

# 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>Ε</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>Ε</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>Ε</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>Ε</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>Ε</sub>X format, however also extracted to the file `ltluatex.tex` which may be used with older L<sup>A</sup>T<sub>Ε</sub>X formats, and with plain TeX.

<code>\newattribute</code>	<code>\newattribute{⟨attribute⟩}</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{⟨catcodetable⟩}</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{⟨function⟩}</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{⟨whatsit⟩}</code>	Defines a custom <code>\whatsit</code> , indexed from 1.
<code>\newluabytecode</code>	<code>\newluabytecode{⟨bytecode⟩}</code>	Allocates a number for Lua bytecode register, indexed from 1.
<code>\newluachunkname</code>	<code>newluachunkname{⟨chunkname⟩}</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{luatex}`. This inputs `luatex.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.
<code>new_luafunction</code>	<code>luatexbase.new_luafunction(⟨functionname⟩)</code> Returns an allocation number for a lua function for use with <code>\luafunction</code> , <code>\lateluafunction</code> , and <code>\luadef</code> , indexed from 1. The optional <code>⟨functionname⟩</code> argument is just used for logging.

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 `luatex.lua`, for example

```

local attribute_count_name = "attributetracker"
require("lualatex")

```

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( $\langle$ name $\rangle$ )`

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 Lua $\TeX$ '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 Lua $\LaTeX$  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
sist@@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.

<code>disable_callback</code>	<code>luatexbase.disable_callback(&lt;callback&gt;)</code> Sets the <code>&lt;callback&gt;</code> to <code>false</code> as described in the LuaTeX manual for the underlying <code>callback.register</code> built-in. Callbacks will only be set to <code>false</code> (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 <*2kernel | tex | latexrelease>
2 <2kernel | 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

```

Two simple L<sup>A</sup>T<sub>E</sub>X macros from `ltdfn.s.dtx` have to be defined here because `ltdfn.s.dtx` is not loaded yet when `ltluatex.dtx` is executed.

```

11 \long\def\@gobble#1{}
12 \long\def\@firstofone#1{#1}

```

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

```

13 <*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.

```

14 \directlua{tex.enableprimitives("",tex.extraprimitives("luatex"))}
15 \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}`.

```

16 \ifx\documentclass\@undefined
17   \ifx\loccount\@undefined
18     \input{etex.src}%
19   \fi
20   \catcode'\@=11 %
21   \outer\expandafter\def\csname newfam\endcsname

```

```

22                                     {\alloc@8\fam\chardef\et@xmaxfam}
23 \else
24   \RequirePackage{etex}
25   \expandafter\def\csname newfam\endcsname
26     {\alloc@8\fam\chardef\et@xmaxfam}
27   \expandafter\let\expandafter\new@mathgroup\csname newfam\endcsname
28   \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.

```

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

```

luatex/xetex also allow more math fam.

```

30 \edef \et@xmaxfam {\ifx\Umathcode\@undefined\sixt@@n\else\ccclvi\fi}
31 \count 270=\et@xmaxregs % locally allocates \count registers
32 \count 271=\et@xmaxregs % ditto for \dimen registers
33 \count 272=\et@xmaxregs % ditto for \skip registers
34 \count 273=\et@xmaxregs % ditto for \muskip registers
35 \count 274=\et@xmaxregs % ditto for \box registers
36 \count 275=\et@xmaxregs % ditto for \toks registers
37 \count 276=\et@xmaxregs % ditto for \marks classes

```

and 256 or 16 fam. (Done above due to plain/LaTeX differences in ltuatex.)

```

38 % \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.

