

The luaotfload package

LaTeX3 Project

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Home: <https://github.com/latex3/luaotfload>

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Abstract

This package is an adaptation of the ConTeXt font loading system. It allows for loading OpenType fonts with an extended syntax and adds support for a variety of font features.

After discussion of the font loading API, this manual gives an overview of the core components of Luaotfload: The packaged font loader code, the names database, configuration, and helper functions on the Lua end.

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1 ENGINE AND VERSION SUPPORT

luaotfload is a quite large and complex package. It imports code from context which is actively developed along with the luatex binary. It is not possible to support a large number of engines variants or versions.

Supported is the luatex versions of a current TeXLive 2019 (and a current MiKTeX). Beginning with version 3.1 of this package also lua_hbtex is supported.

2 CHANGES

2.1 *New in version 3.1 (by Ulrike Fischer/Marcel Krüger)*

- The package has been moved to the github of the LaTeX3 Project and is now maintained officially by the LaTeX3 Project team.
- Code to use the harfbuzz library of luahtex has been added. See the description of the harf mode.
- fonts in ttc-collections can now be indexed by name.
- To reduce the pollution of the global lua environment a number of lua tables have been removed. Only the tables luaotfload, fonts and nodes have been kept there.
- The fontloader has been synched with the context files from 2019-10-29.

2.2 *New in version 3.00 (by Ulrike Fischer/Marcel Krüger)*

- Default Ignorable characters are now invisible by default (issue 63). This can be deactivated with the option invisible.

2.3 *New in version 2.99 (by Ulrike Fischer)*

- Code cleanup.
- The fontloader has been synched with the context files from 2019-08-11.

2.4 *New in version 2.98 (by Ulrike Fischer)*

breaking change!

- The handling of missing chars has been changed. In This version a missing char will insert the /.notdef char of the fonts (this is sometimes a space, sometimes a rectangle with a cross) and no longer simply ignore the glyph. This behaviour can be reverted by using notdef=false as font feature.
- The font feature embolden can now be used to fake a bold font.
- The fontloader has been synched with the context files from 2019-07-04.

2.5 *New in version 2.97 (by Ulrike Fischer)*

- the new generic fontloader improves the handling of large fonts (but some fonts still need a 64bit luatex version to create the font files).
- A number of small bug (also in luaotfload-tool) have been corrected, see the NEWS file for details.

2.6 *New in version 2.96 (by Ulrike Fischer)*

Incompatible change!

- In version 2.95 letterspacing was broken due to a change in the fontloader (issue 38). This has been repaired. At the same time a number of oddities and bugs in the letterspacing has been corrected. This can change existing documents. See page 12 for more information.
- A problem with the detection of bold fonts has been corrected (issue 41, pull request 42).

2.7 *New in version 2.95 (by Ulrike Fischer)*

- This version imports from context the generic fontloader in the version of 2019-01-28. Contrary to the last announcement, it still works with luatex 1.07. So updates will continue.
- The handling of the lucida-fonts had been improved (issue 33).
- tex-files are no longer misused as font fallbacks (issue 35).
- The resolver code has been refactored (pull request 36).

2.8 *New in version 2.94 (by Ulrike Fischer)*

- This version imports from context the generic fontloader in the version of 2018-12-19. It is the last version that works with luatex 1.07 and texlive 2018. As context has moved to luatex 1.09 newer versions of the fontloader needs now this luatex version too. This means that until the texlive 2018 freeze there will be probably no update of luaotfload.
- This version changes the handling of the mode key. It no longer accepts only the values base and node, but can be used to load a font with an alternative font loader/renderer.

2.9 *New in version 2.93 (by Ulrike Fischer)*

Mainly internal clean up of the version info to allow automatic versioning.

2.10 *New in version 2.92 (by Ulrike Fischer)*

- Better devanagari support (issue #9).
- Luaotfload doesn't work when luatex is used with the option --safer. So it now aborts cleanly when the option is detected – but you still can get errors from fontspec later! (issue #12).
- The syntax file: for legacy font works again (issue #11).
- The fontloader has been synched with the newest context version from october, 18.

2.11 *New in version 2.91 (by Ulrike Fischer)*

This version mostly correct two bugs found in the previous fontloader: Glyphvariants weren't copied and pasted correctly. Glyphs encoded in the PUA couldn't be accessed anymore.

2.12 *New in version 2.9 (by Ulrike Fischer)*

On the one side there is not very much new in this version: The native components of Luaotfload are nearly unchanged. A few bugs have been corrected, the various files lists which loads the components of the font loader have been cleaned up.

On the other side there is a lot new:

- **Fontloader**

The fontloader files imported from ConT_EXt have been updated to the current version. This was necessary to make Luaotfload compatible with the coming LuaT_EX 1.08/1.09. Compared to the previous version from february 2017 quite a number of things have changed. Most importantly the handling of arabic fonts has greatly improved. But this also means that changes in the output are possible.

- **Lualibs**

The update of the fontloader files also required an update of the Lualibs package. This Luaotfload version needs version 2.6 of Lualibs.

- **Maintenance**

As the current maintainer wasn't available and it was urgent to get a Luaotfload compatible with LuaT_EX 1.08/1.09 maintenance has been transfered to Ulrike Fischer and Marcel Krüger. The package was maintained and developed at <https://github.com/u-fischer/luaotfload>. Issues should be reported there.

- **Documentation**

The core of documentation is nearly unchanged. I added this introduction. I recreated with the help of @marmot the graphic on 29. I updated the file lists. I imported as appendix pdf versions of the two man files which are part of the Luaotfload documentation.

3 INTRODUCTION

Font management and installation has always been painful with T_EX. A lot of files are needed for one font (TFM, PFB, MAP, FD, VF), and due to the 8-Bit encoding each font is limited to 256 characters.

But the font world has evolved since the original T_EX, and new typographic systems have appeared, most notably the so called *smart font* technologies like OpenType fonts (OTF).

These fonts can contain many more characters than T_EX fonts, as well as additional functionality like ligatures, old-style numbers, small capitals, etc., and support more

complex writing systems like Arabic and Indic¹ scripts.

OpenType fonts are widely deployed and available for all modern operating systems.

As of 2013 they have become the de facto standard for advanced text layout.

However, until recently the only way to use them directly in the T_EX world was with the X_YT_EX engine.

Unlike X_YT_EX, LuaT_EX has no built-in support for OpenType or technologies other than the original T_EX fonts.

Instead, it provides hooks for executing Lua code during the T_EX run that allow implementing extensions for loading fonts and manipulating how input text is processed without modifying the underlying engine.

This is where luaotfload comes into play: Based on code from ConT_EXt, it extends LuaT_EX with functionality necessary for handling OpenType fonts.

Additionally, it provides means for accessing fonts known to the operating system conveniently by indexing the metadata.

4 THANKS

Luaotfload is part of LuaL^AT_EX, the community-driven project to provide a foundation for using the L^AT_EX format with the full capabilities of the LuaT_EX engine. As such, the distinction between end users, contributors, and project maintainers is intentionally kept less strict, lest we unduly personalize the common effort.

Nevertheless, the current maintainers would like to express their gratitude to Khaled Hosny, Akira Kakuto, Hironori Kitagawa and Dohyun Kim. Their contributions – be it patches, advice, or systematic testing – made the switch from version 1.x to 2.2 possible. Also, Hans Hagen, the author of the font loader, made porting the code to L^AT_EX a breeze due to the extra effort he invested into isolating it from the rest of ConT_EXt, not to mention his assistance in the task and willingness to respond to our suggestions.

5 LOADING FONTS

luaotfload supports an extended font request syntax:

$$\backslash\text{font}\backslash\text{foo} = \{ \langle\text{prefix}\rangle : \langle\text{font name}\rangle : \langle\text{font features}\rangle \} \langle\text{T}_{\text{E}}\text{X font features}\rangle$$

The curly brackets are optional and escape the spaces in the enclosed font name. Alternatively, double quotes serve the same purpose. A selection of individual parts of the syntax are discussed below; for a more formal description see figure 1.

5.1 Prefix – the luaotfload Way

In luaotfload, the canonical syntax for font requests requires a *prefix*:

$$\backslash\text{font}\backslash\text{fontname} = \langle\text{prefix}\rangle : \langle\text{fontname}\rangle \dots$$

¹Unfortunately, the default fontloader of luaotfload doesn't support many Indic scripts correctly. For these scripts it is recommended to use the harf mode along with the binary luahbtx.

where $\langle prefix \rangle$ is either `file:` or `name:`.² It determines whether the font loader should interpret the request as a *file name* or *font name*, respectively, which again influences how it will attempt to locate the font. Examples for font names are “Latin Modern Italic”, “GFS Bodoni Rg”, and “PT Serif Caption” – they are the human readable identifiers usually listed in drop-down menus and the like.³ In order for fonts installed both in system locations and in your `texmf` to be accessible by font name, `luaotfload` must first collect the metadata included in the files. Please refer to section 8 below for instructions on how to create the database.

File names are whatever your file system allows them to be, except that they may not contain the characters `(`, `:`, and `/`. As is obvious from the last exception, the `file:` lookup will not process paths to the font location – only those files found when generating the database are addressable this way. Continue below in the \XeTeX section if you need to load your fonts by path. The file names corresponding to the example font names above are `lmroman12-italic.otf`, `GFSBodoni.otf`, and `PTZ56F.ttf`.

5.2 Bracketed Lookups

Bracketed lookups allow for arbitrary character content to be used in a definition. A simple bracketed request looks follows the scheme

```
\font\fontname = [⟨/path/to/file⟩]
```

Inside the square brackets, every character except for a closing bracket is permitted, allowing for arbitrary paths to a font file – including Windows style paths with UNC or drive letter prepended – to be specified. The `luaotfload` syntax differs from \XeTeX in that the subfont selector goes *after* the closing bracket:

```
\font\fontname = [⟨/path/to/file⟩] (n)
```

Naturally, path-less file names are equally valid and processed the same way as an ordinary `file:` lookup.

