

The file `phddoc.dtx` for use with  $\text{\LaTeX} 2_{\varepsilon}$ .\*

It contains the code for `phddoc.cls`

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# STNETNOC FO ELBAT

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section  
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# 1

## The LateX Kernel

In antiquity men and women saw each other as different; accordingly, they developed complex taxonomies (philosophical explanations) for understanding anatomical, physiological, emotional, and rational differences.

Some of these differences seem profoundly odd to us moderns. Modern discussions about erotic art have often concerned the place of women: to what extent are they objects of social manipulation, to what extent can they be subjects?



He who would eat the kernel, must crack the shell. [Lat., *Qui e nuce nucleum esse vult, frangat nucem.*]

Plautus

$\text{\LaTeX}$  is the batteries of  $\text{\TeX}$ . It has given authors the ability to write documents easily and in a consistent way. It has also provided package writers with endless nights of work trying to figure out how things work. In this chapter we will describe briefly the workings of  $\text{\LaTeX}$  and the areas where one could use it for improvements. The best source for how the  $\text{\LaTeX}$  kernel works is  $\text{\LaTeX}$  itself and the publication that comes with it [sourc2e.pdf](#).

The original developer of  $\text{\LaTeX}$  was Leslie Lamport. Lamport who is now a recipient of the Turing award, described his philosophy for document production in a paper *Document Production: Visual or Logical?*, presented before the ACM in 1987. ([lampert1987](#))

Although many developers have criticized the original code it is an amazing fact that it has endured. Although in today's terms the system cannot be considered pluggable, it was certainly extensible and the fact that  $\text{\TeX}$  provides the means to write macros on the fly, the main effort of the  $\text{\LaTeX}$  system was to provide the basic structure for the development of styles (now called classes).

The code was and is well documented and many of the comments are from the first system. I have spent many an evening thinking that analyzing  $\text{latex}$  code, should be mandatory in modern computer classes to instill good discipline in being economical with code and for discovering the right amount of abstraction before designing programming and delving into code.

## 1.1 Idiomatic LaTeX programming

My primary reason for recasting the listing of the LaTeX kernel code was educational. Programming in any language has its idioms and the only way to learn it is by reading other people's programs. Also I am not aware of any book that deals with LaTeX as a programming framework rather than a typesetting framework.

Of course the ultimate reason why LaTeX exists is to typeset documents. The kernel provides the structure and the necessary macros to enable the definition of the LaTeX classes such as books.

Most of the write-up is straight from the kernel files. Now and then I have added a bit of extra explanations, so the credit belongs to the LaTeX Team and to Leslie Lamport. Any mistakes are mine.

### Variable and function names

1. First and foremost use of @ to avoid conflict between user names and internal control sequences. As a prefix: `\@latexerror`. As a suffix to mark auxiliary macros such as `\newmathalphabet@@` or `\newmathalphabet@@@`. When used as a suffix it mostly avoids prefixes. To separate the words in a variable `\scan@fontshape`, `\end@float`.
2. Variables and macro names are mostly in lowercase. If they do not have a @, expected to be used by authors or package writers. `\topmargin`,

`\texttheight`. Occassionaly uper and lower cased.

3. If a macro name had o use @ `\hb@xt@`.
4. Usage of macros for common numbers `\@ne`, `\@cc@v`, `\z@`.
5. Usage of scatch macros and registers. This caused me a lot of grief when I was learning. `\@tempa`, `\@tempboxa`.
6. Usage of `\@@` as a prefix to TeX primitives, `\@@par`, `\@@input`, `\@@end`.

There is no consistency in the convention, which is understable, so the above are just indicative.

## Errors

1. Error trapping, by checking if a command is defined, allowed to be defined etc, before defining it. This partially overcomes the namespacing problems, at least until the point of definitions.

## Use of lists

1. Use of lists extensively. There are three types of lists used. The first one are straight from the plain TeX code, whereas the second and third types were developed by the LATEX Team. Some go to the initial code by Lamport.

```
\def\@onlypreamble#1{%
  \expandafter\gdef\expandafter\@preamblecmds {%
    \expandafter{%
      \expandafter\do#1}%
    }%
  }%
```

Comma delimited lists are used in numerous places. These are normally constructed using special commands. For example:

```
\def\@addtolist#1{\xdef\@filelist{\@filelist,#1}}
```

Iterating through the list can get complicated but one can use a `\@for` loop.

## User interface

1. The kernel tries to provide user commands that have semantic meaning. An extreme example is `\install@mathalphabet` where it is let to `\gdef`.

```
\let\install@mathalphabet\gdef
```

## Frugality

1. The use of scratch variables for example `\@tempboxa` is an amazing example of what I call code thriftiness. Firstly there is only one scratch box register ad is used everywhere from the float and output routines to the picture environment. Scary sometimes, that a small mishap somwhere can case chaos to a far off land.
2. Undefining variable sthat are no longer required `\@onlypreamble` type of commands.

## Backward compatibility

### Stability

## 1.2 Code Organization.

The **LATEX** source code is distributed in a number of **.dtx** files. These are saved in files **a.z** and files **A-Z**. The source files are documented in **source2e**, just **texdoc source2e** to read it.

What I am describing here, is a step by step analysis of the kernel code, supplemented by additional materials, in order to provide an understanding of the inner workings.

Filename	Description	Reference
a ltxdirchk.dtx		
b lplain.dtx	Definitions from PlainTeX	Chapter 2, page 37
c ltvers.dtx	Version information	Chapter 3, page 58
d ltdefns.dtx	Definitions	Chapter 4, pg 62
e ltalloc.dtx	Allocations	Chapter 5, page 85
f ltcntrl.dtx	Control structures	Chapter 6, page 88
g lterror.dtx	Error handling	Chapter 7, page 92
h ltpar.dtx	Paragraph related	Chapter ??, page ??
i ltspace.dtx	Spacing commands	Chapter 8, page 104
j ltlogos.dtx	Logos	Chapter 9, page 119
k files.dtx	File handling	Chapter 10, page 121
l ltoutenc.dtx	Output encodings	Chapter 11, page 133
m ltcounds.dtx	Counters	Chapter 12, page 174
n ltlenghts	Length macros	Chapter 13, page [181]
o ltfssbas.dtx	Low level font commands	Chapter 14, page 186
p ltfssrc.dtx	Tracing fonts	Chapter 15, page 205
q ltfsscmp.dtx		Chapter 20, page 266
s ltfssini.dtx	NFSS font initialization	Chapter 17, page 240
t fontdef.dtx	font definitions	Chapter 18, page 246
u preload.dtx	font preloading	Chapter 19, page 261
v ltfntcmd.dtx	font commands	266
w ltpageno.dtx	page numbers	Chapter 21, page [273]
x ltref.dtx	References	Chapter 22, page 275
y ltmiscen.dtx	Miscellaneous	Chapter 23, page 281
z ltmath.dtx	Math	Chapter 24, page 290
A ltlists.dtx	Lists	Chapter 25, page 25
B ltboxes.dtx	Boxes	Chapter 26, page 331
C ltab.dtx	Tabular and tabbing	Chapter 27, page 346
D ltpictur.dtx	Picture	Chapter 29, page 363
E ltthm.dtx	Theorems	Chapter 30, page 379
F ltsect.dtx	Sectioning	Chapter 31, page 31
G ltfloat.dtx	Floats	Chapter 32, page 32
H ltidxglo.dtx	Indices & Glossaries	Chapter 35, page 428
I ltbibl.dtx	Bibliography	Chapter 36, page 431
J ltpage.dtx	Page	Chapter 37, page [436]

K	ltoutput.dtx	Output routine	Chapter 39, page 39
L	ltclass.dtx	Class and package definitions	Chapter 42, page [531]
M	lthyphen.dtx	Hyphenation	Chapter 43, page [554]
N	ltfinal.dtx	Final	Chapter 44, page 557
O	ltluatex	LuaTeX support	Chapter 45, page [569]

## 1.3 Autoloading

When LaTeX2e was released, personal computers had much less power than nowadays. Moreover, TeX was often compiled with a rather small amount of available memory.<sup>1</sup>

The inclusion of the New Font Selection Scheme (NFSS2), in particular, posed some challenges when LaTeXing big documents. So the developers provided a solution for people with limited memory available: if the autoload option was set during the extraction of `latex.ltx` from the sources, not all the kernel was included in the format which was then produced by running `initex` on this file: some parts of it were included "on demand", for instance the code for the picture environment.

Support of the autoload feature was introduced in the June 1995 release of the LaTeX kernel update and dropped in December 2003.

You can still find a description of this feature in the file

```
<TEX DIST ROOT>/doc/latex/base/autoload.txt
```

On some small systems (perhaps most noticeably emTeX for PCs if your machine is unable to use the TeX386 version) LaTeX uses up a large amount of the memory available to TeX, leaving very little for storage of any further commands, complex text (such as tables), floats or cross references that may occur in a typical document. Note that these limits are built into the TeX executable and do not directly correspond to any physical memory that your machine has installed.

In order to help with this problem, we have produced an experimental configuration of LaTeX in which certain functions are not predefined in the format, but are loaded automatically from a style file the first time they are used. This saves a lot of memory in the case that a document does not use these features.

In this release two environments are 'auto-loaded' in this way, 'picture' and 'tabbing', as are various bits of internal code used in error handling, font loading and advanced page makeup.

`autopict.sty` source for picture mode  
`autotabg.sty` source for tabbing environment  
`autoerr.sty` texts of most LaTeX error commands  
`autofss1.sty` little used internal font selection commands  
`autoout1.sty` source for `\enlargethispage` and related commands.

## 1.4 File a `ltdirchk.dtx`

This file implements the semi-automatic determination of various system dependent parts of the initialisation. The actual definitions may be placed in a file

<sup>1</sup><http://tex.stackexchange.com/questions/38436/what-is-autoload>

**texsys.cfg.** Thus for operating systems for which the tests here do not result in acceptable settings, a ‘hand written’ texsys.cfg may be produced. Current directoty `\@currdir`.

**\input@path** For most common operating sytsems is let to undefined.

The routines define a useful macro to parse file name paths:

#### Example 4.1 Parsing directories

```
1 \filename@parse{./test/some other paths/path/tex.jpg}
2
3 \filename@area
4
5 \filename@base,
6
7 \filename@ext

./test/some other paths/path/
tex,
jpg
```

The `\@TeXversion` is only defined for very old versions of **TeX**, on a reasonable modern distribution, it should be let to undefined.

# 2

## Plain TeX

In antiquity men and women saw each other as different; accordingly, they developed complex taxonomies (philosophical explanations) for understanding anatomical, physiological, emotional, and rational differences.

Some of these differences seem profoundly odd to us moderns.

Modern discussions about erotic art have often concerned the place of women: to what extent are they objects of social manipulation, to what extent can they be subjects?



**LATEX** includes almost all of the functionality of Knuth's original 'Basic Macros'. That is, the plain **TEX** format described in Appendix B of the **TEXBook**. However, some of the user commands are not much use so, in order to save memory, we may remove them from the kernel into a package. Here is a list of the commands that may be removed (PROBABLY NOT COMPLETE).

```
\magstep     \magstephalf
\mathhexbox
\vglue      \vgl@
\hglue      \hgl@
```

This file is by now very small as most of it has been moved to more appropriate kernel files: it may disappear completely one day.

**LATEX** font definitions are done using NFSS2 so none of PLAIN's font definitions are in **LATEX**.

**LATEX** has its own tabbing environment, so PLAIN's is disabled.

**LATEX** uses its own output routine, so most of the plain one was removed.

```
9 %<*2ekernel>
10 \catcode`{\=1 % left brace is begin-group character
11 \catcode`}=\=2 % right brace is end-group character
12 \catcode`\$=3 % dollar sign is math shift
13 \catcode`\&=4 % ampersand is alignment tab
14 \catcode`\#=6 % hash mark is macro parameter character
15 \catcode`\^=7 % circumflex and uparrow are for superscripts
16 \catcode`\_=8 % underline and downarrow are for subscripts
17 \catcode`\^\^I=10 % ascii tab is a blank space
18 \chardef\active=13 \catcode`\~=\active % tilde is active
19 \catcode`\^\^L=\active \def^\^L{\par}% ascii form-feed is \par

20 \message{catcodes,}
```

Here is a list of the characters that have been specially catcoded:

```
21 \def\dospecials{\do\ \do\\ \do{\{} \do{\}} \do\$ \do\&%
22   \do\# \do\^ \do\_ \do%\ \do\~}
```

(not counting ascii null, tab, linefeed, formfeed, return, delete) Each symbol in the list is preceded by **\do**, which can be defined if you want to do something to every item in the list.

We make @ signs act like letters, temporarily, to avoid conflict between user names and internal control sequences of plain format.

```
23 \catcode`@=11
```

To make the plain macros more efficient in time and space, several constant values are declared here as control sequences. If they were changed, anything could happen; so they are private symbols.

```
\@ne    Small constants are defined using \chardef.
\@tw@  24 \chardef \@ne=1
\thr@@ 25 \chardef \tw@=2
@sixt@@n 26 \chardef \thr@@=3
\@cclv  27 \chardef \sixt@@n=16
         28 \chardef \@cclv=255
```

*(End definition for \@ne and others.)*

\@cclvi Constants above 255 defined using \mathchardef.

```

\@m 29 \mathchardef\@cclvi=256
\@M 30 \mathchardef\@m=1000
\@MM 31 \mathchardef\@M=10000
32 \mathchardef\@MM=20000

```

(End definition for \@cclvi and others.)

## 2.1 Allocation of registers

Here are macros for the automatic allocation of \count, \box, \dimen, \skip, \muskip, and \toks registers, as well as \read and \write stream numbers, \fam codes, \language codes, and \insert numbers.

33 \message{registers,}

When a register is used only temporarily, it need not be allocated; grouping can be used, making the value previously in the register return after the close of the group. The main use of these macros is for registers that are defined by one macro and used by others, possibly at different nesting levels. All such registers should be defined through these macros; otherwise conflicts may occur, especially when two or more macro packages are being used at the same time.

New counters are allocated starting with 23, 24, etc. Other registers are allocated starting with 10. This leaves 0 through 9 for the user to play with safely, except that counts 0 to 9 are considered to be the page and subpage numbers (since they are displayed during output). In this scheme, \count 10 always contains the number of the highest-numbered counter that has been allocated, \count 14 the highest-numbered box, etc. Inserts are given numbers 254, 253, etc., since they require a \count, \dimen, \skip, and \box all with the same number; \count 20 contains the lowest-numbered insert that has been allocated. Of course, \box255 is reserved for \output; \count255, \dimen255, and \skip255 can be used freely.

It is recommended that macro designers always use \global assignments with respect to registers numbered

1, 3, 5, 7, 9,

and always non-\global assignments with respect to registers

0, 2, 4, 6, 8, 255.

This will prevent “save stack buildup” that might otherwise occur.

```

34 \count10=22 % allocates \count registers 23, 24, ...
35 \count11=9 % allocates \dimen registers 10, 11, ...
36 \count12=9 % allocates \skip registers 10, 11, ...
37 \count13=9 % allocates \muskip registers 10, 11, ...
38 \count14=9 % allocates \box registers 10, 11, ...
39 \count15=9 % allocates \toks registers 10, 11, ...
40 \count16=-1 % allocates input streams 0, 1, ...
41 \count17=-1 % allocates output streams 0, 1, ...
42 \count18=3 % allocates math families 4, 5, ...
43 \count19=0 % allocates \language codes 1, 2, ...
44 \count20=255 % allocates insertions 254, 253, ...

```

\insc@unt  
\allocationnumber The insertion counter and most recent allocation.

```

45 \countdef\insc@unt=20
46 \countdef\allocationnumber=21

(End definition for \insc@unt and \allocationnumber.)

\m@ne
The constant -1.

47 \countdef\m@ne=22 \m@ne=-1

\wlog Write on log file (only)
48 \def\wlog{\immediate\write\m@ne}

(End definition for \wlog.)

\count@ Here are abbreviations for the names of scratch registers that don't need to be
\dimen@ allocated.

\dimen@i 49 \countdef\count@=255
\dimen@ii 50 \dimendef\dimen@=0
\skip@ 51 \dimendef\dimen@i=1 % global only
\toks@ 52 \dimendef\dimen@ii=2
      53 \skipdef\skip@=0
      54 \toksdef\toks@=0

(End definition for \count@ and others.)

\newdimen Now, we define \newcount, \newbox, etc. so that you can say \newcount\foo
\newskip and \foo will be defined (with \countdef) to be the next counter.
\newmuskip To find out which counter \foo is, you can look at \allocationnumber.
\newbox Since there's no \boxdef command, \chardef is used to define a \newbox,
\newread \newinsert, \newfam, and so on.
\newwrite 55 %</2ekernel>
\newlanguage 56 %<2ekernel|latexrelease>
57 %<latexrelease>\IncludeInRelease{2015/01/01}%
58 %<latexrelease>           {\newcount}{Extended }
      \Allocation{%
59 \def\newcount {\e@alloc\count \countdef \c{\count10}\insc@unt\float@count}
60 \def\newdimen {\e@alloc\dimen \dimendef \c{\count11}\insc@unt\float@count}
61 \def\newskip {\e@alloc\skip \skipdef \c{\count12}\insc@unt\float@count}
62 \def\newmuskip
      {\e@alloc\muskip\muskipdef{\count13}\m@ne\e@alloc@top}
63
64 \def\newbox {\e@alloc\box
65   {\ifnum\allocationnumber<\@cclvi
66     \expandafter\chardef
67   \else
68     \expandafter\@alloc@chardef
69   \fi}
70   {\count14}\insc@unt\float@count}
71 \def\newtoks {\e@alloc\toks \c\toksdef{\count15}\m@ne\e@alloc@top}
72 \def\newread {\e@alloc\read \chardef{\count16}\m@ne\sixt@n}

```

```

73 \ifx\directlua@undefined
74   \def\newwrite {\e@alloc\write }
75   \chardef{\count17}\m@ne\sixt@@n}
76 \else
77   \def\newwrite {\e@alloc\write
78     {\ifnum\allocationnumber=18
79       \advance\count17@ne
80       \allocationnumber\count17 %
81     \fi
82     \global\chardef}%
83     {\count17}%
84     \m@ne
85     {128}}
86 \fi
87 \def\new@mathgroup
88   {\e@alloc\mathgroup\chardef{\count18}\m@ne\mathgroup@top}
89 \let\newfam\new@mathgroup
90 \ifx\directlua@undefined
91   \def\newlanguage {\e@alloc\language }
92   \chardef{\count19}\m@ne@cclvi}
93 \else
94   \def\newlanguage {\e@alloc\language }
95   \chardef{\count19}\m@ne{16384}}
96 \fi
97 %</2ekernel|latexrelease>

  \newcount{cmd}

98 %<latexrelease>\EndIncludeInRelease
99 %<latexrelease>\IncludeInRelease{0000/00/00}%
100 %<latexrelease>          {\newcount}{Extended }%
101   {\Allocation}%
102 \def\newcount{\alloc@0\count\countdef\insc@unt}
103 \def\newdimen{\alloc@1\dimen\dimendef\insc@unt}
104 \def\newskip{\alloc@2\skip\skipdef\insc@unt}
105 \def\newmuskip{\alloc@3\muskip\muskipdef@cclvi}
106 \def\newbox{\alloc@4\box\chardef\insc@unt}
107 \def\newtoks{\alloc@5\toks\toksdef@cclvi}
108 \def\newread{\alloc@6\read\chardef\sixt@@n}
109 \def\newwrite{\alloc@7\write\chardef\sixt@@n}
110 \def\new@mathgroup{\alloc@8\fam\chardef\sixt@@n}
111 \def\newlanguage{\alloc@9\language\chardef@cclvi}
112 \let\newfam\new@mathgroup
113 %<latexrelease>\EndIncludeInRelease

```

(End definition for `\newdimen` and others.)