```

39 \expandafter\let\csname newcount\expandafter\expandafter\endcsname
40   \csname globcount\endcsname
41 \expandafter\let\csname newdimen\expandafter\expandafter\endcsname
42   \csname globdimen\endcsname
43 \expandafter\let\csname newskip\expandafter\expandafter\endcsname
44   \csname globskip\endcsname
45 \expandafter\let\csname newbox\expandafter\expandafter\endcsname
46   \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.

```

47 \chardef\e@alloc@top=65535
48 \let\e@alloc\chardef\chardef
49 \def\e@alloc#1#2#3#4#5#6{%
50   \global\advance#3\@ne
51   \e@ch@ck{#3}{#4}{#5}#1%
52   \allocationnumber#3\relax
53   \global#2#6\allocationnumber
54   \wlog{\string#6=\string#1\the\allocationnumber}}%

```

```

55 \gdef\ech@ck#1#2#3#4{%
56   \ifnum#1<#2\else
57     \ifnum#1=#2\relax
58       #1\@cclvi
59       \ifx\count#4\advance#1 10 \fi
60     \fi
61     \ifnum#1<#3\relax
62     \else
63       \errmessage{No room for a new \string#4}%
64     \fi
65   \fi}%

```

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 TeX / 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 LuaTeX 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   \@alloc@attribute@count=\z@
77 \fi
78 \def\newattribute#1{%
79   \@alloc\attribute\attributedef
80   \@alloc@attribute@count\m@ne\@alloc@top#1%
81 }

```

`\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 LuaTeX for everything else. At the end of allocation there needs to be an initialization 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   \@alloc@ccodetable@count=\z@
87 \fi
88 \def\newcatcodetable#1{%

```

```

89 \e@alloc\catcodetable\chardef
90 \e@alloc\ccodetable@count\m@ne{"8000}#1%
91 \initcatcodetable\allocationnumber
92 }

```

\catcodetable@initex Save a small set of standard tables. The Unicode data is read here in using a parser  
\catcodetable@string simplified from that in load-unicode-data: only the nature of letters needs to  
\catcodetable@latex be detected.

```

\catcodetable@atletter 93 \newcatcodetable\catcodetable@initex
94 \newcatcodetable\catcodetable@string
95 \begingroup
96 \def\setrangecatcode#1#2#3{%
97 \ifnum#1>#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>\relax
125 }%
126 \def\parseunicodedataII#1;#2;#3 First>#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 >0 %

```

```

139     \catcode"#1=11 %
140   \fi
141 }%
142 \def\parseunicodedataIV#1#2#3\relax{%
143   \read\unicoderead to \unicodedataline
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 Lua<sub>TEX</sub> 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   \e@alloc@luafunction@count=\z@
176 \fi
177 \def\newluafunction{%
178   \e@alloc@luafunction\e@alloc@chardef
179   \e@alloc@luafunction@count\m@ne\e@alloc@top
180 }

```

## 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\@alloc@whatsit@count=261
183 \@alloc@whatsit@count=\z@
184 \fi
185 \def\newwhatsit#1{%
186   \@alloc@whatsit\@alloc@chardef
187   \@alloc@whatsit@count\m@ne\@alloc@top#1%
188 }

```

## 5.7 Lua bytecode registers

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

```

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

```

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

```

## 5.9 Lua loader

Lua code loaded in the format often has to be loaded again at the beginning of every job, so we define a helper which allows us to avoid duplicated code:

```

207 \def\now@and@everyjob#1{%
208   \everyjob\expandafter{\the\everyjob
209     #1%
210   }%
211   #1%
212 }

```

Load the Lua code at the start of every job. For the conversion of T<sub>E</sub>X 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.

```

213 <2kernel>\now@and@everyjob{%
214   \begingroup

```

```

215 \attributedef\attributezero=0 %
216 \chardef \charzero =0 %

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

217 \countdef \CountZero =0 %
218 \dimendef \dimenzero =0 %
219 \mathchardef \mathcharzero =0 %
220 \muskipdef \muskipzero =0 %
221 \skipdef \skipzero =0 %
222 \toksdef \tokszero =0 %
223 \directlua{require("lualatex")}
224 \endgroup
225 (2ekernel)}
226 (latexrelease)\EndIncludeInRelease

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

```

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

```

250 (latexrelease)\IncludeInRelease{2017/01/01}%
251 (latexrelease) {\fontencoding}{TU in everyjob}%
252 (latexrelease)\fontencoding{TU}\let\encodingdefault\f@encoding
253 (latexrelease)\ifx\directlua\@undefined\else
254 (2ekernel)\everyjob\expandafter{%
255 (2ekernel) \the\everyjob
256 (*2ekernel, latexrelease)
257 \directlua{%
258 if xpcall(function ()%
259 require('luaotfload-main')%
260 end, texio.write_nl) then %
261 local _void = luaotfload.main ()%
262 else %
263 texio.write_nl('Error in luaotfload: reverting to OT1')%
264 tex.print('\string\def\string\encodingdefault{OT1}')%