5.3 Compatibility

In addition to the regular prefixed requests, `luaotfload` accepts loading fonts the \XeTeX way. There are again two modes: bracketed and unbracketed. For the bracketed variety, see above, 5.2.

²`luaotfload` also knows two further prefixes, `kpse:` and `my:`. A `kpse` lookup is restricted to files that can be found by `kpathsea` and will not attempt to locate system fonts. This behavior can be of value when an extra degree of encapsulation is needed, for instance when supplying a customized `tex` distribution.

The `my` lookup takes this a step further: it lets you define a custom resolver function and hook it into the `resolve_font` callback. This ensures full control over how a file is located. For a working example see the [test in the luaotfload repo](#).

³Font names may appear like a great choice at first because they offer seemingly more intuitive identifiers in comparison to arguably cryptic file names: “PT Sans Bold” is a lot more descriptive than `PTS75F.ttf`. On the other hand, font names are quite arbitrary and there is no universal method to determine their meaning. While `luaotfload` provides fairly sophisticated heuristic to figure out a matching font style, weight, and optical size, it cannot be relied upon to work satisfactorily for all font files. For an in-depth analysis of the situation and how broken font names are, please refer to [this post](#) by Hans Hagen, the author of the font loader. If in doubt, use `filenames`. `luaotfload-tool` can perform the matching for you with the option `--find=<name>`, and you can use the file name it returns in your font definition.

Unbracketed (or, for lack of a better word: *anonymous*) font requests resemble the conventional \TeX syntax.

```
\font\fontname = <font name> ...
```

However, they have a broader spectrum of possible interpretations: before anything else, `luaotfload` attempts to load a traditional \TeX Font Metric (TFM or OFM). If this fails, it performs a path: lookup, which itself will fall back to a file: lookup. Lastly, if none of the above succeeded, attempt to resolve the request as a name: lookup by searching the font index for **. The behavior of this “anonymous” lookup is configurable, see the configuration manpage for details.

Furthermore, `luaotfload` supports the slashed (shorthand) font style notation from \XTeX .

```
\font\fontname = <font name>/<modifier> ...
```

Currently, four style modifiers are supported: I for italic shape, B for bold weight, BI or IB for the combination of both. Other “slashed” modifiers are too specific to the \XTeX engine and have no meaning in Lua \TeX .

5.4 Examples

5.4.1 Loading by File Name

For example, conventional \TeX font can be loaded with a file: request like so:

```
\font \lmromanten = {file:ec-lmr10} at 10pt
```

The OpenType version of Janusz Nowacki’s font *Antykwa Półtawskiego*⁴ in its condensed variant can be loaded as follows:

```
\font \apcregular = file:antpoltltcond-regular.otf at 42pt
```

The next example shows how to load the *Porson* font digitized by the Greek Font Society using \XTeX -style syntax and an absolute path from a non-standard directory:

```
\font \gfsporson = "[/tmp/GFSPorson.otf]" at 12pt
```

TrueType collection files (the extension is usually .ttc) contain more than a single font. In order to refer to these subfonts, the respective index or the respective PostScript font name may be added in parentheses after the file name.⁵

```
\font \cambriamain = "file:cambria.ttc(0)" at 10pt
\font \cambriamath = "file:cambria.ttc(1)" at 10pt
\font \Cambriamain = "file:cambria.ttc(Cambria)" at 10pt
\font \Cambriamath = "file:cambria.ttc(CambriaMath)" at 10pt
```

⁴<http://jmn.pl/antykwa-poltawskiego/>, also available in in \TeX Live.

⁵Incidentally, this syntactical detail also prevents one from loading files that end in balanced parentheses.

and likewise, requesting subfont inside a TTC container by path:

```
\font \asanamain = "[/home/typesetter/.fonts/math/asana.ttc](0):mode=node;+tlig" at 10pt
\font \asanamath = "[/home/typesetter/.fonts/math/asana.ttc](1):mode=base" at 10pt
```

5.4.2 Loading by Font Name

The name: lookup does not depend on cryptic filenames:

```
\font \pagellaregular = {name:TeX Gyre Pagella} at 9pt
```

A bit more specific but essentially the same lookup would be:

```
\font \pagellaregular = {name:TeX Gyre Pagella Regular} at 9pt
```

Which fits nicely with the whole set:

```
\font \pagellaregular = {name:TeX Gyre Pagella Regular} at 9pt
\font \pagellaitalic = {name:TeX Gyre Pagella Italic} at 9pt
\font \pagellabold = {name:TeX Gyre Pagella Bold} at 9pt
\font \pagellabolditalic = {name:TeX Gyre Pagella Bolditalic} at 9pt
{\pagellaregular foo bar baz\endgraf }
{\pagellaitalic foo bar baz\endgraf }
{\pagellabold foo bar baz\endgraf }
{\pagellabolditalic foo bar baz\endgraf }
...
```

5.4.3 Modifiers

If the entire *Iwona* family⁶ is installed in some location accessible by luaotfload, the regular shape can be loaded as follows:

```
\font \iwona = Iwona at 20pt
```

To load the most common of the other styles, the slash notation can be employed as shorthand:

```
\font \iwonaitalic = Iwona/I at 20pt
\font \iwonabold = Iwona/B at 20pt
\font \iwonabolditalic = Iwona/BI at 20pt
```

which is equivalent to these full names:

```
\font \iwonaitalic = "Iwona Italic" at 20pt
\font \iwonabold = "Iwona Bold" at 20pt
\font \iwonabolditalic = "Iwona BoldItalic" at 20pt
```

⁶<http://jmn.pl/kurier-i-iwona/>, also in T_EX Live.

6 FONT FEATURES

Font features are the second to last component in the general scheme for font requests:

```
\font\foo = "<prefix>:<font name>:<font features><TeX font features>"
```

If style modifiers are present (X_YTeX style), they must precede **.

The element ** is a semicolon-separated list of feature tags⁷ and font options. Prepending a font feature with a + (plus sign) enables it, whereas a - (minus) disables it. For instance, the request

```
\font \test = LatinModernRoman:+clig;-kern
```

activates contextual ligatures (clig) and disables kerning (kern). Alternatively the options true or false can be passed to the feature in a key/value expression. The following request has the same meaning as the last one:

```
\font \test = LatinModernRoman:clig=true;kern=false
```

Furthermore, this second syntax is required should a font feature accept other options besides a true/false switch. For example, *stylistic alternates* (salt) are variants of given glyphs. They can be selected either explicitly by supplying the variant index (starting from one), or randomly by setting the value to, obviously, random.

```
\font \librmsaltfirst = LatinModernRoman:salt=1
```

6.1 Basic font features

- **mode**

luaotfload had three OpenType processing *modes*: base, node and harf.

base mode works by mapping OpenType features to traditional TeX ligature and kerning mechanisms. Supporting only non-contextual substitutions and kerning pairs, it is the slightly faster, albeit somewhat limited, variant. node mode works by processing TeX's internal node list directly at the Lua end and supports a wider range of OpenType features. The downside is that the intricate operations required for node mode may slow down typesetting especially with complex fonts and it does not work in math mode.

By default luaotfload is in node mode, and base mode has to be requested where needed, e. g. for math fonts.

harf mode is new in version 3.1 and needs the new luahtex engine (the mode is ignored if luahtex is not used). With it is possible to render a font using the harfbuzz library in-built in the new engine. harf mode improves greatly the rendering of indic and arabic scripts and is highly recommended for such scripts.

When using harf mode it is required to set also the script correctly:

⁷Cf. <http://www.microsoft.com/typography/otspec/featurelist.htm>.

```
\font \burmesefont ={\file:NotoSerifMyanmar-Regular.ttf:mode=harf;script=mymr;}
\font \devafont ={\file:NotoSansDevanagari-Regular.ttf:mode=harf;script=deva;}
\font \banglafont ={\name:Noto Sans Bengali:mode=harf;script=beng;}
\font \tibetanfont ={\name:Noto Serif Tibetan:mode=harf;script=tibt;}
```

မ္ဗတီခေါင်းလောင်းကြို
 နက္ခိ
 কণ্যা এখন কি করিবে
 སྐྱེས་ཙམ་ཉིད་ནས་ཆེ་མཐོངས་དང་།

It is possible to call other font renderers with the mode key. A simple example with a plain reader can be found at <https://github.com/latex3/luatfload/pull/26#issuecomment-437716326>.

- **shaper**

If luahtex and harf mode are used it is possible to specify a shaper, like graphite2 or ot (open type).

```
\pardir TRT\textdir TRT
\font \test ={\file:AwamiNastaliq-Regular.ttf:mode=harf;shaper=ot}
```

اللش لى مى ے

```
\pardir TRT\textdir TRT
\font \test ={\file:AwamiNastaliq-Regular.ttf:mode=harf;shaper=graphite2}
```

اُز شلیمے

- **script**

An OpenType script tag;⁸ the default value is dflt. Some fonts, including very popular ones by foundries like Adobe, do not assign features to the dflt script, in which case the script needs to be set explicitly.

- **language**

An OpenType language system identifier,⁹ defaulting to dflt.

- **color**

A font color, defined as a triplet of two-digit hexadecimal RGB values, with an

⁸See <http://www.microsoft.com/typography/otspec/scripttags.htm> for a list of valid values. For scripts derived from the Latin alphabet the value latn is good choice.

⁹Cf. <http://www.microsoft.com/typography/otspec/languagetags.htm>.

optional fourth value for transparency (where 00 is completely transparent and FF is opaque).

For example, in order to set text in semitransparent red:

```
\font \test = "Latin Modern Roman:color=FF0000BB"
```

- **embolden**

A factor, defined as a decimal number.

For example

```
\font \test = "Latin Modern Roman:mode=node;embolden=2;"
```

Dies is not bold. **Dies is a faked bold font.**

- **kernfactor & letterspace**

Define a font with letterspacing (tracking) enabled. In `luaotfload`, letterspacing is implemented by inserting additional kerning between glyphs.

