

# The fontspec package

## Font selection for X<sub>Y</sub>LaTeX and LuaLaTeX

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## Part I

# Getting started

## 1 History

This package began life as a  $\text{\LaTeX}$  interface to select system-installed Mac OS X fonts in Jonathan Kew's  $\text{\XeTeX}$ , the first widely-used Unicode extension to  $\text{\TeX}$ . Over time,  $\text{\XeTeX}$  was extended to support OpenType fonts and then was ported into a cross-platform program to run also on Windows and Linux.

More recently,  $\text{\LuaTeX}$  is fast becoming the  $\text{\TeX}$  engine of the day; it supports Unicode encodings and OpenType fonts and opens up the internals of  $\text{\TeX}$  via the Lua programming language. Hans Hagen's  $\text{\ConTeXt}$  Mk. IV is a re-write of his powerful typesetting system, taking full advantage of  $\text{\LuaTeX}$ 's features including font support; a kernel of his work in this area has been extracted to be useful for other  $\text{\TeX}$  macro systems as well, and this has enabled fontspec to be adapted for  $\text{\LaTeX}$  when run with the  $\text{\LuaTeX}$  engine.

## 2 Introduction

The fontspec package allows users of either  $\text{\XeTeX}$  or  $\text{\LuaTeX}$  to load OpenType fonts in a  $\text{\LaTeX}$  document. No font installation is necessary, and font features can be selected and used as desired throughout the document.

Without fontspec, it is necessary to write cumbersome font definition files for  $\text{\LaTeX}$ , since  $\text{\LaTeX}$ 's font selection scheme (known as the 'nfss') has a lot going on behind the scenes to allow easy commands like `\emph` or `\bfseries`. With an uncountable number of fonts now available for use, however, it becomes less desirable to have to write these font definition (`.fd`) files for every font one wishes to use.

Because fontspec is designed to work in a variety of modes, this user documentation is split into separate sections that are designed to be relatively independent. Nonetheless, the basic functionality all behaves in the same way, so previous users of fontspec under  $\text{\XeTeX}$  should have little or no difficulty switching over to  $\text{\LuaTeX}$ .

This manual can get rather in-depth, as there are a lot of details to cover. See the documents `fontspec-example.tex` for a complete minimal example to get started quickly.

### 2.1 Acknowledgements

This package could not have been possible without the early and continued support the author of  $\text{\XeTeX}$ , Jonathan Kew. When I started this package, he steered me many times in the right direction.

I've had great feedback over the years on feature requests, documentation queries, bug reports, font suggestions, and so on from lots of people all around the world. Many thanks to you all.

Thanks to David Perry and Markus Böhning for numerous documentation improvements and David Perry again for contributing the text for one of the sections

of this manual.

Special thanks to Khaled Hosny, who was the driving force behind the support for Lua $\TeX$ , ultimately leading to version 2.0 of the package.

## 3 Package loading and options

For basic use, no package options are required:

```
\usepackage{fontspec}
```

Package options will be introduced below; some preliminary details are discussed first.

### 3.1 Font encodings

The 2016 release of `fontspec` initiated some changes for font encodings and the loading of `xunicode`. The 2017 release rolls out those changes as default.

The now-default `tuenc` package option switches the `nfss` font encoding to `TU`. `TU` is a new Unicode font encoding, intended for both  $\TeX$  and  $\text{Lua}\TeX$  engines, and automatically contains support for symbols covered by  $\TeX$ 's traditional `T1` and `TS1` font encodings (for example, `\%`, `\textbullet`, `\"u`, and so on). As a result, with this package option, Ross Moore's `xunicode` package is **not** loaded. Some new, experimental, features are now provided to customise some encoding details; see Part [V on page 54](#) for further details.

Pre-2017 behaviour can be achieved with the `euenc` package option. This selects the `EU1` or `EU2` encoding ( $\TeX$ / $\text{Lua}\TeX$ , resp.) and loads the `xunicode` package. Package authors and users who have referred explicitly to the encoding names `EU1` or `EU2` should update their code or documents. (See internal variable names described in [Section 27 on page 68](#) for how to do this properly.)

### 3.2 Maths fonts adjustments

By default, `fontspec` adjusts  $\TeX$ 's default maths setup in order to maintain the correct Computer Modern symbols when the roman font changes. However, it will attempt to avoid doing this if another maths font package is loaded (such as `mathpazo` or the `unicode-math` package).

If you find that `fontspec` is incorrectly changing the maths font when it shouldn't be, apply the `no-math` package option to manually suppress its behaviour here.

### 3.3 Configuration

If you wish to customise any part of the `fontspec` interface, this should be done by creating your own `fontspec.cfg` file, which will be automatically loaded if it is found by  $\TeX$  or  $\text{Lua}\TeX$ . A `fontspec.cfg` file is distributed with `fontspec` with a small number of defaults set up within it.

To customise `fontspec` to your liking, use the standard `.cfg` file as a starting point or write your own from scratch, then either place it in the same folder as the main document for isolated cases, or in a location that  $\TeX$  or  $\text{Lua}\TeX$  searches by default; e.g. in  $\text{Mac}\TeX$ : `~/Library/texmf/tex/latex/`.

The package option `no-config` will suppress the loading of the `fontspec.cfg` file under all circumstances.

### 3.4 Warnings

This package can give some warnings that can be harmless if you know what you're doing. Use the `quiet` package option to write these warnings to the transcript (`.log`) file instead.

Use the `silent` package option to completely suppress these warnings if you don't even want the `.log` file cluttered up.

## 4 Interaction with L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> and other packages

This section documents some areas of adjustment that `fontspec` makes to improve default behaviour with L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> and third-party packages.

### 4.1 Verbatim

Many verbatim mechanisms assume the existence of a 'visible space' character that exists in the ASCII space slot of the typewriter font. This character is known in Unicode as U+2423: BOX OPEN, which looks like this: '□'.

When a Unicode typewriter font is used, L<sup>A</sup>T<sub>E</sub>X no longer prints visible spaces for the `verbatim*` environment and `\verb*` command. This problem is fixed by using the correct Unicode glyph, and the following packages are patched to do the same: `listings`, `fancyvrb`, `moreverb`, and `verbatim`.

In the case that the typewriter font does not contain '□', the Latin Modern Mono font is used as a fallback.

### 4.2 Discretionary hyphenation: \-

- \- L<sup>A</sup>T<sub>E</sub>X defines the macro `\-` to insert discretionary hyphenation points. However, it is hard-coded in L<sup>A</sup>T<sub>E</sub>X to use the hyphen `-` character. Since `fontspec` provides features to change the hyphenation character on a per font basis, the definition of `\-` is changed to adapt accordingly.

### 4.3 Commands for old-style and lining numbers

`\oldstylenums` L<sup>A</sup>T<sub>E</sub>X's definition of `\oldstylenums` relies on strange font encodings. We provide a  
`\liningnums` `fontspec`-compatible alternative and while we're at it also throw in the reverse option as well. Use `\oldstylenums{<text>}` to explicitly use old-style (or lowercase) numbers in `<text>`, and the reverse for `\liningnums{<text>}`.

### 4.4 Italic small caps

`\itshape` Note that this package redefines the `\itshape`, `\slshape`, and `\scshape` commands  
`\slshape` in order to allow them to select italic small caps in conjunction. With these changes,  
`\scshape` writing `\itshape\scshape` will lead to italic small caps, and `\upshape` subsequently



then moves back to small caps only. `\upshape` again returns from small caps to upright regular. (And similarly for `\slshape`. In addition, once italic small caps are selected then `\slshape` will switch to slanted small caps, and vice versa.)

## 4.5 Emphasis and nested emphasis

`\emminnershape` L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> allows you to specify the behaviour of `\emph` nested within `\emph` by setting the `\emminnershape` command. For example,

```
\renewcommand\emminnershape{\upshape\scshape}
```

will produce small caps within `\emph{\emph{...}}`.

`\emfontdeclare` The `fontspec` package takes this idea one step further to allow arbitrary font changes (e.g., boldness) and arbitrary levels of nesting within emphasis. This is performed using the `\emfontdeclare` command, which takes a comma-separated list of font switches corresponding to increasing levels of emphasis. Two examples:

1. `\emfontdeclare{\itshape,\upshape\scshape,\itshape}` will lead to ‘italics’, ‘small caps’, then ‘italic small caps’ as the level of emphasis increases, as long as italic small caps are defined for the font. Note that `\upshape` is required because the font changes are cascading.
2. `\emfontdeclare{\bfseries,\fontseries{h}\selectfont,\fontseries{x}\selectfont}` could lead to (if fonts are set up correctly) ‘bold’, ‘heavy’, and ‘extra bold’.

The implementation of these feature tries to be ‘smart’ and guess what level of emphasis to use in the case of manual font changing. This is reliable only if you use series- and/or shape- changing commands in `\emfontdeclare`. For example:

```
\emfontdeclare{\itshape,\upshape\scshape,\itshape}
...
\scshape small caps \emph{hello}
```

Here, the emphasised text ‘hello’ will be printed in italic small caps since `\emph` can detect that the current font shape is already in the second ‘mode’ of emphasis.

`\emreset` Finally, if you have so much nested emphasis that `\emfontdeclare` runs out of options, it will insert `\emreset` (by default just `\upshape`) and start again from the beginning.

## Part II

# General font selection

This section concerns the variety of commands that can be used to select fonts.

```
\fontspec{<font name>}[<font features>]  
\setmainfont{<font name>}[<font features>]  
\setsansfont{<font name>}[<font features>]  
\setmonofont{<font name>}[<font features>]  
\newfontfamily<cmd>{<font name>}[<font features>]
```

These are the main font-selecting commands of this package. The `\fontspec` command selects a font for one-time use; all others should be used to define the standard fonts used in a document, as shown in Example 1. Here, the scales of the fonts have been chosen to equalise their lowercase letter heights. The `Scale` font feature will be discussed further in [Section 14 on page 26](#), including methods for automatic scaling.

Note that while these commands all look and behave largely identically, the default setup for font loading automatically adds the `Ligatures=TeX` feature for the `\setmainfont` and `\setsansfont` commands. These defaults (and further customisations possible) are discussed in [Section 8 on page 20](#).

The font features argument accepts comma separated `<font feature>=<option>` lists; these are described later:

- For general font features, see [Section 14 on page 26](#)
- For OpenType fonts, see [Part IV on page 33](#)
- For X<sub>Y</sub>TeX-only general font features, see [Part VII on page 60](#)
- For Lua<sub>Y</sub>TeX-only general font features, see [Part VI on page 58](#)
- For features for AAT fonts in X<sub>Y</sub>TeX, see [Section 22 on page 61](#)

## 5 Font selection

In both Lua<sub>Y</sub>TeX and X<sub>Y</sub>TeX, fonts can be selected either by ‘font name’ or by ‘file name’, but there are some differences in how each engine finds and selects fonts — don’t be too surprised if a font invocation in one engine needs correction to work in the other.

---

Example 1: Loading the default, sans serif, and monospaced fonts.

---

Pack my box with five dozen liquor jugs  
Pack my box with five dozen liquor jugs  
Pack my box with five dozen liquor jugs

```
\setmainfont{texgyrebonum-regular.otf}  
\setsansfont{lmsansio-regular.otf}[Scale=MatchLowercase]  
\setmonofont{Inconsolata.otf}[Scale=MatchLowercase]  
  
\rmfamily Pack my box with five dozen liquor jugs\par  
\sffamily Pack my box with five dozen liquor jugs\par  
\ttfamily Pack my box with five dozen liquor jugs
```

---

## 5.1 By font name

Fonts known to Lua $\TeX$  or X $\TeX$  may be loaded by their standard names as you'd speak them out loud, such as *Times New Roman* or *Adobe Garamond*. 'Known to' in this case generally means 'exists in a standard fonts location' such as `~/Library/Fonts` on Mac OS X, or `C:\Windows\Fonts` on Windows. In Lua $\TeX$ , fonts found in the `TEXMF` tree can also be loaded by name.

The simplest example might be something like

```
\setmainfont{Cambria}[ ... ]
```

in which the bold and italic fonts will be found automatically (if they exist) and are immediately accessible with the usual `\textit` and `\textbf` commands.

The 'font name' can be found in various ways, such as by looking in the name listed in a application like *Font Book* on Mac OS X. Alternatively,  $\TeX$ Live contains the `otfinfo` command line program, which can query this information; for example:

```
otfinfo -a `kpsewhich lmroman10-regular.otf`
```

results in 'LM Roman 10'.

**Lua $\TeX$  users only** In order to load fonts by their name rather than by their file-name (e.g., 'Latin Modern Roman' instead of 'ec-lm`rm10`'), you may need to run the script `luaotfload-tool`, which is distributed with the `luaotfload` package. Note that if you do not execute this script beforehand, the first time you attempt to typeset the process will pause for (up to) several minutes. (But only the first time.) Please see the `luaotfload` documentation for more information.

## 5.2 By file name

X $\TeX$  and Lua $\TeX$  also allow fonts to be loaded by file name instead of font name. When you have a very large collection of fonts, you will sometimes not wish to have them all installed in your system's font directories. In this case, it is more convenient to load them from a different location on your disk. This technique is also necessary in X $\TeX$  when loading OpenType fonts that are present within your  $\TeX$  distribution, such as `/usr/local/texlive/2013/texmf-dist/fonts/opentype/public`. Fonts in such locations are visible to X $\TeX$  but cannot be loaded by font name, only file name; Lua $\TeX$  does not have this restriction.

When selecting fonts by file name, any font that can be found in the default search paths may be used directly (including in the current directory) without having to explicitly define the location of the font file on disk.

Fonts selected by filename must include bold and italic variants explicitly.

```
\setmainfont{texgyrepagella-regular.otf}[
  BoldFont      = texgyrepagella-bold.otf ,
  ItalicFont     = texgyrepagella-italic.otf ,
  BoldItalicFont = texgyrepagella-bolditalic.otf ]
```

`fontspec` knows that the font is to be selected by file name by the presence of the `'.otf'` extension. An alternative is to specify the extension separately, as shown following:

```
\setmainfont{texgyrepagella-regular}[
  Extension      = .otf ,
  BoldFont       = texgyrepagella-bold ,
  ... ]
```

If desired, an abbreviation can be applied to the font names based on the mandatory ‘font name’ argument:

```
\setmainfont{texgyrepagella}[
  Extension      = .otf ,
  UprightFont    = *-regular ,
  BoldFont       = *-bold ,
  ... ]
```

In this case ‘texgyrepagella’ is no longer the name of an actual font, but is used to construct the font names for each shape; the \* is replaced by ‘texgyrepagella’. Note in this case that UprightFont is required for constructing the font name of the normal font to use.

To load a font that is not in one of the default search paths, its location in the filesystem must be specified with the Path feature:

```
\setmainfont{texgyrepagella}[
  Path           = /Users/will/Fonts/ ,
  UprightFont    = *-regular ,
  BoldFont       = *-bold ,
  ... ]
```

Note that X<sub>Y</sub>TeX and LuaTeX are able to load the font without giving an extension, but fontspec must know to search for the file; this can be indicated by using the Path feature without an argument:

```
\setmainfont{texgyrepagella-regular}[
  Path, BoldFont = texgyrepagella-bold,
  ... ]
```

My preference is to always be explicit and include the extension; this also allows fontspec to automatically identify that the font should be loaded by filename.

In previous versions of the package, the Path feature was also provided under the alias ExternalLocation, but this latter name is now deprecated and should not be used for new documents.

### 5.3 Querying whether a font ‘exists’

```
\IfFontExistsTF{<font name>}{<true branch>}{<>false branch>}
```

The conditional \IfFontExistsTF is provided to test whether the <font name> exists or is loadable. If it is, the <true branch> code is executed; otherwise, the <>false branch> code is.

This command can be slow since the engine may resort to scanning the filesystem for a missing font. Nonetheless, it has been a popular request for users who wish to define ‘fallback fonts’ for their documents for greater portability.

In this command, the syntax for the  $\langle font\ name \rangle$  is a restricted/simplified version of the font loading syntax used for `\fontspec` and so on. Fonts to be loaded by filename are detected by the presence of an appropriate extension (`.otf`, etc.), and paths should be included inline. E.g.:

```
\IfFontExistsTF{cmr10}{T}{F}
\IfFontExistsTF{Times New Roman}{T}{F}
\IfFontExistsTF{texgyrepagella-regular.otf}{T}{F}
\IfFontExistsTF{/Users/will/Library/Fonts/CODE2000.TTF}{T}{F}
```

The `\IfFontExistsTF` command is a synonym for the programming interface function `\fontspec_font_if_exist:nTF` (Section 27 on page 68).

## 6 Commands to select font families

```
\newfontfamily\langle font-switch \rangle{\langle font name \rangle}[\langle font features \rangle]
\newfontface\langle font-switch \rangle{\langle font name \rangle}[\langle font features \rangle]
```

For cases when a specific font with a specific feature set is going to be re-used many times in a document, it is inefficient to keep calling `\fontspec` for every use. While the `\fontspec` command does not define a new font instance after the first call, the feature options must still be parsed and processed.

`\newfontfamily`

For this reason, new commands can be created for loading a particular font family with the `\newfontfamily` command, demonstrated in Example 2. This macro should be used to create commands that would be used in the same way as `\rmfamily`, for example. If you would like to create a command that only changes the font inside its argument (i.e., the same behaviour as `\emph`) define it using regular  $\text{\LaTeX}$  commands:

```
\newcommand\textnote[1]{\{\notefont #1\}}
\textnote{This is a note.}
```

Note that the double braces are intentional; the inner pair are used to to delimit the scope of the font change.

`\newfontface`

Sometimes only a specific font face is desired, without accompanying italic or bold variants being automatically selected. This is common when selecting a fancy italic font, say, that has swash features unavailable in the upright forms. `\newfontface` is used for this purpose, shown in Example 3, which is repeated in Section 22.4 on page 62.

Comment for advanced users: The commands defined by `\newfontface` and `\newfontfamily` include their encoding information, so even if the document is set to use a legacy  $\text{\TeX}$  encoding, such commands will still work correctly. For example,

---

Example 2: Defining new font families.

---

This is a *note*.

```
\newfontfamily\notefont{Kurier}
\notefont This is a \emph{note}.
```

---

---

Example 3: Defining a single font face.

---

	<code>\newfontface\fancy{Hoefler Text Italic}%</code>
	<code>[Contextuals={WordInitial,WordFinal}]</code>
<i>where is all the vegemite</i>	<code>\fancy where is all the vegemite</code>
	<code>% \emph, \textbf, etc., all don't work</code>

---

```

\documentclass{article}
\usepackage{fontspec}
\newfontfamily\unicodefont{Lucida Grande}
\usepackage{mathpazo}
\usepackage[T1]{fontenc}
\begin{document}
A legacy \TeX\ font. {\unicodefont A unicode font.}
\end{document}

```

## 6.1 More control over font shape selection

```

BoldFont = <font name>
ItalicFont = <font name>
BoldItalicFont = <font name>
SlantedFont = <font name>
BoldSlantedFont = <font name>
SmallCapsFont = <font name>

```

The automatic bold, italic, and bold italic font selections will not be adequate for the needs of every font: while some fonts mayn't even have bold or italic shapes, in which case a skilled (or lucky) designer may be able to chose well-matching accompanying shapes from a different font altogether, others can have a range of bold and italic fonts to chose among. The `BoldFont` and `ItalicFont` features are provided for these situations. If only one of these is used, the bold italic font is requested as the default from the *new* font. See Example 4.

If a bold italic shape is not defined, or you want to specify *both* custom bold and italic shapes, the `BoldItalicFont` feature is provided.

---

Example 4: Explicit selection of the bold font.

---

	<code>\fontspec{Helvetica Neue UltraLight}%</code>
	<code>[BoldFont={Helvetica Neue}]</code>
Helvetica Neue UltraLight	<code>Helvetica Neue UltraLight</code>
<i>Helvetica Neue UltraLight Italic</i>	<code>{\itshape Helvetica Neue UltraLight Italic} \\\</code>
<b>Helvetica Neue</b>	<code>{\bfseries Helvetica Neue } \\\</code>
<b><i>Helvetica Neue Italic</i></b>	<code>{\bfseries\itshape Helvetica Neue Italic} \\\</code>

---

### 6.1.1 Small caps and slanted font shapes

When a font family has both slanted *and* italic shapes, these may be specified separately using the analogous features `SlantedFont` and `BoldSlantedFont`. Without these, however, the  $\text{\LaTeX}$  font switches for slanted (`\textsl`, `\slshape`) will default to the italic shape.

Pre-OpenType, it was common for font families to be distributed with small caps glyphs in separate fonts, due to the limitations on the number of glyphs allowed in the PostScript Type 1 format. Such fonts may be used by declaring the `SmallCapsFont` of the family you are specifying:

```
\setmainfont{Minion MM Roman}[
  SmallCapsFont={Minion MM Small Caps & Oldstyle Figures}
]
Roman 123 \ \textsc{Small caps 456}
```

In fact, you should specify the small caps font for each individual bold and italic shape as in

```
\setmainfont{ <upright> }[
  UprightFeatures      = { SmallCapsFont={ <sc> } } ,
  BoldFeatures         = { SmallCapsFont={ <bf sc> } } ,
  ItalicFeatures       = { SmallCapsFont={ <it sc> } } ,
  BoldItalicFeatures  = { SmallCapsFont={ <bf it sc> } } ,
]
Roman 123 \ \textsc{Small caps 456}
```

For most modern fonts that have small caps as a font feature, this level of control isn't generally necessary.

All of the bold, italic, and small caps fonts can be loaded with different font features from the main font. See [Section 11](#) for details. When an OpenType font is selected for `SmallCapsFont`, the small caps font feature is *not* automatically enabled. In this case, users should write instead, if necessary,

```
\setmainfont{...}[
  SmallCapsFont={...},
  SmallCapsFeatures={Letters=SmallCaps},
]
```

## 6.2 Specifically choosing the NFSS family

In  $\text{\LaTeX}$ 's NFSS, font families are defined with names such as 'ppl' (Palatino), 'lmr' (Latin Modern Roman), and so on, which are selected with the `\fontfamily` command:

```
\fontfamily{ppl}\selectfont
```

In `fontspec`, the family names are auto-generated based on the `fontname` of the font; for example, writing `\fontspec{Times New Roman}` for the first time would generate an internal font family name of 'TimesNewRoman(1)'. Please note that should not rely on the name that is generated.

In certain cases it is desirable to be able to choose this internal font family name so it can be re-used elsewhere for interacting with other packages that use the  $\text{\LaTeX}$ 's font selection interface; an example might be

```
\usepackage{fancyvrb}
\fvset{fontfamily=myverbatimfont}
```

To select a font for use in this way in fontspec use the `NFSSFamily` feature:<sup>1</sup>

```
\newfontfamily\verbatimfont[NFSSFamily=myverbatimfont]{Inconsolata}
```

It is then possible to write commands such as:

```
\fontfamily{myverbatimfont}\selectfont
```

which is essentially the same as writing `\verbatimfont`, or to go back to the original example:

```
\fvset{fontfamily=myverbatimfont}
```

Only use this feature when necessary; the in-built font switching commands that fontspec generates (such as `\verbatimfont` in the example above) are recommended in all other cases.

If you don't wish to explicitly set the `NFSS` family but you would like to know what it is, an alternative mechanism for package writers is introduced as part of the fontspec programming interface; see the function `\fontspec_set_family:Nnn` for details ([Section 27 on page 68](#)).

### 6.3 Choosing additional `NFSS` font faces

$\text{\LaTeX}$ 's font selection scheme (`NFSS`) is more flexible than the fontspec interface discussed up until this point. It assigns to each font face a *family* (discussed above), a *series* such as bold or light or condensed, and a *shape* such as italic or slanted or small caps. The fontspec features such as `BoldFont` and so on all assign faces for the default series and shapes of the `NFSS`, but it's not uncommon to have font families that have multiple weights and shapes and so on.

If you set up a regular font family with the 'standard four' (upright, bold, italic, and bold italic) shapes and then want to use, say, a light font for a certain document element, many users will be perfectly happy to use `\newfontface\⟨switch⟩` and use the resulting font `\⟨switch⟩`. In other cases, however, it is more convenient or even necessary to load additional fonts using additional `NFSS` specifiers.

```
FontFace = {⟨series⟩}{⟨shape⟩} {Font = ⟨font name⟩ , ⟨features⟩ }
FontFace = {⟨series⟩}{⟨shape⟩}{⟨font name⟩}
```

The font thus specified will inherit the font features of the main font, with optional additional `⟨features⟩` as requested. (Note that the optional `{⟨features⟩}` argument is still surrounded with curly braces.) Multiple `FontFace` commands may be used in a single declaration to specify multiple fonts. As an example:

---

<sup>1</sup>Thanks to Luca Fascione for the example and motivation for finally implementing this feature.



```

\setmainfont{font1.otf}[
  FontFace = {c}{\updefault}{ font2.otf } ,
  FontFace = {c}{m}{ Font = font3.otf , Color = red }
]

```

Writing `\fontseries{c}\selectfont` will result in `font2` being selected, which then followed by `\fontshape{m}\selectfont` will result in `font3` being selected (in red). A font face that is defined in terms of a different series but an upright shape (`\updefault`, as shown above) will attempt to find a matching small caps feature and define that face as well. Conversely, a font face defined in terms of a non-standard font shape will not.

There are some standards for choosing shape and series codes; the  $\text{\LaTeX}$  2 $\epsilon$  font selection guide<sup>2</sup> lists series `m` for medium, `b` for bold, `bx` for bold extended, `sb` for semi-bold, and `c` for condensed. A far more comprehensive listing is included in Appendix A of Philipp Lehman's 'The Font Installation Guide'<sup>3</sup> covering 14 separate weights and 12 separate widths.

The `FontFace` command also interacts properly with the `SizeFeatures` command as follows: (nonsense set of font selection choices)

```

FontFace = {c}{n}{
  Font = Times ,
  SizeFeatures = {
    { Size = -10 , Font = Georgia } ,
    { Size = 10-15} , % default "Font = Times"
    { Size = 15- , Font = Cochin } ,
  },
},

```

Note that if the first `Font` feature is omitted then each size needs its own inner `Font` declaration.

## 6.4 Math(s) fonts

When `\setmainfont`, `\setsansfont` and `\setmonofont` are used in the preamble, they also define the fonts to be used in maths mode inside the `\mathrm`-type commands. This only occurs in the preamble because  $\text{\LaTeX}$  freezes the maths fonts after this stage of the processing. The `fontspec` package must also be loaded after any maths font packages (*e.g.*, `euler`) to be successful. (Actually, it is *only* `euler` that is the problem.<sup>4</sup>)

Note that `fontspec` will not change the font for general mathematics; only the upright and bold shapes will be affected. To change the font used for the mathematical symbols, see either the `mathspec` package or the `unicode-math` package.

Note that you may find that loading some maths packages won't be as smooth as you expect since `fontspec` (and  $\text{X}\text{\LaTeX}$  in general) breaks many of the assumptions of  $\text{\TeX}$  as to where maths characters and accents can be found. Contact me if you have

<sup>2</sup>`texdoc fntguide`

<sup>3</sup>`texdoc fontinstallationguide`

<sup>4</sup>Speaking of `euler`, if you want to use its `[mathbf]` option, it won't work, and you'll need to put this after `fontspec` is loaded instead: `\AtBeginDocument{\DeclareMathAlphabet\mathbf{U}{eur}{b}{n}}`

troubles, but I can't guarantee to be able to fix any incompatibilities. The Lucida and Euler maths fonts should be fine; for all others keep an eye out for problems.

```
\setmathrm{\font name}\[font features]
\setmathsf{\font name}\[font features]
\setmathhtt{\font name}\[font features]
\setboldmathrm{\font name}\[font features]
```

However, the default text fonts may not necessarily be the ones you wish to use when typesetting maths (especially with the use of fancy ligatures and so on). For this reason, you may optionally use the commands above (in the same way as our other `\fontspec`-like commands) to explicitly state which fonts to use inside such commands as `\mathrm`. Additionally, the `\setboldmathrm` command allows you to define the font used for `\mathrm` when in bold maths mode (which is activated with, among others, `\boldmath`).

For example, if you were using Optima with the Euler maths font, you might have this in your preamble:

```
\usepackage{mathpazo}
\usepackage{fontspec}
\setmainfont{Optima}
\setmathrm{Optima}
\setboldmathrm[BoldFont={Optima ExtraBlack}]{Optima Bold}
```

These commands are compatible with the `unicode-math` package. Having said that, `unicode-math` also defines a more general way of defining fonts to use in maths mode, so you can ignore this subsection if you're already using that package.

## 7 Miscellaneous font selecting details

**The optional argument — from v2.4** For the first decade of `fontspec`'s life, optional font features were selected with a bracketed argument before the font name, as in:

```
\setmainfont[
  lots and lots ,
  and more and more ,
  an excessive number really ,
  of font features could go here
]{myfont.otf}
```

This always looked like ugly syntax to me, because the most important detail — the name of the font — was tucked away at the end. The order of these arguments has now been reversed:

```
\setmainfont{myfont.otf}[
  lots and lots ,
  and more and more ,
  an excessive number really ,
  of font features could go here
]
```

I hope this doesn't cause any problems.

1. Backwards compatibility has been preserved, so either input method works.
2. In fact, you can write

```
\fontspec[Ligatures=Rare]{myfont.otf}[Color=red]
```

if you really felt like it and both sets of features would be applied.

3. Following standard xparse behaviour, there must be no space before the opening bracket; writing

```
\fontspec{myfont.otf}_[Color=red]
```

will result in `[Color=red]` not being recognised as an argument and therefore it will be typeset as text. When breaking over lines, write either of:

<pre>\fontspec{myfont.otf}%</pre>	<pre>\fontspec{myfont.otf}[</pre>
<pre>[Color=red]</pre>	<pre>Color=Red]</pre>

**Spaces** `\fontspec` and `\addfontfeatures` ignore trailing spaces as if it were a 'naked' control sequence; e.g., 'M. `\fontspec{...}` N' and 'M. `\fontspec{...}`N' are the same.

## Part III

# Selecting font features

The commands discussed so far such as `\fontspec` each take an optional argument for accessing the font features of the requested font. Commands are provided to set default features to be applied for all fonts, and even to change the features that a font is presently loaded with. Different font shapes can be loaded with separate features, and different features can even be selected for different sizes that the font appears in. This part discusses these options.

## 8 Default settings

```
\defaultfontfeatures{<font features>}
```

It is sometimes useful to define font features that are applied to every subsequent font selection command. This may be defined with the `\defaultfontfeatures` command, shown in Example 5. New calls of `\defaultfontfeatures` overwrite previous ones, and defaults can be reset by calling the command with an empty argument.

```
\defaultfontfeatures[<font name>]{<font features>}
```

Default font features can be specified on a per-font and per-face basis by using the optional argument to `\defaultfontfeatures` as shown.

```
\defaultfontfeatures[tegyreadventor-regular.otf]{Color=blue}  
\setmainfont{tegyreadventor-regular.otf}% will be blue
```

Multiple fonts may be affected by using a comma separated list of font names.

```
\defaultfontfeatures[<\font-switch>]{<font features>}
```

**New in v2.4.** Defaults can also be applied to symbolic families such as those created with the `\newfontfamily` command and for `\rmfamily`, `\sffamily`, and `\ttfamily`:

```
\defaultfontfeatures[\rmfamily,\sffamily]{Ligatures=TeX}  
\setmainfont{tegyreadventor-regular.otf}% will use standard TeX ligatures
```

---

Example 5: A demonstration of the `\defaultfontfeatures` command.

---

Some default text 0123456789

Now grey, with old-style figures: 0123456789

```
\fontspec{tegyreadventor-regular.otf}  
Some default text 0123456789 \\  
\defaultfontfeatures{  
  Numbers=OldStyle, Color=888888  
}  
\fontspec{tegyreadventor-regular.otf}  
Now grey, with old-style figures:  
0123456789
```

The line above to set T<sub>E</sub>X-like ligatures is now activated by *default* in `fontspec.cfg`. To reset default font features, simply call the command with an empty argument:

```
\defaultfontfeatures[\rmfamily,\sffamily]{}
\setmainfont{texgyreadventor-regular.otf}% will no longer use standard TeX ligatures
```

```
\defaultfontfeatures+{<font features>}
\defaultfontfeatures+[<font name>]{<font features>}
```

**New in v2.4.** Using the + form of the command appends the *<font features>* to any already-selected defaults.

## 9 Default settings from a file

In addition to the defaults that may be specified in the document as described above, when a font is first loaded, a configuration file is searched for with the name '*<fontname>.fontspec*'.<sup>5</sup>

The contents of this file can be used to specify default font features without having to have this information present within each document. *<fontname>* is stripped of spaces and file extensions are omitted; for example, the line above for T<sub>E</sub>X Gyre Adventor could be placed in a file called `TeXGyreAdventor.fontspec`, or for specifying options for `texgyreadventor-regular.otf` (when loading by filename), the configuration file would be `texgyreadventor-regular.fontspec`. (N.B. the lettercase of the names should match.)

This mechanism can be used to define custom names or aliases for your font collections. If you create a file `MyCharis.fontspec` containing, say,

```
\defaultfontfeatures[My Charis]
{
  Extension = .ttf ,
  UprightFont = CharisSILR,
  BoldFont = CharisSILB,
  ItalicFont = CharisSILI,
  BoldItalicFont = CharisSILBI,
  % <any other desired options>
}
```

you can load that custom family with `\fontspec{My Charis}` and similar. The optional argument to `\defaultfontfeatures` must match that requested by the font loading command (`\fontspec`, etc.), else the options won't take effect.

Finally, note that options for font faces can also be defined in this way. To continue the example above, here we colour the different faces:

```
\defaultfontfeatures[CharisSILR]{Color=blue}
\defaultfontfeatures[CharisSILB]{Color=red}
```

And such configuration lines can be stored either inline inside `My Charis.fontspec` or within their own `.fontspec` files; in this way, `fontspec` is designed to handle 'nested' configuration options as well.

---

<sup>5</sup>Located in the current folder or within a standard `texmf` location.

## 10 Working with the currently selected features

`\IfFontFeatureActiveTF{<font feature>}{<true code>}{<false code>}`

This command queries the currently selected font face and executes the appropriate branch based on whether the *<font feature>* as specified by `fontspec` is currently active.

For example, the following will print ‘True’:

```
\setmainfont{texgyrepagella-regular.otf}[Numbers=OldStyle]
\IfFontFeatureActiveTF{Numbers=OldStyle}{True}{False}
```

Note that there is no way for `fontspec` to know what the default features of a font will be. For example, by default the `texgyrepagella` fonts use lining numbers. But in the following example, querying for lining numbers returns false since they have not been explicitly requested:

```
\setmainfont{texgyrepagella-regular.otf}
\IfFontFeatureActiveTF{Numbers=Lining}{True}{False}
```

Please note: At time of writing this function only supports OpenType fonts; AAT/Graphite fonts under the Xe<sub>La</sub>TeX engine are not supported.

`\addfontfeatures{<font features>}`

This command allows font features to be changed without knowing what features are currently selected or even what font is being used. A good example of this could be to add a hook to all tabular material to use monospaced numbers, as shown in Example 6. If you attempt to *change* an already-selected feature, `fontspec` will try to deactivate any features that clash with the new ones. *E.g.*, the following two invocations are mutually exclusive:

```
\addfontfeature{Numbers=OldStyle}...
\addfontfeature{Numbers=Lining}...
123
```

Since `Numbers=Lining` comes last, it takes precedence and deactivates the call `Numbers=OldStyle`.

`\addfontfeature` This command may also be executed under the alias `\addfontfeature`.

### 10.1 Priority of feature selection

Features defined with `\addfontfeatures` override features specified by `\fontspec`, which in turn override features specified by `\defaultfontfeatures`. If in doubt, whenever a new font is chosen for the first time, an entry is made in the transcript (`.log`) file displaying the font name and the features requested.

---

Example 6: A demonstration of the `\addfontfeatures` command.

---

```

\fontspec{texgyreadventor-regular.otf}%
[Numbers={Proportional,OldStyle}]
`In 1842, 999 people sailed 97 miles in
13 boats. In 1923, 111 people sailed 54
miles in 56 boats.' \bigskip

`In 1842, 999 people sailed 97 miles in 13 boats. In
1923, 111 people sailed 54 miles in 56 boats.`

\addfontfeatures{Numbers={Monospaced,Lining}}
\begin{tabular}{@{} cccc @{}}
Year & People & Miles & Boats & \\
\hline
1842 & 999 & 75 & 13 & \\
1923 & 111 & 54 & 56 & \\
\end{tabular}

```

---

## 11 Different features for different font shapes

```

BoldFeatures={\features}
ItalicFeatures={\features}
BoldItalicFeatures={\features}
SlantedFeatures={\features}
BoldSlantedFeatures={\features}
SmallCapsFeatures={\features}

```

It is entirely possible that separate fonts in a family will require separate options; e.g., Hoefler Text Italic contains various swash feature options that are completely unavailable in the upright shapes.

The font features defined at the top level of the optional `\fontspec` argument are applied to *all* shapes of the family. Using `Upright-`, `SmallCaps-`, `Bold-`, `Italic-`, and `BoldItalicFeatures`, separate font features may be defined to their respective shapes *in addition* to, and with precedence over, the ‘global’ font features. See Example 7.

Note that because most fonts include their small caps glyphs within the main font, features specified with `SmallCapsFeatures` are applied *in addition* to any other shape-specific features as defined above, and hence `SmallCapsFeatures` can be nested within `ItalicFeatures` and friends. Every combination of upright, italic, bold and small caps can thus be assigned individual features, as shown in the somewhat ludi-

---

Example 7: Features for, say, just italics.

---

```

\fontspec{EBGaramond12-Regular.otf}%
[ItalicFont=EBGaramond12-Italic.otf]
Don't Ask Victoria! \itshape Don't Ask Victoria! \\
Don't Ask Victoria! \addfontfeature{ItalicFeatures={Style=Swash}}
Don't Ask Victoria! \\

```

---

crous Example 8.

## 12 Selecting fonts from TrueType Collections (TTC files)

TrueType Collections are multiple fonts contained within a single file. Each font within a collection must be explicitly chosen using the `FontIndex` command. Since TrueType Collections are often used to contain the italic/bold shapes in a family, `fontspec` automatically selects the italic, bold, and bold italic fontfaces from the same file. For example, to load the macOS system font Optima:

```
\setmainfont{Optima.ttc}[
  Path = /System/Library/Fonts/ ,
  UprightFeatures = {FontIndex=0} ,
  BoldFeatures = {FontIndex=1} ,
  ItalicFeatures = {FontIndex=2} ,
  BoldItalicFeatures = {FontIndex=3} ,
]
```

Support for TrueType Collections has only been tested in X<sub>Y</sub>TeX, but should also work with an up-to-date version of LuaTeX and the `luaotfload` package.

## 13 Different features for different font sizes

```
SizeFeatures = {
  ...
  { Size = <size range>, <font features> },
  { Size = <size range>, Font = <font name>, <font features> },
  ...
}
```

The `SizeFeature` feature is a little more complicated than the previous features discussed. It allows different fonts and different font features to be selected for a given font family as the point size varies.

It takes a comma separated list of braced, comma separated lists of features for each size range. Each sub-list must contain the `Size` option to declare the size range, and optionally `Font` to change the font based on size. Other (regular) `fontspec` features that are added are used on top of the font features that would be used anyway. A demonstration to clarify these details is shown in Example 9. A less trivial example is shown in the context of optical font sizes in Section 14.6 on page 30.

To be precise, the `Size` sub-feature accepts arguments in the form shown in Table 1 on page 26. Braces around the size range are optional. For an exact font size (`Size=X`) font sizes chosen near that size will ‘snap’. For example, for size definitions at exactly 11pt and 14pt, if a 12pt font is requested *actually* the 11pt font will be selected. This is a remnant of the past when fonts were designed in metal (at obviously rigid sizes) and later when bitmap fonts were similarly designed for fixed sizes.



---

Example 8: An example of setting the SmallCapsFeatures separately for each font shape.

---

	<pre> \fontspec{texgyretermes}[   Extension = {.otf},   UprightFont = {*-regular}, ItalicFont = {*-italic},   BoldFont = {*-bold}, BoldItalicFont = {*-bolditalic},   UprightFeatures={Color = 220022,     SmallCapsFeatures = {Color=115511}},   ItalicFeatures={Color = 2244FF,     SmallCapsFeatures = {Color=112299}},   BoldFeatures={Color = FF4422,     SmallCapsFeatures = {Color=992211}},   BoldItalicFeatures={Color = 888844,     SmallCapsFeatures = {Color=444422}}, ]</pre>
Upright <b>SMALL CAPS</b>	Upright {\scshape Small Caps}\
<i>Italic ITALIC SMALL CAPS</i>	\itshape Italic {\scshape Italic Small Caps}\
<b>Bold BOLD SMALL CAPS</b>	\upshape\bfseries Bold {\scshape Bold Small Caps}\
<b><i>Bold Italic BOLD ITALIC SMALL CAPS</i></b>	\itshape Bold Italic {\scshape Bold Italic Small Caps}

---



---

Example 9: An example of specifying different font features for different sizes of font with Size-Features.

---

	<pre> \fontspec{texgyrechorus-mediumitalic.otf}[   SizeFeatures={     {Size={-8}, Font=texgyrebonum-italic.otf, Color=AA0000},     {Size={8-14}, Color=00AA00},     {Size={14-}, Color=0000AA}} ]</pre>
<i>Small</i>	
<i>Normal size</i>	
<i>Large</i>	{\scriptsize Small\par} Normal size\par {\Large Large\par}

---

If additional features are only required for a single size, the other sizes must still be specified. As in:

```
SizeFeatures={
  {Size=-10,Numbers=Uppercase},
  {Size=10-}}
```

Otherwise, the font sizes greater than 10 won't be defined at all!

**Interaction with other features** For `SizeFeatures` to work with `ItalicFeatures`, `BoldFeatures`, etc., and `SmallCapsFeatures`, a strict heirarchy is required:

```
UprightFeatures =
{
  SizeFeatures =
  {
    {
      Size = -10,
      Font = ..., % if necessary
      SmallCapsFeatures = {...},
      ... % other features for this size range
    },
    ... % other size ranges
  }
}
```

Suggestions on simplifying this interface welcome.

## 14 Font independent options

Features introduced in this section may be used with any font.

### 14.1 Colour

`Color` (or `Colour`) uses font specifications to set the colour of the text. You should think of this as the literal glyphs of the font being coloured in a certain way. Notably, this mechanism is different to that of the `color`/`xcolor`/`hyperref`/etc. packages, and in fact using `fontspec` commands to set colour will prevent your text from changing colour using those packages at all! For example, if you set the colour in a `\setmainfont`

Table 1: Syntax for specifying the size to apply custom font features.

Input	Font size, $s$
<code>Size = X-</code>	$s \geq X$
<code>Size = -Y</code>	$s < Y$
<code>Size = X-Y</code>	$X \leq s < Y$
<code>Size = X</code>	$s = X$

command, `\color{...}` and related commands, including hyperlink colouring, will no longer have any effect on text in this font.) Therefore, `fontspec`'s colour commands are best used to set explicit colours in specific situations, and the `xcolor` package is recommended for more general colour functionality.

The colour is defined as a triplet of two-digit Hex RGB values, with optionally another value for the transparency (where `00` is completely transparent and `FF` is opaque.) Transparency is supported by `LuaLaTeX`; `XLaTeX` with the `xdvipdfmx` driver does not support this feature.

If you load the `xcolor` package, you may use any named colour instead of writing the colours in hexadecimal.

```
\usepackage{xcolor}
...
\fontspec[Color=red]{Verdana} ...
\definecolor{Foo}{rgb}{0.3,0.4,0.5}
\fontspec[Color=Foo]{Verdana} ...
```

The `color` package is *not* supported; use `xcolor` instead.

You may specify the transparency with a named colour using the `Opacity` feature which takes an decimal from zero to one corresponding to transparent to opaque respectively:

```
\fontspec[Color=red,Opacity=0.7]{Verdana} ...
```

It is still possible to specify a colour in six-char hexadecimal form while defining opacity in this way, if you like.

## 14.2 Scale

```
Scale = <number>
Scale = MatchLowercase
Scale = MatchUppercase
```

In its explicit form, `Scale` takes a single numeric argument for linearly scaling the font, as demonstrated in Example 1. It is now possible to measure the correct dimensions of the fonts loaded and calculate values to scale them automatically.

As well as a numerical argument, the `Scale` feature also accepts options `MatchLowercase` and `MatchUppercase`, which will scale the font being selected to match the current default roman font to either the height of the lowercase or uppercase letters, respectively; these features are shown in Example 11.

---

Example 10: Selecting colour with transparency.

---



```
\fontsize{48}{48}
\fontspec{texgyrebonum-bold.otf}
{\addfontfeature{Color=FF0000}W}\kern-0.4ex
{\addfontfeature{Color=0000FF}S}\kern-0.4ex
{\addfontfeature{Color=DDBB22}P}\kern-0.5ex
{\addfontfeature{Color=00BB33}R}
```

---

---

Example 11: Automatically calculated scale values.

---

	<code>\setmainfont{Georgia}</code>
	<code>\newfontfamily\lc[Scale=MatchLowercase]{Verdana}</code>
The perfect match is hard to find.	<code>The perfect match {\lc is hard to find.}\</code>
LOG OFONT	<code>\newfontfamily\uc[Scale=MatchUppercase]{Arial}</code>
	<code>L O G O \uc F O N T</code>

---

The amount of scaling used in each instance is reported in the `.log` file. Since there is some subjectivity about the exact scaling to be used, these values should be used to fine-tune the results.

Note that when `Scale=MatchLowercase` is used with `\setmainfont`, the new ‘main’ font of the document will be scaled to match the old default. This may be undesirable in some cases, so to achieve ‘natural’ scaling for the main font but automatically scale all other fonts selected, you may write

```
\defaultfontfeatures{ Scale = MatchLowercase }
\defaultfontfeatures[\rmfamily]{ Scale = 1}
```

One or both of these lines may be placed into a local `fontspec.cfg` file (see [Section 3.3 on page 7](#)) for this behaviour to be effected in your own documents automatically. (Also see [Section 8 on page 20](#) for more information on setting font defaults.)

### 14.3 Interword space

While the space between words can be varied on an individual basis with the  $\TeX$  primitive `\spaceskip` command, it is more convenient to specify this information when the font is first defined.

The space in between words in a paragraph will be chosen automatically, and generally will not need to be adjusted. For those times when the precise details are important, the `WordSpace` feature is provided, which takes either a single scaling factor to scale the default value, or a triplet of comma-separated values to scale the nominal value, the stretch, and the shrink of the interword space by, respectively. (`WordSpace={x}` is the same as `WordSpace={x,x,x}`.)

Note that  $\TeX$ ’s optimisations in how it loads fonts means that you cannot use this feature in `\addfontfeatures`.