`\e@alloc@chardef` The upper limit of extended registers, which leaves this number (eg `\dimen32767`) always unallocated by these macros. cf traditional `\dimen255`.

`\e@alloc@top`

```

110 %<2ekernel|latexrelease>
111 %<latexrelease>\IncludeInRelease{2015/01/01}%
112 %<latexrelease>          {\e@alloc@chardef}{Extended }%
113   {\Allocation}%

```

```

113 \ifx\directlua@undefined
114   \ifx\widowpenalties@undefined
115     \mathchardef\@alloc@top=255
116     \let\@alloc@chardef\mathchardef
117   \else
118     \mathchardef\@alloc@top=32767
119     \let\@alloc@chardef\mathchardef
120   \fi
121 \else
122   \chardef\@alloc@top=65535
123   \let\@alloc@chardef\mathchardef
124 \fi
125 %</2ekernel|latexrelease>
126 %<latexrelease>\EndIncludeInRelease
127 %<latexrelease>\IncludeInRelease{0000/00/00}%
128 %<latexrelease>          {\e@alloc@chardef}{Extended }%
129 %<latexrelease>\let\@alloc@top@\undefined
130 %<latexrelease>\let\@alloc@chardef@\undefined
131 %<latexrelease>\EndIncludeInRelease

(End definition for \e@alloc@chardef and \e@alloc@top.)

132 %<*2ekernel|latexrelease>
133 %<latexrelease>\IncludeInRelease{2015/01/01}%
134 %<latexrelease>          {\e@mathgroup@top}{Extended }%
135 %<*2ekernel|latexrelease>
136 %<*2ekernel|latexrelease>
137 %<*2ekernel|latexrelease>
138 %<*2ekernel|latexrelease>
139 %<*2ekernel|latexrelease>
140 %<*2ekernel|latexrelease>
141 %<*2ekernel|latexrelease>
142 %<*2ekernel|latexrelease>
143 %<*2ekernel|latexrelease>
144 %<*2ekernel|latexrelease>
145 %<*2ekernel|latexrelease>

```

**\e@alloc** A modified version of \alloc@ that takes the count register rather than just the final digit of its number (assuming \count1x). It also has an extra argument to give the top of the extended range.

```
#1 #2      #3      #4      #5      #6
```

```
\e@alloc type defcmd current top extended-top newname
```

Note that if just a single allocation range is required (not omitting a range up to 255 for inserts) then –1 should be used for the first upper bound argument, #4.

```

146 %<*2ekernel|latexrelease>
147 %<*2ekernel|latexrelease>

```

```

148 \def\@alloc#1#2#3#4#5#6{%
149   \global\advance#3\@ne
150   \e@ch@ck{#3}{#4}{#5}#1%
151   \allocationnumber#3\relax
152   \global#2#6\allocationnumber
153   \wlog{\string#6=\string#1\the\allocationnumber}}%
154 %</2ekernel|latexrelease>
155 %<latexrelease>\EndIncludeInRelease
156 %<latexrelease>\IncludeInRelease{0000/00/00}{\e@alloc}{Extended } %
157 %<latexrelease>\let\@alloc@\undefined
158 %<latexrelease>\EndIncludeInRelease
159 %<*2ekernel>

(End definition for \@alloc.)
```

\e@ch@ck Extended check command. If the first range is exceeded, bump to 256 (or 266 for counts) Allocate matching registers from the top of the extended range and add to \@freelist.

```

160 %</2ekernel>
161 %<*2ekernel|latexrelease>
162 %<latexrelease>\IncludeInRelease{2015/10/01}
163 %<latexrelease>          {\e@ch@ck}{Extended } %
164 %<*2ekernel>           Allocation (checking)}%
165 \gdef\@ch@ck#1#2#3#4{%
166   \ifnum#1<#2\else
```

If we've reached the classical top limit, bump to 256 or 266 for counts (count 256–265 are reserved by the allocation system). Use global assignment when switching to extended range

```

166   \ifnum#1=#2\relax
167     \global#1\@cclvi
168     \ifx\count#4\global\advance#1 10 \fi
169   \fi
```

Check we are below the extended limit. Add \string in case argument is not an unexpandable primitive

```

170   \ifnum#1<#3\relax
171   \else
172     \errmessage{No room for a new \string#4}%
173   \fi
174 \fi}%
175 %<latexrelease>\EndIncludeInRelease
176 %<latexrelease>\IncludeInRelease{2015/01/01}%
177 %<latexrelease>          {\e@ch@ck}{Extended } %
178 %<*2ekernel>           Allocation (checking)}%
179 %<*2ekernel> \ifnum#1<#2\else
180 %<*2ekernel>   \ifnum#1=#2\relax
181 %<*2ekernel>     #1\@cclvi
182 %<*2ekernel>     \ifx\count#4\advance#1 10 \fi
183 %<*2ekernel>   \fi
184 %<*2ekernel> \ifnum#1<#3\relax
```

```

185 %<latexrelease>      \else
186 %<latexrelease>      \errmessage{No room for a new #4}%
187 %<latexrelease>      \fi
188 %<latexrelease> \fi}%
189 %<latexrelease>\EndIncludeInRelease
190 %<latexrelease>\IncludeInRelease{0000/00/00}%
191 %<latexrelease>          {\e@ch@ck}{Extended }%
192 %<latexrelease>\Allocation (checking)}%
193 %<latexrelease>\let\@e@ch@ck@undefined
194 %<latexrelease>\EndIncludeInRelease
195 %<latexrelease>\IncludeInRelease{2015/01/01}%
196 %<latexrelease>          {\extrafloats}{Extra floats}%

(End definition for \e@ch@ck.)
```

196 \let\float@count\@alloc@top

197 \ifx\numexpr\@undefined

### \extrafloats

In classic TeX use `\newinsert` to allocate float boxes.

```

198 \def\extrafloats#1{%
199 \count@#1\relax
200 \ifnum\count@>\z@
201 \newinsert\reserved@a
202 \global\expandafter\chardef
203 \csname
204 \bx@\the\allocationnumber\endcsname\allocationnumber
205 \@cons\@freelist{\csname bx@\the\allocationnumber\endcsname}%
206 \advance\count@\m@ne
207 \expandafter\extrafloats
208 \expandafter\count@
209 \fi
210 }%
211 \else
212 \def\extrafloats#1{%
213 \ifnum#1>\z@
214 \count@\numexpr\float@count-1\relax
215 \ch@ck0\count@\count
216 \ch@ck1\count@\dimen
217 \ch@ck2\count@\skip
218 \ch@ck4\count@\box
219 \global\@alloc@chardef\float@count\count@
220 \global\expandafter\@alloc@chardef
221 \csname bx@\the\float@count\endcsname\float@count
222 \@cons\@freelist{\csname bx@\the\float@count\endcsname}%
223 \expandafter
224 \extrafloats\expandafter{\numexpr#1-1\relax}%
225 \fi}%
226 \fi
227 }
```

```

226 %</2ekernel|latexrelease>
227 %<latexrelease>\EndIncludeInRelease
228 %<latexrelease>\IncludeInRelease{0000/00/00}%
229 %<latexrelease>                                {\extrafloats}{Extra floats}%
230 %<latexrelease>\let\float@count@\undefined
231 %<latexrelease>\let\extrafloats@\undefined
232 %<latexrelease>\EndIncludeInRelease
233 %<*2ekernel>

\alloc@
234 \def\alloc@#1#2#3#4#5{\global\advance\count1#1\@ne
235   \ch@ck#1#4#2%
236   \allocationnumber\count1#1%
237   \global#3#5\allocationnumber
238   \wlog{\string#5=\string#2\the\allocationnumber}}}

(End definition for \alloc@.)
```

**\newinsert{⟨cmd⟩}**

```

239 %</2ekernel>
240 %<*2ekernel|latexrelease>
241 %<latexrelease>\IncludeInRelease{2015/10/01}
242 %<latexrelease>                                {\newinsert}{Extended }%
243   {\newinsert}%

244 \ifx\numexpr\undefined
245 \def\newinsert#1{\global\advance\insc@unt \m@ne
246   \ch@ck0\insc@unt\count
247   \ch@ck1\insc@unt\dimen
248   \ch@ck2\insc@unt\skip
249   \ch@ck4\insc@unt\box
250   \allocationnumber\insc@unt
251   \global\chardef#1\allocationnumber
252   \wlog{\string#1=\string\insert\the\allocationnumber}}}

252 \else
253 \ifx\directlua\undefined
254   \chardef\@insert@top255
255 \else
256   \chardef\@insert@top\@alloc@top
257 \fi
```

If the classic registers are exhausted, take an insert from the free float list and use **\extrafloats** to add a new float to that list.

```

258 \def\newinsert#1{%
259   \tempswafalse
260   \global\advance\insc@unt\m@ne
261   \ifnum\count10<\insc@unt
262   \ifnum\count11<\insc@unt
263   \ifnum\count12<\insc@unt
264   \ifnum\count14<\insc@unt
265     \tempswatrue
```

```

266 \fi\fi\fi\fi
267 \if@tempswa
268 \allocationnumber\insc@unt
269 \else
270 \global\advance\insc@unt@\ne
271 \extrafloats@\ne
272 \@next\@currbox\@freelist
273 {\ifnum\@currbox<\e@insert@top
274 \allocationnumber\@currbox
275 \else
276 \ch@ck0\m@ne\insert
277 \fi}%
278 {\ch@ck0\m@ne\insert}%
279 \fi
280 \global\chardef#1\allocationnumber
281 \wlog{\string#1=\string\insert\the\allocationnumber}%
282 }

283 \fi
284 %</2ekernel|latexrelease>

285 %<latexrelease>\EndIncludeInRelease
286 %<latexrelease>\IncludeInRelease{0000/00/00}%
287 %<latexrelease>           {\newinsert}{Extended }%
288 %<latexrelease>\let\@insert@top\@undefined
289 %<latexrelease>\def\newinsert#1{\global\advance\insc@unt \m@ne
290 %<latexrelease> \ch@ck0\insc@unt\count
291 %<latexrelease> \ch@ck1\insc@unt\dimen
292 %<latexrelease> \ch@ck2\insc@unt\skip
293 %<latexrelease> \ch@ck4\insc@unt\box
294 %<latexrelease> \allocationnumber\insc@unt
295 %<latexrelease> \global\chardef#1\allocationnumber
296 %<latexrelease> %
297 %<latexrelease>\EndIncludeInRelease
298 %<*2ekernel>

```

### \ch@ck{}

{ } { type } The dreadful error message, especially if #3 is `write`. Thanks to LuaTeX not seen often.

```

299 \gdef\ch@ck#1#2#3{%
300   \ifnum\count1#1<#2\else
301     \errmessage{No room for a new #3}%
302   \fi}

```

### \newhelp

```
303 \def\newhelp#1#2{\newtoks#1\@1\expandafter{\csname#2\endcsname}}
```

(End definition for `\newhelp`.)

`\maxdimen` Here are some examples of allocation.  
`\hideskip`

```

304 \newdimen\maxdimen \maxdimen=16383.99999pt % the largest
      \legal <dimen>
305 \newskip\hideskip \hideskip=-1000pt plus 1fill % negative
      \but can grow

```

(End definition for `\maxdimen` and `\hideskip`.)

`\p@`

`\z@`

```

\z@skip 306 \newdimen\p@ \p@=1pt % this saves macro space and time
\voldb@x 307 \newdimen\z@ \z@=0pt % can be used both for 0pt and 0
308 \newskip\z@skip \z@skip=0pt plus0pt minus0pt
309 \newbox\voldb@x % permanently void box register

```

(End definition for `\z@`, `\z@skip`, and `\voldb@x`.)

Assign initial values to TeX's parameters

```
310 \message{parameters,}
```

All of TeX's numeric parameters are listed here, but the code is commented out if no special value needs to be set. INITEX makes all parameters zero except where noted.

```

311 \pretolerance=100
312 \tolerance=200 % INITEX sets this to 10000
313 \hbadness=1000
314 \vbadness=1000
315 \linepenalty=10
316 \hyphenpenalty=50
317 \exhyphenpenalty=50
318 \binoppenalty=700
319 \relpenalty=500
320 \clubpenalty=150
321 \widowpenalty=150
322 \displaywidowpenalty=50
323 \brokenpenalty=100
324 \predisplaypenalty=10000
325 \doublehyphendemerits=10000
326 \finalhyphendemerits=5000
327 \adjdemerits=10000

```

```
328 \tracinglostchars=1
```

```
329 \uchyph=1
```

```
330 \defaulthyphenchar=`-
331 \defaultskewchar=-1
```

```
332 \delimiterfactor=901
```

In L<sup>A</sup>T<sub>E</sub>X we don't want box information in the transcript unless we do a full tracing.

```
333 \showboxbreadth=-1
```

```
334 \showboxdepth=-1
```

```
335 \errorcontextlines=-1
```

```

336 \hfuzz=0.1pt
337 \vfuzz=0.1pt
338 \overfullrule=5pt
339 \maxdepth=4pt
340 \splitmaxdepth=\maxdimen
341 \boxmaxdepth=\maxdimen

342 \delimitershortfall=5pt
343 \nulldelimiterspace=1.2pt
344 \scriptspace=0.5pt

345 \parindent=20pt
346 \parskip=0pt plus 1pt
347 \abovedisplayskip=12pt plus 3pt minus 9pt
348 \abovedisplayshortskip=0pt plus 3pt
349 \belowdisplayskip=12pt plus 3pt minus 9pt
350 \belowdisplayshortskip=7pt plus 3pt minus 4pt

351 \topskip=10pt
352 \splittopskip=10pt

353 \parfillskip=0pt plus 1fil

```

\normalbaselineskip We also define special registers that function like parameters:

```

\ normallineskip 354 \newskip\normalbaselineskip \normalbaselineskip=12pt
\ normallineskiplimit 355 \newskip\normallineskip \normallineskip=1pt
356 \newdimen\normallineskiplimit \normallineskiplimit=0pt

```

(End definition for \normalbaselineskip, \normallineskip, and \normallineskiplimit.)

### \interfootlinepenalty

```

357 \newcount\interfootnotelinepenalty \interfootnotelinepenalty=100

```

Definitions for preloaded fonts

```

\magstephalf
\magstep 358 \def\magstephalf{1095 }
359 \def\magstep#1{\ifcase#1 \@m\or 1200\or 1440\or 1728\or
360 2074\or 2488\fi\relax}

```

(End definition for \magstephalf and \magstep.)

## 2.2 Macros for setting ordinary text

### \frenchspacing

### \nonfrenchspacing

```

361 \def\frenchspacing{\sfcode`\.@\m \sfcode`\?@\m \sfcode`\!@\m
362 \sfcode`\:@@\m \sfcode`\@;@\m \sfcode`\,,@\m}
363 \def\nonfrenchspacing{\sfcode`\!.3000\sfcode`\?3000\sfcode`\!3000%
364 \sfcode`\!:2000\sfcode`\;1500\sfcode`\,,1250 }

```

**\normalbaselines**

Set all baselines to their “normal” values.

```
365 \def\normalbaselines{\lineskip\normallineskip
366   \baselineskip\normalbaselineskip \}
367   \lineskiplimit\normallineskiplimit}
368 \def\^\M{\ } % control <return> = control <space>
369 \let\^\I\^\M % same for <tab>
```

```
\lq
\rq 369 \def\lq{`}
370 \def\rq{'}
```

(End definition for `\lq` and `\rq`.)

**\lbrack****\rbrack**

```
371 \def\lbrack{[]
372 \def\rbrack{[]}
```

`\aa` These are not from plain.tex but they are similar to other commands found here  
`\AA` and nowhere else, being alternate input forms for characters.

```
373 \def \aa {\r a}
374 \def \AA {\r A}
```

(End definition for `\aa` and `\AA`.)

**\endgraf**

As usual a control sequence is let equal to `\par`

```
375 \let\endgraf=\par
```

**\endline**

```
376 \let\endline=\cr
```

(End definition for `\endline`.)

**\space**

A very simple definition of a space

```
377 \def\space{ }
```

**\empty**

The primitive `\empty` is let to the L<sup>A</sup>T<sub>E</sub>X equivalent.

This probably ought to go altogether, but let it to the L<sup>A</sup>T<sub>E</sub>X version to save space.

```
378 \let\empty@\empty
```

**\null**

The **\null** macro is just an empty **\hbox{}**.

```
379 \def\null{\hbox{}}
```

**\bgroup** Provide macros for the left and right braces, denoting grouping.

```
380 \let\bgroup=%
381 \let\egroup=%
```

(End definition for **\bgroup** and **\egroup**.)

**\obeylines**

The macros here are identical to those in plain TeX. In **\obeylines**, we say **\let<sup>^^M</sup>=\par** instead of **\def<sup>^^M</sup>{\par}** since this allows, for example, **\let\par=\cr \obeylines \halign{...}** in which **\cr**'s need not be given in the alignment.

```
382 {\catcode`^^M=\active % these lines must end with %
383 \gdef\obeylines{\catcode`^^M\active \let^^M\par}%
384 \global\let^^M\par} % this is in case ^^M appears in a \write
```

**\obeyspaces**

A switch to typeset spaces verbatim. Used in verbatim environments.

```
385 \def\obeyspaces{\catcode` \ \active}
386 {\obeyspaces\global\let =\space}
```

**\loop** We use Kabelschacht's method of doing loops, see TUB 8#2 (1987). (unless  
**\iterate** that breaks something :-). It turned out to need an extra **\relax**: see pr/642  
**\repeat** (**\loop** could do one iteration too much in certain cases).

```
387 \long\def \loop #1\repeat{%
388   \def\iterate{#1\relax % Extra \relax
389             \expandafter\iterate\fi
390           }%
391   \iterate
392   \let\iterate\relax
393 }
```

This setting of **\repeat** is needed to make **\loop... \if... \repeat** skip-  
 pable within another **\if....**

```
394 \let\repeat=\fi
```

(End definition for **\loop**, **\iterate**, and **\repeat**.)

TeX defines **\smallskip**, etc. in **ltspc.dtx** (See 104).

**\nointerlineskip**

```
395 \def\nointerlineskip{\prevdepth-\@m\p@}
396 \def\offinterlineskip{\baselineskip-\@m\p@
397   \lineskip\z@\lineskip\maxdimen}
```

(End definition for `\nointerlineskip` and `\offinterlineskip`.)

The next two macros can be used to introduce “spacing” by means of a `\vrule` or `\hrule`. These are useful for introducing spacing at the start of a line or the top and bottom part of the page, where normal skips will fail. L<sup>A</sup>T<sub>E</sub>X discourages these and defines `\hspace` and `\vspace`.<sup>1</sup>

**\hglue{<glue specification>}**

```
398 \def\hglue{\afterassignment\hgl@{\skip@=}
399 \def\hgl@{\leavevmode \count@\spacefactor \vrule \width\z@
400   \nobreak\hskip\skip@\spacefactor\count@}
```

**\vglue{<glue specification>}**

```
401 \def\vglue{\afterassignment\vgl@{\skip@=}
402 \def\vgl@{\par \dimen@\prevdepth \hrule \height\z@
403   \nobreak\vskip\skip@\prevdepth\dimen@}
```

### Example 2.1 hglue

```
1 A\hglue 10pt plus1pt minus0.5pt test example.
2
3 \hglue 50pt ;test
```

```
A test example.
;test
```

L<sup>A</sup>T<sub>E</sub>X defines ~ in `ltdefs.dtx`, see page 62.