This approach is derived from and still quite similar to the *character kerning* (`\setcharacterkerning` / `\definecharacterkerning` & al.) functionality of Context, see the file `typo-krn.lua` there. The main difference is that `luaotfload` does not use LuaTeX attributes to assign letterspacing to regions, but defines virtual letterspaced versions of a font.

The option `kernfactor` accepts a numeric value that determines the letterspacing factor to be applied to the font size. E. g. a kern factor of 0.42 applied to a 10 pt font results in 4.2 pt of additional kerning applied to each pair of glyphs.

NEW in v2.96!

Spaces between words are now stretched too. This is consistent with the X_YTeX behaviour (and the amount of stretching should be similar). This naturally changes the output of a document. In case you want the old behaviour back use

```
\directlua {luaotfload.letterspace.keepwordspacing = true}
```

The difference between both options is obvious:

N e w : h e l l o w o r l d

O l d : h e l l o w o r l d

NEW in v2.96!

Ligatures are no longer split into their component glyphs. This change too make the `luaotfload` more compatible with X_YTeX. It also makes it much easier to activate or deactivate ligature sets in letterspaced fonts. If you want to split ligatures, you should deactivate as you would do it with a not-letterspaced font, e.g. with the `fontspec` `Ligatures` option, or the low-level `-liga` and similar.

With standard ligatures: fi – ff

Only with `tlig`: fi – ff

No ligatures: fi -- ff

For compatibility with X_YTeX an alternative `letterspace` option is supplied that interprets the supplied value as a *percentage* of the font size but is otherwise identical to `kernfactor`. Consequently, both definitions in below snippet yield the same letterspacing width:

```
\font \iwonakernedA = "file:Iwona-Regular.otf:kernfactor=0.125"  
\font \iwonakernedB = "file:Iwona-Regular.otf:letterspace=12.5"
```

The `microtype` package uses a special implementation of letterspacing, and the commands `\lsstyle` and `\textls` are not affected by these changes.

Setting the ligatures with the font options is the recommended way, to activate or deactivate them. In case of special requirements specific pairs of letters and ligatures may be exempt from letterspacing by defining the Lua functions `keeptgether` and `keempligature`, respectively, inside the namespace `luaotfload.letterspace`. Both functions are called whenever the letterspacing callback encounters an appropriate node or set of nodes. If they return a true-ish value, no extra kern is inserted at the current position. `keeptgether` receives a pair of consecutive glyph nodes in order of their appearance in the node list. `keempligature` receives a single node which can be analyzed into components. (For details refer to the *glyph nodes* section in the LuaTeX reference manual.) The implementation of both functions is left entirely to the user.

- **protrusion & expansion**

These keys control microtypographic features of the font, namely *character protrusion* and *font expansion*. Their arguments are names of Lua tables that contain values for the respective features.¹⁰ For both, only the set default is predefined.

For example, to define a font with the default protrusion vector applied¹¹:

```
\font \test = LatinModernRoman:protrusion=default
```

- **invisible**

Default Ignorable characters are control characters that should be invisible by default even if the font has glyphs for them. Since version 3.0 `luaotfload` makes

¹⁰For examples of the table layout please refer to the section of the file `luaotfload-fonts-ext.lua` where the default values are defined. Alternatively and with loss of information, you can dump those tables into your terminal by issuing

```
\directlua {inspect(fonts.protrusions.setups.default)  
             inspect(fonts.expansions.setups.default)}
```

at some point after loading `luaotfload.sty`.

¹¹You also need to set `pdfprotrudechars=2` and `pdfadjustspacing=2` to activate protrusion and expansion, respectively. See the [pdfTeX manual](#) for details.

them invisible, this can be switch on and off with the invisible. By default it is on.

For example

```
\font \amiri ={\file:amiri-regular.ttf} at 20pt \amiri
\char "200D\char "200D
```

ي

```
\font \amiri ={\file:amiri-regular.ttf:-invisible;} at 20pt \amiri
\char "200D\char "200D
```

ي

6.2 Non-standard font features

luaotfload adds a number of features that are not defined in the original OpenType specification, most of them aiming at emulating the behavior familiar from other \TeX engines. Currently (2014) there are three of them:

- **anum**
Substitutes the glyphs in the ASCII number range with their counterparts from eastern Arabic or Persian, depending on the value of `language`.
- **tlig**
Applies legacy \TeX ligatures¹²:

“	‘	”	’
‘	‘	’	’
”	”	—	--
—	---	!	!’
¿	?’		
- **itlc**
Computes italic correction values (active by default).

7 COMBINING FONTS

Version 2.7 and later support combining characters from multiple fonts into a single virtualized one. This requires that the affected fonts be loaded in advance as well as a special *request syntax*. Furthermore, this allows to define *fallback fonts* to supplement fonts that may lack certain required glyphs.

Combinations are created by defining a font using the `combo:` prefix.

¹²These contain the feature set `trep` of earlier versions of **luaotfload**.

Note to \XTeX users: this is the equivalent of the assignment `mapping=text-tex` using \XTeX 's input remapping feature.

7.1 *Fallbacks*

For example, the Latin Modern family of fonts does, as indicated in the name, not provide Cyrillic glyphs. If Latin script dominates in the copy with interspersed Cyrillic, a fallback can be created from a similar looking font like Computer Modern Unicode, taking advantage of the fact that it too derives from Knuth's original Computer Modern series:

```
\input luaotfload.sty
\font \lm = file:lmroman10-regular.otf:mode=base
\font \cmu = file:cmunrm.otf:mode=base
\font \lmu = "combo: 1->\fontid \lm ; 2->\fontid \cmu ,fallback"
\lmu Eh bien, mon prince. Gênes et Lueques ne sont plus que des
      apanages, des □□□□□□, de la famille Buonaparte.
\bye
```

As simple as this may look on the first glance, this approach is entirely inappropriate if more than a couple letters are required from a different font. Because the combination pulls nothing except the glyph data, all of the important other information that constitute a proper font – kerning, styles, features, and suchlike – will be missing.

7.2 *Combinations*

Generalizing the idea of a *fallback font*, it is also possible to pick definite sets of glyphs from multiple fonts. On a bad day, for instance, it may be the sanest choice to start out with EB Garamond italics, typeset all decimal digits in the bold italics of GNU Freefont, and tone down the punctuation with extra thin glyphs from Source Sans:

```
\def \feats {-tlig;-liga;mode=base;-kern}
\def \fileone {EBGaramond12-Italic.otf}
\def \filetwo {FreeMonoBoldOblique.otf}
\def \filethree {SourceSansPro-ExtraLight.otf}
\input luaotfload.sty
\font \one = file:\fileone : \feats
\font \two = file:\filetwo : \feats
\font \three = file:\filethree : \feats
\font \onetwothree = "combo: 1 -> \fontid \one ;
                        2 -> \fontid \two , 0x30-0x39;
                        3 -> \fontid \three , 0x21*0x3f; "
{\onetwothree \TeX -0123456789-?!}
\bye
```

Despite the atrocious result, the example demonstrates well the syntax that is used to specify ranges and fonts. Fonts are being referred to by their internal index which can be obtained by passing the font command into the `\fontid` macro, e. g. `\fontid\one`, after a font has been defined. The first component of the combination is the base font which will be extended by the others. It is specified by the index alone.

All further fonts require either the literal fallback or a list of codepoint definitions to be appended after a comma. The elements of this list again denote either single codepoints like `0x21` (referring to the exclamation point character) or ranges of codepoints (`0x30-0x39`). Elements are separated by the ASCII asterisk character (`*`). The characters referenced in the list will be imported from the respective font, if available.

8 FONT NAMES DATABASE

As mentioned above, `luaotfload` keeps track of which fonts are available to Lua \TeX by means of a *database*. This allows referring to fonts not only by explicit filenames but also by the proper names contained in the metadata which is often more accessible to humans.¹³

When `luaotfload` is asked to load a font by a font name, it will check if the database exists and load it, or else generate a fresh one. Should it then fail to locate the font, an update to the database is performed in case the font has been added to the system only recently. As soon as the database is updated, the resolver will try and look up the font again, all without user intervention. The goal is for `luaotfload` to act in the background and behave as unobtrusively as possible, while providing a convenient interface to the fonts installed on the system.

Generating the database for the first time may take a while since it inspects every font file on your computer. This is particularly noticeable if it occurs during a typesetting run. In any case, subsequent updates to the database will be quite fast.

8.1 luaotfload-tool

It can still be desirable at times to do some of these steps manually, and without having to compile a document. To this end, `luaotfload` comes with the utility `luaotfload-tool` that offers an interface to the database functionality. Being a Lua script, there are two ways to run it: either make it executable (`chmod +x` on unixoid systems) or pass it as an argument to `texlua`.¹⁴ Invoked with the argument `--update` it will perform a database update, scanning for fonts not indexed.

```
luaotfload-tool --update
```

Adding the `--force` switch will initiate a complete rebuild of the database.

```
luaotfload-tool --update --force
```

¹³The tool `otfinfo` (comes with \TeX Live), when invoked on a font file with the `-i` option, lists the variety of name fields defined for it.

¹⁴Tests by the maintainer show only marginal performance gain by running with Luigi Scarso's `Luajit \TeX` , which is probably due to the fact that most of the time is spent on file system operations.

Note: On MS Windows systems, the script can be run either by calling the wrapper application `luaotfload-tool.exe` or as `texlua.exe luaotfload-tool.lua`.

Table 1: List of paths searched for each supported operating system.

8.2 *Search Paths*

`luaotfload` scans those directories where fonts are expected to be located on a given system. On a Linux machine it follows the paths listed in the `Fontconfig` configuration files; consult `man 5 fonts.conf` for further information. On Windows systems, the standard location is `Windows\Fonts`, while Mac OS X requires a multitude of paths to be examined. The complete list is given in table 1. Other paths can be specified by setting the environment variable `OSFONTDIR`. If it is non-empty, then search will be extended to the included directories.

