

# lualatex.dtx

## (LuaTeX-specific support)

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\*Significant portions of the code here are adapted/simplified from the packages `luatex` and `luatexbase` written by Heiko Oberdiek, Élie Roux, Manuel Pégourié-Gonnar and Philipp Gesang.

# 1 Overview

LuaTeX adds a number of engine-specific functions to TeX. Several of these require set up that is best done in the kernel or need related support functions. This file provides *basic* support for LuaTeX at the L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> kernel level plus as a loadable file which can be used with plain TeX and L<sup>A</sup>T<sub>E</sub>X.

This file contains code for both TeX (to be stored as part of the format) and Lua (to be loaded at the start of each job). In the Lua code, the kernel uses the namespace `luatexbase`.

The following `\count` registers are used here for register allocation:

```
\e@alloc@attribute@count Attributes (default 258)
\e@alloc@ccodetable@count Category code tables (default 259)
\e@alloc@luafunction@count Lua functions (default 260)
  \e@alloc@whatsit@count User whatsits (default 261)
  \e@alloc@bytecode@count Lua bytecodes (default 262)
  \e@alloc@luachunk@count Lua chunks (default 263)
```

(`\count 256` is used for `\newmarks` allocation and `\count 257` is used for `\newXeTeXintercharclass` with XeTeX, with code defined in `ltfinal.dtx`). With any L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> kernel from 2015 onward these registers are part of the block in the extended area reserved by the kernel (prior to 2015 the L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> kernel did not provide any functionality for the extended allocation area).

# 2 Core TeX functionality

The commands defined here are defined for possible inclusion in a future L<sup>A</sup>T<sub>E</sub>X format, however also extracted to the file `ltluatex.tex` which may be used with older L<sup>A</sup>T<sub>E</sub>X formats, and with plain TeX.

<code>\newattribute</code>	<code>\newattribute{&lt;attribute&gt;}</code>	Defines a named <code>\attribute</code> , indexed from 1 ( <i>i.e.</i> <code>\attribute0</code> is never defined). Attributes initially have the marker value <code>-7FFFFFFF</code> ('unset') set by the engine.
<code>\newcatcodetable</code>	<code>\newcatcodetable{&lt;catcodetable&gt;}</code>	Defines a named <code>\catcodetable</code> , indexed from 1 ( <code>\catcodetable0</code> is never assigned). A new catcode table will be populated with exactly those values assigned by IniTeX (as described in the LuaTeX manual).
<code>\newluafunction</code>	<code>\newluafunction{&lt;function&gt;}</code>	Defines a named <code>\luafunction</code> , indexed from 1. (Lua indexes tables from 1 so <code>\luafunction0</code> is not available).
<code>\newwhatsit</code>	<code>\newwhatsit{&lt;whatsit&gt;}</code>	Defines a custom <code>\whatsit</code> , indexed from 1.
<code>\newluabytecode</code>	<code>\newluabytecode{&lt;bytecode&gt;}</code>	Allocates a number for Lua bytecode register, indexed from 1.
<code>\newluachunkname</code>	<code>newluachunkname{&lt;chunkname&gt;}</code>	Allocates a number for Lua chunk register, indexed from 1. Also enters the name of the register (without backslash) into the <code>lua.name</code> table to be used in stack traces.

<code>\catcodetable@initex</code>	Predefined category code tables with the obvious assignments. Note that the
<code>\catcodetable@string</code>	<code>latex</code> and <code>atletter</code> tables set the full Unicode range to the codes predefined by
<code>\catcodetable@latex</code>	the kernel.
<code>\catcodetable@attribute</code>	<code>\setattribute{⟨attribute⟩}{⟨value⟩}</code>
<code>\unsetattribute</code>	<code>\unsetattribute{⟨attribute⟩}</code>

Set and unset attributes in a manner analogous to `\setlength`. Note that attributes take a marker value when unset so this operation is distinct from setting the value to zero.

### 3 Plain T<sub>E</sub>X interface

The `luatex` interface may be used with plain T<sub>E</sub>X using `\input{ltluatex}`. This inputs `ltluatex.tex` which inputs `etex.src` (or `etex.sty` if used with L<sup>A</sup>T<sub>E</sub>X) if it is not already input, and then defines some internal commands to allow the `luatex` interface to be defined.

The `luatexbase` package interface may also be used in plain T<sub>E</sub>X, as before, by inputting the package `\input luatexbase.sty`. The new version of `luatexbase` is based on this `luatex` code but implements a compatibility layer providing the interface of the original package.

## 4 Lua functionality

### 4.1 Allocators in Lua

<code>new_attribute</code>	<code>luatexbase.new_attribute(⟨attribute⟩)</code> Returns an allocation number for the <code>⟨attribute⟩</code> , indexed from 1. The attribute will be initialised with the marker value <code>-0xFFFFFFFF</code> ('unset'). The attribute allocation sequence is shared with the T <sub>E</sub> X code but this function does <i>not</i> define a token using <code>\attributedef</code> . The attribute name is recorded in the <code>attributes</code> table. A metatable is provided so that the table syntax can be used consistently for attributes declared in T <sub>E</sub> X or Lua.
<code>new_whatsit</code>	<code>luatexbase.new_whatsit(⟨whatsit⟩)</code> Returns an allocation number for the custom <code>⟨whatsit⟩</code> , indexed from 1.
<code>new_bytecode</code>	<code>luatexbase.new_bytecode(⟨bytecode⟩)</code> Returns an allocation number for a bytecode register, indexed from 1. The optional <code>⟨name⟩</code> argument is just used for logging.
<code>new_chunkname</code>	<code>luatexbase.new_chunkname(⟨chunkname⟩)</code> Returns an allocation number for a Lua chunk name for use with <code>\directlua</code> and <code>\latelua</code> , indexed from 1. The number is returned and also <code>⟨name⟩</code> argument is added to the <code>lua.name</code> array at that index.

These functions all require access to a named T<sub>E</sub>X count register to manage their allocations. The standard names are those defined above for access from T<sub>E</sub>X, *e.g.* `e@alloc@attribute@count`, but these can be adjusted by defining the variable `⟨type⟩_count_name` before loading `ltluatex.lua`, for example

```
local attribute_count_name = "attributetracker"
require("ltluatex")
```

would use a TeX `\count` (`\countdef`'d token) called `attributetracker` in place of `"e@alloc@attribute@count`.

