGUL
00476         /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00477         /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00478         /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00479         /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00480         /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00481         /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00482         /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00483         /* 0x40F: */ 0, 1, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484         /* 0x415: */ -1 // Mark end of list of vowels.
00485         #else
00486         /* 0x310: */ -1 // Mark end of list of vowels.
00487         #endif
00488     };

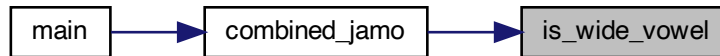
```

```

00489
00490
00491  if (vowel >= 0 && vowel < TOTAL_JUNG) {
00492      retval = wide_vowel [vowel];
00493  }
00494  else {
00495      retval = 0;
00496  }
00497
00498
00499  return retval;
00500 }

```

Here is the caller graph for this function:



### 5.33.2.13 jong\_variation()

```

int jong_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]

```

Return the Johab 6/3/1 jongseong variation.

There is only one jongseong variation, so this function always returns 0. It is a placeholder function for possible future adaptation to other johab encodings.

Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

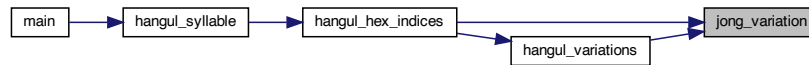
## Returns

The jongseong variation, always 0.

Definition at line 558 of file [unihangul-support.c](#).

```
00558     {
00559
00560     return 0; /* There is only one Jongseong variation. */
00561 }
```

Here is the caller graph for this function:



## 5.33.2.14 jung\_variation()

```
int jung_variation (
    int choseong,
    int jungseong,
    int jongseong ) [inline]
```

Return the Johab 6/3/1 jungseong variation.

This function takes the two or three (if jongseong is included) letters that comprise a syllable and determine the variation of the vowel (jungseong).

Each jungseong has 3 variations:

Variation Occurrence

0 Jungseong with only chungseong (no jungseong). 1 Jungseong with chungseong and jungseong (except nieun). 2 Jungseong with chungseong and jungseong nieun.

## Parameters

in	choseong	The 1st letter in the syllable.
in	jungseong	The 2nd letter in the syllable.
in	jongseong	The 3rd letter in the syllable.

## Returns

The jungseong variation, 0 to 2.

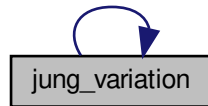
Definition at line 524 of file [unihangul-support.c](#).

```

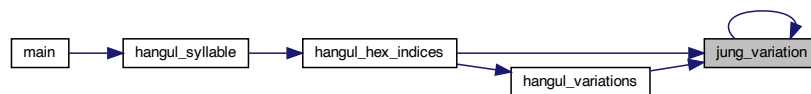
00524     {
00525     int jung_variation; /* Return value */
00526
00527     if (jungseong < 0) {
00528         jung_variation = -1;
00529     }
00530     else {
00531         jung_variation = 0;
00532         if (jongseong >= 0) {
00533             if (jongseong == 3)
00534                 jung_variation = 2; /* Vowel for final Nieun. */
00535             else
00536                 jung_variation = 1;
00537         }
00538     }
00539
00540
00541     return jung_variation;
00542 }

```

Here is the call graph for this function:



Here is the caller graph for this function:



### 5.33.2.15 one\_jamo()

```

void one_jamo (
    unsigned glyph_table[MAX_GLYPHS][16],
    unsigned jamo,
    unsigned * jamo_glyph )

```

Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.

## Parameters

in	glyph_table	The collection of all jamo glyphs.
in	jamo	The Unicode code point, 0 or 0x1100..0x115F.
out	jamo_glyph	The output glyph, 16 columns in each of 16 rows.

Definition at line 717 of file [unihangul-support.c](#).

```

00718         {
00719
00720     int i; /* Loop variable */
00721     int glyph_index; /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724     /* If jamo is invalid range, use blank glyph, */
00725     if (jamo >= 0x1100 && jamo <= 0x11FF) {
00726         glyph_index = jamo - 0x1100 + JAMO_HEX;
00727     }
00728     else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729         glyph_index = jamo - 0xA960 + JAMO_EXTA_HEX;
00730     }
00731     else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732         glyph_index = jamo - 0x1100 + JAMO_EXTB_HEX;
00733     }
00734     else {
00735         glyph_index = 0;
00736     }
00737
00738     for (i = 0; i < 16; i++) {
00739         jamo_glyph[i] = glyph_table[glyph_index][i];
00740     }
00741
00742     return;
00743 }

```

### 5.33.2.16 print\_glyph\_hex()

```

void print_glyph_hex (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )

```

Print one glyph in Unifont hexdraw hexadecimal string style.

## Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 692 of file [unihangul-support.c](#).

```

00692                                     {
00693
00694     int i;
00695
00696     fprintf (fp, "%04X:", codept);
00697
00698     /* for each this_glyph row */
00699     for (i = 0; i < 16; i++) {
00700         fprintf (fp, "%04X", this_glyph[i]);
00701     }
00702     fputc ('\n', fp);
00703
00704     return;
00705 }
00706 }

```

Here is the caller graph for this function:



## 5.33.2.17 print\_glyph\_txt()

```
void print_glyph_txt (
    FILE * fp,
    unsigned codept,
    unsigned * this_glyph )
```

Print one glyph in Unifont hexdraw plain text style.

## Parameters

in	fp	The file pointer for output.
in	codept	The Unicode code point to print with the glyph.
in	this_glyph	The 16-row by 16-column glyph to print.

Definition at line 656 of file [unihangul-support.c](#).

```
00656                                     {
00657     int i;
00658     unsigned mask;
00659
00660     fprintf (fp, "%04X:", codept);
00661
00662     /* for each this_glyph row */
00663     for (i = 0; i < 16; i++) {
00664         mask = 0x8000;
00665         fputc ('\t', fp);
00666         while (mask != 0x0000) {
00667             if (mask & this_glyph [i]) {
00668                 fputc ('#', fp);
00669             }
00670             else {
00671                 fputc ('.', fp);
00672             }
00673             mask »= 1; /* shift to next bit in this_glyph row */
00674         }
00675         fputc ('\n', fp);
00676     }
00677     fputc ('\n', fp);
00678     return;
00679 }
00680 }
00681 }
```

## 5.34 unihangul-support.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unihangul-support.c
00003
00004 @brief Functions for converting Hangul letters into syllables
00005
00006 This file contains functions for reading in Hangul letters
00007 arranged in a Johab 6/3/1 pattern and composing syllables
00008 with them. One function maps an initial letter (choseong),
00009 medial letter (jungseong), and final letter (jongseong)
00010 into the Hangul Syllables Unicode block, U+AC00..U+D7A3.
00011 Other functions allow formation of glyphs that include
00012 the ancient Hangul letters that Hanterm supported. More
00013 can be added if desired, with appropriate changes to
00014 start positions and lengths defined in "hangul.h".
00015
00016 @author Paul Hardy
00017
00018 @copyright Copyright © 2023 Paul Hardy
00019 */
00020 /*
00021 LICENSE:
00022
00023 This program is free software: you can redistribute it and/or modify
00024 it under the terms of the GNU General Public License as published by
00025 the Free Software Foundation, either version 2 of the License, or
00026 (at your option) any later version.
00027
00028 This program is distributed in the hope that it will be useful,
00029 but WITHOUT ANY WARRANTY; without even the implied warranty of
00030 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00031 GNU General Public License for more details.
00032
00033 You should have received a copy of the GNU General Public License
00034 along with this program. If not, see <http://www.gnu.org/licenses/>.
00035 */
00036
00037 #include <stdio.h>
00038 #include "hangul.h"
00039
00040
00041 /**
00042 @brief Read hangul-base.hex file into a unsigned char array.
00043
00044 Read a Hangul base .hex file with separate choseong, jungseong,
00045 and jongseong glyphs for syllable formation. The order is:
00046
00047 - Empty glyph in 0x0000 position.
00048 - Initial consonants (choseong).
00049 - Medial vowels and diphthongs (jungseong).
00050 - Final consonants (jongseong).
00051 - Individual letter forms in isolation, not for syllable formation.
00052
00053 The letters are arranged with all variations for one letter
00054 before continuing to the next letter. In the current
00055 encoding, there are 6 variations of choseong, 3 of jungseong,
00056 and 1 of jongseong per letter.
00057
00058 @param[in] Input file pointer; can be stdin.
00059 @param[out] Array of bit patterns, with 32 8-bit values per letter.
00060 @return The maximum code point value read in the file.
00061 */
00062 unsigned
00063 hangul_read_base8 (FILE *infp, unsigned char base[[32]]) {
00064     unsigned codept;
00065     unsigned max_codept;
00066     int i, j;
00067     char instring[MAXLINE];
00068
00069     max_codept = 0;
00070
00071     while (fgets (instring, MAXLINE, infp) != NULL) {
00072         sscanf (instring, "%X", &codept);
00073         codept -= PUA_START;
00074         /* If code point is within range, add it */
00075         if (codept < MAX_GLYPHS) {
00076             /* Find the start of the glyph bitmap. */

```



```

00078     for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00079     if (instring[i] == ':') {
00080         i++; /* Skip over ':' to get to start of bitmap. */
00081         for (j = 0; j < 32; j++) {
00082             sscanf (&instring[i], "%2hhX", &base[codept][j]);
00083             i += 2;
00084         }
00085         if (codept > max_codept) max_codept = codept;
00086     }
00087 }
00088 }
00089
00090 return max_codept;
00091 }
00092
00093
00094 /**
00095 @brief Read hangul-base.hex file into a unsigned array.
00096
00097 Read a Hangul base .hex file with separate choseong, jungseong,
00098 and jongseong glyphs for syllable formation. The order is:
00099
00100 - Empty glyph in 0x0000 position.
00101 - Initial consonants (choseong).
00102 - Medial vowels and diphthongs (jungseong).
00103 - Final consonants (jongseong).
00104 - Individual letter forms in isolation, not for syllable formation.
00105
00106 The letters are arranged with all variations for one letter
00107 before continuing to the next letter. In the current
00108 encoding, there are 6 variations of choseong, 3 of jungseong,
00109 and 1 of jongseong per letter.
00110
00111 @param[in] Input file pointer; can be stdin.
00112 @param[out] Array of bit patterns, with 16 16-bit values per letter.
00113 @return The maximum code point value read in the file.
00114 */
00115 unsigned
00116 hangul_read_base16 (FILE *infp, unsigned base[][16]) {
00117     unsigned codept;
00118     unsigned max_codept;
00119     int i, j;
00120     char instring[MAXLINE];
00121
00122
00123     max_codept = 0;
00124
00125     while (fgets (instring, MAXLINE, infp) != NULL) {
00126         sscanf (instring, "%X", &codept);
00127         codept -= PUA_START;
00128         /* If code point is within range, add it */
00129         if (codept < MAX_GLYPHS) {
00130             /* Find the start of the glyph bitmap. */
00131             for (i = 1; instring[i] != '\0' && instring[i] != ':'; i++);
00132             if (instring[i] == ':') {
00133                 i++; /* Skip over ':' to get to start of bitmap. */
00134                 for (j = 0; j < 16; j++) {
00135                     sscanf (&instring[i], "%4X", &base[codept][j]);
00136                     i += 4;
00137                 }
00138                 if (codept > max_codept) max_codept = codept;
00139             }
00140         }
00141     }
00142
00143     return max_codept;
00144 }
00145
00146
00147 /**
00148 @brief Decompose a Hangul Syllables code point into three letters.
00149
00150 Decompose a Hangul Syllables code point (U+AC00..U+D7A3) into:
00151
00152 - Choseong 0-19
00153 - Jungseong 0-20
00154 - Jongseong 0-27 or -1 if no jongseong
00155
00156 All letter values are set to -1 if the letters do not
00157 form a syllable in the Hangul Syllables range. This function
00158 only handles modern Hangul, because that is all that is in

```

```

00159 the Hangul Syllables range.
00160
00161 @param[in] codept The Unicode code point to decode, from 0xAC00 to 0xD7A3.
00162 @param[out] initial The 1st letter (choseong) in the syllable.
00163 @param[out] medial The 2nd letter (jungseong) in the syllable.
00164 @param[out] final The 3rd letter (jongseong) in the syllable.
00165 */
00166 void
00167 hangul_decompose (unsigned codept, int *initial, int *medial, int *final) {
00168
00169     if (codept < 0xAC00 || codept > 0xD7A3) {
00170         *initial = *medial = *final = -1;
00171     }
00172     else {
00173         codept -= 0xAC00;
00174         *initial = codept / (28 * 21);
00175         *medial = (codept / 28) % 21;
00176         *final = codept % 28 - 1;
00177     }
00178
00179     return;
00180 }
00181
00182
00183 /**
00184 @brief Compose a Hangul syllable into a code point, or 0 if none exists.
00185
00186 This function takes three letters that can form a modern Hangul
00187 syllable and returns the corresponding Unicode Hangul Syllables
00188 code point in the range 0xAC00 to 0xD7A3.
00189
00190 If a three-letter combination includes one or more archaic letters,
00191 it will not map into the Hangul Syllables range. In that case,
00192 the returned code point will be 0 to indicate that no valid
00193 Hangul Syllables code point exists.
00194
00195 @param[in] initial The first letter (choseong), 0 to 18.
00196 @param[in] medial The second letter (jungseong), 0 to 20.
00197 @param[in] final The third letter (jongseong), 0 to 26 or -1 if none.
00198 @return The Unicode Hangul Syllables code point, 0xAC00 to 0xD7A3.
00199 */
00200 unsigned
00201 hangul_compose (int initial, int medial, int final) {
00202     unsigned codept;
00203
00204
00205     if (initial >= 0 && initial <= 18 &&
00206         medial >= 0 && medial <= 20 &&
00207         final >= 0 && final <= 26) {
00208
00209         codept = 0xAC00;
00210         codept += initial * 21 * 28;
00211         codept += medial * 28;
00212         codept += final + 1;
00213     }
00214     else {
00215         codept = 0;
00216     }
00217
00218     return codept;
00219 }
00220
00221
00222 /**
00223 @brief Determine index values to the bitmaps for a syllable's components.
00224
00225 This function reads these input values for modern and ancient Hangul letters:
00226
00227 - Choseong number (0 to the number of modern and archaic choseong - 1.
00228 - Jungseong number (0 to the number of modern and archaic jungseong - 1.
00229 - Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.
00230
00231 It then determines the variation of each letter given the combination with
00232 the other two letters (or just choseong and jungseong if the jongseong value
00233 is -1).
00234
00235 These variations are then converted into index locations within the
00236 glyph array that was read in from the hangul-base.hex file. Those
00237 index locations can then be used to form a composite syllable.
00238
00239 There is no restriction to only use the modern Hangul letters.

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```

00240
00241 @param[in] choseong The 1st letter in the syllable.
00242 @param[in] jungseong The 2nd letter in the syllable.
00243 @param[in] jongseong The 3rd letter in the syllable, or -1 if none.
00244 @param[out] cho_index Index location to the 1st letter variation from the hangul-base.hex file.
00245 @param[out] jung_index Index location to the 2nd letter variation from the hangul-base.hex file.
00246 @param[out] jong_index Index location to the 3rd letter variation from the hangul-base.hex file.
00247 */
00248 void
00249 hangul_hex_indices (int choseong, int jungseong, int jongseong,
00250                    int *cho_index, int *jung_index, int *jong_index) {
00251
00252     int cho_variation, jung_variation, jong_variation; /* Letter variations */
00253
00254     void hangul_variations (int choseong, int jungseong, int jongseong,
00255                            int *cho_variation, int *jung_variation, int *jong_variation);
00256
00257
00258     hangul_variations (choseong, jungseong, jongseong,
00259                      &cho_variation, &jung_variation, &jong_variation);
00260
00261     *cho_index = CHO_HEX + choseong * CHO_VARIATIONS + cho_variation;
00262     *jung_index = JUNG_HEX + jungseong * JUNG_VARIATIONS + jung_variation;;
00263     *jong_index = jongseong < 0 ? 0x0000 :
00264                 JONG_HEX + jongseong * JONG_VARIATIONS + jong_variation;
00265
00266     return;
00267 }
00268
00269
00270 /**
00271 @brief Determine the variations of each letter in a Hangul syllable.
00272
00273 Given the three letters that will form a syllable, return the variation
00274 of each letter used to form the composite glyph.
00275
00276 This function can determine variations for both modern and archaic
00277 Hangul letters; it is not limited to only the letters combinations
00278 that comprise the Unicode Hangul Syllables range.
00279
00280 This function reads these input values for modern and ancient Hangul letters:
00281
00282 - Choseong number (0 to the number of modern and archaic choseong - 1.
00283 - Jungseong number (0 to the number of modern and archaic jungseong - 1.
00284 - Jongseong number (0 to the number of modern and archaic jongseong - 1, or -1 if none.
00285
00286 It then determines the variation of each letter given the combination with
00287 the other two letters (or just choseong and jungseong if the jongseong value
00288 is -1).
00289
00290 @param[in] choseong The 1st letter in the syllable.
00291 @param[in] jungseong The 2nd letter in the syllable.
00292 @param[in] jongseong The 3rd letter in the syllable, or -1 if none.
00293 @param[out] cho_var Variation of the 1st letter from the hangul-base.hex file.
00294 @param[out] jung_var Variation of the 2nd letter from the hangul-base.hex file.
00295 @param[out] jong_var Variation of the 3rd letter from the hangul-base.hex file.
00296 */
00297 void
00298 hangul_variations (int choseong, int jungseong, int jongseong,
00299                  int *cho_var, int *jung_var, int *jong_var) {
00300
00301     int cho_variation (int choseong, int jungseong, int jongseong);
00302     int jung_variation (int choseong, int jungseong, int jongseong);
00303     int jong_variation (int choseong, int jungseong, int jongseong);
00304
00305     /*
00306 Find the variation for each letter component.
00307 */
00308     *cho_var = cho_variation (choseong, jungseong, jongseong);
00309     *jung_var = jung_variation (choseong, jungseong, jongseong);
00310     *jong_var = jong_variation (choseong, jungseong, jongseong);
00311
00312
00313     return;
00314 }
00315
00316
00317 /**
00318 @brief Return the Johab 6/3/1 choseong variation for a syllable.
00319
00320 This function takes the two or three (if jongseong is included)