### \slash

This generates a / acting a bit like – but still allows hyphenation in the word part preceding it (but not after).

```
5 \def\slash{/penalty\exhyphenpenalty}
```

The following macros introduce penalty markers that make break less, or more, desirable. The macros `\break`, `\nobreak` and `\allowbreak` set penalties to particular values. In the original plain T<sub>E</sub>X, penalties were numbers. In L<sup>A</sup>T<sub>E</sub>X 2e were changed to macros for efficiency.

### \break

Forces a break

```
6 \def\break{\penalty-\@M}
```

### \nobreak

---

<sup>1</sup>See <https://tex.stackexchange.com/questions/30048/what-is-the-difference-between-vskip-and-vspace>

```
\allowbreak
```

```
7 \def\nobreak{\penalty \z@}
8 \def\allowbreak{\penalty \z@}
```

*(End definition for \allowbreak.)*

```
\filbreak
```

```
\goodbreak 9 \def\filbreak{\par\vfil\penalty-200\vfilneg}
10 \def\goodbreak{\par\penalty-500 }
```

*(End definition for \filbreak and \goodbreak.)*

```
\eject
```

Define **\eject** as in plain TeX but define **\supereject** only in the compatibility file.<sup>2</sup>

```
11 \def\eject{\par\break}
```

*(End definition for \eject.)*

```
\removelastskip
```

```
12 \def\removelastskip{\ifdim\lastskip=\z@\else\vskip-\lastskip\fi}
```

*(End definition for \removelastskip.)*

### Example 2.2 Removing the lastskip

```
1 CCCC\par
2 \medskip
3 \the\lastskip
4 \medskip
5 \removelastskip
6 \the\lastskip
7 DDDD
```

CCCC

o.opto.optDDDD

## Adding Penalties

The

```
\smallbreak
```

```
\medbreak 9 \def\smallbreak{\par\ifdim\lastskip<\smallskipamount
```

```
\bigbreak 10 \removelastskip\penalty-50\smallskip\fi}
```

```
11 \def\medbreak{\par\ifdim\lastskip<\medskipamount
```

```
12 \removelastskip\penalty-100\medskip\fi}
```

```
13 \def\bigbreak{\par\ifdim\lastskip<\bigskipamount
```

```
14 \removelastskip\penalty-200\bigskip\fi}
```

*(End definition for \smallbreak, \medbreak, and \bigbreak.)*

---

<sup>2</sup>v1.1S 1995/10/17 Move **\supereject** to compat file

\m@th  
 15 \def\m@th{\mathsurround\z@}

(End definition for \m@th.)

\underbar Due to L<sup>A</sup>T<sub>E</sub>X's redefinition of \underline plain T<sub>E</sub>X's \underbar can be done in a simpler fashion (but do we need it at all?). <sup>3</sup> <sup>4</sup>  
 16 \def\underbar#1{\underline{\sbox\tw@{#1}\dp\tw@\z@\box\tw@}}

(End definition for \underbar.)

\strutbox In plain TeX \strut is implemented as a rule of width zero, since this takes minimum space and time in applications where numerous struts are present

L<sup>A</sup>T<sub>E</sub>X sets \strutbox in \set@fontsize.

\strut 17 \newbox\strutbox  
 18 \def\strut{\relax\ifmmode\copy\strutbox\else\unhcopy\strutbox\fi}

The \relax T<sub>E</sub>XBook [353] is necessary in case \strut appears first in an alignment entry, because T<sub>E</sub>X is in somewhat unpredictable mode at such times (see Chapter 22 in the T<sub>E</sub>XBook).

(End definition for \strutbox and \strut.)

\hidewidth For alignment entries that can stick out.

19 \def\hidewidth{\hskip\hideskip}

(End definition for \hidewidth.)

At this point in plain T<sub>E</sub>X we find the definitions of \item and \itemitem. These were removed in L<sup>A</sup>T<sub>E</sub>X 2e obviously since we have lists. <sup>5</sup> <sup>6</sup> Move \hang and \textindent to latex209.def <sup>7</sup>

### \narrower

20 \def\narrower{%
 21 \advance\leftskip\parindent
 22 \advance\rightskip\parindent}

 23 \chardef\%=\%
 24 \chardef\&='\&
 25 \chardef\#=`\'#

Most text commands are actually encoding specific and therefore defined later, so commented out or removed from this file.

### \leavevmode

begins a paragraph, if necessary

26 \def\leavevmode{\unhbox\vvoidb@x}

<sup>3</sup>v1.1m 1994/05/26 (CAR/FMi) changed to use box \tw@

<sup>4</sup>v1.1p 1994/05/26 (DPC) changed to use \sbox

<sup>5</sup>v1.oh 1994/05/16 Remove unnecessary def for \item

<sup>6</sup>ii 1995/04/27

<sup>7</sup>RmS 1991/11/04 Removed \itemitem since neverneeded/useful with L<sup>A</sup>T<sub>E</sub>X.

```
\mathhexbox
27 \def\mathhexbox#1#2#3{\mbox{$\mathchar"##1#2#3$}}
```

(End definition for `\mathhexbox`.)

```
\ialign
28 \def\ialign{\everycr{}\tabskip\z@skip\halign} % initialized -->
\halign
```

(End definition for `\ialign`.)

```
\oalign
\o@align
```

```
\ooalign
```

```
29 \def\oalign#1{\leavevmode\vtop{\baselineskip\z@skip >
\lineskip.25ex%
30 \ialign{##\crcr#1\crcr}}}
31 \def\o@align{\lineskiplimit\z@\oalign}
32 \def\ooalign{\lineskiplimit-\maxdimen \oalign}
```

**\sh@ft**

The definition of this macro in plain.tex was improved in about 1997; but as a result its usage was changed and its new definition is not appropriate for L<sup>A</sup>T<sub>E</sub>X.

Since the version given here has been in use by L<sup>A</sup>T<sub>E</sub>X for many years it does not seem prudent to remove it now. As far as we can tell it has only been used to define `\b` and `\d` but this cannot be certain.

```
33 \def\sh@ft#1{\dimen@.00#1ex\multiply\dimen@\fontdimen1\font
34 \kern-.0156\dimen@} % compensate for slant in lowered accents
35 \def\ltx@sh@ft #1{%
36 \dimen@ #1%
37 \kern \strip@pt
38 \fontdimen1\font \dimen@
39 } % kern by #1 times the current slant
```

**\hrulefill****\dotfill**

L<sup>A</sup>T<sub>E</sub>X change: `\kern\z@` added to end of `\hrulefill` and `\dotfill` to make them work in ‘tabular’ and ‘array’ environments.<sup>8</sup> L<sup>A</sup>T<sub>E</sub>X change: `\leavevmode` added at beginning of `\dotfill` and `\hrulefill` so that they work as expected in vertical mode.

---

<sup>8</sup>Change made 24 July 1987.

```

40 \def\hrulefill{\leavevmode\leaders\hrule\hfill\kern\z@}
The box in \dotfill originally contained (in plain.tex):
\mkern 1.5mu .\mkern 1.5mu;
the width of .44em differs from this by .04pt which is probably an acceptable
difference within leaders.
41 \def\dotfill{%
42   \leavevmode
43   \leaders \hb@xt@ .44em{\hss.\hss}\hfill
44   \kern\z@}
45 \sfcode`)=0 \sfcode`'=0 \sfcode`\]=0

```

## 2.3 Definitions related to output

\magnification doesn't work in L<sup>A</sup>T<sub>E</sub>X this has been set to verbatim in the code.

```

\def\magnification{\afterassignment\mag\count@}
\def\mag{\mag\count@
\hsize6.5truein\vsize8.9truein\dimen\footins8truein}

```

\showoverfull The following commands are used in debugging:

```
46 \def\showoverfull{\tracingonline@ne}
```

*(End definition for \showoverfull.)*

\showoutput

```

47 \gdef\loggingoutput{\tracingoutput@ne
48   \showboxbreadth\maxdimen\showboxdepth\maxdimen\errorstopmode}
49 \gdef\showoutput{\loggingoutput\showoverfull}
50 %</2ekernel>

```

*(End definition for \showoutput.)*

```

51 %<latexrelease>\IncludeInRelease{2015/01/20}{\loggingall}{etex }%
  \tracing{%
52 %<*2ekernel|latexrelease>
53 \ifx\tracingscantokens\undefined
54 \gdef\loggingall{%
55   \tracingstats\tw@
56   \tracingpages\@ne
57   \tracinglostchars\@ne
58   \tracingparagraphs\@ne
59   \errorcontextlines\maxdimen
60   \loggingoutput
61   \tracingmacros\tw@
62   \tracingcommands\tw@
63   \tracingrestores\@ne
64 }
65 \else
66 \gdef\loggingall{%
67   \tracingstats\tw@
68   \tracingpages\@ne

```

```

69  \tracinglostchars\tw@
70  \tracingparagraphs@ne
71  \tracinggroups@ne
72  \tracingifs@ne
73  \tracingscantokens@ne
74  \tracingnesting@ne
75  \errorcontextlines\maxdimen
76  \loggingoutput
77  \tracingmacros\tw@
78  \tracingcommands\thr@@
79  \tracingrestores@ne
80  \tracingassigns@ne
81 }%
82 \fi
83 \gdef\tracingall{\shoverfull\loggingall}
84 %<2ekernel|latexrelease>
85 %<latexrelease>\EndIncludeInRelease
86 %<latexrelease>\IncludeInRelease{0000/00/00}{\loggingall}{etex }
87 %<latexrelease>\gdef\loggingall{\tracingcommands\tw@\tracingstats\tw@
88 %<latexrelease> \tracingpages@ne\tracinglostchars@ne
89 %<latexrelease> \tracingmacros\tw@\tracingparagraphs@ne\tracingrestores@ne
90 %<latexrelease> \errorcontextlines\maxdimen\loggingoutput}
91 %<latexrelease> \gdef\tracingall{\loggingall\shoverfull}
92 %<latexrelease>\EndIncludeInRelease

\tracingnone
\hideoutput 93 %<latexrelease>\IncludeInRelease{2015/01/20}{\tracingnone}%
94 %<latexrelease> {turn off etex }
95 %<2ekernel|latexrelease>
96 \ifx\tracingscantokens@undefined
97 \def\tracingnone{%
98  \tracingonline\z@
99  \tracingcommands\z@
100 \showboxdepth\m@ne
101 \showboxbreadth\m@ne
102 \tracingoutput\z@
103 \errorcontextlines\m@ne
104 \tracingrestores\z@
105 \tracingparagraphs\z@
106 \tracingmacros\z@
107 \tracinglostchars@ne
108 \tracingpages\z@
109 \tracingstats\z@
110 }%
111 \else
112 \def\tracingnone{%
113  \tracingassigns\z@
114  \tracingrestores\z@
115  \tracingonline\z@
116  \tracingcommands\z@
117  \showboxdepth\m@ne

```

```

118   \showboxbreadth\m@ne
119   \tracingoutput{z@}
120   \errorcontextlines\m@ne
121   \tracingnesting{z@}
122   \tracingscantokens{z@}
123   \tracingifs{z@}
124   \tracinggroups{z@}
125   \tracingparagraphs{z@}
126   \tracingmacros{z@}
127   \tracinglostchars{@ne}
128   \tracingpages{z@}
129   \tracingstats{z@}
130 }%
131 \fi
132 \def\hideoutput{%
133   \tracingoutput{z@}
134   \showboxbreadth\m@ne
135   \showboxdepth\m@ne
136   \tracingonline\m@ne
137 }%
138 %</2ekernel|latexrelease>
139 %<latexrelease>\EndIncludeInRelease
140 %<latexrelease>\IncludeInRelease{0000/00/00}{\tracingnone}%
141 %<latexrelease>                                {turn off etex }
142 %<latexrelease>\let\tracingnone@\undefined
143 %<latexrelease>\let\hideoutput@\undefined
144 %<latexrelease>\EndIncludeInRelease

```

(End definition for `\tracingnone` and `\hideoutput`.)

**LT<sub>E</sub>X** change: `\showhyphens` Defined later. Punctuation affects the spacing. The `\nonfrenchspacing` is set. This can be overwritten later on by the user, if required.

```

145 %<*2ekernel>
146 \nonfrenchspacing
147 %</2ekernel>

```

# 3

## Version Identification

In antiquity men and women saw each other as different; accordingly, they developed complex taxonomies (philosophical explanations) for understanding anatomical, physiological, emotional, and rational differences.

Some of these differences seem profoundly odd to us moderns.

Modern discussions about erotic art have often concerned the place of women: to what extent are they objects of social manipulation, to what extent can they be subjects?



First we identify the date and version number of this release of L<sup>A</sup>T<sub>E</sub>X, and set `\everyjob` so that it is printed at the start of every L<sup>A</sup>T<sub>E</sub>X run.

```
\fmtname
\fmtversion
\latexreleaseversion
\patch@level
```

A `\patch@level` of 0 or higher denotes an official public release. A negative value indicates a candidate release that is not distributed.

If we put code updates into the kernel that are supposed to go into the next release we set the `\patch@level` to -1 and the `\fmtversion/\latexreleaseversion` to the dated of the next release (guessed, the real value is not so important and will get corrected when we make the release official).

If the `\patch@level` is already at -1 we do nothing here and use the `\fmtversion` date for any new `\IncludeInRelease` line when we add further code.

Finally, if we do make a public release we either just set the `\patch@level` to zero (if our initial guess was good) or we also change the date and then have to additionally change to that date on all the `\IncludeInRelease` statements that used the “guessed” date.

```
148 %%<*2ekernel>
149 \def\fmtname{LaTeX2e}
150 \edef\fmtversion
151 %%</2ekernel>
152 %%<\latexrelease>\edef\latexreleaseversion
153 %%<*2ekernel|\latexrelease>
154 {2018-12-01}
155 %%</2ekernel|\latexrelease>
156 %%<*2ekernel>
157 \def\patch@level{0}
```

(End definition for `\fmtname` and others.)

Check that the format being made is not too old. The error message complains about ‘more than 5 years’ but in fact the error is not triggered until 65 months.

This code is currently not activated as we don’t know if we already got to the last official 2e version (due to staff shortage or due to a successor (think positive:-)).

```
158 \iffalse
159 \def\reserved@a{\#1/#2/#3@nil{%
160   \count@\year
161   \advance\count@-\#1\relax
162   \multiply\count@ by 12\relax
163   \advance\count@\month
164   \advance\count@-\#2\relax}
165 \expandafter\reserved@a\fmtversion@nil
\count@ is now the age of this file in months. Take a generous definition of
‘year’ so this message is not generated too often.
166 \ifnum\count@>65
167   \typeout{^^J%
168 !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!^J%
169 ! You are attempting to make a LaTeX format from a source >
   \file^^J%
170 ! That is more than five years old.^J%
171 !^J%
```

```

172 ! If you enter <return> to scroll past this message then %
173 !   the format^J%
174 ! will be built, but please consider obtaining newer source %
175 !   files^J%
176 !
177     \errhelp{To avoid this error message, obtain new LaTeX %
178     sources.}
179 \fi
180 \let\reserved@a\relax
181 \fi
182 \ifnum\patch@level=0
183   \everyjob\expandafter{\the\everyjob
184     \typeout{\fmtname \space<\fmtversion>}}
185   \immediate
186   \write16{\fmtname \space<\fmtversion>}
187 \else\ifnum\patch@level>0
188   \everyjob\expandafter{\the\everyjob
189     \typeout{\fmtname \space<\fmtversion> patch level %
190     \patch@level}}
191   \immediate
192   \write16{\fmtname \space<\fmtversion> patch level %
193     \patch@level}
194 \else
195   \everyjob\expandafter{\the\everyjob
196     \typeout{\fmtname \space<\fmtversion> %
197     \pre-release\patch@level}}
198 \immediate
199 \write16{\fmtname \space<\fmtversion> %
200     \pre-release\patch@level}
201 \fi
202 \fi
203 %</2ekernel>

```

## \IncludeInRelease

```

200 %<2ekernel>\let\@currname\@empty
201 %<*2ekernel|latexrelease>
202 %<latexrelease>\newif\if@includeinrelease
203 %<latexrelease>\@includeinreleasefalse
204 \def\IncludeInRelease#1{%
205   \if@includeinrelease
206     \PackageError{latexrelease}{mis-matched \IncludeInRelease}{}%
207   \else
208   \fi
209   \kernel@ifnextchar[%%
210     {\@IncludeInRelease{#1}}%
211     {\@IncludeInRelease{#1}[#1]}}
212   If a specific date has not been specified in \ latexrelease use '#1'.
213 \def\@IncludeInRelease#1[#2]{\@IncludeInRelease{#2}}

```

```

213 \def\@IncludeInRelease#1#2#3{%
214   \toks@{[#1] #3}%
215   \expandafter\ifx\csname string#2+\@currname+IIR\endcsname\relax
216     \ifnum\expandafter\@parse@version#1//00@nil
217       >\expandafter\@parse@version\fmtversion//00@nil
218       \GenericInfo{}{Skipping: \the\toks@}%
219     \expandafter\expandafter\expandafter@gobble@IncludeInRelease
220   \else
221     \GenericInfo{}{Applying: \the\toks@}%
222     \@includeinreleasetrue
223     \expandafter\let\csname string#2+\@currname+IIR\endcsname@\empty
224     \fi
225   \else
226     \GenericInfo{}{Already applied: \the\toks@}%
227     \expandafter\@gobble@IncludeInRelease
228   \fi
229 }

230 \def\EndIncludeInRelease{%
231 \if@includeinrelease
232   \@includeinreleasefalse
233 \else
234   \PackageError{latexrelease}{mis-matched
235   \langle EndIncludeInRelease\rangle}%
236 \fi}

237 \long\def\@gobble@IncludeInRelease#1\EndIncludeInRelease{%
238   \@includeinreleasefalse
239   \@check@IncludeInRelease#1\IncludeInRelease\@check@IncludeInRelease
240   \@end@check@IncludeInRelease}

241 \long\def\@check@IncludeInRelease#1\IncludeInRelease
242   \#2#3\@end@check@IncludeInRelease{%
243   \ifx\@check@IncludeInRelease#2\else
244     \PackageError{latexrelease}{skipped IncludeInRelease}{}%
245   \fi}

246 %%</2ekernel|latexrelease>

```

(End definition for `\IncludeInRelease`.)

# 4

## LaTeXe Kernel Definitions Module

In antiquity men and women saw each other as different; accordingly, they developed complex taxonomies (philosophical explanations) for understanding anatomical, physiological, emotional, and rational differences.

Some of these differences seem profoundly odd to us moderns. Modern discussions about erotic art have often concerned the place of women: to what extent are they objects of social manipulation, to what extent can they be subjects?



## 4.1 Introduction

This section contains a number of commands used in defining other macros, as well as some useful commands, that can be used by package authors. Some of these commands such as `\@height` were defined to save tokens and hence memory tokens and by now they do not add much value to a modern L<sup>A</sup>T<sub>E</sub>X installation. However, removing them would break backward compatibility, but perhaps in your own packages you may choose to improve the program readability by not using them.