Windows	% WINDIR%\ Fonts
Linux	/usr/local/etc/fonts/fonts.conf and /etc/fonts/fonts.conf
Mac	~/Library/Fonts, /Library/Fonts, /System/Library/Fonts, and /Network/Library/Fonts

8.3 *Querying from Outside*

`luaotfload-tool` also provides rudimentary means of accessing the information collected in the font database. If the option `--find=name` is given, the script will try and search the fonts indexed by `luaotfload` for a matching name. For instance, the invocation

```
luaotfload-tool --find="Iwona Regular"
```

will verify if “Iwona Regular” is found in the database and can be readily requested in a document.

If you are unsure about the actual font name, then add the `-F` (or `--fuzzy`) switch to the command line to enable approximate matching. Suppose you cannot precisely remember if the variant of Iwona you are looking for was “Bright” or “Light”. The query

```
luaotfload-tool -F --find="Iwona Bright"
```

will tell you that indeed the latter name is correct.

Basic information about fonts in the database can be displayed using the `-i` option (`--info`).

```
luaotfload-tool -i --find="Iwona Light Italic"
```

The meaning of the printed values is described in section 4.4 of the LuaTeX reference manual.¹⁵

¹⁵In TeX Live: `texmf-dist/doc/luatex/base/luatexref-t.pdf`.

For a much more detailed report about a given font try the `-I` option instead (`--inspect`).

```
luaotfload-tool -I --find="Iwona Light Italic"
```

`luaotfload-tool --help` will list the available command line switches, including some not discussed in detail here. For a full documentation of `luaotfload-tool` and its capabilities refer to the manpage (`man 1 luaotfload-tool`).¹⁶

8.4 Blacklisting Fonts

Some fonts are problematic in general, or just in Lua \TeX . If you find that compiling your document takes far too long or eats away all your system's memory, you can track down the culprit by running `luaotfload-tool -v` to increase verbosity. Take a note of the *filename* of the font that database creation fails with and append it to the file `luaotfload-blacklist.cnf`.

A blacklist file is a list of font filenames, one per line. Specifying the full path to where the file is located is optional, the plain filename should suffice. File extensions (`.otf`, `.ttf`, etc.) may be omitted. Anything after a percent (`\%`) character until the end of the line is ignored, so use this to add comments. Place this file to some location where the `kpse` library can find it, e. g. `texmf-local/tex/luatex/luaotfload` if you are running \TeX Live,¹⁷ or just leave it in the working directory of your document. `luaotfload` reads all files named `luaotfload-blacklist.cnf` it finds, so the fonts in `./luaotfload-blacklist.cnf` extend the global blacklist.

Furthermore, a filename prepended with a dash character (`-`) is removed from the blacklist, causing it to be temporarily whitelisted without modifying the global file. An example with explicit paths:

```
/Library/Fonts/GillSans.ttc -/Library/Fonts/Optima.ttc
```

9 THE FONTLOADER

9.1 Overview

To a large extent, `luaotfload` relies on code originally written by Hans Hagen for the Con \TeX t format. It integrates the font loader, written entirely in Lua, as distributed in the Lua \TeX -Fonts package. The original Lua source files have been combined using the Con \TeX t packaging library into a single, self-contained blob. In this form the font loader depends only on the `lualibs` package and requires only minor adaptations to integrate into `luaotfload`.

The guiding principle is to let Con \TeX t/Lua \TeX -Fonts take care of the implementation, and update the imported code as frequently as necessary. As maintainers, we aim at importing files from upstream essentially *unmodified*, except for renaming them to

¹⁶Or see `luaotfload-tool.rst` in the source directory.

¹⁷You may have to run `mktxlsr` if you created a new file in your `texmf` tree.

prevent name clashes. This job has been greatly alleviated since the advent of Lua_T_EX-Fonts, prior to which the individual dependencies had to be manually spotted and extracted from the Con_T_EXt source code in a complicated and error-prone fashion.

9.2 Contents and Dependencies

Below is a commented list of the files distributed with `luaotfload` in one way or the other. See the figure on page 29 for a graphical representation of the dependencies. Through the script `mkimport` a Con_T_EXt library is invoked to create the `luaotfload` fontloader as a merged (amalgamated) source file.¹⁸ This file constitutes the “default fontloader” and is part of the `luaotfload` package as `fontloader-YY-MM-DD.lua`, where the uppercase letters are placeholders for the build date. A companion to it, `luatex-basics-gen.lua` (renamed to `fontloader-basics-gen.lua` in `luaotfload`) must be loaded beforehand to set up parts of the environment required by the Con_T_EXt libraries. During a _T_EX run, the fontloader initialization and injection happens in the module `luaotfload-init.lua`. Additionally, the “reference fontloader” as imported from Lua_T_EX-Fonts is provided as the file `fontloader-reference.lua`. This file is self-contained in that it packages all the auxiliary Lua libraries too, as Luaotfload did up to the 2.5 series; since that job has been offloaded to the Lualibs package, loading this fontloader introduces a certain code duplication.

A number of *Lua utility libraries* are not part of the `luaotfload` fontloader, contrary to its equivalent in Lua_T_EX-Fonts. These are already provided by the lualibs and have thus been omitted from the merge.¹⁹

- | | |
|-------------------------------|------------------------------|
| • <code>l-lua.lua</code> | • <code>l-file.lua</code> |
| • <code>l-lpeg.lua</code> | • <code>l-boolean.lua</code> |
| • <code>l-function.lua</code> | • <code>l-math.lua</code> |
| • <code>l-string.lua</code> | • <code>l-unicode.lua</code> |
| • <code>l-table.lua</code> | • <code>util-str.lua</code> |
| • <code>l-io.lua</code> | • <code>util-fil.lua</code> |

The reference fontloader is home to several Lua files that can be grouped twofold as below:

- The *font loader* itself. These files have been written for Lua_T_EX-Fonts and they are distributed along with `luaotfload` so as to resemble the state of the code when it was imported. Their purpose is either to give a slightly aged version of a file if upstream considers latest developments for not yet ready for use outside Context;

¹⁸In Con_T_EXt, this facility can be accessed by means of a `script` which is integrated into `mtxrun` as a subcommand. Run `mtxrun --script package --help` to display further information. For the actual merging code see the file `util-mrg.lua` that is part of Con_T_EXt.

¹⁹Faithful listeners will remember the pre-2.6 era when the fontloader used to be integrated as-is which caused all kinds of code duplication with the pervasive lualibs package. This conceptual glitch has since been amended by tightening the coupling with the excellent Con_T_EXt toolchain.

or, to install placeholders or minimalist versions of APIs relied upon but usually provided by parts of Context not included in the fontloader.

– luatex-basics-nod.lua	– luatex-fonts-def.lua
– luatex-basics-chr.lua	– luatex-fonts-ext.lua
– luatex-fonts-mis.lua	– luatex-fonts-lig.lua
– luatex-fonts-enc.lua	– luatex-fonts-gbn.lua
– luatex-fonts-syn.lua	– luatex-fonts.lua
– luatex-fonts-tfm.lua	

- Code related to *font handling and node processing*, taken directly from ConT_EXt.

– data-con.lua	– font-otj.lua
– font-ini.lua	– font-ota.lua
– font-con.lua	– font-ots.lua
– font-cid.lua	– font-osd.lua
– font-map.lua	– font-ocl.lua
– font-vfc.lua	– font-otc.lua
– font-otr.lua	– font-onr.lua
– font-oti.lua	– font-one.lua
– font-ott.lua	– font-afk.lua
– font-cff.lua	– font-lua.lua
– font-ttf.lua	– font-def.lua
– font-dsp.lua	– font-imp-tex.lua
– font-oup.lua	– font-imp-ligatures.lua
– font-otl.lua	– font-imp-italics.lua
– font-oto.lua	– font-imp-effects.lua

As an alternative to the merged file, Luaotfload may load individual unpackaged Lua libraries that come with the source, or even use the files from Context directly. Thus if you prefer running bleeding edge code from the ConT_EXt beta, choose the context fontloader via the configuration file (see sections 10 and 9.3 below).

Also, the merged file at some point loads the Adobe Glyph List from a Lua table that is contained in luaotfload-glyphlist.lua, which is automatically generated by the script mkglyphlist.²⁰ There is a make target glyphs that will create a fresh glyph list so we don’t need to import it from ConT_EXt any longer.

²⁰See luaotfload-font-enc.lua. The hard-coded file name is why we have to replace the procedure that loads the file in luaotfload-init.lua.

In addition to these, `luaotfload` requires a number of files not contained in the merge. Some of these have no equivalent in `LuaTeX-Fonts` or `ConTeXt`, some were taken unmodified from the latter.

- `luaotfload-features.lua` – font feature handling; incorporates some of the code from `font-otc` from `ConTeXt`;
- `luaotfload-configuration.lua` – handling of `luaotfload.conf(5)`.
- `luaotfload-log.lua` – overrides the `ConTeXt` logging functionality.
- `luaotfload-loaders.lua` – registers readers in the fontloader for various kinds of font formats
- `luaotfload-parsers.lua` – various LPEG-based parsers.
- `luaotfload-database.lua` – font names database.
- `luaotfload-resolvers.lua` – file name resolvers.
- `luaotfload-colors.lua` – color handling.
- `luaotfload-auxiliary.lua` – access to internal functionality for package authors (proposals for additions welcome).
- `luaotfload-letterspace.lua` – font-based letterspacing.
- `luaotfload-filelist.lua` – data about the files in the package.

9.3 Packaging

The fontloader code is integrated as an isolated component that can be switched out on demand. To specify the fontloader you wish to use, the configuration file (described in section 10) provides the option `fontloader`. Its value can be one of the identifiers `default` or `reference` (see above, section 9.2) or the name of a file somewhere in the search path of `LuaTeX`. This will make `Luaotfload` locate the `ConTeXt` source by means of `kpathsea` lookups and use those instead of the merged package. The parameter may be extended with a path to the `ConTeXt` `texmf`, separated with a colon:

```
[run]
fontloader = context:~/context/tex/texmf-context
```

This setting allows accessing an installation – e. g. the standalone distribution or a source repository – outside the current `TeX` distribution.