## 4.2 Lua access to TeX register numbers

`registernumber` `luatexbase.registernumber(<name>)`

Sometimes (notably in the case of Lua attributes) it is necessary to access a register *by number* that has been allocated by TeX. This package provides a function to look up the relevant number using LuaTeX's internal tables. After for example `\newattribute\myattrib`, `\myattrib` would be defined by (say) `\myattrib=\attribute15`. `luatexbase.registernumber("myattrib")` would then return the register number, 15 in this case. If the string passed as argument does not correspond to a token defined by `\attributedef`, `\countdef` or similar commands, the Lua value `false` is returned.

As an example, consider the input:

```
\newcommand\test[1]{%
\typeout{#1: \expandafter\meaning\csname#1\endcsname^^J
\space\space\space\space
\directlua{tex.write(luatexbase.registernumber("#1") or "bad input")}%
}

\test{undefinedrubbish}

\test{space}

\test{hbox}

\test{@MM}

\test{@tempdima}
\test{@tempdimb}

\test{strutbox}

\test{sixt@@n}

\attributedef\myattr=12
\myattr=200
\test{myattr}
```

If the demonstration code is processed with LuaLaTeX then the following would be produced in the log and terminal output.

```
undefinedrubbish: \relax
      bad input
space: macro:->
      bad input
hbox: \hbox
      bad input
@MM: \mathchar"4E20
      20000
@tempdima: \dimen14
```

```

14
@tempdimb: \dimen15
15
strutbox: \char"B
11
sixt@@n: \char"10
16
myattr: \attribute12
12

```

Notice how undefined commands, or commands unrelated to registers do not produce an error, just return **false** and so print **bad input** here. Note also that commands defined by `\newbox` work and return the number of the box register even though the actual command holding this number is a `\chardef` defined token (there is no `\boxdef`).

### 4.3 Module utilities

`provides_module` `luatexbase.provides_module(<info>)`

This function is used by modules to identify themselves; the *info* should be a table containing information about the module. The required field **name** must contain the name of the module. It is recommended to provide a field **date** in the usual L<sup>A</sup>T<sub>E</sub>X format *yyyy/mm/dd*. Optional fields **version** (a string) and **description** may be used if present. This information will be recorded in the log. Other fields are ignored.

`module_info` `luatexbase.module_info(<module>, <text>)`

`module_warning` `luatexbase.module_warning(<module>, <text>)`

`module_error` `luatexbase.module_error(<module>, <text>)`

These functions are similar to L<sup>A</sup>T<sub>E</sub>X's `\PackageError`, `\PackageWarning` and `\PackageInfo` in the way they format the output. No automatic line breaking is done, you may still use `\n` as usual for that, and the name of the package will be prepended to each output line.

Note that `luatexbase.module_error` raises an actual Lua error with `error()`, which currently means a call stack will be dumped. While this may not look pretty, at least it provides useful information for tracking the error down.

### 4.4 Callback management

`add_to_callback` `luatexbase.add_to_callback(<callback>, <function>, <description>)` Registers the *<function>* into the *<callback>* with a textual *<description>* of the function. Functions are inserted into the callback in the order loaded.

`remove_from_callback` `luatexbase.remove_from_callback(<callback>, <description>)` Removes the callback function with *<description>* from the *<callback>*. The removed function and its description are returned as the results of this function.

`in_callback` `luatexbase.in_callback(<callback>, <description>)` Checks if the *<description>* matches one of the functions added to the list for the *<callback>*, returning a boolean value.

`disable_callback` `luatexbase.disable_callback(<callback>)` Sets the *<callback>* to **false** as described in the LuaT<sub>E</sub>X manual for the underlying `callback.register` built-in. Callbacks will only be set to false (and thus be skipped entirely) if there are no functions registered using the callback.

<code>callback_descriptions</code>	A list of the descriptions of functions registered to the specified callback is returned. <code>{}</code> is returned if there are no functions registered.
<code>create_callback</code>	<code>luatexbase.create_callback(&lt;name&gt;,metatype,&lt;default&gt;)</code> Defines a user defined callback. The last argument is a default function or <code>false</code> .
<code>call_callback</code>	<code>luatexbase.call_callback(&lt;name&gt;,...)</code> Calls a user defined callback with the supplied arguments.

## 5 Implementation

```

1 <*2ekernel | tex | latexrelease>
2 <2ekernel | latexrelease>\ifx\directlua\@undefined\else

```

### 5.1 Minimum LuaTeX version

LuaTeX has changed a lot over time. In the kernel support for ancient versions is not provided: trying to build a format with a very old binary therefore gives some information in the log and loading stops. The cut-off selected here relates to the tree-searching behaviour of `require()`: from version 0.60, LuaTeX will correctly find Lua files in the `texmf` tree without ‘help’.

```

3 <latexrelease>\IncludeInRelease{2015/10/01}
4 <latexrelease>                {\newluafunction}{LuaTeX}%
5 \ifnum\luatexversion<60 %
6   \wlog{*****}
7   \wlog{* LuaTeX version too old for ltuatex support *}
8   \wlog{*****}
9   \expandafter\endinput
10 \fi

```

### 5.2 Older L<sup>A</sup>T<sub>E</sub>X/Plain T<sub>E</sub>X setup

```

11 <*tex>

```

Older L<sup>A</sup>T<sub>E</sub>X formats don’t have the primitives with ‘native’ names: sort that out. If they already exist this will still be safe.

```

12 \directlua{tex.enableprimitives("",tex.extraprimitives("luatex"))}
13 \ifx\@alloc\@undefined

```

In pre-2014 L<sup>A</sup>T<sub>E</sub>X, or plain T<sub>E</sub>X, load `etex.{sty,src}`.

```

14 \ifx\documentclass\@undefined
15   \ifx\loccount\@undefined
16     \input{etex.src}%
17   \fi
18   \catcode'\@=11 %
19   \outer\expandafter\def\csname newfam\endcsname
20     {\alloc@8\fam\chardef\et@xmaxfam}
21 \else
22   \RequirePackage{etex}
23   \expandafter\def\csname newfam\endcsname
24     {\alloc@8\fam\chardef\et@xmaxfam}
25   \expandafter\let\expandafter\new@mathgroup\csname newfam\endcsname
26 \fi

```

### 5.2.1 Fixes to etex.src/etex.sty

These could and probably should be made directly in an update to `etex.src` which already has some LuaTeX-specific code, but does not define the correct range for LuaTeX.