```

```

265 end %
266 }%
267 \let\f@encoding\encodingdefault
268 \expandafter\let\csname ver@luaotfload.sty\endcsname\fmtversion
269 \<2ekernel, latexrelease>
270 \<latexrelease>\fi
271 \<2ekernel> }
272 \<latexrelease>\EndIncludeInRelease
273 \<latexrelease>\IncludeInRelease{0000/00/00}%
274 \<latexrelease> {\fontencoding}{TU in everyjob}%
275 \<latexrelease>\fontencoding{OT1}\let\encodingdefault\f@encoding
276 \<latexrelease>\EndIncludeInRelease
277 \<2ekernel | latexrelease>\fi
278 \</2ekernel | tex | latexrelease>

```

## 5.10 Lua module preliminaries

```

279 \<*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.

```

280 luatexbase = luatexbase or { }
281 local luatexbase = luatexbase

```

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

```

282 local string_gsub = string.gsub
283 local tex_count = tex.count
284 local tex_setattribute = tex.setattribute
285 local tex_setcount = tex.setcount
286 local texio_write_nl = texio.write_nl
287 local luatexbase_warning
288 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.

```

289 local modules = modules or { }

```

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

```

290 local function luatexbase_log(text)
291 texio_write_nl("log", text)
292 end

```

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

```

293 local function provides_module(info)
294 if not (info and info.name) then
295 luatexbase_error("Missing module name for provides_module")

```

```

296 end
297 local function spaced(text)
298     return text and (" " .. text) or ""
299 end
300 luatexbase_log(
301     "Lua module: " .. info.name
302     .. spaced(info.date)
303     .. spaced(info.version)
304     .. spaced(info.description)
305 )
306 modules[info.name] = info
307 end
308 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  $\text{T}_{\text{E}}\text{X}$ . For errors we have to make some changes. Here we give the text of the error in the  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$  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.

```

309 local function msg_format(mod, msg_type, text)
310     local leader = ""
311     local cont
312     local first_head
313     if mod == "LaTeX" then
314         cont = string_gsub(leader, ".", " ")
315         first_head = leader .. "LaTeX: "
316     else
317         first_head = leader .. "Module " .. msg_type
318         cont = "(" .. mod .. ")"
319         .. string_gsub(first_head, ".", " ")
320         first_head = leader .. "Module " .. mod .. " " .. msg_type .. ":"
321     end
322     if msg_type == "Error" then
323         first_head = "\n" .. first_head
324     end
325     if string.sub(text,-1) ~= "\n" then
326         text = text .. " "
327     end
328     return first_head .. " "
329     .. string_gsub(
330         text
331         .. "on input line "
332         .. tex.inputlineno, "\n", "\n" .. cont .. " "
333     )
334     .. "\n"
335 end

```

```

module_info Write messages.
module_warning 336 local function module_info(mod, text)
module_error

```

```

337 texio_write_nl("log", msg_format(mod, "Info", text))
338 end
339 luatexbase.module_info = module_info
340 local function module_warning(mod, text)
341   texio_write_nl("term and log", msg_format(mod, "Warning", text))
342 end
343 luatexbase.module_warning = module_warning
344 local function module_error(mod, text)
345   error(msg_format(mod, "Error", text))
346 end
347 luatexbase.module_error = module_error

```

Dedicated versions for the rest of the code here.