Like the `Lualibs` package, the fontloader is deployed as a *merged package* containing a series of Lua files joined together in their expected order and stripped of non-significant parts. The `mkimport` utility assists in pulling the files from a `ConTeXt` tree and packaging them for use with `Luaotfload`. The state of the files currently in `Luaotfload`'s repository can be queried:

```
./scripts/mkimport news
```

The subcommand for importing takes the prefix of the desired ConT_EXt texmf as an optional argument:

```
./scripts/mkimport import ~/context/tex/texmf-context
```

Whereas the command for packaging requires a path to the *package description file* and the output name to be passed.

```
./scripts/mkimport package fontloader-custom.lua
```

From the toplevel makefile, the targets `import` and `package` provide easy access to the commands as invoked during the Luaotfload build process.²¹ These will call `mkimport` script with the correct parameters to generate a dated package. Whether files have been updated in the upstream distribution can be queried by `./scripts/mkimport news`. This will compare the imported files with their counterparts in the ConT_EXt distribution and report changes.

10 CONFIGURATION FILES

Caution: For the authoritative documentation, consult the manpage for `luaotfload.conf(5)`.

The runtime behavior of Luaotfload can be customized by means of a configuration file. At startup, it attempts to locate a file called `luaotfload.conf` or `luaotfloadrc` at a number of candidate locations:

- `./luaotfload.conf`
- `./luaotfloadrc`
- `$XDG_CONFIG_HOME/luaotfload/luaotfload.conf`
- `$XDG_CONFIG_HOME/luaotfload/luaotfload.rc`
- `/.luaotfloadrc`

Caution: The configuration potentially modifies the final document. A project-local file belongs under version control along with the rest of the document. This is to ensure that everybody who builds the project also receives the same customizations as the author.

The syntax is fairly close to the format used by `git-config(1)` which in turn was derived from the popular `.INI` format: Lines of key-value pairs are grouped under different configuration “sections”.²² An example for customization via `luaotfload.conf` might look as below:

²¹Hint for those interested in the packaging process: issue `make show` for a list of available build routines.

²²The configuration parser in `luaotfload-parsers.lua` might be employed by other packages for similar purposes.

```

; Example luaotfload.conf containing a rudimentary configuration
[db]
  update-live = false
[run]
  color-callback = pre_linebreak_filter
  definer = info_patch
  log-level = 5
[default-features]
  global = mode=base

```

This specifies that for the given project, `Luaotfload` shall not attempt to automatically scan for fonts if it can't resolve a request. The font-based colorization will happen during `LuaTeX`'s pre-linebreak filter. The fontloader will output verbose information about the fonts at definition time along with globally increased verbosity. Lastly, the fontloader defaults to the less expensive base mode like it does in `ConTeXt`.

11 AUXILIARY FUNCTIONS

With release version 2.2, `Luaotfload` received additional functions for package authors to call from outside (see the file `luaotfload-auxiliary.lua` for details). The purpose of this addition twofold. Firstly, `luaotfload` failed to provide a stable interface to internals in the past which resulted in an unmanageable situation of different packages abusing the raw access to font objects by means of the `patch_font` callback. When the structure of the font object changed due to an update, all of these imploded and several packages had to be fixed while simultaneously providing fallbacks for earlier versions. Now the patching is done on the `luaotfload` side and can be adapted with future modifications to font objects without touching the packages that depend on it. Second, some the capabilities of the font loader and the names database are not immediately relevant in `luaotfload` itself but might nevertheless be of great value to package authors or end users.

Note that the current interface is not yet set in stone and the development team is open to suggestions for improvements or additions.

11.1 *Callback Functions*

The `patch_font` callback is inserted in the wrapper `luaotfload` provides for the font definition callback. At this place it allows manipulating the font object immediately after the font loader is done creating it. For a short demonstration of its usefulness, here is a snippet that writes an entire font object to the file `fontdump.lua`:

```

\input luaotfload.sty
\directlua {
  local dumpfile = "fontdump.lua"
  local dump_font = function (tfmdata)
    local data = table.serialize(tfmdata)
    io.savedata(dumpfile, data)
  end
  luatexbase.add_to_callback(

```

```

        "luaotfload.patch_font",
        dump_font,
        "my_private_callbacks.dump_font"
    )
}
\font \dumpme = name:Iwona
\bye

```

Beware: this creates a Lua file of around 150,000 lines of code, taking up 3 MB of disk space. By inspecting the output you can get a first impression of how a font is structured in LuaTeX's memory, what elements it is composed of, and in what ways it can be rearranged.

11.1.1 Compatibility with Earlier Versions

As has been touched on in the preface to this section, the structure of the object as returned by the fontloader underwent rather drastic changes during different stages of its development, and not all packages that made use of font patching have kept up with every one of it. To ensure compatibility with these as well as older versions of some packages, `luaotfload` sets up copies of or references to data in the font table where it used to be located. For instance, important parameters like the requested point size, the units factor, and the font name have again been made accessible from the toplevel of the table even though they were migrated to different subtables in the meantime.

11.1.2 Patches

These are mostly concerned with establishing compatibility with X_YTeX.

- `set_sscale_dimens`
Calculate `\fontdimens 10` and `11` to emulate X_YTeX.
- `set_capheight`
Calculates `\fontdimen 8` like X_YTeX.
- `patch_cambria_domh`
Correct some values of the font *Cambria Math*.

11.2 Package Author's Interface

As LuaTeX release 1.0 is nearing, the demand for a reliable interface for package authors increases.

11.2.1 Font Properties

Below functions mostly concern querying the different components of a font like for instance the glyphs it contains, or what font features are defined for which scripts.

- `aux.font_has_glyph (id : int, index : int)`
Predicate that returns true if the font `id` has glyph `index`.

- `aux.slot_of_name(name : string)`
Translates an Adobe Glyph name to the corresponding glyph slot.
- `aux.name_of_slot(slot : int)`
The inverse of `slot_of_name`; note that this might be incomplete as multiple glyph names may map to the same codepoint, only one of which is returned by `name_of_slot`.
- `aux.provides_script(id : int, script : string)`
Test if a font supports script.
- `aux.provides_language(id : int, script : string, language : string)`
Test if a font defines language for a given script.
- `aux.provides_feature(id : int, script : string, language : string, feature : string)`
Test if a font defines feature for language for a given script.
- `aux.get_math_dimension(id : int, dimension : string)`
Get the dimension dimension of font id.
- `aux.sprint_math_dimension(id : int, dimension : string)`
Same as `get_math_dimension()`, but output the value in scaled points at the \TeX end.

11.2.2 Database

- `aux.read_font_index (void)`
Read the index file from the appropriate location (usually the bytecode file `luaotfload-names.luc` somewhere in the `texmf-var` tree) and return the result as a table. The file is processed with each call so it is up to the user to store the result for later access.
- `aux.font_index (void)`
Return a reference of the font names table used internally by `luaotfload`. The index will be read if it has not been loaded up to this point. Also a font scan that overwrites the current index file might be triggered. Since the return value points to the actual index, any modifications to the table might influence runtime behavior of `luaotfload`.

12 TROUBLESHOOTING

12.1 Database Generation

If you encounter problems with some fonts, please first update to the latest version of this package before reporting a bug, as `luaotfload` is under active development and still a moving target. The development takes place on github at <https://github.com/lualatex/luaotfload> where there is an issue tracker for submitting bug reports, feature requests and the likes.

Bug reports are more likely to be addressed if they contain the output of

```
luaotfload-tool --diagnose=environment,files,permissions
```

Consult the man page for a description of these options.

Errors during database generation can be traced by increasing the verbosity level and redirecting log output to stdout:

```
luaotfload-tool -fuvvv --log=stdout
```

or to a file in /tmp:

```
luaotfload-tool -fuvvv --log=file
```

In the latter case, invoke the `tail(1)` utility on the file for live monitoring of the progress.

If database generation fails, the font last printed to the terminal or log file is likely to be the culprit. Please specify it when reporting a bug, and blacklist it for the time being (see above, page 18).

12.2 *Font Features*

A common problem is the lack of features for some OpenType fonts even when specified. This can be related to the fact that some fonts do not provide features for the `df1t` script (see above on page 11), which is the default one in this package. If this happens, assigning a noth script when the font is defined should fix it. For example with `latn`:

```
\font \test = file:MyFont.otf:script=latn;+liga;
```

You can get a list of features that a font defines for scripts and languages by querying it in `luaotfload-tool`:

```
luaotfload-tool --find="Iwona" --inspect
```

12.3 *LuaTeX Programming*

Another strategy that helps avoiding problems is to not access raw LuaTeX internals directly. Some of them, even though they are dangerous to access, have not been overridden or disabled. Thus, whenever possible prefer the functions in the `aux` namespace over direct manipulation of font objects. For example, raw access to the `font.fonts` table like:

```
local somefont = font.fonts[2]
```

can render already defined fonts unusable. Instead, the function `font.getfont()` should be used because it has been replaced by a safe variant.