```

```

00321 letters that comprise a syllable and determine the variation
00322 of the initial consonant (choseong).
00323
00324 Each choseong has 6 variations:
00325
00326 Variation Occurrence
00327 -----
00328 0 Choseong with a vertical vowel such as "A".
00329 1 Choseong with a horizontal vowel such as "O".
00330 2 Choseong with a vertical and horizontal vowel such as "WA".
00331 3 Same as variation 0, but with jongseong (final consonant).
00332 4 Same as variation 1, but with jongseong (final consonant).
00333 Also a horizontal vowel pointing down, such as U and YU.
00334 5 Same as variation 2, but with jongseong (final consonant).
00335 Also a horizontal vowel pointing down with vertical element,
00336 such as WEO, WE, and WI.
00337
00338 In addition, if the vowel is horizontal and a downward-pointing stroke
00339 as in the modern letters U, WEO, WE, WI, and YU, and in archaic
00340 letters YU-YEO, YU-YE, YU-I, araea, and araea-i, then 3 is added
00341 to the initial variation of 0 to 2, resulting in a choseong variation
00342 of 3 to 5, respectively.
00343
00344 @param[in] choseong The 1st letter in the syllable.
00345 @param[in] jungseong The 2nd letter in the syllable.
00346 @param[in] jongseong The 3rd letter in the syllable.
00347 @return The choseong variation, 0 to 5.
00348 */
00349 int
00350 cho_variation (int choseong, int jungseong, int jongseong) {
00351     int cho_variation; /* Return value */
00352
00353     /*
00354     The Choseong cho_var is determined by the
00355     21 modern + 50 ancient Jungseong, and whether
00356     or not the syllable contains a final consonant
00357     (Jongseong).
00358     */
00359     static int choseong_var [TOTAL_JUNG + 1] = {
00360         /*
00361         Modern Jungseong in positions 0..20.
00362         */
00363         /* Location Variations Unicode Range Vowel # Vowel Names */
00364         /* ----- */
00365         /* 0x2FB */ 0, 0, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00366         /* 0x304 */ 0, 0, 0, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00367         /* 0x30D */ 0, 0, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00368         /* 0x313 */ 1, // U+1169 -->[ 8] O
00369         /* 0x316 */ 2, 2, 2, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00370         /* 0x31F */ 1, 4, // U+116D..U+116E-->[12..13] YO, U
00371         /* 0x325 */ 5, 5, 5, // U+116F..U+1171-->[14..16] WEO, WE, WI
00372         /* 0x32E */ 4, 1, // U+1172..U+1173-->[17..18] YU, EU
00373         /* 0x334 */ 2, // U+1174 -->[19] YI
00374         /* 0x337 */ 0, // U+1175 -->[20] I
00375         /*
00376         Ancient Jungseong in positions 21..70.
00377         */
00378         /* Location Variations Unicode Range Vowel # Vowel Names */
00379         /* ----- */
00380         /* 0x33A: */ 2, 5, 2, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00381         /* 0x343: */ 2, 2, 5, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00382         /* 0x34C: */ 2, 2, 5, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00383         /* 0x355: */ 2, 5, 5, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00384         /* 0x35E: */ 4, 4, 2, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00385         /* 0x367: */ 2, 2, 5, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00386         /* 0x370: */ 2, 5, 5, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00387         /* 0x379: */ 5, 5, 5, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00388         /* 0x382: */ 5, 5, 5, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00389         /* 0x38B: */ 5, 5, 2, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00390         /* 0x394: */ 5, 2, 2, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00391         /* 0x39D: */ 2, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00392         /* 0x3A6: */ 2, 5, 2, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00393         /* 0x3AF: */ 0, 1, 2, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00394         /* 0x3B8: */ 1, 2, 1, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00395         /* 0x3C1: */ 2, 5, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00396         /* 0x3CA: */ 2, 2, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE,
00397         #ifndef EXTENDED_HANGUL
00398         /* 0x3D0: */ 2, 4, 5, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00399         /* 0x3D9: */ 5, 2, 5, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00400         /* 0x3E2: */ 5, 5, 4, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00401         /* 0x3EB: */ 5, 2, 5, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,

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00402 /* 0x3F4: */ 4, 2, 3, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00403 /* 0x3FD: */ 3, 3, 2, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00404 /* 0x406: */ 2, 2, 0, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,
00405 /* 0x40F: */ 2, 2, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00406 /* 0x415: */ -1 // Mark end of list of vowels.
00407 #else
00408 /* 0x310: */ -1 // Mark end of list of vowels.
00409 #endif
00410 };
00411
00412
00413 if (jungseong < 0 || jungseong >= TOTAL_JUNG) {
00414     cho_variation = -1;
00415 }
00416 else {
00417     cho_variation = choseong_var [jungseong];
00418     if (choseong >= 0 && jongseong >= 0 && cho_variation < 3)
00419         cho_variation += 3;
00420 }
00421
00422
00423 return cho_variation;
00424 }
00425
00426
00427 /**
00428 @brief Whether vowel has rightmost vertical stroke to the right.
00429
00430 @param[in] vowel vowel number, from 0 to TOTAL_JUNG - 1.
00431 @return 1 if this vowel's vertical stroke is wide on the right side; else 0.
00432 */
00433 int
00434 is_wide_vowel (int vowel) {
00435     int retval; /* Return value. */
00436
00437     static int wide_vowel [TOTAL_JUNG + 1] = {
00438         /*
00439 Modern Jungseong in positions 0..20.
00440 */
00441 /* Location Variations Unicode Range Vowel # Vowel Names */
00442 /* ----- */
00443 /* 0x2FB */ 0, 1, 0, // U+1161..U+1163-->[ 0.. 2] A, AE, YA
00444 /* 0x304 */ 1, 0, 1, // U+1164..U+1166-->[ 3.. 5] YAE, EO, E
00445 /* 0x30D */ 0, 1, // U+1167..U+1168-->[ 6.. 7] YEO, YE
00446 /* 0x313 */ 0, // U+1169 -->[ 8] O
00447 /* 0x316 */ 0, 1, 0, // U+116A..U+116C-->[ 9..11] WA, WAE, WE
00448 /* 0x31F */ 0, 0, // U+116D..U+116E-->[12..13] YO, U
00449 /* 0x325 */ 0, 1, 0, // U+116F..U+1171-->[14..16] WEO, WE, WI
00450 /* 0x32E */ 0, 0, // U+1172..U+1173-->[17..18] YU, EU
00451 /* 0x334 */ 0, // U+1174 -->[19] YI
00452 /* 0x337 */ 0, // U+1175 -->[20] I
00453 /*
00454 Ancient Jungseong in positions 21..70.
00455 */
00456 /* Location Variations Unicode Range Vowel # Vowel Names */
00457 /* ----- */
00458 /* 0x33A: */ 0, 0, 0, // U+1176..U+1178-->[21..23] A-O, A-U, YA-O
00459 /* 0x343: */ 0, 0, 0, // U+1179..U+117B-->[24..26] YA-YO, EO-O, EU-U
00460 /* 0x34C: */ 0, 0, 0, // U+117C..U+117E-->[27..29] EO-EU, YEO-O, YEO-U
00461 /* 0x355: */ 0, 1, 1, // U+117F..U+1181-->[30..32] O-EO, O-E, O-YE,
00462 /* 0x35E: */ 0, 0, 0, // U+1182..U+1184-->[33..35] O-O, O-U, YO-YA,
00463 /* 0x367: */ 1, 0, 0, // U+1185..U+1187-->[36..38] YO-YAE, YO-YEO, YO-O,
00464 /* 0x370: */ 0, 0, 1, // U+1188..U+118A-->[39..41] YO-I, U-A, U-AE,
00465 /* 0x379: */ 0, 1, 0, // U+118B..U+118D-->[42..44] U-EO-EU, U-YE, U-U,
00466 /* 0x382: */ 0, 0, 1, // U+118E..U+1190-->[45..47] YU-A, YU-EO, YU-E,
00467 /* 0x38B: */ 0, 1, 0, // U+1191..U+1193-->[48..50] YU-YEO, YU-YE, YU-U,
00468 /* 0x394: */ 0, 0, 0, // U+1194..U+1196-->[51..53] YU-I, EU-U, EU-EU,
00469 /* 0x39D: */ 0, 0, 0, // U+1197..U+1199-->[54..56] YI-U, I-A, I-YA,
00470 /* 0x3A6: */ 0, 0, 0, // U+119A..U+119C-->[57..59] I-O, I-U, I-EU,
00471 /* 0x3AF: */ 0, 0, 0, // U+119D..U+119F-->[60..62] I-ARAEA, ARAEA, ARAEA-EO,
00472 /* 0x3B8: */ 0, 0, 0, // U+11A0..U+11A2-->[63..65] ARAEA-U, ARAEA-I,SSANGARAEA,
00473 /* 0x3C1: */ 0, 0, 0, // U+11A3..U+11A5-->[66..68] A-EU, YA-U, YEO-YA,
00474 /* 0x3CA: */ 0, 1, // U+11A6..U+11A7-->[69..70] O-YA, O-YAE
00475 #ifndef EXTENDED_HANGUL
00476 /* 0x3D0: */ 0, 0, 0, // U+D7B0..U+D7B2-->[71..73] O-YEO, O-O-I, YO-A,
00477 /* 0x3D9: */ 1, 0, 0, // U+D7B3..U+D7B5-->[74..76] YO-AE, YO-EO, U-YEO,
00478 /* 0x3E2: */ 1, 1, 0, // U+D7B6..U+D7B8-->[77..79] U-I-I, YU-AE, YU-O,
00479 /* 0x3EB: */ 0, 0, 1, // U+D7B9..U+D7BB-->[80..82] EU-A, EU-EO, EU-E,
00480 /* 0x3F4: */ 0, 0, 1, // U+D7BC..U+D7BE-->[83..85] EU-O, I-YA-O, I-YAE,
00481 /* 0x3FD: */ 0, 1, 0, // U+D7BF..U+D7C1-->[86..88] I-YEO, I-YE, I-O-I,
00482 /* 0x406: */ 0, 0, 1, // U+D7C2..U+D7C4-->[89..91] I-YO, I-YU, I-I,

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00483 /* 0x40F: */ 0, 1, // U+D7C5..U+D7C6-->[92..93] ARAEA-A, ARAEA-E,
00484 /* 0x415: */ -1 // Mark end of list of vowels.
00485 #else
00486 /* 0x310: */ -1 // Mark end of list of vowels.
00487 #endif
00488 };
00489
00490
00491 if (vowel >= 0 && vowel < TOTAL_JUNG) {
00492     retval = wide_vowel [vowel];
00493 }
00494 else {
00495     retval = 0;
00496 }
00497
00498
00499 return retval;
00500 }
00501
00502
00503 /**
00504 @brief Return the Johab 6/3/1 jungseong variation.
00505
00506 This function takes the two or three (if jongseong is included)
00507 letters that comprise a syllable and determine the variation
00508 of the vowel (jungseong).
00509
00510 Each jungseong has 3 variations:
00511
00512 Variation Occurrence
00513 -----
00514 0 Jungseong with only chungseong (no jungseong).
00515 1 Jungseong with chungseong and jungseong (except nieun).
00516 2 Jungseong with chungseong and jungseong nieun.
00517
00518 @param[in] choseong The 1st letter in the syllable.
00519 @param[in] jungseong The 2nd letter in the syllable.
00520 @param[in] jongseong The 3rd letter in the syllable.
00521 @return The jungseong variation, 0 to 2.
00522 */
00523 inline int
00524 jung_variation (int choseong, int jungseong, int jongseong) {
00525     int jung_variation; /* Return value */
00526
00527     if (jungseong < 0) {
00528         jung_variation = -1;
00529     }
00530     else {
00531         jung_variation = 0;
00532         if (jongseong >= 0) {
00533             if (jongseong == 3)
00534                 jung_variation = 2; /* Vowel for final Nieun. */
00535             else
00536                 jung_variation = 1;
00537         }
00538     }
00539
00540
00541     return jung_variation;
00542 }
00543
00544
00545 /**
00546 @brief Return the Johab 6/3/1 jongseong variation.
00547
00548 There is only one jongseong variation, so this function
00549 always returns 0. It is a placeholder function for
00550 possible future adaptation to other johab encodings.
00551
00552 @param[in] choseong The 1st letter in the syllable.
00553 @param[in] jungseong The 2nd letter in the syllable.
00554 @param[in] jongseong The 3rd letter in the syllable.
00555 @return The jongseong variation, always 0.
00556 */
00557 inline int
00558 jong_variation (int choseong, int jungseong, int jongseong) {
00559     return 0; /* There is only one Jongseong variation. */
00560 }
00561
00562
00563

```

```

00564 /**
00565 @brief Given letters in a Hangul syllable, return a glyph.
00566
00567 This function returns a glyph bitmap comprising up to three
00568 Hangul letters that form a syllable. It reads the three
00569 component letters (choseong, jungseong, and jongseong),
00570 then calls a function that determines the appropriate
00571 variation of each letter, returning the letter bitmap locations
00572 in the glyph array. Then these letter bitmaps are combined
00573 with a logical OR operation to produce a final bitmap,
00574 which forms a 16 row by 16 column bitmap glyph.
00575
00576 @param[in] choseong The 1st letter in the composite glyph.
00577 @param[in] jungseong The 2nd letter in the composite glyph.
00578 @param[in] jongseong The 3rd letter in the composite glyph.
00579 @param[in] hangul_base The glyphs read from the "hangul_base.hex" file.
00580 @return syllable The composite syllable, as a 16 by 16 pixel bitmap.
00581 */
00582 void
00583 hangul_syllable (int choseong, int jungseong, int jongseong,
00584                unsigned char hangul_base[][32], unsigned char *syllable) {
00585
00586     int i; /* loop variable */
00587     int cho_hex, jung_hex, jong_hex;
00588     unsigned char glyph_byte;
00589
00590
00591     hangul_hex_indices (choseong, jungseong, jongseong,
00592                        &cho_hex, &jung_hex, &jong_hex);
00593
00594     for (i = 0; i < 32; i++) {
00595         glyph_byte = hangul_base [cho_hex][i];
00596         glyph_byte |= hangul_base [jung_hex][i];
00597         if (jong_hex >= 0) glyph_byte |= hangul_base [jong_hex][i];
00598         syllable[i] = glyph_byte;
00599     }
00600
00601     return;
00602 }
00603
00604
00605 /**
00606 @brief See if two glyphs overlap.
00607
00608 @param[in] glyph1 The first glyph, as a 16-row bitmap.
00609 @param[in] glyph2 The second glyph, as a 16-row bitmap.
00610 @return 0 if no overlaps between glyphs, 1 otherwise.
00611 */
00612 int
00613 glyph_overlap (unsigned *glyph1, unsigned *glyph2) {
00614     int overlaps; /* Return value; 0 if no overlaps, -1 if overlaps. */
00615     int i;
00616
00617     /* Check for overlaps between the two glyphs. */
00618
00619     i = 0;
00620     do {
00621         overlaps = (glyph1[i] & glyph2[i]) != 0;
00622         i++;
00623     } while (i < 16 && overlaps == 0);
00624
00625     return overlaps;
00626 }
00627
00628
00629 /**
00630 @brief Combine two glyphs into one glyph.
00631
00632 @param[in] glyph1 The first glyph to overlap.
00633 @param[in] glyph2 The second glyph to overlap.
00634 @param[out] combined_glyph The returned combination glyph.
00635 */
00636 void
00637 combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00638               unsigned *combined_glyph) {
00639     int i;
00640
00641     for (i = 0; i < 16; i++)
00642         combined_glyph [i] = glyph1 [i] | glyph2 [i];
00643
00644     return;

```

```

00645 }
00646
00647
00648 /**
00649 @brief Print one glyph in Unifont hexdraw plain text style.
00650
00651 @param[in] fp      The file pointer for output.
00652 @param[in] codept  The Unicode code point to print with the glyph.
00653 @param[in] this_glyph The 16-row by 16-column glyph to print.
00654 */
00655 void
00656 print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph) {
00657     int i;
00658     unsigned mask;
00659
00660
00661     fprintf (fp, "%04X:", codept);
00662
00663     /* for each this_glyph row */
00664     for (i = 0; i < 16; i++) {
00665         mask = 0x8000;
00666         fputc ('\t', fp);
00667         while (mask != 0x0000) {
00668             if (mask & this_glyph [i]) {
00669                 fputc ('#', fp);
00670             }
00671             else {
00672                 fputc ('-', fp);
00673             }
00674             mask »= 1; /* shift to next bit in this_glyph row */
00675         }
00676         fputc ('\n', fp);
00677     }
00678     fputc ('\n', fp);
00679
00680     return;
00681 }
00682
00683
00684 /**
00685 @brief Print one glyph in Unifont hexdraw hexadecimal string style.
00686
00687 @param[in] fp      The file pointer for output.
00688 @param[in] codept  The Unicode code point to print with the glyph.
00689 @param[in] this_glyph The 16-row by 16-column glyph to print.
00690 */
00691 void
00692 print_glyph_hex (FILE *fp, unsigned codept, unsigned *this_glyph) {
00693
00694     int i;
00695
00696
00697     fprintf (fp, "%04X:", codept);
00698
00699     /* for each this_glyph row */
00700     for (i = 0; i < 16; i++) {
00701         fprintf (fp, "%04X", this_glyph[i]);
00702     }
00703     fputc ('\n', fp);
00704
00705     return;
00706 }
00707
00708
00709 /**
00710 @brief Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
00711
00712 @param[in] glyph_table The collection of all jamo glyphs.
00713 @param[in] jamo         The Unicode code point, 0 or 0x1100..0x115F.
00714 @param[out] jamo_glyph The output glyph, 16 columns in each of 16 rows.
00715 */
00716 void
00717 one_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00718          unsigned jamo, unsigned *jamo_glyph) {
00719
00720     int i; /* Loop variable */
00721     int glyph_index; /* Location of glyph in "hangul-base.hex" array */
00722
00723
00724     /* If jamo is invalid range, use blank glyph, */
00725     if (jamo >= 0x1100 && jamo <= 0x11FF) {

```



```

00726     glyph_index = jamo - 0x1100 + JAMO_HEX;
00727 }
00728 else if (jamo >= 0xA960 && jamo <= 0xA97F) {
00729     glyph_index = jamo - 0xA960 + JAMO_EXT_A_HEX;
00730 }
00731 else if (jamo >= 0xD7B0 && jamo <= 0xD7FF) {
00732     glyph_index = jamo - 0x1100 + JAMO_EXT_B_HEX;
00733 }
00734 else {
00735     glyph_index = 0;
00736 }
00737
00738 for (i = 0; i < 16; i++) {
00739     jamo_glyph[i] = glyph_table[glyph_index][i];
00740 }
00741
00742 return;
00743 }
00744
00745
00746 /**
00747 @brief Convert Hangul Jamo choseong, jungseong, and jongseong into a glyph.
00748
00749 This function converts input Hangul choseong, jungseong, and jongseong
00750 Unicode code triplets into a Hangul syllable. Any of those with an
00751 out of range code point are assigned a blank glyph for combining.
00752
00753 This function performs the following steps:
00754
00755 1) Determine the sequence number of choseong, jungseong,
00756 and jongseong, from 0 to the total number of choseong,
00757 jungseong, or jongseong, respectively, minus one. The
00758 sequence for each is as follows:
00759
00760 a) Choseong: Unicode code points of U+1100..U+115E
00761 and then U+A960..U+A97C.
00762
00763 b) Jungseong: Unicode code points of U+1161..U+11A7
00764 and then U+D7B0..U+D7C6.
00765
00766 c) Jongseong: Unicode code points of U+11A8..U+11FF
00767 and then U+D7CB..U+D7FB.
00768
00769 2) From the choseong, jungseong, and jongseong sequence number,
00770 determine the variation of choseong and jungseong (there is
00771 only one jongseong variation, although it is shifted right
00772 by one column for some vowels with a pair of long vertical
00773 strokes on the right side).
00774
00775 3) Convert the variation numbers for the three syllable
00776 components to index locations in the glyph array.
00777
00778 4) Combine the glyph array glyphs into a syllable.
00779
00780 @param[in] glyph_table The collection of all jamo glyphs.
00781 @param[in] cho The choseong Unicode code point, 0 or 0x1100..0x115F.
00782 @param[in] jung The jungseong Unicode code point, 0 or 0x1160..0x11A7.
00783 @param[in] jong The jongseong Unicode code point, 0 or 0x11A8..0x11FF.
00784 @param[out] combined_glyph The output glyph, 16 columns in each of 16 rows.
00785 */
00786 void
00787 combine_jamo (unsigned glyph_table [MAX_GLYPHS][16],
00788             unsigned cho, unsigned jung, unsigned jong,
00789             unsigned *combined_glyph) {
00790     int i; /* Loop variable. */
00791     int cho_num, jung_num, jong_num;
00792     int cho_group, jung_group, jong_group;
00793     int cho_index, jung_index, jong_index;
00794
00795     unsigned tmp_glyph[16]; /* Hold shifted jongsung for wide vertical vowel. */
00796
00797     int cho_variation (int choseong, int jungseong, int jongseong);
00798
00799     void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00800                       unsigned *combined_glyph);
00801
00802     /* Choose a blank glyph for each syllable by default. */
00803     cho_index = jung_index = jong_index = 0x000;
00804
00805
00806

```

```

00807  /*
00808  Convert Unicode code points to jamo sequence number
00809  of each letter, or -1 if letter is not in valid range.
00810  */
00811  if (cho >= 0x1100 && cho <= 0x115E)
00812    cho_num = cho - CHO_UNICODE_START;
00813  else if (cho >= CHO_EXT_A_UNICODE_START &&
00814    cho < (CHO_EXT_A_UNICODE_START + NCHO_EXT_A))
00815    cho_num = cho - CHO_EXT_A_UNICODE_START + NCHO_MODERN + NJONG_ANCIENT;
00816  else
00817    cho_num = -1;
00818
00819  if (jung >= 0x1161 && jung <= 0x11A7)
00820    jung_num = jung - JUNG_UNICODE_START;
00821  else if (jung >= JUNG_EXT_B_UNICODE_START &&
00822    jung < (JUNG_EXT_B_UNICODE_START + NJUNG_EXT_B))
00823    jung_num = jung - JUNG_EXT_B_UNICODE_START + NJUNG_MODERN + NJUNG_ANCIENT;
00824  else
00825    jung_num = -1;
00826
00827  if (jong >= 0x11A8 && jong <= 0x11FF)
00828    jong_num = jong - JONG_UNICODE_START;
00829  else if (jong >= JONG_EXT_B_UNICODE_START &&
00830    jong < (JONG_EXT_B_UNICODE_START + NJONG_EXT_B))
00831    jong_num = jong - JONG_EXT_B_UNICODE_START + NJONG_MODERN + NJONG_ANCIENT;
00832  else
00833    jong_num = -1;
00834
00835  /*
00836  Choose initial consonant (choseong) variation based upon
00837  the vowel (jungseong) if both are specified.
00838  */
00839  if (cho_num < 0) {
00840    cho_index = cho_group = 0; /* Use blank glyph for choseong. */
00841  }
00842  else {
00843    if (jung_num < 0 && jong_num < 0) { /* Choseong is by itself. */
00844      cho_group = 0;
00845      if (cho_index < (NCHO_MODERN + NCHO_ANCIENT))
00846        cho_index = cho_num + JAMO_HEX;
00847      else /* Choseong is in Hangul Jamo Extended-A range. */
00848        cho_index = cho_num - (NCHO_MODERN + NCHO_ANCIENT)
00849          + JAMO_EXT_A_HEX;
00850    }
00851    else {
00852      if (jung_num >= 0) { /* Valid jungseong with choseong. */
00853        cho_group = cho_variation(cho_num, jung_num, jong_num);
00854      }
00855      else { /* Invalid vowel; see if final consonant is valid. */
00856        /*
00857         If initial consonant and final consonant are specified,
00858         set cho_group to 4, which is the group tha would apply
00859         to a horizontal-only vowel such as Hangul "O", so the
00860         consonant appears full-width.
00861         */
00862        cho_group = 0;
00863        if (jong_num >= 0) {
00864          cho_group = 4;
00865        }
00866      }
00867      cho_index = CHO_HEX + CHO_VARIATIONS * cho_num +
00868        cho_group;
00869    } /* Choseong combined with jungseong and/or jongseong. */
00870  } /* Valid choseong. */
00871
00872  /*
00873  Choose vowel (jungseong) variation based upon the choseong
00874  and jungseong.
00875  */
00876  jung_index = jung_group = 0; /* Use blank glyph for jungseong. */
00877
00878  if (jung_num >= 0) {
00879    if (cho_num < 0 && jong_num < 0) { /* Jungseong is by itself. */
00880      jung_group = 0;
00881      jung_index = jung_num + JUNG_UNICODE_START;
00882    }
00883    else {
00884      if (jong_num >= 0) { /* If there is a final consonant. */
00885        if (jong_num == 3) /* Nieun; choose variation 3. */
00886          jung_group = 2;
00887        else

```

```

00888     jung_group = 1;
00889 } /* Valid jongseong. */
00890 /* If valid choseong but no jongseong, choose jongseong variation 0. */
00891 else if (cho_num >= 0)
00892     jung_group = 0;
00893 }
00894 jung_index = JUNG_HEX + JUNG_VARIATIONS * jung_num + jung_group;
00895 }
00896
00897 /*
00898 Choose final consonant (jongseong) based upon whether choseong
00899 and/or jongseong are present.
00900 */
00901 if (jong_num < 0) {
00902     jung_index = jong_group = 0; /* Use blank glyph for jongseong. */
00903 }
00904 else { /* Valid jongseong. */
00905     if (cho_num < 0 && jung_num < 0) { /* Jongseong is by itself. */
00906         jung_group = 0;
00907         jung_index = jung_num + 0x4A8;
00908     }
00909     else { /* There is only one jongseong variation if combined. */
00910         jung_group = 0;
00911         jung_index = JONG_HEX + JONG_VARIATIONS * jung_num +
00912             jung_group;
00913     }
00914 }
00915
00916 /*
00917 Now that we know the index locations for choseong, jongseong, and
00918 jongseong glyphs, combine them into one glyph.
00919 */
00920 combine_glyphs (glyph_table [cho_index], glyph_table [jung_index],
00921     combined_glyph);
00922
00923 if (jong_index > 0) {
00924     /*
00925     If the vowel has a vertical stroke that is one column
00926     away from the right border, shift this jongseung right
00927     by one column to line up with the rightmost vertical
00928     stroke in the vowel.
00929     */
00930     if (is_wide_vowel (jung_num)) {
00931         for (i = 0; i < 16; i++) {
00932             tmp_glyph [i] = glyph_table [jong_index] [i] » 1;
00933         }
00934         combine_glyphs (combined_glyph, tmp_glyph,
00935             combined_glyph);
00936     }
00937     else {
00938         combine_glyphs (combined_glyph, glyph_table [jong_index],
00939             combined_glyph);
00940     }
00941 }
00942
00943 return;
00944 }
00945

```

## 5.35 src/unihex2bmp.c File Reference

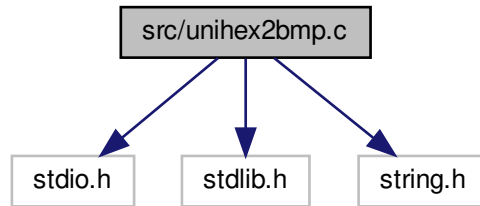
unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

```

Include dependency graph for unihex2bmp.c:



## Macros

- `#define` [MAXBUF](#) 256

## Functions

- `int` [main](#) (`int` argc, `char` \*argv[])  
The main function.
- `int` [hex2bit](#) (`char` \*instring, `unsigned char` character[32][4])  
Generate a bitmap for one glyph.
- `int` [init](#) (`unsigned char` bitmap[17 \*32][18 \*4])  
Initialize the bitmap grid.

## Variables

- `char` \* [hex](#) [18]  
GNU Unifont bitmaps for hexadecimal digits.
- `unsigned char` [hexbits](#) [18][32]  
The digits converted into bitmaps.
- `unsigned` [unipage](#) =0  
Unicode page number, 0x00..0xff.
- `int` [flip](#) =1  
Transpose entire matrix as in Unicode book.

### 5.35.1 Detailed Description

`unihex2bmp` - Turn a GNU Unifont hex glyph page of 256 code points into a bitmap for editing

#### Author

Paul Hardy, [unifoundry <at> unifoundry.com](mailto:unifoundry@unifoundry.com), December 2007

## Copyright

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This program reads in a GNU Unifont .hex file, extracts a range of 256 code points, and converts it a Microsoft Bitmap (.bmp) or Wireless Bitmap file.

Synopsis: unihex2bmp [-iin\_file.hex] [-oout\_file.bmp] [-f] [-phex\_page\_num] [-w]

Definition in file [unihex2bmp.c](#).

## 5.35.2 Macro Definition Documentation

## 5.35.2.1 MAXBUF

```
#define MAXBUF 256
```

Definition at line 47 of file [unihex2bmp.c](#).

## 5.35.3 Function Documentation

## 5.35.3.1 hex2bit()

```
int hex2bit (
    char * instring,
    unsigned char character[32][4] )
```

Generate a bitmap for one glyph.

Convert the portion of a hex string after the ':' into a character bitmap.

If string is  $\geq 128$  characters, it will fill all 4 bytes per row. If string is  $\geq 64$  characters and  $< 128$ , it will fill 2 bytes per row. Otherwise, it will fill 1 byte per row.

## Parameters

in	instring	The character array containing the glyph bitmap.
out	character	<a href="#">Glyph</a> bitmap, 8, 16, or 32 columns by 16 rows tall.

## Returns

Always returns 0.

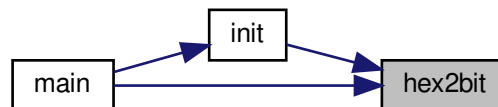
Definition at line 361 of file [unihex2bmp.c](#).