### 14.4 Post-punctuation space

If `\frenchspacing` is *not* in effect,  $\TeX$  will allow extra space after some punctuation in its goal of justifying the lines of text. Generally, this is considered old-fashioned, but occasionally in small amounts the effect can be justified, pardon the pun.

The `PunctuationSpace` feature takes a scaling factor by which to adjust the nominal value chosen for the font; this is demonstrated in [Example 13](#). Note that `PunctuationSpace=0` is *not* equivalent to `\frenchspacing`, although the difference will only be apparent when a line of text is under-full.

---

Example 12: Scaling the default interword space. An exaggerated value has been chosen to emphasise the effects here.

---

	<pre> \fontspec{texgyretermes-regular.otf} Some text for our example to take up some space, and to demonstrate the default interword space. \bigskip </pre>
Some text for our example to take up some space, and to demonstrate the default interword space.	<pre> \fontspec{texgyretermes-regular.otf}% [WordSpace = 0.3] Some text for our example to take up some space, and to demonstrate the default interword space. </pre>
Some text for our example to take up some space, and to demonstrate the default interword space.	

---



---

Example 13: Scaling the default post-punctuation space.

---

	<pre> \nonfrenchspacing \fontspec{texgyreschola-regular.otf} Letters, Words. Sentences. \par \fontspec{texgyreschola-regular.otf}[PunctuationSpace=2] Letters, Words. Sentences. \par \fontspec{texgyreschola-regular.otf}[PunctuationSpace=0] Letters, Words. Sentences. </pre>
Letters, Words. Sentences.	
Letters, Words. Sentences.	
Letters, Words. Sentences.	

---

Note that  $\TeX$ 's optimisations in how it loads fonts means that you cannot use this feature in `\addfontfeatures`.

## 14.5 The hyphenation character

The letter used for hyphenation may be chosen with the `HyphenChar` feature. It takes three types of input, which are chosen according to some simple rules. If the input is the string `None`, then hyphenation is suppressed for this font. If the input is a single character, then this character is used. Finally, if the input is longer than a single character it must be the UTF-8 slot number of the hyphen character you desire.

This package redefines  $\TeX$ 's `\-` macro such that it adjusts along with the above changes.

Note that  $\TeX$ 's optimisations in how it loads fonts means that you cannot use this feature in `\addfontfeatures`.

## 14.6 Optical font sizes

Optically scaled fonts thicken out as the font size decreases in order to make the glyph shapes more robust (less prone to losing detail), which improves legibility. Conversely, at large optical sizes the serifs and other small details may be more delicately rendered.

OpenType fonts with optical scaling will exist in several discrete sizes, and these will be selected by  $\text{X}\TeX$  and  $\text{Lua}\TeX$  *automatically* determined by the current font size as in Example 15, in which we've scaled down some large text in order to be able to compare the difference for equivalent font sizes.

The `OpticalSize` option may be used to specify a different optical size. With `OpticalSize` set to zero, no optical size font substitution is performed, as shown in Example 16.

The `SizeFeatures` feature (Section 13 on page 24) can be used to specify exactly which optical sizes will be used for ranges of font size. For example, something like:

```
\fontspec{Latin Modern Roman}[
  UprightFeatures = { SizeFeatures = {
    {Size=-10,      OpticalSize=8 },
    {Size= 10-14,   OpticalSize=10},
    {Size= 14-18,   OpticalSize=14},
```

---

Example 14: Explicitly choosing the hyphenation character.

---

EXAMPLE  
HYPHENATION

```
\def\text{\fbox{\parbox{1.55cm}{%
  EXAMPLE HYPHENATION%
}}\quad\quad\quad\par\bigskip}
```

EXAMPLE  
HYPHEN+  
ATION

```
\fontspec{Linux Libertine O}[HyphenChar=None]
\text
\fontspec{Linux Libertine O}[HyphenChar={+}]
\text
```

---

Example 15: A demonstration of automatic optical size selection.		
	<code>\fontspec{Latin Modern Roman}</code>	
Automatic optical size	Automatic optical size	<code>\</code>
Automatic optical size	<code>\scalebox{0.4}{\Huge</code>	
	Automatic optical size}	

Example 16: Optical size substitution is suppressed when set to zero.		
	<code>\fontspec{Latin Modern Roman 5 Regular}[OpticalSize=0]</code>	
	Latin Modern optical sizes	<code>\</code>
	<code>\fontspec{Latin Modern Roman 8 Regular}[OpticalSize=0]</code>	
	Latin Modern optical sizes	<code>\</code>
Latin Modern optical sizes	<code>\fontspec{Latin Modern Roman 12 Regular}[OpticalSize=0]</code>	
Latin Modern optical sizes	Latin Modern optical sizes	<code>\</code>
Latin Modern optical sizes	<code>\fontspec{Latin Modern Roman 17 Regular}[OpticalSize=0]</code>	
Latin Modern optical sizes	Latin Modern optical sizes	

```
{Size= 18-, OpticalSize=18}}
]
```

### 14.7 Font transformations

In rare situations users may want to mechanically distort the shapes of the glyphs in the current font such as shown in Example 17. Please don't overuse these features; they are *not* a good alternative to having the real shapes.

If values are omitted, their defaults are as shown above.

If you want the bold shape to be faked automatically, or the italic shape to be slanted automatically, use the `AutoFakeBold` and `AutoFakeSlant` features. For example, the following two invocations are equivalent:

```
\fontspec[AutoFakeBold=1.5]{Charis SIL}
\fontspec[BoldFeatures={FakeBold=1.5}]{Charis SIL}
```

Example 17: Artificial font transformations.		
	<code>\fontspec{Charis SIL} \emph{ABCxyz} \quad</code>	
	<code>\fontspec{Charis SIL}[FakeSlant=0.2] ABCxyz</code>	
	<code>\fontspec{Charis SIL} ABCxyz \quad</code>	
	<code>\fontspec{Charis SIL}[FakeStretch=1.2] ABCxyz</code>	
<i>ABCxyz</i>	<b>ABCxyz</b>	
ABCxyz	<b>ABCxyz</b>	<code>\fontspec{Charis SIL} \textbf{ABCxyz} \quad</code>
<b>ABCxyz</b>	<b>ABCxyz</b>	<code>\fontspec{Charis SIL}[FakeBold=1.5] ABCxyz</code>

If both of the `AutoFake...` features are used, then the bold italic font will also be faked.

The `FakeBold` and `AutoFakeBold` features are only available with the  $\text{\XeTeX}$  engine and will be ignored in  $\text{\LuaTeX}$ .

### 14.8 Letter spacing

Letter spacing, or tracking, is the term given to adding (or subtracting) a small amount of horizontal space in between adjacent characters. It is specified with the `LetterSpace`, which takes a numeric argument, shown in Example 18.

The letter spacing parameter is a normalised additive factor (not a scaling factor); it is defined as a percentage of the font size. That is, for a 10 pt font, a letter spacing parameter of ‘1.0’ will add 0.1 pt between each letter.

This functionality is not generally used for lowercase text in modern typesetting but does have historic precedent in a variety of situations. In particular, small amounts of letter spacing can be very useful, when setting small caps or all caps titles. Also see the OpenType Uppercase option of the `Letters` feature (Section 16.2 on page 35).

---

Example 18: The `LetterSpace` feature.

---

	<code>\fontspec{Didot}</code>
	<code>\addfontfeature{LetterSpace=0.0}</code>
USE TRACKING FOR DISPLAY CAPS TEXT	USE TRACKING FOR DISPLAY CAPS TEXT \
	<code>\addfontfeature{LetterSpace=2.0}</code>
USE TRACKING FOR DISPLAY CAPS TEXT	USE TRACKING FOR DISPLAY CAPS TEXT

---



## Part IV

# OpenType

## 15 Introduction

OpenType fonts (and other ‘smart’ font technologies such as AAT and Graphite) can change the appearance of text in many different ways. These changes are referred to as font features. When the user applies a feature — for example, small capitals — to a run of text, the code inside the font makes appropriate substitutions and small capitals appear in place of lowercase letters. However, the use of such features does not affect the underlying text. In our small caps example, the lowercase letters are still stored in the document; only the appearance has been changed by the OpenType feature. This makes it possible to search and copy text without difficulty. If the user selected a different font that does not support small caps, the ‘plain’ lowercase letters would appear instead.

Some OpenType features are required to support particular scripts, and these features are often applied automatically. The Indic scripts, for example, often require that characters be reshaped and reordered after they are typed by the user, in order to display them in the traditional ways that readers expect. Other features can be applied to support a particular language. The Junicode font for medievalists uses by default the Old English shape of the letter thorn, while in modern Icelandic thorn has a more rounded shape. If a user tags some text as being in Icelandic, Junicode will automatically change to the Icelandic shape through an OpenType feature that localises the shapes of letters.

There are a large group of OpenType features, designed to support high quality typography a multitude of languages and writing scripts. Examples of some font features have already been shown in previous sections; the complete set of OpenType font features supported by fontspec is described below in [Section 16](#).

The OpenType specification provides four-letter codes (e.g., `smcp` for small capitals) for each feature. The four-letter codes are given below along with the fontspec names for various features, for the benefit of people who are already familiar with OpenType. You can ignore the codes if they don’t mean anything to you.

### 15.1 How to select font features

Font features are selected by a series of `<feature>=<option>` selections. Features are (usually) grouped logically; for example, all font features relating to ligatures are accessed by writing `Ligatures={...}` with the appropriate argument(s), which could be `TeX`, `Rare`, etc., as shown below in [16.1.1](#).

Multiple options may be given to any feature that accepts non-numerical input, although doing so will not always work. Some options will override others in generally obvious ways; `Numbers={OldStyle,Lining}` doesn’t make much sense because the two options are mutually exclusive, and  $\text{\TeX}$  will simply use the last option that is specified (in this case using `Lining` over `OldStyle`).

If a feature or an option is requested that the font does not have, a warning is given in the console output. As mentioned in [Section 3.4 on page 8](#) these warnings can be

suppressed by selecting the [quiet] package option.

## 15.2 How do I know what font features are supported by my fonts?

Although I've long desired to have a feature within fontspec to display the OpenType features within a font, it's never been high on my priority list. One reason for that is the existence of the document `opentype-info.tex`, which is available on CTAN or typing `kpsewhich opentype-info.tex` in a Terminal window. Make a copy of this file and place it somewhere convenient. Then open it in your regular T<sub>E</sub>X editor and change the font name to the font you'd like to query; after running through plain X<sub>Y</sub>T<sub>E</sub>X, the output PDF will look something like this:

### OpenType Layout features found in '[Asana-Math.otf]'

```
script = 'DFLT'
  language = <default>
    features = 'onum' 'salt' 'kern'
script = 'cher'
  language = <default>
    features = 'onum' 'salt' 'kern'
script = 'grek'
  language = <default>
    features = 'onum' 'salt' 'kern'
script = 'latn'
  language = <default>
    features = 'onum' 'salt' 'kern'
script = 'math'
  language = <default>
    features = 'dtls' 'onum' 'salt' 'ssty' 'kern'
```

I intentionally picked a font that by design needs few font features; 'regular' text fonts such as Latin Modern Roman contain many more, and I didn't want to clutter up the document too much. You'll then need to cross-check the OpenType feature tags with the 'logical' names used by fontspec.

**otfinfo** Alternatively, and more simply, you can use the command line tool `otfinfo`, which is distributed with T<sub>E</sub>XLive. Simply type in a Terminal window, say:

```
otfinfo -f `kpsewhich lmromandunh10-oblique.otf`
```

which results in:

aalt	Access All Alternates
csp	Capital Spacing
dlig	Discretionary Ligatures
frac	Fractions

kern	Kerning
liga	Standard Ligatures
lnum	Lining Figures
onum	Oldstyle Figures
pnum	Proportional Figures
size	Optical Size
tnum	Tabular Figures
zero	Slashed Zero

## 16 OpenType font features

There are a finite set of OpenType font features, and fontspec provides an interface to around half of them. Full documentation will be presented in the following sections, including how to enable and disable individual features, and how they interact.

A brief reference is provided ([Table 2 on the next page](#)) but note that this is an incomplete listing — only the ‘enable’ keys are shown, and where alternative interfaces are provided for convenience only the first is shown. (E.g., `Numbers=OldStyle` is the same as `Numbers=Lowercase`.)

For completeness, the complete list of OpenType features *not* provided with a fontspec interface is shown in [Table 3 on page 37](#). Features omitted are partially by design and partially by oversight; for example, the `aalt` feature is largely useless in  $\text{\TeX}$  since it is designed for providing a `textscgui` interface for selecting ‘all alternates’ of a glyph. Others, such as optical bounds for example, simply haven’t yet been considered due to a lack of fonts available for testing. Suggestions welcome for how/where to add these missing features to the package.

### 16.1 Tag-based features

#### 16.1.1 Ligatures

Ligatures refer to the replacement of two separate characters with a specially drawn glyph for functional or aesthetic reasons. The list of options, of which multiple may be selected at one time, is shown in [Table 4](#). A demonstration with the Linux Libertine fonts<sup>6</sup> is shown in [Example 19](#).

Note the additional features accessed with `Ligatures=TeX`. These are not actually real OpenType features, but additions provided by `luaotfload` (i.e.,  $\text{\LuaTeX}$  only) to emulate  $\text{\TeX}$ ’s behaviour for ASCII input of curly quotes and punctuation. In  $\text{\XeTeX}$  this is achieved with the Mapping feature (see [Section 21.1 on page 60](#)) but for consistency `Ligatures=TeX` will perform the same function as `Mapping=tex-text`.

### 16.2 Letters

The Letters feature specifies how the letters in the current font will look. OpenType fonts may contain the following options: `Uppercase`, `SmallCaps`, `PetiteCaps`, `UppercaseSmallCaps`, `UppercasePetiteCaps`, and `Unicase`.

<sup>6</sup><http://www.linuxlibertine.org/>

Table 2: Summary of OpenType features in fontspec, alphabetic by feature tag.

ABVM	Diacritics = AboveBase	<i>Above-base Mark Positioning</i>	NUMR	VerticalPosition = Numerator	<i>Numerators</i>
AFRC	Fractions = Alternate	<i>Alternative Fractions</i>	ONUM	Numbers = Lowercase	<i>Oldstyle Figures</i>
BLWM	Diacritics = BelowBase	<i>Below-base Mark Positioning</i>	ORDN	VerticalPosition = Ordinal	<i>Ordinals</i>
			ORNM	Ornament = <i>N</i>	<i>Ornaments</i>
CALT	Contextuals = Alternate	<i>Contextual Alternates</i>	PALT	CharacterWidth = AlternateProportional	<i>Proportional Alternate Widths</i>
CASE	Letters = Uppercase	<i>Case-Sensitive Forms</i>	PCAP	Letters = PetiteCaps	<i>Petite Capitals</i>
CLIG	Ligatures = Contextual	<i>Contextual Ligatures</i>	PKNA	Style = ProportionalKana	<i>Proportional Kana</i>
CPSP	Kerning = Uppercase	<i>Capital Spacing</i>	PNUM	Numbers = Proportional	<i>Proportional Figures</i>
CSWH	Contextuals = Swash	<i>Contextual Swash</i>	PWID	CharacterWidth = Proportional	<i>Proportional Widths</i>
CVNN	CharacterVariant = <i>N:M</i>	<i>Character Variant N</i>	QWID	CharacterWidth = Quarter	<i>Quarter Widths</i>
C2PC	Letters = UppercasePetiteCaps	<i>Petite Capitals From Capitals</i>	RAND	Letters = Random	<i>Randomize</i>
			RLIG	Ligatures = Required	<i>Required Ligatures</i>
C2SC	Letters = UppercaseSmallCaps	<i>Small Capitals From Capitals</i>	RUBY	Style = Ruby	<i>Ruby Notation Forms</i>
			SALT	Alternate = <i>N</i>	<i>Stylistic Alternates</i>
DLIG	Ligatures = Rare	<i>Discretionary Ligatures</i>	SINF	VerticalPosition = ScientificInferior	<i>Scientific Inferiors</i>
DNOM	VerticalPosition = Denominator	<i>Denominators</i>	SMCP	Letters = SmallCaps	<i>Small Capitals</i>
EXPT	CJKShape = Expert	<i>Expert Forms</i>	SMPL	CJKShape = Simplified	<i>Simplified Forms</i>
FALT	Contextuals = LineFinal	<i>Final Glyph on Line Alternates</i>	ssNN	StylisticSet = <i>N</i>	<i>Stylistic Set N</i>
			SSTY	Style = MathScript	<i>Math script style alternates</i>
FINA	Contextuals = WordFinal	<i>Terminal Forms</i>	SUBS	VerticalPosition = Inferior	<i>Subscript</i>
FRAC	Fractions = On	<i>Fractions</i>	SUPS	VerticalPosition = Superior	<i>Superscript</i>
FWID	CharacterWidth = Full	<i>Full Widths</i>	SWSH	Style = Swash	<i>Swash</i>
HALT	CharacterWidth = AlternateHalf	<i>Alternate Half Widths</i>	TITL	Style = TitlingCaps	<i>Titling</i>
HIST	Style = Historic	<i>Historical Forms</i>	TNUM	Numbers = Monospaced	<i>Tabular Figures</i>
HKNA	Style = HorizontalKana	<i>Horizontal Kana Alternates</i>	TRAD	CJKShape = Traditional	<i>Traditional Forms</i>
HLIG	Ligatures = Historic	<i>Historical Ligatures</i>	TWID	CharacterWidth = Third	<i>Third Widths</i>
HWID	CharacterWidth = Half	<i>Half Widths</i>	UNIC	Letters = Unicase	<i>Unicase</i>
INIT	Contextuals = WordInitial	<i>Initial Forms</i>	VALT	Vertical = AlternateMetrics	<i>Alternate Vertical Metrics</i>
ITAL	Style = Italic	<i>Italics</i>	VERT	Vertical = Alternates	<i>Vertical Writing</i>
JP78	CJKShape = JIS1978	<i>JIS78 Forms</i>	VHAL	Vertical = HalfMetrics	<i>Alternate Vertical Half Metrics</i>
JP83	CJKShape = JIS1983	<i>JIS83 Forms</i>			
JP90	CJKShape = JIS1990	<i>JIS90 Forms</i>	VKNA	Style = VerticalKana	<i>Vertical Kana Alternates</i>
JP04	CJKShape = JIS2004	<i>JIS2004 Forms</i>	VKRN	Vertical = Kerning	<i>Vertical Kerning</i>
KERN	Kerning = On	<i>Kerning</i>	VPAL	Vertical = ProportionalMetrics	<i>Proportional Alternate Vertical Metrics</i>
LIGA	Ligatures = Common	<i>Standard Ligatures</i>			
LNUM	Numbers = Uppercase	<i>Lining Figures</i>	VRT2	Vertical = RotatedGlyphs	<i>Vertical Alternates and Rotation</i>
MARK	Diacritics = MarkToBase	<i>Mark Positioning</i>			
MEDI	Contextuals = Inner	<i>Medial Forms</i>	VRTR	Vertical = AlternatesForRotation	<i>Vertical Alternates for Rotation</i>
MKMK	Diacritics = MarkToMark	<i>Mark to Mark Positioning</i>			
NALT	Annotation = <i>N</i>	<i>Alternate Annotation Forms</i>	ZERO	Numbers = SlashedZero	<i>Slashed Zero</i>
NLCK	CJKShape = NLC	<i>NLC Kanji Forms</i>			

Table 3: List of *unsupported* OpenType features.

AALT	<i>Access All Alternates</i>	HNGL	<i>Hangul</i>	PSTS	<i>Post-base Substitutions</i>
ABVF	<i>Above-base Forms</i>	HOJO	<i>Hojo Kanji Forms</i>	RCLT	<i>Required Contextual Alternates</i>
ABVS	<i>Above-base Substitutions</i>	ISOL	<i>Isolated Forms</i>	RKRF	<i>Rakar Forms</i>
AKHN	<i>Akhands</i>	JALT	<i>Justification Alternates</i>	RPHE	<i>Reph Forms</i>
BLWF	<i>Below-base Forms</i>	LFBD	<i>Left Bounds</i>	RTBD	<i>Right Bounds</i>
BLWS	<i>Below-base Substitutions</i>	LJMO	<i>Leading Jamo Forms</i>	RTLA	<i>Right-to-left alternates</i>
CCMP	<i>Glyph Composition / Decomposition</i>	LOCL	<i>Localized Forms</i>	RTLTM	<i>Right-to-left mirrored forms</i>
CFAR	<i>Conjunct Form After Ro</i>	LTRM	<i>Left-to-right mirrored forms</i>	RVRN	<i>Required Variation Alternates</i>
CJCT	<i>Conjunct Forms</i>	MED2	<i>Medial Forms #2</i>	SIZE	<i>Optical size</i>
CPCT	<i>Centered CJK Punctuation</i>	MGRK	<i>Mathematical Greek</i>	STCH	<i>Stretching Glyph Decomposition</i>
CURS	<i>Cursive Positioning</i>	MSET	<i>Mark Positioning via Substitution</i>	TJMO	<i>Trailing Jamo Forms</i>
DIST	<i>Distances</i>	NUKT	<i>Nukta Forms</i>	TNAM	<i>Traditional Name Forms</i>
DTLS	<i>Dotless Forms</i>	OPBD	<i>Optical Bounds</i>	VATU	<i>Vattu Variants</i>
FIN2	<i>Terminal Forms #2</i>	PREF	<i>Pre-Base Forms</i>	VJMO	<i>Vowel Jamo Forms</i>
FIN3	<i>Terminal Forms #3</i>	PRES	<i>Pre-base Substitutions</i>		
FLAC	<i>Flattened accent forms</i>	PSTF	<i>Post-base Forms</i>		
HALF	<i>Half Forms</i>				
HALN	<i>Halant Forms</i>				

Table 4: Options for the OpenType font feature ‘Ligatures’.

Feature	Option	Tag
Ligatures =	Required	r <sub>lig</sub> †
	Common	l <sub>iga</sub> †
	Contextual	c <sub>lig</sub> †
	Rare/Discretionary	d <sub>lig</sub> †
	Historic	h <sub>lig</sub> †
	TeX	t <sub>lig</sub> †
ResetAll		

† These feature options can be disabled with `. .Off` variants, and reset to default state (neither explicitly on nor off) with `. .Reset`.

---

Example 19: An example of the Ligatures feature.

---

strict	→	ſtrict	<pre> \def\test#1#2{%   #2 \$\to\$ {\addfontfeature{#1} #2}\} \fontspec{Linux Libertine O} \test{Ligatures=Historic}{strict} \test{Ligatures=Rare}{wurtzite} \test{Ligatures=NoCommon}{firefly} </pre>
wurtzite	→	wurtzite	
firefly	→	firefly	

---

Table 5: Options for the OpenType font feature ‘Letters’.

Feature	Option	Tag
Letters =	Uppercase	case †
	SmallCaps	smcp †
	PetiteCaps	pcap †
	UppercaseSmallCaps	c2sc †
	UppercasePetiteCaps	c2pc †
	Unicase	unic †
ResetAll		

† These feature options can be disabled with `. .Off` variants, and reset to default state (neither explicitly on nor off) with `. .Reset`.

Petite caps are smaller than small caps. `SmallCaps` and `PetiteCaps` turn lowercase letters into the smaller caps letters, whereas the `Uppercase` . . . options turn the *capital* letters into the smaller caps (good, *e.g.*, for applying to already uppercase acronyms like ‘NASA’). This difference is shown in Example 20. ‘Unicase’ is a weird hybrid of upper and lower case letters.

Note that the `Uppercase` option will (probably) not actually map letters to uppercase.<sup>7</sup> It is designed to select various uppercase forms for glyphs such as accents and dashes, such as shown in Example 21; note the raised position of the hyphen to better match the surrounding letters.

The `Kerning` feature also contains an `Uppercase` option, which adds a small amount of spacing in between letters (see Section 16.5 on page 44).

### 16.2.1 Numbers

The `Numbers` feature defines how numbers will look in the selected font, accepting options shown in Table 6.

The synonyms `Uppercase` and `Lowercase` are equivalent to `Lining` and `OldStyle`, respectively. The differences have been shown previously in Section 10 on page 22. The `Monospaced` option is useful for tabular material when digits need to be vertically aligned.

The `SlashedZero` option replaces the default zero with a slashed version to prevent confusion with an uppercase ‘O’, shown in Example 22.

The `Arabic` option (with tag `anum`) maps regular numerals to their Arabic script or Persian equivalents based on the current `Language` setting (see Section 16.9 on page 49). This option is based on a LuaTeX feature of the `luaotfload` package, not an OpenType feature. (Thus, this feature is unavailable in X<sub>Y</sub>TeX.)

### 16.2.2 Contextuals

This feature refers to substitutions of glyphs that vary ‘contextually’ by their relative position in a word or string of characters; features such as contextual swashes are accessed via the options shown in Table 7.

Historic forms are accessed in OpenType fonts via the feature `Style=Historic`; this is generally *not* contextual in OpenType, which is why it is not included in this feature.

---

Example 20: Small caps from lowercase or uppercase letters.

---

	<code>\fontspec{texgyreadventor-regular.otf}[Letters=SmallCaps]</code>
	THIS SENTENCE no verb      \\\
THIS SENTENCE NO VERB	<code>\fontspec{texgyreadventor-regular.otf}[Letters=UppercaseSmallCaps]</code>
THIS SENTENCE NO verb	THIS SENTENCE no verb

---

Example 21: An example of the Uppercase option of the Letters feature.		
UPPER-CASE example		<code>\fontspec{Linux Libertine O}</code>
UPPER-CASE example		<code>UPPER-CASE example \</code>
		<code>\addfontfeature{Letters=Uppercase}</code>
		<code>UPPER-CASE example</code>

Table 6: Options for the OpenType font feature ‘Numbers’.

Feature	Option	Tag
Numbers =	Uppercase	lnum †
	Lowercase	onum †
	Lining	lnum †
	OldStyle	onum †
	Proportional	pnum †
	Monospaced	tnum †
	SlashedZero	zero †
	Arabic	anum †
ResetAll		

† These feature options can be disabled with `.Off` variants, and reset to default state (neither explicitly on nor off) with `.Reset`.

Example 22: The effect of the SlashedZero option.		
		<code>\fontspec[Numbers=Lining]{texgyrebonum-regular.otf}</code>
		<code>0123456789</code>
		<code>\fontspec[Numbers=SlashedZero]{texgyrebonum-regular.otf}</code>
0123456789 0123456789		<code>0123456789</code>

Table 7: Options for the OpenType font feature ‘Contextuals’.

Feature	Option	Tag
Contextuals =	Swash	csw †
	Alternate	calt †
	WordInitial	init †
	WordFinal	fina †
	LineFinal	falt †
	Inner	medi †
ResetAll		

† These feature options can be disabled with `.Off` variants, and reset to default state (neither explicitly on nor off) with `.Reset`.



Table 8: Options for the OpenType font feature ‘VerticalPosition’.

Feature	Option	Tag
VerticalPosition =	Superior	sup <sup>s</sup> †
	Inferior	sub <sup>s</sup> †
	Numerator	num <sup>r</sup> †
	Denominator	dnom †
	ScientificInferior	sinf †
	Ordinal	ord <sup>n</sup> †
ResetAll		

† These feature options can be disabled with . .Off variants, and reset to default state (neither explicitly on nor off) with . .Reset.

16.2.3 Vertical Position

The VerticalPosition feature is used to access things like subscript (Inferior) and superscript (Superior) numbers and letters (and a small amount of punctuation, sometimes). The Ordinal option will only raise characters that are used in some languages directly after a number. The ScientificInferior feature will move glyphs further below the baseline than the Inferior feature. These are shown in Example 23

Numerator and Denominator should only be used for creating arbitrary fractions (see next section).

The realscripts package (which is also loaded by xltextra for X<sub>Y</sub>TeX) redefines the \textsubscript and \textsuperscript commands to use the above font features automatically, including for use in footnote labels. If this is the only feature of xltextra you wish to use, consider loading realscripts on its own instead.

16.2.4 Fractions

For OpenType fonts use a regular text slash to create fractions, but the Fraction feature must be explicitly activated. Some (Asian fonts predominantly) also provide for the Alternate feature. These are both shown in Example 24.

<sup>7</sup>If you want automatic uppercase letters, look to L<sup>A</sup>T<sub>E</sub>X’s \MakeUppercase command.

Example 23: The VerticalPosition feature.

Superior: 1234567890  
Numerator: 12345  
Denominator: 12345  
Scientific Inferior: 12345

\fontspec{LibreCaslonText-Regular.otf}[VerticalPosition=Superior]	
Superior: 1234567890	\\
\fontspec{LibreCaslonText-Regular.otf}[VerticalPosition=Numerator]	
Numerator: 12345	\\
\fontspec{LibreCaslonText-Regular.otf}[VerticalPosition=Denominator]	
Denominator: 12345	\\
\fontspec{LibreCaslonText-Regular.otf}[VerticalPosition=ScientificInferior]	
Scientific Inferior: 12345	

Table 9: Options for the OpenType font feature ‘Fractions’.

Feature	Option	Tag
Fractions	= On	+frac
	Off	-frac
	Reset	
	Alternate afrc	†
	ResetAll	

† These feature options can be disabled with . .Off variants, and reset to default state (neither explicitly on nor off) with . .Reset.

Example 24: The Fractions feature.

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{5}{6}$	13579/24680	<code>\fontspec{Hiragino Maru Gothic Pro W4}</code>
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{5}{6}$	13579/24680	<code>1/2 \quad 1/4 \quad 5/6 \quad 13579/24680 \\\</code>
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{5}{6}$	13579/24680	<code>\addfontfeature{Fractions=On}</code>
				<code>1/2 \quad 1/4 \quad 5/6 \quad 13579/24680 \\\</code>
				<code>\addfontfeature{Fractions=Alternate}</code>
				<code>1/2 \quad 1/4 \quad 5/6 \quad 13579/24680 \\\</code>

### 16.3 Style

‘Ruby’ refers to a small optical size, used in Japanese typography for annotations. For fonts with multiple salt OpenType features, use the `fontspec Alternate` feature instead.

Example 25 and Example 26 both contain glyph substitutions with similar characteristics. Note the occasional inconsistency with which font features are labelled; a long-tailed ‘Q’ could turn up anywhere!

In other features, larger breadths of changes can be seen, covering the style of an entire alphabet. See Example 27 and Example 28; in the latter, the `Italic` option affects the Latin text and the `Ruby` option the Japanese.

Note the difference here between the default and the horizontal style kana in Example 29: the horizontal style is slightly wider.

Example 25: Example of the Alternate option of the Style feature.

M Q W	<code>\fontspec{Quattrocento Roman}</code>
M Q W	<code>M Q W \\\</code>
M Q W	<code>\addfontfeature{Style=Alternate}</code>
M Q W	<code>M Q W</code>

Table 10: Options for the OpenType font feature ‘Style’.

Feature	Option	Tag
Style = Alternate		salt †
	Italic	ital †
	Ruby	ruby †
	Swash	swsh †
	Cursive	curs †
	Historic	hist †
	TitlingCaps	titl †
	HorizontalKana	hkna †
	VerticalKana	vkna †
	ResetAll	

† These feature options can be disabled with `..Off` variants, and reset to default state (neither explicitly on nor off) with `..Reset`.

Example 26: Example of the Historic option of the Style feature.

<b>M Q Z</b>	<code>\fontspec{Adobe Jenson Pro}</code>
<b>M Q Z</b>	<code>M Q Z</code>
<b>M Q Z</b>	<code>\addfontfeature{Style=Historic}</code>
<b>M Q Z</b>	<code>M Q Z</code>

Example 27: Example of the TitlingCaps option of the Style feature.

<b>TITLING CAPS</b>	<code>\fontspec{Adobe Garamond Pro}</code>
<b>TITLING CAPS</b>	<code>TITLING CAPS</code>
<b>TITLING CAPS</b>	<code>\addfontfeature{Style=TitlingCaps}</code>
<b>TITLING CAPS</b>	<code>TITLING CAPS</code>

Example 28: Example of the Italic and Ruby options of the Style feature.

<b>Latin</b> ようこそ ワカヨタレソ	<code>\fontspec{Hiragino Mincho Pro}</code>
<b>Latin</b> ようこそ ワカヨタレソ	<code>Latin \kana</code>
<b>Latin</b> ようこそ ワカヨタレソ	<code>\addfontfeature{Style={Italic, Ruby}}</code>
<b>Latin</b> ようこそ ワカヨタレソ	<code>Latin \kana</code>

Example 29: Example of the HorizontalKana and VerticalKana options of the Style feature.

ようこそ ワカヨタレソ	<code>\fontspec{Hiragino Mincho Pro}</code>
ようこそ ワカヨタレソ	<code>\kana</code>
ようこそ ワカヨタレソ	<code>\addfontfeature{Style=HorizontalKana}</code>
ようこそ ワカヨタレソ	<code>\kana }</code>
ようこそ ワカヨタレソ	<code>\addfontfeature{Style=VerticalKana}</code>
ようこそ ワカヨタレソ	<code>\kana }</code>

## 16.4 Diacritics

Specifies how combining diacritics should be placed. These will usually be controlled automatically according to the Script setting.

## 16.5 Kerning

Specifies how inter-glyph spacing should behave. Well-made fonts include information for how differing amounts of space should be inserted between separate character pairs. This kerning space is inserted automatically but in rare circumstances you may wish to turn it off.

As briefly mentioned previously at the end of [Section 16.2 on page 35](#), the `Uppercase` option will add a small amount of tracking between uppercase letters, seen in [Example 30](#), which uses the *Romande* fonts<sup>8</sup> (thanks to Clea F. Rees for the suggestion). The `Uppercase` option acts separately to the regular kerning controlled by the `On/Off` options.

## 16.6 Character width

Many Asian fonts are equipped with variously spaced characters for shoe-horning into their generally monospaced text. These are accessed through the `CharacterWidth` feature.

Japanese alphabetic glyphs (in Hiragana or Katakana) may be typeset proportionally, to better fit horizontal measures, or monospaced, to fit into the rigid grid imposed by ideographic typesetting. In this latter case, there are also half-width forms for squeezing more kana glyphs (which are less complex than the kanji they are amongst) into a given block of space. The same features are given to roman letters in Japanese fonts, for typesetting foreign words in the same style as the surrounding text.

The same situation occurs with numbers, which are provided in increasingly illegible compressed forms seen in [Example 32](#).

Table 11: Options for the OpenType font feature ‘Diacritics’.

Feature	Option	Tag
Diacritics	<code>MarkToBase</code>	<code>mark</code> †
	<code>MarkToMark</code>	<code>mkmk</code> †
	<code>AboveBase</code>	<code>abvm</code> †
	<code>BelowBase</code>	<code>blwm</code> †
ResetAll		

† These feature options can be disabled with `.Off` variants, and reset to default state (neither explicitly on nor off) with `.Reset`.

Table 12: Options for the OpenType font feature ‘Kerning’.

Feature	Option	Tag
Kerning =	On	+kern
	Off	-kern
	Reset	
<hr/>		
	Uppercase csp	†
<hr/>		
	ResetAll	

† These feature options can be disabled with . .Off variants, and reset to default state (neither explicitly on nor off) with . .Reset.

Example 30: Adding extra kerning for uppercase letters. (The difference is usually very small.)

UPPERCASE EXAMPLE  
UPPERCASE EXAMPLE

```
\fontspec{Romande ADF Std Bold}
UPPERCASE EXAMPLE \
\addfontfeature{Kerning=Uppercase}
UPPERCASE EXAMPLE
```

Table 13: Options for the OpenType font feature ‘CharacterWidth’.

Feature	Option	Tag
CharacterWidth =	Proportional	pwid †
	Full	fwid †
	Half	hwid †
	Third	twid †
	Quarter	qwid †
	AlternateProportional	palt †
	AlternateHalf	halt †
	ResetAll	

† These feature options can be disabled with . .Off variants, and reset to default state (neither explicitly on nor off) with . .Reset.

Example 31: Proportional or fixed width forms.

ようこそ  
ようこそ  
ようこそ

ワカヨタレソ  
ワカヨタレソ  
ワカヨタレソ

abcdef  
a b c d e f  
abcdef

```
\def\test{\makebox[2cm]{1}{\texta}%
\makebox[2.5cm]{1}{\textb}%
\makebox[2.5cm]{1}{abcdef}}
\fontspec{Hiragino Mincho Pro}
{\addfontfeature{CharacterWidth=Proportional}\test}\
{\addfontfeature{CharacterWidth=Full}\test}\
{\addfontfeature{CharacterWidth=Half}\test}
```

Example 32: Numbers can be compressed significantly.	
— 1 2 3 2 1 — -1234554321- -123456787654321- -12345678900987654321-	<pre>\fontspec[Renderer=AAT]{Hiragino Mincho Pro} {\addfontfeature{CharacterWidth=Full} ---12321---}\ {\addfontfeature{CharacterWidth=Half} ---1234554321---}\ {\addfontfeature{CharacterWidth=Third} ---123456787654321---}\ {\addfontfeature{CharacterWidth=Quarter} ---12345678900987654321---}</pre>

Table 14: Options for the OpenType font feature ‘CJKShape’.

Feature	Option	Tag
CJKShape =	Traditional	trad
	Simplified	smp1
	JIS1978	jp78
	JIS1983	jp83
	JIS1990	jp90
	Expert	expt
	NLC	nlck

† These feature options can be disabled with `.Off` variants, and reset to default state (neither explicitly on nor off) with `.Reset`.

### 16.6.1 CJK shape

There have been many standards for how CJK ideographic glyphs are ‘supposed’ to look. Some fonts will contain many alternate glyphs available in order to be able to display these glyphs correctly in whichever form is appropriate. Both AAT and OpenType fonts support the following CJKShape options: Traditional, Simplified, JIS1978, JIS1983, JIS1990, and Expert. OpenType also supports the NLC option.

## 16.7 Vertical typesetting

OpenType provides a plethora of features for accommodating the varieties of possibilities needed for vertical typesetting (CJK and others). No capabilities for achieving such vertical typesetting are provided by fontspec, however; please get in touch if there are improvements that could be made.

## 16.8 Numeric features

### 16.8.1 Stylistic Set variations — ssNN

This feature selects a ‘Stylistic Set’ variation, which usually corresponds to an alternate glyph style for a range of characters (usually an alphabet or subset thereof). This feature is specified numerically. These correspond to OpenType features ss01, ss02, etc.

Two demonstrations from the Junicond font<sup>9</sup> are shown in Example 34 and Example 35; thanks to Adam Buchbinder for the suggestion.

Multiple stylistic sets may be selected simultaneously by writing, e.g., StylisticSet={1,2,3}.

The StylisticSet feature is a synonym of the Variant feature for AAT fonts. See Section 23 on page 66 for a way to assign names to stylistic sets, which should be done on a per-font basis.

### 16.8.2 Character Variants — cvNN

Similar to the ‘Stylistic Sets’ above, ‘Character Variations’ are selected numerically to adjust the output of (usually) a single character for the particular font. These correspond to the OpenType features cv01 to cv99.

<sup>8</sup><http://arkandis.tuxfamily.org/adffonts.html>

<sup>9</sup><http://junicode.sf.net>

---

Example 33: Different standards for CJK ideograph presentation.

---

啞嚙軀 妍并訝	<code>\fontspec{Hiragino Mincho Pro}</code>
啞嚙軀 妍并訝	<code>{\addfontfeature{CJKShape=Traditional}}</code>
啞嚙軀 妍并訝	<code>\text }</code> <code>\\</code>
啞嚙軀 妍并訝	<code>{\addfontfeature{CJKShape=NLC}}</code>
啞嚙軀 妍并訝	<code>\text }</code> <code>\\</code>
啞嚙軀 妍并訝	<code>{\addfontfeature{CJKShape=Expert}}</code>
啞嚙軀 妍并訝	<code>\text }</code>

---

Table 15: Options for the OpenType font feature ‘Vertical’.

Feature	Option	Tag
Vertical =	RotatedGlyphs	vrt2 †
	AlternatesForRotation	vrtr †
	Alternates	vert †
	KanaAlternates	vkna †
	Kerning	vkrr †
	AlternateMetrics	valt †
	HalfMetrics	vhal †
	ProportionalMetrics	vpal †
ResetAll		

† These feature options can be disabled with .Off variants, and reset to default state (neither explicitly on nor off) with .Reset.

Example 34: Insular letterforms, as used in medieval Northern Europe, for the Junicode font accessed with the StylisticSet feature.

Insular forms.	\fontspec{Junicode}
Insular forms.	Insular forms. \
Insular forms.	\addfontfeature{StylisticSet=2}
Insular forms.	Insular forms. \

Example 35: Enlarged minuscules (capital letters remain unchanged) for the Junicode font, accessed with the StylisticSet feature.

ENLARGED Minuscules.	\fontspec{Junicode}
ENLARGED Minuscules.	ENLARGED Minuscules. \
ENLARGED Minuscules.	\addfontfeature{StylisticSet=6}
ENLARGED Minuscules.	ENLARGED Minuscules. \



For each character that can be varied, it is possible to select among possible options for that particular glyph. For example, in Example 36 a variety of glyphs for the character ‘v’ are selected, in which 5 corresponds to the character ‘v’ for this font feature, and the trailing `:⟨n⟩` corresponds to which variety to choose. Georg Duffner’s open source Garamond revival font<sup>10</sup> is used in this example. Character variants are specifically designed not to conflict with each other, so you can enable them individually per character as shown in Example 37. (Unlike stylistic alternates, say.)

Note that the indexing starts from zero.

### 16.8.3 Alternates — `salt`

The `Alternate` feature, alias `StylisticAlternates`, is used to access alternate font glyphs when variations exist in the font, such as in Example 38. It uses a numerical selection, starting from zero, that will be different for each font. Note that the `Style=Alternate` option is equivalent to `Alternate=o` to access the default case.

Note that the indexing starts from zero. With the LuaTeX engine, `Alternate=Random` selects a random alternate.

See Section 23 on page 66 for a way to assign names to alternates if desired.

### 16.8.4 Annotation — `nalt`

Some fonts are equipped with an extensive range of numbers and numerals in different forms. These are accessed with the `Annotation` feature (OpenType feature `nalt`), selected numerically as shown in Example 39. Note that the indexing starts from zero.

### 16.8.5 Ornament — `ornm`

Ornaments are selected with the `Ornament` feature (OpenType feature `ornm`), selected numerically such as for the `Annotation` feature. If you know of an Open Source font that supports this feature, let me know and I’ll add an example.

## 16.9 OpenType scripts and languages

Fonts that include glyphs for various scripts and languages may contain different font features for the different character sets and languages they support, and different font features may behave differently depending on the script or language chosen. When multilingual fonts are used, it is important to select which language they are being used for, and more importantly what script is being used.

The ‘script’ refers to the alphabet in use; for example, both English and French use the Latin script. Similarly, the Arabic script can be used to write in both the Arabic and Persian languages.

The `Script` and `Language` features are used to designate this information. The possible options are tabulated in Table 16 on page 52 and Table 17 on page 53, respectively. When a script or language is requested that is not supported by the current font, a warning is printed in the console output.

Because these font features can change which features are able to be selected for the font, they are automatically selected by `fontspec` before all others and, if XeTeX is

<sup>10</sup><http://www.georgduffner.at/ebgaramond/>

---

Example 36: The CharacterVariant feature showing off Georg Duffner's open source Garamond revival font.

---

<i>very</i>	
<i>very</i>	
<i>very</i>	
<i>very</i>	<code>\fontspec{EB Garamond 12 Italic} very \\</code>
<i>very</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant=5] very \\</code>
<i>very</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant=5:0] very \\</code>
<i>very</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant=5:1] very \\</code>
<i>very</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant=5:2] very \\</code>
<i>very</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant=5:3] very \\</code>

---



---

Example 37: The CharacterVariant feature selecting multiple variants simultaneously.

---

<i>É violet</i>	
<i>É violet</i>	
<i>É violet</i>	<code>\fontspec{EB Garamond 12 Italic} \&amp; violet \\</code>
<i>É violet</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant={4}] \&amp; violet \\</code>
<i>É violet</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant={5:2}] \&amp; violet \\</code>
<i>É violet</i>	<code>\fontspec{EB Garamond 12 Italic}[CharacterVariant={4,5:2}] \&amp; violet \\</code>

---



---

Example 38: The Alternate feature.

---

A & h	<code>\fontspec{Linux Libertine 0}</code>
A & h	<code>\textsc{a} \&amp; h \\</code>
A & h	<code>\addfontfeature{Alternate=o}</code>
A & h	<code>\textsc{a} \&amp; h</code>

---

---

Example 39: Annotation forms for OpenType fonts.

---

1 2 3 4 5 6 7 8 9	
(1) (2) (3) (4) (5) (6) (7) (8) (9)	
⟨1⟩ ⟨2⟩ ⟨3⟩ ⟨4⟩ ⟨5⟩ ⟨6⟩ ⟨7⟩ ⟨8⟩ ⟨9⟩	
1) 2) 3) 4) 5) 6) 7) 8) 9)	
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨	
➊ ➋ ➌ ➍ ➎ ➏ ➐ ➑ ➒	
Ⓛ Ⓜ Ⓨ Ⓩ ⓐ ⓑ ⓓ ⓔ ⓖ	
Ⓢ Ⓣ Ⓤ Ⓥ Ⓦ Ⓧ Ⓨ Ⓩ ⓐ	
ⓑ ⓓ ⓔ ⓖ Ⓢ Ⓣ Ⓤ Ⓥ Ⓦ	<code>\fontspec{Hiragino Maru Gothic Pro}</code>
Ⓧ Ⓨ Ⓩ ⓐ ⓑ ⓓ ⓔ ⓖ Ⓢ	<code>1 2 3 4 5 6 7 8 9</code>
Ⓣ Ⓤ Ⓥ Ⓦ Ⓧ Ⓨ Ⓩ ⓐ ⓑ	<code>\def\x#1{\{\addfontfeature{Annotation=#1}</code>
ⓓ ⓔ ⓖ Ⓢ Ⓣ Ⓤ Ⓥ Ⓦ Ⓧ	<code>1 2 3 4 5 6 7 8 9 }}</code>
1. 2. 3. 4. 5. 6. 7. 8. 9.	<code>\xo\x1\x2\x3\x4\x5\x6\x7\x8\x9</code>

---

being used, will specifically select the OpenType renderer for this font, as described in [Section 21.2 on page 60](#).

See [Section 24 on page 67](#) for methods to create new Script or Language options if required.

### 16.9.1 Script and Language examples

In the examples shown in [Example 40](#), the Code2000 font<sup>11</sup> is used to typeset various input texts with and without the OpenType Script applied for various alphabets. The text is only rendered correctly in the second case; many examples of incorrect diacritic spacing as well as a lack of contextual ligatures and rearrangement can be seen. Thanks to Jonathan Kew, Yves Codet and Gildas Hamel for their contributions towards these examples.