However, `font.getfont()` only covers fonts handled by the font loader, e. g. OpenType and TrueType fonts, but not TFM or OFM. Should you absolutely require access to all fonts known to LuaTeX, including the virtual and autogenerated ones, then you need to query both `font.getfont()` and `font.fonts`. In this case, best define you own accessor:

```

local unsafe_getfont = function (id)
  local tfmdata = font.getfont (id)
  if not tfmdata then
    tfmdata = font.fonts[id]
  end
  return tfmdata
end
--- use like getfont()
local somefont = unsafe_getfont (2)

```

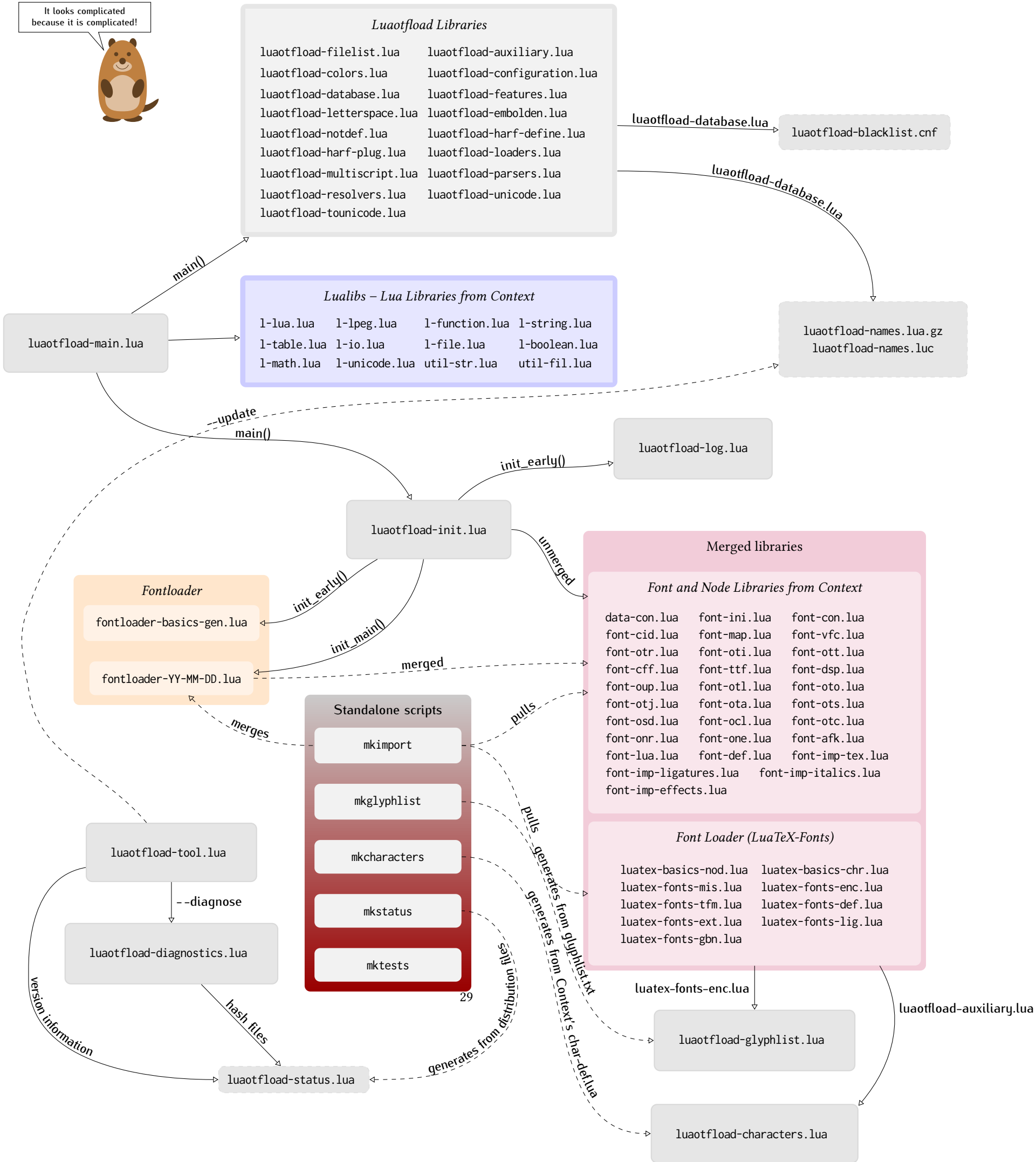
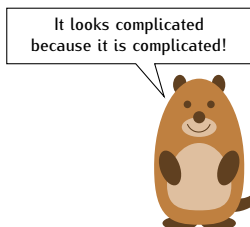
13 LICENSE

luaotfload is licensed under the terms of the [GNU General Public License version 2.0](#). Following the underlying fontloader code luaotfload recognizes only that exact version as its license. The „any later version” clause of the original license text as copyrighted by the [Free Software Foundation](#) *does not apply* to either luaotfload or the code imported from ConT_EXt.

The complete text of the license is given as a separate file COPYING in the toplevel directory of the [Luaotfload Git repository](#). Distributions probably package it as doc/luatex/luaotfload/COPYING in the relevant texmf tree.

$\langle \text{definition} \rangle$::= '\font', CSNAME, '=', $\langle \text{font request} \rangle$, [$\langle \text{size} \rangle$] ;
$\langle \text{size} \rangle$::= 'at', DIMENSION ;
$\langle \text{font request} \rangle$::= '"', $\langle \text{unquoted font request} \rangle$ '"' '{', $\langle \text{unquoted font request} \rangle$ '}' $\langle \text{unquoted font request} \rangle$;
$\langle \text{unquoted font request} \rangle$::= $\langle \text{specification} \rangle$, [':' , $\langle \text{feature list} \rangle$] $\langle \text{path lookup} \rangle$, [[':'], $\langle \text{feature list} \rangle$] ;
$\langle \text{specification} \rangle$::= $\langle \text{prefixed spec} \rangle$, [$\langle \text{subfont no} \rangle$], { $\langle \text{modifier} \rangle$ } $\langle \text{anon lookup} \rangle$, { $\langle \text{modifier} \rangle$ } ;
$\langle \text{prefixed spec} \rangle$::= 'combo:', $\langle \text{combo list} \rangle$ 'file:', $\langle \text{file lookup} \rangle$ 'name:', $\langle \text{name lookup} \rangle$;
$\langle \text{combo list} \rangle$::= $\langle \text{combo def 1} \rangle$, { ';' , $\langle \text{combo def} \rangle$ } ;
$\langle \text{combo def 1} \rangle$::= $\langle \text{combo id} \rangle$, '->' , $\langle \text{combo id} \rangle$;
$\langle \text{combo def} \rangle$::= $\langle \text{combo id} \rangle$, '->' , $\langle \text{combo id chars} \rangle$;
$\langle \text{combo id} \rangle$::= ('C', { DIGIT }, ') { DIGIT }) ;
$\langle \text{combo id chars} \rangle$::= ('C', { DIGIT }, ', ' , $\langle \text{combo chars} \rangle$, ') { DIGIT }) ;
$\langle \text{combo chars} \rangle$::= 'fallback' { $\langle \text{combo range} \rangle$, { '*' , $\langle \text{combo range} \rangle$ } } ;
$\langle \text{combo range} \rangle$::= $\langle \text{combo num} \rangle$, ['-' , $\langle \text{combo num} \rangle$] ;
$\langle \text{combo num} \rangle$::= '0x' , { HEXDIGIT } 'U+' , { DIGIT } { DIGIT } ;
$\langle \text{file lookup} \rangle$::= { $\langle \text{name character} \rangle$ } ;
$\langle \text{name lookup} \rangle$::= { $\langle \text{name character} \rangle$ } ;
$\langle \text{anon lookup} \rangle$::= TFMNAME $\langle \text{name lookup} \rangle$;
$\langle \text{path lookup} \rangle$::= '[', { $\langle \text{path content} \rangle$ }, ']' , [$\langle \text{subfont no} \rangle$] ;
$\langle \text{path content} \rangle$::= $\langle \text{path balanced} \rangle$ '\', ALL_CHARACTERS ALL_CHARACTERS - '['
$\langle \text{path balanced} \rangle$::= '[', [$\langle \text{path content} \rangle$], ']'
$\langle \text{modifier} \rangle$::= '/', ('I' 'B' 'BI' 'IB' 'S=' , { DIGIT }) ;
$\langle \text{subfont no} \rangle$::= ('C', { DIGIT }, ') ;
$\langle \text{feature list} \rangle$::= $\langle \text{feature expr} \rangle$, { ';' , $\langle \text{feature expr} \rangle$ } ;
$\langle \text{feature expr} \rangle$::= FEATURE_ID, '=', FEATURE_VALUE $\langle \text{feature switch} \rangle$, FEATURE_ID ;
$\langle \text{feature switch} \rangle$::= '+' '-' ;
$\langle \text{name character} \rangle$::= ALL_CHARACTERS - ('(' '/' ':') ;

Figure 1: Font request syntax. Braces or double quotes around the *specification* rule will preserve whitespace in file names. In addition to the font style modifiers (*slash-notation*) given above, there are others that are recognized but will be silently ignored: *aat*, *icu*, and *gr*. The special terminals are: *FEATURE_ID* for a valid font feature name and *FEATURE_VALUE* for the corresponding value. *TFMNAME* is the name of a TFM file. *DIGIT* again refers to bytes 48–57, and *ALL_CHARACTERS* to all byte values. *CSNAME* and *DIMENSION* are the \TeX concepts.



luaotfload.conf

Luaotfload configuration file

Date: 2019-11-04
Copyright: GPL v2.0
Version: 3.1
Manual section: 5
Manual group: text processing

SYNOPSIS

- `./luaotfload{.conf,rc}`
- `XDG_CONFIG_HOME/luaotfload/luaotfload{.conf,rc}`
- `~/.luaotfloadrc`

DESCRIPTION

The file `luaotfload.conf` contains configuration options for *Luaotfload*, a font loading and font management component for LuaTeX.

EXAMPLE

A small Luaotfload configuration file with few customizations could look as follows:

```
[db]
  formats = afm,ttf
  compress = false

[misc]
  termwidth = 60

[run]
  log-level = 6
```

This will make Luaotfload ignore all font files except for PostScript binary fonts with a matching AFM file, and Truetype fonts. Also, an uncompressed index file will be dumped which is going to be much larger than the default gzip'ed index. The terminal width is truncated to 60 characters which influences the verbose output during

indexing. Finally, the verbosity is increased greatly: each font file being processed will be printed to the stdout on a separate line, along with lots of other information.

To observe the difference in behavior, save above snippet to `./luaotfload.conf` and update the font index:

```
luaotfload-tool --update --force
```

The current configuration can be written to disk using **luaotfload-tool**:

```
luaotfload-tool --dumpconf > luaotfload.conf
```

The result can itself be used as a configuration file.

