

The luaotfload package

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Abstract

This package is an adaptation of the Con \TeX t 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,

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

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

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_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 syntax is documented in Adobe's [OpenType Feature File Specification](#).

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 protrusion²:

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

²You also need to set \pdfprotrudechars2 \pdfadjustspacing2 to activate protrusion and expansion, respectively. See PDF_T_EX manual for details

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 Font names 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.

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 system³.

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` 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.

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

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 black-listed 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. So we try not to modify the files taken from Con_T_EXt as far as possible, but we changed their names to prevent name clashes.

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-ctx.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 `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   = 1.22,
6     date      = "2011/01/25",
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.

```

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.

First we create a callback for patching fonts on the fly, to be used by other packages.

```

66 luatexbase.create_callback("luaotfload.patch_font", "simple", function() end)

    then define a function where font manipulation will take place.

67 local function def_font(...)
68     local fontdata = fonts.define.read(...)
69     if type(fontdata) == "table" and fontdata.shared then

```

Here 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'.

XXX: move to fontspec.

```

70     local capheight
71     local units      = fontdata.units
72     local size       = fontdata.size
73     local otfddata   = fontdata.shared.otfddata
74
75     if otfddata.pfminfo.os2_capheight > 0 then
76         capheight = otfddata.pfminfo.os2_capheight / units * size
77     else
78         if fontdata.characters[string.byte("X")] then
79             capheight = fontdata.characters[string.byte("X")].height
80         else
81             capheight = otfddata.metadata.ascent / units * size
82         end
83     end
84     fontdata.parameters[8] = capheight

```

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

```

85     if otfddata.metadata.math then
86         local mc = { }
87         for k,v in next, otfddata.metadata.math do
88             if k:find("Percent") then
89                 -- keep percent values as is
90                 mc[k] = v

```

```

91             else
92                 mc[k] = v / units * size
93             end
94         end
95         -- for \overwithdelims
96         mc.FractionDelimiterSize = 1.01 * size
97         mc.FractionDelimiterDisplayStyleSize = 2.39 * size
98
99         fontdata.MathConstants = mc

```

Lua_{TeX} does not provide interface to accessing (Script)ScriptPercentScaleDown math constants, so we emulate X_{TeX} behaviour by setting `\fontdimen10` and `\fontdimen11`.

XXX: move to unicode-math.

```

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

```

Execute any registered font patching callbacks.

```

111         luatexbase.call_callback("luaotfload.patch_font", fontdata)
112     end
113     return fontdata
114 end

```

5.3 Con_{TeX}t override

Here we override some defaults set in Con_{TeX}t code.

```

115 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.

```

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

```

126 end

Finally we register the 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')
```

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    [2011/01/25 v1.22 OpenType layout system]
11   \RequirePackage{luatexbase}
12 \fi
13
14 \RequireLuaModule{lualibs}
```

Finally we load the lua module.

```
15 \RequireLuaModule{luaotfload}
```

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