```

348 function luatexbase_warning(text)
349   module_warning("luatexbase", text)
350 end
351 function luatexbase_error(text)
352   module_error("luatexbase", text)
353 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.

```

354 local luaregisterbasetable = { }
355 local registermap = {
356   attributezero = "assign_attr"    ,
357   charzero      = "char_given"     ,
358   CountZero     = "assign_int"     ,
359   dimenzero     = "assign_dimen"   ,
360   mathcharzero  = "math_given"     ,
361   muskipzero    = "assign_mu_skip" ,
362   skipzero      = "assign_skip"    ,
363   tokszero      = "assign_toks"    ,
364 }
365 local createtoken
366 if tex.luatexversion > 81 then
367   createtoken = token.create
368 elseif tex.luatexversion > 79 then
369   createtoken = newtoken.create
370 end
371 local hashtokens = tex.hashtokens()
372 local luatexversion = tex.luatexversion
373 for i,j in pairs (registermap) do
374   if luatexversion < 80 then
375     luaregisterbasetable[hashtokens[i][1]] =
376       hashtokens[i][2]
377   else
378     luaregisterbasetable[j] = createtoken(i).mode
379   end
380 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

LuaTeX's have `newtoken`, and whilst `.mode` isn't currently documented, Hans Hagen pointed to this approach so we should be OK.

```

381 local registernumber
382 if luatexversion < 80 then
383   function registernumber(name)
384     local nt = hashtokens[name]
385     if(nt and luaregisterbasetable[nt[1]]) then
386       return nt[2] - luaregisterbasetable[nt[1]]
387     else
388       return false
389     end
390   end
391 else
392   function registernumber(name)
393     local nt = createtoken(name)
394     if(luaregisterbasetable[nt.cmdname]) then
395       return nt.mode - luaregisterbasetable[nt.cmdname]
396     else
397       return false
398     end
399   end
400 end
401 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.

```

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

```

## 5.14 Custom whatsit allocation

`new_whatsit` Much the same as for attribute allocation in Lua.

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

## 5.15 Bytecode register allocation

`new_bytecode` Much the same as for attribute allocation in Lua. The optional *(name)* argument is used in the log if given.

```
436 local bytecode_count_name =
437     bytecode_count_name or "e@alloc@bytecode@count"
438 local function new_bytecode(name)
439   tex_setcount("global", bytecode_count_name,
440               tex_count[bytecode_count_name] + 1)
441   if tex_count[bytecode_count_name] > 65534 then
442     luatexbase_error("No room for a new bytecode register")
443   end
444   luatexbase_log("Lua bytecode " .. (name or "") .. " = " ..
445               tex_count[bytecode_count_name])
446   return tex_count[bytecode_count_name]
447 end
448 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.

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

## 5.17 Lua function allocation

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

```
465 local luafunction_count_name =
466     luafunction_count_name or "e@alloc@luafunction@count"
467 local function new_luafunction(name)
468     tex_setcount("global", luafunction_count_name,
469         tex_count[luafunction_count_name] + 1)
470     if tex_count[luafunction_count_name] > 65534 then
471         luatexbase_error("No room for a new luafunction register")
472     end
473     luatexbase_log("Lua function " .. (name or "") .. " = " ..
474         tex_count[luafunction_count_name])
475     return tex_count[luafunction_count_name]
476 end
477 luatexbase.new_luafunction = new_luafunction
```

## 5.18 Lua callback management

The native mechanism for callbacks in LuaTeX allows only one per function. That is extremely restrictive and so a mechanism is needed to add and remove callbacks from the appropriate hooks.

### 5.18.1 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.

```
478 local callbacklist = callbacklist or { }
```

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

```
479 local list, data, exclusive, simple, reverselist = 1, 2, 3, 4, 5
480 local types = {
481     list      = list,
482     data      = data,
483     exclusive = exclusive,
484     simple    = simple,
485     reverselist = reverselist,
486 }
```

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.)

487 local callbacktypes = callbacktypes or {

Section 8.2: file discovery callbacks.

```

488 find_read_file      = exclusive,
489 find_write_file     = exclusive,
490 find_font_file      = data,
491 find_output_file    = data,
492 find_format_file    = data,
493 find_vf_file        = data,
494 find_map_file       = data,
495 find_enc_file       = data,
496 find_pk_file        = data,
497 find_data_file      = data,
498 find_opentype_file  = data,
499 find_truetype_file  = data,
500 find_type1_file     = data,
501 find_image_file     = data,

502 open_read_file      = exclusive,
503 read_font_file      = exclusive,
504 read_vf_file        = exclusive,
505 read_map_file       = exclusive,
506 read_enc_file       = exclusive,
507 read_pk_file        = exclusive,
508 read_data_file      = exclusive,
509 read_truetype_file  = exclusive,
510 read_type1_file     = exclusive,
511 read_opentype_file  = exclusive,

```

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

```

512 find_cidmap_file    = data,
513 read_cidmap_file    = exclusive,

```

Section 8.3: data processing callbacks.