SYNTAX

The configuration file syntax follows the common INI format. For a more detailed description please refer to the section “CONFIGURATION FILE” of **git-config**(1). A brief list of rules is given below:

- Blank lines and lines starting with a semicolon (;) are ignored.
- A configuration file is partitioned into sections that are declared by specifying the section title in brackets on a separate line:

```
[some-section]
... section content ...
```
- Sections consist of one or more variable assignments of the form `variable-name = value` E. g.:

```
[foo]
  bar = baz
  quux = xyzy
  ...
```
- Section and variable names may contain only uppercase and lowercase letters as well as dashes (-).

VARIABLES

Variables in belong into a configuration section and their values must be of a certain type. Some of them have further constraints. For example, the “color callback” must be a string of one of the values `post_linebreak_filter`, `pre_linebreak_filter`, or `pre_output_filter`, defined in the section *run* of the configuration file.

Currently, the configuration is organized into four sections:

db Options relating to the font index.

misc Options without a clearly defined category.

paths Path and file name settings.

run Options controlling runtime behavior of Luaotfload.

The list of valid variables, the sections they are part of and their type is given below. Types represent Lua types that the values must be convertible to; they are abbreviated as follows: *s* for the *string* type, *n* for *number*, *b* for *boolean*. A value of `nil` means the variable is unset.

Section db

variable	type	default
compress	b	true
designsize-dimen	b	bp
formats	s	"otf,ttf,ttc"
max-fonts	n	2 ⁵¹
scan-local	b	false
skip-read	b	false
strip	b	true
update-live	b	true

The flag `compress` determines whether the font index (usually `luaotfload-names.lua[.gz]`) will be stored in compressed forms. If unset it is equivalent of passing `--no-compress` to **luaotfload-tool**. Since the file is only created for convenience and has no effect on the runtime behavior of Luaotfload, the flag should remain set. Most editors come with zlib support anyways.

The setting `designsize-dimen` applies when looking up fonts from families with design sizes. In Opentype, these are specified as “decipoints” where one decipoint equals ten DTP style “big points”. When indexing fonts these values are converted to sp. In order to treat the values as though they were specified in TeX points or Didot points, set `designsize-dimen` to `pt` or `dd`.

The list of `formats` must be a comma separated sequence of strings containing one or more of these elements:

- `otf` (OpenType format),
- `ttf` and `ttc` (TrueType format),
- `afm` (Adobe Font Metrics),

It corresponds loosely to the `--formats` option to **luaotfload-tool**. Invalid or duplicate members are ignored; if the list does not contain any useful identifiers, the default list `"otf,ttf,ttc"` will be used.

The variable `max-fonts` determines after processing how many font files the font scanner will terminate the search. This is useful for debugging issues with the font index and has the same effect as the option `--max-fonts` to **luaotfload-tools**.

The `scan-local` flag, if set, will incorporate the current working directory as a font search location. NB: This will potentially slow down document processing because a font index with local fonts will not be saved to disk, so these fonts will have to be re-indexed whenever the document is built.

The `skip-read` flag is only useful for debugging: It makes Luaotfload skip reading fonts. The font information for rebuilding the index is taken from the presently existing one.

Unsetting the `strip` flag prevents Luaotfload from removing data from the index that is only useful when processing font files. NB: this can increase the size of the index files significantly and has no effect on the runtime behavior.

If `update-live` is set, Luaotfload will reload the database if it cannot find a requested font. Those who prefer to update manually using **luaotfload-tool** should unset this flag. This option does not affect rebuilds due to version mismatch.

Section default-features

By default Luaotfload enables node mode and picks the default font features that are prescribed in the OpenType standard. This behavior may be overridden in the `default-features` section. Global defaults that will be applied for all scripts can be set via the `global` option, others by the script they are to be applied to. For example, a setting of

```
[default-features]
  global = mode=base,color=0000FF
  dflt   = smcp,onum
```

would force *base* mode, tint all fonts blue and activate small capitals and text figures globally. Features are specified as a comma separated list of variables or variable-value pairs. Variables without an explicit value are set to true.

Section misc

variable	type	default
statistics	b	false
termwidth	n	nil
version	s	<Luaotfload version>

With `statistics` enabled, extra statistics will be collected during index creation and appended to the index file. It may then be queried at the Lua end or inspected by reading the file itself.

The value of `termwidth`, if set, overrides the value retrieved by querying the properties of the terminal in which Luatex runs. This is useful if the engine runs with `shell_escape` disabled and the actual terminal dimensions cannot be retrieved.

The value of `version` is derived from the version string hard-coded in the Luaotfload source. Override at your own risk.

Section paths

variable	type	default
cache-dir	s	"fonts"
names-dir	s	"names"
index-file	s	"luaotfload-names.lua"
lookups-file	s	"luaotfload-lookup-cache.lua"

The paths `cache-dir` and `names-dir` determine the subdirectory inside the Luaotfload subtree of the `luatex-cache` directory where the font cache and the font index will be stored, respectively.

Inside the index directory, the names of the index file and the font lookup cache will be derived from the respective values of `index-file` and `lookups-file`. This is the filename base for the bytecode compiled version as well as – for the index – the gzipped version.

Section run

variable	type	default
anon-sequence	s	"tex,path,name"
color-callback	s	"post_linebreak_filter"
definer	s	"patch"
log-level	n	0
resolver	s	"cached"
fontloader	s	"default"

Unqualified font lookups are treated with the flexible “anonymous” mechanism. This involves a chain of lookups applied successively until the first one yields a match. By default, the lookup will first search for TFM fonts using the Kpathsea library. If this wasn’t successful, an attempt is made at interpreting the request as an absolute path (like the `[/path/to/font/foo.ttf]` syntax) or a file name (`file:foo.ttf`). Finally, the request is interpreted as a font name and retrieved from the index (`name:Foo Regular`). This behavior can be configured by specifying a list as the value to `anon-sequence`. Available items are `tex`, `path`, `name` – representing the lookups described above, respectively –, and `file` for searching a filename but not an absolute path. Also, `my` lookups are valid values but they should only be used from within TeX documents, because there is no means of customizing a `my` lookups on the command line.

The `color-callback` option determines the stage at which fonts that defined with a `color=xyyyzz` feature will be colored. By default this happens in a `post_linebreak_filter` but alternatively the `pre_linebreak_filter` or `pre_output_filter` may be chosen, which is faster but might produce inconsistent output. The `pre_output_filter` used to be the default in the 1.x series of Luaotfload, whilst later versions up to and including 2.5 hooked into the `pre_linebreak_filter` which naturally didn’t affect any glyphs inserting during hyphenation. Both are kept around as options to restore the previous behavior if necessary.

The `definer` allows for switching the `define_font` callback. Apart from the default `patch` one may also choose the generic one that comes with the vanilla fontloader. Beware that this might break tools like Fontspec that rely on the `patch_font` callback provided by Luaotfload to perform important corrections on font data.

The fontloader backend can be selected by setting the value of `fontloader`. The most important choices are `default`, which will load the dedicated Luaotfload fontloader, and `reference`, the upstream package as shipped with Luaotfload. Other than those, a file name accessible via `kpathsea` can be specified.

Alternatively, the individual files that constitute the fontloader can be loaded directly. While less efficient, this greatly aids debugging since error messages will reference the actual line numbers of the source files and explanatory comments are not stripped. Currently, three distinct loading strategies are available: `unpacked` will load the batch that is part of Luaotfload. These contain the identical source code that the reference fontloader has been compiled from. Another option, `context` will attempt to load the same files by their names in the Context format from the search path. Consequently this option allows to use the version of Context that comes with the TeX distribution. Distro tend to prefer the stable version (“current” in Context jargon) of those files so certain bugs encountered in the more bleeding edge Luaotfload can be avoided this way. A third option is to use `context` with a colon to specify

a directory prefix where the *TEXMF* is located that the files should be loaded from, e. g. `context:~/context/tex/texmf-context`. This can be used when referencing another distribution like the Context minimals that is installed under a different path not indexed by `kpathsea`.

The value of `log-level` sets the default verbosity of messages printed by `Luaotfload`. Only messages defined with a verbosity of less than or equal to the supplied value will be output on the terminal. At a log level of five `Luaotfload` can be very noisy. Also, printing too many messages will slow down the interpreter due to line buffering being disabled (see `setbuf(3)`).

The `resolver` setting allows choosing the font name resolution function: With the default value `cached` `Luaotfload` saves the result of a successful font name request to a cache file to speed up subsequent lookups. The alternative, `normal` circumvents the cache and resolves every request individually. (Since to the restructuring of the font name index in `Luaotfload` 2.4 the performance difference between the cached and uncached lookups should be marginal.)

FILES

`Luaotfload` only processes the first configuration file it encounters at one of the search locations. The file name may be either `luaotfload.conf` or `luaotfloadrc`, except for the dotfile in the user's home directory which is expected at `~/.luaotfloadrc`.

Configuration files are located following a series of steps. The search terminates as soon as a suitable file is encountered. The sequence of locations that `Luaotfload` looks at is

- i. The current working directory of the `LuaTeX` process.
- ii. The subdirectory `luaotfload/` inside the XDG configuration tree, e. g. `/home/oenothea/config/luaotfload/`.
- iii. The dotfile.
- iv. The *TEXMF* (using `kpathsea`).

SEE ALSO

luaotfload-tool(1), luatex(1), lua(1)

- `texdoc luaotfload` to display the PDF manual for the *Luaotfload* package
- `Luaotfload` development <https://github.com/u-fischer/luaotfload>
- `LuaLaTeX` mailing list <http://tug.org/pipermail/lualatex-dev/>
- `LuaTeX` <http://luatex.org/>
- `Luaotfload` on CTAN <http://ctan.org/pkg/luaotfload>

REFERENCES

- The XDG base specification <http://standards.freedesktop.org/basedir-spec/basedir-spec-latest.html>.

