

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 \TeX . A lot of files are needed for one font (tfm, pfb, map, fd, vf), and as \TeX is 8-bit each font is limited to 256 characters. But the font world has evolved since \TeX , 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 Indic¹ 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 \TeX world was by using them with \XeTeX .

Unlike \XeTeX , Lua \TeX 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 \TeX 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 \TeX 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 $\langle prefix \rangle$ 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 \XeTeX , 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,

¹Unfortunately, luaotfload doesn't support Indic scripts right now

```

\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 $\langle font\ features \rangle$ 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 \TeX 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 mode, 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 needs 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 tkern feature from mykern.fea file:

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

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
```

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`.

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

- `anum`: replaces European numbers with eastern Arabic numbers or Persian numbers, depending on the value of `language`.
- `tlig`: applies legacy \TeX ligatures (`‘ ’ ’ -- -- ! ‘ ? ‘ <>>`).
- `trep`: applies legacy \TeX replacements (`‘ ’ ”`).

3 Font names database

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.

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.

³On MS Windows it can be run either by calling the wrapper application `mkluatexfontdb.exe` or with `texlua.exe mkluatexfontdb.lua`

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 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 Lua_T_EX, 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 Con_T_EXt files

This package is a wrapper for several files taken from the Con_T_EXt macro package. The philosophy is to let Con_T_EXt do all the implementation and update these files from time to time. To do so we did not modify the files taken from Con_T_EXt, 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 Con_T_EXt, without (theoretically) changing the `.sty` file nor the main `.lua` file.

The Con_T_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:

- font-clr.lua
- font-nms.lua
- luat-ovr.lua

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 `df1t` 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   = 1.21,
6   date      = "2010/11/11",
7   description = "OpenType layout system.",
8   author    = "Elie Roux & Hans Hagen",
9   copyright  = "Elie Roux",
10  license    = "CC0"
11 }
12
13 local error, warning, info, log = luatexbase.provides_module(luaotfload.module)
```

This is a necessary initialization in order not to rebuild an existing font. Maybe 600 should be replaced by `\pdfpkresolution` or `texconfig.pk_dpi` (and it should be replaced dynamically), but we don't have access (yet) to the `texconfig` table, so we let it be 600. Anyway, it does still work fine even if `\pdfpkresolution` is changed.

```
14 kpse.init_prog('', 600, '/')

```

The minimal required Lua_T_EX version.

```
15 local luatex_version = 60
16
17 if tex.luatexversion < luatex_version then
```

```

18     warning('LuaTeX v%.2f is old, v%.2f is recommended.',
19             tex.luatexversion/100,
20             luatex_version   /100)
21 end

```

5.1 Module loading

We load the ConT_EXt files with this function. It automatically adds the `otfl-` prefix to it, so that we call it with the actual ConT_EXt name.

```

22 function luaotfload.loadmodule(name)
23     local tofind = 'otfl-' .. name
24     local found = kpse.find_file(tofind, "tex")
25     if found then
26         log('loading file %s.', found)
27         dofile(found)
28     else
29         error('file %s not found.', tofind)
30     end
31 end

```

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.

```

32 luaotfload.loadmodule('luat-dum.lua') -- not used in context at all
33 luaotfload.loadmodule('luat-ovr.lua') -- override some luat-dum functions
34 luaotfload.loadmodule('data-con.lua') -- maybe some day we don't need this one

```

A hack to remove a warning from `node-dum.lua` as it is ConT_EXt specific.

```

35 tex.attribute[0] = 0

```

Node support modules.

```

36 luaotfload.loadmodule('font-ini.lua')
37 luaotfload.loadmodule('node-dum.lua')
38 luaotfload.loadmodule('node-inj.lua')

```

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.

```

39 function attributes.private(name)
40     local attr = 'otfl@' .. name
41     local number = luatexbase.attributes[attr]
42     if not number then
43         number = luatexbase.new_attribute(attr)
44     end
45     return number
46 end

```

Font handling modules.

```
47 luaotfload.loadmodule('font-tfm.lua')
48 luaotfload.loadmodule('font-cid.lua')
49 luaotfload.loadmodule('font-ott.lua')
50 luaotfload.loadmodule('font-map.lua')
51 luaotfload.loadmodule('font-otf.lua')
52 luaotfload.loadmodule('font-otd.lua')
53 luaotfload.loadmodule('font-oti.lua')
54 luaotfload.loadmodule('font-otb.lua')
55 luaotfload.loadmodule('font-otn.lua')
56 luaotfload.loadmodule('font-ota.lua')
57 luaotfload.loadmodule('font-otc.lua')
58 luaotfload.loadmodule('font-def.lua')
59 luaotfload.loadmodule('font-xtx.lua')
60 luaotfload.loadmodule('font-dum.lua')
```

This is a patch for `otfl-font-def.lua`, that defines a reader for ofm fonts, this is necessary if we set the forced field of the specification to ofm, we use it only when using luaotfload, not mkluatexfontdb.

```
61 if fonts and fonts.tfm and fonts.tfm.readers then
62     fonts.tfm.readers.ofm = fonts.tfm.readers.tfm
63 end
```

luaotfload specific modules.