<code>\two@digits</code>	<sup>→ P.549</sup>	prefix a number less than 10 with ‘o’
<code>\typeout</code>		display something on the terminal
<code>\newlinechar</code>		newline character
<code>\@height</code>		height
<code>\@width</code>		width
<code>\@depth</code>		depth

### `\two@digits{number}`

Prefix a number less than 10 with ‘o’.

```
246 \def\two@digits#1{\ifnum#1<10 0\fi\number#1}
```

### `\typeout<message>`

Display something on the terminal.

```
247 \def\typeout#1{\begingroup\set@display@protect
248   \immediate\write\@unused{#1}\endgroup}
```

### `\newlinechar`

A char to be used as new-line in output to files.

```
249 \newlinechar`\\^J
```

## 4.2 Saved versions of T<sub>E</sub>X primitives

### `\@@par`

The TeX primitive `\foo` is saved as `\@@foo`. The following primitives are handled in this way:

```
250 \let\@@par=\par
251 \let\@@input=\input      %%% moved earlier
252 \let\@@end=\end        %%%
```

### `\@@hyph`

## \-

The following comment was added when these commands were first set up, 19 April 1986: the \- command is redefined to allow it to work in the **\ttfamily** type style, where automatic hyphenation is suppressed by setting **\hyphenchar** to -1. The original primitive TeX definition is saved as **\@@hyph** just in case anyone needs it.

There is a need for a robust command for a discretionary hyphen since its exact representation depends on the glyphs available in the current font. For example, with suitable fonts and the T1 font encoding it is possible to use hanging hyphens.

A suitable robust definition that allows for many possible types of font and encoding may be as follows:

```
\DeclareRobustCommand {\-}{%
  \discretionary {%
    \char \ifnum\hyphenchar\font<\z@%
      \defaulthyphenchar%
    \else%
      \hyphenchar\font%
    \fi%
  }{}{}%
}
```

The redefinition (via **\let**) of \- within tabbing also makes the use of a robust command advisable since then any redefinition of \- via **\DeclareRobustCommand** will not cause a conflict.

Therefore, macro writers should be hereby warned that these internals will probably change! It is likely that a future release of LATEX will make \- effectively an encoding specific text command.

```
253 \let\@@hyph=\-          % Save original primitive definition
254 \def\-\{\discretionary{-}{}{}\}
```

**\@dischyp**

```
255 \let\@dischyp=\-
```

**\@@italiccorr**

Save the original italic correction.

```
256 \let\@@italiccorr=\/
```

**\@height**

**\@depth**

**\@width**

**\@minus**

### \@plus

The following definitions save token space e.g., using `\@height` instead of `height` saves 5 tokens at the cost in time of one macro expansion.

```
257 \def\@height{height} \def\@depth{depth} \def\@width{width}
258 \def\@minus{minus}
259 \def\@plus{plus}
```

### \hb@xt@

The next one is another 100 tokens worth.

```
260 \def\hb@xt@{\hbox to}
261 \message{hacks,}
```

## 4.2.1 Command definitions

This section defines the following commands:

`\@namedef→ σ 65 {⟨name⟩}` Expands to `\def\{⟨name⟩}`, except name can contain any characters.

`\@nameuse→ σ 66 {⟨name⟩}` Expands to `\⟨name⟩`.

`\@ifnextchar→ σ 80 X{⟨Yes⟩}{⟨No⟩}` Expands to `⟨Yes⟩` if next character is an ‘X’, and to `⟨No⟩` otherwise. (Uses `\reserved@a`–`\reserved@c`.) Note: GOBBLES ANY SPACE FOLLOWING IT.

`\@ifstar→ σ 82 {⟨Yes⟩}{⟨No⟩}` Gobbles following spaces and then tests if the next character is a ‘\*’. If it is, then it gobbles the star (\*) and expands to `⟨Yes⟩`, otherwise it expands to `⟨No⟩`.

`\@dblarg→ σ 82 {⟨CMD⟩}{⟨ARG⟩}`

Expands to `\{⟨CMD⟩\}[⟨ARG⟩]{⟨ARG⟩}`. Use `\@dblarg\CS` when `\CS` takes arguments `[ARG1]{ARG2}`, where default is `ARG1 = ARG2`.

`\@ifundefined→ σ 80 {⟨name⟩}{⟨Yes⟩}{⟨No⟩}`

: If `\name` is undefined then it executes `⟨Yes⟩`, otherwise it executes `⟨No⟩`. More precisely, true if `\name` either undefined or = `\relax`.

`\@ifdefinable→ σ 71 {⟨name⟩}{⟨Yes⟩}` Executes `⟨Yes⟩` if the user is allowed to define `\name`, otherwise it gives an error. The user can define `\name` if `\@ifundefined{name}` is true, `'name' ≠ 'relax'` and the first three letters of `'name'` are not `'end'`, and if `\endname` is not defined.

`\newcommand→ σ 68 *{⟨\FOO⟩}{⟨i⟩}{⟨TEXT⟩}`

User command to define `\FOO` to be a macro with `i` arguments (`i = 0` if missing) having the definition `⟨TEXT⟩`. Produces an error if `\FOO` already defined.

Normally the command is defined to be `\long` (ie it may take multiple paragraphs in its argument). In the star-form, the command is not defined as `\long` and a blank line in any argument to the command would generate an error.

**\renewcommand**<sup>→ σ 71</sup> \*{⟨FOO⟩}[⟨i⟩]{⟨TEXT⟩}

Same as **\newcommand**, except it checks if **\FOO** already defined.

**\newenvironment**<sup>→ σ 72</sup> \*{⟨FOO⟩}[⟨i⟩]{⟨DEF1⟩}{⟨DEF2⟩}

equivalent to:  
**\newcommand{\FOO}[i]{DEF1} \def{\endFOO}{DEF2}**  
(or the appropriate star forms).

**\renewenvironment**<sup>→ σ 72</sup> Obvious companion to **\newenvironment**.

### 4.2.2 **\@cons** and **\@car**

The following macros are used extensively for lists.

**\@cons**<sup>→ σ 66</sup> : See description of **\output** routine.

**@car** **\@car** T1 T2 ... Tn~~\@nil == T1~~ (unexpanded)

**@cdr** **\@cdr** T1 T2 ... Tn~~\@nil == T2 ... Tn~~ (unexpanded)

**\typeout**<sup>→ σ 62</sup> {⟨message⟩}

Produces a warning message on the terminal.

**\typein** {⟨message⟩}

Types message, asks the user to type in a command, then executes it.

**\typein** [⟨CS⟩]{⟨MSG⟩}

Same as above, except defines **\CS** to be the input instead of executing it.<sup>1</sup>

## 4.3 Code

```
typein
262 \def\typein{%
263   \let\@typein\relax
264   \@testopt\@xtypein\@typein}

265 \def\@xtypein[#1]#2{%
266   \typeout{#2}%
267   \advance\endlinechar\@M
268   \read\@inputcheck to#1%
269   \advance\endlinechar-\@M
270 }
```

(End definition for **typein**.)

### 4.3.1 **csname** abstractions

#### **\@namedef**

The **\@namedef** and **\@nameuse**<sup>→ P. 66</sup> are used to define or use **\csname**. You need to watch that the arguments are *names* i.e, they are not preceded by a backslash or other active character. (See example 3.1).

---

<sup>1</sup>LaTeX209 1992/03/18 (RMS) changed input channel from o to **\@inputcheck** to avoid conflicts with other channels allocated by **\newread**

### \@nameuse

```
271 \def\@namedef#1{\expandafter\def\csname #1\endcsname}
272 \def\@nameuse#1{\csname #1\endcsname}
```

#### Example 3.1 Using \@namedef

```
1 \makeatletter
2 \@namedef{test1}{This is the first test}
3 \@nameuse{test1}
4 \makeatother
```

This is the first test

## 4.4 List helper macros

These helper macros are primarily for constructing and manipulating lists.

### \@cons

The command `\@cons` is used for the construction of lists. Its unique characteristic being that it constructs *elt* lists. What this means is that each entry in the list is preceded by another as yet undefined command `\@elt`. This can be later used to grab the element as its argument and do something about it.

```
5 \def\@cons#1#2{\begingroup\let\@elt\relax\xdef#1{\@elt
  #2}\endgroup}
```

Assume we have a list `\mylist` which has been defined as `\mylist{\@elt one \@elt two ...}`. We can use `\@cons` to append more elements as shown in the next example,

#### Example 4.2 Usage of cons

```
1 \makeatletter
2
3 % define a list
4 \def\mylist{}
5
6 % add elements
7 \@cons\mylist{{one}}
8 \@cons\mylist{{two}}
9
10 % define \@elt to be a space
11 \def\@elt{\space}
12
13 % type the meaning
14 \meaning\mylist
15
16 % define \@elt to print its argument with a comma
```

```

17 \def\@elt#1{#1, }
18
19 % print the list
20 \mylist
21
22 \makeatother

macro:-> \@elt {one}\@elt {two}
one, two,

```

If you have noticed, when we added the element, we have used an extra set of brackets. If we did not do this `\@elt` would have captured only the first letter that follows it and the result would have been `o`, `net`, `wo`. Try it out.

### \@car

### \@cdr

The next two macros `\@car` and `\@cdr` capture either the first element of a list or the rest of the elements except the first. They are both delimited by `\@nil`.

```

23 \def\@car#1#2\@nil{#1}
24 \def\@cdr#1#2\@nil{#2}

```

`\@carcube` Given a list  $T_1 \dots T_n$  `\@carcube` will grub  $T_1 T_2 T_3$  for `T1 T2 T3`,  $n > 3$ . If you are familiar with lisp `car`, `cdr` and `cons` are fundamental functions. The `cons` function is used to construct lists, and the `car` and `cdr` functions are used to take them apart.<sup>2</sup>

```
25 \def\@carcube#1#2#3#4\@nil{#1#2#3}
```

(End definition for `\@carcube`.)

### \@onlypreamble

This macro adds its argument to the list of commands stored in `\@preamblecmds` to be disabled after `\begin{document}`. These commands are redefined to generate `\@notprerr` at this point

### \@preamblecmds

---

<sup>2</sup>The name of the `cons` function is not unreasonable: it is an abbreviation of the word ‘construct’. The origins of the names for `car` and `cdr`, on the other hand, are esoteric: `car` is an acronym from the phrase ‘Contents of the Address part of the Register’; and `cdr` (pronounced ‘could-er’) is an acronym from the phrase ‘Contents of the Decrement part of the Register’. These phrases refer to specific pieces of hardware on the very early computer on which the original Lisp was developed. Besides being obsolete, the phrases have been completely irrelevant for more than 35 years to anyone thinking about Lisp. Nonetheless, although a few brave scholars have begun to use more reasonable names for these functions, the old terms are still in use. In particular, since the terms are still used in the Emacs Lisp source code.

```

26 \def\@preamblecmds{%
27 \def\@onlypreamble#1{%
28   \expandafter\gdef\expandafter\@preamblecmds\expandafter{%
29     \@preamblecmds\do#1}%
30   }%
31 \@onlypreamble\@onlypreamble
32 \@onlypreamble\@preamblecmds

```

## 4.5 Command Building

**\@star@or@long** *<parameter text>*

This is an interesting command in that it checks if #1 is a star then sets `\l@ngrel@x` to either `\long` or `\relax`. It is used for building `\newcommand`, which is always `\long` except its star version.

```

33 \def\@star@or@long#1{%
34   \@ifstar
35   {\let\l@ngrel@x\relax#1}%
36   {\let\l@ngrel@x\long#1}}

```

**\l@ngrel@x**

This is either `\relax` or `\long` depending on whether the `*`-form of a definition command is being executed.

```
37 \let\l@ngrel@x\relax
```

**\newcommand** {*<cmd name>*} [*<number of arguments>*] [*<default for optional argument>*] {*<replacement text>*}

User level `\newcommand`.

```
38 \def\newcommand{\@star@or@long\new@command}
```

The command simply checks if it is long or short and the calls `\new@command`.

```

\new@command
39 \def\new@command#1{%
40   \@testopt{\@newcommand#1}0}

  \@newcommand

  \@argdef

  \@xargdef

41 \def\@newcommand#1[#2]{%
42   \kernel@ifnextchar [{\@xargdef#1[#2]}{%
43     {\@argdef#1[#2]}}}

```

Define #1 if it is definable.

Both here and in `\@xargdef` the replacement text is absorbed as an argument because if we are not allowed to make the definition we have to get rid of it completely.

```

44 \long\def\@argdef#1[#2]#3{%
45   \@ifdefinable #1{\@yargdef#1\@ne{#2}{#3}}}
46 \long\def\@xargdef#1[#2][#3]#4{%
47   \@ifdefinable#1{%
Define the actual command to be:
\def\foo{\@protected@testopt\foo\\foo{default}}
where \\foo is a csname generated from applying \csname and \string
to \foo, ie the actual name contains a backslash and therefore can't clash
easily with existing command names. "Default" is the contents of the sec-
ond optional argument of (re)newcommand.

```

**Example 5.3 newcommand internal form**

```

1      \newcommand\mytest[2][other material] {some
          text}
2      \meaning\mytest
macro:->\@protected@testopt \mytest \\mytest {other material}

```

```

4 %<autoload>\aut@global
5   \expandafter\def\expandafter#1\expandafter{%
6     \expandafter
7     \@protected@testopt
8     \expandafter
9     #1%
10    \csname\string#1\endcsname
11    {#3}}%

```

Now we define the internal macro ie \\foo which is supposed to pick up all arguments (optional and mandatory).

```

12   \expandafter\@yargdef
13     \csname\string#1\endcsname
14     \tw@
15     {#2}%
16     {#4}}}

```

**\@testopt**

This macro encapsulates the most common call to \@ifnextchar, saving several tokens each time it is used in the definition of a command with an optional argument.

#1 The code to execute in the case that there is a [ need not be a single token but can be any sequence of commands that 'expects' to be followed by [. If this command were only used in \newcommand definitions then #1 would be a single token and the braces could be omitted from {#1} in the definition below, saving a bit of memory.

```

17 \long\def\@testopt#1#2{%
18   \kernel@ifnextchar[{#1}{#1[{#2}]}}}

```

### \@protected@testopt

Robust version of \@testopt. The extra argument (#1) must be a single token. If protection is needed the call expands to \protect applied to this token, and the 2nd and 3rd arguments are discarded (by \x@protect). Otherwise \@testopt is called on the 2nd and 3rd arguments.

This method of making commands robust avoids the need for using up two csnames per command, the price is the extra expansion time for the \ifx test.

```

19 \def\@protected@testopt#1{%%
20   \ifx\protect\@typeset@protect
21     \expandafter\@testopt
22   \else
23     \x@protect#1%
24   \fi}

```

### \@yargdef

#### \@yargd@f

These generate a primitive argument specification, from a L<sup>A</sup>T<sub>E</sub>X [ $\langle digit \rangle$ ] form; in fact  $\langle digit \rangle$  can be anything such that \number  $\langle digit \rangle$  is single digit.

Reorganised slightly so that \renewcommand{\reserved@a}{1}{foo} works. I am not sure this is worth it, as a following \newcommand would overwrite the definition of \reserved@a.

Recall that L<sup>A</sup>T<sub>E</sub>X2.09 goes into an infinite loop with \renewcommand[1]{\@tempa}{foo} (DPC 6 October 93).

Reorganised again (DPC 1999). Rather than make a loop to construct the argument spec by counting, just extract the required argument spec by using a delimited argument (delimited by the digit). This is faster and uses less tokens. The coding is slightly odd to preserve the old interface (using #2 = \tw@ as the flag to surround the first argument with []). But the new method did not allow for the number of arguments #3 not being given as an explicit digit; hence (further expansion of this argument and use of) \number was added later in 1999.

It is not clear why these are still \long.

```

25 \long \def \@yargdef #1#2#3{%
26   \ifx#2\tw@
27     \def\reserved@b##1{[####1]}%
28   \else
29     \let\reserved@b\@gobble
30   \fi
31   \expandafter
32     \@yargd@f \expandafter{\number #3}#1%
33 }

34 \long \def \@yargd@f#1#2{%
35   \def \reserved@a ##1##2##{%
36 %<autoload>\aut@global
37     \expandafter\def\expandafter#2\reserved@b ##1#1%
38   }%
39   \l@ngrel@x \reserved@a 0##1##2##3##4##5##6##7##8##9##1%
40 }

```

## \@reargdef

```
41 \long\def\@reargdef#1[#2]{%
42   \@yargdef#1\@ne{#2}}
```

## \renewcommand

Check the command name is already used. If not give an error message.  
Then temporarily disable \ifdefinable then call \newcommand. (Previous version \let#1=\relax but this does not work too well if #1 is \temp

```
43 \def\renewcommand{\@star@or@long\renew@command}
```

## \renew@command

```
44 \def\renew@command#1{%
45   \begingroup
46     {\escapechar\m@ne\xdef\@gtempa{{\string#1}}\endgroup
47   \expandafter\ifundefined\@gtempa
48     {\@latex@error{\noexpand#1undefined}\@ehc}%
49   \relax
50   \let\@ifdefinable\rc@ifdefinable
51   \new@command#1}
```

## 4.5.1 Checking if a command is definable

## \@ifdefinable

Test if user is allowed to define a command.

## \@rc@ifdefinable

```
51 \long\def\@ifdefinable #1#2{%
52   \edef\reserved@a{\expandafter\gobble\string #1}%
53   \ifundefined\reserved@a
54     {\edef\reserved@b{\expandafter\@carcube \reserved@a }
55      \xxx@\nil}%
56     \ifx \reserved@b\@qend \notdefinable\else
57       \ifx \reserved@a\@qrelax \notdefinable\else
58         #2%
59       \fi
60     \fi}%
61 \notdefinable
```

```
61 \let\@@ifdefinable\@ifdefinable
```

Version of \ifdefinable for use with \renewcommand. Does not do the check this time, but restores the normal definition.

```
62 \long\def\@rc@ifdefinable#1#2{%
63   \let\@ifdefinable\@@ifdefinable
64   #2}
```

This command is not a general command for package builders but it has its uses. If the command has been defined then it issues an error message via `\@notdefinable`. In the example below we save the `\@notdefinable` in order to redirect the error message to the example. We check if the counter `c@chapter` can be defined, since it has it will activate the `\@notdefinable` and print an error. We then restore the command to its previous meaning.

#### Example 5.4 `ifdefinable`

```

1 \makeatletter
2 \let\save@notdefinable\@notdefinable
3 \def\@notdefinable{Not definable}
4 \@ifdefinable{c@chapter}{true}
5 \let\@notdefinable\save@notdefinable
6 \makeatother

```

Not definable

## 4.6 Environment Building commands

### `\newenvironment`

Define a new user environment. #1 is the environment name. #2# Grabs all the tokens up to the first {. These will be any optional arguments. They are not parsed at this point, but are just passed to `\@newenv` which will eventually call `\newcommand`. Any optional arguments will then be parsed by `\newcommand` as it defines the command that executes the ‘begin code’ of the environment.