```

00362 {
00363
00364     int i; /* current row in bitmap character */
00365     int j; /* current character in input string */
00366     int k; /* current byte in bitmap character */
00367     int width; /* number of output bytes to fill - 1: 0, 1, 2, or 3 */
00368
00369     for (i=0; i<32; i++) /* erase previous character */
00370         character[i][0] = character[i][1] = character[i][2] = character[i][3] = 0;
00371     j=0; /* current location is at beginning of instring */
00372
00373     if (strlen (instring) <= 34) /* 32 + possible '\r', '\n' */
00374         width = 0;
00375     else if (strlen (instring) <= 66) /* 64 + possible '\r', '\n' */
00376         width = 1;
00377     else if (strlen (instring) <= 98) /* 96 + possible '\r', '\n' */
00378         width = 3;
00379     else /* the maximum allowed is quadruple-width */
00380         width = 4;
00381
00382     k = (width > 1) ? 0 : 1; /* if width > double, start at index 1 else at 0 */
00383
00384     for (i=8; i<24; i++) { /* 16 rows per input character, rows 8..23 */
00385         sscanf (&instring[j], "%2hhx", &character[i][k]);
00386         j += 2;
00387         if (width > 0) { /* add next pair of hex digits to this row */
00388             sscanf (&instring[j], "%2hhx", &character[i][k+1]);
00389             j += 2;
00390             if (width > 1) { /* add next pair of hex digits to this row */
00391                 sscanf (&instring[j], "%2hhx", &character[i][k+2]);
00392                 j += 2;
00393                 if (width > 2) { /* quadruple-width is maximum width */
00394                     sscanf (&instring[j], "%2hhx", &character[i][k+3]);
00395                     j += 2;
00396                 }
00397             }
00398         }
00399     }
00400
00401     return (0);
00402 }

```

Here is the caller graph for this function:



### 5.35.3.2 init()

```
int init (
    unsigned char bitmap[17 * 32][18 * 4] )
```

Initialize the bitmap grid.

## Parameters

out	bitmap	The bitmap to generate, with 32x32 pixel glyph areas.
-----	--------	---

## Returns

Always returns 0.

Definition at line 412 of file [unihex2bmp.c](#).

```

00413 {
00414     int i, j;
00415     unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00416     unsigned toppixelrow;
00417     unsigned thiscol;
00418     unsigned char pnybble0, pnybble1, pnybble2, pnybble3;
00419
00420     for (i=0; i<18; i++) { /* bitmaps for '0':9', 'A':F', 'u', '+' */
00421
00422         hex2bit (&hex[i][5], charbits); /* convert hex string to 32*4 bitmap */
00423
00424         for (j=0; j<32; j++) hexbits[i][j] = ~charbits[j][1];
00425     }
00426
00427     /*
00428     Initialize bitmap to all white.
00429     */
00430     for (toppixelrow=0; toppixelrow < 17*32; toppixelrow++) {
00431         for (thiscol=0; thiscol<18; thiscol++) {
00432             bitmap[toppixelrow][(thiscol « 2) ] = 0xff;
00433             bitmap[toppixelrow][(thiscol « 2) | 1] = 0xff;
00434             bitmap[toppixelrow][(thiscol « 2) | 2] = 0xff;
00435             bitmap[toppixelrow][(thiscol « 2) | 3] = 0xff;
00436         }
00437     }
00438     /*
00439     Write the "u+nnnn" table header in the upper left-hand corner,
00440     where nnnn is the upper 16 bits of a 32-bit Unicode assignment.
00441     */
00442     pnybble3 = (unipage » 20);
00443     pnybble2 = (unipage » 16) & 0xf;
00444     pnybble1 = (unipage » 12) & 0xf;
00445     pnybble0 = (unipage » 8) & 0xf;
00446     for (i=0; i<32; i++) {
00447         bitmap[i][1] = hexbits[16][i]; /* copy 'u' */
00448         bitmap[i][2] = hexbits[17][i]; /* copy '+' */
00449         bitmap[i][3] = hexbits[pnybble3][i];
00450         bitmap[i][4] = hexbits[pnybble2][i];
00451         bitmap[i][5] = hexbits[pnybble1][i];
00452         bitmap[i][6] = hexbits[pnybble0][i];
00453     }
00454     /*
00455     Write low-order 2 bytes of Unicode number assignments, as hex labels
00456     */
00457     pnybble3 = (unipage » 4) & 0xf; /* Highest-order hex digit */
00458     pnybble2 = (unipage » 0) & 0xf; /* Next highest-order hex digit */
00459     /*
00460     Write the column headers in bitmap[][] (row headers if flipped)
00461     */
00462     toppixelrow = 32 * 17 - 1; /* maximum pixel row number */
00463     /*
00464     Label the column headers. The hexbits[][] bytes are split across two
00465     bitmap[][] entries to center a the hex digits in a column of 4 bytes.
00466     OR highest byte with 0xf0 and lowest byte with 0x0f to make outer
00467     nybbles white (0=black, 1=white).

```

```

00468 */
00469 for (i=0; i<16; i++) {
00470     for (j=0; j<32; j++) {
00471         if (flip) { /* transpose matrix */
00472             bitmap[j][((i+2) << 2) | 0] = (hexbits[pybble3][j] >> 4) | 0xf0;
00473             bitmap[j][((i+2) << 2) | 1] = (hexbits[pybble3][j] << 4) |
00474                 (hexbits[pybble2][j] >> 4);
00475             bitmap[j][((i+2) << 2) | 2] = (hexbits[pybble2][j] << 4) |
00476                 (hexbits[i][j] >> 4);
00477             bitmap[j][((i+2) << 2) | 3] = (hexbits[i][j] << 4) | 0x0f;
00478         }
00479         else {
00480             bitmap[j][((i+2) << 2) | 1] = (hexbits[i][j] >> 4) | 0xf0;
00481             bitmap[j][((i+2) << 2) | 2] = (hexbits[i][j] << 4) | 0x0f;
00482         }
00483     }
00484 }
00485 /*
00486 Now use the single hex digit column graphics to label the row headers.
00487 */
00488 for (i=0; i<16; i++) {
00489     toppixelrow = 32 * (i + 1) - 1; /* from bottom to top */
00490
00491     for (j=0; j<32; j++) {
00492         if (!flip) { /* if not transposing matrix */
00493             bitmap[toppixelrow + j][4] = hexbits[pybble3][j];
00494             bitmap[toppixelrow + j][5] = hexbits[pybble2][j];
00495         }
00496         bitmap[toppixelrow + j][6] = hexbits[i][j];
00497     }
00498 }
00499 /*
00500 Now draw grid lines in bitmap, around characters we just copied.
00501 */
00502 /* draw vertical lines 2 pixels wide */
00503 for (i=1*32; i<17*32; i++) {
00504     if ((i & 0x1f) == 7)
00505         i++;
00506     else if ((i & 0x1f) == 14)
00507         i += 2;
00508     else if ((i & 0x1f) == 22)
00509         i++;
00510     for (j=1; j<18; j++) {
00511         bitmap[i][j << 2 | 3] &= 0xfe;
00512     }
00513 }
00514 /* draw horizontal lines 1 pixel tall */
00515 for (i=1*32-1; i<18*32-1; i+=32) {
00516     for (j=2; j<18; j++) {
00517         bitmap[i][j << 2] = 0x00;
00518         bitmap[i][j << 2 | 1] = 0x81;
00519         bitmap[i][j << 2 | 2] = 0x81;
00520         bitmap[i][j << 2 | 3] = 0x00;
00521     }
00522 }
00523 /* fill in top left corner pixel of grid */
00524 bitmap[31][7] = 0xfe;
00525
00526 return (0);
00527 }

```

Here is the call graph for this function:





Here is the caller graph for this function:



### 5.35.3.3 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line 96 of file [unihex2bmp.c](#).

```
00097 {
00098
00099 int i, j;          /* loop variables */
00100 unsigned k0;      /* temp Unicode char variable */
00101 unsigned swap;   /* temp variable for swapping values */
00102 char inbuf[256]; /* input buffer */
00103 unsigned filesize; /* size of file in bytes */
00104 unsigned bitmapsze; /* size of bitmap image in bytes */
00105 unsigned thischar; /* the current character */
00106 unsigned char thischarbyte; /* unsigned char lowest byte of Unicode char */
00107 int thischarrow; /* row 0..15 where this character belongs */
00108 int thiscol; /* column 0..15 where this character belongs */
00109 int toppixelrow; /* pixel row, 0..16*32-1 */
00110 unsigned lastpage=0; /* the last Unicode page read in font file */
```

```

00111 int wbmp=0;          /* set to 1 if writing .wbmp format file */
00112
00113 unsigned char bitmap[17*32][18*4]; /* final bitmap */
00114 unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00115
00116 char *infile="", *outfile=""; /* names of input and output files */
00117 FILE *infp, *outfp; /* file pointers of input and output files */
00118
00119 int init();          /* initializes bitmap row/col labeling, &c. */
00120 int hex2bit();      /* convert hex string --> bitmap */
00121
00122 bitmapsizesize = 17*32*18*4; /* 17 rows by 18 cols, each 4 bytes */
00123
00124 if (argc > 1) {
00125     for (i = 1; i < argc; i++) {
00126         if (argv[i][0] == '-') { /* this is an option argument */
00127             switch (argv[i][1]) {
00128                 case 'f': /* flip (transpose) glyphs in bitmap as in standard */
00129                     flip = !flip;
00130                     break;
00131                 case 'i': /* name of input file */
00132                     infile = &argv[i][2];
00133                     break;
00134                 case 'o': /* name of output file */
00135                     outfile = &argv[i][2];
00136                     break;
00137                 case 'p': /* specify a Unicode page other than default of 0 */
00138                     sscanf (&argv[i][2], "%x", &unipage); /* Get Unicode page */
00139                     break;
00140                 case 'w': /* write a .wbmp file instead of a .bmp file */
00141                     wbmp = 1;
00142                     break;
00143                 default: /* if unrecognized option, print list and exit */
00144                     fprintf (stderr, "\nSyntax:\n\n");
00145                     fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00146                     fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00147                     fprintf (stderr, " -w specifies .wbmp output instead of ");
00148                     fprintf (stderr, "default Windows .bmp output.\n\n");
00149                     fprintf (stderr, " -p is followed by 1 to 6 ");
00150                     fprintf (stderr, "Unicode page hex digits ");
00151                     fprintf (stderr, "(default is Page 0).\n\n");
00152                     fprintf (stderr, "\nExample:\n\n");
00153                     fprintf (stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n",
00154                             argv[0]);
00155                     exit (1);
00156             }
00157         }
00158     }
00159 }
00160 /*
00161 Make sure we can open any I/O files that were specified before
00162 doing anything else.
00163 */
00164 if (strlen (infile) > 0) {
00165     if ((infp = fopen (infile, "r")) == NULL) {
00166         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00167         exit (1);
00168     }
00169 }
00170 else {
00171     infp = stdin;
00172 }
00173 if (strlen (outfile) > 0) {
00174     if ((outfp = fopen (outfile, "w")) == NULL) {
00175         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00176         exit (1);
00177     }
00178 }
00179 else {
00180     outfp = stdout;
00181 }
00182
00183 (void)init(bitmap); /* initialize bitmap with row/column headers, etc. */
00184
00185 /*
00186 Read in the characters in the page
00187 */
00188 while (lastpage <= unipage && fgetc (inbuf, MAXBUF-1, infp) != NULL) {
00189     sscanf (inbuf, "%x", &thischar);
00190     lastpage = thischar » 8; /* keep Unicode page to see if we can stop */
00191     if (lastpage == unipage) {

```

```

00192     thischarbyte = (unsigned char)(thischar & 0xff);
00193     for (k0=0; inbuf[k0] != ':'; k0++);
00194     k0++;
00195     hex2bit (&inbuf[k0], charbits); /* convert hex string to 32*4 bitmap */
00196
00197     /*
00198 Now write character bitmap upside-down in page array, to match
00199 .bmp file order. In the .wbmp' and .bmp files, white is a '1'
00200 bit and black is a '0' bit, so complement charbits[].
00201 */
00202
00203     thiscol = (thischarbyte & 0xf) + 2; /* column number will be 1..16 */
00204     thischarrow = thischarbyte » 4; /* character row number, 0..15 */
00205     if (flip) { /* swap row and column placement */
00206         swap = thiscol;
00207         thiscol = thischarrow;
00208         thischarrow = swap;
00209         thiscol += 2; /* column index starts at 1 */
00210         thischarrow -= 2; /* row index starts at 0 */
00211     }
00212     toppixelrow = 32 * (thischarrow + 1) - 1; /* from bottom to top */
00213
00214     /*
00215 Copy the center of charbits[] because hex characters only
00216 occupy rows 8 to 23 and column byte 2 (and for 16 bit wide
00217 characters, byte 3). The charbits[] array was given 32 rows
00218 and 4 column bytes for completeness in the beginning.
00219 */
00220     for (i=8; i<24; i++) {
00221         bitmap[toppixelrow + i][(thiscol « 2) | 0] =
00222             ~charbits[i][0] & 0xff;
00223         bitmap[toppixelrow + i][(thiscol « 2) | 1] =
00224             ~charbits[i][1] & 0xff;
00225         bitmap[toppixelrow + i][(thiscol « 2) | 2] =
00226             ~charbits[i][2] & 0xff;
00227         /* Only use first 31 bits; leave vertical rule in 32nd column */
00228         bitmap[toppixelrow + i][(thiscol « 2) | 3] =
00229             ~charbits[i][3] & 0xfe;
00230     }
00231     /*
00232 Leave white space in 32nd column of rows 8, 14, 15, and 23
00233 to leave 16 pixel height upper, middle, and lower guides.
00234 */
00235     bitmap[toppixelrow + 8][(thiscol « 2) | 3] |= 1;
00236     bitmap[toppixelrow + 14][(thiscol « 2) | 3] |= 1;
00237     bitmap[toppixelrow + 15][(thiscol « 2) | 3] |= 1;
00238     bitmap[toppixelrow + 23][(thiscol « 2) | 3] |= 1;
00239 }
00240 }
00241 /*
00242 Now write the appropriate bitmap file format, either
00243 Wireless Bitmap or Microsoft Windows bitmap.
00244 */
00245 if (wbmp) { /* Write a Wireless Bitmap .wbmp format file */
00246     /*
00247 Write WBMP header
00248 */
00249     fprintf (outfp, "%c", 0x00); /* Type of image; always 0 (monochrome) */
00250     fprintf (outfp, "%c", 0x00); /* Reserved; always 0 */
00251     fprintf (outfp, "%c%c", 0x84, 0x40); /* Width = 576 pixels */
00252     fprintf (outfp, "%c%c", 0x84, 0x20); /* Height = 544 pixels */
00253     /*
00254 Write bitmap image
00255 */
00256     for (toppixelrow=0; toppixelrow <= 17*32-1; toppixelrow++) {
00257         for (j=0; j<18; j++) {
00258             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)  ]);
00259             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00260             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00261             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00262         }
00263     }
00264 }
00265 else { /* otherwise, write a Microsoft Windows .bmp format file */
00266     /*
00267 Write the .bmp file -- start with the header, then write the bitmap
00268 */
00269     /*
00270 'B', 'M' appears at start of every .bmp file */
00271     fprintf (outfp, "%c%c", 0x42, 0x4d);
00272

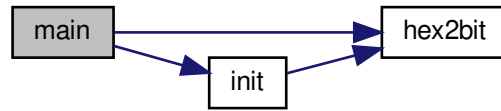
```

```

00273  /* Write file size in bytes */
00274  filesize = 0x3E + bitmapsizes;
00275  fprintf (outfp, "%c", (unsigned char)((filesize & 0xff));
00276  fprintf (outfp, "%c", (unsigned char)((filesize >> 0x08) & 0xff));
00277  fprintf (outfp, "%c", (unsigned char)((filesize >> 0x10) & 0xff));
00278  fprintf (outfp, "%c", (unsigned char)((filesize >> 0x18) & 0xff));
00279
00280  /* Reserved - 0's */
00281  fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00282
00283  /* Offset from start of file to bitmap data */
00284  fprintf (outfp, "%c%c%c%c", 0x3E, 0x00, 0x00, 0x00);
00285
00286  /* Length of bitmap info header */
00287  fprintf (outfp, "%c%c%c%c", 0x28, 0x00, 0x00, 0x00);
00288
00289  /* Width of bitmap in pixels */
00290  fprintf (outfp, "%c%c%c%c", 0x40, 0x02, 0x00, 0x00);
00291
00292  /* Height of bitmap in pixels */
00293  fprintf (outfp, "%c%c%c%c", 0x20, 0x02, 0x00, 0x00);
00294
00295  /* Planes in bitmap (fixed at 1) */
00296  fprintf (outfp, "%c%c", 0x01, 0x00);
00297
00298  /* bits per pixel (1 = monochrome) */
00299  fprintf (outfp, "%c%c", 0x01, 0x00);
00300
00301  /* Compression (0 = none) */
00302  fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00303
00304  /* Size of bitmap data in bytes */
00305  fprintf (outfp, "%c", (unsigned char)((bitmapsizes & 0xff));
00306  fprintf (outfp, "%c", (unsigned char)((bitmapsizes >> 0x08) & 0xff));
00307  fprintf (outfp, "%c", (unsigned char)((bitmapsizes >> 0x10) & 0xff));
00308  fprintf (outfp, "%c", (unsigned char)((bitmapsizes >> 0x18) & 0xff));
00309
00310  /* Horizontal resolution in pixels per meter */
00311  fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00312
00313  /* Vertical resolution in pixels per meter */
00314  fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00315
00316  /* Number of colors used */
00317  fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00318
00319  /* Number of important colors */
00320  fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00321
00322  /* The color black: B=0x00, G=0x00, R=0x00, Filler=0xFF */
00323  fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00324
00325  /* The color white: B=0xFF, G=0xFF, R=0xFF, Filler=0xFF */
00326  fprintf (outfp, "%c%c%c%c", 0xFF, 0xFF, 0xFF, 0x00);
00327
00328  /*
00329  Now write the raw data bits.  Data is written from the lower
00330  left-hand corner of the image to the upper right-hand corner
00331  of the image.
00332  */
00333  for (toppixelrow=17*32-1; toppixelrow >= 0; toppixelrow--) {
00334      for (j=0; j<18; j++) {
00335          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2)  ]);
00336          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2) | 1]);
00337          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2) | 2]);
00338
00339          fprintf (outfp, "%c", bitmap[toppixelrow][(j<<2) | 3]);
00340      }
00341  }
00342  }
00343  exit (0);
00344  }

```

Here is the call graph for this function:



## 5.35.4 Variable Documentation

### 5.35.4.1 flip

```
int flip =1
```

Transpose entire matrix as in Unicode book.

Definition at line 85 of file [unihex2bmp.c](#).

### 5.35.4.2 hex

```
char* hex[18]
```

Initial value:

```
= {
    "0030:0000000018244242424242424180000",
    "0031:000000000818280808080808083E0000",
    "0032:000000003C4242020C102040407E0000",
    "0033:000000003C4242021C020242423C0000",
    "0034:0000000040C142444447E0404040000",
    "0035:000000007E4040407C020202423C0000",
    "0036:000000001C2040407C424242423C0000",
    "0037:000000007E02020404040808080000",
    "0038:000000003C4242423C424242423C0000",
    "0039:000000003C4242423E02020204380000",
    "0041:0000000018242442427E424242420000",
    "0042:000000007C4242427C424242427C0000",
    "0043:000000003C42424040404042423C0000",
    "0044:00000000784442424242424244780000",
    "0045:000000007E4040407C404040407E0000",
    "0046:000000007E4040407C4040404040000",
    "0055:000000004242424242424242423C0000",
    "002B:0000000000080808087F08080800000"
}
```

GNU Unifont bitmaps for hexadecimal digits.

These are the GNU Unifont hex strings for '0'-'9' and 'A'-'F', for encoding as bit strings in row and column headers.

Looking at the final bitmap as a grid of 32\*32 bit tiles, the first row contains a hexadecimal character string of the first 3 hex digits in a 4 digit Unicode character name; the top column contains a hex character string of the 4th (low-order) hex digit of the Unicode character.

Definition at line 62 of file [unihex2bmp.c](#).

### 5.35.4.3 hexbits

```
unsigned char hexbits[18][32]
```

The digits converted into bitmaps.

Definition at line 82 of file [unihex2bmp.c](#).

#### 5.35.4.4 unipage

unsigned unipage =0

Unicode page number, 0x00..0xff.

Definition at line 84 of file [unihex2bmp.c](#).

## 5.36 unihex2bmp.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unihex2bmp.c
00003
00004  @brief unihex2bmp - Turn a GNU Unifont hex glyph page of 256 code points
00005  into a bitmap for editing
00006
00007  @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009  @copyright Copyright (C) 2007, 2008, 2013, 2017 Paul Hardy
00010
00011  This program reads in a GNU Unifont .hex file, extracts a range of
00012  256 code points, and converts it a Microsoft Bitmap (.bmp) or Wireless
00013  Bitmap file.
00014
00015  Synopsis: unihex2bmp [-iin_file.hex] [-out_file.bmp]
00016  [-f] [-phex_page_num] [-w]
00017  */
00018  /*
00019  LICENSE:
00020
00021  This program is free software: you can redistribute it and/or modify
00022  it under the terms of the GNU General Public License as published by
00023  the Free Software Foundation, either version 2 of the License, or
00024  (at your option) any later version.
00025
00026  This program is distributed in the hope that it will be useful,
00027  but WITHOUT ANY WARRANTY; without even the implied warranty of
00028  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00029  GNU General Public License for more details.
00030
00031  You should have received a copy of the GNU General Public License
00032  along with this program. If not, see <http://www.gnu.org/licenses/>.
00033  */
00034
00035  /*
00036  20 June 2017 [Paul Hardy]:
00037  - Adds capability to output triple-width and quadruple-width (31 pixels
00038  wide, not 32) glyphs. The 32nd column in a glyph cell is occupied by
00039  the vertical cell border, so a quadruple-width glyph can only occupy
00040  the first 31 columns; the 32nd column is ignored.
00041  */
00042
00043  #include <stdio.h>
00044  #include <stdlib.h>
00045  #include <string.h>
00046
00047  #define MAXBUF 256
00048
00049
00050  /**
00051  @brief GNU Unifont bitmaps for hexadecimal digits.
00052
00053  These are the GNU Unifont hex strings for '0'-'9' and 'A'-'F',
00054  for encoding as bit strings in row and column headers.
00055
00056  Looking at the final bitmap as a grid of 32*32 bit tiles, the
00057  first row contains a hexadecimal character string of the first
00058  3 hex digits in a 4 digit Unicode character name; the top column
00059  contains a hex character string of the 4th (low-order) hex digit
00060  of the Unicode character.
00061  */
00062  char *hex[18]= {
00063      "0030:0000000018244242424242424180000", /* Hex digit 0 */