2015-07-13 higher range in luatex.

```
27 \edef \et@xmaxregs {\ifx\directlua\@undefined 32768\else 65536\fi}
```

luatex/xetex also allow more math fam.

```
28 \edef \et@xmaxfam {\ifx\Umathchar\@undefined\sixt@@n\else\@ccclvi\fi}
```

```
29 \count 270=\et@xmaxregs % locally allocates \count registers
```

```
30 \count 271=\et@xmaxregs % ditto for \dimen registers
```

```
31 \count 272=\et@xmaxregs % ditto for \skip registers
```

```
32 \count 273=\et@xmaxregs % ditto for \muskip registers
```

```
33 \count 274=\et@xmaxregs % ditto for \box registers
```

```
34 \count 275=\et@xmaxregs % ditto for \toks registers
```

```
35 \count 276=\et@xmaxregs % ditto for \marks classes
```

and 256 or 16 fam. (Done above due to plain/L<sup>A</sup>T<sub>E</sub>X differences in l<sup>A</sup>uatex.)

```
36 % \outer\def\newfam{\alloc@8\fam\chardef\et@xmaxfam}
```

End of proposed changes to `etex.src`

### 5.2.2 luatex specific settings

Switch to global cf `luatex.sty` to leave room for inserts not really needed for luatex but possibly most compatible with existing use.

```
37 \expandafter\let\csname newcount\expandafter\expandafter\endcsname
```

```
38 \csname globcount\endcsname
```

```
39 \expandafter\let\csname newdimen\expandafter\expandafter\endcsname
```

```
40 \csname globdimen\endcsname
```

```
41 \expandafter\let\csname newskip\expandafter\expandafter\endcsname
```

```
42 \csname globskip\endcsname
```

```
43 \expandafter\let\csname newbox\expandafter\expandafter\endcsname
```

```
44 \csname globbox\endcsname
```

Define `\e@alloc` as in latex (the existing macros in `etex.src` hard to extend to further register types as they assume specific 26x and 27x count range. For compatibility the existing register allocation is not changed.

```
45 \chardef\e@alloc@top=65535
```

```
46 \let\e@alloc@chardef\chardef
```

```
47 \def\e@alloc#1#2#3#4#5#6{%
```

```
48 \global\advance#3\@ne
```

```
49 \e@ch@ck{#3}{#4}{#5}#1%
```

```
50 \allocationnumber#3\relax
```

```
51 \global#2#6\allocationnumber
```

```
52 \wlog{\string#6=\string#1\the\allocationnumber}}%
```

```
53 \gdef\e@ch@ck#1#2#3#4{%
```

```
54 \ifnum#1<#2\else
```

```
55 \ifnum#1=#2\relax
```

```
56 #1\@ccclvi
```

```
57 \ifx\count#4\advance#1 10 \fi
```

```
58 \fi
```

```
59 \ifnum#1<#3\relax
```

```

60     \else
61         \errmessage{No room for a new \string#4}%
62     \fi
63 \fi}%

```

Two simple L<sup>A</sup>T<sub>E</sub>X macros used in `lAtex.sty`.

```

64 \long\def\@gobble#1{}
65 \long\def\@firstofone#1{#1}

```

Fix up allocations not to clash with `etex.src`.

```

66 \expandafter\csname newcount\endcsname\@alloc@attribute@count
67 \expandafter\csname newcount\endcsname\@alloc@ccodetable@count
68 \expandafter\csname newcount\endcsname\@alloc@luafunction@count
69 \expandafter\csname newcount\endcsname\@alloc@whatsit@count
70 \expandafter\csname newcount\endcsname\@alloc@bytecode@count
71 \expandafter\csname newcount\endcsname\@alloc@luachunk@count

```

End of conditional setup for plain T<sub>E</sub>X / old L<sup>A</sup>T<sub>E</sub>X.

```

72 \fi
73 </tex>

```

### 5.3 Attributes

`\newattribute` As is generally the case for the LuaT<sub>E</sub>X registers we start here from 1. Notably, some code assumes that `\attribute0` is never used so this is important in this case.

```

74 \ifx\@alloc@attribute@count\@undefined
75     \countdef\@alloc@attribute@count=258
76 \fi
77 \def\newattribute#1{%
78     \e@alloc@attribute\attributedef
79     \e@alloc@attribute@count\m@ne\@alloc@top#1%
80 }
81 \e@alloc@attribute@count=\z@

```

`\setattribute` Handy utilities.

```

\unsetattribute 82 \def\setattribute#1#2{#1=\numexpr#2\relax}
83 \def\unsetattribute#1{#1=-"7FFFFFFF\relax}

```

### 5.4 Category code tables

`\newcatcodetable` Category code tables are allocated with a limit half of that used by LuaT<sub>E</sub>X for everything else. At the end of allocation there needs to be an initialisation step. Table 0 is already taken (it's the global one for current use) so the allocation starts at 1.

```

84 \ifx\@alloc@ccodetable@count\@undefined
85     \countdef\@alloc@ccodetable@count=259
86 \fi
87 \def\newcatcodetable#1{%
88     \e@alloc@catcodetable\chardef
89     \e@alloc@ccodetable@count\m@ne{"8000}#1%
90     \initcatcodetable\allocationnumber
91 }
92 \e@alloc@ccodetable@count=\z@