---

<sup>11</sup><http://www.code2000.net/>

Example 40: An example of various Scripts and Languages.

العربي	العربي	
हिन्दी	हिन्दी	
লেখ	লেখ	
ਮੁੱਢਲਾ-ਸ਼ੁੱਧ ਨਿਵੇਦਨ	ਮੁੱਢਲਾ-ਸ਼ੁੱਧ ਨਿਵੇਦਨ	\testfeature{Script=Arabic}{\arabictext}
നമുടറ പാരബരയ	നമുടറ പാരബരയ	\testfeature{Script=Devanagari}{\devanagaritext}
আদি সচু জগাদি সচু	আদি সচু জগাদি সচু	\testfeature{Script=Bengali}{\bengalitext}
தமிழ் தடே	தமிழ் தேடி	\testfeature{Script=Gujarati}{\gujaratitext}
תנ"ך. תנ"ך		\testfeature{Script=Malayalam}{\malayalamtext}
cáp số mõi	cáp số mõi	\testfeature{Script=Gurmukhi}{\gurmukhitext}
		\testfeature{Script=Tamil}{\tamiltext}
		\testfeature{Script=Hebrew}{\hebrewtext}
		\def\examplefont{Doulos SIL}
		\testfeature{Language=Vietnamese}{\vietnamesetext}

Table 16: Defined Scripts for OpenType fonts. Aliased names are shown in adjacent positions marked with red pilcrow (¶).

Arabic	Ethiopic	Limbu	Sumero-Akkadian
Armenian	Georgian	Linear B	Cuneiform
Balinese	Glagolitic	Malayalam	Syloti Nagri
Bengali	Gothic	¶ Math	Syriac
Bopomofo	Greek	¶ Maths	Tagalog
Braille	Gujarati	Mongolian	Tagbanwa
Buginese	Gurmukhi	Musical Symbols	Tai Le
Buhid	Hangul Jamo	Myanmar	Tai Lu
Byzantine Music	Hangul	N'ko	Tamil
Canadian Syllabics	Hanunoo	Ogham	Telugu
Cherokee	Hebrew	Old Italic	Thaana
¶ CJK	¶ Hiragana and Katakana	Old Persian Cuneiform	Thai
¶ CJK Ideographic	¶ Kana	Oriya	Tibetan
Coptic	Javanese	Osmanya	Tifinagh
Cypriot Syllabary	Kannada	Phags-pa	Ugaritic Cuneiform
Cyrillic	Kharosthi	Phoenician	Yi
Default	Khmer	Runic	
Deseret	Lao	Shavian	
Devanagari	Latin	Sinhala	

Table 17: Defined Languages for OpenType fonts. Aliased names are shown in adjacent positions marked with red pilcrow (¶).

Abaza	Default	Igbo	Koryak	Norway House Cree	Serer
Abkhazian	Dogri	Ijo	Ladin	Nisi	South Slavey
Adyghe	Divehi	Ilokano	Lahuli	Niuean	Southern Sami
Afrikaans	Djerma	Indonesian	Lak	Nkole	Suri
Afar	Dangme	Ingush	Lambani	N'ko	Svan
Agaw	Dinka	Inuktitut	Lao	Dutch	Swedish
Altai	Dungan	Irish	Latin	Nogai	Swadaya Aramaic
Amharic	Dzongkha	Irish Traditional	Laz	Norwegian	Swahili
Arabic	Ebira	Icelandic	L-Cree	Northern Sami	Swazi
Aari	Eastern Cree	Inari Sami	Ladakhi	Northern Tai	Sutu
Arakanese	Edo	Italian	Lezgi	Esperanto	Syriac
Assamese	Efik	Hebrew	Lingala	Nynorsk	Tabasaran
Athapaskan	Greek	Javanese	Low Mari	Oji-Cree	Tajiki
Avar	English	Yiddish	Limbu	Ojibway	Tamil
Awadhi	Erzya	Japanese	Lomwe	Oriya	Tatar
Aymara	Spanish	Judezmo	Lower Sorbian	Oromo	TH-Cree
Azeri	Estonian	Jula	Lule Sami	Ossetian	Telugu
Badaga	Basque	Kabardian	Lithuanian	Palestinian Aramaic	Tongan
Baghelkhandi	Evenki	Kachchi	Luba	Pali	Tigre
Balkar	Even	Kalenjin	Luganda	Punjabi	Tigrinya
Baule	Ewe	Kannada	Luhya	Palpa	Thai
Berber	French Antillean	Karachay	Luo	Pashto	Tahitian
Bench	¶ Farsi	Georgian	Latvian	Polytonic Greek	Tibetan
Bible Cree	¶ Parsi	Kazakh	Majang	Pilipino	Turkmen
Belarussian	¶ Persian	Kebena	Makua	Palaung	Temne
Bemba	Finnish	Khutsuri Georgian	Malayalam	Polish	Tswana
Bengali	Fijian	Khakass	Traditional	Provençal	Tundra Nenets
Bulgarian	Flemish	Khanty-Kazim	Mansi	Portuguese	Tonga
Bhili	Forest Nenets	Khmer	Marathi	Chin	Todo
Bhojpuri	Fon	Khanty-Shurishkar	Marwari	Rajasthani	Turkish
Bikol	Faroese	Khanty-Vakhi	Mbundu	R-Cree	Tsonga
Bilen	French	Khowar	Manchu	Russian Buriat	Turoyo Aramaic
Blackfoot	Frisian	Kikuyu	Moose Cree	Riang	Tulu
Balochi	Friulian	Kirghiz	Mende	Rhaeto-Romanic	Tuvin
Balante	Futa	Kisii	Me'en	Romanian	Twi
Balti	Fulani	Kokni	Mizo	Romany	Udmurt
Bambara	Ga	Kalmyk	Macedonian	Rusyn	Ukrainian
Bamileke	Gaelic	Kamba	Male	Ruanda	Urdu
Breton	Gagauz	Kumaoni	Malagasy	Russian	Upper Sorbian
Brahui	Galician	Komo	Malinke	Sadri	Uyghur
Brj Bhasha	Garshuni	Komso	Malayalam	Sanskrit	Uzbek
Burmese	Garhwali	Kanuri	Reformed	Santali	Venda
Bashkir	Ge'ez	Kodagu	Malay	Sayisi	Vietnamese
Beti	Gilyak	Korean Old Hangul	Mandinka	Sekota	Wa
Catalan	Gumuz	Konkani	Mongolian	Selkup	Wagdi
Cebuano	Gondi	Kikongo	Manipuri	Sango	West-Cree
Chechen	Greenlandic	Komi-Permyak	Maninka	Shan	Welsh
Chaha Gurage	Gar	Korean	Manx Gaelic	Sibe	Wolof
Chattisgarhi	Guarani	Komi-Zyrian	Moksha	Sidamo	Tai Lue
Chichewa	Gujarati	Kpelle	Moldavian	Silte Gurage	Xhosa
Chukchi	Haitian	Krio	Mon	Skolt Sami	Yakut
Chipewyan	Halam	Karakalpak	Moroccan	Slovak	Yoruba
Cherokee	Harauti	Karelian	Maori	Slavey	Y-Cree
Chuvash	Hausa	Karaim	Maithili	Slovenian	Yi Classic
Comorian	Hawaiian	Karen	Maltese	Somali	Yi Modern
Coptic	Hammer-Banna	Koorete	Mundari	Samoan	Chinese Hong Kong
Cree	Hiligaynon	Kashmiri	Naga-Assamese	Sena	Chinese Phonetic
Carrier	Hindi	Khasi	Nanai	Sindhi	Chinese Simplified
Crimean Tatar	High Mari	Kildin Sami	Naskapi	Sinhalese	Chinese Traditional
Church Slavonic	Hindko	Kui	N-Cree	Soninke	Zande
Czech	Ho	Kulvi	Ndebele	Sodo Gurage	Zulu
Danish	Harari	Kumyk	Ndonga	Sotho	
Dargwa	Croatian	Kurdish	Nepali	Albanian	
Woods Cree	Hungarian	Kurukh	Newari	Serbian	
German	Armenian	Kuy	Nagari	Saraiki	

## Part V

# Commands for accents and symbols (‘encodings’)

The functionality described in this section is experimental.

In the pre-Unicode era, significant work was required by  $\text{\LaTeX}$  to ensure that input characters in the source could be interpreted correctly depending on file encoding, and that glyphs in the output were selected correctly depending on the font encoding. With Unicode, we have the luxury of a single file and font encoding that is used for both input and output.

While this may provide some illusion that we could get away simply with typing Unicode text and receive correct output, this is not always the case. For a start, hyphenation in particular is language-specific, so tags should be used when switch between languages in a document. The `babel` and `polyglossia` packages both provide features for this.

Multilingual documents will often use different fonts for different languages, not just for style, but for the more pragmatic reason that fonts do not all contain the same glyphs. (In fact, only test fonts such as `Code2000` provide anywhere near the full Unicode coverage.) Indeed, certain fonts may be perfect for a certain application but miss a handful of necessary diacritics or accented letters. In these cases, `fontspec` can leverage the font encoding technology built into  $\text{\LaTeX}2_{\epsilon}$  to provide on a per-font basis either provide fallback options or error messages when a desired accent or symbol is not available. However, at present these features can only be provided for input using  $\text{\LaTeX}$  commands rather than Unicode input; for example, typing `\`e` instead of `è` or `\textcopyright` instead of `©` in the source file.

The most widely-used encoding in  $\text{\LaTeX}2_{\epsilon}$  was `T1` with companion ‘`TS1`’ symbols provided by the `textcomp` package. These encodings provided glyphs to typeset text in a variety of western European languages. As with most legacy  $\text{\LaTeX}2_{\epsilon}$  input methods, accents and symbols were input using encoding-dependent commands such as `\`e` as described above. As of 2017, in  $\text{\LaTeX}2_{\epsilon}$  on  $\text{\XeTeX}$  and  $\text{\LuaTeX}$ , the default encoding is `TU`, which uses Unicode for input and output. The `TU` encoding provides appropriate encoding-dependent definitions for input commands to match the coverage of the `T1+TS1` encodings. Wider coverage is not provided by default since (a) each font will provide different glyph coverage, and (b) it is expected that most users will be writing with direct Unicode input.

For those users who do need finer-grained control, `fontspec` provides an interface for a more extensible system.

## 17 A new Unicode-based encoding from scratch

Let’s say you need to provide support for a document originally written with fonts in the `OT2` encoding, which contains encoding-dependent commands for Cyrillic letters. An example from the `OT2` encoding definition file (`ot2enc.def`) reads:

```

57 \DeclareTextSymbol{\CYRIE}{OT2}{5}
58 \DeclareTextSymbol{\CYRDJE}{OT2}{6}
59 \DeclareTextSymbol{\CYRTSHE}{OT2}{7}
60 \DeclareTextSymbol{\cyrnje}{OT2}{8}
61 \DeclareTextSymbol{\cyrlje}{OT2}{9}
62 \DeclareTextSymbol{\cyrdzhe}{OT2}{10}

```

To recreate this encoding in a form suitable for fontspec, create a new file named, say, `fontrange-cyr.def` and populate it with

```

...
\DeclareTextSymbol{\CYRIE}{\LastDeclaredEncoding}{0404}
\DeclareTextSymbol{\CYRDJE}{\LastDeclaredEncoding}{0402}
\DeclareTextSymbol{\CYRTSHE}{\LastDeclaredEncoding}{040B}
\DeclareTextSymbol{\cyrnje}{\LastDeclaredEncoding}{045A}
\DeclareTextSymbol{\cyrlje}{\LastDeclaredEncoding}{0459}
\DeclareTextSymbol{\cyrdzhe}{\LastDeclaredEncoding}{045F}
...

```

The numbers "0404", "0402", ..., are the Unicode slots (in hexadecimal) of each glyph respectively. The fontspec package provides a number of shorthands to simplify this style of input; in this case, you could also write

```

\EncodingSymbol{\CYRIE}{0404}
...

```

To use this encoding in a fontspec font, you would first add this to your preamble:

```

\DeclareUnicodeEncoding{unicyr}{
  \input{fontrange-cyr.def}
}

```

Then follow it up with a font loading call such as

```

\setmainfont{...}[NFSSEncoding=unicyr]

```

The first argument `unicyr` is the name of the 'encoding' to use in the font family. (There's nothing special about the name chosen but it must be unique.) The second argument to `\DeclareUnicodeEncoding` also allows adjustments to be made for per-font changes. We'll cover this use case in the next section.

## 18 Adjusting a pre-existing encoding

There are three reasons to adjust a pre-existing encoding: to add, to remove, and to redefine some symbols, letters, and/or accents.

When adding symbols, etc., simply write

```

\DeclareUnicodeEncoding{unicyr}{
  \input{tuenc.def}
  \input{fontrange-cyr.def}
  \EncodingSymbol{\textruble}{20BD}
}

```

Of course if you consistently add a number of symbols to an encoding it would be a good idea to create a new `font-range-XX.def` file to suit your needs.

When removing symbols, use the `\UndeclareSymbol{<cmd>}` command. For example, if you are loading a font that you know is missing, say, the interrobang (not that unusual a situation), you might write:

```
\DeclareUnicodeEncoding{nobang}{
  \input{tuenc.def}
  \UndeclareSymbol\textinterrobang
}
```

Provided that you use the command `\textinterrobang` to typeset this symbol, it will appear in fonts with the default encoding, while in any font loaded with the `nobang` encoding an attempt to access the symbol will either use the default fallback definition or return an error, depending on the symbol being undeclared.

The third use case is to redefine a symbol or accent. The most common use case in this scenario is to adjust a specific accent command to either fine-tune its placement or to ‘fake’ it entirely. For example, the underdot diacritic is used in typeset Sanskrit, but it is not necessarily included as an accent symbol in all fonts. By default the underdot is defined in TU as:

```
\EncodingAccent{\d}{"0323}
```

For fonts with a missing (or poorly-spaced) "0323 accent glyph, the ‘traditional’  $\TeX$  fake accent construction could be used instead:

```
\DeclareUnicodeEncoding{fakeacc}{
  \input{tuenc.def}
  \EncodingCommand{\d}[1]{%
    \hmode\bgroup
      \o@lign{\relax#1\cr\hidewidth\ltx@sh@ft{-1ex}.\hidewidth}%
    \egroup
  }
}
```

This would be set up in a document as such:

```
\newfontfamily\sanskritfont{CharisSIL}
\newfontfamily\titlefont{Posterama}[NFSSEncoding=fakeacc]
```

Then later in the document, no additional work is needed:

```
...{\titlefont kalita\d m}... % <- uses fake accent
...{\sanskritfont kalita\d m}... % <- uses real accent
```

To reiterate from above, typing this input with Unicode text (‘kalitaṃ’) will *bypass* this encoding mechanism and you will receive only what is contained literally within the font.



## 19 Summary of commands

The  $\text{\LaTeX}$  2 $\epsilon$  kernel provides the following font encoding commands suitable for Unicode encodings:

```
\DeclareTextCommand{<command>}{<encoding>}[<num>][<default>]{<code>}
\DeclareUnicodeAccent{<command>}{<encoding>}{<slot>}
\DeclareTextSymbol{<command>}{<encoding>}{<slot>}
\DeclareTextComposite{<command>}{<encoding>}{<letter>}{<slot>}
\DeclareTextCompositeCommand{<command>}{<encoding>}{<letter>}{<code>}
\UndeclareTextCommand{<command>}{<encoding>}
```

See `fntguide.pdf` for full documentation of these. As shown above, the following shorthands are provided by `fontspec` to simplify the process of defining Unicode font range encodings:

```
\EncodingCommand{<command>}[<num>][<default>]{<code>}
\EncodingAccent{<command>}{<code>}
\EncodingSymbol{<command>}{<code>}
\EncodingComposite{<command>}{<letter>}{<slot>}
\EncodingCompositeCommand{<command>}{<letter>}{<code>}
\UndeclareSymbol{<command>}
\UndeclareComposite{<command>}{<letter>}
```

Despite its name, `\UndeclareSymbol` can be used for commands defined by all three of `\EncodingCommand`, `\EncodingAccent`, and `\EncodingSymbol`.

## Part VI

# LuaT<sub>E</sub>X-only font features

## 20 Custom font features

Pre-2016, it was possible to load an OpenType font feature file to define new OpenType features for a selected font. This facility was particularly useful to implement custom substitutions, for example. As of T<sub>E</sub>XLive 2016, LuaT<sub>E</sub>X/luat<sub>o</sub>tfload no longer supports this feature, but provides its own internal mechanisms for an equivalent interface.

Any documents using ‘feature file’ options will need to transition to the new interface. Figure 1 shows an example. Please refer to the LuaT<sub>E</sub>X/luat<sub>o</sub>tfload documentation for more details.

Figure 1: An example of custom font features.

---

```
\documentclass{article}
\usepackage{fontspec}
\directlua{
  fonts.handlers.otf.addfeature {
    name = "oneb",
    {
      type = "substitution",
      data = {
        ["1"] = "one.sso1",
      },
    },
    "feature oneb for vollkorn font",
  }
}
\setmainfont{Vollkorn-Regular.otf}[RawFeature=+oneb]
\begin{document}
1234567890
\end{document}
```

---

## Part VII

# Fonts and features with X<sub>Y</sub>TeX

## 21 X<sub>Y</sub>TeX-only font features

The features described here are available for any font selected by fontspec.

### 21.1 Mapping

Mapping enables a X<sub>Y</sub>TeX text-mapping scheme, shown in Example 41.

Using the `tex-text` mapping is also equivalent to writing `Ligatures=TeX`. The use of the latter syntax is recommended for better compatibility with LuaTeX documents.

### 21.2 Different font technologies: AAT and OpenType

X<sub>Y</sub>TeX supports two rendering technologies for typesetting, selected with the `Renderer` font feature. The first, AAT, is that provided (only) by Mac OS X itself. The second, OpenType, is an open source OpenType interpreter.<sup>12</sup> It provides greater support for OpenType features, notably contextual arrangement, over AAT.

In general, this feature will not need to be explicitly called: for OpenType fonts, the OpenType renderer is used automatically, and for AAT fonts, AAT is chosen by default. Some fonts, however, will contain font tables for *both* rendering technologies, such as the Hiragino Japanese fonts distributed with Mac OS X, and in these cases the choice may be required.

Among some other font features only available through a specific renderer, OpenType provides for the `Script` and `Language` features, which allow different font behaviour for different alphabets and languages; see Section 16.9 on page 49 for the description of these features. *Because these font features can change which features are able to be selected for the font instance, they are selected by fontspec before all others and will automatically and without warning select the OpenType renderer.*

### 21.3 Optical font sizes

Multiple Master fonts are parameterised over orthogonal font axes, allowing continuous selection along such features as weight, width, and optical size (see ?? on page ?? for further details). Whereas an OpenType font will have only a few separate optical sizes, a Multiple Master font's optical size can be specified over a continuous range.

<sup>12</sup>v2.4: This was called 'ICU' in previous versions of X<sub>Y</sub>TeX and fontspec. Backwards compatibility is preserved.

---

Example 41: X<sub>Y</sub>TeX's Mapping feature.

---

“!A small amount of—text!”

```
\fontspec{Cochin}[Mapping=tex-text]
``!\A small amount of---text!''
```

---

Unfortunately, this flexibility makes it harder to create an automatic interface through  $\text{\LaTeX}$ , and the optical size for a Multiple Master font must always be specified explicitly.

```
\fontspec{Minion MM Roman}[OpticalSize=11]
MM optical size test          \\\
\fontspec{Minion MM Roman}[OpticalSize=47]
MM optical size test          \\\
\fontspec{Minion MM Roman}[OpticalSize=71]
MM optical size test          \\\
```

## 22 Mac OS X's AAT fonts

*Warning!  $X_{\text{\LaTeX}}$ 's implementation on Mac OS X is currently in a state of flux and the information contained below may well be wrong from 2013 onwards. There is a good chance that the features described in this section will not be available any more as  $X_{\text{\LaTeX}}$ 's completes its transition to a cross-platform-only application.*

Mac OS X's font technology began life before the ubiquitous-OpenType era and revolved around the Apple-invented 'AAT' font format. This format had some advantages (and other disadvantages) but it never became widely popular in the font world.

Nonetheless, this is the font format that was first supported by  $X_{\text{\LaTeX}}$  (due to its pedigree on Mac OS X in the first place) and was the first font format supported by `fontspec`. A number of fonts distributed with Mac OS X are still in the AAT format, such as 'Skia'.

### 22.1 Ligatures

Ligatures refer to the replacement of two separate characters with a specially drawn glyph for functional or aesthetic reasons. For AAT fonts, you may choose from any combination of Required, Common, Rare (or Discretionary), Logos, Rebus, Diphthong, Squared, AbbrevSquared, and Icelandic.

Some other Apple AAT fonts have those 'Rare' ligatures contained in the Icelandic feature. Notice also that the old  $\text{\TeX}$  trick of splitting up a ligature with an empty brace pair does not work in  $X_{\text{\LaTeX}}$ ; you must use a `opt kern` or `\hbox` (e.g., `\null`) to split the characters up if you do not want a ligature to be performed (the usual examples for when this might be desired are words like 'shelffull').

### 22.2 Letters

The Letters feature specifies how the letters in the current font will look. For AAT fonts, you may choose from Normal, Uppercase, Lowercase, SmallCaps, and InitialCaps.

### 22.3 Numbers

The Numbers feature defines how numbers will look in the selected font. For AAT fonts, they may be a combination of Lining or OldStyle and Proportional or Monospaced

(the latter is good for tabular material). The synonyms `Uppercase` and `Lowercase` are equivalent to `Lining` and `OldStyle`, respectively. The differences have been shown previously in [Section 10 on page 22](#).

### 22.4 Contextuals

This feature refers to glyph substitution that vary by their position; things like contextual swashes are implemented here. The options for AAT fonts are `WordInitial`, `WordFinal` (Example 42), `LineInitial`, `LineFinal`, and `Inner` (Example 43, also called ‘non-final’ sometimes). As non-exclusive selectors, like the ligatures, you can turn them off by prefixing their name with `No`.

### 22.5 Vertical position

The `VerticalPosition` feature is used to access things like subscript (`Inferior`) and superscript (`Superior`) numbers and letters (and a small amount of punctuation, sometimes). The `Ordinal` option is (supposed to be) contextually sensitive to only raise characters that appear directly after a number. These are shown in Example 44.

The `realscripts` package (also loaded by `xltxtra`) redefines the `\textsubscript` and `\textsuperscript` commands to use the above font features, including for use in footnote labels.

### 22.6 Fractions

Many fonts come with the capability to typeset various forms of fractional material. This is accessed in `fontspec` with the `Fractions` feature, which may be turned `On` or `Off` in both AAT and OpenType fonts.

In AAT fonts, the ‘fraction slash’ or solidus character, is to be used to create fractions. When `Fractions` are turned `On`, then only pre-drawn fractions will be used. See Example 45.

Using the `Diagonal` option (AAT only), the font will attempt to create the fraction from superscript and subscript characters.

Some (Asian fonts predominantly) also provide for the `Alternate` feature shown in Example 46.

### 22.7 Variants

The `Variant` feature takes a single numerical input for choosing different alphabetic shapes. Don’t mind my fancy Example 47 :) I’m just looping through the nine (!) variants of Zapfino.

---

Example 42: Contextual glyph for the beginnings and ends of words.	
<i>where is all the vegemite</i>	<code>\newfontface\fancy{Hoefler Text Italic}{% Contextuals={WordInitial,WordFinal}} \fancy where is all the vegemite</code>

---

Example 43: A contextual feature for the ‘long s’ can be convenient as the character does not need to be marked up explicitly.

‘Inner’ fwafhes can <i>sometimes</i> contain the archaic long s.	<code>\fontspec{Hoefler Text}[Contextuals=Inner]</code> ‘Inner’ swashes can <code>\emph{sometimes}</code> <code>\\</code> contain the archaic long~s.
--	---

Example 44: Vertical position for AAT fonts.

	<code>\fontspec{Skia}</code> Normal
	<code>\fontspec{Skia}[VerticalPosition=Superior]</code> Superior
	<code>\fontspec{Skia}[VerticalPosition=Inferior]</code> Inferior <code>\\</code>
Normal <sup>superior</sup> <sub>inferior</sub> 1 <sup>st</sup> 2 <sup>nd</sup> 3 <sup>rd</sup> 4 <sup>th</sup> 0 <sup>th</sup> 8abcde	<code>\fontspec{Skia}[VerticalPosition=Ordinal]</code> 1st 2nd 3rd 4th oth 8abcde

Example 45: Fractions in AAT fonts. The `~~~~2044` glyph is the ‘fraction slash’ that may be typed in Mac OS X with `OPT+SHIFT+I`; not shown literally here due to font constraints.

	<code>\fontspec[Fractions=On]{Skia}</code> 1{~~~~2044}2 \quad 5{~~~~2044}6 \\ % fraction slash 1/2 \quad 5/6        % regular slash
$\frac{1}{2}$ $\frac{5}{6}$ $\frac{1}{2}$ $\frac{5}{6}$ 13579/24680 13579/24680	<code>\fontspec[Fractions=Diagonal]{Skia}</code> 13579{~~~~2044}24680 \\ % fraction slash \quad 13579/24680        % regular slash

Example 46: Alternate design of pre-composed fractions.

	<code>\fontspec{Hiragino Maru Gothic Pro}</code> 1/2 \quad 1/4 \quad 5/6 \quad 13579/24680 \\ <code>\addfontfeature{Fractions=Alternate}</code> 1/2 \quad 1/4 \quad 5/6 \quad 13579/24680
$\frac{1}{2}$ $\frac{1}{4}$ $\frac{5}{6}$ 13579/24680 $\frac{1}{2}$ $\frac{1}{4}$ $\frac{5}{6}$ 13579/24680	

---

Example 47: Nine variants of Zapfino.

---



```
\newcounter{var}
\whiledo{\value{var}<9}{%
  \edef\1{%
    \noexpand\fontspec[Variant=\thevar,
      Color=0099\thevar\thevar]{Zapfino}}\1%
  \makebox[0.75\width]{d}%
  \stepcounter{var}}
\hspace*{2cm}
```

---

See [Section 23 on page 66](#) for a way to assign names to variants, which should be done on a per-font basis.

## 22.8 Alternates

Selection of Alternates *again* must be done numerically; see [Example 48](#). See [Section 23 on page 66](#) for a way to assign names to alternates, which should be done on a per-font basis.

## 22.9 Style

The options of the Style feature are defined in AAT as one of the following: Display, Engraved, IlluminatedCaps, Italic, Ruby,<sup>13</sup> TallCaps, or TitlingCaps.

Typical examples for these features are shown in [Section 16.3](#).

## 22.10 CJK shape

There have been many standards for how CJK ideographic glyphs are ‘supposed’ to look. Some fonts will contain many alternate glyphs in order to be able to display these glyphs correctly in whichever form is appropriate. Both AAT and OpenType fonts support the following CJKShape options: Traditional, Simplified, JIS1978, JIS1983, JIS1990, and Expert. OpenType also supports the NLC option.

---

<sup>13</sup>‘Ruby’ refers to a small optical size, used in Japanese typography for annotations.

---

Example 48: Alternate shape selection must be numerical.

---

*Sphinx Of Black Quartz, JUDGE My Vow*  
*Sphinx Of Black Quartz, JUDGE Mr Vow*

```
\fontspec{Hoefler Text Italic}[Alternate=0]
Sphinx Of Black Quartz, {\scshape Judge My Vow} \
\fontspec{Hoefler Text Italic}[Alternate=1]
Sphinx Of Black Quartz, {\scshape Judge My Vow}
```

---



### 22.11 Character width

See [Section 16.6 on page 44](#) for relevant examples; the features are the same between OpenType and AAT fonts. AAT also allows `CharacterWidth=Default` to return to the original font settings.

### 22.12 Vertical typesetting

X<sub>Y</sub>TeX provides for vertical typesetting simply with the ability to rotate the individual glyphs as a font is used for typesetting, as shown in [Example 49](#).

No actual provision is made for typesetting top-to-bottom languages; for an example of how to do this, see the vertical Chinese example provided in the X<sub>Y</sub>TeX documentation.

### 22.13 Diacritics

Diacritics are marks, such as the acute accent or the tilde, applied to letters; they usually indicate a change in pronunciation. In Arabic scripts, diacritics are used to indicate vowels. You may either choose to `Show`, `Hide` or `Decompose` them in AAT fonts. The `Hide` option is for scripts such as Arabic which may be displayed either with or without vowel markings. E.g., `\fontspec[Diacritics=Hide]{...}`

Some older fonts distributed with Mac OS X included ‘Ø’ *etc.* as shorthand for writing ‘Ø’ under the label of the `Diacritics` feature. If you come across such fonts, you’ll want to turn this feature off (imagine typing `hello/goodbye` and getting ‘helløgoodbye’ instead!) by decomposing the two characters in the diacritic into the ones you actually want. I recommend using the proper L<sup>A</sup>T<sub>E</sub>X input conventions for obtaining such characters instead.

### 22.14 Annotation

Various Asian fonts are equipped with a more extensive range of numbers and numerals in different forms. These are accessed through the `Annotation` feature with the following options: `Off`, `Box`, `RoundedBox`, `Circle`, `BlackCircle`, `Parenthesis`, `Period`, `RomanNumerals`, `Diamond`, `BlackSquare`, `BlackRoundSquare`, and `DoubleCircle`.

---

Example 49: Vertical typesetting.

---

共産主義者は

共  
産  
主  
義  
者

```
\fontspec{Hiragino Mincho Pro}  
\verttext
```

```
\fontspec{Hiragino Mincho Pro}[Renderer=AAT,Vertical=RotatedGlyphs]  
\rotatebox{-90}{\verttext}% requires the graphicx package
```

---

## Part VIII

# Customisation and programming interface

This is the beginning of some work to provide some hooks that use fontspec for various macro programming purposes.

## 23 Defining new features

This package cannot hope to contain every possible font feature. Three commands are provided for selecting font features that are not provided for out of the box. If you are using them a lot, chances are I've left something out, so please let me know.

`\newAATfeature` New AAT features may be created with this command:

`\newAATfeature{<feature>}{<option>}{<feature code>}{<selector code>}`

Use the X<sub>Y</sub>TeX file `AAT-info.tex` to obtain the code numbers. See Example 50.

`\newopentypefeature` New OpenType features may be created with this command:

`\newopentypefeature{<feature>}{<option>}{<feature tag>}`

The synonym `\newICUfeature` is deprecated.

Here's what it would look like in practise:

`\newopentypefeature{Style}{NoLocalForms}{-loc1}`

`\newfontfeature` In case the above commands do not accommodate the desired font feature (perhaps a new X<sub>Y</sub>TeX feature that fontspec hasn't been updated to support), a command is provided to pass arbitrary input into the font selection string:

`\newfontfeature{<name>}{<input string>}`

For example, Zapfino used to contain an AAT feature 'Avoid d-collisions'. To access it with this package, you could do some like the following:

```
\newfontfeature{AvoidD} {Special= Avoid d-collisions}
\newfontfeature{NoAvoidD}{Special=!Avoid d-collisions}
\fontspec{Zapfino}[AvoidD,Variant=1]
sockdolager rubdown
\fontspec{Zapfino}[NoAvoidD,Variant=1]
sockdolager rubdown
```

The advantage to using the `\newAATfeature` and `\newopentypefeature` commands instead of `\newfontfeature` is that they check if the selected font actually

---

Example 50: Assigning new AAT features.

---

*This is XeTeX by Jonathan Kew.*

```
\newAATfeature{Alternate}{HoeflerSwash}{17}{1}
\fontspec{Hoefler Text Italic}[Alternate=HoeflerSwash]
This is XeTeX by Jonathan Kew.
```

---

contains the desired font feature at load time. By contrast, `\newfontfeature` will not give a warning for improper input.

## 24 Defining new scripts and languages

`\newfontscript`  
`\newfontlanguage`

While the scripts and languages listed in [Table 16](#) and [Table 17](#) are intended to be comprehensive, there may be some missing; alternatively, you might wish to use different names to access scripts/languages that are already listed. Adding scripts and languages can be performed with the `\newfontscript` and `\newfontlanguage` commands. For example,

```
\newfontscript{Arabic}{arab}
\newfontlanguage{Zulu}{ZUL}
```

The first argument is the fontspec name, the second the OpenType tag. The advantage to using these commands rather than `\newfontfeature` (see [Section 23 on the preceding page](#)) is the error-checking that is performed when the script or language is requested.

## 25 Going behind fontspec's back

Expert users may wish not to use fontspec's feature handling at all, while still taking advantage of its  $\LaTeX$  font selection conveniences. The `RawFeature` font feature allows font feature selection using a literal feature selection string if you happen to have the OpenType feature tag memorised.

Multiple features can either be included in a single declaration:

```
[RawFeature=+smcp;+onum]
```

or with multiple declarations:

```
[RawFeature=+smcp, RawFeature=+onum]
```

## 26 Renaming existing features & options

`\aliasfontfeature`

If you don't like the name of a particular font feature, it may be aliased to another with the `\aliasfontfeature{\langle existing name \rangle}{\langle new name \rangle}` command, such as shown in [Example 52](#).

Spaces in feature (and option names, see below) *are* allowed. (You may have noticed this already in the lists of OpenType scripts and languages).

`\aliasfontfeatureoption`

If you wish to change the name of a font feature option, it can be aliased to another

---

Example 51: Using raw font features directly.

---

```
\fontspec{texgyrepagella-regular.otf}[RawFeature=+smcp]
PAGELLA SMALL CAPS Pagella small caps
```

---

Example 52: Renaming font features.	
	<code>\aliasfontfeature{ItalicFeatures}{IF}</code>
	<code>\fontspec{Hoefler Text}[IF = {Alternate=1}]</code>
Roman Letters <i>And Swash</i>	Roman Letters \itshape And Swash

Example 53: Renaming font feature options.	
	<code>\aliasfontfeature{VerticalPosition}{Vert Pos}</code>
	<code>\aliasfontfeatureoption{VerticalPosition}{ScientificInferior}{Sci Inf}</code>
	<code>\fontspec{LinLibertine_R.otf}[Vert Pos=Sci Inf]</code>
Scientific Inferior: 12345	Scientific Inferior: 12345

with the command `\aliasfontfeatureoption{<font feature>}{<existing name>}{<new name>}`, such as shown in Example 53.

This example demonstrates an important point: when aliasing the feature options, the *original* feature name must be used when declaring to which feature the option belongs.

Only feature options that exist as sets of fixed strings may be altered in this way. That is, Proportional can be aliased to Prop in the Letters feature, but 550099BB cannot be substituted for Purple in a Color specification. For this type of thing, the `\newfontfeature` command should be used to declare a new, e.g., PurpleColor feature:

```
\newfontfeature{PurpleColor}{color=550099BB}
```

Except that this example was written before support for named colours was implemented. But you get the idea.

## 27 Programming interface

### 27.1 Variables

`\l_fontspec_family_tl`  
`\l_fontspec_font`  
  
`\g_fontspec_encoding_tl`

In some cases, it is useful to know what the  $\LaTeX$  font family of a specific fontspec font is. After a `\fontspec`-like command, this is stored inside the `\l_fontspec_family_tl` macro. Otherwise,  $\LaTeX$ 's own `\f@family` macro can be useful here, too. The raw  $\TeX$  font that is defined from the 'base' font in the family is stored in `\l_fontspec_font`.

Package authors who need to load fonts with legacy  $\LaTeX$  `\fontspec` commands may also need to know what the default font encoding is. Since this has changed from EU1/EU2 to TU, it is best to use the variables `\g_fontspec_encoding_tl` or `\UTFencname` instead.

### 27.2 Functions for loading new fonts and families

`\fontspec_set_family:Nnn`

`#1 :  $\LaTeX$  family`

#2 : fontspec features

#3 : font name

Defines a new NFSS family from given *features* and *font*, and stores the family name in the variable *family*. This font family can then be selected with standard L<sup>A</sup>T<sub>E</sub>X commands `\fontfamily{family}\selectfont`. See the standard fontspec user commands for applications of this function.

`\fontspec_set_fontface:NNnn`

#1 : primitive font

#2 : L<sup>A</sup>T<sub>E</sub>X family

#3 : fontspec features

#4 : font name

Variant of the above in which the primitive T<sub>E</sub>X font command is stored in the variable *primitive font*. If a family is loaded (with bold and italic shapes) the primitive font command will only select the regular face. This feature is designed for L<sup>A</sup>T<sub>E</sub>X programmers who need to perform subsequent font-related tests on the *primitive font*.

## 27.3 Conditionals

The following functions in expl3 syntax may be used for writing code that interfaces with fontspec-loaded fonts. The following conditionals are all provided in TF, T, and F forms.

### 27.3.1 Querying font families

`\fontspec_font_if_exist:nTF`

Test whether the ‘font name’ (#1) exists or is loadable. The syntax of #1 is a restricted/simplified version of fontspec’s usual font loading syntax; fonts to be loaded by filename are detected by the presence of an appropriate extension (.otf, etc.), and paths should be included inline. E.g.:

```
\fontspec_font_if_exist:nTF {cmr10}{T}{F}
```

```
\fontspec_font_if_exist:nTF {Times~ New~ Roman}{T}{F}
```

```
\fontspec_font_if_exist:nTF {texgyrepagella-regular.otf}{T}{F}
```

```
\fontspec_font_if_exist:nTF {/Users/will/Library/Fonts/CODE2000.TTF}{T}{F}
```

The synonym `\IfFontExistsTF` is provided for ‘document authors’.

`\fontspec_if_fontspec_font:TF`

Test whether the currently selected font has been loaded by fontspec.

`\fontspec_if_opentype:TF`

Test whether the currently selected font is an OpenType font. Always true for LuaT<sub>E</sub>X fonts.

`\fontspec_if_small_caps:TF`

Test whether the currently selected font has a ‘small caps’ face to be selected with `\scshape` or similar. Note that testing whether the font has the Letters=SmallCaps font feature is sufficient but not necessary for this command to return true, since small caps can also be loaded from separate font files. The logic of this command is complicated by the fact that fontspec will merge shapes together (for italic small caps, etc.).

### 27.3.2 Availability of features

<code>\fontspec_if_aat_feature:nnTF</code>	Test whether the currently selected font contains the AAT feature (#1,#2).
<code>\fontspec_if_feature:nTF</code>	Test whether the currently selected font contains the raw OpenType feature #1. E.g.: <code>\fontspec_if_feature:nTF {pnum} {True} {False}</code> . Returns false if the font is not loaded by fontspec or is not an OpenType font.
<code>\fontspec_if_feature:nnnTF</code>	Test whether the currently selected font with raw OpenType script tag #1 and raw OpenType language tag #2 contains the raw OpenType feature tag #3. E.g.: <code>\fontspec_if_feature:nnnTF {script} {language} {feature} {True} {False}</code> . Returns false if the font is not loaded by fontspec or is not an OpenType font.
<code>\fontspec_if_script:nTF</code>	Test whether the currently selected font contains the raw OpenType script #1. E.g.: <code>\fontspec_if_script:nTF {latn} {True} {False}</code> . Returns false if the font is not loaded by fontspec or is not an OpenType font.
<code>\fontspec_if_language:nTF</code>	Test whether the currently selected font contains the raw OpenType language tag #1. E.g.: <code>\fontspec_if_language:nTF {ROM} {True} {False}</code> . Returns false if the font is not loaded by fontspec or is not an OpenType font.
<code>\fontspec_if_language:nnTF</code>	Test whether the currently selected font contains the raw OpenType language tag #2 in script #1. E.g.: <code>\fontspec_if_language:nnTF {cyr1} {SRB} {True} {False}</code> . Returns false if the font is not loaded by fontspec or is not an OpenType font.

### 27.3.3 Currently selected features

<code>\fontspec_if_current_feature:nTF</code>	Test whether the currently loaded font is using the specified raw OpenType feature tag #1. The tag string #1 should be prefixed with + to query an active feature, and with a - (hyphen) to query a disabled feature.
<code>\fontspec_if_current_script:nTF</code>	Test whether the currently loaded font is using the specified raw OpenType script tag #1.
<code>\fontspec_if_current_language:nTF</code>	Test whether the currently loaded font is using the specified raw OpenType language tag #1.

