

Abstract: T_EXLive 2010 will contain LuaT_EX 0.60. This article gives an overview of the changes between this version and the version on last year's T_EXLive. Highlights of this release: cweb code base, dynamic loading of lua modules, various font subsystem improvements including support for Apple .dfont, font collection files, braced input file names, extended pdf Lua table, and access to the line breaking algorithm from Lua code.

Key words: Lua, LuaT_EX, verze 0.60

Abstrakt: Článek představuje změny a novinky ve verzi LuaT_EXu 0.60.

Klíčová slova: programovací jazyk Lua, LuaT_EX, verze 0.60

References

- [1] LuaT_EX Available at URL: <http://www.luatex.org/>
- [2] The Programming Language Lua. Home page. Available at URL: <http://www.lua.org/>

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General changes

Some of the changes can be organised into sections, but not all. So first, here are the changes that are more or less standalone.

- Many of the source files have been converted to cweb. Early versions of Lua_{TeX} were based on Pascal web, but by 0.40 all code has been hand-converted to C. The literate programming comments were kept, and the relevant sources have now been converted back to cweb, reinstating the literate documentation.

This change does not make Lua_{TeX} a literate program in the traditional sense because the typical C source code layout with pairs of header & implementation files has been kept and no code reshuffling takes place. But it does mean that it is now much easier to keep the source documentation up to date, and it is possible to create nicely typeset program listings with indices.

- There are now source repository revision numbers in the banner again, which is a useful thing to have while tracking down bugs. For example, the Lua_{TeX} binary being used to write this article starts up with:

```
This is LuaTeX, Version beta-0.60.1-2010042817 (rev 3659)
```

- The horizontal nodes that are added during line breaking now inherit the attributes from the nodes inside the created line.

Previously, these nodes (`\leftskip` and `\rightskip` in particular) inherited the attributes in effect at the end of the (partial) paragraph because that is where line breaking takes place.

- All Lua errors now report file and line numbers to aid in debugging, even if the error happens inside a callback.
- Lua_{TeX} can now use the embedded kpathsea library to find Lua `require()` files, and will do so by default if the kpathsea library is enabled by the format (as is the case in plain Lua_{TeX} and the various Lua^A_{TeX} formats).
- The print precision for small numbers in Lua code (the return value of `tostring()`) has been improved.
- Of course there were lots of code cleanups and improvements to the reference manual.

Embedded libraries and other third-party inclusions

The following are changes to third-party code that for the most part should not need much explanation.

- MetaPost is now at version 1.211.
- Libpng is now at version 1.2.40.
- New Sync_{TeX} code is imported from _{TeX} Live.
- The Lua source file from the `luamd5` library (which provides the `md5_hexsuma` function) is now embedded in the executable. In older versions of Lua_{TeX}, this file was missing completely.
- The Lua co-routine patch (`coco`) is now disabled on `powerpc-linux` because it caused crashes on that platform due to a bad upstream implementation.

Dynamic loading of lua modules

Lua_{TeX} now has support for dynamic loading of external compiled Lua libraries.

As with other `require()` files, Lua_{TeX} can and will use kpathsea if the format allows it to do so. For this purpose, kpathsea has been extended with a new file type: `c.lua`. The associated `texmf.cnf` variable is by default defined like this:

```
CLUAINPUTS=.:$SELFAUTOLOC/lib/{"$progname,$engine,}/lua//
```

which means that if your LuaTeX binary lives in

```
/opt/tex/texmf-linux-64/bin/
```

then your compiled Lua modules should go into the local directory, or in a tree below

```
/opt/tex/texmf-linux-64/bin/lib/lua
```

Be warned that not all available Lua modules will work. LuaTeX is a command line program, and on some platforms that makes it nearly impossible to use GUI-based extensions.

Font related

Lots of small changes have taken place in the font processing.

- The backend message

```
cannot open Type 1 font file for reading
```

now reports the name of the Type1 font file it was looking for.

- It is no longer possible for fonts from included pdf files to be replaced by / merged with the document fonts of the enveloping pdf.
- Support for Type3 .pgc files has been removed. This is just for the .pgc format invented by Hàn Thê Thành, bitmapped pk files still work.
- For TrueType font collections (.ttc files), the used subfont name and its index id are printed to the terminal, and if the backend cannot find the font in the collection, the run is aborted.
- It is now possible to use Apple .dfont font collection files.

Unfortunately, in Snow Leopard (a.k.a. MacOSX 10.6) Apple switched to a .ttc format that is not quite compatible with the Microsoft version of .ttc. As a result, the system fonts from Snow Leopard cannot be used in LuaTeX 0.60.