```



<code>\catcodetable@initex</code> <code>\catcodetable@string</code> <code>\catcodetable@latex</code> <code>\catcodetable@atletter</code>	<p>Save a small set of standard tables. The Unicode data is read here in using a parser simplified from that in load-unicode-data: only the nature of letters needs to be detected.</p> <pre> 93 \newcatcodetable\catcodetable@initex 94 \newcatcodetable\catcodetable@string 95 \begingroup 96   \def\setrangecatcode#1#2#3{% 97     \ifnum#1&gt;#2 % 98       \expandafter\@gobble 99     \else 100      \expandafter\@firstofone 101    \fi 102    {% 103      \catcode#1=#3 % 104      \expandafter\setrangecatcode\expandafter 105        {\number\numexpr#1 + 1\relax}{#2}{#3} 106    }% 107  } 108  \@firstofone{% 109    \catcodetable\catcodetable@initex 110    \catcode0=12 % 111    \catcode13=12 % 112    \catcode37=12 % 113    \setrangecatcode{65}{90}{12}% 114    \setrangecatcode{97}{122}{12}% 115    \catcode92=12 % 116    \catcode127=12 % 117    \savecatcodetable\catcodetable@string 118  \endgroup 119 }% 120 \newcatcodetable\catcodetable@latex 121 \newcatcodetable\catcodetable@atletter 122 \begingroup 123   \def\parseunicodedataI#1;#2;#3;#4\relax{% 124     \parseunicodedataII#1;#3;#2 First&gt;\relax 125   }% 126   \def\parseunicodedataII#1;#2;#3 First&gt;#4\relax{% 127     \ifx\relax#4\relax 128       \expandafter\parseunicodedataIII 129     \else 130       \expandafter\parseunicodedataIV 131     \fi 132     {#1}#2\relax% 133   }% 134   \def\parseunicodedataIII#1#2#3\relax{% 135     \ifnum 0% 136       \if L#21\fi 137       \if M#21\fi 138       &gt;0 % 139       \catcode"#1=11 % 140     \fi 141   }% 142   \def\parseunicodedataIV#1#2#3\relax{% 143     \read\unicoderead to \unicodedataline </pre>
---	--

```

144 \if L#2%
145 \count0="#1 %
146 \expandafter\parseunicodedataV\unicodedataline\relax
147 \fi
148 }%
149 \def\parseunicodedataV#1;#2\relax{%
150 \loop
151 \unless\ifnum\count0>"#1 %
152 \catcode\count0=11 %
153 \advance\count0 by 1 %
154 \repeat
155 }%
156 \def\storedpar{\par}%
157 \chardef\unicoderead=\numexpr\count16 + 1\relax
158 \openin\unicoderead=UnicodeData.txt %
159 \loop\unless\ifeof\unicoderead %
160 \read\unicoderead to \unicodedataline
161 \unless\ifx\unicodedataline\storedpar
162 \expandafter\parseunicodedataI\unicodedataline\relax
163 \fi
164 \repeat
165 \closein\unicoderead
166 \@firstofone{%
167 \catcode64=12 %
168 \savecatcodetable\catcodetable@latex
169 \catcode64=11 %
170 \savecatcodetable\catcodetable@atletter
171 }
172 \endgroup

```

## 5.5 Named Lua functions

`\newluafunction` Much the same story for allocating LuaTeX functions except here they are just numbers so they are allocated in the same way as boxes. Lua indexes from 1 so once again slot 0 is skipped.

```

173 \ifx\e@alloc@luafunction@count\@undefined
174 \countdef\e@alloc@luafunction@count=260
175 \fi
176 \def\newluafunction{%
177 \e@alloc@luafunction\e@alloc@chardef
178 \e@alloc@luafunction@count\m@ne\e@alloc@top
179 }
180 \e@alloc@luafunction@count=\z@

```

## 5.6 Custom whatsits

`\newwhatsit` These are only settable from Lua but for consistency are definable here.

```

181 \ifx\e@alloc@whatsit@count\@undefined
182 \countdef\e@alloc@whatsit@count=261
183 \fi
184 \def\newwhatsit#1{%
185 \e@alloc@whatsit\e@alloc@chardef
186 \e@alloc@whatsit@count\m@ne\e@alloc@top#1%

```

```

187 }
188 \e@alloc@whatsit@count=\z@

```

## 5.7 Lua bytecode registers

`\newluabytcode` These are only settable from Lua but for consistency are definable here.

```

189 \ifx\e@alloc@bytecode@count\@undefined
190 \countdef\e@alloc@bytecode@count=262
191 \fi
192 \def\newluabytcode#1{%
193   \e@alloc\luabytcode\e@alloc@chardef
194   \e@alloc@bytecode@count\m@ne\e@alloc@top#1%
195 }
196 \e@alloc@bytecode@count=\z@

```

## 5.8 Lua chunk registers

`\newluachunkname` As for bytecode registers, but in addition we need to add a string to the `lua.name` table to use in stack tracing. We use the name of the command passed to the allocator, with no backslash.

```

197 \ifx\e@alloc@luachunk@count\@undefined
198 \countdef\e@alloc@luachunk@count=263
199 \fi
200 \def\newluachunkname#1{%
201   \e@alloc\luachunk\e@alloc@chardef
202   \e@alloc@luachunk@count\m@ne\e@alloc@top#1%
203   {\escapechar\m@ne
204    \directlua{lua.name[\the\allocationnumber]="\string#1"}}%
205 }
206 \e@alloc@luachunk@count=\z@

```

## 5.9 Lua loader

Load the Lua code at the start of every job. For the conversion of  $\TeX$  into numbers at the Lua side we need some known registers: for convenience we use a set of systematic names, which means using a group around the Lua loader.

```

207 <2kernel> \everyjob\expandafter{%
208 <2kernel> \the\everyjob
209 \begingroup
210 \attributedef\attributezero=0 %
211 \chardef \charzero =0 %

```

Note name change required on older luatex, for hash table access.

```

212 \countdef \CountZero =0 %
213 \dimendef \dimenzero =0 %
214 \mathchardef \mathcharzero =0 %
215 \muskipdef \muskipzero =0 %
216 \skipdef \skipzero =0 %
217 \toksdef \tokszero =0 %
218 \directlua{require("lualatex")}
219 \endgroup
220 <2kernel>}
221 <latexrelease> \EndIncludeInRelease