```

514 process_input_buffer = data,
515 process_output_buffer = data,
516 process_jobname      = data,

```

Section 8.4: node list processing callbacks.

```

517 contribute_filter    = simple,
518 buildpage_filter     = simple,
519 build_page_insert    = exclusive,
520 pre_linebreak_filter = list,
521 linebreak_filter     = exclusive,
522 append_to_vlist_filter = exclusive,
523 post_linebreak_filter = reverselist,
524 hpack_filter         = list,
525 vpack_filter         = list,
526 hpack_quality        = list,
527 vpack_quality        = list,
528 pre_output_filter    = list,
529 process_rule         = exclusive,
530 hyphenate            = simple,

```

```

531 ligaturing          = simple,
532 kerning             = simple,
533 insert_local_par    = simple,
534 pre_mlist_to_hlist_filter = list,
535 mlist_to_hlist      = exclusive,
536 post_mlist_to_hlist_filter = reverselist,
537 new_graf            = exclusive,

```

Section 8.5: information reporting callbacks.

```

538 pre_dump            = simple,
539 start_run           = simple,
540 stop_run            = simple,
541 start_page_number   = simple,
542 stop_page_number    = simple,
543 show_error_hook     = simple,
544 show_warning_message = simple,
545 show_error_message  = simple,
546 show_lua_error_hook = simple,
547 start_file          = simple,
548 stop_file           = simple,
549 call_edit           = simple,
550 finish_synctex      = simple,
551 wrapup_run          = simple,

```

Section 8.6: PDF-related callbacks.

```

552 finish_pdffile      = data,
553 finish_pdfpage      = data,
554 page_objnum_provider = data,
555 page_order_index    = data,
556 process_pdf_image_content = data,

```

Section 8.7: font-related callbacks.

```

557 define_font          = exclusive,
558 glyph_info           = exclusive,
559 glyph_not_found      = exclusive,
560 glyph_stream_provider = exclusive,
561 make_extensible      = exclusive,
562 font_descriptor_objnum_provider = exclusive,
563 input_level_string    = exclusive,
564 }
565 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.

```

566 local callback_register = callback_register or callback.register
567 function callback.register()
568   luatexbase_error("Attempt to use callback.register() directly\n")
569 end

```

### 5.18.2 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.

**reverselist** is a specialized variant of *list* which executes functions in inverse order.

**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.

```
570 local function data_handler(name)
571   return function(data, ...)
572     for _,i in ipairs(callbacklist[name]) do
573       data = i.func(data,...)
574     end
575     return data
576   end
577 end
```

Default for user-defined **data** callbacks without explicit default.

```
578 local function data_handler_default(value)
579   return value
580 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.

```
581 local function exclusive_handler(name)
582   return function(...)
583     return callbacklist[name][1].func(...)
584   end
585 end
```

Handler for list callbacks.

```
586 local function list_handler(name)
587   return function(head, ...)
588     local ret
589     local alltrue = true
590     for _,i in ipairs(callbacklist[name]) do
591       ret = i.func(head, ...)
592       if ret == false then
593         luatexbase_warning(
594           "Function '" .. i.description .. "' returned false\n"
595           .. "in callback '" .. name .. "'")
596       )
597       return false
598     end
599     if ret ~= true then
600       alltrue = false
601       head = ret
602     end
603   end
604   return alltrue and true or head
605 end
606 end
```

Default for user-defined list and reverselist callbacks without explicit default.

```
607 local function list_handler_default()
608   return true
609 end
```

Handler for reverselist callbacks.