```

```

00064     "0031:000000000818280808080808083E0000", /* Hex digit 1 */
00065     "0032:0000000003C4242020C102040407E0000", /* Hex digit 2 */
00066     "0033:0000000003C4242021C020242423C0000", /* Hex digit 3 */
00067     "0034:00000000040C142444447E0404040000", /* Hex digit 4 */
00068     "0035:0000000007E4040407C020202423C0000", /* Hex digit 5 */
00069     "0036:0000000001C2040407C424242423C0000", /* Hex digit 6 */
00070     "0037:0000000007E02020404040808080000", /* Hex digit 7 */
00071     "0038:0000000003C4242423C424242423C0000", /* Hex digit 8 */
00072     "0039:0000000003C4242423E02020204380000", /* Hex digit 9 */
00073     "0041:0000000018242442427E424242420000", /* Hex digit A */
00074     "0042:0000000007C4242427C424242427C0000", /* Hex digit B */
00075     "0043:0000000003C42424040404042423C0000", /* Hex digit C */
00076     "0044:000000007844424242424244780000", /* Hex digit D */
00077     "0045:0000000007E4040407C404040407E0000", /* Hex digit E */
00078     "0046:0000000007E4040407C404040400000", /* Hex digit F */
00079     "0055:00000000424242424242423C0000", /* Unicode 'U' */
00080     "002B:0000000000000808087F080808000000" /* Unicode '+' */
00081 };
00082 unsigned char hexbits[18][32]; ///< The digits converted into bitmaps.
00083
00084 unsigned unipage=0; ///< Unicode page number, 0x00..0xff.
00085 int flip=1; ///< Transpose entire matrix as in Unicode book.
00086
00087
00088 /**
00089 @brief The main function.
00090
00091 @param[in] argc The count of command line arguments.
00092 @param[in] argv Pointer to array of command line arguments.
00093 @return This program exits with status 0.
00094 */
00095 int
00096 main (int argc, char *argv[])
00097 {
00098
00099     int i, j; /* loop variables */
00100     unsigned k0; /* temp Unicode char variable */
00101     unsigned swap; /* temp variable for swapping values */
00102     char inbuf[256]; /* input buffer */
00103     unsigned filesize; /* size of file in bytes */
00104     unsigned bitmapsizes; /* size of bitmap image in bytes */
00105     unsigned thischar; /* the current character */
00106     unsigned char thischarbyte; /* unsigned char lowest byte of Unicode char */
00107     int thischarrow; /* row 0..15 where this character belongs */
00108     int thiscol; /* column 0..15 where this character belongs */
00109     int toppixelrow; /* pixel row, 0..16*32-1 */
00110     unsigned lastpage=0; /* the last Unicode page read in font file */
00111     int wbmp=0; /* set to 1 if writing .wbmp format file */
00112
00113     unsigned char bitmap[17*32][18*4]; /* final bitmap */
00114     unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00115
00116     char *infile="", *outfile=""; /* names of input and output files */
00117     FILE *infp, *outfp; /* file pointers of input and output files */
00118
00119     int init(); /* initializes bitmap row/col labeling, &c. */
00120     int hex2bit(); /* convert hex string --> bitmap */
00121
00122     bitmapsizes = 17*32*18*4; /* 17 rows by 18 cols, each 4 bytes */
00123
00124     if (argc > 1) {
00125         for (i = 1; i < argc; i++) {
00126             if (argv[i][0] == '-') { /* this is an option argument */
00127                 switch (argv[i][1]) {
00128                     case 'f': /* flip (transpose) glyphs in bitmap as in standard */
00129                         flip = !flip;
00130                         break;
00131                     case 'i': /* name of input file */
00132                         infile = &argv[i][2];
00133                         break;
00134                     case 'o': /* name of output file */
00135                         outfile = &argv[i][2];
00136                         break;
00137                     case 'p': /* specify a Unicode page other than default of 0 */
00138                         sscanf (&argv[i][2], "%x", &unipage); /* Get Unicode page */
00139                         break;
00140                     case 'w': /* write a .wbmp file instead of a .bmp file */
00141                         wbmp = 1;
00142                         break;
00143                     default: /* if unrecognized option, print list and exit */
00144                         fprintf (stderr, "\nSyntax:\n\n");

```

```

00145         fprintf (stderr, " %s -p<Unicode_Page> ", argv[0]);
00146         fprintf (stderr, "-i<Input_File> -o<Output_File> -w\n\n");
00147         fprintf (stderr, " -w specifies .wbmp output instead of ");
00148         fprintf (stderr, "default Windows .bmp output.\n\n");
00149         fprintf (stderr, " -p is followed by 1 to 6 ");
00150         fprintf (stderr, "Unicode page hex digits ");
00151         fprintf (stderr, "(default is Page 0).\n\n");
00152         fprintf (stderr, "\nExample:\n\n");
00153         fprintf (stderr, " %s -p83 -iunifont.hex -ou83.bmp\n\n\n",
00154                 argv[0]);
00155         exit (1);
00156     }
00157 }
00158 }
00159 }
00160 /*
00161 Make sure we can open any I/O files that were specified before
00162 doing anything else.
00163 */
00164 if (strlen (infile) > 0) {
00165     if ((infp = fopen (infile, "r")) == NULL) {
00166         fprintf (stderr, "Error: can't open %s for input.\n", infile);
00167         exit (1);
00168     }
00169 }
00170 else {
00171     infp = stdin;
00172 }
00173 if (strlen (outfile) > 0) {
00174     if ((outfp = fopen (outfile, "w")) == NULL) {
00175         fprintf (stderr, "Error: can't open %s for output.\n", outfile);
00176         exit (1);
00177     }
00178 }
00179 else {
00180     outfp = stdout;
00181 }
00182
00183 (void)init(bitmap); /* initialize bitmap with row/column headers, etc. */
00184
00185 /*
00186 Read in the characters in the page
00187 */
00188 while (lastpage <= unipage && fgets (inbuf, MAXBUF-1, infp) != NULL) {
00189     sscanf (inbuf, "%x", &thischar);
00190     lastpage = thischar » 8; /* keep Unicode page to see if we can stop */
00191     if (lastpage == unipage) {
00192         thischarbyte = (unsigned char)(thischar & 0xff);
00193         for (k0=0; inbuf[k0] != '\0'; k0++);
00194         k0++;
00195         hex2bit (&inbuf[k0], charbits); /* convert hex string to 32*4 bitmap */
00196     }
00197     /*
00198 Now write character bitmap upside-down in page array, to match
00199 .bmp file order. In the .wbmp' and .bmp files, white is a '1'
00200 bit and black is a '0' bit, so complement charbits[].
00201 */
00202
00203     thiscol = (thischarbyte & 0xf) + 2; /* column number will be 1..16 */
00204     thischarrow = thischarbyte » 4; /* charcter row number, 0..15 */
00205     if (flip) { /* swap row and column placement */
00206         swap = thiscol;
00207         thiscol = thischarrow;
00208         thischarrow = swap;
00209         thiscol += 2; /* column index starts at 1 */
00210         thischarrow -= 2; /* row index starts at 0 */
00211     }
00212     toppixelrow = 32 * (thischarrow + 1) - 1; /* from bottom to top */
00213
00214     /*
00215 Copy the center of charbits[] because hex characters only
00216 occupy rows 8 to 23 and column byte 2 (and for 16 bit wide
00217 characters, byte 3). The charbits[] array was given 32 rows
00218 and 4 column bytes for completeness in the beginning.
00219 */
00220     for (i=8; i<24; i++) {
00221         bitmap[toppixelrow + i][(thiscol « 2) | 0] =
00222             ~charbits[i][0] & 0xff;
00223         bitmap[toppixelrow + i][(thiscol « 2) | 1] =
00224             ~charbits[i][1] & 0xff;
00225         bitmap[toppixelrow + i][(thiscol « 2) | 2] =

```



```

00226     ~charbits[i][2] & 0xff;
00227     /* Only use first 31 bits; leave vertical rule in 32nd column */
00228     bitmap[toppixelrow + i][(thiscol « 2) | 3] =
00229     ~charbits[i][3] & 0xfe;
00230     }
00231     /*
00232 Leave white space in 32nd column of rows 8, 14, 15, and 23
00233 to leave 16 pixel height upper, middle, and lower guides.
00234 */
00235     bitmap[toppixelrow + 8][(thiscol « 2) | 3] |= 1;
00236     bitmap[toppixelrow + 14][(thiscol « 2) | 3] |= 1;
00237     bitmap[toppixelrow + 15][(thiscol « 2) | 3] |= 1;
00238     bitmap[toppixelrow + 23][(thiscol « 2) | 3] |= 1;
00239     }
00240     }
00241     /*
00242 Now write the appropriate bitmap file format, either
00243 Wireless Bitmap or Microsoft Windows bitmap.
00244 */
00245     if (wbmp) { /* Write a Wireless Bitmap .wbmp format file */
00246         /*
00247 Write WBMP header
00248 */
00249         fprintf (outfp, "%c", 0x00); /* Type of image; always 0 (monochrome) */
00250         fprintf (outfp, "%c", 0x00); /* Reserved; always 0 */
00251         fprintf (outfp, "%c%c", 0x84, 0x40); /* Width = 576 pixels */
00252         fprintf (outfp, "%c%c", 0x84, 0x20); /* Height = 544 pixels */
00253         /*
00254 Write bitmap image
00255 */
00256         for (toppixelrow=0; toppixelrow <= 17*32-1; toppixelrow++) {
00257             for (j=0; j<18; j++) {
00258                 fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)  ]);
00259                 fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00260                 fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00261                 fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00262             }
00263         }
00264     }
00265     else { /* otherwise, write a Microsoft Windows .bmp format file */
00266         /*
00267 Write the .bmp file -- start with the header, then write the bitmap
00268 */
00269         /* 'B', 'M' appears at start of every .bmp file */
00270         fprintf (outfp, "%c%c", 0x42, 0x4d);
00271
00272         /* Write file size in bytes */
00273         filesize = 0x3E + bitmapsizesize;
00274         fprintf (outfp, "%c", (unsigned char)((filesize          ) & 0xff));
00275         fprintf (outfp, "%c", (unsigned char)((filesize » 0x08) & 0xff));
00276         fprintf (outfp, "%c", (unsigned char)((filesize » 0x10) & 0xff));
00277         fprintf (outfp, "%c", (unsigned char)((filesize » 0x18) & 0xff));
00278
00279         /* Reserved - 0's */
00280         fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00281
00282         /* Offset from start of file to bitmap data */
00283         fprintf (outfp, "%c%c%c%c", 0x3E, 0x00, 0x00, 0x00);
00284
00285         /* Length of bitmap info header */
00286         fprintf (outfp, "%c%c%c%c", 0x28, 0x00, 0x00, 0x00);
00287
00288         /* Width of bitmap in pixels */
00289         fprintf (outfp, "%c%c%c%c", 0x40, 0x02, 0x00, 0x00);
00290
00291         /* Height of bitmap in pixels */
00292         fprintf (outfp, "%c%c%c%c", 0x20, 0x02, 0x00, 0x00);
00293
00294         /* Planes in bitmap (fixed at 1) */
00295         fprintf (outfp, "%c%c", 0x01, 0x00);
00296
00297         /* bits per pixel (1 = monochrome) */
00298         fprintf (outfp, "%c%c", 0x01, 0x00);
00299
00300         /* Compression (0 = none) */
00301         fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00302
00303         /* Size of bitmap data in bytes */
00304         fprintf (outfp, "%c", (unsigned char)((bitmapsizesize          ) & 0xff));
00305         fprintf (outfp, "%c", (unsigned char)((bitmapsizesize » 0x08) & 0xff));
00306

```

```

00307     fprintf (outfp, "%c", (unsigned char)((bitmapsizem » 0x10) & 0xff));
00308     fprintf (outfp, "%c", (unsigned char)((bitmapsizem » 0x18) & 0xff));
00309
00310     /* Horizontal resolution in pixels per meter */
00311     fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00312
00313     /* Vertical resolution in pixels per meter */
00314     fprintf (outfp, "%c%c%c%c", 0xC4, 0x0E, 0x00, 0x00);
00315
00316     /* Number of colors used */
00317     fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00318
00319     /* Number of important colors */
00320     fprintf (outfp, "%c%c%c%c", 0x02, 0x00, 0x00, 0x00);
00321
00322     /* The color black: B=0x00, G=0x00, R=0x00, Filler=0xFF */
00323     fprintf (outfp, "%c%c%c%c", 0x00, 0x00, 0x00, 0x00);
00324
00325     /* The color white: B=0xFF, G=0xFF, R=0xFF, Filler=0xFF */
00326     fprintf (outfp, "%c%c%c%c", 0xFF, 0xFF, 0xFF, 0xFF);
00327
00328     /*
00329     Now write the raw data bits.  Data is written from the lower
00330     left-hand corner of the image to the upper right-hand corner
00331     of the image.
00332     */
00333     for (toppixelrow=17*32-1; toppixelrow >= 0; toppixelrow--) {
00334         for (j=0; j<18; j++) {
00335             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2)  ]);
00336             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 1]);
00337             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 2]);
00338
00339             fprintf (outfp, "%c", bitmap[toppixelrow][(j«2) | 3]);
00340         }
00341     }
00342 }
00343 exit (0);
00344 }
00345
00346
00347 /**
00348 @brief Generate a bitmap for one glyph.
00349
00350 Convert the portion of a hex string after the ':' into a character bitmap.
00351
00352 If string is >= 128 characters, it will fill all 4 bytes per row.
00353 If string is >= 64 characters and < 128, it will fill 2 bytes per row.
00354 Otherwise, it will fill 1 byte per row.
00355
00356 @param[in] instring The character array containing the glyph bitmap.
00357 @param[out] character Glyph bitmap, 8, 16, or 32 columns by 16 rows tall.
00358 @return Always returns 0.
00359 */
00360 int
00361 hex2bit (char *instring, unsigned char character[32][4])
00362 {
00363
00364     int i; /* current row in bitmap character */
00365     int j; /* current character in input string */
00366     int k; /* current byte in bitmap character */
00367     int width; /* number of output bytes to fill - 1: 0, 1, 2, or 3 */
00368
00369     for (i=0; i<32; i++) /* erase previous character */
00370         character[i][0] = character[i][1] = character[i][2] = character[i][3] = 0;
00371     j=0; /* current location is at beginning of instring */
00372
00373     if (strlen (instring) <= 34) /* 32 + possible '\r', '\n' */
00374         width = 0;
00375     else if (strlen (instring) <= 66) /* 64 + possible '\r', '\n' */
00376         width = 1;
00377     else if (strlen (instring) <= 98) /* 96 + possible '\r', '\n' */
00378         width = 3;
00379     else /* the maximum allowed is quadruple-width */
00380         width = 4;
00381
00382     k = (width > 1) ? 0 : 1; /* if width > double, start at index 1 else at 0 */
00383
00384     for (i=8; i<24; i++) { /* 16 rows per input character, rows 8..23 */
00385         sscanf (&instring[j], "%2hhx", &character[i][k]);
00386         j += 2;
00387         if (width > 0) { /* add next pair of hex digits to this row */

```

```

00388     sscanf (&instring[j], "%2hhx", &character[i][k+1]);
00389     j += 2;
00390     if (width > 1) { /* add next pair of hex digits to this row */
00391         sscanf (&instring[j], "%2hhx", &character[i][k+2]);
00392         j += 2;
00393         if (width > 2) { /* quadruple-width is maximum width */
00394             sscanf (&instring[j], "%2hhx", &character[i][k+3]);
00395             j += 2;
00396         }
00397     }
00398 }
00399 }
00400
00401 return (0);
00402 }
00403
00404 /**
00405  * @brief Initialize the bitmap grid.
00406  * @param[out] bitmap The bitmap to generate, with 32x32 pixel glyph areas.
00407  * @return Always returns 0.
00408  */
00409 int
00410 init (unsigned char bitmap[17*32][18*4])
00411 {
00412     int i, j;
00413     unsigned char charbits[32][4]; /* bitmap for one character, 4 bytes/row */
00414     unsigned toppixelrow;
00415     unsigned thiscol;
00416     unsigned char pnybble0, pnybble1, pnybble2, pnybble3;
00417     for (i=0; i<18; i++) { /* bitmaps for '0'..'9', 'A'..'F', 'u', '+' */
00418         hex2bit (&hex[i][5], charbits); /* convert hex string to 32*4 bitmap */
00419         for (j=0; j<32; j++) hexbits[i][j] = ~charbits[j][1];
00420     }
00421     /*
00422     Initialize bitmap to all white.
00423     */
00424     for (toppixelrow=0; toppixelrow < 17*32; toppixelrow++) {
00425         for (thiscol=0; thiscol<18; thiscol++) {
00426             bitmap[toppixelrow][(thiscol << 2) ] = 0xff;
00427             bitmap[toppixelrow][(thiscol << 2) | 1] = 0xff;
00428             bitmap[toppixelrow][(thiscol << 2) | 2] = 0xff;
00429             bitmap[toppixelrow][(thiscol << 2) | 3] = 0xff;
00430         }
00431     }
00432     /*
00433     Write the "u+nnnn" table header in the upper left-hand corner,
00434     where nnnn is the upper 16 bits of a 32-bit Unicode assignment.
00435     */
00436     pnybble3 = (unipage >> 20);
00437     pnybble2 = (unipage >> 16) & 0xf;
00438     pnybble1 = (unipage >> 12) & 0xf;
00439     pnybble0 = (unipage >> 8) & 0xf;
00440     for (i=0; i<32; i++) {
00441         bitmap[i][1] = hexbits[16][i]; /* copy 'u' */
00442         bitmap[i][2] = hexbits[17][i]; /* copy '+' */
00443         bitmap[i][3] = hexbits[pnybble3][i];
00444         bitmap[i][4] = hexbits[pnybble2][i];
00445         bitmap[i][5] = hexbits[pnybble1][i];
00446         bitmap[i][6] = hexbits[pnybble0][i];
00447     }
00448     /*
00449     Write low-order 2 bytes of Unicode number assignments, as hex labels
00450     */
00451     pnybble3 = (unipage >> 4) & 0xf; /* Highest-order hex digit */
00452     pnybble2 = (unipage >> 0) & 0xf; /* Next highest-order hex digit */
00453     /*
00454     Write the column headers in bitmap[][] (row headers if flipped)
00455     */
00456     toppixelrow = 32 * 17 - 1; /* maximum pixel row number */
00457     /*
00458     Label the column headers. The hexbits[][] bytes are split across two
00459     bitmap[][] entries to center a the hex digits in a column of 4 bytes.
00460     OR highest byte with 0xf0 and lowest byte with 0x0f to make outer
00461     nybbles white (0=black, 1=white).
00462     */

```

```

00469 for (i=0; i<16; i++) {
00470     for (j=0; j<32; j++) {
00471         if (flip) { /* transpose matrix */
00472             bitmap[j][((i+2) << 2) | 0] = (hexbits[pybble3][j] >> 4) | 0xf0;
00473             bitmap[j][((i+2) << 2) | 1] = (hexbits[pybble3][j] << 4) |
00474                 (hexbits[pybble2][j] >> 4);
00475             bitmap[j][((i+2) << 2) | 2] = (hexbits[pybble2][j] << 4) |
00476                 (hexbits[i][j] >> 4);
00477             bitmap[j][((i+2) << 2) | 3] = (hexbits[i][j] << 4) | 0x0f;
00478         }
00479         else {
00480             bitmap[j][((i+2) << 2) | 1] = (hexbits[i][j] >> 4) | 0xf0;
00481             bitmap[j][((i+2) << 2) | 2] = (hexbits[i][j] << 4) | 0x0f;
00482         }
00483     }
00484 }
00485 /*
00486 Now use the single hex digit column graphics to label the row headers.
00487 */
00488 for (i=0; i<16; i++) {
00489     toppixelrow = 32 * (i + 1) - 1; /* from bottom to top */
00490
00491     for (j=0; j<32; j++) {
00492         if (!flip) { /* if not transposing matrix */
00493             bitmap[toppixelrow + j][4] = hexbits[pybble3][j];
00494             bitmap[toppixelrow + j][5] = hexbits[pybble2][j];
00495         }
00496         bitmap[toppixelrow + j][6] = hexbits[i][j];
00497     }
00498 }
00499 /*
00500 Now draw grid lines in bitmap, around characters we just copied.
00501 */
00502 /* draw vertical lines 2 pixels wide */
00503 for (i=1*32; i<17*32; i+=32) {
00504     if ((i & 0x1f) == 7)
00505         i++;
00506     else if ((i & 0x1f) == 14)
00507         i += 2;
00508     else if ((i & 0x1f) == 22)
00509         i++;
00510     for (j=1; j<18; j++) {
00511         bitmap[i][j << 2 | 3] &= 0xfe;
00512     }
00513 }
00514 /* draw horizontal lines 1 pixel tall */
00515 for (i=1*32-1; i<18*32-1; i+=32) {
00516     for (j=2; j<18; j++) {
00517         bitmap[i][j << 2] = 0x00;
00518         bitmap[i][j << 2 | 1] = 0x81;
00519         bitmap[i][j << 2 | 2] = 0x81;
00520         bitmap[i][j << 2 | 3] = 0x00;
00521     }
00522 }
00523 /* fill in top left corner pixel of grid */
00524 bitmap[31][7] = 0xfe;
00525
00526 return (0);
00527 }

```

## 5.37 src/unihexgen.c File Reference

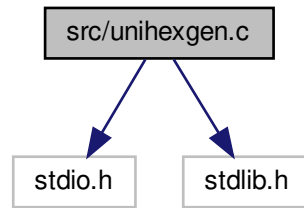
unihexgen - Generate a series of glyphs containing hexadecimal code points

```

#include <stdio.h>
#include <stdlib.h>

```

Include dependency graph for unihexgen.c:



## Functions

- int [main](#) (int argc, char \*argv[])  
The main function.
- void [hexprint4](#) (int thiscp)  
Generate a bitmap containing a 4-digit Unicode code point.
- void [hexprint6](#) (int thiscp)  
Generate a bitmap containing a 6-digit Unicode code point.

## Variables

- char [hexdigit](#) [16][5]  
Bitmap pattern for each hexadecimal digit.

### 5.37.1 Detailed Description

unihexgen - Generate a series of glyphs containing hexadecimal code points

Author

Paul Hardy

Copyright

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This program generates glyphs in Unifont .hex format that contain four- or six-digit hexadecimal numbers in a 16x16 pixel area. These are rendered as white digits on a black background. `argv[1]` is the starting code point (as a hexadecimal string, with no leading "0x"). `argv[2]` is the ending code point (as a hexadecimal string, with no leading "0x").