## Part IX

# Implementation

## 28 Loading

The `expl3` module is `fontspec`.

```
1 <@@=fontspec>
   Check engine and load specific modules. For LuaTeX, load luaotfload.
2 <*load>
3 \sys_if_engine luatex:T
4   { \RequirePackage{luaotfload}
5     \directlua{require("fontspec")}}
6     \RequirePackageWithOptions{fontspec-luatex} \endinput }
7 \sys_if_engine xetex:T
8   { \RequirePackageWithOptions{fontspec-xetex} \endinput }
```

If not one of the above, error:

```
9 \msg_new:nnn {fontspec} {cannot-use-pdfTeX}
10 {
11   The~ fontspec~ package~ requires~ either~ XeTeX~ or~ LuaTeX.\\\
12   You~ must~ change~ your~ typesetting~ engine~ to,~ e.g.,~ "xelatex"~ or~ "lu-
13   alatex" instead~ of~ plain~ "latex"~ or~ "pdflatex".
14 }
15 \msg_fatal:nn {fontspec} {cannot-use-pdfTeX}
16 \endinput
17 </load>
```

## 29 Declaration of variables and functions

```
17 <*fontspec>
```

### Booleans

**firsttime** As `\keys_set:nn` is run multiple times, some of its information storing only occurs once while we decide if the font family has been defined or not. When the later processing is occurring per-shape this no longer needs to happen; this is indicated by the ‘firsttime’ conditional.

```
18 \bool_new:N \l_@@_firsttime_bool
19 \bool_new:N \l_@@_nobf_bool
20 \bool_new:N \l_@@_noit_bool
21 \bool_new:N \l_@@_nosc_bool
```

These strange set functions are to simplify returning code from LuaTeX:

```
22 \bool_new:N \l_@@_check_bool
23 \cs_new:Npn \FontspecSetCheckBoolTrue { \bool_set_true:N \l_@@_check_bool }
24 \cs_new:Npn \FontspecSetCheckBoolFalse { \bool_set_false:N \l_@@_check_bool }
```

```

25 \bool_new:N \l_@@_tfm_bool
26 \bool_new:N \l_@@_atsui_bool
27 \bool_new:N \l_@@_ot_bool
28 \bool_new:N \l_@@_mm_bool
29 \bool_new:N \l_@@_graphite_bool

```

For dealing with legacy maths:

```

30 \bool_new:N \g_@@_math_euler_bool
31 \bool_new:N \g_@@_math_lucida_bool
32 \bool_new:N \g_@@_pkg_euler_loaded_bool

```

For package options:

```

33 \bool_new:N \g_@@_cfg_bool
34 \bool_new:N \g_@@_math_bool
35 \bool_new:N \g_@@_euenc_bool

36 \bool_new:N \l_@@_disable_defaults_bool
37 \bool_new:N \l_@@_alias_bool
38 \bool_new:N \l_@@_external_bool
39 \bool_new:N \l_@@_never_check_bool
40 \bool_new:N \l_@@_defining_encoding_bool
41 \bool_new:N \l_@@_script_exist_bool

```

## Counters

```

42 \int_new:N \l_@@_script_int
43 \int_new:N \l_@@_language_int
44 \int_new:N \l_@@_strnum_int
45 \int_new:N \l_@@_tmp_int
46 \int_new:N \l_@@_em_int
47 \int_new:N \l_@@_emdef_int

```

## Floating point

```

48 \fp_new:N \l_@@_tmpa_fp
49 \fp_new:N \l_@@_tmpb_fp

```

## Dimensions

```

50 \dim_new:N \l_@@_tmpa_dim
51 \dim_new:N \l_@@_tmpb_dim
52 \dim_new:N \l_@@_tmpc_dim
53 \seq_new:N \g_@@_bf_series_seq

```

## Comma lists

```

54 \clist_new:N \g_@@_default_fontopts_clist
55 \clist_new:N \g_@@_all_keyval_modules_clist
56 \clist_set:Nn \l_@@_sizefeat_clist {Size={-}}

```

## Property lists

```

57 \prop_new:N \g_@@_fontopts_prop
58 \prop_new:N \l_@@_nfss_prop
59 \prop_new:N \l_@@_nfssfont_prop

```



```

60 \prop_new:N \g_@@_OT_features_prop
61 \prop_new:N \g_@@_all_opentype_feature_names_prop
62 \prop_new:N \g_@@_em_prop

```

### Token lists

```

63 \tl_new:N \g_@@_mathrm_tl
64 \tl_new:N \g_@@_bfmathrm_tl
65 \tl_new:N \g_@@_mathsf_tl
66 \tl_new:N \g_@@_mathtt_tl

67 \tl_new:N \l_@@_family_label_tl
68 \tl_new:N \l_@@_fake_slant_tl
69 \tl_new:N \l_@@_fake_embolden_tl

70 \tl_new:N \l_@@_fontname_up_tl
71 \tl_new:N \l_@@_fontname_bf_tl
72 \tl_new:N \l_@@_fontname_it_tl
73 \tl_new:N \l_@@_fontname_bfit_tl
74 \tl_new:N \l_@@_fontname_sl_tl
75 \tl_new:N \l_@@_fontname_bfsl_tl
76 \tl_new:N \l_@@_fontname_sc_tl

77 \tl_new:N \l_@@_fontfeat_up_clist
78 \tl_new:N \l_@@_fontfeat_bf_clist
79 \tl_new:N \l_@@_fontfeat_it_clist
80 \tl_new:N \l_@@_fontfeat_bfit_clist
81 \tl_new:N \l_@@_fontfeat_sl_clist
82 \tl_new:N \l_@@_fontfeat_bfsl_clist
83 \tl_new:N \l_@@_fontfeat_sc_clist

84 \tl_new:N \l_@@_script_name_tl
85 \tl_new:N \l_fontspeg_script_tl
86 \tl_new:N \l_@@_lang_name_tl
87 \tl_new:N \l_fontspeg_lang_tl

88 \tl_new:N \g_@@_hexcol_tl
89 \tl_new:N \g_@@_opacity_tl
90 \tl_set:Nn \g_@@_hexcol_tl {000000}
91 \tl_set:Nn \g_@@_opacity_tl {FF~}
92 \tl_set:Nn \g_@@_postadjust_tl { \l_@@_wordspace_adjust_tl \l_@@_punctspace_adjust_tl }

```

## 29.1 Generic functions

`\@@_keys_set_known:nnN`

```

93 \cs_new:Nn \@@_keys_set_known:nnN
94 {
95 <debug> \typeout{::: Keys~set::~~{#1}~{#2} }
96 \keys_set_known:nnN {#1} {#2} #3
97 <debug> \typeout{::: Leftover::~~{#3} }
98 }
99 \cs_generate_variant:Nn \@@_keys_set_known:nnN {nx}

```

`\@@_head_ii:n` Expands to the first two *<items>* of #1.

```

100 \cs_set:Npn \@@_head_ii:n #1 { \@@_head_ii:w #1 *** \q_stop}
101 \cs_set:Npn \@@_head_ii:w #1#2#3 \q_stop { #1#2 }
102 \cs_generate_variant:Nn \@@_head_ii:n {o}

```

\@@\_int\_mult\_truncate:Nn Missing in expl3, IMO.

```

103 \cs_new:Nn \@@_int_mult_truncate:Nn
104 {
105   \int_set:Nn #1 { \__dim_eval:w #2 #1 \__dim_eval_end: }
106 }

```

## 29.2 expl3 variants

```

107 \cs_generate_variant:Nn \int_set:Nn {Nv}
108 \cs_generate_variant:Nn \keys_set:nn {nx}
109 \cs_generate_variant:Nn \keys_set_known:nnN {nx}
110 \cs_generate_variant:Nn \prop_put:Nnn {Nxx}
111 \cs_generate_variant:Nn \prop_put:Nnn {NxV}
112 \cs_generate_variant:Nn \prop_gput_if_new:Nnn {NxV}
113 \cs_generate_variant:Nn \prop_gput:Nnn {NxN}
114 \cs_generate_variant:Nn \prop_get:NnNT {NxN}
115 \cs_generate_variant:Nn \prop_get:NnNTF {NxN}
116 \cs_generate_variant:Nn \str_if_eq:nnTF {nv}
117 \cs_generate_variant:Nn \tl_if_empty:nTF {x}
118 \cs_generate_variant:Nn \tl_if_empty:nF {x}
119 \cs_generate_variant:Nn \tl_if_empty:nF {f}
120 \cs_generate_variant:Nn \tl_if_eq:nnT {ox}
121 \cs_generate_variant:Nn \tl_replace_all:Nnn {Nnx}
122 </fontspec>

```

## 30 Error/warning/info messages

```

123 < *fontspec>

```

Shorthands for messages:

```

124 \cs_new:Npn \@@_error:n { \msg_error:nn {fontspec} }
125 \cs_new:Npn \@@_error:nn { \msg_error:nnn {fontspec} }
126 \cs_new:Npn \@@_error:nx { \msg_error:nnx {fontspec} }
127 \cs_new:Npn \@@_warning:n { \msg_warning:nn {fontspec} }
128 \cs_new:Npn \@@_warning:nx { \msg_warning:nnx {fontspec} }
129 \cs_new:Npn \@@_warning:nxx { \msg_warning:nnxx {fontspec} }
130 \cs_new:Npn \@@_info:n { \msg_info:nn {fontspec} }
131 \cs_new:Npn \@@_info:nx { \msg_info:nnx {fontspec} }
132 \cs_new:Npn \@@_info:nxx { \msg_info:nnxx {fontspec} }
133 \cs_new:Npn \@@_trace:n { \msg_trace:nn {fontspec} }

```

Allow messages to be written with spaces acting as normal:

```

134 \cs_generate_variant:Nn \msg_new:nnn {nnx}
135 \cs_generate_variant:Nn \msg_new:nnnn {nnxx}
136 \cs_new:Nn \@@_msg_new:nnn
137 { \msg_new:nnx {#1} {#2} { \tl_trim_spaces:n {#3} } }
138 \cs_new:Nn \@@_msg_new:nnnn
139 { \msg_new:nnxx {#1} {#2} { \tl_trim_spaces:n {#3} } { \tl_trim_spaces:n {#4} } }

```

```
140 \char_set_catcode_space:n {32}
```

### 30.1 Errors

```
141 \@@_msg_new:nnn {fontspec} {only-inside-encdef}
142 {
143   \exp_not:N#1 can only be used in the second argument
144   to \string\DeclareUnicodeEncoding.
145 }
146 \@@_msg_new:nnn {fontspec} {only-import-tu}
147 {
148   The "\string\ImportEncoding" command can only take "TU" as an argument at this stage.
149 }
150 \@@_msg_new:nnn {fontspec} {no-size-info}
151 {
152   Size information must be supplied.\\
153   For example, SizeFeatures={Size={8-12},...}.
154 }
155 \@@_msg_new:nnnn {fontspec} {font-not-found}
156 {
157   The font "#1" cannot be found.
158 }
159 {
160   A font might not be found for many reasons.\\
161   Check the spelling, where the font is installed etc. etc.\\
162   When in doubt, ask someone for help!
163 }
164 \@@_msg_new:nnnn {fontspec} {rename-feature-not-exist}
165 {
166   The feature #1 doesn't appear to be defined.
167 }
168 {
169   It looks like you're trying to rename a feature that doesn't exist.
170 }
171 \@@_msg_new:nnn {fontspec} {no-glyph}
172 {
173   '\l_fontspec_fontname_tl' does not contain glyph #1.
174 }
175 \@@_msg_new:nnnn {fontspec} {euler-too-late}
176 {
177   The euler package must be loaded BEFORE fontspec.
178 }
179 {
180   fontspec only overwrites euler's attempt to
181   define the maths text fonts if fontspec is
182   loaded after euler. Type <return> to proceed
183   with incorrect \string\mathit, \string\mathbf, etc.
184 }
185 \@@_msg_new:nnnn {fontspec} {no-xcolor}
186 {
187   Cannot load named colours without the xcolor package.
188 }
```

```

189 {
190   Sorry, I can't do anything to help. Instead of loading
191   the color package, use xcolor instead.
192 }
193 \@@_msg_new:nnnn {fontspec} {unknown-color-model}
194 {
195   Error loading colour `#1'; unknown colour model.
196 }
197 {
198   Sorry, I can't do anything to help. Please report this error
199   to my developer with a minimal example that causes the problem.
200 }
201 \@@_msg_new:nnnn {fontspec} {not-in-addfontfeatures}
202 {
203   The "#1" font feature cannot be used in \string\addfontfeatures.
204 }
205 {
206   This is due to how TeX loads fonts; such settings
207   are global so adding them mid-document within a group causes
208   confusion. You'll need to define multiple font families to achieve
209   what you want.
210 }

```

## 30.2 Warnings

```

211 \@@_msg_new:nnn {fontspec} {tu-clash}
212 {
213   I have found the tuenc.def encoding definition file but the TU encoding is not
214   defined by the LaTeX2e kernel; attempting to correct but you really should up-
215   date
216   to the latest version of LaTeX2e.
217 }
218 \@@_msg_new:nnn {fontspec} {tu-missing}
219 {
220   The TU encoding seems to be missing; please update to the latest version of La-
221   TeX2e.
222 }
223 \@@_msg_new:nnn {fontspec} {addfontfeatures-ignored}
224 {
225   \string\addfontfeature (s) ignored \msg_line_context;;
226   it cannot be used with a font that wasn't selected by a fontspec command.\
227   \
228   The current font is "\use:c{font@name}".$\
229   \int_compare:nTF { \clist_count:n {#1} = 1 }
230     { The requested feature is "#1". }
231     { The requested features are "#1". }
232 }
233 \@@_msg_new:nnn {fontspec} {feature-option-overwrite}
234 {
235   Option '#2' of font feature '#1' overwritten.
236 }
237 \@@_msg_new:nnn {fontspec} {script-not-exist-latn}

```

```

236 {
237   Font '\l_fontspec_fontname_tl' does not contain script '#1'.\\
238   'Latin' script used instead.
239 }
240 \@@_msg_new:nnn {fontspec} {script-not-exist}
241 {
242   Font '\l_fontspec_fontname_tl' does not contain script '#1'.
243 }
244 \@@_msg_new:nnn {fontspec} {aat-feature-not-exist}
245 {
246   '\l_keys_key_tl=\l_keys_value_tl' feature not supported
247   for AAT font '\l_fontspec_fontname_tl'.
248 }
249 \@@_msg_new:nnn {fontspec} {aat-feature-not-exist-in-font}
250 {
251   AAT feature '\l_keys_key_tl=\l_keys_value_tl' (#1) not available
252   in font '\l_fontspec_fontname_tl'.
253 }
254 \@@_msg_new:nnn {fontspec} {icu-feature-not-exist}
255 {
256   '\l_keys_key_tl=\l_keys_value_tl' feature not supported
257   for OpenType font '\l_fontspec_fontname_tl'
258 }
259 \@@_msg_new:nnn {fontspec} {icu-feature-not-exist-in-font}
260 {
261   OpenType feature '\l_keys_key_tl=\l_keys_value_tl' (#1) not available
262   for font '\l_fontspec_fontname_tl'
263   with script '\l_@@_script_name_tl' and language '\l_@@_lang_name_tl'.
264 }
265 \@@_msg_new:nnn {fontspec} {no-opticals}
266 {
267   '\l_fontspec_fontname_tl' doesn't appear to have an Optical Size axis.
268 }
269 \@@_msg_new:nnn {fontspec} {language-not-exist}
270 {
271   Language '#1' not available
272   for font '\l_fontspec_fontname_tl'
273   with script '\l_@@_script_name_tl'.\\
274   'Default' language used instead.
275 }
276 \@@_msg_new:nnn {fontspec} {only-xetex-feature}
277 {
278   Ignored XeTeX only feature: '#1'.
279 }
280 \@@_msg_new:nnn {fontspec} {only-luatex-feature}
281 {
282   Ignored LuaTeX only feature: '#1'.
283 }
284 \@@_msg_new:nnn {fontspec} {no-mapping}
285 {
286   Input mapping not (yet?) supported in LuaTeX.

```

```

287 }
288 \@@_msg_new:nnn {fontspec} {no-mapping-ligtext}
289 {
290   Input mapping not (yet?) supported in LuaTeX.\\
291   Use "Ligatures=TeX" instead of "Mapping=tex-text".
292 }
293 \@@_msg_new:nnn {fontspec} {cm-default-obsolete}
294 {
295   The "cm-default" package option is obsolete.
296 }
297 \@@_msg_new:nnn {fontspec} {fakebold-only-xetex}
298 {
299   The "FakeBold" and "AutoFakeBold" options are only available with XeLaTeX.\\
300   Option ignored.
301 }
302 \@@_msg_new:nnn {fontspec} {font-index-needs-ttc}
303 {
304   The "FontIndex" feature is only supported by TTC (TrueType Collection) fonts.\\
305   Feature ignored.
306 }
307 \@@_msg_new:nnn {fontspec} {feat-cannot-remove}
308 {
309   The "#1" feature cannot be deactivated. Request ignored.
310 }

```

### 30.3 Info messages

```

311 \@@_msg_new:nnn {fontspec} {defining-font}
312 {
313   Font family '\l_fontspec_family_tl' created for font '#2'
314   with options [\l_@@_all_features_clist].\\
315   \\
316   This font family consists of the following NFSS series/shapes:\\
317   \l_fontspec_defined_shapes_tl
318 }
319 \@@_msg_new:nnn {fontspec} {no-font-shape}
320 {
321   Could not resolve font "#1" (it probably doesn't exist).
322 }
323 \@@_msg_new:nnn {fontspec} {set-scale}
324 {
325   \l_fontspec_fontname_tl\space scale = \l_@@_scale_tl.
326 }
327 \@@_msg_new:nnn {fontspec} {setup-math}
328 {
329   Adjusting the maths setup (use [no-math] to avoid this).
330 }
331 \@@_msg_new:nnn {fontspec} {no-scripts}
332 {
333   Font "\l_fontspec_fontname_tl" does not contain any OpenType `Script' in-
334   formation.
335 }

```

```

335 \@@_msg_new:nnn {fontspec} {opa-twice}
336 {
337   Opacity set twice, in both Colour and Opacity.\\
338   Using specification "Opacity=#1".
339 }
340 \@@_msg_new:nnn {fontspec} {opa-twice-col}
341 {
342   Opacity set twice, in both Opacity and Colour.\\
343   Using an opacity specification in hex of "#1/FF".
344 }
345 \@@_msg_new:nnn {fontspec} {bad-colour}
346 {
347   Bad colour declaration "#1".
348   Colour must be one of:\\
349   * a named xcolor colour\\
350   * a six-digit hex colour RRGGBB\\
351   * an eight-digit hex colour RRGGBBTT with opacity
352 }

```

Reset ‘space’ behaviour:

```

353 \char_set_catcode_ignore:n {32}
354 \</fontspec>

```

## 31 Opening code

### 31.1 Package options

```

355 \DeclareOption{cm-default}
356 { \@@_warning:n {cm-default-obsolete} }
357 \DeclareOption{math}{\bool_set_true:N \g_@@_math_bool}
358 \DeclareOption{no-math}{\bool_set_false:N \g_@@_math_bool}
359 \DeclareOption{config}{\bool_set_true:N \g_@@_cfg_bool}
360 \DeclareOption{no-config}{\bool_set_false:N \g_@@_cfg_bool}
361 \DeclareOption{euenc}{\bool_set_true:N \g_@@_euenc_bool}
362 \DeclareOption{tuenc}{\bool_set_false:N \g_@@_euenc_bool}
363 \DeclareOption{quiet}
364 {
365   \msg_redirect_module:nnn { fontspec } { warning } { info }
366   \msg_redirect_module:nnn { fontspec } { info } { none }
367 }
368 \DeclareOption{silent}
369 {
370   \msg_redirect_module:nnn { fontspec } { warning } { none }
371   \msg_redirect_module:nnn { fontspec } { info } { none }
372 }
373 \ExecuteOptions{config,math,tuenc}
374 \ProcessOptions*

```

### 31.2 Encodings

Soon to be the default, with a just-in-case check:

```

375 \bool_if:NF \g_@@_euenc_bool

```

```

376 {
377   \file_if_exist:nTF {tuenc.def}
378   {
379     \cs_if_exist:cF {T@TU}
380     {
381       \@@_warning:n {tu-clash}
382       \DeclareFontEncoding{TU}{}{ }
383       \DeclareFontSubstitution{TU}{lmr}{m}{n}
384     }
385   }
386   {
387     \@@_warning:n {tu-missing}
388     \bool_set_true:N \g_@@_euenc_bool
389   }
390 }
391 \bool_if:NTF \g_@@_euenc_bool
392 {
393   \xetex \tl_set:Nn \g_fontspec_encoding_tl {EU1}
394   \luatex \tl_set:Nn \g_fontspec_encoding_tl {EU2}
395 }
396 { \tl_set:Nn \g_fontspec_encoding_tl { TU } }

397 \tl_set:Nn \rmdefault {lmr}
398 \tl_set:Nn \sfdefault {lms}
399 \tl_set:Nn \ttdefault {lmtt}
400 \RequirePackage[\g_fontspec_encoding_tl]{fontenc}
401 \tl_set_eq:NN \UTFencname \g_fontspec_encoding_tl % for xunicode if needed

```

To overcome the encoding changing the current font size, but only if a class has been loaded first:

```

402 \tl_if_in:NnT \@filelist {.cls} { \normalsize }

```

Dealing with a couple of the problems introduced by babel:

```

403 \tl_set_eq:NN \cyrillicencoding \g_fontspec_encoding_tl
404 \tl_set_eq:NN \latinencoding \g_fontspec_encoding_tl
405 \AtBeginDocument
406 {
407   \tl_set_eq:NN \cyrillicencoding \g_fontspec_encoding_tl
408   \tl_set_eq:NN \latinencoding \g_fontspec_encoding_tl
409 }

```

That latin encoding definition is repeated to suppress font warnings. Something to do with `\select@language` ending up in the `.aux` file which is read at the beginning of the document.

```

410 \bool_if:NT \g_@@_euenc_bool
411 {
412   \luatex \cs_set_eq:NN \fontspec_tmp: \XeTeXpicfile
413   \luatex \cs_set:Npn \XeTeXpicfile {}
414   \RequirePackage{xunicode}
415   \luatex \cs_set_eq:NN \XeTeXpicfile \fontspec_tmp:
416 }

```



## 32 expl3 interface for font loading

n,\@@\_primitive\_font\_gset:Nnn

```

417 \cs_set:Npn \@@_primitive_font_set:Nnn #1#2#3
418 {
419   \font #1 = #2 ~at~ #3 \scan_stop:
420 }
421 \cs_set:Npn \@@_primitive_font_gset:Nnn #1#2#3
422 {
423   \global \font #1 = #2 ~at~ #3 \scan_stop:
424 }

```

ont\_suppress\_not\_found\_error:

```

425 \cs_set:Npn \@@_font_suppress_not_found_error:
426 {
427   \int_set_eq:NN \xetex_suppressfontnotfounderror:D \c_one
428 }

```

[ pTF]@\_primitive\_font\_if\_null:N

```

429 \prg_set_conditional:Nnn \@@_primitive_font_if_null:N {p,TF,T,F}
430 {
431   \ifx #1 \nullfont
432     \prg_return_true:
433   \else
434     \prg_return_false:
435   \fi
436 }

```

[ TF]@\_primitive\_font\_if\_exist:n

```

437 \prg_set_conditional:Nnn \@@_primitive_font_if_exist:n {TF,T,F}
438 {
439   \group_begin:
440     \@@_font_suppress_not_found_error:
441     \@@_primitive_font_set:Nnn \l_@@_primitive_font {#1} {1opt}
442     \@@_primitive_font_if_null:NTF \l_@@_primitive_font
443     { \group_end: \prg_return_false: }
444     { \group_end: \prg_return_true: }
445 }

```

tive\_font\_glyph\_if\_exist:NnTF

```

446 \prg_new_conditional:Nnn \@@_primitive_font_glyph_if_exist:Nn {p,TF,T,F}
447 {
448   \etex_iffontchar:D #1 #2 \scan_stop:
449   \prg_return_true:
450 \else:
451   \prg_return_false:
452 \fi:
453 }

```

## 33 User commands

This section contains the definitions of the commands detailed in the user documentation. Only the ‘top level’ definitions of the commands are contained herein; they all use or define macros which are defined or used later on in [Section 35.1 on page 94](#).

### 33.0.1 Font selection

`\fontspec` This is the main command of the package that selects fonts with various features. It takes two arguments: the font name and the optional requested features of that font. Then this new font family is selected.

```
454 \NewDocumentCommand \fontspec { O{} m O{} }
455 {
456   \fontspec_set_family:Nnn \f@family {#1,#3} {#2}
457   \fontencoding { \l_@@_nfss_enc_tl }
458   \selectfont
459   \ignorespaces
460 }
```

`\setmainfont` The following three macros perform equivalent operations setting the default font for a particular family: ‘roman’, sans serif, or typewriter (monospaced). I end them with `\normalfont` so that if they’re used in the document, the change registers immediately.

```
461 \DeclareDocumentCommand \setmainfont { O{} m O{} }
462 {
463   \fontspec_set_family:Nnn \g_@@_rmfamily_family {#1,#3} {#2}
464   \tl_set_eq:NN \rmdefault \g_@@_rmfamily_family
465   \use:x { \exp_not:n { \DeclareRobustCommand \rmfamily }
466     {
467       \exp_not:N \fontencoding { \l_@@_nfss_enc_tl }
468       \exp_not:N \fontfamily { \g_@@_rmfamily_family }
469       \exp_not:N \selectfont
470     }
471   }
472   \str_if_eq:x:nnT {\familydefault} {\rmdefault}
473     { \tl_set_eq:NN \encodingdefault \l_@@_nfss_enc_tl }
474   \normalfont
475   \ignorespaces
476 }
```

`\setsansfont`

```
477 \DeclareDocumentCommand \setsansfont { O{} m O{} }
478 {
479   \fontspec_set_family:Nnn \g_@@_sffamily_family {#1,#3} {#2}
480   \tl_set_eq:NN \sfdefault \g_@@_sffamily_family
481   \use:x { \exp_not:n { \DeclareRobustCommand \sffamily }
482     {
483       \exp_not:N \fontencoding { \l_@@_nfss_enc_tl }
484       \exp_not:N \fontfamily { \g_@@_sffamily_family }
485       \exp_not:N \selectfont
486     }
487   }
```

```

487 }
488 \str_if_eq_x:nnT {\familydefault} {\sfdefault}
489 { \tl_set_eq:NN \encodingdefault \l_@@_nfss_enc_tl }
490 \normalfont
491 \ignorespaces
492 }

\setmonofont
493 \DeclareDocumentCommand \setmonofont { O{} m O{} }
494 {
495   \fontspec_set_family:Nnn \g_@@_ttfamily_family {#1,#3} {#2}
496   \tl_set_eq:NN \ttdefault \g_@@_ttfamily_family
497   \use:x { \exp_not:n { \DeclareRobustCommand \ttfamily }
498     {
499       \exp_not:N \fontencoding { \l_@@_nfss_enc_tl }
500       \exp_not:N \fontfamily { \g_@@_ttfamily_family }
501       \exp_not:N \selectfont
502     }
503   }
504   \str_if_eq_x:nnT {\familydefault} {\ttdefault}
505   { \tl_set_eq:NN \encodingdefault \l_@@_nfss_enc_tl }
506   \normalfont
507   \ignorespaces
508 }

\setromanfont This is the old name for \setmainfont, retained ad infinitum for backwards compati-
bility. It was deprecated in 2010.
509 \cs_set_eq:NN \setromanfont \setmainfont

\setmathrm These commands are analogous to \setmainfont and others, but for selecting the
\setmathsf font used for \mathrm, etc. They can only be used in the preamble of the document.
\setboldmathrm \setboldmathrm is used for specifying which fonts should be used in \boldmath.
\setmathtt
510 \DeclareDocumentCommand \setmathrm { O{} m O{} }
511 {
512   \fontspec_set_family:Nnn \g_@@_mathrm_tl {#1} {#2}
513 }
514
515 \DeclareDocumentCommand \setboldmathrm { O{} m O{} }
516 {
517   \fontspec_set_family:Nnn \g_@@_bfmathrm_tl {#1} {#2}
518 }
519
520 \DeclareDocumentCommand \setmathsf { O{} m O{} }
521 {
522   \fontspec_set_family:Nnn \g_@@_mathsf_tl {#1} {#2}
523 }
524
525 \DeclareDocumentCommand \setmathtt { O{} m O{} }
526 {
527   \fontspec_set_family:Nnn \g_@@_mathtt_tl {#1} {#2}
528 }

```

```

529 \@onlypreamble\setmathrm
530 \@onlypreamble\setboldmathrm
531 \@onlypreamble\setmathsf
532 \@onlypreamble\setmathtt

```

If the commands above are not executed, then `\rmdefault` (*etc.*) will be used.

```

533 \tl_set:Nn \g_@@_mathrm_tl {\rmdefault}
534 \tl_set:Nn \g_@@_mathsf_tl {\sfdefault}
535 \tl_set:Nn \g_@@_mathtt_tl {\ttdefault}

```

`\newfontfamily` This macro takes the arguments of `\fontspec` with a prepended *(instance cmd)*. This command is used when a specific font instance needs to be referred to repetitively (*e.g.*, in a section heading) since continuously calling `\fontspec_select:nn` is inefficient because it must parse the option arguments every time.

`\fontspec_select:nn` defines a font family and saves its name in `\l_fontspec_family_tl`. This family is then used in a typical NFSS `\fontfamily` declaration, saved in the macro name specified.

```

536 \DeclareDocumentCommand \newfontfamily { m O{} m O{} }
537 {
538   \fontspec_set_family:cnn { g_@@_ \cs_to_str:N #1 _family } {#2,#4} {#3}
539   \use:x
540   {
541     \exp_not:N \DeclareRobustCommand \exp_not:N #1
542     {
543       \exp_not:N \fontfamily { \use:c {g_@@_ \cs_to_str:N #1 _family} }
544       \exp_not:N \fontencoding { \l_@@_nfss_enc_tl }
545       \exp_not:N \selectfont
546     }
547   }
548 }

```

`\newfontface` `\newfontface` uses the fact that if the argument to `BoldFont`, *etc.*, is empty (*i.e.*, `BoldFont={}`), then no bold font is searched for.

```

549 \DeclareDocumentCommand \newfontface { m O{} m O{} }
550 {
551   \newfontfamily #1 [ BoldFont={},ItalicFont={},SmallCapsFont={},#2,#4 ] {#3}
552 }

```

### 33.0.2 Font feature selection

`\defaultfontfeatures` This macro takes one argument that consists of all of feature options that will be applied by default to all subsequent `\fontspec`, *et al.*, commands. It stores its value in `\g_fontspec_default_fontopts_tl` (initialised empty), which is concatenated with the individual macro choices in the [...] macro.

```

553 \DeclareDocumentCommand \defaultfontfeatures { t+ o m }
554 {
555   \IfNoValueTF {#2}
556   { \@@_set_default_features:nn {#1} {#3} }
557   { \@@_set_font_default_features:nnn {#1} {#2} {#3} }
558   \ignorespaces

```

```

559 }
560 \cs_new:Nn \@@_set_default_features:nn
561 {
562   \IfBooleanTF {#1} \clist_put_right:Nn \clist_set:Nn
563     \g_@@_default_fontopts_clist {#2}
564 }

```

The optional argument specifies a font identifier. Branch for either (a) single token input such as `\rmdefault`, or (b) otherwise assume its a fontname. In that case, strip spaces and file extensions and lower-case to ensure consistency.

```

565 \cs_new:Nn \@@_set_font_default_features:nnn
566 {
567   \clist_map_inline:nn {#2}
568   {
569     \tl_if_single:nTF {##1}
570     { \tl_set:No \l_@@_tmp_tl { \cs:w g_@@_ \cs_to_str:N ##1 _family\cs_end: } }
571     { \@@_sanitise_fontname:Nn \l_@@_tmp_tl {##1} }
572   }
573   \IfBooleanTF {#1}
574   {
575     \prop_get:NVNF \g_@@_fontopts_prop \l_@@_tmp_tl \l_@@_tmpb_tl
576     { \tl_clear:N \l_@@_tmpb_tl }
577     \tl_put_right:Nn \l_@@_tmpb_tl {#3,}
578     \prop_gput:NVV \g_@@_fontopts_prop \l_@@_tmp_tl \l_@@_tmpb_tl
579   }
580   {
581     \tl_if_empty:nTF {#3}
582     { \prop_gremove:NV \g_@@_fontopts_prop \l_@@_tmp_tl }
583     { \prop_put:NVn \g_@@_fontopts_prop \l_@@_tmp_tl {#3,} }
584   }
585 }
586 }

```

`\addfontfeatures` In order to be able to extend the feature selection of a given font, two things need to be known: the currently selected features, and the currently selected font. Every time a font family is created, this information is saved inside a control sequence with the name of the font family itself.

This macro extracts this information, then appends the requested font features to add to the already existing ones, and calls the font again with the top level `\fontspec` command.

The default options are *not* applied (which is why `\g_fontspec_default_fontopts_tl` is emptied inside the group; this is allowed as `\l_fontspec_family_tl` is globally defined in `\@@_select_font_family:nn`), so this means that the only added features to the font are strictly those specified by this command.

`\addfontfeature` is defined as an alias, as I found that I often typed this instead when adding only a single font feature.

```

587 \DeclareDocumentCommand \addfontfeatures {m}
588 {
589   <debug> \typeout{^^J:~::~::~::~::~::~::~::~::~::~::~::~::~::~::~^^J: addfontfeatures}
590   \fontspec_if_fontspec_font:TF
591   {

```

```

592 \group_begin:
593 \keys_set_known:nnN {fontspec-addfeatures} {#1} \l_@@_tmp_tl
594 \prop_get:cnN {g_@@_ \f@family _prop} {options} \l_@@_options_tl
595 \prop_get:cnN {g_@@_ \f@family _prop} {fontname} \l_@@_fontname_tl
596 \bool_set_true:N \l_@@_disable_defaults_bool
597 <debug> \typeout{ \@@_select_font_family:nn { \l_@@_options_tl , #1 } {\l_@@_fontname
598 \use:x
599 {
600 \@@_select_font_family:nn
601 { \l_@@_options_tl , #1 } {\l_@@_fontname_tl}
602 }
603 \group_end:
604 \fontfamily\l_fontspec_family_tl\selectfont
605 }
606 {
607 \@@_warning:nx {addfontfeatures-ignored} {#1}
608 }
609 \ignorespaces
610 }
611 \cs_set_eq:NN \addfontfeature \addfontfeatures

```

### 33.0.3 Defining new font features

`\newfontfeature` `\newfontfeature` takes two arguments: the name of the feature tag by which to reference it, and the string that is used to select the font feature.

```

612 \DeclareDocumentCommand \newfontfeature {mm}
613 {
614 \keys_define:nn { fontspec }
615 {
616 #1 .code:n =
617 {
618 \@@_update_featstr:n {#2}
619 }
620 }
621 }

```

`\newAATfeature` This command assigns a new AAT feature by its code (`#2`,`#3`) to a new name (`#1`). Better than `\newfontfeature` because it checks if the feature exists in the font it's being used for.

```

622 \DeclareDocumentCommand \newAATfeature {mmmm}
623 {
624 \keys_if_exist:nnF { fontspec } {#1}
625 { \@@_define_aat_feature_group:n {#1} }
626 \keys_if_choice_exist:nnnT {fontspec} {#1} {#2}
627 { \@@_warning:nxx {feature-option-overwrite} {#1} {#2} }
628 \@@_define_aat_feature:nnnn {#1}{#2}{#3}{#4}
629 }

```

`\newopentypefeature` This command assigns a new OpenType feature by its abbreviation (`#2`) to a new name (`#1`). Better than `\newfontfeature` because it checks if the feature exists in the font it's being used for.

```

630 \DeclareDocumentCommand \newopentypefeature {mmm}
631 {
632   \keys_if_exist:nnF { fontspec / options } {#1}
633   { \@@_define_opentype_feature_group:n {#1} }
634   \keys_if_choice_exist:nnnT {fontspec} {#1} {#2}
635   { \@@_warning:nxx {feature-option-overwrite} {#1} {#2} }
636   \@@_define_opentype_feature:nnn {#1}{#2}{#3}
637 }

```

\newICUfeature

```

638 \cs_set_eq:NN \newICUfeature \newopentypefeature % deprecated

```

\aliasfontfeature User commands for renaming font features and font feature options.

```

639 \DeclareDocumentCommand \aliasfontfeature {mm}
640 {
641   <debug> \typeout{::::::::::::::::::::~^J:: aliasfontfeature{#1}{#2}}
642   \bool_set_false:N \l_@@_alias_bool
643
644   \clist_map_inline:nn
645     { fontspec, fontspec-opentype, fontspec-aat, fontspec-preparse, fontspec-
646       preparse-external,
647       fontspec-preparse-nested, fontspec-renderer }
648   {
649     \keys_if_exist:nnT {##1} {#1}
650     {
651       <debug> \typeout{::: Key~exists~##1~/~#1}
652       \bool_set_true:N \l_@@_alias_bool
653       \keys_define:nn {##1}
654         { #2 .code:n = { \keys_set:nn {##1} { #1 = {####1} } } }
655     }
656   }
657
658   \bool_if:NF \l_@@_alias_bool
659   { \@@_warning:nx {rename-feature-not-exist} {#1} }
660 }

```

\aliasfontfeatureoption

```

661 \DeclareDocumentCommand \aliasfontfeatureoption {mmm}
662 {
663   \bool_set_false:N \l_@@_alias_bool
664
665   \clist_map_inline:Nn \g_@@_all_keyval_modules_clist
666   {
667
668     \keys_if_exist:nnT {##1} {#1}
669     {
670       \bool_set_true:N \l_@@_alias_bool
671       \keys_define:nn { ##1 / #1 } { #3 .meta:n = {#2} }
672     }
673   }

```

```

674
675 \bool_if:NF \l_@@_alias_bool
676 { \@@_warning:nx {rename-feature-not-exist} {#1} }
677 }

```

`\newfontscript` Mostly used internally, but also possibly useful for users, to define new OpenType ‘scripts’, mapping logical names to OpenType script tags.

```

678 \DeclareDocumentCommand \newfontscript {mm}
679 {
680 \fontspec_new_script:nn {#1} {#2}
681 }

```

`\newfontlanguage` Mostly used internally, but also possibly useful for users, to define new OpenType ‘languages’, mapping logical names to OpenType language tags.

```

682 \DeclareDocumentCommand \newfontlanguage {mm}
683 {
684 \fontspec_new_lang:nn {#1} {#2}
685 }

```

`\DeclareFontsExtensions` dfont would never be uppercase, right?

```

686 \DeclareDocumentCommand \DeclareFontsExtensions {m}
687 {
688 \clist_set:Nn \l_@@_extensions_clist { #1 }
689 \tl_remove_all:Nn \l_@@_extensions_clist {~}
690 }
691 \DeclareFontsExtensions{.otf,.ttf,.OTF,.TTF,.ttc,.TTC,.dfont}

```

`\IfFontFeaturesTF`

```

692 \DeclareDocumentCommand \IfFontFeatureActiveTF {mmm}
693 {
694 <debug> \typeout{^~J::::::::::::::::::::::::::::::::::::::::::::::::::}
695 <debug> \typeout{:IfFontFeatureActiveTF \exp_not:n{#{1}{#{2}{#{3}}}}
696 \@@_if_font_feature:nTF {#1} {#2} {#3}
697 }

698 \prg_new_conditional:Nnn \@@_if_font_feature:n {TF}
699 {
700 \tl_gclear:N \g_@@_single_feat_tl
701 \group_begin:
702 \@@_font_suppress_not_found_error:
703 \@@_init:
704 \bool_set_true:N \l_@@_ot_bool
705 \bool_set_true:N \l_@@_never_check_bool
706 \bool_set_false:N \l_@@_firsttime_bool
707 \clist_clear:N \l_@@_fontfeat_clist
708 \@@_get_features:Nn \l_@@_rawfeatures_sclist {#1}
709 \group_end:
710
711 <debug> \typeout{::> \exp_not:N\l_@@_rawfeatures_sclist->~{\l_@@_rawfeatures_sclist}}
712 <debug> \typeout{::> \exp_not:N\g_@@_single_feat_tl->~{\g_@@_single_feat_tl}}
713
714 \tl_if_empty:NTF \g_@@_single_feat_tl { \prg_return_false: }

```



```

715     {
716       \exp_args:NV \fontspec_if_current_feature:nTF \g_@@_single_feat_tl
717       { \prg_return_true: } { \prg_return_false: }
718     }
719   }

```

## 34 Programmer's interface

These functions are not used directly by fontspec when defining fonts; they are designed to be used by other packages who wish to do font-related things on top of fontspec itself.

Because I haven't fully explored how these functions will behave in practise, I am not giving them user-level names. As it becomes more clear which of these should be accessible by document writers, I'll open them up a little more.

All functions are defined assuming that the font to be queried is currently selected as a fontspec font. (I.e., via `\fontspec` or from a `\newfontfamily` macro or from `\setmainfont` and so on.)

```

\fontspec_if_fontspec_font:TF Test whether the currently selected font has been loaded by fontspec.
720 \prg_new_conditional:Nnn \fontspec_if_fontspec_font: {TF,T,F}
721 {
722   \cs_if_exist:cTF {g_@@_ \f@family _prop} \prg_return_true: \prg_return_false:
723 }

\fontspec_if_aat_feature:nnTF Conditional to test if the currently selected font contains the AAT feature (#1,#2).
724 \prg_new_conditional:Nnn \fontspec_if_aat_feature:nn {TF,T,F}
725 {
726   \fontspec_if_fontspec_font:TF
727   {
728     \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
729     \@@_primitive_font_set:Nnn \l_fontspec_font {\l_@@_fontdef_tl} {\f@size pt}
730     \bool_if:NTF \l_@@_atsui_bool
731     {
732       \@@_make_AAT_feature_string:nnTF {#1}{#2}
733       \prg_return_true: \prg_return_false:
734     }
735     {
736       \prg_return_false:
737     }
738   }
739   {
740     \prg_return_false:
741   }
742 }

\fontspec_if_opentype:TF Test whether the currently selected font is an OpenType font. Always true for LuaTeX
fonts.
743 \prg_new_conditional:Nnn \fontspec_if_opentype: {TF,T,F}
744 {
745   \fontspec_if_fontspec_font:TF

```

```

746 {
747   \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
748   \@@_primitive_font_set:Nnn \l_fontspec_font {\l_@@_fontdef_tl} {\f@size pt}
749   \@@_set_font_type:
750   \bool_if:NTF \l_@@_ot_bool \prg_return_true: \prg_return_false:
751 }
752 {
753   \prg_return_false:
754 }
755 }

```

\fontspec\_if\_feature:nTF Test whether the currently selected font contains the raw OpenType feature #1. E.g.:  
\fontspec\_if\_feature:nTF {pnum} {True} {False} Returns false if the font is not loaded by fontspec or is not an OpenType font.

```

756 \prg_new_conditional:Nnn \fontspec_if_feature:n {TF,T,F}
757 {
758   \fontspec_if_fontspec_font:TF
759   {
760     \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
761     \@@_primitive_font_set:Nnn \l_fontspec_font {\l_@@_fontdef_tl} {\f@size pt}
762     \@@_set_font_type:
763     \bool_if:NTF \l_@@_ot_bool
764     {
765       \prop_get:cnN {g_@@_ \f@family _prop} {script-num} \l_@@_tmp_tl
766       \int_set:Nn \l_@@_script_int {\l_@@_tmp_tl}
767
768       \prop_get:cnN {g_@@_ \f@family _prop} {lang-num} \l_@@_tmp_tl
769       \int_set:Nn \l_@@_language_int {\l_@@_tmp_tl}
770
771       \prop_get:cnN {g_@@_ \f@family _prop} {script-tag} \l_fontspec_script_tl
772       \prop_get:cnN {g_@@_ \f@family _prop} {lang-tag} \l_fontspec_lang_tl
773
774       \@@_check_ot_feat:nTF {#1} {\prg_return_true:} {\prg_return_false:}
775     }
776     {
777       \prg_return_false:
778     }
779   }
780   {
781     \prg_return_false:
782   }
783 }

```

\fontspec\_if\_feature:nnnTF Test whether the currently selected font with raw OpenType script tag #1 and raw OpenType language tag #2 contains the raw OpenType feature tag #3. E.g.: \fontspec\_if\_feature:nTF {la  
Returns false if the font is not loaded by fontspec or is not an OpenType font.

```

784 \prg_new_conditional:Nnn \fontspec_if_feature:nnn {TF,T,F}
785 {
786   \fontspec_if_fontspec_font:TF
787   {
788     \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl

```

```

789 \@@_primitive_font_set:Nnn \l_fontspeg_font {\l_@@_fontdef_tl} {\f@size pt}
790 \@@_set_font_type:
791 \bool_if:NTF \l_@@_ot_bool
792 {
793   \@@_iv_str_to_num:Nn \l_@@_script_int {#1}
794   \@@_iv_str_to_num:Nn \l_@@_language_int {#2}
795   \@@_check_ot_feat:NTF {#3} \prg_return_true: \prg_return_false:
796 }
797 { \prg_return_false: }
798 }
799 { \prg_return_false: }
800 }

```

\fontspec\_if\_script:nTF Test whether the currently selected font contains the raw OpenType script #1. E.g.:  
 \fontspec\_if\_script:nTF {latn} {True} {False} Returns false if the font is not loaded by fontspec or is not an OpenType font.

```

801 \prg_new_conditional:Nnn \fontspec_if_script:n {TF,T,F}
802 {
803   \fontspec_if_fontspec_font:TF
804   {
805     \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
806     \@@_primitive_font_set:Nnn \l_fontspeg_font {\l_@@_fontdef_tl} {\f@size pt}
807     \@@_set_font_type:
808     \bool_if:NTF \l_@@_ot_bool
809     {
810       \@@_check_script:nTF {#1} \prg_return_true: \prg_return_false:
811     }
812     { \prg_return_false: }
813   }
814   { \prg_return_false: }
815 }

```

\fontspec\_if\_language:nTF Test whether the currently selected font contains the raw OpenType language tag #1.  
 E.g.: \fontspec\_if\_language:nTF {ROM} {True} {False}. Returns false if the font is not loaded by fontspec or is not an OpenType font.

```

816 \prg_new_conditional:Nnn \fontspec_if_language:n {TF,T,F}
817 {
818   \fontspec_if_fontspec_font:TF
819   {
820     \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
821     \@@_primitive_font_set:Nnn \l_fontspeg_font {\l_@@_fontdef_tl} {\f@size pt}
822     \@@_set_font_type:
823     \bool_if:NTF \l_@@_ot_bool
824     {
825       \prop_get:cnN {g_@@_ \f@family _prop} {script-num} \l_@@_tmp_tl
826       \int_set:Nn \l_@@_script_int {\l_@@_tmp_tl}
827       \prop_get:cnN {g_@@_ \f@family _prop} {script-tag} \l_fontspeg_script_tl
828
829       \@@_check_lang:nTF {#1} \prg_return_true: \prg_return_false:
830     }
831     { \prg_return_false: }

```

```

832 }
833 { \prg_return_false: }
834 }

```

\fontspec\_if\_language:nnTF    Test whether the currently selected font contains the raw OpenType language tag #2 in script #1. E.g.: \fontspec\_if\_language:nnTF {cyr1} {SRB} {True} {False}. Returns false if the font is not loaded by fontspec or is not an OpenType font.

```

835 \prg_new_conditional:Nnn \fontspec_if_language:nn {TF,T,F}
836 {
837   \fontspec_if_fontspec_font:TF
838   {
839     \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
840     \@@_primitive_font_set:Nnn \l_fontspec_font {\l_@@_fontdef_tl} {\f@size pt}
841     \@@_set_font_type:
842     \bool_if:NTF \l_@@_ot_bool
843     {
844       \tl_set:Nn \l_fontspec_script_tl {#1}
845       \@@_iv_str_to_num:Nn \l_@@_script_int {#1}
846       \@@_check_lang:nTF {#2} \prg_return_true: \prg_return_false:
847     }
848     { \prg_return_false: }
849   }
850   { \prg_return_false: }
851 }

```

fontspec\_if\_current\_script:nTF    Test whether the currently loaded font is using the specified raw OpenType script tag #1.

```

852 \prg_new_conditional:Nnn \fontspec_if_current_script:n {TF,T,F}
853 {
854   \fontspec_if_fontspec_font:TF
855   {
856     \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
857     \@@_primitive_font_set:Nnn \l_fontspec_font {\l_@@_fontdef_tl} {\f@size pt}
858     \@@_set_font_type:
859     \bool_if:NTF \l_@@_ot_bool
860     {
861       \prop_get:cnN {g_@@_ \f@family _prop} {script-tag} \l_@@_tmp_tl
862       \str_if_eq:nVTF {#1} \l_@@_tmp_tl
863       {\prg_return_true:} {\prg_return_false:}
864     }
865     { \prg_return_false: }
866   }
867   { \prg_return_false: }
868 }

```

fontspec\_if\_current\_language:nTF    Test whether the currently loaded font is using the specified raw OpenType language tag #1.

```

869 \prg_new_conditional:Nnn \fontspec_if_current_language:n {TF,T,F}
870 {
871   \fontspec_if_fontspec_font:TF
872   {

```

```

873 \prop_get:cnN {g_@@_ \f@family _prop} {fontdef} \l_@@_fontdef_tl
874 \@@_primitive_font_set:Nnn \l_fontspec_font {\l_@@_fontdef_tl} {\f@size pt}
875 \@@_set_font_type:
876 \bool_if:NTF \l_@@_ot_bool
877 {
878   \prop_get:cnN {g_@@_ \f@family _prop} {lang-tag} \l_@@_tmp_tl
879   \str_if_eq:nVTF {#1} \l_@@_tmp_tl
880   {\prg_return_true:} {\prg_return_false:}
881 }
882 { \prg_return_false: }
883 }
884 { \prg_return_false: }
885 }

```

`\fontspec_set_family:Nnn` #1 : family  
 #2 : fontspec features  
 #3 : font name

Defines a new font family from given *features* and *font*, and stores the name in the variable *family*. See the standard fontspec user commands for applications of this function.

We want to store the actual name of the font family within the *family* variable because the actual L<sup>A</sup>T<sub>E</sub>X family name is automatically generated by fontspec and it's easier to keep it that way.

Please use `\fontspec_set_family:Nnn` instead of `\@@_select_font_family:nn`, which may change in the future.

```

886 \cs_new:Nn \fontspec_set_family:Nnn
887 {
888   \tl_set:Nn \l_@@_family_label_tl { #1 }
889   \@@_select_font_family:nn {#2}{#3}
890   \tl_set_eq:NN #1 \l_fontspec_family_tl
891 }
892 \cs_generate_variant:Nn \fontspec_set_family:Nnn {c}

```

`\fontspec_set_fontface:NNnn`

```

893 \cs_new:Nn \fontspec_set_fontface:NNnn
894 {
895   \tl_set:Nn \l_@@_family_label_tl { #1 }
896   \@@_select_font_family:nn {#3}{#4}
897   \tl_set_eq:NN #1 \l_fontspec_font
898   \tl_set_eq:NN #2 \l_fontspec_family_tl
899 }

```

`\fontspec_font_if_exist:n`

```

900 \prg_new_conditional:Nnn \fontspec_font_if_exist:n {TF,T,F}
901 {
902   \group_begin:
903   \@@_init:
904   \@@_if_detect_external:nT {#1} { \@@_font_is_file: }
905   \@@_primitive_font_if_exist:nTF { \@@_construct_font_call:nn {#1} {} }
906   { \group_end: \prg_return_true: }

```

```

907         { \group_end: \prg_return_false: }
908     }
909 \cs_set_eq:NN \IfFontExistsTF \fontspec_font_if_exist:nTF
\fontspec_if_current_feature:nTF Test whether the currently loaded font is using the specified raw OpenType feature tag
#1.
910 \prg_new_conditional:Nnn \fontspec_if_current_feature:n {TF,T,F}
911 {
912     \exp_args:Nxx \tl_if_in:nnTF
913     { \fontname\font } { \tl_to_str:n {#1} }
914     { \prg_return_true: } { \prg_return_false: }
915 }
\fontspec_if_small_caps:TF
916 \prg_new_conditional:Nnn \fontspec_if_small_caps: {TF,T,F}
917 {
918     \@@_if_merge_shape:nTF {sc}
919     {
920         \tl_set_eq:Nc \l_@@_smcp_shape_tl { \@@_shape_merge:nn {\f@shape} {sc} }
921     }
922     {
923         \tl_set:Nn \l_@@_smcp_shape_tl {sc}
924     }
925 }
926 \cs_if_exist:cTF { \f@encoding/\f@family/\f@series/\l_@@_smcp_shape_tl }
927 {
928     \tl_if_eq:ccTF
929     { \f@encoding/\f@family/\f@series/\l_@@_smcp_shape_tl }
930     { \f@encoding/\f@family/\f@series/\updefault }
931     { \prg_return_false: }
932     { \prg_return_true: }
933 }
934 { \prg_return_false: }
935 }

```

## 35 Internals

### 35.1 The main function for setting fonts

`\@@_select_font_family:nn` This is the command that defines font families for use, the underlying procedure of all `\fontspec`-like commands. Given a list of font features (`#1`) for a requested font (`#2`), it will define an NFSS family for that font and put the family name (globally) into `\l_fontspec_family_tl`. The TeX `\font` command is (globally) stored in `\l_fontspec_font`.