```

```

222 <latexrelease> \IncludeInRelease{0000/00/00}
223 <latexrelease>           {\newluafunction}{LuaTeX}%
224 <latexrelease> \let\@alloc@attribute@count\@undefined
225 <latexrelease> \let\newattribute\@undefined
226 <latexrelease> \let\setattribute\@undefined
227 <latexrelease> \let\unsetattribute\@undefined
228 <latexrelease> \let\@alloc@ccodetable@count\@undefined
229 <latexrelease> \let\newcatcodetable\@undefined
230 <latexrelease> \let\catcodetable@initex\@undefined
231 <latexrelease> \let\catcodetable@string\@undefined
232 <latexrelease> \let\catcodetable@latex\@undefined
233 <latexrelease> \let\catcodetable@atletter\@undefined
234 <latexrelease> \let\@alloc@luafunction@count\@undefined
235 <latexrelease> \let\newluafunction\@undefined
236 <latexrelease> \let\@alloc@luafunction@count\@undefined
237 <latexrelease> \let\newwhatsit\@undefined
238 <latexrelease> \let\@alloc@whatsit@count\@undefined
239 <latexrelease> \let\newluabytecode\@undefined
240 <latexrelease> \let\@alloc@bytecode@count\@undefined
241 <latexrelease> \let\newluachunkname\@undefined
242 <latexrelease> \let\@alloc@luachunk@count\@undefined
243 <latexrelease> \directlua{luatexbase.uninstall()}
244 <latexrelease> \EndIncludeInRelease

```

In `\everyjob`, if `luaotfload` is available, load it and switch to TU.

```

245 <latexrelease> \IncludeInRelease{2017/01/01}%
246 <latexrelease>           {\fontencoding}{TU in everyjob}%
247 <latexrelease> \fontencoding{TU}\let\encodingdefault\f@encoding
248 <latexrelease> \ifx\directlua\@undefined\else
249 <2ekernel> \everyjob\expandafter{%
250 <2ekernel>   \the\everyjob
251 <*2ekernel, latexrelease>
252   \directlua{%
253     if xpcall(function ()%
254               require('luaotfload-main')%
255               end, texio.write_nl) then %
256       local _void = luaotfload.main ()%
257     else %
258       texio.write_nl('Error in luaotfload: reverting to OT1')%
259       tex.print('\string\def\string\encodingdefault{OT1}')%
260     end %
261   }%
262   \let\f@encoding\encodingdefault
263   \expandafter\let\csname ver@luaotfload.sty\endcsname\fmtversion
264 </2ekernel, latexrelease>
265 <latexrelease> \fi
266 <2ekernel>   }
267 <latexrelease> \EndIncludeInRelease
268 <latexrelease> \IncludeInRelease{0000/00/00}%
269 <latexrelease>           {\fontencoding}{TU in everyjob}%
270 <latexrelease> \fontencoding{OT1}\let\encodingdefault\f@encoding
271 <latexrelease> \EndIncludeInRelease

272 <2ekernel | latexrelease> \fi
273 </2ekernel | tex | latexrelease>

```

## 5.10 Lua module preliminaries

274 `{*lua}`

Some set up for the Lua module which is needed for all of the Lua functionality added here.

**luatexbase** Set up the table for the returned functions. This is used to expose all of the public functions.

```
275 luatexbase      = luatexbase or { }
276 local luatexbase = luatexbase
```

Some Lua best practice: use local versions of functions where possible.

```
277 local string_gsub      = string.gsub
278 local tex_count        = tex.count
279 local tex_setattribute  = tex.setattribute
280 local tex_setcount     = tex.setcount
281 local texio_write_nl   = texio.write_nl

282 local luatexbase_warning
283 local luatexbase_error
```

## 5.11 Lua module utilities

### 5.11.1 Module tracking

**modules** To allow tracking of module usage, a structure is provided to store information and to return it.

```
284 local modules = modules or { }
```

**provides\_module** Local function to write to the log.

```
285 local function luatexbase_log(text)
286   texio_write_nl("log", text)
287 end
```

Modelled on `\ProvidesPackage`, we store much the same information but with a little more structure.

```
288 local function provides_module(info)
289   if not (info and info.name) then
290     luatexbase_error("Missing module name for provides_module")
291   end
292   local function spaced(text)
293     return text and (" " .. text) or ""
294   end
295   luatexbase_log(
296     "Lua module: " .. info.name
297     .. spaced(info.date)
298     .. spaced(info.version)
299     .. spaced(info.description)
300   )
301   modules[info.name] = info
302 end
303 luatexbase.provides_module = provides_module
```

### 5.11.2 Module messages

There are various warnings and errors that need to be given. For warnings we can get exactly the same formatting as from  $\TeX$ . For errors we have to make some changes. Here we give the text of the error in the  $\LaTeX$  format then force an error from Lua to halt the run. Splitting the message text is done using `\n` which takes the place of `\MessageBreak`.

First an auxiliary for the formatting: this measures up the message leader so we always get the correct indent.

```

304 local function msg_format(mod, msg_type, text)
305   local leader = ""
306   local cont
307   local first_head
308   if mod == "LaTeX" then
309     cont = string_gsub(leader, ".", " ")
310     first_head = leader .. "LaTeX: "
311   else
312     first_head = leader .. "Module " .. msg_type
313     cont = "(" .. mod .. ")"
314     .. string_gsub(first_head, ".", " ")
315     first_head = leader .. "Module " .. mod .. " " .. msg_type .. ":"
316   end
317   if msg_type == "Error" then
318     first_head = "\n" .. first_head
319   end
320   if string.sub(text,-1) ~= "\n" then
321     text = text .. " "
322   end
323   return first_head .. " "
324   .. string_gsub(
325     text
326     .. "on input line "
327     .. tex.inputlineno, "\n", "\n" .. cont .. " "
328   )
329   .. "\n"
330 end

```

```

module_info Write messages.
module_warning 331 local function module_info(mod, text)
module_error 332   texio_write_nl("log", msg_format(mod, "Info", text))
333 end
334 luatexbase.module_info = module_info
335 local function module_warning(mod, text)
336   texio_write_nl("term and log", msg_format(mod, "Warning", text))
337 end
338 luatexbase.module_warning = module_warning
339 local function module_error(mod, text)
340   error(msg_format(mod, "Error", text))
341 end
342 luatexbase.module_error = module_error

```

Dedicated versions for the rest of the code here.

```

343 function luatexbase_warning(text)

```

```

344 module_warning("luatexbase", text)
345 end
346 function luatexbase_error(text)
347   module_error("luatexbase", text)
348 end