This #2# trick removed with version 1.2i as it fails if a { occurs in the optional argument. Now use `\@ifnextchar` directly.

```

7 \def\newenvironment{\@star@or@long\newenvironment}

\newenvironment
8 \def\newenvironment#1{%
9   \@testopt{\@newenva#1}0}

\@newenva
10 \def\@newenva#1[#2]{%
11   \kernel@ifnextchar [{\@newenvb#1[#2]}{\@newenv{#1}{[#2]}}]

\@newenvb
12 \def\@newenvb#1[#2][#3]{\@newenv{#1}{[#2][{#3}]}}
```

### `\renewenvironment`

Redefine an environment. For `\renewenvironment` disable `\@ifdefinable` and then call `\newenvironment`. It is OK to `\let` the argument to `\relax` here as there should not be a @temp... environment.

```

13 \def\renewenvironment{\@star@or@long\renewenvironment}

\renewenvironment
As a csname is used the name of an environment can contain non-letters, such as dashes etc.

14 \def\renewenvironment#1{%
15   \@ifundefined{#1}{%
16     {\@latex@error{Environment #1 undefined}\@ehc
17   }\relax
18   \expandafter\let\csname#1\endcsname\relax
19   \expandafter\let\csname end#1\endcsname\relax
20   \newenvironment{#1}}

```

### **\@newenv**

The internal version of **\newenvironment**.

Call **\newcommand** to define the **\begin-code** for the environment. **\def** is used for the **\end-code** as it does not take arguments. (but may contain **\pars**) Make sure that an attempt to define a ‘graf’ or ‘group’ environment fails.

```

21 \long\def\@newenv#1#2#3#4{%
22   \@ifundefined{#1}{%
23     {\expandafter\let\csname#1\expandafter\endcsname
24      \csname end#1\endcsname}%
25   }\relax
26   \expandafter\new@command
27     \csname #1\endcsname#2{#3}%
28 %<autoload>\aut@global
29   \l@ngrel@x\expandafter\def\csname end#1\endcsname{#4}}

```

## 4.7 newif

The **LATEX** kernel provides the **\newif** command that can be used to define boolean switches. It uses a couple of tricks to remove the **if** part of the command being defined and to **\let** the switches to true or false.

### **\newif{*cmd*}**

This is as the notes in the kernel mention a different type of allocation. A macro to define boolean switches

For example, **\newif\if@foo** creates **\@footrue**, **\@foofalse** to go with **\if@foo**.<sup>3</sup>

Before we describe how this is achieved we make a small digression to test a not so widely known trick to get the **\string** not to print the backslash character, by setting the **\escapechar** to -1. This is really an esoteric trick.

---

<sup>3</sup>Customarily these command use the ‘@’ to make the definitions internal and also more readable.

**Example 7.5 escapechar**

```

1  \bgroup
2  \def\test{This is a test}
3  \makeatletter
4  \escapechar\m@ne
5  \test
6
7  \string\test
8
9  test
10 \makeatother
11 \egroup

```

This is a test  
test  
test

The `\newif` is defined in a very clever way.

```

13 \def\newif#1{%
14   % save original definition
15   \count@\escapechar
16
17   % allocate to -1
18   \escapechar\m@ne
19
20   % set to false as a default
21   \let#1\iffalse
22
23   % define \@footrue and \@foofalse
24   \@if#1\iftrue
25   \@if#1\iffalse
26   \escapechar\count@

```

`\@if<name of newif>\iffalse or \iftrue`

The auxiliary macro for the `\newif` command.

```

\def\@if#1#2{%
  \expandafter\def\csname\expandafter\@gobbletwo\string#1%
    \expandafter\@gobbletwo\string#2\endcsname
  {\let#1#2}}

```

This is a mind twisting way to define the `\newif` and I am sure a method applauded by every Byzantine General. It also resolved a long standing query in my head as to why there was never a `@gobblethree` command in the kernel (see subsection 4.8.1).

## 4.8 Provide version of commands

`\providemode`

`\providemode` takes the same arguments as `\newcommand`, but discards them if #1 is already defined. Otherwise it just acts like `\newcommand`.

This implementation currently leaves any discarded definition in `\reserved@a` (and possibly `\reserved@a`) this wastes a bit of space, but it will be re-claimed as soon as these scratch macros are redefined.

```
31 \def\providecommand{\@star@or@long\provide@command}

    \provide@command

32 \def\provide@command#1{%
33   \begingroup
34     \escapechar\m@ne\xdef\@gtempa{{\string#1}}%
35   \endgroup
36   \expandafter\ifundefined\@gtempa
37     {\def\reserved@a{\new@command#1}}%
38     {\def\reserved@a{\renew@command\reserved@a}}%
39   \reserved@a}%
```

### \CheckCommand

`\CheckCommand` takes the same arguments as `\newcommand`. If the command already exists, with the same definition, then nothing happens, otherwise a warning is issued. Useful for checking the current state before a macro package starts redefining things. Currently two macros are considered to have the same definition if they are the same except for different default arguments. That is, if the old definition was: `\newcommand\xxx[2][a]{(#1)(#2)}` then `\CheckCommand\xxx[2][b]{(#1)(#2)}` would *not* generate a warning, but, for instance `\CheckCommand\xxx[2]{(#1)(#2)}` would.

```
40 \def\CheckCommand{\@star@or@long\check@command}
    \CheckCommand is only available in the preamble part of the document.
41 \@onlypreamble\CheckCommand
```

### \check@command

```
42 \def\check@command#1#2{\@check@c#1{#2}}
43 \@onlypreamble\check@command
```

### \@check@c

`\CheckCommand` itself just grabs all the arguments we need, without actually looking for [ optional argument forms. Now define `\reserved@a`. If `\reserved@a` is then defined, compare it with the “`\#1`” otherwise compare `\reserved@a` with `#1`.

```
44 \long\def\@check@c#1#2#3{%
45   \expandafter\let\csname\string\reserved@a\endcsname\relax
46   \renew@command\reserved@a#2{#3}%
47   \@ifundefined{\string\reserved@a}{%
48     {\@check@eq#1\reserved@a}%
49     {\expandafter\@check@eq
50       \csname\string#1\expandafter\endcsname
51       \csname\string\reserved@a\endcsname}}%
52 \@onlypreamble\@check@c
```

### \@check@eq

Complain if `#1` and `#2` are not `\ifx` equal.

```

53 \def\@check@eq#1#2{%
54   \ifx#1#2\else
55     \@latex@warning@no@line
56       {Command \noexpand#1 has
57        changed.\MessageBreak
58        Check if current package is valid}%
59   \fi}
60 \@onlypreamble\@check@eq

```

### 4.8.1 Argument gobbling command utilities

The `\@gobble` macro is used to get rid of its argument. Similarly `\@gobbletwo` and `\@gobblefour` eat two or four arguments respectively.

```

61 \long\def \@gobble #1{}
62 \long\def \@gobbletwo #1#2){}
63 \long\def \@gobblefour #1#2#3#4){}

```

### 4.8.2 Other argument grabbers

The commands `\@firstofone`, `\@firstoftwo` and `\@secondoftwo` are amongst the most widely used commands in the kernel. They only grab the argumenten indicated by their name.

```

64 \long\def\@firstofone#1{#1}
65 \long\def\@firstoftwo#1#2{#1}
66 \long\def\@secondoftwo#1#2{#2}

```

#### \@iden

`\@iden` is another name for `\@firstofone` for compatibility reasons.

```

\@iden
67 \let\@iden\@firstofone

```

(End definition for `\@iden`.)

#### \@thirddofthree

Another grabber now used in the encoding specific section.

```
68 \long\def\@thirddofthree#1#2#3{#3}
```

#### \@expandtwoargs

A macro to totally expand two arguments to another macro

```

69 \def\@expandtwoargs#1#2#3{%
70   \edef\reserved@a{\noexpand#1#2}{#3}\reserved@a

```

**Example 8.6 Expand two arguments**

```

1 \makeatletter
2 \bgroup
3   \def\test#1#2{#1, #2}
4   \def\xx{first argument}
5   \def\yy{second argument}
6   \@expandtwoargs\test{\xx}{\yy}
7 \egroup
8 \makeatother

```

first argument, second argument

**\@backslashchar**

A category code 12 backslash. See also ??<sup>P.??</sup> which is a better alternative.

```
9 \edef\@backslashchar{\expandafter\gobble\string\\ }
```

## 4.9 Robust commands and protect

Fragile and robust commands are one of the thornier issues in L<sup>A</sup>T<sub>E</sub>X's commands. Whilst typesetting documents, L<sup>A</sup>T<sub>E</sub>X makes use of many of T<sub>E</sub>X's features, such as arithmetic, defining macros, and setting variables. However, there are (at least) three different occasions when these commands are not safe. These are called 'moving arguments' by L<sup>A</sup>T<sub>E</sub>X, and consist of:

- writing information to a file, such as indexes or tables of contents.
- writing information to the screen.
- inside an `\edef`, `\message`, `\mark`, or other command which evaluates its argument fully.

The method L<sup>A</sup>T<sub>E</sub>X uses for making fragile commands robust is to precede them with `\protect`. This can have one of five possible values:

- `\relax`, for normal typesetting. So `\protect\foo` will execute `\foo`.
- `\string`, for writing to the screen. So `\protect\foo` will write `\foo`.
- `\noexpand`, for writing to a file. So `\protect\foo` will write `\foo` followed by a space.
- `\@unexpandable@protect`, for writing a moving argument to a file. So `\protect\foo` will write `\protect\foo` followed by a space. This value is also used inside `\edefs`, `\marks` and other commands which evaluate their arguments fully.
- `\@unexpandable@noexpand`, for performing a deferred write inside an `\edef`. So `\protect\foo` will write `\foo` followed by a space. If you want `\protect\foo` to be written, you should use `\@unexpandable@protect`. (Removed as never used).

```
\@unexpandable@protect
```

```
\@unexpandable@noexpand
```

```
10 \def\@unexpandable@protect{\noexpand\protect\noexpand}
11 %\def\@unexpandable@noexpand{\noexpand\noexpand\noexpand}
```

```
\DeclareRobustCommand
```

```
\declare@robustcommand
```

This is a package-writers command, which has the same syntax as `\newcommand`, but which declares a protected command. It does this by having

```
\DeclareRobustCommand\foo
define \foo to be \protect\foo<space>,
```

and then use `\newcommand\foo<space>`.

Since the internal command is `\foo<space>`, when it is written to an auxiliary file, it will appear as `\foo`.

We have to be a bit cleverer if we're defining a short command, such as `\_`, in order to make sure that the auxiliary file does not include a space after the command, since `\_ a` and `\_a` aren't the same. In this case we define `\_` to be:

```
\x@protect\_@protect\_<space>
```

which expands to:

```
\ifx\protect@typeset@protect\else
  \@x@protect@\_
\fi
\protect\_<space>
```

Then if `\protect` is `\@typeset@protect` (normally `\relax`) then we just perform `\_<space>`, and otherwise `\@x@protect@` gobbles everything up and expands to `\protect\_`.

*Note:* setting `\protect` to any value other than `\relax` whilst in ‘typesetting’ mode will cause commands to go into an infinite loop! In particular, setting `\relax` to `\@empty` will cause `\_` to loop forever. It will also break lots of other things, such as protected `\ifmmodes` inside `\haligns`. If you really really have to do such a thing, then please set `\@typeset@protect` to be `\@empty` as well. (This is what the code for `\patterns` does, for example.)

More fun with `\expandafter` and `\csname`.

```
12 \def\DeclareRobustCommand{@star@or@long\declare@robustcommand}
13 \def\declare@robustcommand#1{%
14   \ifx#1\undefined\else\ifx#1\relax\else
15     @latex@info{Redefining \string#1}%
16   \fi\fi
17   \edef\reserved@a{\string#1}%
18   \def\reserved@b{\#1}%
19   \edef\reserved@b{\expandafter\strip@prefix\meaning\reserved@b}%
```

```

20 %<autoload>\aut@global
21   \edef#1{%
22     \ifx\reserved@a\reserved@b
23       \noexpand\x@protect
24       \noexpand#1%
25     \fi
26     \noexpand\protect
27     \expandafter\noexpand\csname
28       \expandafter\@gobble\string#1 \endcsname
29   }%
30 \let\@ifdefinable\rc@ifdefinable
31 \expandafter\new@command\csname
32   \expandafter\@gobble\string#1 \endcsname
33 }

\x@protect

\@typeset@protect
34 \def\x@protect#1{%
35   \ifx\protect\@typeset@protect\else
36     \x@protect#1%
37   \fi
38 }
39 \def\@x@protect#1\fi#2#3{%
40   \fi\protect#1%
41 }

\@typeset@protect
42 \let\@typeset@protect\relax

\set@display@protect

\set@typeset@protect
43 \def\set@display@protect{\let\protect\string}
44 \def\set@typeset@protect{\let\protect\@typeset@protect}

\protected@edef
\protected@xdef

\unrestored@protected@xdef

\restore@protect
The commands \protected@edef and \protected@xdef perform ‘safe’ \edefs and \xdefs, saving and restoring \protect appropriately. For cases where restoring \protect doesn’t matter, there’s an ‘unsafe’ \unrestored@protected@xdef, useful if you know what you’re doing!

```

```

45 \def\protected@edef{%
46   \let\@@protect\protect
47   \let\protect\@unexpandable@protect
48   \afterassignment\restore@protect
49   \edef
50 }
51 \def\protected@xdef{%
52   \let\@@protect\protect
53   \let\protect\@unexpandable@protect
54   \afterassignment\restore@protect
55   \xdef
56 }
57 \def\unrestored@protected@xdef{%
58   \let\protect\@unexpandable@protect
59   \xdef
60 }
61 \def\restore@protect{\let\protect\@@protect}

\protect
62 \set@typeset@protect

```

### 4.9.1 Internal defining commands

#### \@ifundefined

```

63 \def\@ifundefined#1{%
64   \expandafter\ifx\csname#1\endcsname\relax
65   \expandafter\@firstoftwo
66 \else
67   \expandafter\@secondoftwo
68 \fi}

```

#### \@qend

#### \@qrelax

```

69 \edef\@qend{\expandafter\@cdr\string\end\@nil}
70 \edef\@qrelax{\expandafter\@cdr\string\relax\@nil}

```

#### \@ifnextchar

\@ifnextchar peeks at the following character and compares it with its first argument. If both are the same it executes its second argument, otherwise its third.

```

71 \long\def\@ifnextchar#1#2#3{%
72   \let\reserved@d=#1%
73   \def\reserved@a{#2}%
74   \def\reserved@b{#3}%
75   \futurelet\@let@token\@ifnch}

```

#### \kernel@ifnextchar

This macro is the kernel version of `\@ifnextchar` which is used in a couple of places to prevent the AMS variant from being used since in some places this produced chaos (for example if an `fd` file is loaded in a random place then the optional argument to `\ProvidesFile` could get printed there instead of being written only in the log file. This happened when there was a space or a newline between the mandatory and optional arguments! It should really be fixed in the `amsmath` package one day, but...

Note that there may be other places in the kernel where this version should be used rather than the original, but variable, version.

```
76 \let\kernel@ifnextchar\@ifnextchar
```

### \@ifnch

`\@ifnch` is a tricky macro to skip any space tokens that may appear before the character in question. If it encounters a space token, it calls `\@xifnch`.<sup>4</sup>

```
77 \def\@ifnch{%
78   \ifx\@let@token\@sptoken
79     \let\reserved@c\@xifnch
80   \else
81     \ifx\@let@token\reserved@d
82       \let\reserved@c\reserved@a
83     \else
84       \let\reserved@c\reserved@b
85     \fi
86   \fi
87   \reserved@c}
```

### \@sptoken

The following code makes `\@sptoken` a space token. It is important here that the control sequence `\:` consists of a non-letter only, so that the following whitespace is significant. Together with the fact that the equal sign in a `\let` may be followed by only one optional space the desired effect is achieved. NOTE: the following hacking must precede the definition of `\:` as math medium space.

```
88 \def\:{\let\@sptoken= } \: % this makes \@sptoken a space }
```

### Example 9.7 sptoken

```
1 \makeatletter
2 \noindent
3 A\:\:A\@sptoken\@sptoken A\\
4 AAA
5 \makeatother
```

---

<sup>4</sup>There is an error in the kernel at this point in the documentation, as the verbatim guards have been omitted.

```
A A A
AAA
```

### \@xifnch

In the following definition of `\@xifnch`, `\:` is again used to get a space token as delimiter into the definition.

```
6 \def\@xifnch{\expandafter\def\:@
  {\futurelet@let@token\@ifnch}}
```

The following two commands are widely used in preambles to change the `\catcode` of @ to 11 or 12.

### \makeatletter

Make internal control sequences accessible and inaccessible (`\makeatother`).

```
7 \def\makeatletter{\catcode`\@=11\relax}
8 \def\makeatother{\catcode`\@=12\relax}
```

This `\@ifstar` command is another useful

### \@ifstar{<true code>} {<false code>}

The new implementation below avoids passing the `<true code>` through one more  $\text{??}^P\text{??}$  than the `<false code>`, which previously meant that # had to be written as ##### in one argument, but ## in the other. The \* is gobbled by `\@firstoftwo`.

```
9 \def\@ifstar#1{\@ifnextchar *{\@firstoftwo{#1}}{}}
```

### \@dblarg

#### \@dblarg

```
10 \long\def\@dblarg#1{\kernel@ifnextchar[{\@dblarg{#1}}]{\@dblarg{#1}}}
11 \long\def\@dblarg#1#2[#1][#2]{#2}
```

### \@sanitize

The command `\@sanitize` footnote changes the catcode of all *special characters* except for braces to ‘other’. It can be used for commands like `\index` that want to write their arguments verbatim. Needless to say, this command should only be executed within a group, or chaos will ensue.

```
12 \def\@sanitize{\@makeother\ :
  {\@makeother\\@makeother\$@makeother\&%
  \@makeother\#\@makeother\^\@makeother\_@makeother\%\@makeother\~}}
```

### \@onelvel@sanitize

This makes the whole “meaning” of #1 (its one-level expansion) into cat-

code 12 tokens: it could be used in `\DeclareRobustCommand`.

If it is to be used on default float specifiers, this should be done when they are defined.<sup>5</sup>

---

<sup>5</sup>v1.2c 1994/10/30 Macro added

```

14 \def \@onellevel@sanitize #1{%
15   \edef #1{\expandafter\strip@prefix
16     \meaning #1}%
17 }

```

## 4.9.2 Commands for Autoloading

### \aut@global

<sup>6</sup> This command is only defined in the ‘autoload’ format. It is normally `\relax` but may be set to `\global`, in which case `\newif` and the commands based on `\newcommand` will all make global definitions.

```
18 \let\aut@global\relax
```

### @autoload

Use `\@@input` not `\input` to save string space and stops autoload files appearing in `\listfiles`

This macro is only defined in the ‘autoload’ format. It inputs a package ‘`auto#1.sty`’ within a local group, and with normalised catcodes. `\aut@global` is set to `\global` so that `\newif` `\newcommand` and related commands make global definitions.

```

19 \def\@autoload#1{%
20   \begingroup
21   \makeatletter
22   \let\aut@global\global
23   \nfss@catcodes
24   \catcode`\\ =10
25   \let\@latex@error\@gobble
26   \@@input auto#1.sty\relax
27   \endgroup

```

This been a rather long discussion, but this is almost the heart of the kernel commands that are most useful for package writers. Spend time to understand this section well, as many of the hacks described here are useful and are used in most of the other sections of the kernel.

---

<sup>6</sup>v1.2q 1995/10/02 Macro added

# 5

## Allocations

In antiquity men and women saw each other as different; accordingly, they developed complex taxonomies (philosophical explanations) for understanding anatomical, physiological, emotional, and rational differences.