This macro does its processing inside a group to attempt to restrict the scope of its internal processing. This works to some degree to insulate the internal commands from having to be manually cleared.

Some often-used variables to know about:

- `\l_fontspec_fontname_tl` is used as the generic name of the font being defined.

- `\l_@@_fontid_tl` is the unique identifier of the font with all its features.
- `\l_@@_fontname_up_tl` is the font specifically to be used as the upright font.
- `\l_@@_basename_tl` is the (immutable) original argument used for \*-replacing.
- `\l_fontspec_font` is the plain T<sub>E</sub>X font of the upright font requested.

```

936 \cs_new_protected:Nn \@@_select_font_family:nn
937 {
938 <debug>\typeout{^^J^^J::::::::::::::::::::::::::::::::^^J:: fontspec_select:nn~ {#1}~ {#2} }
939 \group_begin:
940 \@@_font_suppress_not_found_error:
941 \@@_init:
942
943 \@@_sanitise_fontname:Nn \l_fontspec_fontname_tl {#2}
944 \@@_sanitise_fontname:Nn \l_@@_fontname_up_tl {#2}
945 \@@_sanitise_fontname:Nn \l_@@_basename_tl {#2}
946
947 \@@_if_detect_external:nT {#2}
948 { \keys_set:nn {fontspec-preparse-external} {Path} }
949
950 \@@_init_ttc:n {#2}
951 \@@_load_external_fontoptions:Nn \l_fontspec_fontname_tl {#2}
952
953 \@@_extract_all_features:n {#1}
954 \tl_set:Nx \l_@@_fontid_tl { \tl_to_str:N \l_fontspec_fontname_tl-:-\tl_to_str:N \l_@@_all_f
955
956 <debug>\typeout{fontid: \l_@@_fontid_tl}
957
958 \@@_preparse_features:
959 \@@_load_font:
960 \@@_set_scriptlang:
961 \@@_get_features:Nn \l_@@_rawfeatures_sclist {}
962 \bool_set_false:N \l_@@_firsttime_bool
963
964 \@@_save_family_needed:nTF {#2}
965 {
966 \@@_save_family:nn {#1} {#2}
967 <debug> \@@_warning:nxx {defining-font} {#1} {#2}
968 }
969 {
970 <debug> \typeout{Font~ family~ already~ defined.}
971 }
972 \group_end:
973 }

```

`\fontspec_select:nn` This old name has been used by 3rd party packages so for compatibility:

```

974 \cs_set_eq:NN \fontspec_select:nn \@@_select_font_family:nn

```

`\@@_sanitise_fontname:Nn` Assigns font name #2 to token list variable #1 and strips extension(s) from it in the case of an external font. We strip spaces for luatex for consistency with luaotfload, although I'm not sure this is necessary any more. At one stage this also lowercased

the name, but this step has been removed unless someone can remind me why it was necessary.

```

975 \cs_new:Nn \@@_sanitise_fontname:Nn
976 {
977   \tl_set:Nx #1 {#2}
978 \luatex \tl_remove_all:Nn #1 {~}
979   \clist_map_inline:Nn \l_@@_extensions_clist
980   {
981     \tl_if_in:NnT #1 {##1}
982     {
983       \tl_remove_once:Nn #1 {##1}
984       \tl_set:Nn \l_@@_extension_tl {##1}
985       \clist_map_break:
986     }
987   }
988 }

```

\@@\_if\_detect\_external:nT Check if either the fontname ends with a known font extension.

```

989 \prg_new_conditional:Nnn \@@_if_detect_external:n {T}
990 {
991 \debug \typeout{:: @@_if_detect_external:n { \exp_not:n {#1} } }
992   \clist_map_inline:Nn \l_@@_extensions_clist
993   {
994     \bool_set_false:N \l_@@_tmpa_bool
995     \exp_args:Nx % <- this should be handled earlier
996     \tl_if_in:nnT {#1} <= end_of_string {##1} <= end_of_string
997     { \bool_set_true:N \l_@@_tmpa_bool \clist_map_break: }
998   }
999   \bool_if:NTF \l_@@_tmpa_bool \prg_return_true: \prg_return_false:
1000 }

```

\@@\_init\_ttc:n For TTC fonts we assume they will be loading the italic/bold fonts from the same file, so prepopulate the fontnames to avoid needing to do it manually.

```

1001 \cs_new:Nn \@@_init_ttc:n
1002 {
1003   \str_if_eq:x:nnT { \str_lower_case:f { \l_@@_extension_tl } } {.ttc}
1004   {
1005     \@@_sanitise_fontname:Nn \l_@@_fontname_it_tl {#1}
1006     \@@_sanitise_fontname:Nn \l_@@_fontname_bf_tl {#1}
1007     \@@_sanitise_fontname:Nn \l_@@_fontname_bfit_tl {#1}
1008   }
1009 }

```

\_load\_external\_fontoptions:Nn Load a possible .fontspec font configuration file. This file could set font-specific options for the font about to be loaded.

```

1010 \cs_new:Nn \@@_load_external_fontoptions:Nn
1011 {
1012 \debug \typeout{:: @@_load_external_fontoptions:Nn \exp_not:N #1 {#2} }
1013   \@@_sanitise_fontname:Nn #1 {#2}
1014   \tl_set:Nx \l_@@_ext_filename_tl {#1.fontspec}
1015   \tl_remove_all:Nn \l_@@_ext_filename_tl {~}

```



```

1016 \prop_if_in:NVF \g_@@_fontopts_prop #1
1017 {
1018   \exp_args:No \file_if_exist:nT { \l_@@_ext_filename_tl }
1019   { \file_input:n { \l_@@_ext_filename_tl } }
1020 }
1021 }

```

\@@\_extract\_all\_features:

```

1022 \cs_new:Nn \@@_extract_all_features:n
1023 {
1024   <debug> \typeout{:: @@_extract_all_features:n { \unexpanded {#1} } }
1025   \bool_if:NTF \l_@@_disable_defaults_bool
1026   {
1027     \clist_set:Nx \l_@@_all_features_clist {#1}
1028   }
1029   {
1030     \prop_get:NVNF \g_@@_fontopts_prop \l_fontspec_fontname_tl \l_@@_fontopts_clist
1031     { \clist_clear:N \l_@@_fontopts_clist }
1032   }
1033   \prop_get:NVNF \g_@@_fontopts_prop \l_@@_family_label_tl \l_@@_family_fontopts_clist
1034   { \clist_clear:N \l_@@_family_fontopts_clist }
1035   \tl_clear:N \l_@@_family_label_tl
1036 }
1037 \clist_set:Nx \l_@@_all_features_clist
1038 {
1039   \g_@@_default_fontopts_clist,
1040   \l_@@_family_fontopts_clist,
1041   \l_@@_fontopts_clist,
1042   #1
1043 }
1044 }
1045 }

```

\@@\_preparse\_features: #1 : feature options

#2 : font name

Perform the (multi-step) feature parsing process.

Convert the requested features to font definition strings. First the features are parsed for information about font loading (whether it's a named font or external font, etc.), and then information is extracted for the names of the other shape fonts.

```

1046 \cs_new:Nn \@@_preparse_features:
1047 {
1048   <debug> \typeout{:: @@_preparse_features:}

```

Detect if external fonts are to be used, possibly automatically, and parse fontspec features for bold/italic fonts and their features.

```

1049
1050 \@@_keys_set_known:nxN {fontspec-preparse-external}
1051 { \l_@@_all_features_clist }
1052 \l_@@_keys_leftover_clist
1053

```

When `\l_fontspec_fontname_tl` is augmented with a prefix or whatever to create the name of the upright font (`\l_@@_fontname_up_tl`), this latter is the new ‘general font name’ to use.

```

1054 \tl_set_eq:NN \l_fontspec_fontname_tl \l_@@_fontname_up_tl
1055 \@@_keys_set_known:nxN {fontspec-renderer} {\l_@@_keys_leftover_clist}
1056 \l_@@_keys_leftover_clist
1057 \@@_keys_set_known:nxN {fontspec-prepare} {\l_@@_keys_leftover_clist}
1058 \l_@@_fontfeat_clist
1059 }

```

`\@@_load_font:`

```

1060 \cs_new:Nn \@@_load_font:
1061 {
1062   <debug>\typeout{: @@_load_font}
1063   <debug>\typeout{Set~ base~ font~ for~ preliminary~ analysis: \@@_construct_font_call:nn { \l_@
1064     \@@_primitive_font_set:Nnn \l_fontspec_font
1065     { \@@_construct_font_call:nn { \l_@@_fontname_up_tl } {} } {\f@size pt}
1066     \@@_primitive_font_if_null:NT \l_fontspec_font { \@@_error:nx {font-not-
1067       found} {\l_@@_fontname_up_tl} } }
1067   \@@_set_font_type:
1068   <debug>\typeout{Set~ base~ font~ properly: \@@_construct_font_call:nn { \l_@@_fontname_up_tl } }
1069   \@@_primitive_font_gset:Nnn \l_fontspec_font
1070   { \@@_construct_font_call:nn { \l_@@_fontname_up_tl } {} } {\f@size pt}
1071   \l_fontspec_font % this is necessary for LuaLaTeX to check the scripts prop-
1072     erly
1072 }

```

`\@@_construct_font_call:nn` Constructs the complete font invocation. #1 : Base name

#2 : Extension  
 #3 : TTC Index  
 #4 : Renderer  
 #5 : Optical size  
 #6 : Font features

We check if *<Font features>* are empty and if so don’t add in the separator colon.

```

1073 \cs_set:Nn \@@_construct_font_call:nnnnnn
1074 {
1075   " \@@_fontname_wrap:n { #1 #2 #3 } #4 #5
1076   \str_if_eq_x:nnF {#6}{ } {:#6} "
1077 }

```

In practice, we don’t use the six-argument version, since most arguments are constructed on-the-fly:

```

1078 \cs_set:Nn \@@_construct_font_call:nn
1079 {
1080   \@@_construct_font_call:nnnnnn
1081   {#1}
1082   \l_@@_extension_tl
1083   \l_@@_ttc_index_tl
1084   \l_fontspec_renderer_tl
1085   \l_@@_optical_size_tl
1086   {#2}

```

```
1087 }
```

nt\_is\_file:, \@@\_font\_is\_name: The \@@\_fontname\_wrap:n command takes the font name and either passes it through unchanged or wraps it in the syntax for loading a font 'by filename'. X<sub>Y</sub>TEX's syntax is followed since luaotfload provides compatibility.

```
1088 \cs_new:Nn \@@_font_is_name:
```

```
1089 {
```

```
1090     \cs_set_eq:NN \@@_fontname_wrap:n \use:n
```

```
1091 }
```

```
1092 \cs_new:Nn \@@_font_is_file:
```

```
1093 {
```

```
1094 \xetex \cs_set:Npn \@@_fontname_wrap:n ##1 { [ \l_@@_font_path_tl ##1 ] }
```

```
1095 \luatex \cs_set:Npn \@@_fontname_wrap:n ##1 { file:\l_@@_font_path_tl ##1 }
```

```
1096 }
```

\@@\_set\_scriptlang: Only necessary for OpenType fonts. First check if the font supports scripts, then apply defaults if none are explicitly requested. Similarly with the language settings.

```
1097 \cs_new:Nn \@@_set_scriptlang:
```

```
1098 {
```

```
1099     \bool_if:NT \l_@@_firsttime_bool
```

```
1100     {
```

```
1101         \tl_if_empty:NTF \l_@@_script_name_tl
```

```
1102         {
```

```
1103             \@@_check_script:nTF {latn}
```

```
1104             {
```

```
1105                 \tl_set:Nn \l_@@_script_name_tl {Latin}
```

```
1106                 \tl_if_empty:NNT \l_@@_lang_name_tl
```

```
1107                 {
```

```
1108                     \tl_set:Nn \l_@@_lang_name_tl {Default}
```

```
1109                 }
```

```
1110                 \keys_set:nx {fontspec-opentype} {Script=\l_@@_script_name_tl}
```

```
1111                 \keys_set:nx {fontspec-opentype} {Language=\l_@@_lang_name_tl}
```

```
1112             }
```

```
1113         }
```

```
1114         \@@_info:n {no-scripts}
```

```
1115     }
```

```
1116 }
```

```
1117 {
```

```
1118     \tl_if_empty:NNT \l_@@_lang_name_tl
```

```
1119     {
```

```
1120         \tl_set:Nn \l_@@_lang_name_tl {Default}
```

```
1121     }
```

```
1122     \keys_set:nx {fontspec-opentype} {Script=\l_@@_script_name_tl}
```

```
1123     \keys_set:nx {fontspec-opentype} {Language=\l_@@_lang_name_tl}
```

```
1124 }
```

```
1125 }
```

```
1126 }
```

\@@\_get\_features:Nn This macro is a wrapper for \keys\_set:nn which expands and adds a default specification to the original passed options. It begins by initialising the commands used to hold font-feature specific strings. Its argument is any additional features to prepend to the default.

Do not set the colour if not explicitly spec'd else \color (using specials) will not work.

```

1127 \cs_set:Nn \@@_get_features:Nn
1128 {
1129 <debug> \typeout{:: @@_get_features:Nn \exp_not:N #1 { \exp_not:n {#2} } }
1130 \@@_init_fontface:
1131 \@@_keys_set_known:nxN {fontspec-renderer} {\l_@@_fontfeat_clist,#2}
1132 \l_@@_keys_leftover_clist
1133 \@@_keys_set_known:nxN {fontspec} {\l_@@_keys_leftover_clist} \l_@@_keys_leftover_clist
1134 <*xetex>
1135 \bool_if:NTF \l_@@_ot_bool
1136 {
1137 <debug> \typeout{::: Setting~ keys~ for~ OpenType~ font~ features:~"\l_@@_keys_leftover_clist
1138 \keys_set:nx {fontspec-opentype} {\l_@@_keys_leftover_clist}
1139 }
1140 {
1141 <debug> \typeout{::: Setting~ keys~ for~ AAT~ font~ features:~"\l_@@_keys_leftover_clist"}
1142 \bool_if:NT \l_@@_atsui_bool
1143 { \keys_set:nx {fontspec-aat} {\l_@@_keys_leftover_clist} }
1144 }
1145 </xetex>
1146 <*luatex>
1147 <debug> \typeout{::: Setting~ keys~ for~ OpenType~ font~ features:~"\l_@@_keys_leftover_clist
1148 \keys_set:nx {fontspec-opentype} {\l_@@_keys_leftover_clist}
1149 </luatex>
1150
1151 \str_if_eq:x:nnF { \l_@@_hexcol_tl \l_@@_opacity_tl }
1152 { \g_@@_hexcol_tl \g_@@_opacity_tl }
1153 { \@@_update_featstr:n { color = \l_@@_hexcol_tl\l_@@_opacity_tl } }
1154
1155 \tl_set_eq:NN #1 \l_@@_rawfeatures_sclist
1156 }

```

\@@\_save\_family\_needed:nTF Check if the family is unique and, if so, save its information. (\addfontfeature and other macros use this data.) Then the font family and its shapes are defined in the NFSS.

Now we have a unique (in fact, too unique!) string that contains the family name and every option in abbreviated form. This is used with a counter to create a simple NFSS family name for the font we're selecting.

```

1157 \prg_new_conditional:Nnn \@@_save_family_needed:n {TF}
1158 {
1159
1160 <debug> \typeout{save~ family:~ #1}
1161 <debug> \typeout{== fontid_tl: "\l_@@_fontid_tl".}
1162
1163 \cs_if_exist:NT \l_@@_nfss_fam_tl
1164 {
1165 \cs_set_eq:cN {g_@@_UID_\l_@@_fontid_tl} \l_@@_nfss_fam_tl
1166 }
1167 \cs_if_exist:cF {g_@@_UID_\l_@@_fontid_tl}
1168 {

```

```

1169 % The font name is fully expanded, in case it's defined in terms of macros, be-
      fore having its spaces zapped:
1170 \tl_set:Nx \l_@@_tmp_tl {#1}
1171 \tl_remove_all:Nn \l_@@_tmp_tl {~}
1172
1173 \cs_if_exist:cTF {g_@@_family_ \l_@@_tmp_tl _int}
1174 { \int_gincr:c {g_@@_family_ \l_@@_tmp_tl _int} }
1175 { \int_new:c {g_@@_family_ \l_@@_tmp_tl _int} }
1176
1177 \tl_gset:cx {g_@@_UID_ \l_@@_fontid_tl}
1178 {
1179   \l_@@_tmp_tl ( \int_use:c {g_@@_family_ \l_@@_tmp_tl _int} )
1180 }
1181 }
1182 \tl_gset:Nv \l_fontspec_family_tl {g_@@_UID_ \l_@@_fontid_tl}
1183 \cs_if_exist:cTF {g_@@_ \l_fontspec_family_tl _prop}
1184 \prg_return_false: \prg_return_true:
1185 }

```

`\@@_save_family:nn` Saves the relevant font information for future processing.

```

1186 \cs_new:Nn \@@_save_family:nn
1187 {
1188   \@@_save_fontinfo:n {#2}
1189   \@@_find_autofonts:
1190   \DeclareFontFamily{\l_@@_nfss_enc_tl}{\l_fontspec_family_tl}{ }
1191   \@@_set_faces:
1192   \@@_info:nxx {defining-font} {#1} {#2}
1193 }

```

`\@@_save_fontinfo:n` Saves the relevant font information for future processing.

```

1194 \cs_new:Nn \@@_save_fontinfo:n
1195 {
1196   \prop_new:c {g_@@_ \l_fontspec_family_tl _prop}
1197   \prop_gput:cnx {g_@@_ \l_fontspec_family_tl _prop} {fontname} { #1 }
1198   \prop_gput:cnx {g_@@_ \l_fontspec_family_tl _prop} {options} { \l_@@_all_features_clist }
1199   \prop_gput:cnx {g_@@_ \l_fontspec_family_tl _prop} {fontdef}
1200   {
1201     \@@_construct_font_call:nn {\l_fontspec_fontname_tl}
1202     { \l_@@_pre_feat_sclist \l_@@_rawfeatures_sclist }
1203   }
1204   \prop_gput:cnV {g_@@_ \l_fontspec_family_tl _prop} {script-num} \l_@@_script_int
1205   \prop_gput:cnV {g_@@_ \l_fontspec_family_tl _prop} {lang-num} \l_@@_language_int
1206   \prop_gput:cnV {g_@@_ \l_fontspec_family_tl _prop} {script-tag} \l_fontspec_script_tl
1207   \prop_gput:cnV {g_@@_ \l_fontspec_family_tl _prop} {lang-tag} \l_fontspec_lang_tl
1208 }

```

## 35.2 Setting font shapes in a family

All NFSS specifications take their default values, so if any of them are redefined, the shapes will be selected to fit in with the current state. For example, if `\bfdefault` is redefined to `b`, all bold shapes defined by this package will also be assigned to `b`.

The combination shapes are searched first because they use information that may be redefined in the single cases. E.g., if no bold font is specified then `set_autofont` will attempt to set it. This has subtle/small ramifications on the logic of choosing the bold italic font.

`\@@_find_autofonts:`

```

1209 \cs_new:Nn \@@_find_autofonts:
1210 {
1211   \bool_if:nF {\l_@@_noit_bool || \l_@@_nobf_bool}
1212   {
1213     \@@_set_autofont:Nnn \l_@@_fontname_bfit_tl {\l_@@_fontname_it_tl} {/B}
1214     \@@_set_autofont:Nnn \l_@@_fontname_bfit_tl {\l_@@_fontname_bf_tl} {/I}
1215     \@@_set_autofont:Nnn \l_@@_fontname_bfit_tl {\l_fontspeg_fontname_tl} {/BI}
1216   }
1217
1218   \bool_if:NF \l_@@_nobf_bool
1219   {
1220     \@@_set_autofont:Nnn \l_@@_fontname_bf_tl {\l_fontspeg_fontname_tl} {/B}
1221   }
1222
1223   \bool_if:NF \l_@@_noit_bool
1224   {
1225     \@@_set_autofont:Nnn \l_@@_fontname_it_tl {\l_fontspeg_fontname_tl} {/I}
1226   }
1227
1228   \@@_set_autofont:Nnn \l_@@_fontname_bfsl_tl {\l_@@_fontname_sl_tl} {/B}
1229 }

```

`\@@_set_faces:`

```

1230 \cs_new:Nn \@@_set_faces:
1231 {
1232   \@@_add_nfssfont:nnnn \mddefault \updefault \l_fontspeg_fontname_tl \l_@@_fontfeat_up_clist
1233   \@@_add_nfssfont:nnnn \bfdefault \updefault \l_@@_fontname_bf_tl \l_@@_fontfeat_bf_clist
1234   \@@_add_nfssfont:nnnn \mddefault \itdefault \l_@@_fontname_it_tl \l_@@_fontfeat_it_clist
1235   \@@_add_nfssfont:nnnn \mddefault \sldefault \l_@@_fontname_sl_tl \l_@@_fontfeat_sl_clist
1236   \@@_add_nfssfont:nnnn \bfdefault \itdefault \l_@@_fontname_bfit_tl \l_@@_fontfeat_bfit_clist
1237   \@@_add_nfssfont:nnnn \bfdefault \sldefault \l_@@_fontname_bfsl_tl \l_@@_fontfeat_bfsl_clist
1238
1239   \prop_map_inline:Nn \l_@@_nfssfont_prop { \@@_set_faces_aux:nnnnn ##2 }
1240 }
1241 \cs_new:Nn \@@_set_faces_aux:nnnnn
1242 {
1243   \fontspec_complete_fontname:Nn \l_@@_curr_fontname_tl {#3}
1244   \@@_make_font_shapes:Nnnnn \l_@@_curr_fontname_tl {#1} {#2} {#4} {#5}
1245 }

```

`fontspec_complete_fontname:Nn` This macro defines `#1` as the input with any `*` tokens of its input replaced by the font name. This lets us define supplementary fonts in full (“Baskerville Semibold”) or in abbreviation (“\* Semibold”).

```

1246 \cs_set:Nn \fontspec_complete_fontname:Nn
1247 {

```

```

1248 \tl_set:Nx #1 {#2}
1249 \tl_replace_all:Nnx #1 {*} {\l_@@_basename_tl}
1250 \luatex \tl_remove_all:Nn #1 {~}
1251 }

\@@_add_nfssfont:nmmn #1 : series
#2 : shape
#3 : fontname
#4 : fontspec features

1252 \cs_new:Nn \@@_add_nfssfont:nmmn
1253 {
1254 \tl_set:Nx \l_@@_this_font_tl {#3}
1255
1256 \tl_if_empty:xF {#4}
1257 { \clist_set:Nn \l_@@_sizefeat_clist {Size={-}} }
1258 { \@@_keys_set_known:nxN {fontspec-preparse-nested} {#4} \l_@@_tmp_tl }
1259
1260 \tl_if_empty:NF \l_@@_this_font_tl
1261 {
1262 \prop_put:Nxx \l_@@_nfssfont_prop {#1/#2}
1263 { {#1}{#2}{\l_@@_this_font_tl}{#4}{\l_@@_sizefeat_clist} }
1264 }
1265 }

```

### 35.2.1 Fonts

`\@@_set_font_type:` Now check if the font is to be rendered with `ATSUI` or `Harfbuzz`. This will either be automatic (based on the font type), or specified by the user via a font feature.

This macro sets booleans accordingly depending if the font in `\l_fontspec_font` is an AAT font or an OpenType font or a font with feature axes (either AAT or Multiple Master), respectively.

```

1266 \cs_new:Nn \@@_set_font_type:
1267 {
1268 \debug \typeout{:: @@_set_font_type:}
1269 \*xetexx
1270 \bool_set_false:N \l_@@_tfm_bool
1271 \bool_set_false:N \l_@@_atsui_bool
1272 \bool_set_false:N \l_@@_ot_bool
1273 \bool_set_false:N \l_@@_mm_bool
1274 \bool_set_false:N \l_@@_graphite_bool
1275 \ifcase\XeTeXfonttype\l_fontspec_font
1276 \bool_set_true:N \l_@@_tfm_bool
1277 \or
1278 \bool_set_true:N \l_@@_atsui_bool
1279 \ifnum\XeTeXcountvariations\l_fontspec_font > \c_zero
1280 \bool_set_true:N \l_@@_mm_bool
1281 \fi
1282 \or
1283 \bool_set_true:N \l_@@_ot_bool
1284 \fi

```

If automatic, the `\l_fontspec_renderer_tl` token list will still be empty (other suffices that could be added will be later in the feature processing), and if it is indeed still empty, assign it a value so that the other weights of the font are specifically loaded with the same renderer.

```

1285 \tl_if_empty:NT \l_fontspec_renderer_tl
1286 {
1287   \bool_if:NTF \l_@@_atsui_bool
1288   { \tl_set:Nn \l_fontspec_renderer_tl {/AAT} }
1289   {
1290     \bool_if:NT \l_@@_ot_bool
1291     { \tl_set:Nn \l_fontspec_renderer_tl {/OT} }
1292   }
1293 }
1294 </xetex>
1295 <*luatex>
1296 \bool_set_true:N \l_@@_ot_bool
1297 </luatex>
1298 }

```

`\@@_set_autofont:Nnn` #1 : Font name tl  
 #2 : Base font name  
 #3 : Font name modifier

This function looks for font with *<name>* and *<modifier>* #2#3, and if found (i.e., different to font with name #2) stores it in tl #1. A modifier is something like /B to look for a bold font, for example.

We can't match external fonts in this way (in X<sub>Y</sub>TeX anyway; todo: test with Lua-TeX). If *<font name tl>* is not empty, then it's already been specified by the user so abort. If *<Base font name>* is not given, we also abort for obvious reasons.

If *<font name tl>* is empty, then proceed. If not found, *<font name tl>* remains empty. Otherwise, we have a match.

```

1299 \cs_new:Nn \@@_set_autofont:Nnn
1300 {
1301   \bool_if:NF \l_@@_external_bool
1302   {
1303     \tl_if_empty:xF {#2}
1304     {
1305       \tl_if_empty:NT #1
1306       {
1307         \@@_if_autofont:nnTF {#2} {#3}
1308         { \tl_set:Nx #1 {#2#3} }
1309         { \@@_info:nx {no-font-shape} {#2#3} }
1310       }
1311     }
1312   }
1313 }
1314
1315 \prg_new_conditional:Nnn \@@_if_autofont:nn {T,TF}
1316 {
1317   \@@_primitive_font_set:Nnn \l_tmpa_font { \@@_construct_font_call:nn {#1} {} } {\f@size pt}
1318   \@@_primitive_font_set:Nnn \l_tmpb_font { \@@_construct_font_call:nn {#1#2} {} } {\f@size pt}

```



```

1319 \str_if_eq_x:nnTF { \fontname \l_tmpa_font } { \fontname \l_tmpb_font }
1320 { \prg_return_false: }
1321 { \prg_return_true: }
1322 }

```

`\@@_make_font_shapes:Nnnnn` #1 : Font name  
#2 : Font series  
#3 : Font shape  
#4 : Font features  
#5 : Size features

This macro eventually uses `\DeclareFontShape` to define the font shape in question.

```

1323 \cs_new:Nn \@@_make_font_shapes:Nnnnn
1324 {
1325   \group_begin:
1326     \@@_keys_set_known:nxN {fontspec-preparse-external} { #4 } \l_@@_leftover_clist
1327     \@@_load_fontname:n {#1}
1328     \@@_declare_shape:nxxx {#2} {#3} { \l_@@_fontopts_clist, \l_@@_leftover_clist } {#5}
1329   \group_end:
1330 }
1331
1332 \cs_new:Nn \@@_load_fontname:n
1333 {
1334   <debug> \typeout{: @@@_load_fontname:n {#1} }
1335   \@@_load_external_fontoptions:Nn \l_fontspec_fontname_tl {#1}
1336   \prop_get:NVNF \g_@@_fontopts_prop \l_fontspec_fontname_tl \l_@@_fontopts_clist
1337   { \clist_clear:N \l_@@_fontopts_clist }
1338   \@@_primitive_font_set:Nnn \l_fontspec_font { \@@_construct_font_call:nn { \l_fontspec_font
1339     \@@_primitive_font_if_null:NT \l_fontspec_font { \@@_error:nx {font-not-
      found} {#1} }
1340 }

```

`\@@_declare_shape:nnnn` #1 : Font series  
#2 : Font shape  
#3 : Font features  
#4 : Size features

Wrapper for `\DeclareFontShape`. And finally the actual font shape declaration using `\l_@@_nfss_tl` defined above. `\l_@@_postadjust_tl` is defined in various places to deal with things like the hyphenation character and interword spacing.

The main part is to loop through `SizeFeatures` arguments, which are of the form `SizeFeatures={{<one>},{<two>},{<three>}}`.

```

1341 \cs_new:Nn \@@_declare_shape:nnnn
1342 {
1343   <debug> \typeout{=~ declare_shape:~{ \l_fontspec_fontname_tl }~{#1}~{#2}}
1344   \tl_clear:N \l_@@_nfss_tl
1345   \tl_clear:N \l_@@_nfss_sc_tl
1346   \tl_set_eq:NN \l_@@_saved_fontname_tl \l_fontspec_fontname_tl
1347
1348   \exp_args:Nx \clist_map_inline:nn {#4} { \@@_setup_single_size:nn {#3} {##1} }
1349

```

```

1350 \@@_declare_shapes_normal:nn {#1} {#2}
1351 \@@_declare_shapes_smcaps:nn {#1} {#2}
1352 \@@_declare_shape_slanted:nn {#1} {#2}
1353 \@@_declare_shape_loginfo:nn {#1} {#2}
1354 }
1355 \cs_generate_variant:Nn \@@_declare_shape:nnnn {nnxx}

```

\@@\_setup\_single\_size:nn

```

1356 \cs_new:Nn \@@_setup_single_size:nn
1357 {
1358   \tl_clear:N \l_@@_size_tl
1359   \tl_set_eq:NN \l_@@_sizedfont_tl \l_@@_saved_fontname_tl % in case not spec'ed
1360
1361   \keys_set_known:nxN {fontspec-sizing} { \exp_after:wN \use:n #2 }
1362   \l_@@_sizing_leftover_clist
1363   \tl_if_empty:NT \l_@@_size_tl { \@@_error:n {no-size-info} }
1364   (debug)\typeout{==~ size:~\l_@@_size_tl}
1365
1366   % "normal"
1367   \@@_load_fontname:n {\l_@@_sizedfont_tl}
1368   \@@_setup_nfss:Nnnn \l_@@_nfss_tl {#1} {\l_@@_sizing_leftover_clist} {}
1369   (debug)\typeout{===~ sized~ font:~ \l_@@_sizedfont_tl}
1370
1371   % small caps
1372   \clist_set_eq:NN \l_@@_fontfeat_curr_clist \l_@@_fontfeat_sc_clist
1373
1374   \bool_if:NF \l_@@_nosc_bool
1375   {
1376     \tl_if_empty:NTF \l_@@_fontname_sc_tl
1377     {
1378       \@@_make_smallcaps:TF
1379       {
1380         (debug)\typeout{====~Small~ caps~ found.}
1381         \clist_put_left:Nn \l_@@_fontfeat_curr_clist {Letters=SmallCaps}
1382       }
1383       {
1384         (debug)\typeout{====~Small~ caps~ not~ found.}
1385         \bool_set_true:N \l_@@_nosc_bool
1386       }
1387     }
1388     { \@@_load_fontname:n {\l_@@_fontname_sc_tl} }% local for each size
1389   }
1390
1391   \bool_if:NF \l_@@_nosc_bool
1392   {
1393     \@@_setup_nfss:Nnnn \l_@@_nfss_sc_tl
1394     {#1} {\l_@@_sizing_leftover_clist} {\l_@@_fontfeat_curr_clist}
1395   }
1396 }

```

\@@\_setup\_nfss:Nnnn

```

1397 \cs_new:Nn \@@_setup_nfss:Nnnn
1398 {
1399 <debug>\typeout{====~Setup~NFSS~shape:~<\l_@@_size_tl>~\l_fontspec_fontname_tl}
1400
1401 \@@_get_features:Nn \l_@@_rawfeatures_sclist { #2 , #3 , #4 }
1402 <debug>\typeout{====~Gathered~features:~\l_@@_rawfeatures_sclist}
1403
1404 \tl_put_right:Nx #1
1405 {
1406   <\l_@@_size_tl> \l_@@_scale_tl
1407   \@@_construct_font_call:nn { \l_fontspec_fontname_tl }
1408   { \l_@@_pre_feat_sclist \l_@@_rawfeatures_sclist }
1409 }
1410 }

```

\@@\_declare\_shapes\_normal:nn

```

1411 \cs_new:Nn \@@_declare_shapes_normal:nn
1412 {
1413   \@@_DeclareFontShape:xxxxxx {\l_@@_nfss_enc_tl} {\l_fontspec_family_tl}
1414   {#1} {#2} {\l_@@_nfss_tl}{\l_@@_postadjust_tl}
1415 }

```

\@@\_declare\_shapes\_smcaps:nn

```

1416 \cs_new:Nn \@@_declare_shapes_smcaps:nn
1417 {
1418   \tl_if_empty:NF \l_@@_nfss_sc_tl
1419   {
1420     \@@_DeclareFontShape:xxxxxx {\l_@@_nfss_enc_tl} {\l_fontspec_family_tl} {#1}
1421     { \@@_combo_sc_shape:n {#2} } {\l_@@_nfss_sc_tl} {\l_@@_postadjust_tl}
1422   }
1423 }
1424
1425 \cs_new:Nn \@@_combo_sc_shape:n
1426 {
1427   \tl_if_exist:cTF { \@@_shape_merge:nn {#1} {\scdefault} }
1428   { \tl_use:c { \@@_shape_merge:nn {#1} {\scdefault} } }
1429   { \scdefault }
1430 }

```

\@@\_DeclareFontShape:nnnnnn

```

1431 \cs_new:Nn \@@_DeclareFontShape:nnnnnn
1432 {
1433 <debug>\typeout{DeclareFontShape:~{#1}{#2}{#3}{#4}...}
1434 \group_begin:
1435   \normalsize
1436   \cs_undefine:c {#1/#2/#3/#4/\f@size}
1437   \group_end:
1438   \DeclareFontShape{#1}{#2}{#3}{#4}{#5}{#6}
1439 }
1440 \cs_generate_variant:Nn \@@_DeclareFontShape:nnnnnn {xxxxxx}

```

\@@\_declare\_shape\_slanted:nn This extra stuff for the slanted shape substitution is a little bit awkward. We define the slanted shape to be a synonym for it when (a) we're defining an italic font, but also (b) when the default slanted shape isn't 'it'. (Presumably this turned up once in a test and I realised it caused problems. I doubt this would happen much.)

We should test when a slanted font has been specified and not run this code if so, but the \@@\_set\_slanted: code will overwrite this anyway if necessary.

```

1441 \cs_new:Nn \@@_declare_shape_slanted:nn
1442 {
1443   \bool_if:nT
1444   {
1445     \str_if_eq_x_p:nn {#2} {\itdefault} &&
1446     !(\str_if_eq_x_p:nn {\itdefault} {\sldefault})
1447   }
1448   {
1449     \@@_DeclareFontShape:xxxxxx {\l_@@_nfss_enc_tl}{\l_fontspec_family_tl}{#1}{\sldefault}
1450     {<->ssub*\l_fontspec_family_tl/#1/\itdefault}{\l_@@_postadjust_tl}
1451   }
1452 }

```

\@@\_declare\_shape\_loginfo:nn Lastly some informative messaging.

```

1453 \cs_new:Nn \@@_declare_shape_loginfo:nn
1454 {
1455   \tl_gput_right:Nx \l_fontspec_defined_shapes_tl
1456   {
1457     \exp_not:n { \ \ }
1458     -- \exp_not:N \str_case:nn {#1/#2}
1459     {
1460       {\mddefault/\updefault} {'normal'~}
1461       {\bfdefault/\updefault} {'bold'~}
1462       {\mddefault/\itdefault} {'italic'~}
1463       {\mddefault/\sldefault} {'slanted'~}
1464       {\bfdefault/\itdefault} {'bold~ italic'~}
1465       {\bfdefault/\sldefault} {'bold~ slanted'~}
1466     } (#1/#2)~
1467     with~ NFSS~ spec.:~
1468     \l_@@_nfss_tl
1469     \exp_not:n { \ \ }
1470     -- \exp_not:N \str_case:nn { #1 / \@@_combo_sc_shape:n {#2} }
1471     {
1472       {\mddefault/\scdefault} {'small~ caps'~}
1473       {\bfdefault/\scdefault} {'bold~ small~ caps'~}
1474       {\mddefault/\itscdefault} {'italic~ small~ caps'~}
1475       {\bfdefault/\itscdefault} {'bold~ italic~ small~ caps'~}
1476       {\mddefault/\slscdefault} {'slanted~ small~ caps'~}
1477       {\bfdefault/\slscdefault} {'bold~ slanted~ small~ caps'~}
1478     }~( #1 / \@@_combo_sc_shape:n {#2} )~
1479     with~ NFSS~ spec.:~
1480     \l_@@_nfss_sc_tl
1481     \tl_if_empty:fF {\l_@@_postadjust_tl}
1482     {
1483       \exp_not:N \ \ and~ font~ adjustment~ code: \exp_not:N \ \ \l_@@_postadjust_tl

```

```

1484     }
1485   }
1486 }

```

Maybe `\str_if_eq_x:nnF` would be better?

### 35.2.2 Features

`\l_@@_pre_feat_sclist` These are the features always applied to a font selection before other features.

```

1487 \tl_set:Nn \l_@@_pre_feat_sclist
1488 <*xetex>
1489 {
1490   \bool_if:NT \l_@@_ot_bool
1491   {
1492     \tl_if_empty:NF \l_fontspec_script_tl
1493     {
1494       script = \l_fontspec_script_tl ;
1495       language = \l_fontspec_lang_tl ;
1496     }
1497   }
1498 }
1499 </xetex>
1500 <*luatex>
1501 {
1502   mode = \l_fontspec_mode_tl ;
1503   \tl_if_empty:NF \l_fontspec_script_tl
1504   {
1505     script = \l_fontspec_script_tl ;
1506     language = \l_fontspec_lang_tl ;
1507   }
1508 }
1509 </luatex>

```

`\@@_make_ot_smallcaps:TF` This macro checks if the font contains small caps.

```

1510 <luatex>\cs_set:Nn \@@_make_smallcaps:TF
1511 <xetex>\cs_set:Nn \@@_make_ot_smallcaps:TF
1512 {
1513   \@@_check_ot_feat:nTF {smcp} {#1} {#2}
1514 }
1515 <*xetex>
1516 \cs_set:Nn \@@_make_smallcaps:TF
1517 {
1518   \bool_if:NTF \l_@@_ot_bool
1519   { \@@_make_ot_smallcaps:TF {#1} {#2} }
1520   {
1521     \bool_if:NT \l_@@_atsui_bool
1522     { \@@_make_AAT_feature_string:nnTF {3}{3} {#1} {#2} }
1523   }
1524 }
1525 </xetex>

```

`\@@_update_featstr:n` `\l_@@_rawfeatures_sclist` is the string used to define the list of specific font features. Each time another font feature is requested, this macro is used to add that feature to the list. Font features are separated by semicolons.

```

1526 \cs_new:Nn \@@_update_featstr:n
1527 {
1528   <debug> \typeout{::: @@_update_featstr:n {#1}}
1529   \bool_if:NF \l_@@_firsttime_bool
1530   {
1531     \tl_gset:Nx \g_@@_single_feat_tl { #1 }
1532     <debug> \typeout{:::~ Adding~ feature.}
1533     \tl_gput_right:Nx \l_@@_rawfeatures_sclist {#1;}
1534   }
1535 }

```

`\@@_remove_clashing_featstr:n`

```

1536 \cs_new:Nn \@@_remove_clashing_featstr:n
1537 {
1538   <debug> \typeout{::: @@_remove_clashing_featstr:n {#1}}
1539   \clist_map_inline:nn {#1}
1540   {
1541     <debug> \typeout{:::~ Removing~ feature~ "##1;"}
1542     \tl_gremove_all:Nn \l_@@_rawfeatures_sclist {##1;}
1543   }
1544 }

```

### 35.3 Initialisation

`\@@_init:` Initialisations that need to occur once per fontspec font invocation. (Some of these may be redundant. Check whether they're assigned to globally or not.)

```

1545 \cs_set:Npn \@@_init:
1546 {
1547   <debug> \typeout{:: @@_init:}
1548   \bool_set_false:N \l_@@_ot_bool
1549   \bool_set_true:N \l_@@_firsttime_bool
1550   \@@_font_is_name:
1551   \tl_clear:N \l_@@_font_path_tl
1552   \tl_clear:N \l_@@_optical_size_tl
1553   \tl_clear:N \l_@@_ttc_index_tl
1554   \tl_clear:N \l_fontspeg_renderer_tl
1555   \tl_clear:N \l_fontspeg_defined_shapes_tl
1556   \tl_clear:N \g_@@_curr_series_tl
1557   \tl_gset_eq:NN \l_@@_nfss_enc_tl \g_fontspeg_encoding_tl
1558
1559   <*luatex>
1560   \tl_set:Nn \l_fontspeg_mode_tl {node}
1561   \int_set:Nn \luatex_prehyphenchar:D { `\- } % fixme
1562   \int_zero:N \luatex_posthyphenchar:D % fixme
1563   \int_zero:N \luatex_preexhyphenchar:D % fixme
1564   \int_zero:N \luatex_postexhyphenchar:D % fixme
1565   </luatex>
1566 }

```

```

\@@_init_fontface: Executed in \@@_get_features:Nn.
1567 \cs_new:Nn \@@_init_fontface:
1568 {
1569   \tl_clear:N \l_@@_rawfeatures_sclist
1570   \tl_clear:N \l_@@_scale_tl
1571   \tl_set_eq:NN \l_@@_opacity_tl \g_@@_opacity_tl
1572   \tl_set_eq:NN \l_@@_hexcol_tl \g_@@_hexcol_tl
1573   \tl_set_eq:NN \l_@@_postadjust_tl \g_@@_postadjust_tl
1574   \tl_clear:N \l_@@_wordspace_adjust_tl
1575   \tl_clear:N \l_@@_punctspace_adjust_tl
1576 }

```

## 35.4 Miscellaneous

`\@@_iv_str_to_num:Nn` This macro takes a four character string and converts it to the numerical representation required for X<sub>3</sub>TeX OpenType script/language/feature purposes. The output is stored in #1.