For example:

```
unihexgen e000 f8ff > pua.hex
```

This generates the Private Use Area glyph file.

This utility program works in Roman Czyborra's unifont.hex file format, the basis of the GNU Unifont package.

Definition in file [unihexgen.c](#).

## 5.37.2 Function Documentation

### 5.37.2.1 hexprint4()

```
void hexprint4 (
    int thiscp )
```

Generate a bitmap containing a 4-digit Unicode code point.

Takes a 4-digit Unicode code point as an argument and prints a unifont.hex string for it to stdout.

Parameters

in	thiscp	The current code point for which to generate a glyph.
----	--------	---

Definition at line 160 of file [unihexgen.c](#).

```
00161 {
00162
00163     int grid[16]; /* the glyph grid we'll build */
00164
00165     int row;      /* row number in current glyph */
00166     int digitrow; /* row number in current hex digit being rendered */
00167     int rowbits; /* 1 & 0 bits to draw current glyph row */
00168
00169     int d1, d2, d3, d4; /* four hexadecimal digits of each code point */
00170
00171     d1 = (thiscp » 12) & 0xF;
00172     d2 = (thiscp » 8) & 0xF;
00173     d3 = (thiscp » 4) & 0xF;
00174     d4 = (thiscp    ) & 0xF;
00175
00176     /* top and bottom rows are white */
00177     grid[0] = grid[15] = 0x0000;
00178
00179     /* 14 inner rows are 14-pixel wide black lines, centered */
00180     for (row = 1; row < 15; row++) grid[row] = 0x7FFE;
00181
00182     printf ("%04X:", thiscp);
00183
00184     /*
00185     Render the first row of 2 hexadecimal digits
00186     */
00187     digitrow = 0; /* start at top of first row of digits to render */
00188     for (row = 2; row < 7; row++) {
00189         rowbits = (hexdigit[d1][digitrow] « 9) |
00190                 (hexdigit[d2][digitrow] « 3);
00191         grid[row] ^= rowbits; /* digits appear as white on black background */
00192         digitrow++;
00193     }
00194
00195     /*
00196     Render the second row of 2 hexadecimal digits
00197     */
00198     digitrow = 0; /* start at top of first row of digits to render */
00199     for (row = 9; row < 14; row++) {
00200         rowbits = (hexdigit[d3][digitrow] « 9) |
00201                 (hexdigit[d4][digitrow] « 3);
00202         grid[row] ^= rowbits; /* digits appear as white on black background */
00203         digitrow++;
```

```

00204 }
00205
00206 for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00207
00208 putchar ('\n');
00209
00210 return;
00211 }

```

Here is the caller graph for this function:



### 5.37.2.2 hexprint6()

```

void hexprint6 (
    int thiscp )

```

Generate a bitmap containing a 6-digit Unicode code point.

Takes a 6-digit Unicode code point as an argument and prints a unifont.hex string for it to stdout.

Parameters

in	thiscp	The current code point for which to generate a glyph.

Definition at line 223 of file unihexgen.c.

```

00224 {
00225
00226 int grid[16]; /* the glyph grid we'll build */
00227
00228 int row; /* row number in current glyph */
00229 int digitrow; /* row number in current hex digit being rendered */
00230 int rowbits; /* 1 & 0 bits to draw current glyph row */
00231
00232 int d1, d2, d3, d4, d5, d6; /* six hexadecimal digits of each code point */
00233
00234 d1 = (thiscp » 20) & 0xF;
00235 d2 = (thiscp » 16) & 0xF;
00236 d3 = (thiscp » 12) & 0xF;
00237 d4 = (thiscp » 8) & 0xF;
00238 d5 = (thiscp » 4) & 0xF;
00239 d6 = (thiscp ) & 0xF;
00240
00241 /* top and bottom rows are white */
00242 grid[0] = grid[15] = 0x0000;

```

```

00243
00244  /* 14 inner rows are 16-pixel wide black lines, centered */
00245  for (row = 1; row < 15; row++) grid[row] = 0xFFFF;
00246
00247
00248  printf ("%06X:", thiscp);
00249
00250  /*
00251  Render the first row of 3 hexadecimal digits
00252  */
00253  digitrow = 0; /* start at top of first row of digits to render */
00254  for (row = 2; row < 7; row++) {
00255      rowbits = (hexdigit[d1][digitrow] « 11) |
00256                (hexdigit[d2][digitrow] « 6) |
00257                (hexdigit[d3][digitrow] « 1);
00258      grid[row] ^= rowbits; /* digits appear as white on black background */
00259      digitrow++;
00260  }
00261
00262  /*
00263  Render the second row of 3 hexadecimal digits
00264  */
00265  digitrow = 0; /* start at top of first row of digits to render */
00266  for (row = 9; row < 14; row++) {
00267      rowbits = (hexdigit[d4][digitrow] « 11) |
00268                (hexdigit[d5][digitrow] « 6) |
00269                (hexdigit[d6][digitrow] « 1);
00270      grid[row] ^= rowbits; /* digits appear as white on black background */
00271      digitrow++;
00272  }
00273
00274  for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00275
00276  putchar ('\n');
00277
00278  return;
00279 }

```

Here is the caller graph for this function:



### 5.37.2.3 main()

```

int main (
    int argc,
    char * argv[] )

```

The main function.



## Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments (code point range).

## Returns

This program exits with status `EXIT_SUCCESS`.

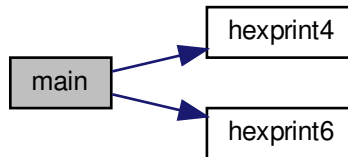
Definition at line 112 of file `unihexgen.c`.

```

00113 {
00114
00115     int startcp, endcp, thiscp;
00116     void hexprint4(int); /* function to print one 4-digit unifont.hex code point */
00117     void hexprint6(int); /* function to print one 6-digit unifont.hex code point */
00118
00119     if (argc != 3) {
00120         fprintf(stderr, "\n%s - generate unifont.hex code points as\n", argv[0]);
00121         fprintf(stderr, "four-digit hexadecimal numbers in a 2 by 2 grid.\n");
00122         fprintf(stderr, "or six-digit hexadecimal numbers in a 3 by 2 grid.\n");
00123         fprintf(stderr, "Syntax:\n\n");
00124         fprintf(stderr, "    %s first_code_point last_code_point > glyphs.hex\n\n", argv[0]);
00125         fprintf(stderr, "Example (to generate glyphs for the Private Use Area):\n\n");
00126         fprintf(stderr, "    %s e000 f8ff > pua.hex\n\n", argv[0]);
00127         exit (EXIT_FAILURE);
00128     }
00129
00130     sscanf (argv[1], "%x", &startcp);
00131     sscanf (argv[2], "%x", &endcp);
00132
00133     startcp &= 0xFFFFF; /* limit to 6 hex digits */
00134     endcp   &= 0xFFFFF; /* limit to 6 hex digits */
00135
00136     /*
00137     For each code point in the desired range, generate a glyph.
00138     */
00139     for (thiscp = startcp; thiscp <= endcp; thiscp++) {
00140         if (thiscp <= 0xFFFF) {
00141             hexprint4 (thiscp); /* print digits 2/line, 2 lines */
00142         }
00143         else {
00144             hexprint6 (thiscp); /* print digits 3/line, 2 lines */
00145         }
00146     }
00147     exit (EXIT_SUCCESS);
00148 }

```

Here is the call graph for this function:



### 5.37.3 Variable Documentation

#### 5.37.3.1 hexdigit

```
char hexdigit[16][5]
```

Initial value:

```
= {
  {0x6,0x9,0x9,0x9,0x6},
  {0x2,0x6,0x2,0x2,0x7},
  {0xF,0x1,0xF,0x8,0xF},
  {0xE,0x1,0x7,0x1,0xE},
  {0x9,0x9,0xF,0x1,0x1},
  {0xF,0x8,0xF,0x1,0xF},
  {0x6,0x8,0xE,0x9,0x6},
  {0xF,0x1,0x2,0x4,0x4},
  {0x6,0x9,0x6,0x9,0x6},
  {0x6,0x9,0x7,0x1,0x6},
  {0xF,0x9,0xF,0x9,0x9},
  {0xE,0x9,0xE,0x9,0xE},
  {0x7,0x8,0x8,0x8,0x7},
  {0xE,0x9,0x9,0x9,0xE},
  {0xF,0x8,0xE,0x8,0xF},
  {0xF,0x8,0xE,0x8,0x8}
}
```

Bitmap pattern for each hexadecimal digit.

hexdigit[][] definition: the bitmap pattern for each hexadecimal digit.

Each digit is drawn as a 4 wide by 5 high bitmap, so each digit row is one hexadecimal digit, and each entry has 5 rows.

For example, the entry for digit 1 is:

```
{0x2,0x6,0x2,0x2,0x7},
```

which corresponds graphically to:

```
-#- ==> 0010 ==> 0x2 -##- ==> 0110 ==> 0x6 -#- ==> 0010 ==> 0x2 -##- ==> 0010 ==> 0x2
-### ==> 0111 ==> 0x7
```

These row values will then be exclusive-ORed with four one bits (binary 1111, or 0xF) to form white digits on a black background.

Functions hexprint4 and hexprint6 share the hexdigit array; they print four-digit and six-digit hexadecimal code points in a single glyph, respectively.

Definition at line 84 of file [unihexgen.c](#).

## 5.38 unihexgen.c

[Go to the documentation of this file.](#)

```
00001 /**
```

```

00002 @file unihexgen.c
00003
00004 @brief unihexgen - Generate a series of glyphs containing
00005 hexadecimal code points
00006
00007 @author Paul Hardy
00008
00009 @copyright Copyright (C) 2013 Paul Hardy
00010
00011 This program generates glyphs in Unifont .hex format that contain
00012 four- or six-digit hexadecimal numbers in a 16x16 pixel area. These
00013 are rendered as white digits on a black background.
00014
00015 argv[1] is the starting code point (as a hexadecimal
00016 string, with no leading "0x".
00017
00018 argv[2] is the ending code point (as a hexadecimal
00019 string, with no leading "0x".
00020
00021 For example:
00022
00023 unihexgen e000 f8ff > pua.hex
00024
00025 This generates the Private Use Area glyph file.
00026
00027 This utility program works in Roman Czyborra's unifont.hex file
00028 format, the basis of the GNU Unifont package.
00029 */
00030 /*
00031 This program is released under the terms of the GNU General Public
00032 License version 2, or (at your option) a later version.
00033
00034 LICENSE:
00035
00036 This program is free software: you can redistribute it and/or modify
00037 it under the terms of the GNU General Public License as published by
00038 the Free Software Foundation, either version 2 of the License, or
00039 (at your option) any later version.
00040
00041 This program is distributed in the hope that it will be useful,
00042 but WITHOUT ANY WARRANTY; without even the implied warranty of
00043 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00044 GNU General Public License for more details.
00045
00046 You should have received a copy of the GNU General Public License
00047 along with this program. If not, see <http://www.gnu.org/licenses/>.
00048 */
00049
00050 #include <stdio.h>
00051 #include <stdlib.h>
00052
00053
00054 /**
00055 @brief Bitmap pattern for each hexadecimal digit.
00056
00057 hexdigit[][] definition: the bitmap pattern for
00058 each hexadecimal digit.
00059
00060 Each digit is drawn as a 4 wide by 5 high bitmap,
00061 so each digit row is one hexadecimal digit, and
00062 each entry has 5 rows.
00063
00064 For example, the entry for digit 1 is:
00065
00066 {0x2,0x6,0x2,0x2,0x7},
00067
00068 which corresponds graphically to:
00069
00070 --#- ==> 0010 ==> 0x2
00071 -##- ==> 0110 ==> 0x6
00072 --#- ==> 0010 ==> 0x2
00073 --#- ==> 0010 ==> 0x2
00074 -### ==> 0111 ==> 0x7
00075
00076 These row values will then be exclusive-ORed with four one bits
00077 (binary 1111, or 0xF) to form white digits on a black background.
00078
00079
00080 Functions hexprint4 and hexprint6 share the hexdigit array;
00081 they print four-digit and six-digit hexadecimal code points
00082 in a single glyph, respectively.

```

```

00083 */
00084 char hexdigit[16][5] = {
00085     {0x6,0x9,0x9,0x9,0x6}, /* 0x0 */
00086     {0x2,0x6,0x2,0x2,0x7}, /* 0x1 */
00087     {0xF,0x1,0xF,0x8,0xF}, /* 0x2 */
00088     {0xE,0x1,0x7,0x1,0xE}, /* 0x3 */
00089     {0x9,0x9,0xF,0x1,0x1}, /* 0x4 */
00090     {0xF,0x8,0xF,0x1,0xF}, /* 0x5 */
00091     {0x6,0x8,0xE,0x9,0x6}, /* 0x6 */ // {0x8,0x8,0xF,0x9,0xF} [alternate square form of 6]
00092     {0xF,0x1,0x2,0x4,0x4}, /* 0x7 */
00093     {0x6,0x9,0x6,0x9,0x6}, /* 0x8 */
00094     {0x6,0x9,0x7,0x1,0x6}, /* 0x9 */ // {0xF,0x9,0xF,0x1,0x1} [alternate square form of 9]
00095     {0xF,0x9,0xF,0x9,0x9}, /* 0xA */
00096     {0xE,0x9,0xE,0x9,0xE}, /* 0xB */
00097     {0x7,0x8,0x8,0x8,0x7}, /* 0xC */
00098     {0xE,0x9,0x9,0x9,0xE}, /* 0xD */
00099     {0xF,0x8,0xE,0x8,0xF}, /* 0xE */
00100     {0xF,0x8,0xE,0x8,0x8} /* 0xF */
00101 };
00102
00103
00104 /**
00105  @brief The main function.
00106
00107  @param[in] argc The count of command line arguments.
00108  @param[in] argv Pointer to array of command line arguments (code point range).
00109  @return This program exits with status EXIT_SUCCESS.
00110  */
00111 int
00112 main (int argc, char *argv[])
00113 {
00114
00115     int startcp, endcp, thiscp;
00116     void hexprint4(int); /* function to print one 4-digit unifont.hex code point */
00117     void hexprint6(int); /* function to print one 6-digit unifont.hex code point */
00118
00119     if (argc != 3) {
00120         fprintf (stderr, "\n%s - generate unifont.hex code points as\n", argv[0]);
00121         fprintf (stderr, "four-digit hexadecimal numbers in a 2 by 2 grid.\n");
00122         fprintf (stderr, "or six-digit hexadecimal numbers in a 3 by 2 grid.\n");
00123         fprintf (stderr, "Syntax:\n");
00124         fprintf (stderr, "%s first_code_point last_code_point > glyphs.hex\n", argv[0]);
00125         fprintf (stderr, "Example (to generate glyphs for the Private Use Area):\n");
00126         fprintf (stderr, "%s e000 f8ff > pua.hex\n", argv[0]);
00127         exit (EXIT_FAILURE);
00128     }
00129
00130     sscanf (argv[1], "%x", &startcp);
00131     sscanf (argv[2], "%x", &endcp);
00132
00133     startcp &= 0xFFFFF; /* limit to 6 hex digits */
00134     endcp &= 0xFFFFF; /* limit to 6 hex digits */
00135
00136     /*
00137     For each code point in the desired range, generate a glyph.
00138     */
00139     for (thiscp = startcp; thiscp <= endcp; thiscp++) {
00140         if (thiscp <= 0xFFFF) {
00141             hexprint4 (thiscp); /* print digits 2/line, 2 lines */
00142         }
00143         else {
00144             hexprint6 (thiscp); /* print digits 3/line, 2 lines */
00145         }
00146     }
00147     exit (EXIT_SUCCESS);
00148 }
00149
00150
00151 /**
00152  @brief Generate a bitmap containing a 4-digit Unicode code point.
00153
00154  Takes a 4-digit Unicode code point as an argument
00155  and prints a unifont.hex string for it to stdout.
00156
00157  @param[in] thiscp The current code point for which to generate a glyph.
00158  */
00159 void
00160 hexprint4 (int thiscp)
00161 {
00162
00163     int grid[16]; /* the glyph grid we'll build */

```

```

00164
00165 int row; /* row number in current glyph */
00166 int digitrow; /* row number in current hex digit being rendered */
00167 int rowbits; /* 1 & 0 bits to draw current glyph row */
00168
00169 int d1, d2, d3, d4; /* four hexadecimal digits of each code point */
00170
00171 d1 = (thiscp » 12) & 0xF;
00172 d2 = (thiscp » 8) & 0xF;
00173 d3 = (thiscp » 4) & 0xF;
00174 d4 = (thiscp ) & 0xF;
00175
00176 /* top and bottom rows are white */
00177 grid[0] = grid[15] = 0x0000;
00178
00179 /* 14 inner rows are 14-pixel wide black lines, centered */
00180 for (row = 1; row < 15; row++) grid[row] = 0x7FFE;
00181
00182 printf ("%04X:", thiscp);
00183
00184 /*
00185 Render the first row of 2 hexadecimal digits
00186 */
00187 digitrow = 0; /* start at top of first row of digits to render */
00188 for (row = 2; row < 7; row++) {
00189     rowbits = (hexdigit[d1][digitrow] « 9) |
00190             (hexdigit[d2][digitrow] « 3);
00191     grid[row] ^= rowbits; /* digits appear as white on black background */
00192     digitrow++;
00193 }
00194
00195 /*
00196 Render the second row of 2 hexadecimal digits
00197 */
00198 digitrow = 0; /* start at top of first row of digits to render */
00199 for (row = 9; row < 14; row++) {
00200     rowbits = (hexdigit[d3][digitrow] « 9) |
00201             (hexdigit[d4][digitrow] « 3);
00202     grid[row] ^= rowbits; /* digits appear as white on black background */
00203     digitrow++;
00204 }
00205
00206 for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00207
00208 putchar ('\n');
00209
00210 return;
00211 }
00212
00213
00214 /**
00215 @brief Generate a bitmap containing a 6-digit Unicode code point.
00216
00217 Takes a 6-digit Unicode code point as an argument
00218 and prints a unifont.hex string for it to stdout.
00219
00220 @param[in] thiscp The current code point for which to generate a glyph.
00221 */
00222 void
00223 hexprint6 (int thiscp)
00224 {
00225
00226 int grid[16]; /* the glyph grid we'll build */
00227
00228 int row; /* row number in current glyph */
00229 int digitrow; /* row number in current hex digit being rendered */
00230 int rowbits; /* 1 & 0 bits to draw current glyph row */
00231
00232 int d1, d2, d3, d4, d5, d6; /* six hexadecimal digits of each code point */
00233
00234 d1 = (thiscp » 20) & 0xF;
00235 d2 = (thiscp » 16) & 0xF;
00236 d3 = (thiscp » 12) & 0xF;
00237 d4 = (thiscp » 8) & 0xF;
00238 d5 = (thiscp » 4) & 0xF;
00239 d6 = (thiscp ) & 0xF;
00240
00241 /* top and bottom rows are white */
00242 grid[0] = grid[15] = 0x0000;
00243
00244 /* 14 inner rows are 16-pixel wide black lines, centered */

```

```

00245  for (row = 1; row < 15; row++) grid[row] = 0xFFFF;
00246
00247
00248  printf ("%06X:", thiscp);
00249
00250  /*
00251  Render the first row of 3 hexadecimal digits
00252  */
00253  digitrow = 0; /* start at top of first row of digits to render */
00254  for (row = 2; row < 7; row++) {
00255      rowbits = (hexdigit[d1][digitrow] « 11) |
00256              (hexdigit[d2][digitrow] « 6) |
00257              (hexdigit[d3][digitrow] « 1);
00258      grid[row] ^= rowbits; /* digits appear as white on black background */
00259      digitrow++;
00260  }
00261
00262  /*
00263  Render the second row of 3 hexadecimal digits
00264  */
00265  digitrow = 0; /* start at top of first row of digits to render */
00266  for (row = 9; row < 14; row++) {
00267      rowbits = (hexdigit[d4][digitrow] « 11) |
00268              (hexdigit[d5][digitrow] « 6) |
00269              (hexdigit[d6][digitrow] « 1);
00270      grid[row] ^= rowbits; /* digits appear as white on black background */
00271      digitrow++;
00272  }
00273
00274  for (row = 0; row < 16; row++) printf ("%04X", grid[row] & 0xFFFF);
00275
00276  putchar ('\n');
00277
00278  return;
00279 }
00280

```

## 5.39 unihexpose.c

```

00001 /**
00002 @file: unihetranspose.c
00003
00004 @brief: Transpose Unifont glyph bitmaps.
00005
00006 This program takes Unifont .hex format glyphs and converts those
00007 glyphs so that each byte (two hexadecimal digits in the .hex file)
00008 represents a column of 8 rows. This simplifies use with graphics
00009 display controllers that write lines consisting of 8 rows at a time
00010 to a display.
00011
00012 The bytes are ordered as first all the columns for the glyph in
00013 the first 8 rows, then all the columns in the next 8 rows, with
00014 columns ordered from left to right.
00015
00016 This file must be linked with functions in unifont-support.c.
00017
00018 @author Paul Hardy
00019
00020 @copyright Copyright © 2023 Paul Hardy
00021 */
00022 /*
00023 LICENSE:
00024
00025 This program is free software: you can redistribute it and/or modify
00026 it under the terms of the GNU General Public License as published by
00027 the Free Software Foundation, either version 2 of the License, or
00028 (at your option) any later version.
00029
00030 This program is distributed in the hope that it will be useful,
00031 but WITHOUT ANY WARRANTY; without even the implied warranty of
00032 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00033 GNU General Public License for more details.
00034
00035 You should have received a copy of the GNU General Public License
00036 along with this program. If not, see <http://www.gnu.org/licenses/>.
00037 */
00038 #include <stdio.h>
00039 #include <stdlib.h>

```

```

00040
00041 #define MAXWIDTH 128
00042
00043 int
00044 main (int argc, char *argv[]) {
00045     unsigned codept; /* Unicode code point for glyph */
00046     char instring [MAXWIDTH]; /* input Unifont hex string */
00047     char outstring [MAXWIDTH]; /* output Unifont hex string */
00048     int width; /* width of current glyph */
00049     unsigned char glyph [16][2];
00050     unsigned char glyphbits [16][16]; /* One glyphbits row, for transposing */
00051     unsigned char transpose [2][16]; /* Transposed glyphbits bitmap */
00052
00053     void print_syntax ();
00054
00055     void parse_hex (char *hexstring,
00056                   int *width,
00057                   unsigned *codept,
00058                   unsigned char glyph[16][2]);
00059
00060     void glyph2bits (int width,
00061                   unsigned char glyph[16][2],
00062                   unsigned char glyphbits [16][16]);
00063
00064     void hexpose (int width,
00065                 unsigned char glyphbits [16][16],
00066                 unsigned char transpose [2][16]);
00067
00068     void xglyph2string (int width, unsigned codept,
00069                      unsigned char transpose [2][16],
00070                      char *outstring);
00071
00072     if (argc > 1) {
00073         print_syntax ();
00074         exit (EXIT_FAILURE);
00075     }
00076
00077     while (fgets (instring, MAXWIDTH, stdin) != NULL) {
00078         parse_hex (instring, &width, &codept, glyph);
00079
00080         glyph2bits (width, glyph, glyphbits);
00081
00082         hexpose (width, glyphbits, transpose);
00083
00084         xglyph2string (width, codept, transpose, outstring);
00085
00086         fprintf (stdout, "%s\n", outstring);
00087     }
00088
00089     exit (EXIT_SUCCESS);
00090 }
00091
00092
00093 void
00094 print_syntax () {
00095
00096     fprintf (stderr, "\nSyntax: unihexpose < input.hex > output.hex\n\n");
00097
00098     return;
00099 }
00100

```

## 5.40 src/unijohab2html.c File Reference

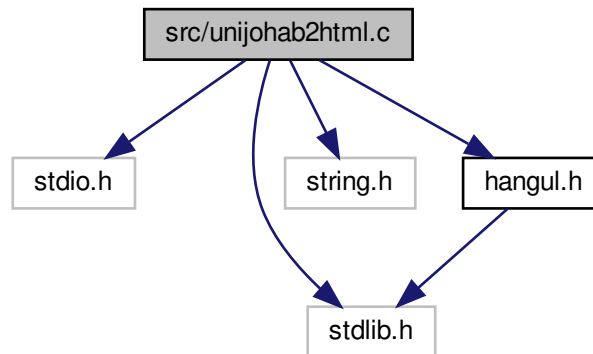
Display overlapped Hangul letter combinations in a grid.

```

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hangul.h"

```

Include dependency graph for unijohab2html.c:



## Macros

- #define [MAXFILENAME](#) 1024
- #define [START\\_JUNG](#) 0  
Vowel index of first vowel with which to begin.
- #define [RED](#) 0xCC0000  
Color code for slightly unsaturated HTML red.
- #define [GREEN](#) 0x00CC00  
Color code for slightly unsaturated HTML green.
- #define [BLUE](#) 0x0000CC  
Color code for slightly unsaturated HTML blue.
- #define [BLACK](#) 0x000000  
Color code for HTML black.
- #define [WHITE](#) 0xFFFFFFFF  
Color code for HTML white.