Some of these differences seem profoundly odd to us moderns.

Modern discussions about erotic art have often concerned the place of women: to what extent are they objects of social manipulation, to what extent can they be subjects?



## 5.1 Counters

This section deals with counter and other variable allocation.

<sup>28</sup> %<\*2ekernel>

The following are from plain TeX:

\z@ A zero dimen or number. It's more efficient to write \parindent\z@ than \parindent 0pt.

\@ne The number 1.

\m@ne The number -1.

\tw@ The number 2.

\sixt@@n The number 16.

\@m The number 1000.

\@MM The number 20000.

\@xxxii The constant 32.

<sup>29</sup> \chardef\@xxxii=32

(End definition for \@xxxii.)

\@Mi Constants 1001–1004. These are used mostly for special penalty values used in the output routines to signal the context of the caller.

\@Mii <sup>30</sup> \mathchardef\@Mi=10001

\@miv <sup>31</sup> \mathchardef\@Mii=10002

<sup>32</sup> \mathchardef\@Miii=10003

<sup>33</sup> \mathchardef\@Miv=10004

(End definition for \@Mi and others.)

## 5.2 Scratch registers

\@tempcnta Scratch count registers used by L<sup>A</sup>T<sub>E</sub>X kernel commands.

\@tempcntb <sup>34</sup> \newcount\@tempcnta

<sup>35</sup> \newcount\@tempcntb

(End definition for \@tempcnta and \@tempcntb.)

\if@tempswa General boolean switch used by L<sup>A</sup>T<sub>E</sub>X kernel commands. To remmeber the name think of temporary switch ‘a’. This is used extensively when writing to auxiliary, toc and other list files.

<sup>36</sup> \newif\if@tempswa

(End definition for \if@tempswa.)

\@tempdima Scratch dimen registers used by L<sup>A</sup>T<sub>E</sub>X kernel commands.

\@tempdimb <sup>37</sup> \newdimen\@tempdima

<sup>38</sup> \newdimen\@tempdimb

<sup>39</sup> \newdimen\@tempdimc

(End definition for `\@tempdima`, `\@tempdimb`, and `\@tempdimc`.)

`\@tempboxa` Scratch box register used by L<sup>A</sup>T<sub>E</sub>X kernel commands.

40 `\newbox\@tempboxa`

(End definition for `\@tempboxa`.)

`\@tempskipa` Scratch skip registers used by L<sup>A</sup>T<sub>E</sub>X kernel commands.

`\@tempskipb` 41 `\newskip\@tempskipa`

42 `\newskip\@tempskipb`

(End definition for `\@tempskipa` and `\@tempskipb`.)

`\@temptokena` Scratch token register used by L<sup>A</sup>T<sub>E</sub>X kernel commands.

43 `\newtoks\@temptokena`

(End definition for `\@temptokena`.)

`\@flushglue` Glue used for `\right-` & `\leftskip = opt plus 1fil`

44 `\newskip\@flushglue \@flushglue = 0pt plus 1fil`

(End definition for `\@flushglue`.)

45 %</2ekernel>

# 6

## Control Structures

In antiquity men and women saw each other as different; accordingly, they developed complex taxonomies (philosophical explanations) for understanding anatomical, physiological, emotional, and rational differences.

Some of these differences seem profoundly odd to us moderns. Modern discussions about erotic art have often concerned the place of women: to what extent are they objects of social manipulation, to what extent can they be subjects?



## 6.1 Introduction

Looping structures are an absolute necessity to handle lists and other constructions. As TeX is so different from traditional programming languages, macro writers propose to harness TeX into a more familiar system, by imposing syntaxes borrowed from various successful highlevel programming languages.

[laan1992](#) claims that this sugaring does injustice to TeX's nature might result, and users might become intimidated, because of the difficult—at least unusual—encoding used to achieve the aim. The more so when functional equivalents are already there, although perhaps hidden, and not tagged by familiar names.<sup>1</sup>

Leslie Lamport provided a somewhat limited amount of macros, but adequate for L<sup>A</sup>T<sub>E</sub>X. It must be emphasized that [expl3](#) did a tremendous job in providing tens of alternatives in a more organized manner. If you need to program any serious amount of code you are advised to move over to these. The [etoolbox](#) package<sup>2</sup> also provides many alternatives. However it is advisable to go over these older methods in order to understand the rest of the kernel.<sup>3</sup>

```

46 %<*2ekernel>
47 \message{control,}

{@whilenoop

{@whilenum

{@iwhilenum
Changes 4 5 6
48 \long\def{@whilenum#1\do #2{\ifnum #1\relax
  \relax#2\relax}@iwhilenum{#1\relax
49      #2\relax}\fi}
50 \long\def{@iwhilenum#1{\ifnum #1\expandafter@iwhilenum
51      \else\expandafter@gobble\fi{#1}}}

{@whiledim
52 \long\def{@whiledim#1\do #2{\ifdim
  #1\relax#2@iwhiledim{#1\relax#2}\fi}

{@iwhiledim
53 \long\def{@iwhiledim#1{\ifdim #1\expandafter@iwhiledim
54      \else\expandafter@gobble\fi{#1}}}

{@whileswnoop

{@whilesw

```

---

<sup>1</sup>[laan1992](#).

<sup>2</sup>[etoolbox](#).

<sup>3</sup>[Kabelschacht1987](#).

<sup>4</sup>v1.0f 1995/07/09 Reimplemented using Kabelschacht method

<sup>5</sup>v1.0g 1995/08/16 Removed {@whilenoop}

<sup>6</sup>v1.0g 1995/08/16 Made defs long

```
\@iwhilesw
55 \long\def\@whilesw#1\fi{#1#2\@iwhilesw{#1#2}\fi\fi}
56 \long\def\@iwhilesw#1\fi{#1\expandafter\@iwhilesw
57     \else\@gobbletwo\fi{#1}\fi}
```

## \@nnil

A quark to mark delimited macros.

```
58 \def\@nnil{\@nil}
```

## \@empty

```
59 \def\@empty{}
```

## \@fornoop

```
60 \long\def\@fornoop#1\@@#2#3{}
```

## \@for{\{:\}}{\{=\}}{\{comma list\}}

Note that this is a macro delimited with `:=` and `\do`. After expanding #2 it handles control to `\@forloop` which takes over control. If you wandering why `:=`, this was the **becomes** symbol used in Pascal and people were familiar with the convention.

```
61 \long\def\@for#1:=#2\do#3%
62   {%
63     \expandafter\def\expandafter\@fortmp\expandafter{#2}%
64       \ifx\@fortmp\@empty%
65       \else
66         \expandafter\@forloop#2,\@nil,\@nil\@@#1{#3}%
67       \fi
68   }
```

## \@forloop

```
69 \long\def\@forloop#1,#2,#3\@@#4#5{\def#4{#1}\ifx #4\@nnil \else
70     #5\def#4{#2}\ifx #4\@nnil \else#5\@forloop
71     #3\@@#4{#5}\fi\fi}
```

## \@iforloop

```
71 \long\def\@iforloop#1,#2\@@#3#4{\def#3{#1}\ifx #3\@nnil
72   \expandafter\@fornoop \else
73     #4\relax\expandafter\@iforloop\fi#2\@@#3{#4}}
```

## \@tfor {\{next token\}}{\{list\}}{\{body code\}}

The looping structure iterates over each token in a list. It uses the Kabelschacht method. Note that you may have to expand the list if in a macro, using an appropriate number of `\expandafter` commands.

**Example 1.1 tfor**

```

1 \makeatletter
2 \def\alist{ABCDE FGH}
3 \expandafter\@tfor\expandafter\next%
4 \expandafter:\expandafter=\alist\do{%
5   [\next]\tikz[inner sep=0pt, outer sep=0pt]\node (X)
6   {\&};%
7 } \makeatother

```

[A]&[B]&[C]&[D]&[E]&[F]&[G]&[H]&

```
8 \def\@tfor#1:={\@tf@r#1 }
```

```
\@tf@r
9 \long\def\@tf@r#1#2\do#3{\def\@fortmp{#2}\ifx\@fortmp\space\else
10   \@tforloop#2\@nil\@nil\@#1{#3}\fi}
11
12 \long\def\@tforloop#1#2\@#3#4{\def#3{#1}\ifx #3\@nil
13   \expandafter\@fornoop \else
14   #4\relax\expandafter\@tforloop\fi#2\@#3{#4}}

```

Note that it ignores any spaces in the list

(End definition for `\@tf@r`.)

**\@break@tfor**

Break out of a `\@tfor` loop. This should be called *inside* the scope of an `\if`. See `\@iffileonpath`<sup>→ σ 128</sup> for an example.

```
15 \long\def\@break@tfor#1\@#2#3{\fi\fi}
```

**\@removeelement**

Removes an element from a comma-separated list and puts it into a control sequence, called as `\@removeelement{<element>} {<list>} {<cs>}`. Due to the implementation method the `<element>` is not allowed to contain braces.

```

16 \def\@removeelement#1#2#3{%
17   \def\reserved@a##1,#1##2\reserved@a{##1,##2\reserved@b}%
18   \def\reserved@b##1,\reserved@a##2\reserved@b{%
19     \ifx,##1\empty\else##1\fi}%
20   \edef#3{%
21     \expandafter\reserved@b\reserved@a,#2,\reserved@b,##1,\reserved@a}}

```

# 7

## Error Handling (file `lterror.dtx`)

This Chapter defines  $\text{\LaTeX} 2_{\varepsilon}$ 's error commands. Most of the error messages are defined here, although now and then some error messages are defined in other `.dtx` files. Warnings, fatal errors and help are amongst the techniques discussed.



## 7.1 Error handling

This section defines  $\text{\LaTeX} 2_{\epsilon}$ 's error commands. Most of the error messages are defined here, although now and then some error messages are defined in other **.dtx** files.

The '2ekernel' code ensures that a `\usepackage{autoerr}` is essentially ignored if a 'full' format is being used that has the error messages already in the format.

```
22   \expandafter\let\csname \ver@autoerr.sty\endcsname\fmtversion
```

### 7.1.1 General commands

#### `\MessageBreak`

This command prints a new-line inside a message, followed by a continuation line beginning with `\@msg@continuation`. Normally it is defined to be `\relax`, but inside messages, it is let to `??P.??` for example in the definition of `\GenericWarning`.

```
23 \let\MessageBreak\relax
```

#### `\GenericInfo`

This takes two arguments: a continuation and a message, and sends the result to the log file.

```
24 \DeclareRobustCommand{\GenericInfo}[2]{%
25   \begingroup
26   \def\MessageBreak{\^J#1}%
27   \set@display@protect
28   \immediate\write\m@ne{\#2\on@line.}%
29   \endgroup
30 }
```

#### `\GenericWarning`

This takes two arguments: a continuation and a message, and sends the result to the screen.

```
31 \DeclareRobustCommand{\GenericWarning}[2]{%
32   \begingroup
33   \def\MessageBreak{\^J#1}%
34   \set@display@protect
35   \immediate\write\@unused{\^J#2\on@line.\^J}%
36   \endgroup
37 }
```

#### `\GenericError`

This macro takes four arguments: a continuation, an error message, where to go for further information, and the help information. It displays the error message, and sets the error help (the result of typing `h` to the prompt), and does a horrible hack to turn the last context line (which by default is the only context line) into just three dots. This could be made more efficient.

```

38 \def\GenericError{\@autoerr\GenericError}
39
40 \bgroup
41 \lccode`\@=`\ \
42 \lccode`\~=`\ \
43 \lccode`\}=`\ \
44 \lccode`\{=` \
45 \lccode`\T=`\T%
46 \lccode`\H=`\H%
47 \catcode`\ =11\relax%
48 \lowercase{%
49 \egroup%

```

Unfortunately TeX versions older than 3.141 have a bug which means that `^J` does not force a linebreak in `\message` and `\errmessage` commands. So for these old TeX's we use `\typeout` to produce the message, and then have an empty `\errmessage` command. This causes an extra line of the form

`! .`

To appear on the terminal, but if you do not like it, you can always upgrade your TeX! In order for your format to use this version, you must define the macro `\@TeXversion` to be the version number, e.g., 3.14 of the underlying TeX. See the comments in `ltdircheck.dtx`.

```

50 \dimen@\ifx\@TeXversion\undefined4\else\@TeXversion\fi\p@%
51 \ifdim\dimen@>3.14\p@%

```

First the ‘standard case’.

```

52 \DeclareRobustCommand{\GenericError}[4]{%
53 \begingroup%
54 \immediate\write\@unused{}%
55 \def\MessageBreak{^J}%
56 \set@display@protect%
57 \edef%
58 %      %<-----do not delete this %
59 \err@ %
60 {%
61 \errhelp
62 %      %<-----do not delete this %
63 \err@ %
64 \let
65 %      %<-----do not delete this %
66 \err@ %
67 \empty%
68 \def\MessageBreak{^J#1}%

```

```

69 \def~{\errmessage{%
70 #2.^^J^^J%
71 #3^^J%
72 Type H <return> for immediate help%
73 %   %<-----do not delete this %
74   \space!----->%
75 }%
76 ~%
77 \endgroup}%
78 \else%
    Secondly the version for old TEX's.
79 \DeclareRobustCommand{\GenericError}[4]{%
80 \begingroup%
81 \immediate\write\@unused{}%
82 \def\MessageBreak{^^J}%
83 \set@display@protect%
84 \edef%
85   %<-----do not delete this %
86   \space!----->%
87 }{%
88 \errhelp%
89   %<-----do not delete this %
90   \space!----->%
91 \let%
92   %<-----do not delete this %
93 \err@%
94 \errmessage%
95 \def\MessageBreak{^^J#1}%
96 \def~{\typeout{! }%
97 #2.^^J^^J%
98 #3^^J%
99 Type H <return> for immediate help.%}
100   %<-----do not delete this %
101   \space!----->%
102 }{%
103 ~%
104 \endgroup}%
105 \fi}%

```

### 7.1.2 Package and Class error messages

\PackageWarningNoLine

\PackageInfo

\ClassError

\ClassWarning

\ClassWarningNoLine

\ClassInfo

These commands are intended for use by package and class writers, to give information to authors. The syntax is:

```
\PackageError{<package>}{<error>}{{<help>}}
\PackageWarning{<package>}{<warning>}
\PackageWarningNoLine{<package>}{<warning>}
\PackageInfo{<package>}{{<info>}}
```

and similarly for classes. The **Error** commands print the *<error>* message, and present the interactive prompt; if the author types **h**, then the *<help>* information is displayed. The **Warning** commands produce a warning but do not present the interactive prompt. The **WarningNoLine** commands do the same, but don't print the input line number. The **Info** commands write the message to the **log** file. Within the messages, the command \MessageBreak can be used to break a line, \protect can be used to protect command names, and \space is a space, for example:

```
\newcommand{\foo}{FOO}
\PackageWarning{ethel}{%
  Your hovercraft is full of eels,\MessageBreak
  and \protect\foo\space is \foo}
```

produces:

```
Package ethel warning: Your hovercraft is full of eels,
(ethel)                                and \foo is FOO on input line 54.
```

The definition of the commands are fairly straight forward. They all use the \GenericError<sup>[92](#)</sup> command to display the error on the terminal. The new expl3 module for L<sup>A</sup>T<sub>E</sub>X 3e, has expanded on this work tremendously, so that there is no real need for using these macros any longer.

\PackageError {<package>} {<error>} {{<help>}}

```

107 \gdef\PackageError#1#2#3{%
108   \GenericError{%
109     (#1)\@spaces \@spaces \@spaces \@spaces
110   }{%
111     Package #1 Error: #2%
112   }{%
113     See the #1 package documentation for explanation.%
114   }{#3}%
115 }

\Packagewarning {package} {warning}

116 \def\PackageWarning#1#2{%
117   \GenericWarning{%
118     (#1)\@spaces \@spaces \@spaces \@spaces
119   }{%
120     Package #1 Warning: #2%
121   }{%
122 }
123 \def\PackageWarningNoLine#1#2{%
124   \PackageWarning{#1}{#2\@gobble}%
125 }
126 \def\PackageInfo#1#2{%
127   \GenericInfo{%
128     (#1) \@spaces \@spaces \@spaces
129   }{%
130     Package #1 Info: #2%
131   }{%
132 }

\ClassError

133 \gdef\ClassError#1#2#3{%
134   \GenericError{%
135     (#1) \space \@spaces \@spaces \@spaces
136   }{%
137     Class #1 Error: #2%
138   }{%
139     See the #1 class documentation for explanation.%
140   }{#3}%
141 }

(End definition for \ClassError.)

142 \def\ClassWarning#1#2{%
143   \GenericWarning{%
144     (#1) \space \@spaces \@spaces \@spaces
145   }{%
146     Class #1 Warning: #2%
147   }{%
148 }
149 \def\ClassWarningNoLine#1#2{%
150   \ClassWarning{#1}{#2\@gobble}%
151 }
152 \def\ClassInfo#1#2{%

```

```

153   \GenericInfo{%
154     (#1) \space\space\@spaces\@spaces
155   }{%
156     Class #1 Info: #2%
157   }%
158 }

```

Some errors are marked to be generated only in the L<sup>A</sup>T<sub>E</sub>X 2e kernel. This is where we see the reference to the LaTeX Manual or the LaTeX Companion for help is mentioned.

```

\@latex@error
\@latex@warning
\@latex@warning@no@line
\@latex@info
\@latex@info@no@line

159 \gdef\@latex@error#1#2{%
160   \GenericError{%
161     \space\space\space\@spaces\@spaces\@spaces
162   }{%
163     LaTeX Error: #1%
164   }{%
165     See the LaTeX manual or LaTeX Companion for explanation.%
166   }{#2}%
167 }

168 \def\@latex@warning#1{%
169   \GenericWarning{%
170     \space\space\space\@spaces\@spaces\@spaces
171   }{%
172     LaTeX Warning: #1%
173   }%
174 }

175 \def\@latex@warning@no@line#1{%
176   \@latex@warning{#1\@gobble}%
177 }

178 \def\@latex@info#1{%
179   \GenericInfo{%
180     \@spaces\@spaces\@spaces
181   }{%
182     LaTeX Info: #1%
183   }%
184 }

185 \def\@latex@info@no@line#1{%
186   \@latex@info{#1\@gobble}%
187 }

188 \font@warning and \font@info are defined later
189 since they have to be redefined by the tracefn package.
190 \def\@font@warning#1{%
191   \GenericWarning{%

```

```

        {(font)\@spaces\@spaces}%
{Font Warning: #1}%
}
\def\@font@info#1{%
  \GenericInfo{%
    (font)\space\@spaces
  }{%
    Font Info: #1%
  }%
}
}

\c@errorcontextlines
\errorcontextlines as a LATEX counter, so that it may be manipulated with \setcounter (once it is defined :-)
186 \let\c@errorcontextlines\errorcontextlines
187 \c@errorcontextlines=-1

\on@line
The message ‘on input line n’, if possible.
188 \ifnum\inputlineno=\m@ne
189   \let\on@line\empty
190 \else
191   \def\on@line{ on input line \the\inputlineno}
192 \fi

\@warning
\@@warning
\@latexerr
Older LATEX messages. For the moment, these \let to the new message commands. They may be changed later, once only obsolete packages and classes contain them.
193 \let\@warning\@latex@warning
194 \let\@@warning\@latex@warning@no@line
195 </2ekernel|autoload>
196 \global\let\@latexerr\@latex@error

\@spaces
Four spaces.
197 \def\@spaces{\space\space\space\space}
```

### 7.1.3 Specific errors

The four commands **\@eha**, **\@ehb**, **\@ehc**, and **\@ehd**, expand to specific errors. The more common error help messages are defined by macros named as a series of **\@eh*letter***. Obviously short for errorhelp

```

198 \gdef\@eha{%
199   Your command was ignored.\MessageBreak
200   Type \space I <command> <return> \space to replace it %
201   with another command,\MessageBreak
202   or \space <return> \space to continue without it.}
203 \gdef\@ehb{%
204   You've lost some text. \space \@ehc}
205 \gdef\@ehc{%
206   Try typing \space <return> %
207   \space to proceed.\MessageBreak
208   If that doesn't work, type \space X <return> \space to quit.}
209 \gdef\@ehd{%
210   You're in trouble here. \space\@ehc}

As \ latex@error triggers the autoload, these definitions should not be needed
in the autoload format, but just to be safe...

211 %<*autoload>
212 \let\@eha\@empty\let\@ehb\@empty\let\@ehc\@empty\let\@ehd\@empty
213 %</autoload>

```

Here are most of the error message-generating commands of  $\text{\LaTeX}$ .