```

## 5.12 Accessing register numbers from Lua

Collect up the data from the T<sub>E</sub>X level into a Lua table: from version 0.80, LuaT<sub>E</sub>X makes that easy.

```

349 local luaregisterbasetable = { }
350 local registermap = {
351   attributezero = "assign_attr"   ,
352   charzero      = "char_given"    ,
353   CountZero     = "assign_int"    ,
354   dimenzero     = "assign_dimen"  ,
355   mathcharzero  = "math_given"    ,
356   muskipzero    = "assign_mu_skip",
357   skipzero      = "assign_skip"   ,
358   tokszero      = "assign_toks"   ,
359 }
360 local createtoken
361 if tex.luatexversion > 81 then
362   createtoken = token.create
363 elseif tex.luatexversion > 79 then
364   createtoken = newtoken.create
365 end
366 local hashtokens = tex.hashtokens()
367 local luatexversion = tex.luatexversion
368 for i,j in pairs (registermap) do
369   if luatexversion < 80 then
370     luaregisterbasetable[hashtokens[i][1]] =
371       hashtokens[i][2]
372   else
373     luaregisterbasetable[j] = createtoken(i).mode
374   end
375 end

```

**registernumber** Working out the correct return value can be done in two ways. For older LuaT<sub>E</sub>X releases it has to be extracted from the `hashtokens`. On the other hand, newer LuaT<sub>E</sub>X's have `newtoken`, and whilst `.mode` isn't currently documented, Hans Hagen pointed to this approach so we should be OK.

```

376 local registernumber
377 if luatexversion < 80 then
378   function registernumber(name)
379     local nt = hashtokens[name]
380     if(nt and luaregisterbasetable[nt[1]]) then
381       return nt[2] - luaregisterbasetable[nt[1]]
382     else
383       return false
384     end
385   end
386 else

```

```

387 function registernumber(name)
388   local nt = createtoken(name)
389   if(luaregisterbasetable[nt.cmdname]) then
390     return nt.mode - luaregisterbasetable[nt.cmdname]
391   else
392     return false
393   end
394 end
395 end
396 luatexbase.registernumber = registernumber

```

### 5.13 Attribute allocation

**new\_attribute** As attributes are used for Lua manipulations its useful to be able to assign from this end.

```

397 local attributes=setmetatable(
398 {},
399 {
400   __index = function(t,key)
401     return registernumber(key) or nil
402   end}
403 )
404 luatexbase.attributes = attributes
405 local attribute_count_name =
406   attribute_count_name or "e@alloc@attribute@count"
407 local function new_attribute(name)
408   tex_setcount("global", attribute_count_name,
409     tex_count[attribute_count_name] + 1)
410   if tex_count[attribute_count_name] > 65534 then
411     luatexbase_error("No room for a new \\attribute")
412   end
413   attributes[name]= tex_count[attribute_count_name]
414   luatexbase_log("Lua-only attribute " .. name .. " = " ..
415     tex_count[attribute_count_name])
416   return tex_count[attribute_count_name]
417 end
418 luatexbase.new_attribute = new_attribute

```

### 5.14 Custom whatsit allocation

**new\_whatsit** Much the same as for attribute allocation in Lua.

```

419 local whatsit_count_name = whatsit_count_name or "e@alloc@whatsit@count"
420 local function new_whatsit(name)
421   tex_setcount("global", whatsit_count_name,
422     tex_count[whatsit_count_name] + 1)
423   if tex_count[whatsit_count_name] > 65534 then
424     luatexbase_error("No room for a new custom whatsit")
425   end
426   luatexbase_log("Custom whatsit " .. (name or "") .. " = " ..
427     tex_count[whatsit_count_name])
428   return tex_count[whatsit_count_name]
429 end
430 luatexbase.new_whatsit = new_whatsit

```



## 5.15 Bytecode register allocation

`new_bytecode` Much the same as for attribute allocation in Lua. The optional  $\langle name \rangle$  argument is used in the log if given.

```
431 local bytecode_count_name =
432     bytecode_count_name or "e@alloc@bytecode@count"
433 local function new_bytecode(name)
434     tex_setcount("global", bytecode_count_name,
435         tex_count[bytecode_count_name] + 1)
436     if tex_count[bytecode_count_name] > 65534 then
437         luatexbase_error("No room for a new bytecode register")
438     end
439     luatexbase_log("Lua bytecode " .. (name or "") .. " = " ..
440         tex_count[bytecode_count_name])
441     return tex_count[bytecode_count_name]
442 end
443 luatexbase.new_bytecode = new_bytecode
```

## 5.16 Lua chunk name allocation

`new_chunkname` As for bytecode registers but also store the name in the `lua.name` table.

```
444 local chunkname_count_name =
445     chunkname_count_name or "e@alloc@luachunk@count"
446 local function new_chunkname(name)
447     tex_setcount("global", chunkname_count_name,
448         tex_count[chunkname_count_name] + 1)
449     local chunkname_count = tex_count[chunkname_count_name]
450     chunkname_count = chunkname_count + 1
451     if chunkname_count > 65534 then
452         luatexbase_error("No room for a new chunkname")
453     end
454     lua.name[chunkname_count]=name
455     luatexbase_log("Lua chunkname " .. (name or "") .. " = " ..
456         chunkname_count .. "\n")
457     return chunkname_count
458 end
459 luatexbase.new_chunkname = new_chunkname
```

## 5.17 Lua callback management

The native mechanism for callbacks in LuaT<sub>E</sub>X allows only one per function. That is extremely restrictive and so a mechanism is needed to add and remove callbacks from the appropriate hooks.