## Functions

- int [main](#) (int argc, char \*argv[])  
The main function.
- void [parse\\_args](#) (int argc, char \*argv[], int \*inindex, int \*outindex, int \*modern\_only)  
Parse command line arguments.

### 5.40.1 Detailed Description

Display overlapped Hangul letter combinations in a grid.

This displays overlapped letters that form Unicode Hangul Syllables combinations, as a tool to determine bounding boxes for all combinations. It works with both modern and archaic Hangul letters.

Input is a Unifont .hex file such as the "hangul-base.hex" file that is part of the Unifont package. Glyphs are all processed as being 16 pixels wide and 16 pixels tall.



Output is an HTML file containing 16 by 16 pixel grids showing overlaps in table format, arranged by variation of the initial consonant (choseong).

Initial consonants (choseong) have 6 variations. In general, the first three are for combining with vowels (jungseong) that are vertical, horizontal, or vertical and horizontal, respectively; the second set of three variations are for combinations with a final consonant.

The output HTML file can be viewed in a web browser.

Author

Paul Hardy

Copyright

Copyright © 2023 Paul Hardy

Definition in file [unijohab2html.c](#).

## 5.40.2 Macro Definition Documentation

### 5.40.2.1 BLACK

```
#define BLACK 0x000000
```

Color code for HTML black.

Definition at line [62](#) of file [unijohab2html.c](#).

### 5.40.2.2 BLUE

```
#define BLUE 0x0000CC
```

Color code for slightly unsaturated HTML blue.

Definition at line [61](#) of file [unijohab2html.c](#).

### 5.40.2.3 GREEN

```
#define GREEN 0x00CC00
```

Color code for slightly unsaturated HTML green.

Definition at line [60](#) of file [unijohab2html.c](#).

### 5.40.2.4 MAXFILENAME

```
#define MAXFILENAME 1024
```

Definition at line [52](#) of file [unijohab2html.c](#).

### 5.40.2.5 RED

```
#define RED 0xCC0000
```

Color code for slightly unsaturated HTML red.

Definition at line [59](#) of file [unijohab2html.c](#).

### 5.40.2.6 START\_JUNG

```
#define START_JUNG 0
```

Vowel index of first vowel with which to begin.

Definition at line 54 of file [unijohab2html.c](#).

### 5.40.2.7 WHITE

```
#define WHITE 0xFFFFFF
```

Color code for HTML white.

Definition at line 63 of file [unijohab2html.c](#).

## 5.40.3 Function Documentation

### 5.40.3.1 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Definition at line 70 of file [unijohab2html.c](#).

```
00070     {
00071     int i, j; /* loop variables */
00072     unsigned codept;
00073     unsigned max_codept;
00074     int modern_only = 0; /* To just use modern Hangul */
00075     int group, consonant1, vowel, consonant2;
00076     int vowel_variation;
00077     unsigned glyph[MAX_GLYPHS][16];
00078     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00079     unsigned mask;
00080     unsigned overlapped; /* To find overlaps */
00081     int ancient_choseong; /* Flag when within ancient choseong range. */
00082
00083     /*
00084     16x16 pixel grid for each Choseong group, for:
00085
00086     Group 0 to Group 5 with no Jongseong
00087     Group 3 to Group 5 with Jongseong except Nieun
00088     Group 3 to Group 5 with Jongseong Nieun
00089
00090     12 grids total.
00091
00092     Each grid cell will hold a 32-bit HTML RGB color.
00093     */
00094     unsigned grid[12][16][16];
00095
00096     /*
00097     Matrices to detect and report overlaps. Identify vowel
00098     variations where an overlap occurred. For most vowel
00099     variations, there will be no overlap. Then go through
00100     choseong, and then jongseong to find the overlapping
00101     combinations. This saves storage space as an alternative
00102     to storing large 2- or 3-dimensional overlap matrices.
00103     */
00104     // jungcho: Jungseong overlap with Choseong
00105     unsigned jungcho [TOTAL_JUNG * JUNG_VARIATIONS];
00106     // jongjung: Jongseong overlap with Jungseong -- for future expansion
00107     // unsigned jongjung [TOTAL_JUNG * JUNG_VARIATIONS];
00108
00109     int glyphs_overlap; /* If glyph pair being considered overlap. */
00110     int cho_overlaps = 0; /* Number of choseong+vowel overlaps. */
00111     // int jongjung_overlaps = 0; /* Number of vowel+jongseong overlaps. */
00112
00113     int inindex = 0;
00114     int outindex = 0;
00115     FILE *infp, *outfp; /* Input and output file pointers. */
00116
```

```

00117 void   parse_args (int argc, char *argv[], int *inindex, int *outindex,
00118                  int *modern_only);
00119 int    cho_variation (int cho, int jung, int jong);
00120 unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00121 int    glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00122
00123 void   combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00124                      unsigned *combined_glyph);
00125 void   print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00126
00127
00128 /*
00129 Parse command line arguments to open input & output files, if given.
00130 */
00131 if (argc > 1) {
00132     parse_args (argc, argv, &inindex, &outindex, &modern_only);
00133 }
00134
00135 if (inindex == 0) {
00136     infp = stdin;
00137 }
00138 else {
00139     infp = fopen (argv[inindex], "r");
00140     if (infp == NULL) {
00141         fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00142                argv[inindex]);
00143         exit (EXIT_FAILURE);
00144     }
00145 }
00146 if (outindex == 0) {
00147     outfp = stdout;
00148 }
00149 else {
00150     outfp = fopen (argv[outindex], "w");
00151     if (outfp == NULL) {
00152         fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00153                argv[outindex]);
00154         exit (EXIT_FAILURE);
00155     }
00156 }
00157
00158 /*
00159 Initialize glyph array to all zeroes.
00160 */
00161 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00162     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00163 }
00164
00165 /*
00166 Initialize overlap matrices to all zeroes.
00167 */
00168 for (i = 0; i < TOTAL_JUNG * JUNG_VARIATIONS; i++) {
00169     jungcho [i] = 0;
00170 }
00171 // jongjung is reserved for expansion.
00172 // for (i = 0; i < TOTAL_JONG * JONG_VARIATIONS; i++) {
00173 //     jongjung [i] = 0;
00174 // }
00175
00176 /*
00177 Read Hangul base glyph file.
00178 */
00179 max_codept = hangul_read_base16 (infp, glyph);
00180 if (max_codept > 0x8FFF) {
00181     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00182 }
00183
00184 /*
00185 If only examining modern Hangul, fill the ancient glyphs
00186 with blanks to guarantee they won't overlap. This is
00187 not as efficient as ending loops sooner, but is easier
00188 to verify for correctness.
00189 */
00190 if (modern_only) {
00191     for (i = 0x0073; i < JUNG_HEX; i++) {
00192         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00193     }
00194     for (i = 0x027A; i < JONG_HEX; i++) {
00195         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00196     }
00197     for (i = 0x032B; i < 0x0400; i++) {

```

```

00198     for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00199     }
00200 }
00201
00202 /*
00203 Initialize grids to all black (no color) for each of
00204 the 12 Choseong groups.
00205 */
00206 for (group = 0; group < 12; group++) {
00207     for (i = 0; i < 16; i++) {
00208         for (j = 0; j < 16; j++) {
00209             grid[group][i][j] = BLACK; /* No color at first */
00210         }
00211     }
00212 }
00213
00214 /*
00215 Superimpose all Choseong glyphs according to group.
00216 Each grid spot with choseong will be blue.
00217 */
00218 for (group = 0; group < 6; group++) {
00219     for (consonant1 = CHO_HEX + group;
00220         consonant1 < CHO_HEX +
00221             CHO_VARIATIONS * TOTAL_CHO;
00222         consonant1 += CHO_VARIATIONS) {
00223         for (i = 0; i < 16; i++) { /* For each glyph row */
00224             mask = 0x8000;
00225             for (j = 0; j < 16; j++) {
00226                 if (glyph[consonant1][i] & mask) grid[group][i][j] |= BLUE;
00227                 mask »= 1; /* Get next bit in glyph row */
00228             }
00229         }
00230     }
00231 }
00232
00233 /*
00234 Fill with Choseong (initial consonant) to prepare
00235 for groups 3-5 with jongseong except niuen (group+3),
00236 then for groups 3-5 with jongseong nieun (group+6).
00237 */
00238 for (group = 3; group < 6; group++) {
00239     for (i = 0; i < 16; i++) {
00240         for (j = 0; j < 16; j++) {
00241             grid[group + 3][i][j]
00242                 = grid[group][i][j];
00243         }
00244     }
00245 }
00246
00247 /*
00248 For each Jungseong, superimpose first variation on
00249 appropriate Choseong group for grids 0 to 5.
00250 */
00251 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00252     group = cho_variation (-1, vowel, -1);
00253     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00254
00255     for (i = 0; i < 16; i++) { /* For each glyph row */
00256         mask = 0x8000;
00257         for (j = 0; j < 16; j++) {
00258             if (glyph[JUNG_HEX + JUNG_VARIATIONS * vowel][i] & mask) {
00259                 /*
00260 If there was already blue in this grid cell,
00261 mark this vowel variation as having overlap
00262 with choseong (initial consonant) letter(s).
00263 */
00264                 if (grid[group][i][j] & BLUE) glyphs_overlap = 1;
00265
00266                 /* Add green to grid cell color. */
00267                 grid[group][i][j] |= GREEN;
00268             }
00269             mask »= 1; /* Mask for next bit in glyph row */
00270         } /* for j */
00271     } /* for i */
00272     if (glyphs_overlap) {
00273         jungcho [JUNG_VARIATIONS * vowel] = 1;
00274         cho_overlaps++;
00275     }
00276 } /* for each vowel */
00277
00278 /*

```

```

00279 For each Jungseong, superimpose second variation on
00280 appropriate Choseong group for grids 6 to 8.
00281 */
00282 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00283     /*
00284     The second vowel variation is for combination with
00285     a final consonant (Jongseong), with initial consonant
00286     (Choseong) variations (or "groups") 3 to 5. Thus,
00287     if the vowel type returns an initial Choseong group
00288     of 0 to 2, add 3 to it.
00289     */
00290     group = cho_variation (-1, vowel, -1);
00291     /*
00292     Groups 0 to 2 don't use second vowel variation,
00293     so increment if group is below 2.
00294     */
00295     if (group < 3) group += 3;
00296     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00297
00298     for (i = 0; i < 16; i++) { /* For each glyph row */
00299         mask = 0x8000; /* Start mask at leftmost glyph bit */
00300         for (j = 0; j < 16; j++) { /* For each column in this row */
00301             /* "+ 1" is to get each vowel's second variation */
00302             if (glyph [JUNG_HEX +
00303                     JUNG_VARIATIONS * vowel + 1][i] & mask) {
00304                 /* If this cell has blue already, mark as overlapped. */
00305                 if (grid [group + 3][i][j] & BLUE) glyphs_overlap = 1;
00306
00307                 /* Superimpose green on current cell color. */
00308                 grid [group + 3][i][j] |= GREEN;
00309             }
00310             mask »= 1; /* Get next bit in glyph row */
00311         } /* for j */
00312     } /* for i */
00313     if (glyphs_overlap) {
00314         jungcho [JUNG_VARIATIONS * vowel + 1] = 1;
00315         cho_overlaps++;
00316     }
00317 } /* for each vowel */
00318
00319 /*
00320 For each Jungseong, superimpose third variation on
00321 appropriate Choseong group for grids 9 to 11 for
00322 final consonant (Jongseong) of Nieun.
00323 */
00324 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00325     group = cho_variation (-1, vowel, -1);
00326     if (group < 3) group += 3;
00327     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00328
00329     for (i = 0; i < 16; i++) { /* For each glyph row */
00330         mask = 0x8000;
00331         for (j = 0; j < 16; j++) {
00332             if (glyph [JUNG_HEX +
00333                     JUNG_VARIATIONS * vowel + 2][i] & mask) {
00334                 /* If this cell has blue already, mark as overlapped. */
00335                 if (grid [group + 6][i][j] & BLUE) glyphs_overlap = 1;
00336
00337                 grid [group + 6][i][j] |= GREEN;
00338             }
00339             mask »= 1; /* Get next bit in glyph row */
00340         } /* for j */
00341     } /* for i */
00342     if (glyphs_overlap) {
00343         jungcho [JUNG_VARIATIONS * vowel + 2] = 1;
00344         cho_overlaps++;
00345     }
00346 } /* for each vowel */
00347
00348 /*
00350 Superimpose all final consonants except nieun for grids 6 to 8.
00351 */
00352 for (consonant2 = 0; consonant2 < TOTAL_JONG; consonant2++) {
00353     /*
00354     Skip over Jongseong Nieun, because it is covered in
00355     grids 9 to 11 after this loop.
00356     */
00357     if (consonant2 == 3) consonant2++;
00358
00359     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */

```

```

00360     for (i = 0; i < 16; i++) { /* For each glyph row */
00361         mask = 0x8000;
00362         for (j = 0; j < 16; j++) {
00363             if (glyph [JONG_HEX +
00364                 JONG_VARIATIONS * consonant2][i] & mask) {
00365                 if (grid[6][i][j] & GREEN ||
00366                     grid[7][i][j] & GREEN ||
00367                     grid[8][i][j] & GREEN) glyphs_overlap = 1;
00368
00369                 grid[6][i][j] |= RED;
00370                 grid[7][i][j] |= RED;
00371                 grid[8][i][j] |= RED;
00372             }
00373             mask »= 1; /* Get next bit in glyph row */
00374         } /* for j */
00375     } /* for i */
00376     // jongjung is for expansion
00377     // if (glyphs_overlap) {
00378     //     jongjung [JONG_VARIATIONS * consonant2] = 1;
00379     //     jongjung_overlaps++;
00380     // }
00381 } /* for each final consonant except nieun */
00382
00383 /*
00384 Superimpose final consonant 3 (Jongseong Nieun) on
00385 groups 9 to 11.
00386 */
00387 codept = JONG_HEX + 3 * JONG_VARIATIONS;
00388
00389 for (i = 0; i < 16; i++) { /* For each glyph row */
00390     mask = 0x8000;
00391     for (j = 0; j < 16; j++) {
00392         if (glyph[codept][i] & mask) {
00393             grid[ 9][i][j] |= RED;
00394             grid[10][i][j] |= RED;
00395             grid[11][i][j] |= RED;
00396         }
00397     } mask »= 1; /* Get next bit in glyph row */
00398 }
00399 }
00400
00401
00402 /*
00403 Turn the black (uncolored) cells into white for better
00404 visibility of grid when displayed.
00405 */
00406 for (group = 0; group < 12; group++) {
00407     for (i = 0; i < 16; i++) {
00408         for (j = 0; j < 16; j++) {
00409             if (grid[group][i][j] == BLACK) grid[group][i][j] = WHITE;
00410         }
00411     }
00412 }
00413
00414
00415 /*
00416 Generate HTML output.
00417 */
00418 fprintf (outfp, "<html>\n");
00419 fprintf (outfp, "<head>\n");
00420 fprintf (outfp, " <title>Johab 6/3/1 Overlaps</title>\n");
00421 fprintf (outfp, "</head>\n");
00422 fprintf (outfp, "<body bgcolor=\`#FFFFCC\`>\n");
00423
00424 fprintf (outfp, "<center>\n");
00425 fprintf (outfp, " <h1>Unifont Hangul Jamo Syllable Components</h1>\n");
00426 fprintf (outfp, " <h2>Johab 6/3/1 Overlap</h2><br><br>\n");
00427
00428 /* Print the color code key for the table. */
00429 fprintf (outfp, " <table border=\`1\` cellpadding=\`10\`>\n");
00430 fprintf (outfp, " <tr><th colspan=\`2\` align=\`center\` bgcolor=\`#FFCC80\`>");
00431 fprintf (outfp, "<font size=\`+1\`>Key</font></th></tr>\n");
00432 fprintf (outfp, " <tr>\n");
00433 fprintf (outfp, " <th align=\`center\` bgcolor=\`#FFFF80\`>Color</th>\n");
00434 fprintf (outfp, " <th align=\`center\` bgcolor=\`#FFFF80\`>Letter(s)</th>\n");
00435 fprintf (outfp, " </tr>\n");
00436
00437 fprintf (outfp, " <tr><td bgcolor=\`#%06X\`>", BLUE);
00438 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00439 fprintf (outfp, "<td>Choseong (Initial Consonant)</td></tr>\n");
00440

```

```

00441 fprintf (outfp, " <tr><td bgcolor=\\"#%06X\">", GREEN);
00442 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00443 fprintf (outfp, "<td>Jungseong (Medial Vowel/Diphthong)</td></tr>\n");
00444
00445 fprintf (outfp, " <tr><td bgcolor=\\"#%06X\">", RED);
00446 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00447 fprintf (outfp, "<td>Jongseong (Final Consonant)</td></tr>\n");
00448
00449 fprintf (outfp, " <tr><td bgcolor=\\"#%06X\">", BLUE | GREEN);
00450 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00451 fprintf (outfp, "<td>Choseong + Jungseong Overlap</td></tr>\n");
00452
00453 fprintf (outfp, " <tr><td bgcolor=\\"#%06X\">", GREEN | RED);
00454 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00455 fprintf (outfp, "<td>Jungseong + Jongseong Overlap</td></tr>\n");
00456
00457 fprintf (outfp, " <tr><td bgcolor=\\"#%06X\">", RED | BLUE);
00458 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00459 fprintf (outfp, "<td>Choseong + Jongseong Overlap</td></tr>\n");
00460
00461 fprintf (outfp, " <tr><td bgcolor=\\"#%06X\">", RED | GREEN | BLUE);
00462 fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>");
00463 fprintf (outfp, "<td>Choseong + Jungseong + Jongseong Overlap</td></tr>\n");
00464
00465 fprintf (outfp, " </table>\n");
00466 fprintf (outfp, " <br><br>\n");
00467
00468
00469 for (group = 0; group < 12; group++) {
00470     /* Arrange tables 3 across, 3 down. */
00471     if ((group % 3) == 0) {
00472         fprintf (outfp, " <table border=\\"0\" cellpadding=\\"10\">\n");
00473         fprintf (outfp, " <tr>\n");
00474     }
00475
00476     fprintf (outfp, " <td>\n");
00477     fprintf (outfp, " <table border=\\"3\" cellpadding=\\"2\">\n");
00478     fprintf (outfp, " <tr><th colspan=\\"16\" bgcolor=\\"#FFF80\">");
00479     fprintf (outfp, "Choseong Group %d, %s %s</th></tr>\n",
00480             group < 6 ? group : (group > 8 ? group - 6 : group - 3),
00481             group < 6 ? (group < 3 ? "No" : "Without") : "With",
00482             group < 9 ? "Jongseong" : "Nieun");
00483
00484     for (i = 0; i < 16; i++) {
00485         fprintf (outfp, " <tr>\n");
00486         for (j = 0; j < 16; j++) {
00487             fprintf (outfp, " <td bgcolor=\\"#%06X\">",
00488                     grid[group][i][j]);
00489             fprintf (outfp, "&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;</td>\n");
00490         }
00491         fprintf (outfp, " </tr>\n");
00492     }
00493
00494     fprintf (outfp, " </td>\n");
00495     fprintf (outfp, " </tr>\n");
00496     fprintf (outfp, " </table>\n");
00497     fprintf (outfp, " </td>\n");
00498
00499     if ((group % 3) == 2) {
00500         fprintf (outfp, " </tr>\n");
00501         fprintf (outfp, " </table>\n <br>\n");
00502     }
00503 }
00504
00505 /* Wrap up HTML table output. */
00506 fprintf (outfp, "</center>\n");
00507
00508 /*
00509 Print overlapping initial consonant + vowel combinations.
00510 */
00511 fprintf (outfp, "<h2>%d Vowel Overlaps with Initial Consonants Found</h2>",
00512         cho_overlaps);
00513 fprintf (outfp, "<font size=\"+1\"><pre>\n");
00514
00515 for (i = JUNG_HEX;
00516      i < JUNG_HEX + TOTAL_JUNG * JUNG_VARIATIONS;
00517      i++) {
00518     /*
00519 If this vowel variation (Jungseong) had overlaps
00520 with one or more initial consonants (Choseong),
00521 find and print them.