### \@autoerr

Make this autoload command robust, as it may be read in at unpredictable times.

```
214 <autoload>\def\@autoerr{\protect\@autoload{err}\protect}
```

### \@notdefinable

Error message generated in \ifdefinable from calls to one of the commands \newcommand, \newlength or \newtheorem specifying an already-defined command name or one that begins \end....

```
215 \gdef\@notdefinable{%
```

### \@nolnerr

Generated by \newline and \\ when called in vertical mode.

```
216 \gdef\@nolnerr{%
217 <!autoload>  \@latex@error{There's no line here to end}\@eha}
218 <autoload>  \@autoerr\@nolnerr}
```

### \@nocounterr

Generated by \setcounter, \addtocounter or \newcounter if applied to an undefined counter <cnt>.

### \@nocnterr

Obsolete error message generated in  $\text{\LaTeX}2.09$  by \setcounter, \addtocounter or \newcounter for undefined counter. DO NOT use for  $\text{\LaTeX}2_{\epsilon}$  it MIGHT vanish! Use \@nocounterr{<cnt>} instead.

```
219 \gdef\@nocnterr#1{%
220 <!autoload>  \@latex@error{No counter '#1' defined}\@eha}
221 <autoload>  \@autoerr\@nocounterr}
222 \gdef\@nocnterr{\@nocounterr?}
```

\@ctrerr

Called when trying to print the value of a counter numbered by letters that's greater than 26.

```
223 \gdef\@ctrerr{\%  
224 <!autoload>  \@latex@error{Counter too large}\@ehb  
225 <autoload>  \@autoerr\@ctrerr}
```

## \@nодокумент

Error produced if paragraphs are typeset in the preamble.

```
226 <!def> \gdef\@nodocument{%
227 <!def> \@latex@error{Missing \protect\begin{document}}\@ehd}
```

\@badend

Called by \end that doesn't match its \begin. RmS 1992/08/24: added code to \@badend to display position of non-matching \begin. FMi 1993/01/14: missing space added.

```
228 \gdef\@badend#1{%
229 <!autoload>    %
230 <!autoload>          \space ended by %
231 <autoload>  \@autoerr\@badend}
```

\@badmath

Called by `\[`, `\]`, `\(` or `\)` when used in wrong mode.

```
232 \gdef\@badmath{%
233 <!autoload>  \@latex@error{Bad math environment }%
234 <autoload>  \autoerr\@badmath}
```

\@toodeep

Called by a list environment nested more than six levels deep, or an enumerate or itemize nested more than four levels.

```
235 \gdef\@toodeep{%
236 <!autoload> \@latex@error{Too deeply nested}\@ehd}
237 <autoload> \@autoerr\@toodeep}
```

## \@badpoptabs

Called by `\endtabbing` when not enough `\poptabs` have occurred, or by `\poptabs` when too many have occurred.

```
238 \gdef\@badpoptabs{%
239 <!autoload>  \@latex@error{\protect\pushtabs\space and }%
240 & \protect\poptabs
241 <!autoload>  \space don't match}\@ehd
242 <autoload>  \@autoerr\@badpoptabs}
```

\@badtab

Called by \>, \+ , \- or \< when stepping to an undefined tab.

```
242 \gdef\@badtab{%
243 <!autoload> \@latex@error{Undefined tab position}\@ehd}
244 <autoload> \@autoerr\@badtab}
```

### \@preamerr

This error is special: it appears in places where we normally have to `\protect` expansions. However, to prevent a protection of the error message itself (which would result in the message getting printed not issued on the terminal) we need to locally reset `\protect` to `\relax`.

```
245 \gdef\@preamerr#1{%
246   \begingroup
247     \let\protect\relax
248 <!*autoload>
249   \@latex@error{\ifcase #1 Illegal character\or
250     Missing @-exp\or Missing p-arg\fi\space
251     in array arg}\@ehd
252 </!autoload>
253 <autoload> \@autoerr\@preamerr{#1}%
254 \endgroup}
```

### \@badlinearg

Occurs in `\line` and `\vector` command when a bad slope argument is encountered.

```
255 \gdef\@badlinearg{%
256 <!autoload> \@latex@error{%
257 <!autoload>      Bad \protect\line\space or \protect\vector
258 <!autoload>      \space argument}\@ehb}
259 <autoload> \@autoerr\@badlinearg}
```

### \@parmoderr

Occurs in a float environment or a `\marginpar` when encountered in inner vertical mode.

```
260 \gdef\@parmoderr{%
261 <!autoload> \@latex@error{Not in outer par mode}\@ehb}
262 <autoload> \@autoerr\@parmoderr}
```

### \@fltovf

Occurs in float environment or `\marginpar` when there are no more free boxes for storing floats.

```
263 \gdef\@fltovf{%
264 <!autoload> \@latex@error{Too many unprocessed floats}\@ehb}
265 <autoload> \@autoerr\@fltovf}
```

### \@latexbug

Occurs in output routine. This is bad news.

```
266 \gdef\@latexbug{%
267 <!autoload> \@latex@error{This may be a LaTeX bug}{Call for }
268 <autoload> \@autoerr\@latexbug}
```

**\@badcrerr**

This error was removed and replaced by \@nolnerr.

```
269 \def\@badcrerr {\@latex@error{Bad use of \protect\\}\@ehc}
```

**\@noitemerr**

\addvspace or \addpenalty was called when not in vmode. Probably caused by a missing \item.

```
270 \gdef\@noitemerr{%
271 <!autoload> \@latex@error{Something's wrong--perhaps a }%
272 \missing %
273 <!autoload> \protect\item}\@ehc}
274 <autoload> \autoerr\@noitemerr}
```

**\@notprerr**

A command that can be used only in the preamble appears after the command \begin{document}.

```
274 \gdef\@notprerr{%
275 <!autoload> \@latex@error{Can be used only in preamble}\@eha}
276 <autoload> \autoerr\@notprerr}
```

**\@inmatherr**

Issued by commands that don't work correctly within math (like \item). There is no real error recovery happening, e.g., the user might get additional errors afterwards.

```
277 \gdef\@inmatherr#1{%
278   \relax
279   \ifmmode
280 <!autoload> \@latex@error{Command \protect#1 invalid in math }%
281 \missing %
282   \fi}
```

As well as the above error commands some error messages are directly coded to save space. The Messages alrerady present in L<sup>A</sup>T<sub>E</sub>X2.09 included:

**Environment --- undefined**

Issued by \begin for undefined environment.

**tab overflow**

Occurs in \= when maximum number of tabs exceeded.

**\< in mid line**

Occurs in \< when it appears in middle of line.

**Float(s) lost**

In output routine, caused by a float environment or \marginpar occurring in inner vertical mode.

# 8

## ltspacex.dtx

This Chapter defines L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub> ’s error commands. Most of the error messages are defined here, although now and then some error messages are defined in other .dtx files.

Warnings, fatal errors and help are amongst the techniques discussed.



## 8.1 Spacing

This section of the L<sup>A</sup>T<sub>E</sub>X kernel deals with spacing, line and page-breaking.

### 8.1.1 User Commands

#### \nopagebreak{⟨o,...,4⟩}

The command \nopagebreak<sup>→ P. 107</sup>[⟨i⟩] : ⟨i⟩ = o,...,4 attempts to stop the page breaking at this point, by inserting an appropriate amount of penalty.

Default argument = 4. Puts a penalty into the vertical list output as follows:

```
o : penalty = 0
1 : penalty = \@lowpenalty
2 : penalty = \@medpenalty
3 : penalty = \@highpenalty
4 : penalty = 10000
```

Interestingly the definitions of the penalties is left to the class files such as book. How are \@lowpenalty etc. defined? Their definition is found in the class file, although the counters are defined in the kernel source.:

```
\@lowpenalty 51
\@medpenalty 151
\@highpenalty 301
```

As Frank Mittelbach noted <http://tex.stackexchange.com/questions/83350/nopagebreak-and-penalty>: \nopagebreak is a high-level L<sup>A</sup>T<sub>E</sub>X command that inspects its surroundings (to some extend) and does different things depending on whether it is used in vertical or in horizontal mode.

If you are in the middle of a paragraph, then saying \penalty 10000 is inserting a penalty that directs the linebreaking, but not one that affects the page breaking. In contrast \nopagebreak would insert more or less \vadjust{\penalty 10000} and it would do some additional magic to ensure that you don't end up with two spaces in that place.

So bottom line, as a user you shouldn't use \penalty at all, there are good reasons why L<sup>A</sup>T<sub>E</sub>X provides higher-level user commands. As a developer of a package, you may use penalty if you know what situation are in and of course using \penalty directly removes a tiny bit of overhead.

#### \pagebreak[⟨i⟩]

\pagebreak<sup>→ P. 107</sup> is the same as \nopagebreak<sup>→ σ 107</sup> except negatives of its penalty.

#### \linebreak[⟨i⟩]

analog of the above

\nolinebreak[*i*]

analog of the above

\samepage\*

Inhibits page breaking most places by setting the following penalties to 10000:

```
\interlinepenalty
\postdisplaypenalty
\interdisplaylinepenalty
@beginparpenalty
@endparpenalty
@itempenalty
@secpenalty
\interfootnotelinepenalty
```

#### Example 1.1 Example

```
1 \bgroup
2 \samepage
3
4 \the\interlinepenalty
5
6 \the\postdisplaypenalty
7
8 \the\interfootnotelinepenalty
9 \egroup
10
11 \the\interlinepenalty

10000
10000
10000
0
```

### 8.1.2 Vertical spacing commands

The vertical spacing commands are similar to the horizontal commands. The plain TeX commands `\smallskip`<sup>P. 114</sup>, `\medskip`<sup>P. 114</sup> and `\bigskip`<sup>P. 114</sup> are supported by L<sup>A</sup>T<sub>E</sub>X, however they are redefined in terms of `\vspace` instead of `\vskip`.

\smallskip

\medskip

\bigskip

**\vspace{*dim*}**

The commands **\vspace** and **\vspace\*** add a fixed amount of vertical spacing.

**\addvspace{*skip*}**

Extra vertical space is added by the command **\addvspace**. It adds a vertical amount of skip of *skip* to the document. The command can only be used in vertical mode. The **\addvspace**<sup>P. 113</sup> command does not add vertical space if **minipage** is true.

### 8.1.3 Horizontal spacing

**\hspace****\hspace\***

The commands **\hspace{*skip*}** and **\hspace\*{*skip*}** are robust commands that add a horizontal skip. The star version of the command should be used at the beginning of a line.

**\nobreakspace**

The no breaking space ~ The **\nobreakspace**<sup>P. 115</sup> command is a robust command that produces a horizontal space at which, in paragraph mode, a line-break is not possible. The is defined as active to expand to **\nobreakspace**<sup>P. 115</sup>.

When \. is used in paragraph mode it produces a **\thinspace**. The command \@ when placed before a ‘.’ makes it a sentence-ending period. It also does the right thing after other punctuation marks as well.

The command **\thinspace** adds a .16667em kern, whereas the **\negthinspace** adds an equal negative amount of kern. An **\enspace** is a .5em kern.

**\thinspace**

Adds a .16667em kern.

**\negthinspace****\enspace**

### 8.1.4 Obsolete Commands

**\obeycr** : defines <CR> == \\relax  
**\restorecr** : restores <CR> to its usual meaning.

### 8.1.5 The code

The code follows the sequence and commentary of the original source to a large extend. I have added additional commentary where necessary to provide additional explanatory comments and to cross-reference code to algorithms and other sections.

```
12 \message{spacing,}
```

In the definition of `\pagebreak` and `\nopagebreak` observe the use of `\@testoptP.69`. This macro is defined in `ltdefns.dtx` and encapsulates the most common call to `\@ifnextcharP.80`. It takes two arguments. There is also a robust version available `??P.??`.

#### `\pagebreak`

The control sequence `\pagebreak` inserts penalties to force a page break.

```
13 \def\pagebreak{\@testopt{\@no@pgbk-}4}
```

#### `\nopagebreak`

The opposite of `\pagebreak`

```
14 \def\nopagebreak{\@testopt{\@no@pgbk4}}
```

#### `\@no@pgbk`

This is the main internal macro for adding the penalties. Penalties are added after examining if the command has been issued in vertical or horizontal mode. The command `\@getpen` is defined on Line 67.

```
16 \def \@no@pgbk #1[#2]{%
17   \ifvmode
18     \penalty #1\@getpen{#2}%
19   \else
20     \@bsphack
21     \vadjust{\penalty #1\@getpen{#2}}%
22     \@esphack
23   \fi}
```

#### `\linebreak`

##### `\nolinebreak`

```
24 \def\linebreak{\@testopt{\@no@lnbk-}4}
25 \def\nolinebreak{\@testopt{\@no@lnbk4}}
```

##### `\@no@lnbk`

```
26 \def \@no@lnbk #1[#2]{%
27   \ifvmode
28     \nolnerr
29   \else
30     \tempskipa\lastskip
```

```

31      \unskip
32      \penalty #1\@getpen{#2}%
33      \ifdim\@tempskipa>\z@
34          \hskip\@tempskipa
35          \ignorespaces
36      \fi
37  \fi}

```

### \samepage

The macro `\samepage` is a versatile macro that can be used in many different environments to set penalties, in such a way as to discourage page breaking. All penalties are set to `\@M`

```

38 \def\samepage{\interlinepenalty\@M
39   \postdisplaypenalty\@M
40   \interdisplaylinepenalty\@M
41   \beginparpenalty\@M
42   \endparpenalty\@M
43   \itempenalty\@M
44   \secpenalty\@M
45   \interfootnotelinepenalty\@M}

```

`\\\`

It appears to be safe to use `\reserved@e` and `\reserved@f` here (other reserved macros are somewhat disastrous).

These changes made `\newline` even less robust than it had been, so now it is explicitly robust, like `\\\`.

### \@normalcr

The internal definition of the ‘normal’ definition of `\\\`.

```

46 \DeclareRobustCommand\\{%
47   \let \reserved@e \relax
48   \let \reserved@f \relax
49   \@ifstar{\let \reserved@e \vadjust \let \reserved@f \nobreak
50           \xnewline}%
51           \xnewline}
52 \expandafter\let\expandafter\@normalcr
53   \csname\expandafter\gobble\string\\ \endcsname

```

### \newline

The `\newline` provides syntactic sugar to a simple form of the `\@normalcr` definition of `\\\`.

```
54 \DeclareRobustCommand\newline{@normalcr\relax}
```

### \@xnewline

```

55 \def\xnewline{@ifnextchar[% ] bracket matching for Emacs!
56   \newline
57   {\gnewline\relax}}
```

## \@newline

```
58 \def\@newline[#1]{\let \reserved@e \vadjust
59   \@gnewline {\vskip #1}}
```

## \@gnewline

The `\nobreak` added to prevent null lines when `\`` ends an overfull line.

```
60 \def\@gnewline #1{%
61   \ifvmode
62     \@nolnerr
63   \else
64     \unskip \reserved@e {\reserved@f#1}\nobreak \hfil \break
65   \fi}
```

## \@getpen

The command `\@getpen` is a helper command to allocate penalties. This has been abstracted to make it easier for classes to insert penalties that they predefine.

```
66 \def\@getpen#1{\ifcase #1 \z@ \or \@lowpenalty\or
67   \@medpenalty \or \@highpenalty
68   \else \@M \fi}
```

## \if@nobreak

Switch used to avoid page breaks caused by `\label` after a section heading, etc. It should be **GLOBALLY** set true after the `\nobreak` and **globally** set false by the next invocation of `\everypar`.

Commands that reset `\everypar` should globally set it false if appropriate.

```
69 \def\@nobreakfalse{\global\let\if@nobreak\iffalse}
70 \def\@nobreaktrue {\global\let\if@nobreak\iftrue}
71 \@nobreakfalse
```

**8.1.6 Space removing macros**

`\@bsphack` and `\@esphack` used by macros such as `\index` and `\begin{@float}` ... `\end{@float}` that want to be invisible — i.e., not leave any extra space when used in the middle of text. Such a macro should begin with `\@bsphack` and end with `\@esphack`. The macro in question should not create any text, nor change the mode.

Before giving the current definition we give an extended definition that is currently not used (because it doesn't work as advertised:-)

These are generalised hacks which attempt to do sensible things when ‘invisible commands’ appear in vmode too.

They need to cope with space in both hmode (plus spacefactor) and vmode, and also cope with breaks etc. In vmode this means ensuring that any following `\addvspace`, etc sees the correct glue in `\lastskip`.

In fact, these improved versions should be used for other cases of ‘whatsits, thingies etc’ which should be invisible. They are only for commands, not environments (see notes on `\@EspHack`).

BTW, anyone know why the standard hacks are surrounded by `\ifmmode\else` rather than simply `\ifhmode`?

And are there any cases where saving the spacefactor is essential? I have some extensions where it is, but it does not appear to be so in the standard uses.

### `\@savsk{<skip>}`

#### `\@savesfnumber`

The registers `\@savsk` and `\@savesf` used to save the space factor and last skip.

```
72 \newdimen\@savsk
73 \newcount\@savesf
```

#### `\@bsphack`

```
74 \def \@bsphack{%
75   \relax \ifvmode
76     \@savsk \lastskip
77     \ifdim \lastskip=\z@
78     \else
79       \vskip -\lastskip
80     \fi
81   \else
82     \ifhmode
83       \@savsk \lastskip
84       \@savesf \spacefactor
85     \fi
86   \fi
87 }
```

I think that, in vmode, it is the safest to put in a `\nobreak` immediately after such things since writes, inserts etc followed by glue give valid breakpoints and, in general, it is possible to create breaks but impossible to destroy them.

```
\def \@espHack{%
  \relax \ifvmode
    \nobreak
    \ifdim \@savsk=\z@
    \else
      \vskip\@savsk
    \fi
  \else
    \ifhmode
      \spacefactor \@savesf
      \ifdim \@savsk>\z@
        \ignorespaces
      \fi
    \fi
  \fi}
```

```

        \fi
    \fi
}
}

\@bsphack

88
89 \def\@bsphack{%
90   \relax
91   \ifhmode
92     \@savsk\lastskip
93     \@savsf\spacefactor
94   \fi}

\@esphack
Companion to \@bsphack.
95 \def\@esphack{%
96   \relax
97   \ifhmode
98     \spacefactor@savsf
99     \ifdim\@savsk>\z@
100       \ignorespaces
101     \fi
102   \fi}

\@Eshack

103 \def\@Eshack{%
104   \relax
105   \ifhmode
106     \spacefactor@savsf
107     \ifdim\@savsk>\z@
108       \ignoretrue
109     \ignorespaces
110   \fi
111   \fi}

```

### 8.1.7 Vertical spacing

**LATEX** supports the plain TeX commands **\smallskip**, **\medskip** and **\bigskip**. However, it redefines them using **\vspace** instead of **\vskip**.

