

The luaotfload package

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Abstract

This package is an adaptation of the ConT_EXt 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 that must be pre-generated; 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 ** 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_EX 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.

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 protrusion¹:

```
\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_EX ligatures (‘ ’ ’ ’ -- -- ! ‘ ? ‘ <>>).
- **trep**: applies legacy T_EX replacements (‘ ’ ’ ’).

(For X_YT_EX users: these last two are the equivalent of writing `mapping=text-tex` using X_YT_EX’s input remapping feature.)

3 Maintaining the font database

As introduced in the previous section, `luaotfload` uses a database to keep track of fonts available to LuaT_EX. Using this database, fonts can be loaded by font name as well as filename.

This font database is maintained automatically as you add and remove fonts to/from your system. To update the database manually, run the script `mkluatexfontdb` that is included with this package. If you have not run it before, it 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.

The script will parse standard places for fonts in your system to build the font database. Linux, it will use `fontconfig` 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 script to search the standard font locations by default but would rather specify the exact locations in which to find your fonts, set the `OSFONTDIR` environment variable instead. When this variable is set, the script will only search in those directories.

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

4 Required ConT_EXt files

This package is a wrapper for several files taken from the ConT_EXt macro package. The philosophy is to let ConT_EXt do all the implementation and update these files from time to time. To do so we did not modify the files taken from ConT_EXt, we

¹You also need to set `\pdfprotrudechars2` `\pdfadjustspacing2` to activate protrusion and expansion, respectively. See PDF_TE_X manual for details

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 ConT_EXt, without (theoretically) changing the `.sty` file nor the main `.lua` file.

The ConT_EXt 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 `dfmt` 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   = 1.13,
6   date      = "2010/06/24",
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 LuaTeX 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 ConTeXt files with this function. It automatically adds the `otfl-` prefix to it, so that we call it with the actual ConTeXt 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_EXt at all that allow other modules to be used, it provides some low-level ConT_EXt 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_EXt 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_EXt 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 \TeX 's `\fontdimen8`, which stores the caps-height of the font. (Cf. `\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_EXt override

Here we override some defaults set in ConT_EXt 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^AT_EX 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     [2010/06/24 v1.13 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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