```

```

00522 */
00523 if (jungcho [i - JUNG_HEX]) {
00524     ancient_choseong = 0; /* Not within ancient choseong range yet. */
00525     fprintf (outfp, "<font color=#0000FF><b>");
00526     if (i >= JUNG_ANCIENT_HEX) {
00527         if (i >= JUNG_EXTB_HEX) fprintf (outfp, "Extended-B ");
00528         fprintf (outfp, "Ancient ");
00529     }
00530     fprintf (outfp, "Vowel at 0x%04X and&hellip;</b>", i + PUA_START);
00531     fprintf (outfp, "</font>\n\n");
00532
00533     /*
00534     Get current vowel number, 0 to (TOTAL_JUNG - 1), and
00535     current vowel variation, 0 or 1, or 2 for final nieun.
00536     */
00537     vowel = (i - JUNG_HEX) / JUNG_VARIATIONS;
00538     vowel_variation = (i - JUNG_HEX) % JUNG_VARIATIONS;
00539
00540     /* Get first Choseong group for this vowel, 0 to 5. */
00541     group = cho_variation (-1, vowel, -1);
00542
00543     /*
00544     If this vowel variation is used with a final consonant
00545     (Jongseong) and the default initial consonant (Choseong)
00546     group for this vowel is < 3, add 3 to current Chosenong
00547     group.
00548     */
00549     if (vowel_variation > 0 && group < 3) group += 3;
00550
00551     for (consonant1 = 0; consonant1 < TOTAL_CHO; consonant1++) {
00552         overlapped = glyph_overlap (glyph [i],
00553             glyph [consonant1 * CHO_VARIATIONS
00554                 + CHO_HEX + group]);
00555
00556         /*
00557         If we just entered ancient choseong range, flag it.
00558         */
00559         if (overlapped && consonant1 >= 19 && ancient_choseong == 0) {
00560             fprintf (outfp, "<font color=#0000FF>><b>");
00561             fprintf (outfp, "&hellip;Ancient Choseong&hellip;</b></font>\n");
00562             ancient_choseong = 1;
00563         }
00564         /*
00565         If overlapping choseong found, print combined glyph.
00566         */
00567         if (overlapped != 0) {
00568
00569             combine_glyphs (glyph [i],
00570                 glyph [consonant1 * CHO_VARIATIONS
00571                     + CHO_HEX + group],
00572                 tmp_glyph);
00573
00574             print_glyph_txt (outfp,
00575                 PUA_START +
00576                 consonant1 * CHO_VARIATIONS +
00577                 CHO_HEX + group,
00578                 tmp_glyph);
00579
00580             } /* If overlapping pixels found. */
00581         } /* For each initial consonant (Choseong) */
00582     } /* Find the initial consonant that overlapped this vowel variation. */
00583 } /* For each variation of each vowel (Jungseong) */
00584
00585 fputc ('\n', outfp);
00586
00587 fprintf (outfp, "</pre></font>\n");
00588 fprintf (outfp, "</body>\n");
00589 fprintf (outfp, "</html>\n");
00590
00591 fclose (infp);
00592 fclose (outfp);
00593
00594
00595 exit (EXIT_SUCCESS);
00596 }

```



## 5.40.3.2 parse\_args()

```
void parse_args (
    int argc,
    char * argv[],
    int * inindex,
    int * outindex,
    int * modern_only )
```

Parse command line arguments.

## Parameters

in	argc	The argc parameter to the main function.
in	argv	The argv command line arguments to the main function.
in,out	infile	The input file-name; defaults to NULL.
in,out	outfile	The output file-name; defaults to NULL.

Definition at line [608](#) of file [unijohab2html.c](#).

```
00609     {
00610     int arg_count; /* Current index into argv[]. */
00611
00612     int strcmp (const char *s1, const char *s2, size_t n);
00613
```

```

00614
00615 arg_count = 1;
00616
00617 while (arg_count < argc) {
00618     /* If input file is specified, open it for read access. */
00619     if (strcmp (argv [arg_count], "-i", 2) == 0) {
00620         arg_count++;
00621         if (arg_count < argc) {
00622             *inindex = arg_count;
00623         }
00624     }
00625     /* If only modern Hangul is desired, set modern_only flag. */
00626     else if (strcmp (argv [arg_count], "-m", 2) == 0 ||
00627             strcmp (argv [arg_count], "--modern", 8) == 0) {
00628         *modern_only = 1;
00629     }
00630     /* If output file is specified, open it for write access. */
00631     else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00632         arg_count++;
00633         if (arg_count < argc) {
00634             *outindex = arg_count;
00635         }
00636     }
00637     /* If help is requested, print help message and exit. */
00638     else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00639             strcmp (argv [arg_count], "--help", 6) == 0) {
00640         printf ("\nunjohab2html [options]\n\n");
00641         printf (" Generates an HTML page of overlapping Hangul letters from an input\n");
00642         printf (" Unifont .hex file encoded in Johab 6/3/1 format.\n\n");
00643
00644         printf (" Option      Parameters  Function\n");
00645         printf (" -----  -\n");
00646         printf (" -h, --help          Print this message and exit.\n\n");
00647         printf (" -i                input_file  Unifont hangul-base.hex formatted input file.\n\n");
00648         printf (" -o                output_file  HTML output file showing overlapping letters.\n\n");
00649         printf (" -m, --modern       Only examine modern Hangul letters.\n\n");
00650         printf (" Example:\n\n");
00651         printf ("     unjohab2html -i hangul-base.hex -o hangul-syllables.html\n\n");
00652
00653         exit (EXIT_SUCCESS);
00654     }
00655
00656     arg_count++;
00657 }
00658
00659 return;
00660 }

```

## 5.41 unjohab2html.c

[Go to the documentation of this file.](#)

```

00001 /**
00002 @file unjohab2html.c
00003
00004 @brief Display overlapped Hangul letter combinations in a grid.
00005
00006 This displays overlapped letters that form Unicode Hangul Syllables
00007 combinations, as a tool to determine bounding boxes for all combinations.
00008 It works with both modern and archaic Hangul letters.
00009
00010 Input is a Unifont .hex file such as the "hangul-base.hex" file that
00011 is part of the Unifont package. Glyphs are all processed as being
00012 16 pixels wide and 16 pixels tall.
00013
00014 Output is an HTML file containing 16 by 16 pixel grids showing
00015 overlaps in table format, arranged by variation of the initial
00016 consonant (choseong).
00017
00018 Initial consonants (choseong) have 6 variations. In general, the
00019 first three are for combining with vowels (jungseong) that are
00020 vertical, horizontal, or vertical and horizontal, respectively;
00021 the second set of three variations are for combinations with a final
00022 consonant.
00023
00024 The output HTML file can be viewed in a web browser.
00025
00026 @author Paul Hardy
00027

```

```

00028 @copyright Copyright © 2023 Paul Hardy
00029 */
00030 /*
00031 LICENSE:
00032
00033 This program is free software: you can redistribute it and/or modify
00034 it under the terms of the GNU General Public License as published by
00035 the Free Software Foundation, either version 2 of the License, or
00036 (at your option) any later version.
00037
00038 This program is distributed in the hope that it will be useful,
00039 but WITHOUT ANY WARRANTY; without even the implied warranty of
00040 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00041 GNU General Public License for more details.
00042
00043 You should have received a copy of the GNU General Public License
00044 along with this program. If not, see <http://www.gnu.org/licenses/>.
00045 */
00046
00047 #include <stdio.h>
00048 #include <stdlib.h>
00049 #include <string.h>
00050 #include "hangul.h"
00051
00052 #define MAXFILENAME 1024
00053
00054 #define START_JUNG 0 ///< Vowel index of first vowel with which to begin.
00055 // #define START_JUNG 21 /* Use this #define for just ancient vowels */
00056
00057
00058 /* (Red, Green, Blue) HTML color coordinates. */
00059 #define RED 0xCC0000 ///< Color code for slightly unsaturated HTML red.
00060 #define GREEN 0x00CC00 ///< Color code for slightly unsaturated HTML green.
00061 #define BLUE 0x0000CC ///< Color code for slightly unsaturated HTML blue.
00062 #define BLACK 0x000000 ///< Color code for HTML black.
00063 #define WHITE 0xFFFFFFFF ///< Color code for HTML white.
00064
00065
00066 /**
00067 @brief The main function.
00068 */
00069 int
00070 main (int argc, char *argv[]) {
00071     int i, j; /* loop variables */
00072     unsigned codept;
00073     unsigned max_codept;
00074     int modern_only = 0; /* To just use modern Hangul */
00075     int group, consonant1, vowel, consonant2;
00076     int vowel_variation;
00077     unsigned glyph[MAX_GLYPHS][16];
00078     unsigned tmp_glyph [16]; /* To build one combined glyph at a time. */
00079     unsigned mask;
00080     unsigned overlapped; /* To find overlaps */
00081     int ancient_choseong; /* Flag when within ancient choseong range. */
00082
00083     /*
00084     16x16 pixel grid for each Choseong group, for:
00085
00086     Group 0 to Group 5 with no Jongseong
00087     Group 3 to Group 5 with Jongseong except Nieun
00088     Group 3 to Group 5 with Jongseong Nieun
00089
00090     12 grids total.
00091
00092     Each grid cell will hold a 32-bit HTML RGB color.
00093     */
00094     unsigned grid[12][16][16];
00095
00096     /*
00097     Matrices to detect and report overlaps. Identify vowel
00098     variations where an overlap occurred. For most vowel
00099     variations, there will be no overlap. Then go through
00100     choseong, and then jongseong to find the overlapping
00101     combinations. This saves storage space as an alternative
00102     to storing large 2- or 3-dimensional overlap matrices.
00103     */
00104     // jungcho: Jungseong overlap with Choseong
00105     unsigned jungcho [TOTAL_JUNG * JUNG_VARIATIONS];
00106     // jongjung: Jongseong overlap with Jungseong -- for future expansion
00107     // unsigned jongjung [TOTAL_JUNG * JUNG_VARIATIONS];
00108

```

```

00109 int glyphs_overlap; /* If glyph pair being considered overlap. */
00110 int cho_overlaps = 0; /* Number of choseong+vowel overlaps. */
00111 // int jongjung_overlaps = 0; /* Number of vowel+jongseong overlaps. */
00112
00113 int inindex = 0;
00114 int outindex = 0;
00115 FILE *infp, *outfp; /* Input and output file pointers. */
00116
00117 void parse_args (int argc, char *argv[], int *inindex, int *outindex,
00118                 int *modern_only);
00119 int cho_variation (int cho, int jung, int jong);
00120 unsigned hangul_read_base16 (FILE *infp, unsigned glyph[][16]);
00121 int glyph_overlap (unsigned *glyph1, unsigned *glyph2);
00122
00123 void combine_glyphs (unsigned *glyph1, unsigned *glyph2,
00124                    unsigned *combined_glyph);
00125 void print_glyph_txt (FILE *fp, unsigned codept, unsigned *this_glyph);
00126
00127
00128 /*
00129 Parse command line arguments to open input & output files, if given.
00130 */
00131 if (argc > 1) {
00132     parse_args (argc, argv, &inindex, &outindex, &modern_only);
00133 }
00134
00135 if (inindex == 0) {
00136     infp = stdin;
00137 }
00138 else {
00139     infp = fopen (argv[inindex], "r");
00140     if (infp == NULL) {
00141         fprintf (stderr, "\n*** ERROR: Cannot open %s for input.\n\n",
00142                 argv[inindex]);
00143         exit (EXIT_FAILURE);
00144     }
00145 }
00146 if (outindex == 0) {
00147     outfp = stdout;
00148 }
00149 else {
00150     outfp = fopen (argv[outindex], "w");
00151     if (outfp == NULL) {
00152         fprintf (stderr, "\n*** ERROR: Cannot open %s for output.\n\n",
00153                 argv[outindex]);
00154         exit (EXIT_FAILURE);
00155     }
00156 }
00157
00158 /*
00159 Initialize glyph array to all zeroes.
00160 */
00161 for (codept = 0; codept < MAX_GLYPHS; codept++) {
00162     for (i = 0; i < 16; i++) glyph[codept][i] = 0x0000;
00163 }
00164
00165 /*
00166 Initialize overlap matrices to all zeroes.
00167 */
00168 for (i = 0; i < TOTAL_JUNG * JUNG_VARIATIONS; i++) {
00169     jungcho [i] = 0;
00170 }
00171 // jongjung is reserved for expansion.
00172 // for (i = 0; i < TOTAL_JONG * JONG_VARIATIONS; i++) {
00173 //     jongjung [i] = 0;
00174 // }
00175
00176 /*
00177 Read Hangul base glyph file.
00178 */
00179 max_codept = hangul_read_base16 (infp, glyph);
00180 if (max_codept > 0x8FFF) {
00181     fprintf (stderr, "\nWARNING: Hangul glyph range exceeds PUA space.\n\n");
00182 }
00183
00184 /*
00185 If only examining modern Hangul, fill the ancient glyphs
00186 with blanks to guarantee they won't overlap. This is
00187 not as efficient as ending loops sooner, but is easier
00188 to verify for correctness.
00189 */

```

```

00190 if (modern_only) {
00191     for (i = 0x0073; i < JUNG_HEX; i++) {
00192         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00193     }
00194     for (i = 0x027A; i < JONG_HEX; i++) {
00195         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00196     }
00197     for (i = 0x032B; i < 0x0400; i++) {
00198         for (j = 0; j < 16; j++) glyph[i][j] = 0x0000;
00199     }
00200 }
00201
00202 /*
00203 Initialize grids to all black (no color) for each of
00204 the 12 Choseong groups.
00205 */
00206 for (group = 0; group < 12; group++) {
00207     for (i = 0; i < 16; i++) {
00208         for (j = 0; j < 16; j++) {
00209             grid[group][i][j] = BLACK; /* No color at first */
00210         }
00211     }
00212 }
00213
00214 /*
00215 Superimpose all Choseong glyphs according to group.
00216 Each grid spot with choseong will be blue.
00217 */
00218 for (group = 0; group < 6; group++) {
00219     for (consonant1 = CHO_HEX + group;
00220          consonant1 < CHO_HEX +
00221                CHO_VARIATIONS * TOTAL_CHO;
00222          consonant1 += CHO_VARIATIONS) {
00223         for (i = 0; i < 16; i++) { /* For each glyph row */
00224             mask = 0x8000;
00225             for (j = 0; j < 16; j++) {
00226                 if (glyph[consonant1][i] & mask) grid[group][i][j] |= BLUE;
00227                 mask »= 1; /* Get next bit in glyph row */
00228             }
00229         }
00230     }
00231 }
00232
00233 /*
00234 Fill with Choseong (initial consonant) to prepare
00235 for groups 3-5 with jongseong except niuen (group+3),
00236 then for groups 3-5 with jongseong nieun (group+6).
00237 */
00238 for (group = 3; group < 6; group++) {
00239     for (i = 0; i < 16; i++) {
00240         for (j = 0; j < 16; j++) {
00241             grid[group + 6][i][j] = grid[group + 3][i][j]
00242                 = grid[group][i][j];
00243         }
00244     }
00245 }
00246
00247 /*
00248 For each Jungseong, superimpose first variation on
00249 appropriate Choseong group for grids 0 to 5.
00250 */
00251 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00252     group = cho_variation (-1, vowel, -1);
00253     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00254
00255     for (i = 0; i < 16; i++) { /* For each glyph row */
00256         mask = 0x8000;
00257         for (j = 0; j < 16; j++) {
00258             if (glyph[JUNG_HEX + JUNG_VARIATIONS * vowel][i] & mask) {
00259                 /*
00260 If there was already blue in this grid cell,
00261 mark this vowel variation as having overlap
00262 with choseong (initial consonant) letter(s).
00263 */
00264                 if (grid[group][i][j] & BLUE) glyphs_overlap = 1;
00265
00266                 /* Add green to grid cell color. */
00267                 grid[group][i][j] |= GREEN;
00268             }
00269             mask »= 1; /* Mask for next bit in glyph row */
00270         } /* for j */

```

```

00271     } /* for i */
00272     if (glyphs_overlap) {
00273         jungcho [JUNG_VARIATIONS * vowel] = 1;
00274         cho_overlaps++;
00275     }
00276 } /* for each vowel */
00277
00278 /*
00279 For each Jungseong, superimpose second variation on
00280 appropriate Choseong group for grids 6 to 8.
00281 */
00282 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00283     /*
00284 The second vowel variation is for combination with
00285 a final consonant (Jongseong), with initial consonant
00286 (Choseong) variations (or "groups") 3 to 5. Thus,
00287 if the vowel type returns an initial Choseong group
00288 of 0 to 2, add 3 to it.
00289 */
00290     group = cho_variation (-1, vowel, -1);
00291     /*
00292 Groups 0 to 2 don't use second vowel variation,
00293 so increment if group is below 2.
00294 */
00295     if (group < 3) group += 3;
00296     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00297
00298     for (i = 0; i < 16; i++) { /* For each glyph row */
00299         mask = 0x8000; /* Start mask at leftmost glyph bit */
00300         for (j = 0; j < 16; j++) { /* For each column in this row */
00301             /* "+ 1" is to get each vowel's second variation */
00302             if (glyph [JUNG_HEX +
00303                     JUNG_VARIATIONS * vowel + 1][i] & mask) {
00304                 /* If this cell has blue already, mark as overlapped. */
00305                 if (grid [group + 3][i][j] & BLUE) glyphs_overlap = 1;
00306
00307                 /* Superimpose green on current cell color. */
00308                 grid [group + 3][i][j] |= GREEN;
00309             }
00310             mask »= 1; /* Get next bit in glyph row */
00311         } /* for j */
00312     } /* for i */
00313     if (glyphs_overlap) {
00314         jungcho [JUNG_VARIATIONS * vowel + 1] = 1;
00315         cho_overlaps++;
00316     }
00317 } /* for each vowel */
00318
00319 /*
00320 For each Jungseong, superimpose third variation on
00321 appropriate Choseong group for grids 9 to 11 for
00322 final consonant (Jongseong) of Nieun.
00323 */
00324 for (vowel = START_JUNG; vowel < TOTAL_JUNG; vowel++) {
00325     group = cho_variation (-1, vowel, -1);
00326     if (group < 3) group += 3;
00327     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00328
00329     for (i = 0; i < 16; i++) { /* For each glyph row */
00330         mask = 0x8000;
00331         for (j = 0; j < 16; j++) {
00332             if (glyph[JUNG_HEX +
00333                     JUNG_VARIATIONS * vowel + 2][i] & mask) {
00334                 /* If this cell has blue already, mark as overlapped. */
00335                 if (grid[group + 6][i][j] & BLUE) glyphs_overlap = 1;
00336
00337                 grid[group + 6][i][j] |= GREEN;
00338             }
00339             mask »= 1; /* Get next bit in glyph row */
00340         } /* for j */
00341     } /* for i */
00342     if (glyphs_overlap) {
00343         jungcho [JUNG_VARIATIONS * vowel + 2] = 1;
00344         cho_overlaps++;
00345     }
00346 } /* for each vowel */
00347
00348 /*
00349 Superimpose all final consonants except nieun for grids 6 to 8.
00350 */
00351 */

```

```

00352 for (consonant2 = 0; consonant2 < TOTAL_JONG; consonant2++) {
00353     /*
00354     Skip over Jongseong Nieun, because it is covered in
00355     grids 9 to 11 after this loop.
00356     */
00357     if (consonant2 == 3) consonant2++;
00358
00359     glyphs_overlap = 0; /* Assume the 2 glyphs do not overlap. */
00360     for (i = 0; i < 16; i++) { /* For each glyph row */
00361         mask = 0x8000;
00362         for (j = 0; j < 16; j++) {
00363             if (glyph [JONG_HEX +
00364                 JONG_VARIATIONS * consonant2][i] & mask) {
00365                 if (grid[6][i][j] & GREEN ||
00366                     grid[7][i][j] & GREEN ||
00367                     grid[8][i][j] & GREEN) glyphs_overlap = 1;
00368
00369                 grid[6][i][j] |= RED;
00370                 grid[7][i][j] |= RED;
00371                 grid[8][i][j] |= RED;
00372             }
00373             mask >>= 1; /* Get next bit in glyph row */
00374         } /* for j */
00375     } /* for i */
00376     // jongjung is for expansion
00377     // if (glyphs_overlap) {
00378     //     jongjung [JONG_VARIATIONS * consonant2] = 1;
00379     //     jongjung_overlaps++;
00380     // }
00381 } /* for each final consonant except nieun */
00382
00383 /*
00384 Superimpose final consonant 3 (Jongseong Nieun) on
00385 groups 9 to 11.
00386 */
00387 codept = JONG_HEX + 3 * JONG_VARIATIONS;
00388
00389 for (i = 0; i < 16; i++) { /* For each glyph row */
00390     mask = 0x8000;
00391     for (j = 0; j < 16; j++) {
00392         if (glyph[codept][i] & mask) {
00393             grid[9][i][j] |= RED;
00394             grid[10][i][j] |= RED;
00395             grid[11][i][j] |= RED;
00396         }
00397         mask >>= 1; /* Get next bit in glyph row */
00398     }
00399 }
00400
00401 /*
00402 Turn the black (uncolored) cells into white for better
00403 visibility of grid when displayed.
00404 */
00405 for (group = 0; group < 12; group++) {
00406     for (i = 0; i < 16; i++) {
00407         for (j = 0; j < 16; j++) {
00408             if (grid[group][i][j] == BLACK) grid[group][i][j] = WHITE;
00409         }
00410     }
00411 }
00412 }
00413
00414 /*
00415 Generate HTML output.
00416 */
00417 fprintf (outfp, "<html>\n");
00418 fprintf (outfp, "<head>\n");
00420 fprintf (outfp, " <title>Johab 6/3/1 Overlaps</title>\n");
00421 fprintf (outfp, "</head>\n");
00422 fprintf (outfp, "<body bgcolor=#FFFFCC>\n");
00423
00424 fprintf (outfp, "<center>\n");
00425 fprintf (outfp, " <h1>Unifont Hangul Jamo Syllable Components</h1>\n");
00426 fprintf (outfp, " <h2>Johab 6/3/1 Overlap</h2><br><br>\n");
00427
00428 /* Print the color code key for the table. */
00429 fprintf (outfp, " <table border='1' cellpadding='10'>\n");
00430 fprintf (outfp, " <tr><th colspan='2' align='center' bgcolor=#FFCC80'>");
00431 fprintf (outfp, "<font size='+1'>Key</font></th></tr>\n");
00432 fprintf (outfp, " <tr>\n");

```





```

00514
00515 for (i = JUNG_HEX;
00516      i < JUNG_HEX + TOTAL_JUNG * JUNG_VARIATIONS;
00517      i++) {
00518     /*
00519     If this vowel variation (Jungseong) had overlaps
00520     with one or more initial consonants (Choseong),
00521     find and print them.
00522     */
00523     if (jungcho [i - JUNG_HEX]) {
00524         ancient_choseong = 0; /* Not within ancient choseong range yet. */
00525         fprintf (outfp, "<font color=\">#0000FF\ "><b>");
00526         if (i >= JUNG_ANCIENT_HEX) {
00527             if (i >= JUNG_EXTB_HEX) fprintf (outfp, "Extended-B ");
00528             fprintf (outfp, "Ancient ");
00529         }
00530         fprintf (outfp, "Vowel at 0x%04X and&hellip;</b>", i + PUA_START);
00531         fprintf (outfp, "</font>\n\n");
00532     }
00533     /*
00534     Get current vowel number, 0 to (TOTAL_JUNG - 1), and
00535     current vowel variation, 0 or 1, or 2 for final nieun.
00536     */
00537     vowel = (i - JUNG_HEX) / JUNG_VARIATIONS;
00538     vowel_variation = (i - JUNG_HEX) % JUNG_VARIATIONS;
00539
00540     /* Get first Choseong group for this vowel, 0 to 5. */
00541     group = cho_variation (-1, vowel, -1);
00542
00543     /*
00544     If this vowel variation is used with a final consonant
00545     (Jongseong) and the default initial consonant (Choseong)
00546     group for this vowel is < 3, add 3 to current Chosenong
00547     group.
00548     */
00549     if (vowel_variation > 0 && group < 3) group += 3;
00550
00551     for (consonant1 = 0; consonant1 < TOTAL_CHO; consonant1++) {
00552         overlapped = glyph_overlap (glyph [i],
00553                                   glyph [consonant1 * CHO_VARIATIONS
00554                                             + CHO_HEX + group]);
00555     }
00556     /*
00557     If we just entered ancient choseong range, flag it.
00558     */
00559     if (overlapped && consonant1 >= 19 && ancient_choseong == 0) {
00560         fprintf (outfp, "<font color=\">#0000FF\ "><b>");
00561         fprintf (outfp, "&hellip;Ancient Choseong&hellip;</b></font>\n");
00562         ancient_choseong = 1;
00563     }
00564     /*
00565     If overlapping choseong found, print combined glyph.
00566     */
00567     if (overlapped != 0) {
00568
00569         combine_glyphs (glyph [i],
00570                       glyph [consonant1 * CHO_VARIATIONS
00571                               + CHO_HEX + group],
00572                       tmp_glyph);
00573
00574         print_glyph_txt (outfp,
00575                          PUA_START +
00576                          consonant1 * CHO_VARIATIONS +
00577                          CHO_HEX + group,
00578                          tmp_glyph);
00579
00580     } /* If overlapping pixels found. */
00581     } /* For each initial consonant (Choseong) */
00582     } /* Find the initial consonant that overlapped this vowel variation. */
00583 } /* For each variation of each vowel (Jungseong) */
00584
00585 fputc ('\n', outfp);
00586
00587 fprintf (outfp, "</pre></font>\n");
00588 fprintf (outfp, "</body>\n");
00589 fprintf (outfp, "</html>\n");
00590
00591 fclose (infp);
00592 fclose (outfp);
00593
00594