- The loading speed of large fonts via the fontloader library, and the inclusion speed for sub-setting in the backend have both been improved.
- There are two new MathConstants entries added. Suppose the Lua math font loading code produces a Lua table named `f`. In that table, you can set

```
f.MathConstants.FractionDelimiterSize  
f.Mathconstants.FractionDelimiterDisplayStyleSize
```

These new fields allows proper setting of the size parameters for LuaTeX's `...withdelims` math primitives, for which there is no ready replacement in the OpenType MATH table.

- Artificially slanted or extended fonts now work via the pdf text matrix so that this now also works for non-Type1 fonts. In other words: the Lua `f.slant` and `f.extend` font keys are now obeyed in all cases.
- There is another new allowed key: `f.psname`. When set, this value should be the original PostScript font name of the font. In the pdf generation backend, fonts inside .dfont and .ttc collections are fetched from the archive using this field, so in those cases the key is required.

- A related change is made to the font name discovery used by the backend for storage into the pdf file structure: now it tries `f.psnam` first, as that is much less likely to contain spaces than `f.fontname` (which is the field that 0.40 used). If there is no `f.psnam`, it falls back to the old behaviour.
- Finally, Lua-loaded fonts now support a `f.nomath` key to speed up loading the Lua table in the normal case of fonts that do not provide OpenType MATH data.

'T_EX'-side extensions and changes

LuaT_EX is not actually T_EX even though it uses an input language that is very similar, hence the quotes in this section's title. Some of the following items are new LuaT_EX extensions, others are adjustments to pre-existing pdfT_EX or Aleph functionality.

- The primitives `\input` and `\openin` now accept braced file names, removing the need for double quote escapes in case of files with spaces in their name.
- The `\endlinechar` can now be set to any value between 0 and 127.
- The new primitives `\aligntab` and `\alignmark` are aliases for the use single characters with the category codes of `&` and `#` in alignments.
- `\latelua` is now allowed inside leaders. To be used with care, because the Lua code will be executed once for each generated leader item.
- The new primitive `\gleader s` provides 'globally aligned' leaders. These leaders are aligned on one side of the main output box instead of to the side of the immediately enclosing box.
- From now on LuaT_EX handles only 4 direction specifiers:
 - TLT (latin),
 - TRT (arabic),
 - RTT (CJK), and
 - LTL (mongolian).
 Other direction specifiers generate an error.
- The `\pdfcompresslevel` is now effectively fixed as soon as any output to the pdf file has occurred.
- `\pdfobj` has gained an extra optional keyword: `uncompressed`. This forces the object to be written to the pdf in plain text, which is needed for certain objects containing metadata.
- Two new token lists are provided: `\pdfxformresources` and `\pdfxformattr`, as an alternative to `\pdfxform` keywords.
- The new syntax

```
\pdfrefxform [width <dimen>] [height <dimen>] [depth <dimen>] <formref>
```

scales a single form object; using similar principle as with `\pdfximage`: depth alone doesn't scale, it shifts vertically.

- Similarly,

```
\pdfrefximage [width <dimen>] [height <dimen>] [depth <dimen>] <imageref>
```

overrules settings from `\pdfximage` for this image only.

- The following obsolete pdfT_EX primitives have been removed:
 - `\pdfoptionalwaysusepdfpagebox`
 - `\pdfoptionpdfinclusionerrorlevel`
 - `\pdfforcepagebox`
 - `\pdfmovechars`

These were already deprecated in pdfTeX itself.

Lua table extensions

In most of the Lua tables that LuaTeX provides, only small changes have taken place, so they do not deserve their own subsections.

- There is a new callback: `process_output_buffer`, for post-processing of `\write` text to a file.
- The callbacks `hpack_filter`, `vpack_filter` and `pre_output_filter` pass on an extra string argument for the current direction.
- `fontloader.open()` previously cleared some of the font name strings during load that it should not do.
- The new function `font.id("tenrm")` returns the internal id number for that font. It takes a bare control sequence name as argument.
- The `os.name` variable now knows about `cygwin` and `kfreebsd`.
- `lfs.readlink("file")` returns the content of a symbolic link (Unix only). This extension is meant for use in `texlua` scripts.
- `lfs.shortname("file")` returns the short (FAT) name of a file (Windows only). This extension is meant for use in `texlua` scripts.
- `kpse.version()` returns the `kpathsea` version string.
- `kpse.lookup({...})` offers a search interface similar to the `kpsewhich` program, an example call looks like this:

```
kpse.set_program_name('luatex')
print(kpse.lookup ('plain.tex',
                  { ["format"] = "tex",
                    ["all"] = true,
                    ["must-exist"] = true })))
```

The 'node' table

In the verbatim code below, `n` stands for a `userdata` node object.

- `node.vpack(n)` packs a list into a `vlist` node, like `\vbox`.
- `node.protrusion_skippable(n)` returns `true` if this node can be skipped for the purpose of protrusion discovery.

This is useful if you want to (re)calculate protrusion in pure Lua.

