

# The luaotfload package

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## Abstract

This package is an adaptation of the ConT<sub>E</sub>Xt font loading system, providing the ability to load OpenType fonts with extended font loading syntax supporting a large selection of OpenType font features.

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# 1 Introduction

Font management and installation has always been painful with  $\text{T}_{\text{E}}\text{X}$ . A lot of files are needed for one font (tfm, pfb, map, fd, vf), and as  $\text{T}_{\text{E}}\text{X}$  is 8-bit each font is limited to 256 characters. But the font world has evolved since  $\text{T}_{\text{E}}\text{X}$ , and new font technologies have appeared, most notably the so called *smart font* technologies like OpenType fonts. These fonts can contain a lot of characters, and additional functionalities like ligatures, old-style numbers, small capitals, etc., and support more complex writing systems like Arabic and Indic scripts. They are widely deployed and available for all modern operating systems and are becoming the de facto standard fonts for advanced text layout. Until now the only way to use them directly in the  $\text{T}_{\text{E}}\text{X}$  world was by using them with  $\text{X}_{\text{Y}}\text{T}_{\text{E}}\text{X}$ .

Unlike  $\text{X}_{\text{Y}}\text{T}_{\text{E}}\text{X}$ ,  $\text{LuaT}_{\text{E}}\text{X}$  does not provide direct support for using these fonts by default, but it provides a way to hook Lua code in some points of the  $\text{T}_{\text{E}}\text{X}$  processing; for instance, we can improve the font loading system, and text procession, which what this package is about.

## 2 Loading fonts

luaotfload supports an extended font loading syntax which looks like:

```
\font\foo={\langle prefix\rangle:\langle font name\rangle:\langle font features\rangle} \langle T_{\text{E}}\text{X font features}\rangle
```

The curly brackets are optional and are used for escaping spaces in font names (double quotes can also be used for the same purpose).

**Prefix** The  $\langle prefix \rangle$  can be either `file:` or `name:`, which specify whether to use a select the font from its filename or font name, respectively. If no prefix is specified, then `file:` is assumed.

For compatibility with  $\text{X}_{\text{Y}}\text{T}_{\text{E}}\text{X}$ , surrounding the  $\langle font name \rangle$  with square brackets is synonymous to using the `file:` prefix.

Accessing fonts by fontname allows loading system installed fonts as well as TEXMF ones, and requires a font names database; see Section 3 for more information.

**Font name** The  $\langle font name \rangle$  can be either a font filename or actual font name based on the  $\langle prefix \rangle$  as mentioned above.

Fonts loaded by filename may either include their absolute path in the filesystem or consist of just the filename with a path. If no path is specified then `kpathsea` is used to locate the font (which will typically be in the TEXMF tree or the current directory).

For example,

```
\font\1={file:ec-lmr10} at 10pt
\font\2={/Users/Shared/Fonts/aldus.otf} at 11pt
\font\3={name:TeX Gyre Pagella} at 9pt
```

**Font features** *<font features>* are a list of items separated by semi-colons, which are either **key=value** font parameters, or switches to enable/disable certain font features in the form of **+feat/-feat**. The supported keys are:

**mode**

luaotfload has two OpenType processing modes; **base** or **node**. Using **mode=base** only supports a subset of OpenType features and works by mapping those features to traditional T<sub>E</sub>X ligature and kerning mechanisms and is a bit faster. Using **mode=node** hopefully supports OpenType fully and works by direct processing of the node list with Lua; it is slower and is not designed to work in math mode.

By default **mode=base** is used, but it is advisable to always enable **node** made, except for math fonts, otherwise many OpenType features will not function properly or even not work at all, especially for advanced scripts like Arabic.

**script**

OpenType script string, default value is **dflt**. Some fonts don't assign features to the **dflt** script, in which case the script need to be set explicitly.

**language**

OpenType language string, default value is **latn**.

**featurefile**

feature files are textual representation of OpenType tables and can be used to extend OpenType features of the font on fly. The file name of the feature file is passed, then features defined in the file can be enabled/disabled like any other feature. The actual syntax is described at <http://fontforge.sourceforge.net/featurefile.html> and [http://www.adobe.com/devnet/opentype/afdko/topic\\_feature\\_file\\_syntax.html](http://www.adobe.com/devnet/opentype/afdko/topic_feature_file_syntax.html).

For example, to set a **tkrn** feature from **mykern.fea** file:

```
\font\lmr=Latin Modern Roman:featurefile=mykern.fea;+tkrn
```

**color**

font color, defined as a triplet of two-digit hexadecimal RGB values, with optionally another value for the transparency (where 00 is completely transparent and FF is opaque.)