```

```

00595  exit (EXIT_SUCCESS);
00596  }
00597
00598
00599 /**
00600 @brief Parse command line arguments.
00601
00602 @param[in] argc The argc parameter to the main function.
00603 @param[in] argv The argv command line arguments to the main function.
00604 @param[in,out] infile The input filename; defaults to NULL.
00605 @param[in,out] outfile The output filename; defaults to NULL.
00606 */
00607 void
00608 parse_args (int argc, char *argv[], int *inindex, int *outindex,
00609             int *modern_only) {
00610     int arg_count; /* Current index into argv[]. */
00611
00612     int strcmp (const char *s1, const char *s2, size_t n);
00613
00614     arg_count = 1;
00615
00616     while (arg_count < argc) {
00617         /* If input file is specified, open it for read access. */
00618         if (strcmp (argv [arg_count], "-i", 2) == 0) {
00619             arg_count++;
00620             if (arg_count < argc) {
00621                 *inindex = arg_count;
00622             }
00623         }
00624         /* If only modern Hangul is desired, set modern_only flag. */
00625         else if (strcmp (argv [arg_count], "-m", 2) == 0 ||
00626                 strcmp (argv [arg_count], "--modern", 8) == 0) {
00627             *modern_only = 1;
00628         }
00629         /* If output file is specified, open it for write access. */
00630         else if (strcmp (argv [arg_count], "-o", 2) == 0) {
00631             arg_count++;
00632             if (arg_count < argc) {
00633                 *outindex = arg_count;
00634             }
00635         }
00636         /* If help is requested, print help message and exit. */
00637         else if (strcmp (argv [arg_count], "-h", 2) == 0 ||
00638                 strcmp (argv [arg_count], "--help", 6) == 0) {
00639             printf ("\nunjohab2html [options]\n\n");
00640             printf ("    Generates an HTML page of overlapping Hangul letters from an input\n");
00641             printf ("    Unifont .hex file encoded in Johab 6/3/1 format.\n\n");
00642
00643             printf ("    Option      Parameters  Function\n");
00644             printf ("    -----      -\n");
00645             printf ("    -h, --help      Print this message and exit.\n\n");
00646             printf ("    -i      input_file  Unifont hangul-base.hex formatted input file.\n\n");
00647             printf ("    -o      output_file  HTML output file showing overlapping letters.\n\n");
00648             printf ("    -m, --modern    Only examine modern Hangul letters.\n\n");
00649             printf ("    Example:\n\n");
00650             printf ("    unjohab2html -i hangul-base.hex -o hangul-syllables.html\n\n");
00651
00652             exit (EXIT_SUCCESS);
00653         }
00654     }
00655     arg_count++;
00656 }
00657
00658
00659 return;
00660 }
00661

```

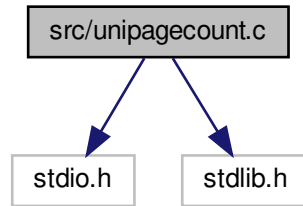
## 5.42 src/unipagecount.c File Reference

unipagecount - Count the number of glyphs defined in each page of 256 code points

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

Include dependency graph for unipagecount.c:



## Macros

- `#define` [MAXBUF](#) 256  
Maximum input line size - 1.

## Functions

- `int` [main](#) (`int` argc, `char` \*argv[])  
The main function.
- `void` [mkftable](#) (`unsigned` plane, `int` pagecount[256], `int` links)  
Create an HTML table linked to PNG images.

### 5.42.1 Detailed Description

`unipagecount` - Count the number of glyphs defined in each page of 256 code points

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This program counts the number of glyphs that are defined in each "page" of 256 code points, and prints the counts in an 8 x 8 grid. Input is from stdin. Output is to stdout.

The background color of each cell in a 16-by-16 grid of 256 code points is shaded to indicate percentage coverage. Red indicates 0% coverage, green represents 100% coverage, and colors in between pure red and pure green indicate partial coverage on a scale.

Each code point range number can be a hyperlink to a PNG file for that 256-code point range's corresponding bitmap glyph image.

Synopsis:

```
unipagecount < font_file.hex > count.txt
unipagecount -phex_page_num < font_file.hex -- just 256 points
unipagecount -h < font_file.hex           -- HTML table
unipagecount -P1 -h < font.hex > count.html -- Plane 1, HTML out
unipagecount -l < font_file.hex          -- linked HTML table
```

Definition in file [unipagecount.c](#).

## 5.42.2 Macro Definition Documentation

### 5.42.2.1 MAXBUF

```
#define MAXBUF 256
```

Maximum input line size - 1.

Definition at line [56](#) of file [unipagecount.c](#).

## 5.42.3 Function Documentation

### 5.42.3.1 main()

```
int main (
    int argc,
    char * argv[] )
```

The main function.

Parameters

in	argc	The count of command line arguments.
in	argv	Pointer to array of command line arguments.

Returns

This program exits with status 0.

Definition at line [67](#) of file [unipagecount.c](#).

```
00068 {
00069     char inbuf[MAXBUF]; /* Max 256 characters in an input line */
00070     int i, j; /* loop variables */
00071     unsigned plane=0; /* Unicode plane number, 0 to 0x16 */
00072     unsigned page; /* unicode page (256 bytes wide) */
00073     unsigned unichar; /* unicode character */
00074     int pagecount[256] = {256 * 0};
00075     int onepage=0; /* set to one if printing character grid for one page */
00076     int pageno=0; /* page number selected if only examining one page */
00077     int html=0; /* =0: print plain text; =1: print HTML */
00078     int links=0; /* =1: print HTML links; =0: don't print links */
00079     void mkftable(); /* make (print) flipped HTML table */
00080     size_t strlen();
00081 }
00082
00083
```

```

00084 if (argc > 1 && argv[1][0] == '-') { /* Parse option */
00085     plane = 0;
00086     for (i = 1; i < argc; i++) {
00087         switch (argv[i][1]) {
00088             case 'p': /* specified -p<hexpage> -- use given page number */
00089                 sscanf (&argv[1][2], "%x", &pageno);
00090                 if (pageno >= 0 && pageno <= 255) onepage = 1;
00091                 break;
00092             case 'h': /* print HTML table instead of text table */
00093                 html = 1;
00094                 break;
00095             case 'l': /* print hyperlinks in HTML table */
00096                 links = 1;
00097                 html = 1;
00098                 break;
00099             case 'P': /* Plane number specified */
00100                 plane = atoi(&argv[1][2]);
00101                 break;
00102         }
00103     }
00104 }
00105 /*
00106 Initialize pagecount to account for noncharacters.
00107 */
00108 if (!onepage && plane==0) {
00109     pagecount[0xfd] = 32; /* for U+FDD0..U+FDEF */
00110 }
00111 pagecount[0xff] = 2; /* for U+nnFFFE, U+nnFFFF */
00112 /*
00113 Read one line at a time from input. The format is:
00114
00115 <hexpos>:<hexbitmap>
00116
00117 where <hexpos> is the hexadecimal Unicode character position
00118 in the range 00..FF and <hexbitmap> is the sequence of hexadecimal
00119 digits of the character, laid out in a grid from left to right,
00120 top to bottom. The character is assumed to be 16 rows of variable
00121 width.
00122 */
00123 while (fgets (inbuf, MAXBUF-1, stdin) != NULL) {
00124     sscanf (inbuf, "%X", &unicar);
00125     page = unichar » 8;
00126     if (onepage) { /* only increment counter if this is page we want */
00127         if (page == pageno) { /* character is in the page we want */
00128             pagecount[unicar & 0xff]++; /* mark character as covered */
00129         }
00130     }
00131     else { /* counting all characters in all pages */
00132         if (plane == 0) {
00133             /* Don't add in noncharacters (U+FDD0..U+FDEF, U+FFFE, U+FFFF) */
00134             if (unicar < 0xfdd0 || (unicar > 0xfdef && unichar < 0xfffe))
00135                 pagecount[page]++;
00136         }
00137         else {
00138             if ((page » 8) == plane) { /* code point is in desired plane */
00139                 pagecount[page & 0xFF]++;
00140             }
00141         }
00142     }
00143 }
00144 if (html) {
00145     mkftable (plane, pagecount, links);
00146 }
00147 else { /* Otherwise, print plain text table */
00148     if (plane > 0) fprintf (stdout, " ");
00149     fprintf (stdout,
00150             " 0 1 2 3 4 5 6 7 8 9 A B C D E F\n");
00151     for (i=0; i<0x10; i++) {
00152         fprintf (stdout, "%02X%X ", plane, i); /* row header */
00153         for (j=0; j<0x10; j++) {
00154             if (onepage) {
00155                 if (pagecount[i*16+j])
00156                     fprintf (stdout, " * ");
00157                 else
00158                     fprintf (stdout, " . ");
00159             }
00160             else {
00161                 fprintf (stdout, "%3X ", pagecount[i*16+j]);
00162             }
00163         }
00164         fprintf (stdout, "\n");

```

```

00165     }
00166
00167     }
00168     exit (0);
00169 }

```

Here is the call graph for this function:



### 5.42.3.2 mkftable()

```

void mkftable (
    unsigned plane,
    int pagecount[256],
    int links )

```

Create an HTML table linked to PNG images.

This function creates an HTML table to show PNG files in a 16 by 16 grid. The background color of each "page" of 256 code points is shaded from red (for 0% coverage) to green (for 100% coverage).

#### Parameters

in	plane	The Uni-code plane, 0..17.
in	pagecount	Array with count of glyphs in each 256 code point range.

## Parameters

in	links	1 = generate hyperlinks, 0 = do not generate hyperlinks.
----	-------	---

Definition at line 185 of file unipagecount.c.

```

00186 {
00187     int i, j;
00188     int count;
00189     unsigned bgcolor;
00190
00191     printf("<html>\n");
00192     printf("<body>\n");
00193     printf("<table border=\"3\" align=\"center\">\n");
00194     printf(" <tr><th colspan=\"16\" bgcolor=\"#ffcc80\">");
00195     printf("GNU Unifont Glyphs<br>with Page Coverage for Plane %d<br>(Green=100%%, Red=0%%)</th></tr>\n",
plane);
00196     for (i = 0x0; i <= 0xF; i++) {
00197         printf(" <tr>\n");
00198         for (j = 0x0; j <= 0xF; j++) {
00199             count = pagecount[ (i « 4) | j ];
00200
00201             /* print link in cell if links == 1 */
00202             if (plane != 0 || (i < 0xd || (i == 0xd && j < 0x8) || (i == 0xf && j > 0x8))) {
00203                 /* background color is light green if completely done */
00204                 if (count == 0x100) bgcolor = 0xccffcc;
00205                 /* otherwise background is a shade of yellow to orange to red */
00206                 else bgcolor = 0xff0000 | (count « 8) | (count » 1);
00207                 printf(" <td bgcolor=\"#%06X\">", bgcolor);
00208                 if (plane == 0)
00209                     printf("<a href=\"png/plane%02X/uni%02X%X%X.png\">%X%X</a>", plane, plane, i, j, i, j);
00210                 else
00211                     printf("<a href=\"png/plane%02X/uni%02X%X%X.png\">%02X%X%X</a>", plane, plane, i, j, plane, i, j);
00212                 printf("</td>\n");
00213             }
00214             else if (i == 0xd) {
00215                 if (j == 0x8) {
00216                     printf(" <td align=\"center\" colspan=\"8\" bgcolor=\"#cccccc\">");
00217                     printf("<b>Surrogate Pairs</b>");
00218                     printf("</td>\n");
00219                 } /* otherwise don't print anything more columns in this row */
00220             }
00221             else if (i == 0xe) {
00222                 if (j == 0x0) {
00223                     printf(" <td align=\"center\" colspan=\"16\" bgcolor=\"#cccccc\">");
00224                     printf("<b>Private Use Area</b>");
00225                     printf("</td>\n");
00226                 } /* otherwise don't print any more columns in this row */
00227             }
00228             else if (i == 0xf) {
00229                 if (j == 0x0) {
00230                     printf(" <td align=\"center\" colspan=\"9\" bgcolor=\"#cccccc\">");
00231                     printf("<b>Private Use Area</b>");
00232                     printf("</td>\n");
00233                 }
00234             }
00235         }
00236         printf(" </tr>\n");
00237     }
00238     printf("</table>\n");
00239     printf("</body>\n");
00240     printf("</html>\n");
00241
00242     return;
00243 }

```

Here is the caller graph for this function:



## 5.43 unipagecount.c

[Go to the documentation of this file.](#)

```

00001 /**
00002  @file unipagecount.c
00003
00004  @brief unipagecount - Count the number of glyphs defined in each page
00005  of 256 code points
00006
00007  @author Paul Hardy, unifoundry <at> unifoundry.com, December 2007
00008
00009  @copyright Copyright (C) 2007, 2008, 2013, 2014 Paul Hardy
00010
00011  This program counts the number of glyphs that are defined in each
00012  "page" of 256 code points, and prints the counts in an 8 x 8 grid.
00013  Input is from stdin. Output is to stdout.
00014
00015  The background color of each cell in a 16-by-16 grid of 256 code points
00016  is shaded to indicate percentage coverage. Red indicates 0% coverage,
00017  green represents 100% coverage, and colors in between pure red and pure
00018  green indicate partial coverage on a scale.
00019
00020  Each code point range number can be a hyperlink to a PNG file for
00021  that 256-code point range's corresponding bitmap glyph image.
00022
00023  Synopsis:
00024
00025  unipagecount < font_file.hex > count.txt
00026  unipagecount -phex_page_num < font_file.hex -- just 256 points
00027  unipagecount -h < font_file.hex -- HTML table
00028  unipagecount -P1 -h < font_file.hex > count.html -- Plane 1, HTML out
00029  unipagecount -l < font_file.hex -- linked HTML table
00030  */
00031  /*
00032  LICENSE:
00033
00034  This program is free software: you can redistribute it and/or modify
00035  it under the terms of the GNU General Public License as published by
00036  the Free Software Foundation, either version 2 of the License, or
00037  (at your option) any later version.
00038
00039  This program is distributed in the hope that it will be useful,
00040  but WITHOUT ANY WARRANTY; without even the implied warranty of
00041  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
00042  GNU General Public License for more details.
00043
00044  You should have received a copy of the GNU General Public License
00045  along with this program. If not, see <http://www.gnu.org/licenses/>.
00046  */
00047
00048  /*
00049  2018, Paul Hardy: Changed "Private Use" to "Private Use Area" in
00050  output HTML file.
00051  */
00052
00053  #include <stdio.h>
00054  #include <stdlib.h>
00055
00056  #define MAXBUF 256 ///< Maximum input line size - 1.
00057
00058
  
```



```

00059 /**
00060 @brief The main function.
00061
00062 @param[in] argc The count of command line arguments.
00063 @param[in] argv Pointer to array of command line arguments.
00064 @return This program exits with status 0.
00065 */
00066 int
00067 main (int argc, char *argv[])
00068 {
00069     char inbuf[MAXBUF]; /* Max 256 characters in an input line */
00070     int i, j; /* loop variables */
00071     unsigned plane=0; /* Unicode plane number, 0 to 0x16 */
00072     unsigned page; /* unicode page (256 bytes wide) */
00073     unsigned unichar; /* unicode character */
00074     int pagecount[256] = {256 * 0};
00075     int onepage=0; /* set to one if printing character grid for one page */
00076     int pageno=0; /* page number selected if only examining one page */
00077     int html=0; /* =0: print plain text; =1: print HTML */
00078     int links=0; /* =1: print HTML links; =0: don't print links */
00079     void mkftable(); /* make (print) flipped HTML table */
00080     size_t strlen();
00081
00082     if (argc > 1 && argv[1][0] == '-') { /* Parse option */
00083         plane = 0;
00084         for (i = 1; i < argc; i++) {
00085             switch (argv[i][1]) {
00086                 case 'p': /* specified -p<hexpage> -- use given page number */
00087                     sscanf (&argv[1][2], "%x", &pageno);
00088                     if (pageno >= 0 && pageno <= 255) onepage = 1;
00089                     break;
00090                 case 'h': /* print HTML table instead of text table */
00091                     html = 1;
00092                     break;
00093                 case 'l': /* print hyperlinks in HTML table */
00094                     links = 1;
00095                     html = 1;
00096                     break;
00097                 case 'P': /* Plane number specified */
00098                     plane = atoi(&argv[1][2]);
00099                     break;
00100             }
00101         }
00102     }
00103     /*
00104     Initialize pagecount to account for noncharacters.
00105     */
00106     if (!onepage && plane==0) {
00107         pagecount[0xfd] = 32; /* for U+FDD0..U+FDEF */
00108     }
00109     pagecount[0xff] = 2; /* for U+nFFFE, U+nFFFF */
00110     /*
00111     Read one line at a time from input. The format is:
00112     <hexpos>:<hexbitmap>
00113     where <hexpos> is the hexadecimal Unicode character position
00114     in the range 00..FF and <hexbitmap> is the sequence of hexadecimal
00115     digits of the character, laid out in a grid from left to right,
00116     top to bottom. The character is assumed to be 16 rows of variable
00117     width.
00118     */
00119     while (fgets (inbuf, MAXBUF-1, stdin) != NULL) {
00120         sscanf (inbuf, "%X", &unichar);
00121         page = unichar » 8;
00122         if (onepage) { /* only increment counter if this is page we want */
00123             if (page == pageno) { /* character is in the page we want */
00124                 pagecount[unichar & 0xff]++; /* mark character as covered */
00125             }
00126         }
00127         else { /* counting all characters in all pages */
00128             if (plane == 0) {
00129                 /* Don't add in noncharacters (U+FDD0..U+FDEF, U+FFFE, U+FFFF) */
00130                 if (unichar < 0xfdd0 || (unichar > 0xfdef && unichar < 0xffff))
00131                     pagecount[page]++;
00132             }
00133             else {
00134                 if ((page » 8) == plane) { /* code point is in desired plane */
00135                     pagecount[page & 0xFF]++;
00136                 }
00137             }
00138         }
00139     }

```

```

00140     }
00141     }
00142   }
00143 } (html) {
00144   if (html) {
00145     mkftable (plane, pagecount, links);
00146   }
00147   else { /* Otherwise, print plain text table */
00148     if (plane > 0) fprintf (stdout, " ");
00149     fprintf (stdout,
00150              " 0 1 2 3 4 5 6 7 8 9 A B C D E F\n");
00151     for (i=0; i<0x10; i++) {
00152       fprintf (stdout, "%02X%X ", plane, i); /* row header */
00153       for (j=0; j<0x10; j++) {
00154         if (onepage) {
00155           if (pagecount[i*16+j])
00156             fprintf (stdout, " * ");
00157           else
00158             fprintf (stdout, ". ");
00159         }
00160         else {
00161           fprintf (stdout, "%3X ", pagecount[i*16+j]);
00162         }
00163       }
00164       fprintf (stdout, "\n");
00165     }
00166   }
00167 }
00168 exit (0);
00169 }
00170
00171
00172 /**
00173 @brief Create an HTML table linked to PNG images.
00174
00175 This function creates an HTML table to show PNG files
00176 in a 16 by 16 grid. The background color of each "page"
00177 of 256 code points is shaded from red (for 0% coverage)
00178 to green (for 100% coverage).
00179
00180 @param[in] plane The Unicode plane, 0..17.
00181 @param[in] pagecount Array with count of glyphs in each 256 code point range.
00182 @param[in] links 1 = generate hyperlinks, 0 = do not generate hyperlinks.
00183 */
00184 void
00185 mkftable (unsigned plane, int pagecount[256], int links)
00186 {
00187   int i, j;
00188   int count;
00189   unsigned bgcolor;
00190
00191   printf ("<html>\n");
00192   printf ("<body>\n");
00193   printf ("<table border=\`3\` align=\`center\`>\n");
00194   printf (" <tr><th colspan=\`16\` bgcolor=\`#ffcc80\`>");
00195   printf ("GNU Unifont Glyphs<br>with Page Coverage for Plane %d<br>(Green=100%%, Red=0%%)</th></tr>\n",
00196           plane);
00197   for (i = 0x0; i <= 0xF; i++) {
00198     printf (" <tr>\n");
00199     for (j = 0x0; j <= 0xF; j++) {
00200       count = pagecount[ (i « 4) | j ];
00201
00202       /* print link in cell if links == 1 */
00203       if (plane != 0 || (i < 0xd || (i == 0xd && j < 0x8) || (i == 0xf && j > 0x8))) {
00204         /* background color is light green if completely done */
00205         if (count == 0x100) bgcolor = 0xccffcc;
00206         /* otherwise background is a shade of yellow to orange to red */
00207         else bgcolor = 0xff0000 | (count « 8) | (count » 1);
00208         printf (" <td bgcolor=\`#%06X\`>", bgcolor);
00209         if (plane == 0)
00210           printf ("<a href=\`png/plane%02X/uni%02X%X%X.png\`>%X%X</a>", plane, plane, i, j, i, j);
00211         else
00212           printf ("<a href=\`png/plane%02X/uni%02X%X%X.png\`>%02X%X%X</a>", plane, plane, i, j, plane, i, j);
00213         printf ("</td>\n");
00214       }
00215       else if (i == 0xd) {
00216         if (j == 0x8) {
00217           printf (" <td align=\`center\` colspan=\`8\` bgcolor=\`#cccccc\`>");
00218           printf ("<b>Surrogate Pairs</b>");
00219           printf ("</td>\n");
00220         } /* otherwise don't print anything more columns in this row */

```

```
00220     }
00221     else if (i == 0xe) {
00222         if (j == 0x0) {
00223             printf (" <td align=\"center\" colspan=\"16\" bgcolor=\"#cccccc\">");
00224             printf ("Private Use Area</b>");
00225             printf ("  
</td>\n");
00226         } /* otherwise don't print any more columns in this row */
00227     }
00228     else if (i == 0xf) {
00229         if (j == 0x0) {
00230             printf (" <td align=\"center\" colspan=\"9\" bgcolor=\"#cccccc\">");
00231             printf ("Private Use Area</b>");
00232             printf ("  
</td>\n");
00233         }
00234     }
00235 }
00236     printf ("  
</tr>\n");
00237 }
00238 printf ("  
</table>\n");
00239 printf ("  
</body>\n");
00240 printf ("  
</html>\n");
00241
00242 return;
00243 }
```



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## xglyph2string

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## y\_ppm

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