```
610 local function reverselist_handler(name)
611   return function(head, ...)
612     local ret
613     local alltrue = true
614     local callbacks = callbacklist[name]
615     for i = #callbacks, 1, -1 do
616       local cb = callbacks[i]
617       ret = cb.func(head, ...)
618       if ret == false then
619         luatexbase_warning(
620           "Function '" .. cb.description .. "' returned false\n"
621           .. "in callback '" .. name .. "'")
622       )
623       return false
624     end
625     if ret ~= true then
626       alltrue = false
627       head = ret
628     end
629   end
630   return alltrue and true or head
631 end
632 end
```

Handler for simple callbacks.

```
633 local function simple_handler(name)
```

```

634 return function(...)
635   for _,i in ipairs(callbacklist[name]) do
636     i.func(...)
637   end
638 end
639 end

```

Default for user-defined `simple` callbacks without explicit default.

```

640 local function simple_handler_default()
641 end

```

Keep a handlers table for indexed access and a table with the corresponding default functions.

```

642 local handlers = {
643   [data]      = data_handler,
644   [exclusive] = exclusive_handler,
645   [list]      = list_handler,
646   [reverselist] = reverselist_handler,
647   [simple]     = simple_handler,
648 }
649 local defaults = {
650   [data]      = data_handler_default,
651   [exclusive] = nil,
652   [list]      = list_handler_default,
653   [reverselist] = list_handler_default,
654   [simple]     = simple_handler_default,
655 }

```

### 5.18.3 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.

```

656 local user_callbacks_defaults = {
657   pre_mlist_to_hlist_filter = list_handler_default,
658   mlist_to_hlist = node.mlist_to_hlist,
659   post_mlist_to_hlist_filter = list_handler_default,
660 }

```

`create_callback` The allocator itself.

```

661 local function create_callback(name, ctype, default)
662   local ctype_id = types[ctype]
663   if not name or name == ""
664   or not ctype_id
665   then
666     luatexbase_error("Unable to create callback:\n" ..
667                       "valid callback name and type required")
668   end
669   if callbacktypes[name] then
670     luatexbase_error("Unable to create callback '" .. name ..
671                       "':\ncallback is already defined")
672   end
673   default = default or defaults[ctype_id]
674   if not default then

```

```

675     luatexbase_error("Unable to create callback '" .. name ..
676                       "':\ndefault is required for '" .. ctype ..
677                       "' callbacks")
678 elseif type (default) ~= "function" then
679     luatexbase_error("Unable to create callback '" .. name ..
680                       "':\ndefault is not a function")
681 end
682 user_callbacks_defaults[name] = default
683 callbacktypes[name] = ctype_id
684 end
685 luatexbase.create_callback = create_callback

```

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

```

686 local function call_callback(name,...)
687   if not name or name == "" then
688     luatexbase_error("Unable to create callback:\n" ..
689                       "valid callback name required")
690   end
691   if user_callbacks_defaults[name] == nil then
692     luatexbase_error("Unable to call callback '" .. name
693                       .. "':\nunknown or empty")
694   end
695   local l = callbacklist[name]
696   local f
697   if not l then
698     f = user_callbacks_defaults[name]
699   else
700     f = handlers[callbacktypes[name]](name)
701   end
702   return f(...)
703 end
704 luatexbase.call_callback=call_callback

```

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

```

705 local function add_to_callback(name, func, description)
706   if not name or name == "" then
707     luatexbase_error("Unable to register callback:\n" ..
708                       "valid callback name required")
709   end
710   if not callbacktypes[name] or
711     type(func) ~= "function" or
712     not description or
713     description == "" then
714     luatexbase_error(
715       "Unable to register callback.\n\n"
716       .. "Correct usage:\n"
717       .. "add_to_callback(<callback>, <function>, <description>)"
718     )
719   end

```

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

```

720   local l = callbacklist[name]
721   if l == nil then

```

```

722     l = { }
723     callbacklist[name] = l

```

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

```

724     if user_callbacks_defaults[name] == nil then
725         callback_register(name, handlers[callbacktypes[name]](name))
726     end
727 end

```

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

```

728     local f = {
729         func      = func,
730         description = description,
731     }
732     local priority = #l + 1
733     if callbacktypes[name] == exclusive then
734         if #l == 1 then
735             luatexbase_error(
736                 "Cannot add second callback to exclusive function\n" ..
737                 name .. "'")
738         end
739     end
740     table.insert(l, priority, f)

```

Keep user informed.