### 5.17.1 Housekeeping

The main table: keys are callback names, and values are the associated lists of functions. More precisely, the entries in the list are tables holding the actual function as `func` and the identifying description as `description`. Only callbacks with a non-empty list of functions have an entry in this list.

```
460 local callbacklist = callbacklist or { }
```

Numerical codes for callback types, and name-to-value association (the table keys are strings, the values are numbers).

```

461 local list, data, exclusive, simple = 1, 2, 3, 4
462 local types = {
463   list      = list,
464   data      = data,
465   exclusive = exclusive,
466   simple    = simple,
467 }

```

Now, list all predefined callbacks with their current type, based on the LuaTeX manual version 1.01. A full list of the currently-available callbacks can be obtained using

```

\directlua{
  for i,_ in pairs(callback.list()) do
    texio.write_nl("- " .. i)
  end
}
\bye

```

in plain LuaTeX. (Some undocumented callbacks are omitted as they are to be removed.)

```

468 local callbacktypes = callbacktypes or {

```

Section 8.2: file discovery callbacks.

```

469   find_read_file      = exclusive,
470   find_write_file     = exclusive,
471   find_font_file      = data,
472   find_output_file    = data,
473   find_format_file    = data,
474   find_vf_file        = data,
475   find_map_file       = data,
476   find_enc_file       = data,
477   find_pk_file        = data,
478   find_data_file      = data,
479   find_opentype_file  = data,
480   find_truetype_file  = data,
481   find_type1_file     = data,
482   find_image_file     = data,
483   open_read_file      = exclusive,
484   read_font_file      = exclusive,
485   read_vf_file        = exclusive,
486   read_map_file       = exclusive,
487   read_enc_file       = exclusive,
488   read_pk_file        = exclusive,
489   read_data_file      = exclusive,
490   read_truetype_file  = exclusive,
491   read_type1_file     = exclusive,
492   read_opentype_file  = exclusive,

```

Not currently used by luatex but included for completeness. may be used by a font handler.

```

493   find_cidmap_file    = data,

```

```

494 read_cidmap_file    = exclusive,
Section 8.3: data processing callbacks.
495 process_input_buffer = data,
496 process_output_buffer = data,
497 process_jobname      = data,
Section 8.4: node list processing callbacks.
498 contribute_filter    = simple,
499 buildpage_filter     = simple,
500 build_page_insert    = exclusive,
501 pre_linebreak_filter = list,
502 linebreak_filter     = list,
503 append_to_vlist_filter = list,
504 post_linebreak_filter = list,
505 hpack_filter         = list,
506 vpack_filter         = list,
507 hpack_quality        = list,
508 vpack_quality        = list,
509 pre_output_filter    = list,
510 process_rule         = list,
511 hyphenate            = simple,
512 ligaturing           = simple,
513 kerning              = simple,
514 insert_local_par     = simple,
515 mlist_to_hlist       = list,
Section 8.5: information reporting callbacks.
516 pre_dump             = simple,
517 start_run            = simple,
518 stop_run             = simple,
519 start_page_number    = simple,
520 stop_page_number     = simple,
521 show_error_hook      = simple,
522 show_warning_message = simple,
523 show_error_message   = simple,
524 show_lua_error_hook  = simple,
525 start_file           = simple,
526 stop_file            = simple,
527 call_edit            = simple,
528 finish_synctex_callback = simple,
Section 8.6: PDF-related callbacks.
529 finish_pdffile = data,
530 finish_pdfpage = data,
Section 8.7: font-related callbacks.
531 define_font      = exclusive,
532 glyph_not_found  = exclusive,
533 glyph_stream_provider = exclusive,
534 }
535 luatexbase.callbacktypes=callbacktypes

```

**callback.register** Save the original function for registering callbacks and prevent the original being used. The original is saved in a place that remains available so other more sophisticated code can override the approach taken by the kernel if desired.

```

536 local callback_register = callback_register or callback.register
537 function callback.register()
538   luatexbase_error("Attempt to use callback.register() directly\n")
539 end

```

### 5.17.2 Handlers

The handler function is registered into the callback when the first function is added to this callback's list. Then, when the callback is called, the handler takes care of running all functions in the list. When the last function is removed from the callback's list, the handler is unregistered.

More precisely, the functions below are used to generate a specialized function (closure) for a given callback, which is the actual handler.

The way the functions are combined together depends on the type of the callback. There are currently 4 types of callback, depending on the calling convention of the functions the callback can hold:

**simple** is for functions that don't return anything: they are called in order, all with the same argument;

**data** is for functions receiving a piece of data of any type except node list head (and possibly other arguments) and returning it (possibly modified): the functions are called in order, and each is passed the return value of the previous (and the other arguments untouched, if any). The return value is that of the last function;

**list** is a specialized variant of *data* for functions filtering node lists. Such functions may return either the head of a modified node list, or the boolean values **true** or **false**. The functions are chained the same way as for *data* except that for the following. If one function returns **false**, then **false** is immediately returned and the following functions are *not* called. If one function returns **true**, then the same head is passed to the next function. If all functions return **true**, then **true** is returned, otherwise the return value of the last function not returning **true** is used.

**exclusive** is for functions with more complex signatures; functions in this type of callback are *not* combined: An error is raised if a second callback is registered..

Handler for **data** callbacks.

```

540 local function data_handler(name)
541   return function(data, ...)
542     for _,i in ipairs(callbacklist[name]) do
543       data = i.func(data,...)
544     end
545     return data
546   end
547 end

```

Handler for **exclusive** callbacks. We can assume `callbacklist[name]` is not empty: otherwise, the function wouldn't be registered in the callback any more.

```

548 local function exclusive_handler(name)
549   return function(...)

```

```

550     return callbacklist[name][1].func(...)
551 end
552 end

Handler for list callbacks.
553 local function list_handler(name)
554     return function(head, ...)
555         local ret
556         local alltrue = true
557         for _,i in ipairs(callbacklist[name]) do
558             ret = i.func(head, ...)
559             if ret == false then
560                 luatexbase_warning(
561                     "Function '" .. i.description .. "' returned false\n"
562                     .. "in callback '" .. name .. "'")
563             )
564             break
565         end
566         if ret ~= true then
567             alltrue = false
568             head = ret
569         end
570     end
571     return alltrue and true or head
572 end
573 end

Handler for simple callbacks.
574 local function simple_handler(name)
575     return function(...)
576         for _,i in ipairs(callbacklist[name]) do
577             i.func(...)
578         end
579     end
580 end

    Keep a handlers table for indexed access.
581 local handlers = {
582     [data]      = data_handler,
583     [exclusive] = exclusive_handler,
584     [list]      = list_handler,
585     [simple]     = simple_handler,
586 }

```

### 5.17.3 Public functions for callback management

Defining user callbacks perhaps should be in package code, but impacts on `add_to_callback`. If a default function is not required, it may be declared as `false`. First we need a list of user callbacks.

```

587 local user_callbacks_defaults = { }