AUTHORS

Luaotfload was developed by the LuaLaTeX dev team (<https://github.com/lualatex/>).
It is currently maintained by Ulrike Fischer and Marcel Krüger at <https://github.com/u-fischer/luaotfload>

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luaotfload-tool

generate and query the Luaotfload font names database

Date: 2019-11-04
Copyright: GPL v2.0
Version: 3.1
Manual section: 1
Manual group: text processing

SYNOPSIS

luaotfload-tool [-bcDfFillLnpqRSuvVhw]

luaotfload-tool **-update** [**-force**] [**-quiet**] [**-verbose**] [**-prefer-texmf**] [**-dry-run**] [**-formats=[+|-]EXTENSIONS**] [**-no-compress**] [**-no-strip**] [**-local**] [**-max-fonts=N**]

luaotfload-tool **-find=FONTNAME** [**-fuzzy**] [**-info**] [**-inspect**] [**-no-reload**]

luaotfload-tool **-flush-lookups**
luaotfload-tool **-cache=DIRECTIVE**
luaotfload-tool **-list=CRITERION[:VALUE]** [**-fields=F1,F2,...,Fn**]
luaotfload-tool **-bisect=DIRECTIVE**
luaotfload-tool **-help**
luaotfload-tool **-version**
luaotfload-tool **-show-blacklist**
luaotfload-tool **-diagnose=CHECK**
luaotfload-tool **-conf=FILE** **-dumpconf**

DESCRIPTION

luaotfload-tool accesses the font names database that is required by the *Luaotfload* package. There are two general modes: **update** and **query**.

- **update**: update the database or rebuild it entirely;
- **query**: resolve a font name or display close matches.

OPTIONS

update mode

- | | |
|----------------------------|---|
| -update, -u | Update the database; indexes new fonts. |
| -force, -f | Force rebuilding of the database; re-indexes all fonts. |
| -local, -L | Include font files in \$PWD. This option will cause large parts of the database to be rebuilt. Thus it is quite inefficient. Additionally, if local font files are found, the database is prevented from being saved to disk, so the local fonts need to be parsed with every invocation of <code>luaotfload-tool</code> . |
| -no-reload, -n | Suppress auto-updates to the database (e.g. when <code>--find</code> is passed an unknown name). |
| -no-compress, -c | Do not filter the plain text version of the font index through <code>gzip</code> . Useful for debugging if your editor is built without <code>zlib</code> . |
| -prefer-texmf, -p | Organize the file name database in a way so that it prefer fonts in the <i>TEXMF</i> tree over system fonts if they are installed in both. |
| -formats=EXTENSIONS | Extensions of the font files to index. Where <i>EXTENSIONS</i> is a comma-separated list of supported file extensions (otf, ttf, ttc). If the list is prefixed with a + sign, the given list is added to the currently active one; - subtracts. Default: <i>otf,ttf,ttc</i> . Examples:

<ol style="list-style-type: none">1) <code>--formats=-ttc,ttf</code> would skip TrueType fonts and font collections;2) <code>--formats=otf</code> would scan only OpenType files;3) <code>--formats+=afm</code> includes binary Postscript files accompanied by an AFM file. |

query mode

- | | |
|-------------------|--|
| -find=NAME | Resolve a font name; this looks up <name> in the database and prints the file name it is mapped to. <code>--find</code> also understands request syntax, i.e. <code>--find=file:foo.otf</code> checks whether <code>foo.otf</code> is indexed. |
| -fuzzy, -F | Show approximate matches to the file name if the lookup was unsuccessful (requires <code>--find</code>). |

- info, -i** Display basic information to a resolved font file (requires --find).
- inspect, -I** Display detailed information by loading the font and analyzing the font table; very slow! For the meaning of the returned fields see the LuaTeX documentation. (requires --find).
- list=CRITERION** Show entries, where *CRITERION* is one of the following:
- 1) the character *, selecting all entries;
 - 2) a field of a database entry, for instance *version* or *format**, according to which the output will be sorted. Information in an unstripped database (see the option --no-strip above) is nested: Subfields of a record can be addressed using the -> separator, e. g. file->location, style->units_per_em, or names->sanitized->english->prefmodifiers. NB: shell syntax requires that arguments containing -> be properly quoted!
 - 3) an expression of the form field:value to limit the output to entries whose field matches value.

For example, in order to output file names and corresponding versions, sorted by the font format:

```
./luaotfload-tool.lua --list="format" --fields="file->base,version"
```

This prints:

```
otf latinmodern-math.otf Version 1.958
otf lmromancaps10-oblique.otf 2.004
otf lmmono8-regular.otf 2.004
otf lmmonoproplt10-bold.otf 2.004
otf lmsans10-oblique.otf 2.004
otf lmromanslant8-regular.otf 2.004
otf lmroman12-italic.otf 2.004
otf lmsansdemicond10-oblique.otf 2.004
...
```

- fields=FIELDS** Comma-separated list of fields that should be printed. Information in an unstripped database (see the option --no-strip above) is nested: Subfields of a record can be addressed using the -> separator, e. g. file->location, style->units_per_em, or names->sanitized->english->subfamily. The default is plainname,version*. (Only meaningful with --list.)

font and lookup caches

- flush-lookups** Clear font name lookup cache (experimental).
- cache=DIRECTIVE** Cache control, where *DIRECTIVE* is one of the following:
 - 1) **purge** -> delete Lua files from cache;
 - 2) **erase** -> delete Lua and Luc files from cache;
 - 3) **show** -> print stats.

debugging methods

- show-blacklist, -b** Show blacklisted files (not directories).
- dry-run, -D** Don't load fonts when updating the database; scan directories only. (For debugging file system related issues.)
- no-strip** Do not strip redundant information after building the database. Warning: this will inflate the index to about two to three times the normal size.
- max-fonts=N** Process at most *N* font files, including fonts already indexed in the count.
- bisect=DIRECTIVE** Bisection of the font database. This mode is intended as assistance in debugging the Luatex engine, especially when tracking memleaks or buggy fonts.

DIRECTIVE can be one of the following:

- 1) **run** -> Make luaotfload-tool respect the bisection progress when running. Combined with **--update** and possibly **--force** this will only process the files from the start up until the pivot and ignore the rest.
- 2) **start** -> Start bisection: create a bisection state file and initialize the low, high, and pivot indices.
- 3) **stop** -> Terminate the current bisection session by deleting the state file.
- 4) **good | bad** -> Mark the section processed last as "good" or "bad", respectively. The next bisection step will continue with the bad section.
- 5) **status** -> Print status information about the current bisection session. Hint: Use with higher verbosity settings for more output.

A bisection session is initiated by issuing the `start` directive. This sets the pivot to the middle of the list of available font files. Now run *luaotfload-tool* with the `--update` flag set as well as `--bisection=run`: only the fonts up to the pivot will be considered. If that task exhibited the issue you are tracking, then tell Luaotfload using `--bisection=bad`. The next step of `--bisection=run` will continue bisection with the part of the files below the pivot. Likewise, issue `--bisection=good` in order to continue with the fonts above the pivot, assuming the tested part of the list did not trigger the bug.

Once the culprit font is tracked down, `good` or `bad` will have no effect anymore. `run` will always end up processing the single font file that was left. Use `--bisection=stop` to clear the bisection state.

miscellaneous

- `--verbose=N, -v`** Set verbosity level to *n* or the number of repetitions of `-v`.
- `--quiet`** No verbose output (log level set to zero).
- `--log=CHANNEL`** Redirect log output (for database troubleshooting), where *CHANNEL* can be
 - 1) `stdout` -> all output will be dumped to the terminal (default); or
 - 2) `file` -> write to a file to the temporary directory (the name will be chosen automatically).
- `--version, -V`** Show version numbers of components as well as some basic information and exit.
- `--help, -h`** Show help message and exit.
- `--diagnose=CHECK`** Run the diagnostic procedure *CHECK*. Available procedures are:
 - 1) `files` -> check *Luaotfload* files for modifications;
 - 2) `permissions` -> check permissions of cache directories and files;
 - 3) **environment** -> **print relevant** environment and `kpse` variables;
 - 4) `repository` -> check the git repository for new releases,

- 5) `index` -> check database, display information about it.

Procedures can be chained by concatenating with commas, e.g. `--diagnose=files,permissions`. Specify thorough to run all checks.

- conf=FILE** Read the configuration from *FILE*. See **luaotfload.conf(%)** for documentation concerning the format and available options.
- dumpconf** Print the currently active configuration; the output can be saved to a file and used for bootstrapping a custom configuration files.

FILES

The font name database is usually located in the directory `texmf-var/luatex-cache/generic/names/` (`$TEXMFCACHE` as set in `texmf.cnf`) of your *TeX Live* distribution as a zlib-compressed file `luaotfload-names.lua.gz`. The experimental lookup cache will be created as `luaotfload-lookup-cache.lua` in the same directory. These Lua tables are not used directly by Luaotfload, though. Instead, they are compiled to Lua bytecode which is written to corresponding files with the extension `.luc` in the same directory. When modifying the files by hand keep in mind that only if the bytecode files are missing will Luaotfload use the plain version instead. Both kinds of files are safe to delete, at the cost of regenerating them with the next run of *LuaTeX*.

SEE ALSO

luaotfload.conf(5), **luatex(1)**, **lua(1)**

- `texdoc luaotfload` to display the manual for the *Luaotfload* package
- Luaotfload development <https://github.com/lualatex/luaotfload>
- LuaLaTeX mailing list <http://tug.org/pipermail/lualatex-dev/>
- LuaTeX <http://luatex.org/>
- ConTeXt <http://wiki.contextgarden.net>
- Luaotfload on CTAN <http://ctan.org/pkg/luaotfload>

BUGS

Tons, probably.

AUTHORS

Luaotfload was developed by the LuaLaTeX dev team (<https://github.com/lualatex/>). It is currently maintained by Ulrike Fischer and Marcel Krüger at <https://github.com/u-fischer/luaotfload>. The fontloader code is provided by Hans Hagen of Pragma ADE, Hasselt NL (<http://pragma-ade.com/>).

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