For example, to set text in semitransparent red:

```
\font\lmr=Latin Modern Roman:color=FF0000BB
```

**protrusion & expansion**

Both keys control microtypographic features of the font, namely glyph protrusion and expansion. The value of the key is the name of predefined Lua tables of protrusion and expansion values; see the end of **otfl-font-dum.lua** file for an example of such tables. The only predefined value is **default**.

For example, to enable default protrusion<sup>1</sup>:

```
\font\lmr=Latin Modern Roman:protrusion=default
```

**Non-standard font features** `luaotfload` defines some additional font feature not defined in OpenType, currently three features are defined:

- **anum**: replaces European numbers with eastern Arabic numbers or Persian numbers, depending on the value of `language`.
- **tlig**: applies legacy T<sub>E</sub>X ligatures (‘ ’ ’ -- -- ! ‘ ? ‘ <>>).
- **trep**: applies legacy T<sub>E</sub>X replacements (‘ ’ ’).

(For X<sub>Y</sub>T<sub>E</sub>X users: these last two are the equivalent of writing `mapping=text-tex` using X<sub>Y</sub>T<sub>E</sub>X’s input remapping feature.)

### 3 Font names database

As introduced in the previous section, `luaotfload` uses a database to keep track of fonts available to LuaT<sub>E</sub>X. Using this database, fonts can be loaded by font name as well as filename.

When `luaotfload` is asked to load a font by font name, it will check if font names database exists and load it, or generate a new database if non exists. This is all done automatically without user intervention. When the asked font is missing from the database, it will attempt to update the database and try to find the font again, so that the user can install new fonts without worrying about manually updating the database.

However, it is sometimes desirable to update the database manually, so `luaotfload` provides a `mkluatexfontdb` utility to manually update the database. `mkluatexfontdb` is a lua script that can be either run directly or as an argument to `texlua`, depending on your system<sup>2</sup>.

The first time the database is generated may take quite some time to process every font on your computer. This is particularly noticeable if it occurs during a typesetting run. Subsequent runs to update the database will be quite fast, however.

`luaotfload` will parse standard places for fonts in your system to build the font database. On Linux, it will read `fontconfig` configuration files to find the font locations; on Windows and Mac OS X, it will search in the standard font locations, `%WINDIR%\Fonts` in Windows and `~/Library/Fonts`, `/Library/Fonts`, `/System/Library/Fonts`, and `/Network/Library/Fonts` in Mac OS X.

If you do not wish the standard font locations be searched by default but would rather specify the exact locations in which to find your fonts, set the `OSFONTDIR`

---

<sup>1</sup>You also need to set `\pdfprotrudechars2` `\pdfadjustspacing2` to activate protrusion and expansion, respectively. See PDF<sub>T</sub>E<sub>X</sub> manual for details

<sup>2</sup>On MS Windows it can be run either by calling the wrapper application `mkluatexfontdb.exe` or with `texlua.exe mkluatexfontdb.lua`

environment variable instead. When this variable is set, only the specified directories will be searched.

`mkluatexfontdb.lua --help` provides a brief summary of the functionality of the script and includes some advanced options that we have not mentioned here.

### 3.1 Blacklisting fonts

Some fonts are problematic in LuaTeX, if you found that your document takes too long to compile, or eats all the free memory, you can find the culprit file by running `mkluatexfontdb` utility with `-v` option to see which font file it is stuck with. You can then instruct `luaotfload` to ignore this font by adding it to the blacklist configuration file.

Simply, create a file named `otfl-blacklist.cnf` and added the to be blacklisted files, one per line. Then put the file some where `kpse` can find. You can either use the base name or the full path. Any thing after a `%` sign is ignored.

## 4 Required ConTeXt files

This package is a wrapper for several files taken from the ConTeXt macro package. The philosophy is to let ConTeXt do all the implementation and update these files from time to time. To do so we did not modify the files taken from ConTeXt, we only changed their names to prevent name clashes. You can thus update the font system of this package simply by updating the files taken from ConTeXt, without (theoretically) changing the `.sty` file nor the main `.lua` file.