```

`create_callback` The allocator itself.

```

588 local function create_callback(name, ctype, default)
589     if not name or name == ""
590     or not ctype or ctype == ""

```

```

591 then
592     luatexbase_error("Unable to create callback:\n" ..
593                     "valid callback name and type required")
594 end
595 if callbacktypes[name] then
596     luatexbase_error("Unable to create callback '" .. name ..
597                     "':\ncallback is already defined")
598 end
599 if default ~= false and type (default) ~= "function" then
600     luatexbase_error("Unable to create callback '" .. name ..
601                     "':\ndefault is not a function")
602 end
603 user_callbacks_defaults[name] = default
604 callbacktypes[name] = types[ctype]
605 end
606 luatexbase.create_callback = create_callback

```

call\_callback Call a user defined callback. First check arguments.

```

607 local function call_callback(name,...)
608     if not name or name == "" then
609         luatexbase_error("Unable to create callback:\n" ..
610                         "valid callback name required")
611     end
612     if user_callbacks_defaults[name] == nil then
613         luatexbase_error("Unable to call callback '" .. name
614                         .. "':\nunknown or empty")
615     end
616     local l = callbacklist[name]
617     local f
618     if not l then
619         f = user_callbacks_defaults[name]
620         if l == false then
621             return nil
622         end
623     else
624         f = handlers[callbacktypes[name]](name)
625     end
626     return f(...)
627 end
628 luatexbase.call_callback=call_callback

```

add\_to\_callback Add a function to a callback. First check arguments.

```

629 local function add_to_callback(name, func, description)
630     if not name or name == "" then
631         luatexbase_error("Unable to register callback:\n" ..
632                         "valid callback name required")
633     end
634     if not callbacktypes[name] or
635        type(func) ~= "function" or
636        not description or
637        description == "" then
638         luatexbase_error(
639             "Unable to register callback.\n\n"
640             .. "Correct usage:\n"

```

```

641         .. "add_to_callback(<callback>, <function>, <description>)"
642     )
643 end

```

Then test if this callback is already in use. If not, initialise its list and register the proper handler.

```

644 local l = callbacklist[name]
645 if l == nil then
646     l = { }
647     callbacklist[name] = l

```

If it is not a user defined callback use the primitive callback register.

```

648     if user_callbacks_defaults[name] == nil then
649         callback_register(name, handlers[callbacktypes[name]](name))
650     end
651 end

```

Actually register the function and give an error if more than one **exclusive** one is registered.

```

652 local f = {
653     func      = func,
654     description = description,
655 }
656 local priority = #l + 1
657 if callbacktypes[name] == exclusive then
658     if #l == 1 then
659         luatexbase_error(
660             "Cannot add second callback to exclusive function\n'" ..
661             name .. "'"")
662     end
663 end
664 table.insert(l, priority, f)

```

Keep user informed.

```

665 luatexbase_log(
666     "Inserting '" .. description .. "' at position "
667     .. priority .. " in '" .. name .. "'."
668 )
669 end
670 luatexbase.add_to_callback = add_to_callback

```

**remove\_from\_callback** Remove a function from a callback. First check arguments.

```

671 local function remove_from_callback(name, description)
672     if not name or name == "" then
673         luatexbase_error("Unable to remove function from callback:\n" ..
674             "valid callback name required")
675     end
676     if not callbacktypes[name] or
677         not description or
678         description == "" then
679         luatexbase_error(
680             "Unable to remove function from callback.\n\n"
681             .. "Correct usage:\n"
682             .. "remove_from_callback(<callback>, <description>)"
683         )

```

```

684 end
685 local l = callbacklist[name]
686 if not l then
687     luatexbase_error(
688         "No callback list for '" .. name .. "'\n")
689 end

```

Loop over the callback's function list until we find a matching entry. Remove it and check if the list is empty: if so, unregister the callback handler.

```

690 local index = false
691 for i,j in ipairs(l) do
692     if j.description == description then
693         index = i
694         break
695     end
696 end
697 if not index then
698     luatexbase_error(
699         "No callback '" .. description .. "' registered for '" ..
700         name .. "'\n")
701 end
702 local cb = l[index]
703 table.remove(l, index)
704 luatexbase_log(
705     "Removing '" .. description .. "' from '" .. name .. "'."
706 )
707 if #l == 0 then
708     callbacklist[name] = nil
709     callback_register(name, nil)
710 end
711 return cb.func,cb.description
712 end
713 luatexbase.remove_from_callback = remove_from_callback

```

**in\_callback** Look for a function description in a callback.

```

714 local function in_callback(name, description)
715     if not name
716         or name == ""
717         or not callbacklist[name]
718         or not callbacktypes[name]
719         or not description then
720         return false
721     end
722     for _, i in pairs(callbacklist[name]) do
723         if i.description == description then
724             return true
725         end
726     end
727     return false
728 end
729 luatexbase.in_callback = in_callback

```

**disable\_callback** As we subvert the engine interface we need to provide a way to access this functionality.



```

730 local function disable_callback(name)
731   if(callbacklist[name] == nil) then
732     callback_register(name, false)
733   else
734     luatexbase_error("Callback list for " .. name .. " not empty")
735   end
736 end
737 luatexbase.disable_callback = disable_callback

callback_descriptions List the descriptions of functions registered for the given callback.
738 local function callback_descriptions (name)
739   local d = {}
740   if not name
741     or name == ""
742     or not callbacklist[name]
743     or not callbacktypes[name]
744   then
745     return d
746   else
747     for k, i in pairs(callbacklist[name]) do
748       d[k] = i.description
749     end
750   end
751   return d
752 end
753 luatexbase.callback_descriptions = callback_descriptions

uninstall Unlike at the TEX level, we have to provide a back-out mechanism here at the
same time as the rest of the code. This is not meant for use by anything other
than latexrelease: as such this is deliberately not documented for users!
754 local function uninstall()
755   module_info(
756     "luatexbase",
757     "Uninstalling kernel luatexbase code"
758   )
759   callback.register = callback_register
760   luatexbase = nil
761 end
762 luatexbase.uninstall = uninstall

763  $\langle$ /lua $\rangle$ 

Reset the catcode of @.
764  $\langle$ tex $\rangle$ \catcode'\@=\etacatcode\relax

```