```

741     luatexbase_log(
742         "Inserting '" .. description .. "' at position "
743         .. priority .. " in '" .. name .. "'")
744     )
745 end
746 luatexbase.add_to_callback = add_to_callback

```

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

```

747 local function remove_from_callback(name, description)
748     if not name or name == "" then
749         luatexbase_error("Unable to remove function from callback:\n" ..
750             "valid callback name required")
751     end
752     if not callbacktypes[name] or
753         not description or
754         description == "" then
755         luatexbase_error(
756             "Unable to remove function from callback.\n\n"
757             .. "Correct usage:\n"
758             .. "remove_from_callback(<callback>, <description>)"
759         )
760     end
761     local l = callbacklist[name]
762     if not l then
763         luatexbase_error(
764             "No callback list for '" .. name .. "'\n")
765     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.

```

766 local index = false
767 for i,j in ipairs(l) do
768   if j.description == description then
769     index = i
770     break
771   end
772 end
773 if not index then
774   luatexbase_error(
775     "No callback '" .. description .. "' registered for '" ..
776     name .. "'\n")
777 end
778 local cb = l[index]
779 table.remove(l, index)
780 luatexbase_log(
781   "Removing '" .. description .. "' from '" .. name .. "'."
782 )
783 if #l == 0 then
784   callbacklist[name] = nil
785   if user_callbacks_defaults[name] == nil then
786     callback_register(name, nil)
787   end
788 end
789 return cb.func,cb.description
790 end
791 luatexbase.remove_from_callback = remove_from_callback

```

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

```

792 local function in_callback(name, description)
793   if not name
794     or name == ""
795     or not callbacklist[name]
796     or not callbacktypes[name]
797     or not description then
798     return false
799   end
800   for _, i in pairs(callbacklist[name]) do
801     if i.description == description then
802       return true
803     end
804   end
805   return false
806 end
807 luatexbase.in_callback = in_callback

```

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

```

808 local function disable_callback(name)
809   if(callbacklist[name] == nil) then
810     callback_register(name, false)
811   else
812     luatexbase_error("Callback list for '" .. name .. "' not empty")
813   end
814 end

```

```
815 luatexbase.disable_callback = disable_callback
```

**callback\_descriptions** List the descriptions of functions registered for the given callback.

```
816 local function callback_descriptions (name)
817   local d = {}
818   if not name
819     or name == ""
820     or not callbacklist[name]
821     or not callbacktypes[name]
822   then
823     return d
824   else
825     for k, i in pairs(callbacklist[name]) do
826       d[k] = i.description
827     end
828   end
829   return d
830 end
831 luatexbase.callback_descriptions = callback_descriptions
```

**uninstall** Unlike at the T<sub>E</sub>X 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!

```
832 local function uninstall()
833   module_info(
834     "luatexbase",
835     "Uninstalling kernel luatexbase code"
836   )
837   callback.register = callback_register
838   luatexbase = nil
839 end
840 luatexbase.uninstall = uninstall
```

**mlist\_to\_hlist** To emulate these callbacks, the “real” `mlist_to_hlist` is replaced by a wrapper calling the wrappers before and after.

```
841 callback_register("mlist_to_hlist", function(head, display_type, need_penalties)
842   local current = call_callback("pre_mlist_to_hlist_filter", head, display_type, need_penalties)
843   if current == false then
844     flush_list(head)
845     return nil
846   elseif current == true then
847     current = head
848   end
849   current = call_callback("mlist_to_hlist", current, display_type, need_penalties)
850   local post = call_callback("post_mlist_to_hlist_filter", current, display_type, need_penalties)
851   if post == true then
852     return current
853   elseif post == false then
854     flush_list(current)
855     return nil
856   end
857   return post
858 end)
```

859 `</lua>`

Reset the catcode of @.

860 `<tex>\catcode'\@=\etatcatcode\relax`