The reason it's ugly is because the input can be of the form of any of these: 'abcd', 'abc', 'abc ', 'ab', 'ab ', etc. (It is assumed the first two chars are *always* not spaces.) So this macro reads in the string, delimited by a space; this input is padded with `\@empty`s and anything beyond four chars is snipped. The `\@empty`s then are used to reconstruct the spaces in the string to number calculation.

```

1577 \cs_set:Nn \@@_iv_str_to_num:Nn
1578 {
1579   \@@_iv_str_to_num:w #1 \q_nil #2 \c_empty_tl \c_empty_tl \q_nil
1580 }
1581 \cs_set:Npn \@@_iv_str_to_num:w #1 \q_nil #2#3#4#5#6 \q_nil
1582 {
1583   \int_set:Nn #1
1584   {
1585     `#2 * "1000000
1586     + `#3 * "10000
1587     + \ifx \c_empty_tl #4 32 \else `#4 \fi * "100
1588     + \ifx \c_empty_tl #5 32 \else `#5 \fi
1589   }
1590 }
1591 \cs_generate_variant:Nn \@@_iv_str_to_num:Nn {No}

```

## 36 OpenType definitions code

`fine_opentype_feature_group:n`

```

1592 \cs_new:Nn \@@_define_opentype_feature_group:n
1593 {
1594   \keys_define:nn {fontspec-opentype} { #1 .multichoice: }
1595 }

```

`define_opentype_feature:nnnnn` #1 : Feature key  
 #2 : Feature option val  
 #3 : Check feature — leave empty for no check

#4 : Exact tag string to activate — leave empty for disable only  
 #5 : Tags to remove (clist)

```

1596 \cs_new:Nn \@@_feat_prop_add:nn
1597 {
1598   \tl_if_empty:nF {#1}
1599   {
1600     \prop_if_in:NnF \g_@@_OT_features_prop {#1}
1601     {
1602       \prop_gput:Nnn \g_@@_OT_features_prop {#1} {#2}
1603     }
1604   }
1605 }
1606 \cs_new:Nn \@@_define_opentype_feature:nnnnn
1607 {
1608   \@@_feat_prop_add:nn {#3} {#1\,=#, #2}
1609   \keys_define:nn {fontspec-opentype}
1610   {
1611     #1/#2 .code:n = { \@@_make_OT_feature:nnn {#3} {#4} {#5} }
1612   }
1613 }

```

ine\_opentype\_onoffreset:nnnnn #1 : Feature key  
 #2 : Feature option val  
 #3 : Check feature  
 #4 : Tag prefix to activate: +#4 = on, -#4 = off.  
 #5 : Tags to remove in the on case (clist)

```

1614 \cs_new:Nn \@@_feat_off:n {#1Off}
1615 \cs_new:Nn \@@_feat_reset:n {#1Reset}
1616 \cs_new:Nn \@@_define_opentype_onoffreset:nnnnn
1617 {
1618   \exp_args:Nnx \@@_define_opentype_feature:nnnnn {#1} {#2} {#3} {+#4} {#5}
1619   \exp_args:Nnx \@@_define_opentype_feature:nnnnn {#1} { \@@_feat_off:n {#2} } {#3} {-
1620     #4} {}
1620   \exp_args:Nnx \@@_define_opentype_feature:nnnnn {#1} { \@@_feat_reset:n {#2} } {} {} {+#4,-
1621     #4}
1621 }

```

define\_opentype\_onreset:nnnnn #1 : Feature key  
 #2 : Feature option val  
 #3 : Check feature  
 #4 : Exact tag string to activate  
 #5 : Tags to remove (clist)

```

1622 \cs_new:Nn \@@_define_opentype_onreset:nnnnn
1623 {
1624   \exp_args:Nnx \@@_define_opentype_feature:nnnnn {#1} {#2} {#3} {#4} {#5}
1625   \exp_args:Nnx \@@_define_opentype_feature:nnnnn {#1} { \@@_feat_reset:n {#2} } {} {} {#4}
1626 }

```



## 36.1 Adding features when loading fonts

When remove clashing features,

1. remove the feature being added (to avoid duplicates);
2. remove the inverse of the feature (to avoid cancellation);
3. finally remove all clashing features.

```

r627 \cs_new:Nn \@@_make_OT_feature:nnn
r628 {
r629 <debug> \typeout{:: \@@_make_OT_feature:nnn \exp_not:n { {#1}{#2}{#3} } }
r630
r631 \bool_set_true:N \l_@@_proceed_bool
r632 \bool_set_true:N \l_@@_check_feat_bool
r633
r634 \tl_if_empty:nT {#1} { \bool_set_false:N \l_@@_check_feat_bool }
r635 \bool_if:NT \l_@@_check_feat_bool
r636 {
r637 \@@_check_ot_feat:nF {#1}
r638 {
r639 \@@_warning:nx {icu-feature-not-exist-in-font} {#1}
r640 \bool_set_false:N \l_@@_proceed_bool
r641 }
r642 }
r643
r644 \bool_if:NT \l_@@_proceed_bool
r645 {
r646 \exp_args:Nx \@@_remove_clashing_featstr:n
r647 { #2 , \@@_swap_plus_minus:n {#2} , #3 }
r648
r649 \@@_update_featstr:n {#2}
r650 }
r651 }
r652 \cs_generate_variant:Nn \@@_make_OT_feature:nnn {xxx}

r653 \cs_new:Nn \@@_swap_plus_minus:n { \@@_swap_plus_minus_aux:NNNNN #1 }
r654 \cs_new:Nn \@@_swap_plus_minus_aux:NNNNN
r655 { \str_case:nn {#1} { {+} {-#2#3#4#5} {-} {+#2#3#4#5} } }

```

`\@@_check_script:nTF` This macro takes an OpenType script tag and checks if it exists in the current font. The output boolean is `\@tempswattrue`. `\l_@@_script_int` is used to store the number corresponding to the script tag string.

```

r656 \prg_new_conditional:Nnn \@@_check_script:n {TF}
r657 {
r658 \bool_if:NTF \l_@@_never_check_bool
r659 { \prg_return_true: }
r660 <*xetex>
r661 {
r662 \@@_iv_str_to_num:Nn \l_@@_strnum_int {#1}
r663 \int_set:Nn \l_tmpb_int { \XeTeXOTcountscript \l_fontspeg_font }
r664 \int_zero:N \l_tmpa_int

```

```

1665 \bool_set_false:N \l__fontspec_check_bool
1666 \bool_until_do:nn { \int_compare_p:nNn \l_tmpa_int = \l_tmpb_int }
1667 {
1668   \ifnum \XeTeXOTscripttag\l_fontspec_font \l_tmpa_int = \l_@@_strnum_int
1669     \bool_set_true:N \l__fontspec_check_bool
1670     \int_set:Nn \l_tmpa_int {\l_tmpb_int}
1671   \else
1672     \int_incr:N \l_tmpa_int
1673   \fi
1674 }
1675 \bool_if:NTF \l__fontspec_check_bool \prg_return_true: \prg_return_false:
1676 }
1677 </xetex>
1678 <*luatex>
1679 {
1680   \directlua{fontspec.check_ot_script("l_fontspec_font", "#1")}
1681   \bool_if:NTF \l__fontspec_check_bool \prg_return_true: \prg_return_false:
1682 }
1683 </luatex>
1684 }

```

`\@@_check_lang:nTF` This macro takes an OpenType language tag and checks if it exists in the current font/script. The output boolean is `\@tempswatrue`. `\l_@@_language_int` is used to store the number corresponding to the language tag string. The script used is whatever's held in `\l_@@_script_int`. By default, that's the number corresponding to 'latn'.

```

1685 \prg_new_conditional:Nnn \@@_check_lang:n {TF}
1686 {
1687   \bool_if:NTF \l_@@_never_check_bool
1688     { \prg_return_true: }
1689 <*xetex>
1690 {
1691   \@@_iv_str_to_num:Nn \l_@@_strnum_int {#1}
1692   \int_set:Nn \l_tmpb_int
1693   { \XeTeXOTcountlanguages \l_fontspec_font \l_@@_script_int }
1694   \int_zero:N \l_tmpa_int
1695   \bool_set_false:N \l__fontspec_check_bool
1696   \bool_until_do:nn { \int_compare_p:nNn \l_tmpa_int = \l_tmpb_int }
1697   {
1698     \ifnum \XeTeXOTlanguagetag\l_fontspec_font\l_@@_script_int \l_tmpa_int = \l_@@_strnum_int
1699       \bool_set_true:N \l__fontspec_check_bool
1700       \int_set:Nn \l_tmpa_int {\l_tmpb_int}
1701     \else
1702       \int_incr:N \l_tmpa_int
1703     \fi
1704   }
1705   \bool_if:NTF \l__fontspec_check_bool \prg_return_true: \prg_return_false:
1706 }
1707 </xetex>
1708 <*luatex>
1709 {

```

```

1710 \directlua
1711 {
1712   fontspec.check_ot_lang( "l_fontspec_font", "#1", "\l_fontspec_script_tl" )
1713 }
1714 \bool_if:NTF \l__fontspec_check_bool \prg_return_true: \prg_return_false:
1715 }
1716 \</luatex>
1717 }

```

`\@@_check_ot_feat:nTF` This macro takes an OpenType feature tag and checks if it exists in the current font/script/language. `\l_@@_strnum_int` is used to store the number corresponding to the feature tag string. The script used is whatever's held in `\l_@@_script_int`. By default, that's the number corresponding to 'latn'. The language used is `\l_@@_language_int`, by default 0, the 'default language'.

```

1718 \prg_new_conditional:Nnn \@@_check_ot_feat:n {TF,F}
1719 {
1720   \bool_if:NTF \l_@@_never_check_bool
1721     { \prg_return_true: }
1722 \*xetexx)
1723 {
1724 \<debug>\typeout{::~ fontspec_check_ot_feat:n~ {#1}}
1725   \int_set:Nn \l_tmpb_int
1726     {
1727       \XeTeXOTcountfeatures \l_fontspec_font
1728                             \l_@@_script_int
1729                             \l_@@_language_int
1730     }
1731   \@@_iv_str_to_num:Nn \l_@@_strnum_int {#1}
1732   \int_zero:N \l_tmpa_int
1733   \bool_set_false:N \l_@@_check_bool
1734   \bool_until_do:nn { \int_compare_p:nNn \l_tmpa_int = \l_tmpb_int }
1735   {
1736     \ifnum\XeTeXOTfeaturetag\l_fontspec_font\l_@@_script_int\l_@@_language_int
1737       \l_tmpa_int = \l_@@_strnum_int
1738       \bool_set_true:N \l_@@_check_bool
1739       \int_set:Nn \l_tmpa_int { \l_tmpb_int }
1740     \else
1741       \int_incr:N \l_tmpa_int
1742     \fi
1743   }
1744   \bool_if:NTF \l_@@_check_bool \prg_return_true: \prg_return_false:
1745 }
1746 \</xetexx>
1747 \*luatex)
1748 {
1749 \<debug>\typeout{::~ fontspec_check_ot_feat:n~ {#1}}
1750   \directlua
1751   {
1752     fontspec.check_ot_feat(
1753       "l_fontspec_font", "#1",
1754       "\l_fontspec_lang_tl", "\l_fontspec_script_tl"

```

```

1755         )
1756     }
1757     \bool_if:NTF \l_@@_check_bool \prg_return_true: \prg_return_false:
1758 }
1759 \</luatex>
1760 }

```

## 36.2 OpenType feature information

```

1761 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {aalt}{Access-All-Alternates}
1762 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {abvf}{Above-base-Forms}
1763 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {abvm}{Above-base-Mark-Positioning}
1764 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {abvs}{Above-base-Substitutions}
1765 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {afrc}{Alternative-Fractions}
1766 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {akhn}{Akhands}
1767 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {blwf}{Below-base-Forms}
1768 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {blwm}{Below-base-Mark-Positioning}
1769 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {blws}{Below-base-Substitutions}
1770 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {calt}{Contextual-Alternates}
1771 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {case}{Case-Sensitive-Forms}
1772 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {ccmp}{Glyph-Composition~/~Decomposition}
1773 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {cfar}{Conjunct-Form-After-Ro}
1774 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {cjct}{Conjunct-Forms}
1775 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {clig}{Contextual-Ligatures}
1776 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {cpct}{Centered-CJK-Punctuation}
1777 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {cspc}{Capital-Spacing}
1778 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {cswh}{Contextual-Swash}
1779 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {curs}{Cursive-Positioning}
1780 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {cvNN}{Character-Variant-~$N$}
1781 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {c2pc}{Petite-Capitals-From-Capitals}
1782 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {c2sc}{Small-Capitals-From-Capitals}
1783 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {dist}{Distances}
1784 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {dlig}{Discretionary-Ligatures}
1785 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {dnom}{Denominators}
1786 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {dtls}{Dotless-Forms}
1787 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {expt}{Expert-Forms}
1788 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {falt}{Final-Glyph-on-Line-Alternates}
1789 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {fin2}{Terminal-Forms-~\#2}
1790 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {fin3}{Terminal-Forms-~\#3}
1791 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {fina}{Terminal-Forms}
1792 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {flac}{Flattened-accent-forms}
1793 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {frac}{Fractions}
1794 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {fwid}{Full-Widths}
1795 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {half}{Half-Forms}
1796 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {halm}{Halant-Forms}
1797 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {halt}{Alternate-Half-Widths}
1798 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {hist}{Historical-Forms}
1799 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {hkna}{Horizontal-Kana-Alternates}
1800 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {hlig}{Historical-Ligatures}
1801 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {hngl}{Hangul}
1802 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {hojo}{Hojo-Kanji-Forms}

```

1803 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {hwid}{Half-Widths}  
 1804 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {init}{Initial-Forms}  
 1805 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {isol}{Isolated-Forms}  
 1806 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {ital}{Italics}  
 1807 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {jalt}{Justification-Alternates}  
 1808 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {jp78}{JIS78-Forms}  
 1809 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {jp83}{JIS83-Forms}  
 1810 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {jp90}{JIS90-Forms}  
 1811 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {jp04}{JIS2004-Forms}  
 1812 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {kern}{Kerning}  
 1813 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {lfbid}{Left-Bounds}  
 1814 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {liga}{Standard-Ligatures}  
 1815 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {ljmo}{Leading-Jamo-Forms}  
 1816 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {lnum}{Lining-Figures}  
 1817 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {locl}{Localized-Forms}  
 1818 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {ltra}{Left-to-right-alternates}  
 1819 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {ltrm}{Left-to-right-mirrored-forms}  
 1820 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {mark}{Mark-Positioning}  
 1821 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {med2}{Medial-Forms-#2}  
 1822 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {medi}{Medial-Forms}  
 1823 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {mgrk}{Mathematical-Greek}  
 1824 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {mkmk}{Mark-to-Mark-Positioning}  
 1825 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {mset}{Mark-Positioning-via-Substitution}  
 1826 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {nalt}{Alternate-Annotation-Forms}  
 1827 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {nlck}{NLC-Kanji-Forms}  
 1828 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {nukt}{Nukta-Forms}  
 1829 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {numr}{Numerators}  
 1830 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {onum}{Oldstyle-Figures}  
 1831 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {opbd}{Optical-Bounds}  
 1832 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {ordn}{Ordinals}  
 1833 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {ornm}{Ornaments}  
 1834 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {palt}{Proportional-Alternate-Widths}  
 1835 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {pcap}{Petite-Capitals}  
 1836 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {pkna}{Proportional-Kana}  
 1837 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {pnum}{Proportional-Figures}  
 1838 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {pref}{Pre-Base-Forms}  
 1839 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {pres}{Pre-base-Substitutions}  
 1840 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {pstf}{Post-base-Forms}  
 1841 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {psts}{Post-base-Substitutions}  
 1842 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {pwid}{Proportional-Widths}  
 1843 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {qwid}{Quarter-Widths}  
 1844 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rand}{Randomize}  
 1845 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rclt}{Required-Contextual-Alternates}  
 1846 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rkrf}{Rakar-Forms}  
 1847 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rlig}{Required-Ligatures}  
 1848 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rphf}{Reph-Forms}  
 1849 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rtbd}{Right-Bounds}  
 1850 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rtla}{Right-to-left-alternates}  
 1851 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rtlm}{Right-to-left-mirrored-forms}  
 1852 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {ruby}{Ruby-Notation-Forms}  
 1853 \prop\_gput:Nnn \g\_@@\_all\_opentype\_feature\_names\_prop {rvrn}{Required-Variation-Alternates}

```

1854 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {salt}{Stylistic-Alternates}
1855 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {sinf}{Scientific-Inferiors}
1856 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {size}{Optical-size}
1857 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {smcp}{Small-Capitals}
1858 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {smp1}{Simplified-Forms}
1859 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {ssNN}{Stylistic-Set-#N$}
1860 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {ssty}{Math-script-style-alternates}
1861 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {stch}{Stretching-Glyph-Decomposition}
1862 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {subs}{Subscript}
1863 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {sup}{Superscript}
1864 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {swsh}{Swash}
1865 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {titl}{Titling}
1866 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {tjmo}{Trailing-Jamo-Forms}
1867 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {tnam}{Traditional-Name-Forms}
1868 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {tnum}{Tabular-Figures}
1869 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {trad}{Traditional-Forms}
1870 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {twid}{Third-Widths}
1871 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {unic}{Unicase}
1872 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {valt}{Alternate-Vertical-Metrics}
1873 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vatu}{Vattu-Variants}
1874 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vert}{Vertical-Writing}
1875 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vhal}{Alternate-Vertical-Half-Metrics}
1876 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vjmo}{Vowel-Jamo-Forms}
1877 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vkna}{Vertical-Kana-Alternates}
1878 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vkern}{Vertical-Kerning}
1879 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vpal}{Proportional-Alternate-Vertical-Metrics}
1880 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vrt2}{Vertical-Alternates-and-Rotation}
1881 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {vrtr}{Vertical-Alternates-for-Rotation}
1882 \prop_gput:Nnn \g_@@_all_opentype_feature_names_prop {zero}{Slashed-Zero}

```

## 37 Graphite/AAT code

@@\_define\_aat\_feature\_group:n

```

1883 \cs_new:Nn \@@_define_aat_feature_group:n
1884 { \keys_define:nn {fontspec-aat} { #1 .multichoice: } }

```

\@@\_define\_aat\_feature:nmmn

```

1885 \cs_new:Nn \@@_define_aat_feature:nmmn
1886 {
1887   \keys_define:nn {fontspec-aat}
1888   {
1889     #1/#2 .code:n = { \@@_make_AAT_feature:nn {#3}{#4} }
1890   }
1891 }

```

\@@\_make\_AAT\_feature:nn

```

1892 \cs_new:Nn \@@_make_AAT_feature:nn
1893 {
1894   \tl_if_empty:nTF {#1}
1895   { \@@_warning:n {aat-feature-not-exist} }
1896   {

```

```

1897 \@@_make_AAT_feature_string:nnTF {#1}{#2}
1898 {
1899 \@@_update_featstr:n {\l_fontspec_feature_string_tl}
1900 }
1901 { \@@_warning:nx {aat-feature-not-exist-in-font} {#1,#2} }
1902 }
1903 }

```

`\make_AAT_feature_string:nnTF` This macro takes the numerical codes for a font feature and creates a specified macro containing the string required in the font definition to turn that feature on or off. Used primarily in [...], but also used to check if small caps exists in the requested font (see page 109).

For exclusive selectors, it's easy; just grab the string: For *non*-exclusive selectors, it's a little more complex. If the selector is even, it corresponds to switching the feature on. If the selector is *odd*, it corresponds to switching the feature off. But X<sub>Y</sub>TeX doesn't return a selector string for this number, since the feature is defined for the 'switching on' value. So we need to check the selector of the previous number, and then prefix the feature string with ! to denote the switch.

Finally, save out the complete feature string in `\l_fontspec_feature_string_tl`.

```

1904 \prg_new_conditional:Nnn \@@_make_AAT_feature_string:nn {TF,T,F}
1905 {
1906 \tl_set:Nx \l_tmpa_tl { \XeTeXfeaturename \l_fontspec_font #1 }
1907 \tl_if_empty:NTF \l_tmpa_tl
1908 { \prg_return_false: }
1909 {
1910 \int_compare:nTF { \XeTeXisexclusivefeature\l_fontspec_font #1 > 0 }
1911 {
1912 \tl_set:Nx \l_tmpb_tl { \XeTeXselectorname\l_fontspec_font #1\space #2}
1913 }
1914 {
1915 \int_if_even:nTF {#2}
1916 {
1917 \tl_set:Nx \l_tmpb_tl { \XeTeXselectorname\l_fontspec_font #1\space #2}
1918 }
1919 {
1920 \tl_set:Nx \l_tmpb_tl
1921 {
1922 \XeTeXselectorname\l_fontspec_font #1\space \numexpr#2-1\relax
1923 }
1924 \tl_if_empty:NF \l_tmpb_tl { \tl_put_left:Nn \l_tmpb_tl {!} }
1925 }
1926 }
1927 \tl_if_empty:NTF \l_tmpb_tl
1928 { \prg_return_false: }
1929 {
1930 \tl_set:Nx \l_fontspec_feature_string_tl { \l_tmpa_tl = \l_tmpb_tl }
1931 \prg_return_true:
1932 }
1933 }
1934 }

```

## 38 Font loading (keyval) definitions

This is the tedious section where we correlate all possible (eventually) font feature requests with their X<sub>Y</sub>TeX representations.

```
1935 \clist_set:Nn \g_@@_all_keyval_modules_clist
1936 {
1937     fontspec, fontspec-opentype, fontspec-aat,
1938     fontspec-preparse, fontspec-preparse-external, fontspec-preparse-nested,
1939     fontspec-renderer
1940 }

1941 \cs_new:Nn \@@_keys_define_code:nnn
1942 {
1943     \keys_define:nn {#1} { #2 .code:n = {#3} }
1944 }
```

For catching features that cannot be used in `\addfontfeatures`:

```
1945 \cs_new:Nn \@@_aff_error:n
1946 {
1947     \@@_keys_define_code:nnn {fontspec-addfeatures} {#1}
1948     { \@@_error:nx {not-in-addfontfeatures} {#1} }
1949 }
```

### 38.0.1 Pre-parsing naming information

These features are extracted from the font feature list before all others.

**Path** For fonts that aren't installed in the system. If no argument is given, the font is located with `kpsewhich`; it's either in the current directory or the TeX tree. Otherwise, the argument given defines the file path of the font.

```
1950 \@@_keys_define_code:nnn {fontspec-preparse-external} {Path}
1951 {
1952     \bool_set_true:N \l_@@_nobf_bool
1953     \bool_set_true:N \l_@@_noit_bool
1954     \bool_set_true:N \l_@@_external_bool
1955     \tl_set:Nn \l_@@_font_path_tl {#1}
1956     \@@_font_is_file:
1957     \*xetex
1958     \keys_set:nn {fontspec-renderer} {Renderer=OpenType}
1959     \*xetex
1960 }
1961 \aliasfontfeature{Path}{ExternalLocation}
1962 \@@_keys_define_code:nnn {fontspec} {Path} {}
```

**Extension** For fonts that aren't installed in the system. Specifies the font extension to use.

```
1963 \@@_keys_define_code:nnn {fontspec-preparse-external} {Extension}
1964 {
1965     \tl_set:Nn \l_@@_extension_tl {#1}
1966     \bool_if:NF \l_@@_external_bool
1967     {
```



```

1968 \keys_set:nn {fontspec-preparse-external} {Path}
1969 }
1970 }
1971 \tl_clear:N \l_@@_extension_tl
1972 \@@_keys_define_code:nnn {fontspec} {Extension} {}

```

### 38.0.2 Pre-parsed features

After the font name(s) have been sorted out, now need to extract any renderer/font configuration features that need to be processed before all other font features.

**Renderer** This feature must be processed before all others (the other font shape and features options are also pre-parsed for convenience) because the renderer determines the format of the features and even whether certain features are available.

```

1973 \keys_define:nn {fontspec-renderer}
1974 {
1975   Renderer .choices:nn =
1976     {AAT,ICU,OpenType,Graphite,Full,Basic}
1977     {
1978       \int_compare:nTF {\l_keys_choice_int <= 4} {
1979 (*xetex)
1980       \tl_set:Nv \l_fontspec_renderer_tl
1981         { g_fontspec_renderer_tag_ \l_keys_choice_tl }
1982       \tl_gset:Nx \g_@@_single_feat_tl { \l_fontspec_renderer_tl }
1983 (/xetex)
1984 (*luatex)
1985       \@@_warning:nx {only-xetex-feature} {Renderer=AAT/OpenType/Graphite}
1986 (/luatex)
1987     }
1988     {
1989 (*xetex)
1990       \@@_warning:nx {only-luatex-feature} {Renderer=Full/Basic}
1991 (/xetex)
1992 (*luatex)
1993       \tl_set:Nv \l_fontspec_mode_tl
1994         { g_fontspec_mode_tag_ \l_keys_choice_tl }
1995       \tl_gset:Nx \g_@@_single_feat_tl { mode=\l_fontspec_mode_tl }
1996 (/luatex)
1997     }
1998   }
1999 }
2000 \tl_set:cn {g_fontspec_renderer_tag_AAT} {/AAT}
2001 \tl_set:cn {g_fontspec_renderer_tag_ICU} {/OT}
2002 \tl_set:cn {g_fontspec_renderer_tag_OpenType} {/OT}
2003 \tl_set:cn {g_fontspec_renderer_tag_Graphite} {/GR}
2004 \tl_set:cn {g_fontspec_mode_tag_Full} {node}
2005 \tl_set:cn {g_fontspec_mode_tag_Basic} {base}

```

**OpenType script/language** See later for the resolutions from fontspec features to OpenType definitions.

```

2006 \@@_keys_define_code:nnn {fontspec-preparse} {Script}
2007 {
2008 \xetexx \keys_set:nn {fontspec-renderer} {Renderer=OpenType}
2009 \tl_set:Nn \l_@@_script_name_tl {#1}
2010 }

```

Exactly the same:

```

2011 \@@_keys_define_code:nnn {fontspec-preparse} {Language}
2012 {
2013 \xetexx \keys_set:nn {fontspec-renderer} {Renderer=OpenType}
2014 \tl_set:Nn \l_@@_lang_name_tl {#1}
2015 }

```

### TTC font index

```

2016 \@@_keys_define_code:nnn {fontspec-preparse} {FontIndex}
2017 {
2018 \str_if_eq:x:nnF { \str_lower_case:f { \l_@@_extension_tl } } {.ttc}
2019 { \@@_warning:n {font-index-needs-ttc} }
2020 \xetexx \tl_set:Nn \l_@@_ttc_index_tl {:#1}
2021 \luatex \tl_set:Nn \l_@@_ttc_index_tl {(#1)}
2022 }
2023 \@@_keys_define_code:nnn {fontspec} {FontIndex}
2024 {
2025 \xetexx \tl_set:Nn \l_@@_ttc_index_tl {:#1}
2026 \luatex \tl_set:Nn \l_@@_ttc_index_tl {(#1)}
2027 }

```

### 38.0.3 Bold/italic choosing options

The Bold, Italic, and BoldItalic features are for defining explicitly the bold and italic fonts used in a font family.

**Bold (NFSS) Series** By default, fontspec uses the default bold series, `\bfdefault`. We want to be able to make this extensible.

```

2028 \@@_keys_define_code:nnn {fontspec-preparse-external} {BoldSeries}
2029 {
2030 \tl_gset:Nx \g_@@_curr_series_tl { #1 }
2031 \seq_gput_right:Nx \g_@@_bf_series_seq { #1 }
2032 }

```

**Fonts Upright:**

```

2033 \@@_keys_define_code:nnn {fontspec-preparse-external} {UprightFont}
2034 {
2035 \fontspec_complete_fontname:Nn \l_@@_fontname_up_tl {#1}
2036 }
2037 \@@_keys_define_code:nnn {fontspec-preparse-external} {FontName}
2038 {
2039 \fontspec_complete_fontname:Nn \l_@@_fontname_up_tl {#1}
2040 }

```

**Bold:**

```
2041 \@@_keys_define_code:nnn {fontspec-preparse-external} {BoldFont}
2042 {
2043   \tl_if_empty:nTF {#1}
2044   {
2045     \bool_set_true:N \l_@@_nobf_bool
2046   }
2047   {
2048     \bool_set_false:N \l_@@_nobf_bool
2049     \fontspec_complete_fontname:Nn \l_@@_curr_bfname_tl {#1}
2050
2051     \seq_if_empty:NT \g_@@_bf_series_seq
2052     {
2053       \tl_gset:Nx \g_@@_curr_series_tl {\bfdefault}
2054       \seq_put_right:Nx \g_@@_bf_series_seq {\bfdefault}
2055     }
2056     \tl_if_eq:oxT \g_@@_curr_series_tl {\bfdefault}
2057     { \tl_set_eq:NN \l_@@_fontname_bf_tl \l_@@_curr_bfname_tl }
2058
2059     (debug)\typeout{Setting~bold~font~"\l_@@_curr_bfname_tl"~with~series~"\g_@@_curr_series_tl"}
2060
2061     \prop_put:NxV \l_@@_nfss_prop
2062     {BoldFont-\g_@@_curr_series_tl} \l_@@_curr_bfname_tl
2063
2064   }
2065 }
```

**Same for italic:**

```
2066 \@@_keys_define_code:nnn {fontspec-preparse-external} {ItalicFont}
2067 {
2068   \tl_if_empty:nTF {#1}
2069   {
2070     \bool_set_true:N \l_@@_noit_bool
2071   }
2072   {
2073     \bool_set_false:N \l_@@_noit_bool
2074     \fontspec_complete_fontname:Nn \l_@@_fontname_it_tl {#1}
2075   }
2076 }
```

**Simpler for bold+italic & slanted:**

```
2077 \@@_keys_define_code:nnn {fontspec-preparse-external} {BoldItalicFont}
2078 {
2079   \fontspec_complete_fontname:Nn \l_@@_fontname_bfit_tl {#1}
2080 }
2081 \@@_keys_define_code:nnn {fontspec-preparse-external} {SlantedFont}
2082 {
2083   \fontspec_complete_fontname:Nn \l_@@_fontname_sl_tl {#1}
2084 }
2085 \@@_keys_define_code:nnn {fontspec-preparse-external} {BoldSlantedFont}
2086 {
2087   \fontspec_complete_fontname:Nn \l_@@_fontname_bfsl_tl {#1}
```

```
2088 }
```

Small caps isn't pre-parsed because it can vary with others above:

```
2089 \@@_keys_define_code:nnn {fontspec} {SmallCapsFont}
2090 {
2091   \tl_if_empty:nTF {#1}
2092   {
2093     \bool_set_true:N \l_@@_nosc_bool
2094   }
2095   {
2096     \bool_set_false:N \l_@@_nosc_bool
2097     \fontspec_complete_fontname:Nn \l_@@_fontname_sc_tl {#1}
2098   }
2099 }
```

## Features

```
2100 \@@_keys_define_code:nnn {fontspec-preparse} {UprightFeatures}
2101 {
2102   \clist_set:Nn \l_@@_fontfeat_up_clist {#1}
2103 }
2104 \@@_keys_define_code:nnn {fontspec-preparse} {BoldFeatures}
2105 {
2106   \clist_set:Nn \l_@@_fontfeat_bf_clist {#1}
2107 }
2108 % \prop_put:NxV \l_@@_nfss_prop
2109 % {BoldFont-\g_@@_curr_series_tl} \l_@@_curr_bfname_tl
2110 }
2111 \@@_keys_define_code:nnn {fontspec-preparse} {ItalicFeatures}
2112 {
2113   \clist_set:Nn \l_@@_fontfeat_it_clist {#1}
2114 }
2115 \@@_keys_define_code:nnn {fontspec-preparse} {BoldItalicFeatures}
2116 {
2117   \clist_set:Nn \l_@@_fontfeat_bfit_clist {#1}
2118 }
2119 \@@_keys_define_code:nnn {fontspec-preparse} {SlantedFeatures}
2120 {
2121   \clist_set:Nn \l_@@_fontfeat_sl_clist {#1}
2122 }
2123 \@@_keys_define_code:nnn {fontspec-preparse} {BoldSlantedFeatures}
2124 {
2125   \clist_set:Nn \l_@@_fontfeat_bfsl_clist {#1}
2126 }
```

Note that small caps features can vary by shape, so these in fact *aren't* pre-parsed.

```
2127 \@@_keys_define_code:nnn {fontspec} {SmallCapsFeatures}
2128 {
2129   \bool_if:NF \l_@@_firsttime_bool
2130   {
2131     \clist_set:Nn \l_@@_fontfeat_sc_clist {#1}
2132   }
2133 }
```

### paragraphFeatures varying by size

```
2134 \@@_keys_define_code:nnn {fontspec-preparse} {SizeFeatures}
2135 {
2136   \clist_set:Nn \l_@@_sizefeat_clist {#1}
2137   \clist_put_right:Nn \l_@@_fontfeat_up_clist { SizeFeatures = {#1} }
2138 }
2139 \@@_keys_define_code:nnn {fontspec-preparse-nested} {SizeFeatures}
2140 {
2141   \clist_set:Nn \l_@@_sizefeat_clist {#1}
2142   \tl_if_empty:NT \l_@@_this_font_tl
2143   { \tl_set:Nn \l_@@_this_font_tl { -- } } % needs to be non-empty as a flag
2144 }
2145 \@@_keys_define_code:nnn {fontspec-preparse-nested} {Font}
2146 {
2147   \tl_set:Nn \l_@@_this_font_tl {#1}
2148 }
2149 \@@_keys_define_code:nnn {fontspec} {SizeFeatures}
2150 {
2151   % dummy
2152 }
2153 \@@_keys_define_code:nnn {fontspec} {Font}
2154 {
2155   % dummy
2156 }
2157 \@@_keys_define_code:nnn {fontspec-sizing} {Size}
2158 {
2159   \tl_set:Nn \l_@@_size_tl {#1}
2160 }
2161 \@@_keys_define_code:nnn {fontspec-sizing} {Font}
2162 {
2163   \fontspec_complete_fontname:Nn \l_@@_sizedfont_tl {#1}
2164 }
```

### 38.0.4 Font-independent features

These features can be applied to any font.

**NFSS encoding** For the very brave.

```
2165 \@@_keys_define_code:nnn {fontspec-preparse} {NFSSEncoding}
2166 {
2167   \tl_gset:Nx \l_@@_nfss_enc_tl { #1 }
2168 }
```

**NFSS family** Interactions with other packages will sometimes require setting the NFSS family explicitly. (By default fontspec auto-generates one based on the font name.)

```
2169 \@@_keys_define_code:nnn {fontspec-preparse} {NFSSFamily}
2170 {
2171   \tl_set:Nx \l_@@_nfss_fam_tl { #1 }
2172   \cs_undefine:c {g_@@_UID_\l_@@_fontid_tl}
```

```

2173 \tl_if_exist:NT \l_fontspec_family_tl
2174 { \cs_undefine:c {g_@@_ \l_fontspec_family_tl _prop} }
2175 }

```

**NFSS series/shape** This option looks similar in name but has a very different function.

```

2176 \@@_keys_define_code:nnn {fontspec} {FontFace}
2177 {
2178   \tl_set:No \l_@@_arg_tl { \use_iii:nnn #1 }
2179   \tl_set_eq:NN \l_@@_this_feat_tl \l_@@_arg_tl
2180   \tl_clear:N \l_@@_this_font_tl
2181   \int_compare:nT { \clist_count:N \l_@@_arg_tl = 1 }
2182   {
2183     (*debug)
2184     \typeout{FontFace~ parsing:~ one~ clist~ item}
2185     (/debug)
2186     \tl_if_in:NnF \l_@@_arg_tl {=}
2187     {
2188       (*debug)
2189       \typeout{FontFace~ parsing:~ no~ equals~ =>~ font~ name~ only}
2190       (/debug)
2191       \tl_set_eq:NN \l_@@_this_font_tl \l_@@_arg_tl
2192       \tl_clear:N \l_@@_this_feat_tl
2193     }
2194   }
2195
2196   \@@_add_nfssfont:nnnn
2197   {\use_i:nnn #1}{\use_ii:nnn #1}{\l_@@_this_font_tl}{\l_@@_this_feat_tl}
2198 }

```

**Scale** If the input isn't one of the pre-defined string options, then it's gotta be numerical. `\fontspec_calc_scale:n` does all the work in the auto-scaling cases.

```

2199 \@@_keys_define_code:nnn {fontspec} {Scale}
2200 {
2201   \str_case:nnF {#1}
2202   {
2203     {MatchLowercase} { \@@_calc_scale:n {5} }
2204     {MatchUppercase} { \@@_calc_scale:n {8} }
2205   }
2206   { \tl_set:Nx \l_@@_scale_tl {#1} }
2207   \tl_set:Nx \l_@@_scale_tl { s*[\l_@@_scale_tl] }
2208 }

```

`\@@_calc_scale:n` This macro calculates the amount of scaling between the default roman font and the (default shape of) the font being selected such that the font dimension that is input is equal for both. The only font dimensions that justify this are 5 (lowercase height) and 8 (uppercase height in X<sub>Y</sub>TeX).

This script is executed for every extra shape, which seems wasteful, but allows alternate italic shapes from a separate font, say, to be loaded and to be auto-scaled correctly. Even if this would be ugly.

```

2209 \cs_new:Nn \@@_calc_scale:n
2210 {
2211   \group_begin:
2212   \rmfamily
2213   \@@_set_font_dimen:NnN \l_@@_tmpa_dim {#1} \font
2214   \@@_set_font_dimen:NnN \l_@@_tmpb_dim {#1} \l_fontspeg_font
2215   \tl_gset:Nx \l_@@_scale_tl
2216   {
2217     \fp_eval:n { \dim_to_fp:n {\l_@@_tmpa_dim} /
2218                 \dim_to_fp:n {\l_@@_tmpb_dim} }
2219   }
2220   \@@_info:n {set-scale}
2221   \group_end:
2222 }

```

`\@@_set_font_dimen:NnN` This function sets the dimension #1 (for font #3) to 'fontdimen' #2 for either font dimension 5 (x-height) or 8 (cap-height). If, for some reason, these return an incorrect 'zero' value (as `\fontdimen8` might for a .tfm font), then we cheat and measure the height of a glyph. We assume in this case that the font contains either an 'X' or an 'x'.

```

2223 \cs_new:Nn \@@_set_font_dimen:NnN
2224 {
2225   \dim_set:Nn #1 { \fontdimen #2 #3 }
2226   \dim_compare:nNnT #1 = {opt}
2227   {
2228     \settoheight #1
2229     {
2230       \str_if_eq:nnTF {#3} {\font} \rmfamily #3
2231       \int_case:nnF #2
2232       {
2233         {5} {x} % x-height
2234         {8} {X} % cap-height
2235       } {?} % "else" clause; never reached.
2236     }
2237   }
2238 }

```

**Inter-word space** These options set the relevant `\fontdimens` for the font being loaded.

```

2239 \@@_keys_define_code:nnn {fontspec} {WordSpace}
2240 {
2241   \bool_if:NF \l_@@_firsttime_bool
2242   { \_fontspec_parse_wordspace:w #1,,,\q_stop }
2243 }
2244 \@@_aff_error:n {WordSpace}

```

`\_fontspec_parse_wordspace:w` This macro determines if the input to `WordSpace` is of the form `{X}` or `{X,Y,Z}` and executes the font scaling. If the former input, it executes `{X,X,X}`.

```

2245 \cs_set:Npn \_fontspec_parse_wordspace:w #1,#2,#3,#4 \q_stop
2246 {
2247   \tl_if_empty:nTF {#4}

```

```

2248 {
2249   \tl_set:Nn \l_@@_wordspace_adjust_tl
2250   {
2251     \fontdimen 2 \font = #1 \fontdimen 2 \font
2252     \fontdimen 3 \font = #1 \fontdimen 3 \font
2253     \fontdimen 4 \font = #1 \fontdimen 4 \font
2254   }
2255 }
2256 {
2257   \tl_set:Nn \l_@@_wordspace_adjust_tl
2258   {
2259     \fontdimen 2 \font = #1 \fontdimen 2 \font
2260     \fontdimen 3 \font = #2 \fontdimen 3 \font
2261     \fontdimen 4 \font = #3 \fontdimen 4 \font
2262   }
2263 }
2264 }

```

**Punctuation space** Scaling factor for the nominal `\fontdimen#7`.

```

2265 \@@_keys_define_code:nnn {fontspec} {PunctuationSpace}
2266 {
2267   \str_case_x:nnF {#1}
2268   {
2269     {WordSpace}
2270     {
2271       \tl_set:Nn \l_@@_punctspace_adjust_tl
2272       { \fontdimen 7 \font = 0 \fontdimen 2 \font }
2273     }
2274     {TwiceWordSpace}
2275     {
2276       \tl_set:Nn \l_@@_punctspace_adjust_tl
2277       { \fontdimen 7 \font = 1 \fontdimen 2 \font }
2278     }
2279   }
2280   {
2281     \tl_set:Nn \l_@@_punctspace_adjust_tl
2282     { \fontdimen 7 \font = #1 \fontdimen 7 \font }
2283   }
2284 }
2285 \@@_aff_error:n {PunctuationSpace}

```

**Secret hook into the font-adjustment code**

```

2286 \@@_keys_define_code:nnn {fontspec} {FontAdjustment}
2287 {
2288   \tl_put_right:Nx \l_@@_postadjust_tl {#1}
2289 }

```

**Letterspacing**

```

2290 \@@_keys_define_code:nnn {fontspec} {LetterSpace}
2291 {

```



```

2292 \@@_update_featstr:n {letterspace=#1}
2293 }

```

**Hyphenation character** This feature takes one of three arguments: ‘None’, *⟨glyph⟩*, or *⟨slot⟩*. If the input isn’t the first, and it’s one character, then it’s the second; otherwise, it’s the third.

```

2294 \@@_keys_define_code:nnn {fontspec} {HyphenChar}
2295 {
2296   \bool_if:NT \l_@@_addfontfeatures_bool
2297   { \@@_error:nx {not-in-addfontfeatures} {HyphenChar} }
2298
2299   \str_if_eq:nnTF {#1} {None}
2300   {
2301     \tl_put_right:Nn \l_@@_postadjust_tl
2302     { \hyphenchar \font = \c_minus_one }
2303   }
2304   {
2305     \tl_if_single:nTF {#1}
2306     { \tl_set:Nn \l_fontspec_hyphenchar_tl {`#1} }
2307     { \tl_set:Nn \l_fontspec_hyphenchar_tl { #1} }
2308     \@@_primitive_font_glyph_if_exist:NnTF \l_fontspec_font {\l_fontspec_hyphenchar_tl}
2309     {
2310       \tl_put_right:Nn \l_@@_postadjust_tl
2311       (*xetex)
2312       { \hyphenchar \font = \l_fontspec_hyphenchar_tl \scan_stop: }
2313       (/xetex)
2314       (*luatex)
2315       {
2316         \hyphenchar \font = \c_zero
2317         \int_set:Nn \luatex_prehyphenchar:D { \l_fontspec_hyphenchar_tl }
2318       }
2319       (/luatex)
2320     }
2321     { \@@_error:nx {no-glyph}{#1} }
2322   }
2323 }
2324 \@@_aff_error:n {HyphenChar}

```

**Color** Hooks into `pkgxcolor`, which names its colours `\color@<name>`.

```

2325 \@@_keys_define_code:nnn {fontspec} {Color}
2326 {
2327   \cs_if_exist:cTF { \token_to_str:N \color@ #1 }
2328   {
2329     \convertcolorspec{named}{#1}{HTML}\l_@@_hexcol_tl
2330   }
2331   {
2332     \int_compare:nTF { \tl_count:n {#1} == 6 }
2333     { \tl_set:Nn \l_@@_hexcol_tl {#1} }
2334     {
2335       \int_compare:nTF { \tl_count:n {#1} == 8 }

```

```

2336     { \fontspec_parse_colour:viii #1 }
2337     {
2338         \bool_if:NF \l_@@_firsttime_bool
2339         { \@@_warning:nx {bad-colour} {#1} }
2340     }
2341 }
2342 }
2343 }

2344 \cs_set:Npn \fontspec_parse_colour:viii #1#2#3#4#5#6#7#8
2345 {
2346     \tl_set:Nn \l_@@_hexcol_tl {#1#2#3#4#5#6}
2347     \tl_if_eq:NNF \l_@@_opacity_tl \g_@@_opacity_tl
2348     {
2349         \bool_if:NF \l_@@_firsttime_bool
2350         { \@@_warning:nx {opa-twice-col} {#7#8} }
2351     }
2352     \tl_set:Nn \l_@@_opacity_tl {#7#8}
2353 }
2354 \aliasfontfeature{Color}{Colour}

2355 \@@_keys_define_code:nnn {fontspec} {Opacity}
2356 {
2357     \int_set:Nn \l_@@_tmp_int {255}
2358     \@@_int_mult_truncate:Nn \l_@@_tmp_int { #1 }
2359     \tl_if_eq:NNF \l_@@_opacity_tl \g_@@_opacity_tl
2360     {
2361         \bool_if:NF \l_@@_firsttime_bool
2362         { \@@_warning:nx {opa-twice} {#1} }
2363     }
2364     \tl_set:Nx \l_@@_opacity_tl
2365     {
2366         \int_compare:nTF { \l_@@_tmp_int <= "F } {o} % zero pad
2367         \int_to_hex:n { \l_@@_tmp_int }
2368     }
2369 }

```

## Mapping

```

2370 \@@_keys_define_code:nnn {fontspec} {Mapping}
2371 {*\xetex}
2372 {
2373     \@@_update_featstr:n { mapping = #1 }
2374 }
2375 \xetex
2376 {*\luatex}
2377 {
2378     \str_if_eq:nnTF {#1} {tex-text}
2379     {
2380         \@@_warning:n {no-mapping-ligtx}
2381         \msg_redirect_name:nnn {fontspec} {no-mapping-ligtx} {none}
2382         \keys_set:nn {fontspec-opentype} { Ligatures=TeX }
2383     }

```

```

2384 { \@@_warning:n {no-mapping} }
2385 }
2386 \</luatex>

```

### 38.0.5 Continuous font axes

```

2387 \@@_keys_define_code:nnn {fontspec} {Weight}
2388 {
2389   \@@_update_featstr:n{weight=#1}
2390 }
2391 \@@_keys_define_code:nnn {fontspec} {Width}
2392 {
2393   \@@_update_featstr:n{width=#1}
2394 }
2395 \@@_keys_define_code:nnn {fontspec} {OpticalSize}
2396 \< *xetex >
2397 {
2398   \bool_if:NTF \l_@@_ot_bool
2399   {
2400     \tl_set:Nn \l_@@_optical_size_tl {/ S = #1}
2401   }
2402   {
2403     \bool_if:NT \l_@@_mm_bool
2404     {
2405       \@@_update_featstr:n { optical size = #1 }
2406     }
2407   }
2408   \bool_if:NTF { !\l_@@_ot_bool && !\l_@@_mm_bool }
2409   {
2410     \bool_if:NT \l_@@_firsttime_bool
2411     { \@@_warning:n {no-opticals} }
2412   }
2413 }
2414 \< /xetex >
2415 \< *luatex >
2416 {
2417   \tl_set:Nn \l_@@_optical_size_tl {/ S = #1}
2418 }
2419 \< /luatex >

```

### 38.0.6 Font transformations

These are to be specified to apply directly to a font shape:

```

2420 \keys_define:nn {fontspec}
2421 {
2422   FakeSlant .code:n =
2423   {
2424     \@@_update_featstr:n{slant=#1}
2425   },
2426   FakeSlant .default:n = {0.2}
2427 }
2428 \keys_define:nn {fontspec}

```

```

2429 {
2430   FakeStretch .code:n =
2431   {
2432     \@@_update_featstr:n{extend=#1}
2433   },
2434   FakeStretch .default:n = {1.2}
2435 }
2436 \*xetex
2437 \keys_define:nn {fontspec}
2438 {
2439   FakeBold .code:n =
2440   {
2441     \@@_update_featstr:n {embolden=#1}
2442   },
2443   FakeBold .default:n = {1.5}
2444 }
2445 \*xetex
2446 \*luatex
2447 \keys_define:nn {fontspec}
2448 {
2449   FakeBold .code:n = { \@@_warning:n {fakebold-only-xetex} }
2450 }
2451 \*luatex

```

These are to be given to a shape that has no real bold/italic to signal that fontspec should automatically create ‘fake’ shapes.

The behaviour is currently that only if both `AutoFakeSlant` and `AutoFakeBold` are specified, the bold italic is also faked.