```
64 luaotfload.loadmodule('font-nms.lua')
65 luaotfload.loadmodule('font-clr.lua')
```

5.2 Post-processing TFM table

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

```
66 local function def_font(...)
67     local fontdata = fonts.define.read(...)
68     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'.

```
69         local capheight
70         local units      = fontdata.units
71         local size       = fontdata.size
72         local otfddata   = fontdata.shared.otfddata
73
74         if otfddata.pfminfo.os2_capheight > 0 then
75             capheight = otfddata.pfminfo.os2_capheight / units * size
76         else
77             if fontdata.characters[string.byte("X")] then
```



```

78         capheight = fontdata.characters[string.byte("X")].height
79     else
80         capheight = otfddata.metadata.ascent / units * size
81     end
82 end
83 fontdata.parameters[8] = capheight

```

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

```

84     if otfddata.metadata.math then
85         local mc = { }
86         for k,v in next, otfddata.metadata.math do
87             if k:find("Percent") then
88                 -- keep percent values as is
89                 mc[k] = v
90             else
91                 mc[k] = v / units * size
92             end
93         end
94         -- for \overwithdelims
95         mc["FractionDelimiterSize"] = 1.01 * size
96         mc["FractionDelimiterDisplayStyleSize"] = 2.39 * size
97
98         fontdata.MathConstants = mc

```

Lua_T_E_X does not provide interface to accessing (Script)ScriptPercentScaleDown math constants, so we emulate X_T_E_X behaviour by setting \fontdimen10 and \fontdimen11.

```

99         if mc["ScriptPercentScaleDown"] then
100             fontdata.parameters[10] = mc["ScriptPercentScaleDown"]
101         else -- resort to plain TeX default
102             fontdata.parameters[10] = 70
103         end
104         if mc["ScriptScriptPercentScaleDown"] then
105             fontdata.parameters[11] = mc["ScriptScriptPercentScaleDown"]
106         else -- resort to plain TeX default
107             fontdata.parameters[11] = 50
108         end
109     end
110
111 end
112 return fontdata
113 end

```

5.3 ConT_EXt override

Here we override some defaults set in ConT_EXt code.

```

114 fonts.mode = "node"

```

The following features are useful in math (e.g. in XITS Math font), but luaotfload does not recognize them in base mode.

```

115 local register_base_sub = fonts.otf.features.register_base_substitution
116 local gsubs = {
117     "ss01", "ss02", "ss03", "ss04", "ss05",
118     "ss06", "ss07", "ss08", "ss09", "ss10",
119     "ss11", "ss12", "ss13", "ss14", "ss15",
120     "ss16", "ss17", "ss18", "ss19", "ss20",
121 }
122
123 for _,v in next, gsubs do
124     register_base_sub(v)
125 end

```

Finally two functions

```

126 function luaotfload.register_callbacks()
127     luatexbase.add_to_callback('pre_linebreak_filter',
128                               nodes.simple_font_handler,
129                               'luaotfload.pre_linebreak_filter')
130     luatexbase.add_to_callback('hpack_filter',
131                               nodes.simple_font_handler,
132                               'luaotfload.hpack_filter')
133     luatexbase.reset_callback('define_font')
134     luatexbase.add_to_callback('define_font',
135                               def_font,
136                               'luaotfload.define_font', 1)
137     luatexbase.add_to_callback('find_vf_file',
138                               fonts.vf.find,
139                               'luaotfload.find_vf_file')
140 end
141
142 function luaotfload.unregister_callbacks()
143     luatexbase.remove_from_callback('pre_linebreak_filter',
144                                     'luaotfload.pre_linebreak_filter')
145     luatexbase.remove_from_callback('hpack_filter',
146                                     'luaotfload.hpack_filter')
147     luatexbase.remove_from_callback('define_font',
148                                     'luaotfload.define_font')
149     luatexbase.remove_from_callback('find_vf_file',
150                                     'luaotfload.find_vf_file')
151 end

```

File II

luaotfload.sty

Classical Plain+ \TeX package initialization.

```

1 \csname ifluaotfloadloaded\endcsname
2 \let\ifluaotfloadloaded\endinput
3
4 \bgroup\expandafter\expandafter\expandafter\egroup
5 \expandafter\ifx\csname ProvidesPackage\endcsname\relax
6   \input luatexbase.sty
7 \else
8   \NeedsTeXFormat{LaTeX2e}
9   \ProvidesPackage{luaotfload}%
10    [2010/11/11 v1.21 OpenType layout system]
11   \RequirePackage{luatexbase}
12 \fi
13 \RequireLuaModule{lualibs}
14
15 \expandafter\edef\csname otfl@AtEnd\endcsname{%
16   \catcode64 \the\catcode64\relax
17 }
18
19 \catcode64 11

```

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

```

20 \def\otfl@off{
21 \directlua{luaotfload.unregister_callbacks()}
22 }
23
24 \def\otfl@on{
25 \directlua{luaotfload.register_callbacks()}
26 }

```

We load the lua file, and we turn the package on.

```

27 \RequireLuaModule{luaotfload}
28
29 \otfl@on
30
31 \otfl@AtEnd

```

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Version 2, June 1991

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END OF TERMS AND CONDITIONS

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