The ConTeXt files are renamed by adding the prefix `otfl-` to them (`otfl` as OTF Load). The files are:

- |                             |                             |                             |
|-----------------------------|-----------------------------|-----------------------------|
| • <code>luat-dum.lua</code> | • <code>font-ott.lua</code> | • <code>font-otc.lua</code> |
| • <code>data-con.lua</code> | • <code>font-otf.lua</code> | • <code>font-def.lua</code> |
| • <code>node-inj.lua</code> | • <code>font-otd.lua</code> | • <code>font-xtx.lua</code> |
| • <code>node-dum.lua</code> | • <code>font-oti.lua</code> | • <code>font-map.lua</code> |
| • <code>font-ini.lua</code> | • <code>font-otb.lua</code> | • <code>font-dum.lua</code> |
| • <code>font-tfm.lua</code> | • <code>font-otn.lua</code> |                             |
| • <code>font-cid.lua</code> | • <code>font-ota.lua</code> |                             |

The following files have been written for this package:

- |                             |                             |                             |
|-----------------------------|-----------------------------|-----------------------------|
| • <code>font-clr.lua</code> | • <code>font-nms.lua</code> | • <code>luat-ovr.lua</code> |
|-----------------------------|-----------------------------|-----------------------------|

## 5 Troubleshooting

If you encounter problems with some fonts, please first update to the latest version of this package before reporting a bug, as this package is under active development.

A very common problem is the lack of features for some OpenType fonts even when specified. It can be related to the fact that some fonts do not provide features

for the `dflt` script, which is the default one in this package, so you may have to specify the script in the command line, for example:

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

Also remember to set `mode=node` as most OpenType features (such as contextual substitution, `calt`), will not work without it.

## File I

# luaotfload.lua

First some usual initializations.

```
1 module('luaotfload', package.seeall)
2
3 luaotfload.module = {
4     name          = "luaotfload",
5     version       = 1.15,
6     date          = "2010/06/28",
7     description   = "ConTeXt font loading system.",
8     author        = "Elie Roux & Hans Hagen",
9     copyright     = "Elie Roux",
10    license       = "CC0"
11 }
12
13 luatexbase.provides_module(luaotfload.module)
14
```

Some helper functions.

```
15
16 local format = string.format
17
18 local function log(...)
19     luatexbase.module_log    ('luaotfload', format(...))
20 end
21
22 local function error(...)
23     luatexbase.module_error  ('luaotfload', format(...))
24 end
25
26 local function warning(...)
27     luatexbase.module_warning('luaotfload', format(...))
28 end
29
```

The minimal required Lua<sub>TEX</sub> version.

```
30
31 local luatex_version = 60
32
```

```

33 if tex.luatexversion < luatex_version then
34     warning('LuaTeX v%.2f is old, v%.2f is recommended.',
35             tex.luatexversion/100,
36             luatex_version   /100)
37 end
38

```

## 5.1 Module loading

We load the ConT<sub>E</sub>Xt files with this function. It automatically adds the `otfl-` prefix to it, so that we call it with the actual ConT<sub>E</sub>Xt name.

```

39
40 function luaotfload.loadmodule(name)
41     local tofind = 'otfl-'..name
42     local found = kpse.find_file(tofind,"tex")
43     if found then
44         log('loading file %s.', found)
45         dofile(found)
46     else
47         error('file %s not found.', tofind)
48     end
49 end
50

```

We start loading some lua files. These two are some code not used by ConT<sub>E</sub>Xt at all that allow other modules to be used, it provides some low-level ConT<sub>E</sub>Xt functions.

```

51
52 luaotfload.loadmodule('luat-dum.lua') -- not used in context at all
53 luaotfload.loadmodule('luat-ovr.lua') -- override some luat-dum functions
54 luaotfload.loadmodule('data-con.lua') -- maybe some day we don't need this one
55

```

A hack to remove a warning from `node-dum.lua` as it is ConT<sub>E</sub>Xt specific.

```

56
57 tex.attribute[0] = 0
58

```

Node support modules.

```

59
60 luaotfload.loadmodule('font-ini.lua')
61 luaotfload.loadmodule('node-dum.lua')
62 luaotfload.loadmodule('node-inj.lua')
63

```

By default ConT<sub>E</sub>Xt takes some private attributes for internal use. To avoid attribute clashes with other packages, we override the function that allocates new attributes, making it a wrapper around `luatexbase.new_attribute()`. We also prefix attributes with `otfl@` to avoid possible name clashes.

```

64
65 function attributes.private(name)
66     local attr  = 'otfl@' .. name
67     local number = luatexbase.attributes[attr]
68     if not number then
69         number = luatexbase.new_attribute(attr)
70     end
71     return number
72 end
73

```

Font handling modules.

```

74
75 luaotfload.loadmodule('font-tfm.lua')
76 luaotfload.loadmodule('font-cid.lua')
77 luaotfload.loadmodule('font-ott.lua')
78 luaotfload.loadmodule('font-map.lua')
79 luaotfload.loadmodule('font-otf.lua')
80 luaotfload.loadmodule('font-otd.lua')
81 luaotfload.loadmodule('font-oti.lua')
82 luaotfload.loadmodule('font-otb.lua')
83 luaotfload.loadmodule('font-otn.lua')
84 luaotfload.loadmodule('font-ota.lua')
85 luaotfload.loadmodule('font-otc.lua')
86 luaotfload.loadmodule('font-def.lua')
87 luaotfload.loadmodule('font-xtx.lua')
88 luaotfload.loadmodule('font-dum.lua')
89