These features presently *override* real shapes found in the font; in the future I’d like these features to be ignored in this case, instead. (This is just a bit harder to program in the current design of fontspec.)

```

2452 \keys_define:nn {fontspec}
2453 {
2454   AutoFakeSlant .code:n =
2455   {
2456     \bool_if:NT \l_@@_firsttime_bool
2457     {
2458       \tl_set:Nn \l_@@_fake_slant_tl {#1}
2459       \clist_put_right:Nn \l_@@_fontfeat_it_clist {FakeSlant=#1}
2460       \tl_set_eq:NN \l_@@_fontname_it_tl \l_fontspec_fontname_tl
2461       \bool_set_false:N \l_@@_noit_bool
2462     }
2463     \tl_if_empty:NF \l_@@_fake_embolden_tl
2464     {
2465       \clist_put_right:Nx \l_@@_fontfeat_bfit_clist
2466       {FakeBold=\l_@@_fake_embolden_tl}
2467       \clist_put_right:Nx \l_@@_fontfeat_bfit_clist {FakeSlant=#1}
2468       \tl_set_eq:NN \l_@@_fontname_bfit_tl \l_fontspec_fontname_tl
2469     }
2470   }
2471 },

```

```

2472 AutoFakeSlant .default:n = {0.2}
2473 }

```

Same but reversed:

```

2474 \keys_define:nn {fontspec}
2475 {
2476   AutoFakeBold .code:n =
2477   {
2478     \bool_if:NT \l_@@_firsttime_bool
2479     {
2480       \tl_set:Nn \l_@@_fake_embolden_tl {#1}
2481       \clist_put_right:Nn \l_@@_fontfeat_bf_clist {FakeBold=#1}
2482       \tl_set_eq:NN \l_@@_fontname_bf_tl \l_fontspec_fontname_tl
2483       \bool_set_false:N \l_@@_nobf_bool
2484
2485       \tl_if_empty:NF \l_@@_fake_slant_tl
2486       {
2487         \clist_put_right:Nx \l_@@_fontfeat_bfit_clist
2488         {FakeSlant=\l_@@_fake_slant_tl}
2489         \clist_put_right:Nx \l_@@_fontfeat_bfit_clist {FakeBold=#1}
2490         \tl_set_eq:NN \l_@@_fontname_bfit_tl \l_fontspec_fontname_tl
2491       }
2492     }
2493   },
2494   AutoFakeBold .default:n = {1.5}
2495 }

```

### 38.0.7 Raw feature string

This allows savvy X<sub>Y</sub>TeX-ers to input font features manually if they have already memorised the OpenType abbreviations and don't mind not having error checking.

```

2496 \@@_keys_define_code:nnn {fontspec} {RawFeature}
2497 {
2498   \@@_update_featstr:n {#1}
2499 }

```

## 38.1 OpenType feature definitions

```

2500 \@@_feat_prop_add:nn {salt} { Alternate\,=\,$N$ }
2501 \@@_feat_prop_add:nn {nalt} { Annotation\,=\,$N$ }
2502 \@@_feat_prop_add:nn {ornm} { Ornament\,=\,$N$ }
2503 \@@_feat_prop_add:nn {cvNN} { CharacterVariant\,=\,$N$:$M$ }
2504 \@@_feat_prop_add:nn {ssNN} { StylisticSet\,=\,$N$ }

```

## 38.2 Regular key=val / tag definitions

### 38.2.1 Ligatures

```

2505 \@@_define_opentype_feature_group:n {Ligatures}
2506 \@@_define_opentype_feature:nnnn {Ligatures} {ResetAll} {} {}
2507 {
2508   +dlig,-dlig,+rlig,-rlig,+liga,-liga,+dlig,-dlig,+clig,-clig,+hlig,-hlig,
2509   <xetex> mapping = tex-text

```

```

2510 \luatex) +tlig,-tlig
2511 }

2512 \@@_define_opentype_onoffreset:nnnnn {Ligatures} {Required}      {rlig} {rlig} {}
2513 \@@_define_opentype_onoffreset:nnnnn {Ligatures} {Common}        {liga} {liga} {}
2514 \@@_define_opentype_onoffreset:nnnnn {Ligatures} {Rare}          {dlig} {dlig} {}
2515 \@@_define_opentype_onoffreset:nnnnn {Ligatures} {Discretionary} {dlig} {dlig} {}
2516 \@@_define_opentype_onoffreset:nnnnn {Ligatures} {Contextual}     {clig} {clig} {}
2517 \@@_define_opentype_onoffreset:nnnnn {Ligatures} {Historic}       {hlig} {hlig} {}

```

Emulate CM extra ligatures.

```

2518 \xetex)\@@_define_opentype_onreset:nnnnn {Ligatures} {TeX} {} { mapping = tex-
      text } {}
2519 \luatex)\@@_define_opentype_onreset:nnnnn {Ligatures} {TeX} {} { +tlig } {}

```

### 38.2.2 Letters

```

2520 \@@_define_opentype_feature_group:n {Letters}
2521 \@@_define_opentype_feature:nnnnn    {Letters} {ResetAll} {} {}
2522 {
2523   +case,+smcp,+pcap,+c2sc,+c2pc,+unic,+rand,
2524   -case,-smcp,-pcap,-c2sc,-c2pc,-unic,-rand
2525 }

2526 \@@_define_opentype_onoffreset:nnnnn {Letters} {Uppercase} {case} {case} {+smcp,+pcap,+c2sc,+
2527 \@@_define_opentype_onoffreset:nnnnn {Letters} {SmallCaps} {smcp} {smcp} {+pcap,+unic,+rand}
2528 \@@_define_opentype_onoffreset:nnnnn {Letters} {PetiteCaps} {pcap} {pcap} {+smcp,+unic,+rand}
2529 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercaseSmallCaps} {c2sc} {c2sc} {+c2pc,+unic,+rand}
2530 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2531 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2532 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2533 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2534 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2535 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2536 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2537 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2538 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2539 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2540 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2541 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2542 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2543 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2544 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2545 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2546 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2547 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2548 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}
2549 \@@_define_opentype_onoffreset:nnnnn {Letters} {UppercasePetiteCaps} {c2pc} {c2pc} {+c2sc,+unic,+rand}

```

### 38.2.3 Numbers

```

2533 \@@_define_opentype_feature_group:n {Numbers}
2534 \@@_define_opentype_feature:nnnnn    {Numbers} {ResetAll} {} {}
2535 {
2536   +tnum,-tnum,
2537   +pnum,-pnum,
2538   +onum,-onum,
2539   +lnum,-lnum,
2540   +zero,-zero,
2541   +anum,-anum,
2542 }

2543 \@@_define_opentype_onoffreset:nnnnn {Numbers} {Monospaced} {tnum} {tnum} {+pnum,-
      pnum}
2544 \@@_define_opentype_onoffreset:nnnnn {Numbers} {Proportional} {pnum} {pnum} {+tnum,-
      tnum}
2545 \@@_define_opentype_onoffreset:nnnnn {Numbers} {Lowercase} {onum} {onum} {+lnum,-
      lnum}
2546 \@@_define_opentype_onoffreset:nnnnn {Numbers} {Uppercase} {lnum} {lnum} {+onum,-
      onum}
2547 \@@_define_opentype_onoffreset:nnnnn {Numbers} {SlashedZero} {zero} {zero} {}
2548 \aliasfontfeatureoption {Numbers} {Lowercase} {OldStyle}
2549 \aliasfontfeatureoption {Numbers} {Uppercase} {Lining}

```

luaotload provides a custom anum feature for replacing Latin (AKA Arabic) numbers with Arabic (AKA Indic-Arabic). The same feature maps to Farsi (Persian) numbers if font language is Farsi.

```
2550 \luaotload \@@_define_opentype_onoffreset:nnnnn {Numbers} {Arabic} {anum} {anum} {}
```

### 38.2.4 Vertical position

```
2551 \@@_define_opentype_feature_group:n {VerticalPosition}
2552 \@@_define_opentype_feature:nnnnn {VerticalPosition} {ResetAll} {} {}
2553 {
2554     +supr,-supr,
2555     +subr,-subr,
2556     +ordn,-ordn,
2557     +numr,-numr,
2558     +dnom,-dnom,
2559     +sinf,-sinf,
2560 }

2561 \@@_define_opentype_onoffreset:nnnnn {VerticalPosition} {Superior} {supr} {supr} {+s
2562 \@@_define_opentype_onoffreset:nnnnn {VerticalPosition} {Inferior} {subr} {subr} {+s
2563 \@@_define_opentype_onoffreset:nnnnn {VerticalPosition} {Ordinal} {ordn} {ordn} {+s
2564 \@@_define_opentype_onoffreset:nnnnn {VerticalPosition} {Numerator} {numr} {numr} {+s
2565 \@@_define_opentype_onoffreset:nnnnn {VerticalPosition} {Denominator} {dnom} {dnom} {+s
2566 \@@_define_opentype_onoffreset:nnnnn {VerticalPosition} {ScientificInferior} {sinf} {sinf} {+s
```

### 38.2.5 Contextuals

```
2567 \@@_define_opentype_feature_group:n {Contextuals}
2568 \@@_define_opentype_feature:nnnnn {Contextuals} {ResetAll} {} {}
2569 {
2570     +cswr,-cswr,
2571     +calr,-calr,
2572     +inir,-inir,
2573     +finr,-finr,
2574     +falr,-falr,
2575     +medr,-medr,
2576 }

2577 \@@_define_opentype_onoffreset:nnnnn {Contextuals} {Swash} {cswr} {cswr} {}
2578 \@@_define_opentype_onoffreset:nnnnn {Contextuals} {Alternate} {calr} {calr} {}
2579 \@@_define_opentype_onoffreset:nnnnn {Contextuals} {WordInitial} {inir} {inir} {}
2580 \@@_define_opentype_onoffreset:nnnnn {Contextuals} {WordFinal} {finr} {finr} {}
2581 \@@_define_opentype_onoffreset:nnnnn {Contextuals} {LineFinal} {falr} {falr} {}
2582 \@@_define_opentype_onoffreset:nnnnn {Contextuals} {Inner} {medr} {medr} {}
```

### 38.2.6 Diacritics

```
2583 \@@_define_opentype_feature_group:n {Diacritics}
2584 \@@_define_opentype_feature:nnnnn {Diacritics} {ResetAll} {} {}
2585 {
2586     +mark,-mark,
2587     +mkmk,-mkmk,
2588     +abvm,-abvm,
2589     +blwm,-blwm,
2590 }
```

```

2591 \@@_define_opentype_onoffreset:nnnnn {Diacritics} {MarkToBase} {mark} {mark} {}
2592 \@@_define_opentype_onoffreset:nnnnn {Diacritics} {MarkToMark} {mkmk} {mkmk} {}
2593 \@@_define_opentype_onoffreset:nnnnn {Diacritics} {AboveBase} {abvm} {abvm} {}
2594 \@@_define_opentype_onoffreset:nnnnn {Diacritics} {BelowBase} {blwm} {blwm} {}

```

### 38.2.7 Kerning

```

2595 \@@_define_opentype_feature_group:n {Kerning}
2596 \@@_define_opentype_feature:nnnnn {Kerning} {ResetAll} {} {}
2597 {
2598     +csp, -csp,
2599     +kern, -kern,
2600 }
2601 \@@_define_opentype_onoffreset:nnnnn {Kerning} {Uppercase} {csp} {csp} {}
2602 \@@_define_opentype_feature:nnnnn {Kerning} {On} {kern} {+kern} {-
    kern}
2603 \@@_define_opentype_feature:nnnnn {Kerning} {Off} {kern} {-kern} {+kern}
2604 \@@_define_opentype_feature:nnnnn {Kerning} {Reset} {} {} {+kern, -kern}

```

### 38.2.8 Fractions

```

2605 \@@_define_opentype_feature_group:n {Fractions}
2606 \@@_define_opentype_feature:nnnnn {Fractions} {ResetAll} {} {}
2607 {
2608     +frac, -frac,
2609     +afrc, -afrc,
2610 }
2611 \@@_define_opentype_feature:nnnnn {Fractions} {On} {frac} {+frac} {}
2612 \@@_define_opentype_feature:nnnnn {Fractions} {Off} {frac} {-frac} {}
2613 \@@_define_opentype_feature:nnnnn {Fractions} {Reset} {} {} {+frac, -frac}
2614 \@@_define_opentype_onoffreset:nnnnn {Fractions} {Alternate} {afrc} {afrc} {-
    frac}

```

### 38.2.9 Style

```

2615 \@@_define_opentype_feature_group:n {Style}
2616 \@@_define_opentype_feature:nnnnn {Style} {ResetAll} {} {}
2617 {
2618     +salt, -salt,
2619     +ital, -ital,
2620     +ruby, -ruby,
2621     +swsh, -swsh,
2622     +hist, -hist,
2623     +titl, -titl,
2624     +hkna, -hkna,
2625     +vkna, -vkna,
2626     +ssty=0, -ssty=0,
2627     +ssty=1, -ssty=1,
2628 }
2629 \@@_define_opentype_onoffreset:nnnnn {Style} {Alternate} {salt} {salt} {}
2630 \@@_define_opentype_onoffreset:nnnnn {Style} {Italic} {ital} {ital} {}
2631 \@@_define_opentype_onoffreset:nnnnn {Style} {Ruby} {ruby} {ruby} {}
2632 \@@_define_opentype_onoffreset:nnnnn {Style} {Swash} {swsh} {swsh} {}
2633 \@@_define_opentype_onoffreset:nnnnn {Style} {Cursive} {swsh} {curs} {}

```



```

2634 \@_define_opentype_onoffreset:nnnnn {Style} {Historic} {hist} {hist} {}
2635 \@_define_opentype_onoffreset:nnnnn {Style} {TitlingCaps} {titl} {titl} {}
2636 \@_define_opentype_onoffreset:nnnnn {Style} {HorizontalKana} {hkna} {hkna} {+vkna,+pkna}
2637 \@_define_opentype_onoffreset:nnnnn {Style} {VerticalKana} {vkna} {vkna} {+hkna,+pkna}
2638 \@_define_opentype_onoffreset:nnnnn {Style} {ProportionalKana} {pkna} {pkna} {+vkna,+hkna}
2639 \@_define_opentype_feature:nnnnn {Style} {MathScript} {ssty} {+ssty=0} {+ssty=1}
2640 \@_define_opentype_feature:nnnnn {Style} {MathScriptScript} {ssty} {+ssty=1} {+ssty=0}

```

### 38.2.10 CJK shape

```

2641 \@_define_opentype_feature_group:n {CJKShape}
2642 \@_define_opentype_feature:nnnnn {CJKShape} {ResetAll} {} {}
2643 {
2644   +trad,-trad,
2645   +smpl,-smpl,
2646   +jp78,-jp78,
2647   +jp83,-jp83,
2648   +jp90,-jp90,
2649   +jpo4,-jpo4,
2650   +expt,-expt,
2651   +nlck,-nlck,
2652 }
2653 \@_define_opentype_onoffreset:nnnnn {CJKShape} {Traditional} {trad} {trad} {+smpl,+jp78,+jp83}
2654 \@_define_opentype_onoffreset:nnnnn {CJKShape} {Simplified} {smpl} {smpl} {+trad,+jp78,+jp83}
2655 \@_define_opentype_onoffreset:nnnnn {CJKShape} {JIS1978} {jp78} {jp78} {+trad,+smpl,+jp83}
2656 \@_define_opentype_onoffreset:nnnnn {CJKShape} {JIS1983} {jp83} {jp83} {+trad,+smpl,+jp78}
2657 \@_define_opentype_onoffreset:nnnnn {CJKShape} {JIS1990} {jp90} {jp90} {+trad,+smpl,+jp78}
2658 \@_define_opentype_onoffreset:nnnnn {CJKShape} {JIS2004} {jpo4} {jpo4} {+trad,+smpl,+jp78}
2659 \@_define_opentype_onoffreset:nnnnn {CJKShape} {Expert} {expt} {expt} {+trad,+smpl,+jp78}
2660 \@_define_opentype_onoffreset:nnnnn {CJKShape} {NLC} {nlck} {nlck} {+trad,+smpl,+jp78}

```

### 38.2.11 Character width

```

2661 \@_define_opentype_feature_group:n {CharacterWidth}
2662 \@_define_opentype_feature:nnnnn {CharacterWidth} {ResetAll} {} {}
2663 {
2664   +pwid,-pwid,
2665   +fwid,-fwid,
2666   +hwid,-hwid,
2667   +twid,-twid,
2668   +qwid,-qwid,
2669   +palt,-palt,
2670   +halt,-halt,
2671 }
2672 \@_define_opentype_onoffreset:nnnnn {CharacterWidth} {Proportional} {pwid} {pwid} {-}
2673 \@_define_opentype_onoffreset:nnnnn {CharacterWidth} {Full} {fwid} {fwid} {-}
2674 \@_define_opentype_onoffreset:nnnnn {CharacterWidth} {Half} {hwid} {hwid} {-}
2675 \@_define_opentype_onoffreset:nnnnn {CharacterWidth} {Third} {twid} {twid} {-}
2676 \@_define_opentype_onoffreset:nnnnn {CharacterWidth} {Quarter} {qwid} {qwid} {-}
2677 \@_define_opentype_onoffreset:nnnnn {CharacterWidth} {AlternateProportional} {palt} {palt} {-}
2678 \@_define_opentype_onoffreset:nnnnn {CharacterWidth} {AlternateHalf} {halt} {halt} {-}

```

### 38.2.12 Vertical

According to spec `vkern` must also activate `vpal` if available but for simplicity we don't do that here (yet?).

```
2679 \@@_define_opentype_feature_group:n {Vertical}
2680 \@@_define_opentype_onoffreset:nnnnn {Vertical} {RotatedGlyphs} {vrt2} {vrt2} {+vrtr,+
2681 \@@_define_opentype_onoffreset:nnnnn {Vertical} {AlternatesForRotation} {vrtr} {vrtr} {+vrt2}
2682 \@@_define_opentype_onoffreset:nnnnn {Vertical} {Alternates} {vert} {vert} {+vrt2}
2683 \@@_define_opentype_onoffreset:nnnnn {Vertical} {KanaAlternates} {vkna} {vkna} {+hkna}
2684 \@@_define_opentype_onoffreset:nnnnn {Vertical} {Kerning} {vkern} {vkern} {}
2685 \@@_define_opentype_onoffreset:nnnnn {Vertical} {AlternateMetrics} {valt} {valt} {+vhal,+
2686 \@@_define_opentype_onoffreset:nnnnn {Vertical} {HalfMetrics} {vhal} {vhal} {+valt,+
2687 \@@_define_opentype_onoffreset:nnnnn {Vertical} {ProportionalMetrics} {vpal} {vpal} {+valt,+
```

## 38.3 OpenType features that need numbering

### 38.3.1 Alternate

```
2688 \@@_define_opentype_feature_group:n {Alternate}
2689 \keys_define:nn {fontspec-opentype}
2690 {
2691   Alternate .default:n = {o} ,
2692   \luatex Alternate / Random .code:n =
2693   \luatex { \@@_make_OT_feature:nnn {salt}{ +salt = random }{} } ,
2694   Alternate / unknown .code:n =
2695   {
2696     \clist_map_inline:nn {#1}
2697     { \@@_make_OT_feature:nnn {salt}{ +salt = ##1 }{} }
2698   }
2699 }
2700 \aliasfontfeature{Alternate}{StylisticAlternates}
```

### 38.3.2 Variant / StylisticSet

```
2701 \@@_define_opentype_feature_group:n {Variant}
2702 \keys_define:nn {fontspec-opentype}
2703 {
2704   Variant .default:n = {o} ,
2705   Variant / unknown .code:n =
2706   {
2707     \clist_map_inline:nn {#1}
2708     {
2709       \@@_make_OT_feature:xxx { ss \two@digits {##1} } { +ss \two@digits {##1} } {}
2710     }
2711   }
2712 }
2713 \aliasfontfeature{Variant}{StylisticSet}
```

### 38.3.3 CharacterVariant

```
2714 \@@_define_opentype_feature_group:n {CharacterVariant}
2715 \use:x
2716 {
```

```

2717 \cs_new:Npn \exp_not:N \fontspec_parse_cv:w
2718     ##1 \c_colon_str ##2 \c_colon_str ##3 \exp_not:N \q_nil
2719 {
2720     \@@_make_OT_feature:xxx
2721     { cv \exp_not:N \two@digits {##1} } { +cv \exp_not:N \two@digits {##1} = ##2 } {}
2722 }
2723 \keys_define:nn {fontspec-opentype}
2724 {
2725     CharacterVariant / unknown .code:n =
2726     {
2727         \clist_map_inline:nn {##1}
2728         {
2729             \exp_not:N \fontspec_parse_cv:w
2730             #####1 \c_colon_str o \c_colon_str \exp_not:N \q_nil
2731         }
2732     }
2733 }
2734 }

```

Possibilities: a:o:\q\_nil or a:b:o:\q\_nil.

### 38.3.4 Annotation

```

2735 \@@_define_opentype_feature_group:n {Annotation}
2736 \keys_define:nn {fontspec-opentype}
2737 {
2738     Annotation .default:n = {o} ,
2739     Annotation / unknown .code:n =
2740     {
2741         \@@_make_OT_feature:nnn {nalt} {+nalt=#1} {}
2742     }
2743 }

```

### 38.3.5 Ornament

```

2744 \@@_define_opentype_feature_group:n {Ornament}
2745 \keys_define:nn {fontspec-opentype}
2746 {
2747     Ornament .default:n = {o} ,
2748     Ornament / unknown .code:n =
2749     {
2750         \@@_make_OT_feature:nnn {ornm} {+ornm=#1} {}
2751     }
2752 }

```

## 38.4 Script and Language

### 38.4.1 Script

```

2753 \keys_define:nn { fontspec-opentype } { Script .choice: }
2754 \cs_new:Nn \fontspec_new_script:nn
2755 {
2756     \keys_define:nn { fontspec-opentype } { Script / #1 .code:n =
2757         \bool_set_false:N \l_@@_script_exist_bool
2758         \clist_map_inline:nn {#2}

```

```

2759 {
2760   \@@_check_script:nTF {####1}
2761   {
2762     \tl_set:Nn \l_fontspec_script_tl {####1}
2763     \int_set:Nn \l_@@_script_int {\l_@@_strnum_int}
2764     \bool_set_true:N \l_@@_script_exist_bool
2765     \tl_gset:Nx \g_@@_single_feat_tl { script=####1 }
2766     \clist_map_break:
2767   }
2768   { }
2769 }
2770 \bool_if:NF \l_@@_script_exist_bool
2771 {
2772   \str_if_eq:nnTF {#1} {Latin}
2773   {
2774     \@@_warning:nx {script-not-exist} {#1}
2775   }
2776   {
2777     \@@_check_script:nTF {latn}
2778     {
2779       \@@_warning:nx {script-not-exist-latn} {#1}
2780       \tl_set:Nn \l_fontspec_script_tl {latn}
2781       \int_set:Nn \l_@@_script_int {\l_@@_strnum_int}
2782     }
2783     {
2784       \@@_warning:nx {script-not-exist} {#1}
2785     }
2786   }
2787 }
2788 }
2789 }

```

### 38.4.2 Language

```

2790 \keys_define:nn { fontspec-opentype } { Language .choice: }
2791 \cs_new:Nn \fontspec_new_lang:nn
2792 {
2793   \keys_define:nn { fontspec-opentype } { Language / #1 .code:n =
2794     \@@_check_lang:nTF {#2}
2795     {
2796       \tl_set:Nn \l_fontspec_lang_tl {#2}
2797       \int_set:Nn \l_@@_language_int {\l_@@_strnum_int}
2798       \tl_gset:Nx \g_@@_single_feat_tl { language=#2 }
2799     }
2800     {
2801       \@@_warning:nx {language-not-exist} {#1}
2802       \keys_set:nn { fontspec-opentype } { Language = Default }
2803     }
2804   }
2805 }

```

### Default

```

2806 \@@_keys_define_code:nnn {fontspec-opentype}{ Language / Default }

```

```

2807 {
2808   \tl_set:Nn \l_fontspec_lang_tl {DFLT}
2809   \int_zero:N \l_@@_language_int
2810   \tl_gset:Nn \g_@@_single_feat_tl { language=DFLT }
2811 }

```

**Turkish** Turns out that many fonts use ‘TUR’ as their Turkish language tag rather than the specified ‘TRK’. So we check for both:

```

2812 \keys_define:nn {fontspec-opentype}
2813 {
2814   Language / Turkish .code:n =
2815   {
2816     \@@_check_lang:nTF {TRK}
2817     {
2818       \int_set:Nn \l_@@_language_int {\l_@@_strnum_int}
2819       \tl_set:Nn \l_fontspec_lang_tl {TRK}
2820       \tl_gset:Nn \g_@@_single_feat_tl { language=TRK }
2821     }
2822     {
2823       \@@_check_lang:nTF {TUR}
2824       {
2825         \int_set:Nn \l_@@_language_int {\l_@@_strnum_int}
2826         \tl_set:Nn \l_fontspec_lang_tl {TUR}
2827         \tl_gset:Nn \g_@@_single_feat_tl { language=TUR }
2828       }
2829       {
2830         \@@_warning:nx {language-not-exist} {Turkish}
2831         \keys_set:nn {fontspec-opentype} {Language=Default}
2832       }
2833     }
2834   }
2835 }

```

## 38.5 Backwards compatibility

Backwards compatibility:

```

2836 \cs_new:Nn \@@_ot_compat:nn
2837 {
2838   \aliasfontfeatureoption {#1} {#2Off} {No#2}
2839 }
2840 \@@_ot_compat:nn {Ligatures} {Rare}
2841 \@@_ot_compat:nn {Ligatures} {Required}
2842 \@@_ot_compat:nn {Ligatures} {Common}
2843 \@@_ot_compat:nn {Ligatures} {Discretionary}
2844 \@@_ot_compat:nn {Ligatures} {Contextual}
2845 \@@_ot_compat:nn {Ligatures} {Historic}
2846 \@@_ot_compat:nn {Numbers} {SlashedZero}
2847 \@@_ot_compat:nn {Contextuals} {Swash}
2848 \@@_ot_compat:nn {Contextuals} {Alternate}
2849 \@@_ot_compat:nn {Contextuals} {WordInitial}

```

```

2850 \@@_ot_compat:nn {Contextuals} {WordFinal}
2851 \@@_ot_compat:nn {Contextuals} {LineFinal}
2852 \@@_ot_compat:nn {Contextuals} {Inner}
2853 \@@_ot_compat:nn {Diacritics} {MarkToBase}
2854 \@@_ot_compat:nn {Diacritics} {MarkToMark}
2855 \@@_ot_compat:nn {Diacritics} {AboveBase}
2856 \@@_ot_compat:nn {Diacritics} {BelowBase}

```

## 38.6 Font script definitions

```

2857 \newfontscript{Arabic}{arab}
2858 \newfontscript{Armenian}{armn}
2859 \newfontscript{Balinese}{bali}
2860 \newfontscript{Bengali}{bng2,beng}
2861 \newfontscript{Bopomofo}{bopo}
2862 \newfontscript{Braille}{brai}
2863 \newfontscript{Buginese}{bugi}
2864 \newfontscript{Buhid}{buhd}
2865 \newfontscript{Byzantine~Music}{byzm}
2866 \newfontscript{Canadian~Syllabics}{cans}
2867 \newfontscript{Cherokee}{cher}
2868 \newfontscript{CJK~Ideographic}{hani}
2869 \newfontscript{Coptic}{copt}
2870 \newfontscript{Cypriot~Syllabary}{cpri}
2871 \newfontscript{Cyrillic}{cyr1}
2872 \newfontscript{Default}{DFLT}
2873 \newfontscript{Deseret}{dsrt}
2874 \newfontscript{Devanagari}{dev2,deva}
2875 \newfontscript{Ethiopic}{ethi}
2876 \newfontscript{Georgian}{geor}
2877 \newfontscript{Glagolitic}{glag}
2878 \newfontscript{Gothic}{goth}
2879 \newfontscript{Greek}{grek}
2880 \newfontscript{Gujarati}{gjr2,gujr}
2881 \newfontscript{Gurmukhi}{gur2,guru}
2882 \newfontscript{Hangul~Jamo}{jamo}
2883 \newfontscript{Hangul}{hang}
2884 \newfontscript{Hanunoo}{hano}
2885 \newfontscript{Hebrew}{hebr}
2886 \newfontscript{Hiragana~and~Katakana}{kana}
2887 \newfontscript{Javanese}{java}
2888 \newfontscript{Kannada}{knd2,knda}
2889 \newfontscript{Kharosthi}{khar}
2890 \newfontscript{Khmer}{khmr}
2891 \newfontscript{Lao}{lao~}
2892 \newfontscript{Latin}{latn}
2893 \newfontscript{Limbu}{limb}
2894 \newfontscript{Linear~B}{linb}
2895 \newfontscript{Malayalam}{mlm2,mlym}
2896 \newfontscript{Math}{math}
2897 \newfontscript{Mongolian}{mong}

```

```

2898 \newfontscript{Musical-Symbols}{musc}
2899 \newfontscript{Myanmar}{mymr}
2900 \newfontscript{N'ko}{nko~}
2901 \newfontscript{Ogham}{ogam}
2902 \newfontscript{Old-Italic}{ital}
2903 \newfontscript{Old-Persian-Cuneiform}{xpeo}
2904 \newfontscript{Oriya}{ory2,orya}
2905 \newfontscript{Osmanya}{osma}
2906 \newfontscript{Phags-pa}{phag}
2907 \newfontscript{Phoenician}{phnx}
2908 \newfontscript{Runic}{runr}
2909 \newfontscript{Shavian}{shaw}
2910 \newfontscript{Sinhala}{sinh}
2911 \newfontscript{Sumero-Akkadian-Cuneiform}{xsux}
2912 \newfontscript{Syloti-Nagri}{sylo}
2913 \newfontscript{Syriac}{syr}
2914 \newfontscript{Tagalog}{tglg}
2915 \newfontscript{Tagbanwa}{tagb}
2916 \newfontscript{Tai-Le}{tale}
2917 \newfontscript{Tai-Lu}{tal}
2918 \newfontscript{Tamil}{tml2,taml}
2919 \newfontscript{Telugu}{tel2,tel}
2920 \newfontscript{Thaana}{thaa}
2921 \newfontscript{Thai}{thai}
2922 \newfontscript{Tibetan}{tib}
2923 \newfontscript{Tifinagh}{tfn}
2924 \newfontscript{Ugaritic-Cuneiform}{ugar}
2925 \newfontscript{Yi}{yi~}

```

For convenience:

```

2926 \newfontscript{Kana}{kana}
2927 \newfontscript{Maths}{math}
2928 \newfontscript{CJK}{hani}

```

## 38.7 Font language definitions

```

2929 \newfontlanguage{Abaza}{ABA}
2930 \newfontlanguage{Abkhazian}{ABK}
2931 \newfontlanguage{Adyghe}{ADY}
2932 \newfontlanguage{Afrikaans}{AFK}
2933 \newfontlanguage{Afar}{AFR}
2934 \newfontlanguage{Agaw}{AGW}
2935 \newfontlanguage{Altai}{ALT}
2936 \newfontlanguage{Amharic}{AMH}
2937 \newfontlanguage{Arabic}{ARA}
2938 \newfontlanguage{Aari}{ARI}
2939 \newfontlanguage{Arakanese}{ARK}
2940 \newfontlanguage{Assamese}{ASM}
2941 \newfontlanguage{Athapaskan}{ATH}
2942 \newfontlanguage{Avar}{AVR}
2943 \newfontlanguage{Awadhi}{AWA}
2944 \newfontlanguage{Aymara}{AYM}
2945 \newfontlanguage{Azeri}{AZE}

```

2946 \newfontlanguage{Badaga}{BAD}  
 2947 \newfontlanguage{Baghelkhandi}{BAG}  
 2948 \newfontlanguage{Balkar}{BAL}  
 2949 \newfontlanguage{Baule}{BAU}  
 2950 \newfontlanguage{Berber}{BBR}  
 2951 \newfontlanguage{Bench}{BCH}  
 2952 \newfontlanguage{Bible~Cree}{BCR}  
 2953 \newfontlanguage{Belarussian}{BEL}  
 2954 \newfontlanguage{Bemba}{BEM}  
 2955 \newfontlanguage{Bengali}{BEN}  
 2956 \newfontlanguage{Bulgarian}{BGR}  
 2957 \newfontlanguage{Bhili}{BHI}  
 2958 \newfontlanguage{Bhojpurī}{BHO}  
 2959 \newfontlanguage{Bikol}{BIK}  
 2960 \newfontlanguage{Bilen}{BIL}  
 2961 \newfontlanguage{Blackfoot}{BKF}  
 2962 \newfontlanguage{Balochi}{BLI}  
 2963 \newfontlanguage{Balante}{BLN}  
 2964 \newfontlanguage{Balti}{BLT}  
 2965 \newfontlanguage{Bambara}{BMB}  
 2966 \newfontlanguage{Bamileke}{BML}  
 2967 \newfontlanguage{Breton}{BRE}  
 2968 \newfontlanguage{Brahui}{BRH}  
 2969 \newfontlanguage{Braj~Bhasha}{BRI}  
 2970 \newfontlanguage{Burmese}{BRM}  
 2971 \newfontlanguage{Bashkir}{BSH}  
 2972 \newfontlanguage{Beti}{BTI}  
 2973 \newfontlanguage{Catalan}{CAT}  
 2974 \newfontlanguage{Cebuano}{CEB}  
 2975 \newfontlanguage{Chechen}{CHE}  
 2976 \newfontlanguage{Chaha~Gurage}{CHG}  
 2977 \newfontlanguage{Chattisgarhi}{CHH}  
 2978 \newfontlanguage{Chichewa}{CHI}  
 2979 \newfontlanguage{Chukchi}{CHK}  
 2980 \newfontlanguage{Chipewyan}{CHP}  
 2981 \newfontlanguage{Cherokee}{CHR}  
 2982 \newfontlanguage{Chuvash}{CHU}  
 2983 \newfontlanguage{Comorian}{CMR}  
 2984 \newfontlanguage{Coptic}{COP}  
 2985 \newfontlanguage{Cree}{CRE}  
 2986 \newfontlanguage{Carrier}{CRR}  
 2987 \newfontlanguage{Crimean~Tatar}{CRT}  
 2988 \newfontlanguage{Church~Slavonic}{CSL}  
 2989 \newfontlanguage{Czech}{CSY}  
 2990 \newfontlanguage{Danish}{DAN}  
 2991 \newfontlanguage{Dargwa}{DAR}  
 2992 \newfontlanguage{Woods~Cree}{DCR}  
 2993 \newfontlanguage{German}{DEU}  
 2994 \newfontlanguage{Dogri}{DGR}  
 2995 \newfontlanguage{Divehi}{DIV}  
 2996 \newfontlanguage{Djerma}{DJR}



2997 \newfontlanguage{Dangme}{DNG}  
 2998 \newfontlanguage{Dinka}{DNK}  
 2999 \newfontlanguage{Dungan}{DUN}  
 3000 \newfontlanguage{Dzongkha}{DZN}  
 3001 \newfontlanguage{Ebira}{EBI}  
 3002 \newfontlanguage{Eastern~Cree}{ECR}  
 3003 \newfontlanguage{Edo}{EDO}  
 3004 \newfontlanguage{Efik}{EFI}  
 3005 \newfontlanguage{Greek}{ELL}  
 3006 \newfontlanguage{English}{ENG}  
 3007 \newfontlanguage{Erzya}{ERZ}  
 3008 \newfontlanguage{Spanish}{ESP}  
 3009 \newfontlanguage{Estonian}{ETI}  
 3010 \newfontlanguage{Basque}{EUQ}  
 3011 \newfontlanguage{Evenki}{EVK}  
 3012 \newfontlanguage{Even}{EVN}  
 3013 \newfontlanguage{Ewe}{EWE}  
 3014 \newfontlanguage{French~Antillean}{FAN}  
 3015 \newfontlanguage{Farsi}{FAR}  
 3016 \newfontlanguage{Parsi}{FAR}  
 3017 \newfontlanguage{Persian}{FAR}  
 3018 \newfontlanguage{Finnish}{FIN}  
 3019 \newfontlanguage{Fijian}{FJI}  
 3020 \newfontlanguage{Flemish}{FLE}  
 3021 \newfontlanguage{Forest~Nenets}{FNE}  
 3022 \newfontlanguage{Fon}{FON}  
 3023 \newfontlanguage{Faroese}{FOS}  
 3024 \newfontlanguage{French}{FRA}  
 3025 \newfontlanguage{Frisian}{FRI}  
 3026 \newfontlanguage{Friulian}{FRL}  
 3027 \newfontlanguage{Futa}{FTA}  
 3028 \newfontlanguage{Fulani}{FUL}  
 3029 \newfontlanguage{Ga}{GAD}  
 3030 \newfontlanguage{Gaelic}{GAE}  
 3031 \newfontlanguage{Gagauz}{GAG}  
 3032 \newfontlanguage{Galician}{GAL}  
 3033 \newfontlanguage{Garshuni}{GAR}  
 3034 \newfontlanguage{Garhwali}{GAW}  
 3035 \newfontlanguage{Ge'ez}{GEZ}  
 3036 \newfontlanguage{Gilyak}{GIL}  
 3037 \newfontlanguage{Gumuz}{GMZ}  
 3038 \newfontlanguage{Gondi}{GON}  
 3039 \newfontlanguage{Greenlandic}{GRN}  
 3040 \newfontlanguage{Garó}{GRO}  
 3041 \newfontlanguage{Guarani}{GUA}  
 3042 \newfontlanguage{Gujarati}{GUJ}  
 3043 \newfontlanguage{Haitian}{HAI}  
 3044 \newfontlanguage{Halam}{HAL}  
 3045 \newfontlanguage{Harauti}{HAR}  
 3046 \newfontlanguage{Hausa}{HAU}  
 3047 \newfontlanguage{Hawaiin}{HAW}

3048 \newfontlanguage{Hammer-Banna}{HBN}  
 3049 \newfontlanguage{Hiligaynon}{HIL}  
 3050 \newfontlanguage{Hindi}{HIN}  
 3051 \newfontlanguage{High-Mari}{HMA}  
 3052 \newfontlanguage{Hindko}{HND}  
 3053 \newfontlanguage{Ho}{HO}  
 3054 \newfontlanguage{Harari}{HRI}  
 3055 \newfontlanguage{Croatian}{HRV}  
 3056 \newfontlanguage{Hungarian}{HUN}  
 3057 \newfontlanguage{Armenian}{HYE}  
 3058 \newfontlanguage{Igbo}{IBO}  
 3059 \newfontlanguage{Ijo}{IJO}  
 3060 \newfontlanguage{Ilokano}{ILO}  
 3061 \newfontlanguage{Indonesian}{IND}  
 3062 \newfontlanguage{Ingush}{ING}  
 3063 \newfontlanguage{Inuktitut}{INU}  
 3064 \newfontlanguage{Irish}{IRI}  
 3065 \newfontlanguage{Irish-Traditional}{IRT}  
 3066 \newfontlanguage{Icelandic}{ISL}  
 3067 \newfontlanguage{Inari-Sami}{ISM}  
 3068 \newfontlanguage{Italian}{ITA}  
 3069 \newfontlanguage{Hebrew}{IWR}  
 3070 \newfontlanguage{Javanese}{JAV}  
 3071 \newfontlanguage{Yiddish}{JII}  
 3072 \newfontlanguage{Japanese}{JAN}  
 3073 \newfontlanguage{Judezmo}{JUD}  
 3074 \newfontlanguage{Jula}{JUL}  
 3075 \newfontlanguage{Kabardian}{KAB}  
 3076 \newfontlanguage{Kachchi}{KAC}  
 3077 \newfontlanguage{Kalenjin}{KAL}  
 3078 \newfontlanguage{Kannada}{KAN}  
 3079 \newfontlanguage{Karachay}{KAR}  
 3080 \newfontlanguage{Georgian}{KAT}  
 3081 \newfontlanguage{Kazakh}{KAZ}  
 3082 \newfontlanguage{Kebena}{KEB}  
 3083 \newfontlanguage{Khutsuri-Georgian}{KGE}  
 3084 \newfontlanguage{Khakass}{KHA}  
 3085 \newfontlanguage{Khanty-Kazim}{KHK}  
 3086 \newfontlanguage{Khmer}{KHM}  
 3087 \newfontlanguage{Khanty-Shurishkar}{KHS}  
 3088 \newfontlanguage{Khanty-Vakhi}{KHV}  
 3089 \newfontlanguage{Khowar}{KHW}  
 3090 \newfontlanguage{Kikuyu}{KIK}  
 3091 \newfontlanguage{Kirghiz}{KIR}  
 3092 \newfontlanguage{Kisii}{KIS}  
 3093 \newfontlanguage{Kokni}{KKN}  
 3094 \newfontlanguage{Kalmyk}{KLM}  
 3095 \newfontlanguage{Kamba}{KMB}  
 3096 \newfontlanguage{Kumaoni}{KMN}  
 3097 \newfontlanguage{Komo}{KMO}  
 3098 \newfontlanguage{Komso}{KMS}

3109 \newfontlanguage{Kanuri}{KNR}  
 3100 \newfontlanguage{Kodagu}{KOD}  
 3101 \newfontlanguage{Korean-Old-Hangul}{KOH}  
 3102 \newfontlanguage{Konkani}{KOK}  
 3103 \newfontlanguage{Kikongo}{KON}  
 3104 \newfontlanguage{Komi-Permyak}{KOP}  
 3105 \newfontlanguage{Korean}{KOR}  
 3106 \newfontlanguage{Komi-Zyrian}{KOZ}  
 3107 \newfontlanguage{Kpelle}{KPL}  
 3108 \newfontlanguage{Krio}{KRI}  
 3109 \newfontlanguage{Karakalpak}{KRK}  
 3110 \newfontlanguage{Karelian}{KRL}  
 3111 \newfontlanguage{Karaim}{KRM}  
 3112 \newfontlanguage{Karen}{KRN}  
 3113 \newfontlanguage{Koorete}{KRT}  
 3114 \newfontlanguage{Kashmiri}{KSH}  
 3115 \newfontlanguage{Khasi}{KSI}  
 3116 \newfontlanguage{Kildin-Sami}{KSM}  
 3117 \newfontlanguage{Kui}{KUI}  
 3118 \newfontlanguage{Kulvi}{KUL}  
 3119 \newfontlanguage{Kumyk}{KUM}  
 3120 \newfontlanguage{Kurdish}{KUR}  
 3121 \newfontlanguage{Kurukh}{KUU}  
 3122 \newfontlanguage{Kuy}{KUY}  
 3123 \newfontlanguage{Koryak}{KYK}  
 3124 \newfontlanguage{Ladin}{LAD}  
 3125 \newfontlanguage{Lahuli}{LAH}  
 3126 \newfontlanguage{Lak}{LAK}  
 3127 \newfontlanguage{Lambani}{LAM}  
 3128 \newfontlanguage{Lao}{LAO}  
 3129 \newfontlanguage{Latin}{LAT}  
 3130 \newfontlanguage{Laz}{LAZ}  
 3131 \newfontlanguage{L-Cree}{LCR}  
 3132 \newfontlanguage{Ladakhi}{LDK}  
 3133 \newfontlanguage{Lezgi}{LEZ}  
 3134 \newfontlanguage{Lingala}{LIN}  
 3135 \newfontlanguage{Low-Mari}{LMA}  
 3136 \newfontlanguage{Limbu}{LMB}  
 3137 \newfontlanguage{Lomwe}{LMW}  
 3138 \newfontlanguage{Lower-Sorbian}{LSB}  
 3139 \newfontlanguage{Lule-Sami}{LSM}  
 3140 \newfontlanguage{Lithuanian}{LTH}  
 3141 \newfontlanguage{Luba}{LUB}  
 3142 \newfontlanguage{Luganda}{LUG}  
 3143 \newfontlanguage{Luhya}{LUH}  
 3144 \newfontlanguage{Luo}{LUO}  
 3145 \newfontlanguage{Latvian}{LVI}  
 3146 \newfontlanguage{Majang}{MAJ}  
 3147 \newfontlanguage{Makua}{MAK}  
 3148 \newfontlanguage{Malayalam-Traditional}{MAL}  
 3149 \newfontlanguage{Mansi}{MAN}

3150 \newfontlanguage{Marathi}{MAR}  
 3151 \newfontlanguage{Marwari}{MAW}  
 3152 \newfontlanguage{Mbundu}{MBN}  
 3153 \newfontlanguage{Manchu}{MCH}  
 3154 \newfontlanguage{Moose-Cree}{MCR}  
 3155 \newfontlanguage{Mende}{MDE}  
 3156 \newfontlanguage{Me'en}{MEN}  
 3157 \newfontlanguage{Mizo}{MIZ}  
 3158 \newfontlanguage{Macedonian}{MKD}  
 3159 \newfontlanguage{Male}{MLE}  
 3160 \newfontlanguage{Malagasy}{MLG}  
 3161 \newfontlanguage{Malinke}{MLN}  
 3162 \newfontlanguage{Malayalam-Reformed}{MLR}  
 3163 \newfontlanguage{Malay}{MLY}  
 3164 \newfontlanguage{Mandinka}{MND}  
 3165 \newfontlanguage{Mongolian}{MNG}  
 3166 \newfontlanguage{Manipuri}{MNI}  
 3167 \newfontlanguage{Maninka}{MNK}  
 3168 \newfontlanguage{Manx-Gaelic}{MNX}  
 3169 \newfontlanguage{Moksha}{MOK}  
 3170 \newfontlanguage{Moldavian}{MOL}  
 3171 \newfontlanguage{Mon}{MON}  
 3172 \newfontlanguage{Moroccan}{MOR}  
 3173 \newfontlanguage{Maori}{MRI}  
 3174 \newfontlanguage{Maithili}{MTH}  
 3175 \newfontlanguage{Maltese}{MTS}  
 3176 \newfontlanguage{Mundari}{MUN}  
 3177 \newfontlanguage{Naga-Assamese}{NAG}  
 3178 \newfontlanguage{Nanai}{NAN}  
 3179 \newfontlanguage{Naskapi}{NAS}  
 3180 \newfontlanguage{N-Cree}{NCR}  
 3181 \newfontlanguage{Ndebele}{NDB}  
 3182 \newfontlanguage{Ndonga}{NDG}  
 3183 \newfontlanguage{Nepali}{NEP}  
 3184 \newfontlanguage{Newari}{NEW}  
 3185 \newfontlanguage{Nagari}{NGR}  
 3186 \newfontlanguage{Norway-House-Cree}{NHC}  
 3187 \newfontlanguage{Nisi}{NIS}  
 3188 \newfontlanguage{Niuean}{NIU}  
 3189 \newfontlanguage{Nkole}{NKL}  
 3190 \newfontlanguage{N'ko}{NKO}  
 3191 \newfontlanguage{Dutch}{NLD}  
 3192 \newfontlanguage{Nogai}{NOG}  
 3193 \newfontlanguage{Norwegian}{NOR}  
 3194 \newfontlanguage{Northern-Sami}{NSM}  
 3195 \newfontlanguage{Northern-Tai}{NTA}  
 3196 \newfontlanguage{Esperanto}{NTO}  
 3197 \newfontlanguage{Nynorsk}{NYN}  
 3198 \newfontlanguage{Oji-Cree}{OCR}  
 3199 \newfontlanguage{Ojibway}{OBJ}  
 3200 \newfontlanguage{Oriya}{ORI}

3201 \newfontlanguage{Oromo}{ORO}  
 3202 \newfontlanguage{Ossetian}{OSS}  
 3203 \newfontlanguage{Palestinian-Aramaic}{PAA}  
 3204 \newfontlanguage{Pali}{PAL}  
 3205 \newfontlanguage{Punjabi}{PAN}  
 3206 \newfontlanguage{Palpa}{PAP}  
 3207 \newfontlanguage{Pashto}{PAS}  
 3208 \newfontlanguage{Polytonic-Greek}{PGR}  
 3209 \newfontlanguage{Pilipino}{PIL}  
 3210 \newfontlanguage{Palaung}{PLG}  
 3211 \newfontlanguage{Polish}{PLK}  
 3212 \newfontlanguage{Provençal}{PRO}  
 3213 \newfontlanguage{Portuguese}{PTG}  
 3214 \newfontlanguage{Chin}{QIN}  
 3215 \newfontlanguage{Rajasthani}{RAJ}  
 3216 \newfontlanguage{R-Cree}{RCR}  
 3217 \newfontlanguage{Russian-Buriat}{RBU}  
 3218 \newfontlanguage{Riang}{RIA}  
 3219 \newfontlanguage{Rhaeto-Romanic}{RMS}  
 3220 \newfontlanguage{Romanian}{ROM}  
 3221 \newfontlanguage{Romany}{ROY}  
 3222 \newfontlanguage{Rusyn}{RSY}  
 3223 \newfontlanguage{Ruanda}{RUA}  
 3224 \newfontlanguage{Russian}{RUS}  
 3225 \newfontlanguage{Sadri}{SAD}  
 3226 \newfontlanguage{Sanskrit}{SAN}  
 3227 \newfontlanguage{Santali}{SAT}  
 3228 \newfontlanguage{Sayisi}{SAY}  
 3229 \newfontlanguage{Sekota}{SEK}  
 3230 \newfontlanguage{Selkup}{SEL}  
 3231 \newfontlanguage{Sango}{SGO}  
 3232 \newfontlanguage{Shan}{SHN}  
 3233 \newfontlanguage{Sibe}{SIB}  
 3234 \newfontlanguage{Sidamo}{SID}  
 3235 \newfontlanguage{Silte-Gurage}{SIG}  
 3236 \newfontlanguage{Skolt-Sami}{SKS}  
 3237 \newfontlanguage{Slovak}{SKY}  
 3238 \newfontlanguage{Slavey}{SLA}  
 3239 \newfontlanguage{Slovenian}{SLV}  
 3240 \newfontlanguage{Somali}{SML}  
 3241 \newfontlanguage{Samoan}{SMO}  
 3242 \newfontlanguage{Sena}{SNA}  
 3243 \newfontlanguage{Sindhi}{SND}  
 3244 \newfontlanguage{Sinhalese}{SNH}  
 3245 \newfontlanguage{Soninke}{SNK}  
 3246 \newfontlanguage{Sodo-Gurage}{SOG}  
 3247 \newfontlanguage{Sotho}{SOT}  
 3248 \newfontlanguage{Albanian}{SQI}  
 3249 \newfontlanguage{Serbian}{SRB}  
 3250 \newfontlanguage{Saraiki}{SRK}  
 3251 \newfontlanguage{Serer}{SRR}

3252 \newfontlanguage{South-Slavey}{SSL}  
 3253 \newfontlanguage{Southern-Sami}{SSM}  
 3254 \newfontlanguage{Suri}{SUR}  
 3255 \newfontlanguage{Svan}{SVA}  
 3256 \newfontlanguage{Swedish}{SVE}  
 3257 \newfontlanguage{Swadaya-Aramaic}{SWA}  
 3258 \newfontlanguage{Swahili}{SWK}  
 3259 \newfontlanguage{Swazi}{SWZ}  
 3260 \newfontlanguage{Sutu}{SXT}  
 3261 \newfontlanguage{Syriac}{SYR}  
 3262 \newfontlanguage{Tabasaran}{TAB}  
 3263 \newfontlanguage{Tajiki}{TAJ}  
 3264 \newfontlanguage{Tamil}{TAM}  
 3265 \newfontlanguage{Tatar}{TAT}  
 3266 \newfontlanguage{TH-Cree}{TCR}  
 3267 \newfontlanguage{Telugu}{TEL}  
 3268 \newfontlanguage{Tongan}{TGN}  
 3269 \newfontlanguage{Tigre}{TGR}  
 3270 \newfontlanguage{Tigrinya}{TGY}  
 3271 \newfontlanguage{Thai}{THA}  
 3272 \newfontlanguage{Tahitian}{THT}  
 3273 \newfontlanguage{Tibetan}{TIB}  
 3274 \newfontlanguage{Turkmen}{TKM}  
 3275 \newfontlanguage{Temne}{TMN}  
 3276 \newfontlanguage{Tswana}{TNA}  
 3277 \newfontlanguage{Tundra-Nenets}{TNE}  
 3278 \newfontlanguage{Tonga}{TNG}  
 3279 \newfontlanguage{Todo}{TOD}  
 3280 \newfontlanguage{Tsonga}{TSG}  
 3281 \newfontlanguage{Turoyo-Aramaic}{TUA}  
 3282 \newfontlanguage{Tulu}{TUL}  
 3283 \newfontlanguage{Tuvini}{TUV}  
 3284 \newfontlanguage{Twini}{TWI}  
 3285 \newfontlanguage{Udmurt}{UDM}  
 3286 \newfontlanguage{Ukrainian}{UKR}  
 3287 \newfontlanguage{Urdu}{URD}  
 3288 \newfontlanguage{Upper-Sorbian}{USB}  
 3289 \newfontlanguage{Uyghur}{UYG}  
 3290 \newfontlanguage{Uzbek}{UZB}  
 3291 \newfontlanguage{Venda}{VEN}  
 3292 \newfontlanguage{Vietnamese}{VIT}  
 3293 \newfontlanguage{Wa}{WA}  
 3294 \newfontlanguage{Wagdi}{WAG}  
 3295 \newfontlanguage{West-Cree}{WCR}  
 3296 \newfontlanguage{Welsh}{WEL}  
 3297 \newfontlanguage{Wolof}{WLF}  
 3298 \newfontlanguage{Tai-Lue}{XBD}  
 3299 \newfontlanguage{Xhosa}{XHS}  
 3300 \newfontlanguage{Yakut}{YAK}  
 3301 \newfontlanguage{Yoruba}{YBA}  
 3302 \newfontlanguage{Y-Cree}{YCR}

```

3303 \newfontlanguage{Yi~Classic}{YIC}
3304 \newfontlanguage{Yi~Modern}{YIM}
3305 \newfontlanguage{Chinese~Hong~Kong}{ZHH}
3306 \newfontlanguage{Chinese~Phonetic}{ZHP}
3307 \newfontlanguage{Chinese~Simplified}{ZHS}
3308 \newfontlanguage{Chinese~Traditional}{ZHT}
3309 \newfontlanguage{Zande}{ZND}
3310 \newfontlanguage{Zulu}{ZUL}

```

## 38.8 AAT feature definitions

These are only defined for X<sub>Y</sub>TeX.