- `node.dimensions(n)` returns the natural width, height and depth of a (horizontal) node list.
- `node.tail(n)` returns the tail node of a node list.
- Each glyph node now has three new virtual read-only fields: `width`, `height`, and `depth`. The values are the number of scaled points.
- `glue_spec` nodes now have an extra boolean read-only field: `writable`.

Some glue specifications can be altered directly, but certain key glue specifications are shared among many nodes. Altering the values of those is prohibited because it would have unpredictable side-effects. For those cases, a copy must be made and assigned to the parent node.

- `hlist` nodes now have a subtype to distinguish between `hlists` generated by the paragraph breaking, explicit `\hbox` commands, and other sources.
- `node.copy_list(n)` now allows a second argument. This argument can be used to copy only part of a node list.
- `node.hpack(n)` now accepts `cal_expand_ratio` and `subst_ex_font` modifiers.

This feature helps the implementation of font expansion in a pure Lua paragraph breaking code.

- `node.hpack(n)` and `node.vpack(n)` now also return the ‘badness’ of the created box, and accept an optional direction argument.

The ‘pdf’ table

- The new functions `pdf.mapfile("...")` and `pdf.mapline("...")` are aliases for the corresponding pdf \TeX primitives.
- `pdf.registerannot()` reserves a pdf object number and returns it.
- The functions `pdf.obj(...)`, `pdf.immediateobj(...)`, and `pdf.reserveobj(...)` are similar to the corresponding pdf \TeX primitives. Full syntax details can be read in the Lua \TeX reference manual.
- New read-write string keys:
 - `pdf.catalog` string goes into the Catalog dictionary.
 - `pdf.info` string goes into the Info dictionary.
 - `pdf.names` string goes into the Names dictionary. referenced by the Catalog object.
 - `pdf.trailer` string goes into the Trailer dictionary.
 - `pdf.pageattributes` string goes into the Page dictionary.
 - `pdf.pageresources` string goes into the Resources dictionary referenced by the Page object.
 - `pdf.pagesattributes` string goes into the Pages dictionary.

The ‘tex’ table

Finally, there are some extensions to the `tex` table that are worth mentioning.

- `tex.badness(f,s)` interfaces to the ‘badness’ internal function.
 - Accidentally, this disables access to the `\badness` internal parameter, this will be corrected in a future Lua \TeX version.
- `tex.sp("1in")` converts Lua-style string units to scaled points.
- `tex.tprint({...},{...})` is like a sequence of `tex.sprint(...)` calls.
- `tex.shipout(n)` ships out a constructed box.
- `tex.nest[]` and `tex.nest.ptr` together allow read-write access to the semantic nest (mode nesting).

For example, this prints the equivalent of `\prevdepth` at the current mode nesting level.

```
print (tex.nest[tex.nest.ptr].prevdepth)
```

`tex.nest.ptr` is the current level, and lower numbers are enclosing modes.

Each of the items in the `tex.nest` array represents a mode nesting level and has a set of virtual keys that be accessed both for reading and writing, but you cannot change the actual `tex.nest` array itself. The possible keys are listed in the Lua \TeX reference manual.

- `tex.linebreak(n, {...})` supports running the paragraph breaker from pure Lua. The second argument specifies a (potentially large) table of line breaking parameters: the parameters that are not passed explicitly are taken from the current typesetter state.

The exact keys in the table are documented in the reference manual, but here is a simple yet complete example of how to run line breaking on the content of `\box0`:

```

\setbox0=\hbox to \hsize{\input knuth }
\startluacode
local n = node.copy_list(tex.box[0].list)
local t = node.tail(n)
local final = node.new(node.id('glue'))
final.spec = node.new(node.id('glue_spec'))
final.spec.stretch_order = 2
final.spec.stretch = 1
node.insert_after(n,t, final)
local m = tex.linebreak(n,
    { hangafter = 2, hangindent = tex.sp("2em")})
local q = node.vpack(m)
node.write(q)
\stoptluacode

```

The result is this:

Thus, I came to the conclusion that the designer of a new system must not only be the implementer and first large-scale user; the designer should also write the first user manual. The separation of any of these four components would have hurt \TeX significantly. If I had not participated fully in all these activities, literally hundreds of improvements would never have been made, because I would never have thought of them or perceived why they were important. But a system cannot be successful if it is too strongly influenced by a single person. Once the initial design is complete and fairly robust, the real test begins as people with many different viewpoints undertake their own experiments.

Summary

All in all, there are not too many incompatible changes compared to Lua \TeX 0.40, and the Lua \TeX project is progressing nicely.

Lua \TeX beta 0.70 will be released in the autumn of 2010. Our current plans for that release are: access to the actual pdf structures of included pdf images; a partial redesign of the mixed direction model; even more access to the Lua \TeX internals from Lua; and probably some more ...