```

luaotfload specific modules.

```

90
91 luaotfload.loadmodule('font-nms.lua')
92 luaotfload.loadmodule('font-clr.lua')
93

```

## 5.2 Post-processing TFM table

Here we do some final touches to the loaded TFM table before passing it to the  $\TeX$  end.

```

94 local function def_font(...)
95     local fontdata = fonts.define.read(...)
96     if type(fontdata) == "table" and fontdata.shared then

```

First, we add some code to emulate  $\text{\texttt{X}\TeX}$ 's  $\text{\texttt{\fontdimen8}}$ , which stores the caps-height of the font. (Cf.  $\text{\texttt{\fontdimen5}}$  which stores the x-height.)

Falls back to measuring the glyph if the font doesn't contain the necessary information. This needs to be extended for fonts that don't contain an 'X'.

```

97         local capheight
98         local units      = fontdata.units

```



```

99         local size      = fontdata.size
100        local otfddata   = fontdata.shared.otfddata
101
102        if otfddata.pfminfo.os2_capheight > 0 then
103            capheight = otfddata.pfminfo.os2_capheight / units * size
104        else
105            if fontdata.characters[string.byte("X")] then
106                capheight = fontdata.characters[string.byte("X")].height
107            else
108                capheight = otfddata.metadata.ascent / units * size
109            end
110        end
111        fontdata.parameters[8] = capheight

```

Then we populate MathConstants table, which is required for OpenType math.

```

112        if otfddata.metadata.math then
113            for k,v in next, otfddata.metadata.math do
114                if k == "RadicalDegreeBottomRaisePercent" then
115                    -- this is a percent
116                    fontdata.MathConstants[k] = v
117                else
118                    fontdata.MathConstants[k] = v / units * size
119                end
120            end
121        end
122
123    end
124    return fontdata
125 end

```

### 5.3 ConT<sub>E</sub>Xt override

Here we override some defaults set in ConT<sub>E</sub>Xt code.

```

126
127 fonts.mode = "node"
128

```

Finally two functions

```

129
130 function luaotfload.register_callbacks()
131     luatexbase.add_to_callback('pre_linebreak_filter',
132                               nodes.simple_font_handler,
133                               'luaotfload.pre_linebreak_filter')
134     luatexbase.add_to_callback('hpack_filter',
135                               nodes.simple_font_handler,
136                               'luaotfload.hpack_filter')
137     luatexbase.reset_callback('define_font')
138     luatexbase.add_to_callback('define_font',
139                               def_font,

```

```

140                                     'luaotfload.define_font', 1)
141     luatexbase.add_to_callback('find_vf_file',
142                               fonts.vf.find,
143                               'luaotfload.find_vf_file')
144 end
145
146 function luaotfload.unregister_callbacks()
147     luatexbase.remove_from_callback('pre_linebreak_filter',
148                                     'luaotfload.pre_linebreak_filter')
149     luatexbase.remove_from_callback('hpack_filter',
150                                     'luaotfload.hpack_filter')
151     luatexbase.remove_from_callback('define_font',
152                                     'luaotfload.define_font')
153     luatexbase.remove_from_callback('find_vf_file',
154                                     'luaotfload.find_vf_file')
155 end

```

## File II

# luaotfload.sty

Classical Plain+L<sup>A</sup>T<sub>E</sub>X package initialization.

```

1 \csname ifluaotfloadloaded\endcsname
2 \let\ifluaotfloadloaded\endinput
3
4 \expandafter\ifx\csname ProvidesPackage\endcsname\relax
5   \input luatextra.sty
6 \else
7   \NeedsTeXFormat{LaTeX2e}
8   \ProvidesPackage{luaotfload}%
9     [2010/06/28 v1.15 ConTeXt font loading system]
10  \RequirePackage{luatextra}
11 \fi
12
13 \expandafter\edef\csname otfl@AtEnd\endcsname{%
14   \catcode64 \the\catcode64\relax
15 }
16
17 \catcode64 11
18

```

Two small macros to register or unregister the callbacks. Without the callbacks this package is totally turned off.

```

19
20 \def\otfl@off{
21 \directlua{luaotfload.unregister_callbacks()}
22 }
23

```

```

24 \def\otfl@on{
25 \directlua{luaotfload.register_callbacks()}
26 }
27
    We load the lua file, and we turn the package on.
28
29 \luatexUseModule{luaotfload}
30
31 \otfl@on
32
33 \otfl@AtEnd

```

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