### 38.8.1 Ligatures

```

3311 \@@_define_aat_feature_group:n {Ligatures}
3312 \@@_define_aat_feature:nnnn {Ligatures} {Required} {1} {0}
3313 \@@_define_aat_feature:nnnn {Ligatures} {NoRequired} {1} {1}
3314 \@@_define_aat_feature:nnnn {Ligatures} {Common} {1} {2}
3315 \@@_define_aat_feature:nnnn {Ligatures} {NoCommon} {1} {3}
3316 \@@_define_aat_feature:nnnn {Ligatures} {Rare} {1} {4}
3317 \@@_define_aat_feature:nnnn {Ligatures} {NoRare} {1} {5}
3318 \@@_define_aat_feature:nnnn {Ligatures} {Discretionary} {1} {4}
3319 \@@_define_aat_feature:nnnn {Ligatures} {NoDiscretionary} {1} {5}
3320 \@@_define_aat_feature:nnnn {Ligatures} {Logos} {1} {6}
3321 \@@_define_aat_feature:nnnn {Ligatures} {NoLogos} {1} {7}
3322 \@@_define_aat_feature:nnnn {Ligatures} {Rebus} {1} {8}
3323 \@@_define_aat_feature:nnnn {Ligatures} {NoRebus} {1} {9}
3324 \@@_define_aat_feature:nnnn {Ligatures} {Diphthong} {1} {10}
3325 \@@_define_aat_feature:nnnn {Ligatures} {NoDiphthong} {1} {11}
3326 \@@_define_aat_feature:nnnn {Ligatures} {Squared} {1} {12}
3327 \@@_define_aat_feature:nnnn {Ligatures} {NoSquared} {1} {13}
3328 \@@_define_aat_feature:nnnn {Ligatures} {AbbrevSquared} {1} {14}
3329 \@@_define_aat_feature:nnnn {Ligatures} {NoAbbrevSquared} {1} {15}
3330 \@@_define_aat_feature:nnnn {Ligatures} {Icelandic} {1} {32}
3331 \@@_define_aat_feature:nnnn {Ligatures} {NoIcelandic} {1} {33}

```

Emulate CM extra ligatures.

```

3332 \keys_define:nn {fontspec-aat}
3333 {
3334   Ligatures / TeX .code:n =
3335   {
3336     \@@_update_featstr:n { mapping = tex-text }
3337   }
3338 }

```

### 38.8.2 Letters

```

3339 \@@_define_aat_feature_group:n {Letters}
3340 \@@_define_aat_feature:nnnn {Letters} {Normal} {3} {0}
3341 \@@_define_aat_feature:nnnn {Letters} {Uppercase} {3} {1}
3342 \@@_define_aat_feature:nnnn {Letters} {Lowercase} {3} {2}
3343 \@@_define_aat_feature:nnnn {Letters} {SmallCaps} {3} {3}
3344 \@@_define_aat_feature:nnnn {Letters} {InitialCaps} {3} {4}

```

### 38.8.3 Numbers

These were originally separated into NumberCase and NumberSpacing following AAT, but it makes more sense to combine them.

Both naming conventions are offered to select the number case.

```
3345 \@@_define_aat_feature_group:n {Numbers}
3346 \@@_define_aat_feature:nnnn {Numbers} {Monospaced} {6} {0}
3347 \@@_define_aat_feature:nnnn {Numbers} {Proportional} {6} {1}
3348 \@@_define_aat_feature:nnnn {Numbers} {Lowercase} {21} {0}
3349 \@@_define_aat_feature:nnnn {Numbers} {OldStyle} {21} {0}
3350 \@@_define_aat_feature:nnnn {Numbers} {Uppercase} {21} {1}
3351 \@@_define_aat_feature:nnnn {Numbers} {Lining} {21} {1}
3352 \@@_define_aat_feature:nnnn {Numbers} {SlashedZero} {14} {5}
3353 \@@_define_aat_feature:nnnn {Numbers} {NoSlashedZero} {14} {4}
```

### 38.8.4 Contextuals

```
3354 \@@_define_aat_feature_group:n {Contextuals}
3355 \@@_define_aat_feature:nnnn {Contextuals} {WordInitial} {8} {0}
3356 \@@_define_aat_feature:nnnn {Contextuals} {NoWordInitial} {8} {1}
3357 \@@_define_aat_feature:nnnn {Contextuals} {WordFinal} {8} {2}
3358 \@@_define_aat_feature:nnnn {Contextuals} {NoWordFinal} {8} {3}
3359 \@@_define_aat_feature:nnnn {Contextuals} {LineInitial} {8} {4}
3360 \@@_define_aat_feature:nnnn {Contextuals} {NoLineInitial} {8} {5}
3361 \@@_define_aat_feature:nnnn {Contextuals} {LineFinal} {8} {6}
3362 \@@_define_aat_feature:nnnn {Contextuals} {NoLineFinal} {8} {7}
3363 \@@_define_aat_feature:nnnn {Contextuals} {Inner} {8} {8}
3364 \@@_define_aat_feature:nnnn {Contextuals} {NoInner} {8} {9}
```

### 38.8.5 Diacritics

```
3365 \@@_define_aat_feature_group:n {Diacritics}
3366 \@@_define_aat_feature:nnnn {Diacritics} {Show} {9} {0}
3367 \@@_define_aat_feature:nnnn {Diacritics} {Hide} {9} {1}
3368 \@@_define_aat_feature:nnnn {Diacritics} {Decompose} {9} {2}
```

### 38.8.6 Vertical position

```
3369 \@@_define_aat_feature_group:n {VerticalPosition}
3370 \@@_define_aat_feature:nnnn {VerticalPosition} {Normal} {10} {0}
3371 \@@_define_aat_feature:nnnn {VerticalPosition} {Superior} {10} {1}
3372 \@@_define_aat_feature:nnnn {VerticalPosition} {Inferior} {10} {2}
3373 \@@_define_aat_feature:nnnn {VerticalPosition} {Ordinal} {10} {3}
```

### 38.8.7 Fractions

```
3374 \@@_define_aat_feature_group:n {Fractions}
3375 \@@_define_aat_feature:nnnn {Fractions} {0n} {11} {1}
3376 \@@_define_aat_feature:nnnn {Fractions} {Off} {11} {0}
3377 \@@_define_aat_feature:nnnn {Fractions} {Diagonal} {11} {2}
```

### 38.8.8 Alternate

```
3378 \@@_define_aat_feature_group:n { Alternate }
3379 \keys_define:nm {fontspec-aat}
```



```

3380 {
3381   Alternate .default:n = {0} ,
3382   Alternate / unknown .code:n =
3383   {
3384     \clist_map_inline:nn {#1}
3385     {
3386       \@@_make_AAT_feature:nn {17}{##1}
3387     }
3388   }
3389 }

```

### 38.8.9 Variant / StylisticSet

```

3390 \@@_define_aat_feature_group:n {Variant}
3391 \keys_define:nn {fontspec-aat}
3392 {
3393   Variant .default:n = {0} ,
3394   Variant / unknown .code:n =
3395   {
3396     \clist_map_inline:nn {#1}
3397     { \@@_make_AAT_feature:nn {18}{##1} }
3398   }
3399 }
3400 \aliasfontfeature{Variant}{StylisticSet}

3401 \@@_define_aat_feature_group:n {Vertical}
3402 \keys_define:nn {fontspec-aat}
3403 {
3404   Vertical .choice: ,
3405   Vertical / RotatedGlyphs .code:n =
3406   {
3407     \__fontspec_update_featstr:n {vertical}
3408   }
3409 }
3410

```

### 38.8.10 Style

```

3411 \@@_define_aat_feature_group:n {Style}
3412 \@@_define_aat_feature:nnnn {Style} {Italic} {32} {2}
3413 \@@_define_aat_feature:nnnn {Style} {Ruby} {28} {2}
3414 \@@_define_aat_feature:nnnn {Style} {Display} {19} {1}
3415 \@@_define_aat_feature:nnnn {Style} {Engraved} {19} {2}
3416 \@@_define_aat_feature:nnnn {Style} {TitlingCaps} {19} {4}
3417 \@@_define_aat_feature:nnnn {Style} {TallCaps} {19} {5}

```

### 38.8.11 CJK shape

```

3418 \@@_define_aat_feature_group:n {CJKShape}
3419 \@@_define_aat_feature:nnnn {CJKShape} {Traditional} {20} {0}
3420 \@@_define_aat_feature:nnnn {CJKShape} {Simplified} {20} {1}
3421 \@@_define_aat_feature:nnnn {CJKShape} {JIS1978} {20} {2}
3422 \@@_define_aat_feature:nnnn {CJKShape} {JIS1983} {20} {3}
3423 \@@_define_aat_feature:nnnn {CJKShape} {JIS1990} {20} {4}
3424 \@@_define_aat_feature:nnnn {CJKShape} {Expert} {20} {10}

```

```
3425 \@@_define_aat_feature:nnnn {CJKShape} {NLC} {20} {13}
```

### 38.8.12 Character width

```
3426 \@@_define_aat_feature_group:n {CharacterWidth}
3427 \@@_define_aat_feature:nnnn {CharacterWidth} {Proportional} {22} {0}
3428 \@@_define_aat_feature:nnnn {CharacterWidth} {Full} {22} {1}
3429 \@@_define_aat_feature:nnnn {CharacterWidth} {Half} {22} {2}
3430 \@@_define_aat_feature:nnnn {CharacterWidth} {Third} {22} {3}
3431 \@@_define_aat_feature:nnnn {CharacterWidth} {Quarter} {22} {4}
3432 \@@_define_aat_feature:nnnn {CharacterWidth} {AlternateProportional} {22} {5}
3433 \@@_define_aat_feature:nnnn {CharacterWidth} {AlternateHalf} {22} {6}
3434 \@@_define_aat_feature:nnnn {CharacterWidth} {Default} {22} {7}
```

### 38.8.13 Annotation

```
3435 \@@_define_aat_feature_group:n {Annotation}
3436 \@@_define_aat_feature:nnnn {Annotation} {Off} {24} {0}
3437 \@@_define_aat_feature:nnnn {Annotation} {Box} {24} {1}
3438 \@@_define_aat_feature:nnnn {Annotation} {RoundedBox} {24} {2}
3439 \@@_define_aat_feature:nnnn {Annotation} {Circle} {24} {3}
3440 \@@_define_aat_feature:nnnn {Annotation} {BlackCircle} {24} {4}
3441 \@@_define_aat_feature:nnnn {Annotation} {Parenthesis} {24} {5}
3442 \@@_define_aat_feature:nnnn {Annotation} {Period} {24} {6}
3443 \@@_define_aat_feature:nnnn {Annotation} {RomanNumerals} {24} {7}
3444 \@@_define_aat_feature:nnnn {Annotation} {Diamond} {24} {8}
3445 \@@_define_aat_feature:nnnn {Annotation} {BlackSquare} {24} {9}
3446 \@@_define_aat_feature:nnnn {Annotation} {BlackRoundSquare} {24} {10}
3447 \@@_define_aat_feature:nnnn {Annotation} {DoubleCircle} {24} {11}
```

## 39 Extended font encodings

To be removed after the 2017 release of LaTeX2e:

```
3448 \providecommand\UnicodeFontFile[2]{ "[#1]:#2" }
3449 \providecommand\UnicodeFontName[2]{ "#1:#2" }
3450 \xetex\providecommand\UnicodeFontTeXLigatures{mapping=tex-text;}
3451 \luatex\providecommand\UnicodeFontTeXLigatures{+tlig;}

3452 \providecommand\add@unicode@accent[2]{#2\char#1\relax}
3453 \providecommand\DeclareUnicodeAccent[3]{%
3454   \DeclareTextCommand{#1}{#2}{\add@unicode@accent{#3}}%
3455 }
```

\EncodingCommand

```
3456 \DeclareDocumentCommand \EncodingCommand {mO{}}m
3457 {
3458   \bool_if:NF \l_@@_defining_encoding_bool
3459   { \@@_error:nn {only-inside-encdef} \EncodingCommand }
3460   \DeclareTextCommand{#1}{#2}{\UnicodeEncodingName}[#2]{#3}
3461 }
```

\EncodingAccent

```
3462 \DeclareDocumentCommand \EncodingAccent {mm}
3463 {
```

```

3464 \bool_if:NF \l_@@_defining_encoding_bool
3465 { \@@_error:nn {only-inside-encdef} \EncodingAccent }
3466 \DeclareTextCommand{#1}{\UnicodeEncodingName}{\add@unicode@accent{#2}}
3467 }

```

#### \EncodingSymbol

```

3468 \DeclareDocumentCommand \EncodingSymbol {mm}
3469 {
3470 \bool_if:NF \l_@@_defining_encoding_bool
3471 { \@@_error:nn {only-inside-encdef} \EncodingSymbol }
3472 \DeclareTextSymbol{#1}{\UnicodeEncodingName}{#2}
3473 }

```

#### \EncodingComposite

```

3474 \DeclareDocumentCommand \EncodingComposite {mmm}
3475 {
3476 \bool_if:NF \l_@@_defining_encoding_bool
3477 { \@@_error:nn {only-inside-encdef} \EncodingComposite }
3478 \DeclareTextComposite{#1}{\UnicodeEncodingName}{#2}{#3}
3479 }

```

#### \EncodingCompositeCommand

```

3480 \DeclareDocumentCommand \EncodingCompositeCommand {mmm}
3481 {
3482 \bool_if:NF \l_@@_defining_encoding_bool
3483 { \@@_error:nn {only-inside-encdef} \EncodingCompositeCommand }
3484 \DeclareTextCompositeCommand{#1}{\UnicodeEncodingName}{#2}{#3}
3485 }

```

#### \DeclareUnicodeEncoding

```

3486 \DeclareDocumentCommand \DeclareUnicodeEncoding {mm}
3487 {
3488 \DeclareFontEncoding{#1}{}{}
3489 \DeclareErrorFont{#1}{lmr}{m}{n}{10}
3490 \DeclareFontSubstitution{#1}{lmr}{m}{n}
3491 \DeclareFontFamily{#1}{lmr}{}
3492
3493 \DeclareFontShape{#1}{lmr}{m}{n}
3494 {<->\UnicodeFontFile{lmroman10-regular}{\UnicodeFontTeXLigatures}}{}
3495 \DeclareFontShape{#1}{lmr}{m}{it}
3496 {<->\UnicodeFontFile{lmroman10-italic}{\UnicodeFontTeXLigatures}}{}
3497 \DeclareFontShape{#1}{lmr}{m}{sc}
3498 {<->\UnicodeFontFile{lmromancaps10-regular}{\UnicodeFontTeXLigatures}}{}
3499 \DeclareFontShape{#1}{lmr}{bx}{n}
3500 {<->\UnicodeFontFile{lmroman10-bold}{\UnicodeFontTeXLigatures}}{}
3501 \DeclareFontShape{#1}{lmr}{bx}{it}
3502 {<->\UnicodeFontFile{lmroman10-bolditalic}{\UnicodeFontTeXLigatures}}{}
3503
3504 \tl_set_eq:NN \l_@@_prev_unicode_name_tl \UnicodeEncodingName
3505 \tl_set:Nn \UnicodeEncodingName {#1}
3506 \bool_set_true:N \l_@@_defining_encoding_bool

```

```

3507      #2
3508      \bool_set_false:N \l_@@_defining_encoding_bool
3509      \tl_set_eq:NN \UnicodeEncodingName \l_@@_prev_unicode_name_tl
3510    }

```

\UndeclareSymbol

```

3511 \DeclareDocumentCommand \UndeclareSymbol {m}
3512 {
3513   \bool_if:NF \l_@@_defining_encoding_bool
3514     { \@@_error:nn {only-inside-encdef} \UndeclareSymbol }
3515   \UndeclareTextCommand {#1} {\UnicodeEncodingName}
3516 }
3517

```

\UndeclareComposite

```

3518 \DeclareDocumentCommand \UndeclareComposite {mm}
3519 {
3520   \bool_if:NF \l_@@_defining_encoding_bool
3521     { \@@_error:nn {only-inside-encdef} \UndeclareComposite }
3522   \cs_undefine:c
3523     { \c_backslash_str \UnicodeEncodingName \token_to_str:N #1 - \tl_to_str:n {#2} }
3524 }

```

## 40 Selecting maths fonts

Here, the fonts used in math mode are redefined to correspond to the default roman, sans serif and typewriter fonts. Unfortunately, you can only define maths fonts in the preamble, otherwise I'd run this code whenever \setmainfont and friends was run.

\fontspec\_setup\_maths: Everything here is performed \AtBeginDocument in order to overwrite euler's attempt. This means fontspec must be loaded *after* euler. We set up a conditional to return an error if this rule is violated.

Since every maths setup is slightly different, we also take different paths for defining various math glyphs depending which maths font package has been loaded.

```

3525 \@ifpackageloaded{euler}
3526 {
3527   \bool_set_true:N \g_@@_pkg_euler_loaded_bool
3528 }
3529 {
3530   \bool_set_false:N \g_@@_pkg_euler_loaded_bool
3531 }
3532 \cs_set:Nn \fontspec_setup_maths:
3533 {
3534   \@ifpackageloaded{euler}
3535   {
3536     \bool_if:NTF \g_@@_pkg_euler_loaded_bool
3537       { \bool_set_true:N \g_@@_math_euler_loaded_bool }
3538       { \@@_error:n {euler-too-late} }
3539   }
3540   {}

```

```

3541 \ifpackageloaded{lucbmath}{\bool_set_true:N \g_@@_math_lucida_bool}{ }
3542 \ifpackageloaded{lucidabr}{\bool_set_true:N \g_@@_math_lucida_bool}{ }
3543 \ifpackageloaded{lucimatx}{\bool_set_true:N \g_@@_math_lucida_bool}{ }

```

Knuth's CM fonts are all squashed together, combining letters, accents, text symbols and maths symbols all in the one font, `cmr`, plus other things in other fonts. Because we are changing the roman font in the document, we need to redefine all of the maths glyphs in  $\TeX$ 's operators maths font to still go back to the legacy `cmr` font for all these random glyphs, unless a separate maths font package has been loaded instead.

In every case, the maths accents are always taken from the operators font, which is generally the main text font. (Actually, there is a `\hat` accent in EulerFraktur, but it's *ugly*. So I ignore it. Sorry if this causes inconvenience.)

```

3544 \DeclareSymbolFont{legacymaths}{OT1}{cmr}{m}{n}
3545 \SetSymbolFont{legacymaths}{bold}{OT1}{cmr}{bx}{n}
3546 \DeclareMathAccent{\acute}{\mathalpha}{legacymaths}{19}
3547 \DeclareMathAccent{\grave}{\mathalpha}{legacymaths}{18}
3548 \DeclareMathAccent{\ddot}{\mathalpha}{legacymaths}{127}
3549 \DeclareMathAccent{\tilde}{\mathalpha}{legacymaths}{126}
3550 \DeclareMathAccent{\bar}{\mathalpha}{legacymaths}{22}
3551 \DeclareMathAccent{\breve}{\mathalpha}{legacymaths}{21}
3552 \DeclareMathAccent{\check}{\mathalpha}{legacymaths}{20}
3553 \DeclareMathAccent{\hat}{\mathalpha}{legacymaths}{94} % too bad, eu-
    ler
3554 \DeclareMathAccent{\dot}{\mathalpha}{legacymaths}{95}
3555 \DeclareMathAccent{\mathring}{\mathalpha}{legacymaths}{23}

```

**\colon: what's going on?** Okay, so `:` and `\colon` in maths mode are defined in a few places, so I need to work out what does what. Respectively, we have:

```

% % fontmath.ltx:
% \DeclareMathSymbol{\colon}{\mathpunct}{operators}{"3A}
% \DeclareMathSymbol{:}{\mathrel}{operators}{"3A}
%
% % amsmath.sty:
% \renewcommand{\colon}{\nobreak\mskip2mu\mathpunct{}\nonscript
% \mkern-\thinmuskip}{\mskip6mu\plus1mu\relax}
%
% % euler.sty:
% \DeclareMathSymbol{:}{\mathrel}{EulerFraktur}{"3A}
%
% % lucbmath.sty:
% \DeclareMathSymbol{@tempb}{\mathpunct}{operators}{58}
% \ifx\colon@tempb
% \DeclareMathSymbol{\colon}{\mathpunct}{operators}{58}
% \fi
% \DeclareMathSymbol{:}{\mathrel}{operators}{58}

```

(`3A.16 = 58.10`) So I think, based on this summary, that it is fair to tell `fontspec` to 'replace' the operators font with `legacymaths` for this symbol, except when `amsmath` is loaded since we want to keep its definition.

```

3556 \group_begin:
3557 \mathchardef\@tempa="603A \relax
3558 \ifx\colon\@tempa
3559 \DeclareMathSymbol{\colon}{\mathpunct}{legacymaths}{58}
3560 \fi
3561 \group_end:

```

The following symbols are only defined specifically in euler, so skip them if that package is loaded.

```

3562 \bool_if:NF \g_@@_math_euler_bool
3563 {
3564 \DeclareMathSymbol{!}{\mathclose}{legacymaths}{33}
3565 \DeclareMathSymbol{:}{\mathrel}{legacymaths}{58}
3566 \DeclareMathSymbol{;}{\mathpunct}{legacymaths}{59}
3567 \DeclareMathSymbol{?}{\mathclose}{legacymaths}{63}

```

And these ones are defined both in euler and lucbmath, so we only need to run this code if no extra maths package has been loaded.

```

3568 \bool_if:NF \g_@@_math_lucida_bool
3569 {
3570 \DeclareMathSymbol{o}{\mathalpha}{legacymaths}{`0}
3571 \DeclareMathSymbol{1}{\mathalpha}{legacymaths}{`1}
3572 \DeclareMathSymbol{2}{\mathalpha}{legacymaths}{`2}
3573 \DeclareMathSymbol{3}{\mathalpha}{legacymaths}{`3}
3574 \DeclareMathSymbol{4}{\mathalpha}{legacymaths}{`4}
3575 \DeclareMathSymbol{5}{\mathalpha}{legacymaths}{`5}
3576 \DeclareMathSymbol{6}{\mathalpha}{legacymaths}{`6}
3577 \DeclareMathSymbol{7}{\mathalpha}{legacymaths}{`7}
3578 \DeclareMathSymbol{8}{\mathalpha}{legacymaths}{`8}
3579 \DeclareMathSymbol{9}{\mathalpha}{legacymaths}{`9}
3580 \DeclareMathSymbol{\Gamma}{\mathalpha}{legacymaths}{0}
3581 \DeclareMathSymbol{\Delta}{\mathalpha}{legacymaths}{1}
3582 \DeclareMathSymbol{\Theta}{\mathalpha}{legacymaths}{2}
3583 \DeclareMathSymbol{\Lambda}{\mathalpha}{legacymaths}{3}
3584 \DeclareMathSymbol{\Xi}{\mathalpha}{legacymaths}{4}
3585 \DeclareMathSymbol{\Pi}{\mathalpha}{legacymaths}{5}
3586 \DeclareMathSymbol{\Sigma}{\mathalpha}{legacymaths}{6}
3587 \DeclareMathSymbol{\Upsilon}{\mathalpha}{legacymaths}{7}
3588 \DeclareMathSymbol{\Phi}{\mathalpha}{legacymaths}{8}
3589 \DeclareMathSymbol{\Psi}{\mathalpha}{legacymaths}{9}
3590 \DeclareMathSymbol{\Omega}{\mathalpha}{legacymaths}{10}
3591 \DeclareMathSymbol{+}{\mathbin}{legacymaths}{43}
3592 \DeclareMathSymbol{=}{\mathrel}{legacymaths}{61}
3593 \DeclareMathDelimiter{()}{\mathopen}{legacymaths}{40}{largesymbols}{0}
3594 \DeclareMathDelimiter{)}{\mathclose}{legacymaths}{41}{largesymbols}{1}
3595 \DeclareMathDelimiter{[]}{\mathopen}{legacymaths}{91}{largesymbols}{2}
3596 \DeclareMathDelimiter{[]}{\mathclose}{legacymaths}{93}{largesymbols}{3}
3597 \DeclareMathDelimiter{/}{\mathord}{legacymaths}{47}{largesymbols}{14}
3598 \DeclareMathSymbol{\mathdollar}{\mathord}{legacymaths}{36}
3599 }
3600 }

```

Finally, we change the font definitions for `\mathrm` and so on. These are defined us-

ing the `\g_@@_mathrm_tl (...)` macros, which default to `\rmdefault` but may be specified with the `\setmathrm (...)` commands in the preamble.

Since  $\TeX$  only generally defines one level of boldness, we omit `\mathbf` in the bold maths series. It can be specified as per usual with `\setboldmathrm`, which stores the appropriate family name in `\g_@@_bfmathrm_tl`.

```

3601 \DeclareSymbolFont{operators}\g_fontspec_encoding_tl\g_@@_mathrm_tl\mddefault\updefault
3602 \SetSymbolFont{operators}{normal}\g_fontspec_encoding_tl\g_@@_mathrm_tl\mddefault\updefault
3603 \DeclareSymbolFontAlphabet\mathrm{operators}
3604 \SetMathAlphabet\mathit{normal}\g_fontspec_encoding_tl\g_@@_mathrm_tl\mddefault\itdefault
3605 \SetMathAlphabet\mathbf{normal}\g_fontspec_encoding_tl\g_@@_mathrm_tl\bfdefault\updefault
3606 \SetMathAlphabet\mathsf{normal}\g_fontspec_encoding_tl\g_@@_mathsf_tl\mddefault\updefault
3607 \SetMathAlphabet\mathtt{normal}\g_fontspec_encoding_tl\g_@@_mathtt_tl\mddefault\updefault
3608 \SetSymbolFont{operators}{bold}\g_fontspec_encoding_tl\g_@@_mathrm_tl\bfdefault\updefault
3609 \tl_if_empty:NTF \g_@@_bfmathrm_tl
3610 {
3611   \SetMathAlphabet\mathit{bold}\g_fontspec_encoding_tl\g_@@_mathrm_tl\bfdefault\itdefault
3612 }
3613 {
3614   \SetMathAlphabet\mathrm{bold}\g_fontspec_encoding_tl\g_@@_bfmathrm_tl\mddefault\updefault
3615   \SetMathAlphabet\mathbf{bold}\g_fontspec_encoding_tl\g_@@_bfmathrm_tl\bfdefault\updefault
3616   \SetMathAlphabet\mathit{bold}\g_fontspec_encoding_tl\g_@@_bfmathrm_tl\mddefault\itdefault
3617 }
3618 \SetMathAlphabet\mathsf{bold}\g_fontspec_encoding_tl\g_@@_mathsf_tl\bfdefault\updefault
3619 \SetMathAlphabet\mathtt{bold}\g_fontspec_encoding_tl\g_@@_mathtt_tl\bfdefault\updefault
3620 }

```

`\fontspec_maybe_setup_maths:` We're a little less sophisticated about not executing the maths setup if various other maths font packages are loaded. This list is based on the wonderful 'T $\TeX$ Font Catalogue': <http://www.tug.dk/FontCatalogue/mathfonts.html>. I'm sure there are more I've missed. Do the T $\TeX$  Gyre fonts have maths support yet?

Untested: would `\unless\ifnum\Gamma=28672\relax\bool_set_false:N \g_@@_math_bool\fi` be a better test? This needs more cooperation with euler and lucida, I think.

```

3621 \cs_new:Nn \fontspec_maybe_setup_maths:
3622 {
3623   \@ifpackageloaded{anttor}
3624   {
3625     \ifx\define@antt@mathversions a\bool_set_false:N \g_@@_math_bool\fi
3626   }{}
3627   \@ifpackageloaded{arevmath}{\bool_set_false:N \g_@@_math_bool}{}
3628   \@ifpackageloaded{eulervm}{\bool_set_false:N \g_@@_math_bool}{}
3629   \@ifpackageloaded{mathdesign}{\bool_set_false:N \g_@@_math_bool}{}
3630   \@ifpackageloaded{concmath}{\bool_set_false:N \g_@@_math_bool}{}
3631   \@ifpackageloaded{cmbright}{\bool_set_false:N \g_@@_math_bool}{}
3632   \@ifpackageloaded{mathesf}{\bool_set_false:N \g_@@_math_bool}{}
3633   \@ifpackageloaded{gfsartemisla}{\bool_set_false:N \g_@@_math_bool}{}
3634   \@ifpackageloaded{gfsneohellenic}{\bool_set_false:N \g_@@_math_bool}{}
3635   \@ifpackageloaded{iwona}
3636   {
3637     \ifx\define@iwona@mathversions a\bool_set_false:N \g_@@_math_bool\fi
3638   }{}
3639   \@ifpackageloaded{kpfonts}{\bool_set_false:N \g_@@_math_bool}{}

```

```

3640 \ifpackageloaded{kmath}{\bool_set_false:N \g_@@_math_bool}{\fi}
3641 \ifpackageloaded{kurier}
3642 {
3643   \ifx\define@kurier@mathversions a\bool_set_false:N \g_@@_math_bool\fi
3644 }{}
3645 \ifpackageloaded{fouriernc}{\bool_set_false:N \g_@@_math_bool}{\fi}
3646 \ifpackageloaded{fourier}{\bool_set_false:N \g_@@_math_bool}{\fi}
3647 \ifpackageloaded{lmodern}{\bool_set_false:N \g_@@_math_bool}{\fi}
3648 \ifpackageloaded{mathpazo}{\bool_set_false:N \g_@@_math_bool}{\fi}
3649 \ifpackageloaded{mathptmx}{\bool_set_false:N \g_@@_math_bool}{\fi}
3650 \ifpackageloaded{MinionPro}{\bool_set_false:N \g_@@_math_bool}{\fi}
3651 \ifpackageloaded{unicode-math}{\bool_set_false:N \g_@@_math_bool}{\fi}
3652 \ifpackageloaded{breqn}{\bool_set_false:N \g_@@_math_bool}{\fi}
3653 \bool_if:NT \g_@@_math_bool
3654 {
3655   \@@_info:n {setup-math}
3656   \fontspec_setup_maths:
3657 }
3658 }
3659 \AtBeginDocument{\fontspec_maybe_setup_maths:}

```

## 41 Closing code

### 41.1 Compatibility

\zf@enc Old interfaces. These are needed by, at least, the mathspec package.

```

\zf@family 3660 \tl_set:Nn \zf@enc { \g_fontspec_encoding_tl }
\zf@basefont 3661 \cs_set:Npn \zf@fontspec #1 #2
\zf@fontspec 3662 {
3663   \@@_select_font_family:nn {#1} {#2}
3664   \tl_set:Nn \zf@family { \l_fontspec_family_tl }
3665   \tl_set:Nn \zf@basefont { \l_fontspec_font }
3666 }

```

### 41.2 Finishing up

Now we just want to set up loading the .cfg file, if it exists.

```

3667 \bool_if:NT \g_@@_cfg_bool
3668 {
3669   \InputIfFileExists{fontspec.cfg}
3670   {}
3671   {\typeout{No~ fontspec.cfg~ file~ found;~ no~ configuration~ loaded.}}
3672 }

```

## 42 Patching code

```

3673 \*fontspec

```



## 42.1 Italic small caps and so on

`\sishape` These commands for actually selecting italic small caps have been defined for many years; I'm inclined to drop them. They're probably used very infrequently; I personally prefer just writing `\textit{\textsc{...}}` instead.

```

3674 \providecommand*\itscdefault{\itdefault\scdefault}
3675 \providecommand*\slscdefault{\sldefault\scdefault}
3676 \DeclareRobustCommand{\sishape}
3677 {
3678   \not@math@alphabet\sishape\relax
3679   \fontshape{\itscdefault}\selectfont
3680 }
3681 \DeclareTextFontCommand{\textsi}{\sishape}

```

LaTeX's 'shape' font axis needs to be overloaded to support italic small caps and slanted small caps. These are the combinations to support:

```

3682 \cs_new:Nn \@@_shape_merge:nn { c_@@_shape_#1_#2_tl }
3683 \tl_const:cn { \@@_shape_merge:nn \itdefault \scdefault } {\itscdefault}
3684 \tl_const:cn { \@@_shape_merge:nn \sldefault \scdefault } {\slscdefault}
3685 \tl_const:cn { \@@_shape_merge:nn \scdefault \itdefault } {\itscdefault}
3686 \tl_const:cn { \@@_shape_merge:nn \scdefault \sldefault } {\slscdefault}
3687 \tl_const:cn { \@@_shape_merge:nn \slscdefault \itdefault } {\itscdefault}
3688 \tl_const:cn { \@@_shape_merge:nn \itscdefault \sldefault } {\slscdefault}
3689 \tl_const:cn { \@@_shape_merge:nn \itscdefault \updefault } {\scdefault}
3690 \tl_const:cn { \@@_shape_merge:nn \slscdefault \updefault } {\scdefault}

```

`\fontspec_merge_shape:n` These macros enable the overload on the `\. . shape` commands. First, a shape 'new+current' (prefix) or 'current+new' (suffix) is tried. If not found, fall back on the 'new' shape.

```

3691 \cs_new:Nn \fontspec_merge_shape:n
3692 {
3693   \@@_if_merge_shape:nTF {#1}
3694     { \fontshape { \tl_use:c { \@@_shape_merge:nn {\f@shape} {#1} } } \selectfont }
3695     { \fontshape {#1} \selectfont }
3696 }

```

The following is rather specific; it only returns true if the merged shape exists, but more importantly also if the merged shape is defined for the current font.

```

3697 \prg_new_conditional:Nnn \@@_if_merge_shape:n {TF}
3698 {
3699   \bool_if:nTF
3700     {
3701       \tl_if_exist_p:c { \@@_shape_merge:nn {\f@shape} {#1} } &&
3702       \cs_if_exist_p:c
3703         {
3704           \f@encoding/\f@family/\f@series/
3705           \tl_use:c { \@@_shape_merge:nn {\f@shape} {#1} }
3706         }
3707     }
3708   \prg_return_true: \prg_return_false:
3709 }

```

`\itshape` The original `\. . shape` commands are redefined to use the merge shape macro.

```

\scshape 3710 \DeclareRobustCommand \itshape
\upshape 3711 {
\slshape 3712 \not@math@alphabet\itshape\mathit
3713 \fontspec_merge_shape:n\itdefault
3714 }
3715 \DeclareRobustCommand \slshape
3716 {
3717 \not@math@alphabet\slshape\relax
3718 \fontspec_merge_shape:n\sldefault
3719 }
3720 \DeclareRobustCommand \scshape
3721 {
3722 \not@math@alphabet\scshape\relax
3723 \fontspec_merge_shape:n\scdefault
3724 }
3725 \DeclareRobustCommand \upshape
3726 {
3727 \not@math@alphabet\upshape\relax
3728 \fontspec_merge_shape:n\updefault
3729 }

```

## 42.2 Emphasis

`\em` Redefinition of `{\em . . .}` and `\emph{ . . .}` to allow nesting of emphases.

```

\emph 3730 \cs_new_protected:Npn \emfontdeclare #1
\emshape 3731 {
\eminnershape 3732 \prop_clear:N \g_@@_em_prop
\emfontdeclare 3733 \int_zero:N \l_@@_emdef_int
3734 \group_begin:
3735 \normalfont
3736 \clist_map_inline:nn {\emreset,#1}
3737 {
3738 ##1
3739 \prop_gput_if_new:NxV \g_@@_em_prop { \f@series/\f@shape } { \l_@@_emdef_int }
3740 \prop_gput:Nxn \g_@@_em_prop { switch-\int_use:N \l_@@_emdef_int } { ##1 }
3741 \int_incr:N \l_@@_emdef_int
3742 }
3743 \group_end:
3744 }

3745 \DeclareRobustCommand \em
3746 {
3747 \@nomath\em
3748
3749 \prop_get:NxNT \g_@@_em_prop { \f@series/\f@shape } \l_@@_em_tmp_tl
3750 { \int_set:Nn \l_@@_em_int { \l_@@_em_tmp_tl } }
3751
3752 \int_incr:N \l_@@_em_int
3753
3754 \prop_get:NxNTF \g_@@_em_prop { switch-\int_use:N \l_@@_em_int } \l_@@_em_switch_tl

```

```

3755     { \l_@@_em_switch_tl }
3756     {
3757         \int_zero:N \l_@@_em_int
3758         \emreset
3759     }
3760
3761 }

```

Document commands:

```

3762 \DeclareTextFontCommand{\emph}{\em}
3763 \cs_set:Npn \emreset { \upshape }
3764 \cs_set:Npn \emshape { \itshape }
3765 \cs_set:Npn \eminnershape { \upshape }
3766 \emfontdeclare{ \emshape, \eminnershape }

```

Ensure nesting resets when necessary:

```

3767 \cs_set:Npn \reset@font { \normalfont \int_zero:N \l__fontspec_em_int }

```

Programmer's interface for setting nesting level:

```

3768 \cs_new:Nn \fontspec_set_em_level:n { \int_set:Nn \l_@@_em_int {#1} }

```

### 42.3 \-

\- This macro is courtesy of Frank Mittelbach and the L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> source code.

```

3769 \DeclareRobustCommand{\-}
3770 {
3771     \discretionary
3772     {
3773         \char\ifnum\hyphenchar\font<\z@
3774             \xlx@defaultthyphenchar
3775         \else
3776             \hyphenchar\font
3777         \fi
3778     }{}{}
3779 }
3780 \def\xlx@defaultthyphenchar{`\-}

```

### 42.4 Verbatims

Many thanks to Apostolos Syropoulos for discovering this problem and writing the redefinition of L<sup>A</sup>T<sub>E</sub>X's verbatim environment and \verb\* command.

\fontspec\_visible\_space: Print U+2423: OPEN BOX, which is used to visibly display a space character.

```

3781 \cs_new:Nn \fontspec_visible_space:
3782 {
3783     \@@_primitive_font_glyph_if_exist:NnTF \font {"2423}
3784     { \char"2423\scan_stop: }
3785     { \fontspec_visible_space_fallback: }
3786 }

```

tspec\_visible\_space\_fallback: If the current font doesn't have U+2423: OPEN BOX, use Latin Modern Mono instead.

```

3787 \cs_new:Nn \fontspec_visible_space_fallback:

```

```

3788 {
3789 {
3790 \usefont{\g_fontspec_encoding_tl}{lmtt}{\f@series}{\f@shape}
3791 \textvisiblespace
3792 }
3793 }

```

fontspec\_print\_visible\_spaces: Helper macro to turn spaces ( $\sim 20$ ) active and print visible space instead.

```

3794 \group_begin:
3795 \char_set_catcode_active:n{"20}%
3796 \cs_gset:Npn\fontspec_print_visible_spaces:{%
3797 \char_set_catcode_active:n{"20}%
3798 \cs_set_eq:NN\sim 20\fontspec_visible_space:%
3799 }%
3800 \group_end:

```

\verb Redefine \verb to use \fontspec\_print\_visible\_spaces:.

```

\verb* 3801 \def\verb
3802 {
3803 \relax\ifmmode\hbox\else\leavevmode\null\fi
3804 \bgroup
3805 \verb@eol@error \let\do\@makeother \dospecials
3806 \verbatim@font\@noligs
3807 \@ifstar\@sverb\@verb
3808 }
3809 \def\@sverb{\fontspec_print_visible_spaces:\@sverb}

```

It's better to put small things into \AtBeginDocument, so here we go:

```

3810 \AtBeginDocument
3811 {
3812 \fontspec_patch_verbatim:
3813 \fontspec_patch_moreverb:
3814 \fontspec_patch_fancyvrb:
3815 \fontspec_patch_listings:
3816 }

```

verbatim\* With the verbatim package.

```

3817 \cs_set:Npn \fontspec_patch_verbatim:
3818 {
3819 \@ifpackageloaded{verbatim}
3820 {
3821 \cs_set:cpn {verbatim*}
3822 {
3823 \group_begin: \@verbatim \fontspec_print_visible_spaces: \verbatim@start
3824 }
3825 }

```

This is for vanilla  $\text{\LaTeX}$ .

```

3826 {
3827 \cs_set:cpn {verbatim*}
3828 {
3829 \@verbatim \fontspec_print_visible_spaces: \@sxverbatim

```

```

3830     }
3831   }
3832 }

```

listingcont\* This is for moreverb. The main listing\* environment inherits this definition.

```

3833 \cs_set:Npn \fontspec_patch_moreverb:
3834 {
3835   \@ifpackageloaded{moreverb}{
3836     \cs_set:cpn {listingcont*}
3837     {
3838       \cs_set:Npn \verbatim@processline
3839       {
3840         \thelisting@line \global\advance\listing@line\c_one
3841         \the\verbatim@line\par
3842       }
3843       \@verbatim \fontspec_print_visible_spaces: \verbatim@start
3844     }
3845   }{}
3846 }

```

listings and fancvrb make things nice and easy:

```

3847 \cs_set:Npn \fontspec_patch_fancyvrb:
3848 {
3849   \@ifpackageloaded{fancyvrb}
3850   {
3851     \cs_set_eq:NN \FancyVerbSpace \fontspec_visible_space:
3852   }{}
3853 }

3854 \cs_set:Npn \fontspec_patch_listings:
3855 {
3856   \@ifpackageloaded{listings}
3857   {
3858     \cs_set_eq:NN \lst@visible_space \fontspec_visible_space:
3859   }{}
3860 }

```

## 42.5 \oldstylenums

\oldstylenums This command obviously needs a redefinition. And we may as well provide the reverse \liningnums command.

```

3861 \RenewDocumentCommand \oldstylenums {m}
3862 {
3863   { \addfontfeature{Numbers=OldStyle} #1 }
3864 }
3865 \NewDocumentCommand \liningnums {m}
3866 {
3867   { \addfontfeature{Numbers=Lining} #1 }
3868 }

3869 </fontspec>

```

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