Extra vertical space is added by the command **\addvspace{<skip>}**, which adds a vertical skip of **<skip>** to the document. The sequence **\addvspace{<s1>} \addvspace{<s2>}** is equivalent to **\addvspace{<maximum of s1, s2>}**.

**\addvspace** should be used only in vertical mode, and gives an error if it's not. The **\addvspace** command does *not* add vertical space if **@minipage** is true. The minipage environment uses this to inhibit the addition of extra vertical space at the beginning.

Penalties are put into the vertical list with the `\addpenalty{⟨penalty⟩}` command. It works properly when `\addpenalty` and `\addvspace` commands are mixed.

The `@nobreak` switch is set true used when in vertical mode and no page break should occur. (Right now, it is used only by the section heading commands to inhibit page breaking after a heading.)

```

1 \addvspace{⟨skip⟩} == begin
2   if vmode then
3     if @minipage then
4       else
5         if \lastskip = 0 then
6           \vskip ⟨skip⟩
7         else
8           if \lastskip < ⟨skip⟩ then
9             \vskip -\lastskip \vskip ⟨skip⟩
10            else
11              if SKIP < 0 and \lastskip >= 0 then
12                \vskip -\lastskip
13                \vskip \lastskip + ⟨skip⟩
14              end
15            end
16          end
17        end
18      end
19      Error message.
20    end
21  end

```

**Algorithm 1:** The `\addvspace` command.

### `\@xaddvskip`

Internal macro for `\vspace` handling the case that space has previously been added.

```

112 \def\@xaddvskip{%
113   \ifdim\lastskip<\@tempskipb
114     \vskip-\lastskip
115     \vskip\@tempskipb
116   \else
117     \ifdim\@tempskipb<\z@
118       \ifdim\lastskip<\z@
119       \else
120         \advance\@tempskipb\lastskip
121         \vskip-\lastskip
122         \vskip \@tempskipb
123       \fi
124     \fi
125   \fi}

```

This is actually a good place to create an example of usage and to also revisit the `\lastskip` and `\unskip` commands.

### Example 1.2 Unskip and lastskip

```

1 \bgroup
2 \newdimen\Tkern
3 \setbox1=\hbox{\kern1pt\hbox{B}\quad}
4 \unhbox1
5 \the\lastskip
6 \skip0=\lastskip \unskip
7 \setbox0=\lastbox
8 \the\lastskip
9 \Tkern=\lastkern \unkern
10 \setbox2=\hbox{\hskip\skip0\box0\kern\Tkern}
11 \egroup

```

B 9.opto.opt

### \addvspace

Add vertical space taking into account space already added, as described above.

```

13 \def\addvspace#1{%
14   \ifvmode
15     \if@minipage\else
16       \ifdim \lastskip =\z@
17         \vskip #1\relax
18       \else
19         \tempskipb#1\relax
20         \xaddvskip
21       \fi
22     \fi
23   \else
24     \noitemerr
25   \fi}

```

### \addpenalty(*penalty*)

```

26 \def\addpenalty#1{%
27   \ifvmode
28     \if@minipage
29     \else
30       \if@nobreak
31       \else
32         \ifdim\lastskip=\z@
33           \penalty#1\relax
34         \else
35           \tempskipb\lastskip
36           \vskip -\lastskip

```

```

37          \penalty#1%
38          \vskip\@tempskipb
39      \fi
40      \fi
41  \else
42  \@noitemerr
43  \fi}

\vspace{glue}

45 \DeclareRobustCommand\vspace{\@ifstar\@vspace\@vspace}
46 \def\@vspace #1{%
47   \ifvmode
48     \vskip #1
49     \vskip\z@skip
50   \else
51     \bphack
52     \vadjust{\@restorepar
53       \vskip #1
54       \vskip\z@skip
55     }%
56     \espachack
57   \fi}

58 \def\@vspace#1{%
59   \ifvmode
60     \dimen@\prevdepth
61     \hrule \height\z@
62     \nobreak
63     \vskip #1
64     \vskip\z@skip
65     \prevdepth\dimen@
66   \else
67     \bphack
68     \vadjust{\@restorepar
69       \hrule \height\z@
70       \nobreak
71       \vskip #1
72       \vskip\z@skip}%
73     \espachack
74   \fi}

\smallskip

75 \def\smallskip{\vspace\smallskipamount}

\medskip

76 \def\medskip{\vspace\medskipamount}

\bigskip

```

```

77 \def\bigskip{\vspace\bigskipamount}

    \smallskipamount
    \medskipamount
    \bigskipamount
78 \newskip\smallskipamount \smallskipamount=3pt plus 1pt minus 2
    \medskipamount
79 \newskip\medskipamount \medskipamount=6pt plus 2pt minus 2
    \bigskipamount
80 \newskip\bigskipamount \bigskipamount=12pt plus 4pt minus 2
    \bigskipamount

```

### 8.1.8 Horizontal space (and breaks)

#### \nobreakdashes

This idea is borrowed from the amsmath package but here we define a robust command.

This command is a low-level command designed for use only before hyphens or dashes (such as -, --, or ---).

It could probably be better implemented: it may need its own private token register and temporary command.

Setting the hyphen in a box and then unboxing it means that the normal penalty will not be added after it—and if the penalty is not there a break will not be taken (unless an explicit penalty or glue follows, thus the final \nobreak).

Note that even if it is not followed by a ‘-’, it still leaves vmode and sets the spacefactor; so use it carefully!

```

81 \DeclareRobustCommand{\nobreakdashes}{%
82   \leavevmode
83   \toks@{}%
84   \def\reserved@a##1{\toks@\expandafter{\the\toks@-}%
85             \futurelet\@let@token \reserved@b}%
86   \def\reserved@b {\ifx\@let@token -%
87     \expandafter\reserved@a
88   \else
89     \setbox\z@\hbox{\the\toks@\nobreak}%
90     \unhbox\z@
91     \spacefactor\sfcodes`-
92   \fi}%
93   \futurelet\@let@token \reserved@b
94 }

```

#### \nobreakspace

This is a robust command that produces a horizontal space at which, in paragraph-mode, a line-break is not possible. We then define an active ~ to expand to it

since this is the documented behaviour of `\~`. One reason for introducing this is that some 8-bit input encodings have a slot for such a space and we do not want to use active characters as the L<sup>A</sup>T<sub>E</sub>X internal commands.

The braces in the definition of `\~` are needed to ensure that a following space is preserved when reading to/from internal files. We need to keep `\@xobeysp` as it is widely used; so here it is let to the non-robust command `\nobreakspace`.

```
95 \DeclareRobustCommand{\nobreakspace}{%
96   \leavevmode\nobreak\ }
97 \catcode `~=13
98 \def~{\nobreakspace{}}
99 \expandafter\let\expandafter\@xobeysp\csname nobreakspace \endcsname
  \,
```

Used in paragraph mode produces a `\thinspace`. It has the ordinary definition in math mode. Useful for quotes inside quotes, as in ``\,`Foo', he said.''

```
100 \DeclareRobustCommand{\,}{%
101   \relax\ifmmode\mskip\thinmuskip\else\thinspace\fi
102 }
```

### \@

Placed before a `'`, makes it a sentence-ending period. Does the right thing for other punctuation marks as well. Does this by setting spacefactor to 1000.

```
103 \def\@{\spacefactor\@m}
```

### \hskip<skip>

The command `\hskip` is declared as robust, so that it can be used in moving argument. The unstarred version is simply an `\hspace`.

```
104 \DeclareRobustCommand\hskip{\@ifstar\@hskip\@hskip}
```

### \@hskip<skip>

```
105 \def\@hskip#1{\hskip #1\relax}
```

### \@hskip\#1<skip>

The star version of the command is more complex. It starts with a zero width `\vrule`, followed by a `\nobreak`. It guards against a following unskip by a `\zskip`. The latter is defined in `ltplain.dtx` as `\newskip\zskip \zskip=0pt plus0pt minus0pt`.

```
106 \def\@hskip\#1{\vrule\@width\z@\nobreak
107           \hskip #1\hskip \zskip}
```

### \fill

```
108 \newskip\fill
109 \fill = 0pt plus 1fill
```

```

\stretch
110 \def\stretch#1{\z@ \@plus #1fill\relax}

\thinspace
\negthinspace
\enspace
111 \def\thinspace{\kern .16667em }
112 \def\negthinspace{\kern-.16667em }
113 \def\enspace{\kern.5em }

\enskip
\quad
\qquad
114 \def\enskip{\hskip.5em\relax}
115 \def\quad{\hskip1em\relax}
116 \def\qquad{\hskip2em\relax}

\obeycr
\restorecr

```

A note in the code, states that ‘the following definitions will probably get deleted or moved to compatibility mode soon.’, I guess they will be here for a few more decades.

```

117 {\catcode`\\^M=13 \gdef\obeycr{\catcode`\\^M13 \>
118   \def\\^M{\relax}%
119   \@gobblecr}%
120 {\catcode`\\^M=13 \gdef\@gobblecr{\@ifnextchar
121   \@gobble\ignorespaces}%
122 \gdef\restorecr{\catcode`\\^M5 }%

```

# 9

## Logos

In this short file provided in the  $\text{\LaTeX}$  kernel the definitions for the basic commands for typesetting the logos for  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeX}_2\epsilon$  are developed.

These can be typeset using the macros  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeXe}$ .



\TeX The \TeX logo, adjusted so that a full stop after the logo counts as ending a sentence.

```
122 %<*2ekernel>
123 \def\TeX{T\kern-.1667em\lower.5ex\hbox{E}\kern-.125emX@\}
```

(End definition for \TeX.)

\LaTeX The \LaTeX logo. 1 2 3 4

5

```
124 \DeclareRobustCommand{\LaTeX}{\kern-.36em%
125   \sbox{z@ T%}
126   \vbox to\ht{z@{\hbox{\check@mathfonts
127           \fontsize\sf@size{z@%
128           \math@fontsfalse\selectfont
129           A}}%
130           \vss}}%
131   }%
132   \kern-.15em%
133   \TeX}
```

(End definition for \LaTeX.)

6

\LaTeXe The \LaTeX<sub>2ε</sub> logo as proposed by A-W designers. 7 8 9 10 11

```
134 \DeclareRobustCommand{\LaTeXe}{\mbox{\math
135   \if b\expandafter\@car\f@series\@nil\boldmath\fi
136   \LaTeX\kern.15em2_{\textstyle\varepsilon}}}
```

137 %</2ekernel>

(End definition for \LaTeXe.)

---

<sup>1</sup>\LaTeXe 1993/11/24 Macro changed

<sup>2</sup>v1.00 1994/05/11 Use \DeclareProtectedCommand. ASAJ.

<sup>3</sup>v1.1d 1994/06/01 Add \math@th to force math size calculations

<sup>4</sup>v1.1e 1994/07/20 Save a few tokens

<sup>5</sup>v1.1h 1997/10/08 Simplify macro (force loading of suitable math fonts once).

<sup>6</sup>v1.1c 1994/05/26 Remove \SLiTeX logo

<sup>7</sup>\LaTeXe 1993/11/22 Macro added

<sup>8</sup>\LaTeXe 1993/12/16 Extended logo by DPC

<sup>9</sup>v1.00 1994/05/11 Use \DeclareProtectedCommand. ASAJ.

<sup>10</sup>v1.1e 1994/07/20 Save a few tokens

<sup>11</sup>v1.1f 1997/05/29 Added \math@th so that the \LaTeX<sub>2ε</sub> logo works with non-zero values of \mathsurround.

# 10

## File Handling

In this short file provided in the  $\text{\LaTeX}$  kernel the definitions for the basic commands for typesetting the logos for  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeX}_2\epsilon$  are developed.

These can be typeset using the macros  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeXe}$ .



The following user commands are defined in this part (k ltfiles.dtx):

- \document**<sup>→ σ 122</sup> (ie **\begin{document}**) Reads in the .AUX files and **\catcode**'s @ to 12.
- \nofiles**<sup>→ σ 124</sup> Suppresses all file output by setting **\@filesw** false.
- \includeonly**<sup>→ σ 125</sup> {*NAME*<sub>1</sub>, ... ,*NAME*<sub>n</sub>}  
Causes only parts NAME<sub>1</sub>, ... ,NAME<sub>n</sub> to be read by their **\include** commands. Works by setting **@partsw** true and setting **\@partlist** to NAME<sub>1</sub>, ... ,NAME<sub>n</sub>.
- \include**<sup>→ σ 125</sup> {*NAME*}  
Does an **\input** NAME unless **\@partsw** is true and NAME is not in **\@partlist**. If **\@filesw** is true, then it directs .AUX output to NAME.AUX, including a checkpoint at the end.
- \input**<sup>→ σ 129</sup> {*NAME*}  
The same as TeX's **\input**, except it allows optional braces around the file name. In LATEX 2<sub>ε</sub>, it also avoids the primitive 'missing file' error, if the file can not be found.
- \IfFileExists**<sup>→ σ 128</sup> {*NAME*}{{*then*}{{*else*}}}  
If the file exists on the system, execute *then* otherwise execute *else*.
- \InputIfFileExists**<sup>→ σ 129</sup> {*NAME*}{{*then*}{{*else*}}}  
If the file exists on the system, execute *then* and input *NAME* otherwise execute *else*.

## 10.1 Variables, switches and internal commands

<b>\@mainaux</b>	Output file number for main .AUX file.
<b>\@partaux</b>	Output file number for current part's .AUX file.
<b>\@auxout</b>	Either <b>\@mainout</b> or <b>\@partout</b> , depending on which .AUX file output goes to.
<b>\@input{<i>foo</i>}</b>	If file <i>foo</i> exists, then <b>\input</b> 's it, otherwise types a warning message.
<b>\@filesw</b>	Switch – set false if no .AUX, .TOC, .IDX etc files are to be written
<b>\@partsw</b>	Set true by a <b>\includeonly</b> command.
<b>\@partlist</b>	Set to the argument of the <b>\includeonly</b> command.
<b>\cp@FOO</b>	The checkpoint for <b>\include</b> 'd file FOO.TEX, written by <b>\@writeckpt</b> at the end of file FOO.AUX

**\@mainaux**

```

1 \includeonly{\FILELIST} == begin
2   \@partsw := True
3   \@partlist := FILELIST
4 end

1 \include{\FILE} == begin
2   \clearpage
3   if \@files = True then
4     | \immediate\write\@mainaux\string\@input{\FILE.AUX}
5   end
6 end

```

### \@partaux

These two macros allocate write streams for the main auxiliary file and the part file.

```

138 \newwrite\@mainaux
139 \newwrite\@partaux

```

Next the switches are defined as well as a newcount for \clubpenalty. The latter still puzzles me as to why here.

```

\if@files
\if@partsw

```

```

140 \newif\if@files \if@filestrue
141 \newif\if@partsw \if@partswfalse

```

### \clubpenalty

This stores the current normal (non-infinite) value of \clubpenalty; it should therefore be reset whenever the normal value is changed (as in the bibliography in the standard styles).

```

142 \newcount\clubpenalty
143 \clubpenalty \clubpenalty

```

### \document

Cancel the \begingroup from \begin

```

144 \def\document{\endgroup

```

If some options on \documentclass<sup>→ σ 542</sup> haven't been used by any package we will now give a warning since this is most certainly a misspelling.

```

145 \ifx\@unusedoptionlist\empty\else
146   \@latex@warning@no@line{Unused global option(s):^{^J}%
147   \@spaces[\@unusedoptionlist]}%

```

```

148  \fi
149  \@colht\textheight
150  \@colroom\textheight \vsize\textheight
151  \columnwidth\textwidth
152  \clubpenalty\clubpenalty
153  \if@twocolumn
154    \advance\columnwidth -\columnsep
155    \divide\columnwidth\tw@ \hsize\columnwidth \relax
156    \if@firstcolumntrue
157    \hsize\columnwidth \linewidth\hsize
158    \begingroup\@floatplacement\@dblfloatplacement
159      \makeatletter\let\@writefile\gobbletwo
160      \global\let\@multiplelabels\relax
161      \@input{\jobname.aux}%
162    \endgroup
163  \if@files
164    \immediate\openout\@mainaux\jobname.aux
165    \immediate\write\@mainaux{\relax}%
166  \fi

```

Next FMi added `\process@table` to support NFSS; This will also work with old lfonts if no other style defines `\process@table`. The following line forces the initialization of the math fonts.

```

167  \process@table
168  \let\glb@currsize\empty %% Force math initialization.
169  \normalsize
170  \everypar{}%

```

So that punctuation in headings is not disturbed by verbatim or other local changes to the space factor codes, save the document default here. This will be locally reset by the output routine. For special cases a class may want to define `\normalsfcodes` directly, in case that definition will be used. (This is an old bug, problem existed in L<sup>A</sup>T<sub>E</sub>X2.ox and plain T<sub>E</sub>X.)

```

171  \ifx\normalsfcodes\empty
172    \ifnum\sfcodes`.=\@m
173      \let\normalsfcodes\frenchspacing
174    \else
175      \let\normalsfcodes\nonfrenchspacing
176    \fi
177  \fi

```

Way back in 1991 (08/26) FMi & RmS set the `\@noskipsec` switch to true in the preamble and to false here. This was done to trap lists and related text in the preamble but it does not catch everything; hence Change 1.1g was introduced.

```

178  \@noskipsecfalse
changesv1.1a1995/10/24 Removed refundefined switch
179  \let\@refundefined\relax

```

Just before disabling the preamble commands we execute the begin document hook which contains any code contributed by `\AtBeginDocument`. Also disable the gathering of the file list, if no `\listfiles` has been issued. `\AtBeginDocument` is redefined at this point so that and such commands that get into the hook do not chase their tail...

```
180 \let\AtBeginDocument@\firstofone
181 \begindocumenthook
```

Most of the following assignments will be done globally in case the user adds something like `\begin{multicols}` to the document hook, i.e. starts are group in `\begin{document}`. Since a value of exactly `opt` for `\topskip` causes `\twocolumn[]` to misbehave, we add this check, hoping that it will not cause any problems elsewhere.

```
182 \ifdim\topskip<1sp\global\topskip 1sp\relax\fi
183 \global\@maxdepth\maxdepth
184 \global\let\@begindocumenthook\@undefined
185 \ifx\@listfiles\@undefined
186   \global\let\@filelist\relax
187   \global\let\@addtofilelist\@gobble
188 \fi
```

At the very end we disable all preamble commands. This has to happen after the begin document hooks was executed so that this hook can still use such commands.

```
189 \gdef\do##1{\global\let ##1\@notprerr}%
190 \@preamblecmds
```

Added disabling of `\@nодокумент`

```
191 \global\let\@nодокумент\relax
```

The next line is a pure safety measure in case a do list is ever expanded at the wrong place. In addition it will save a few tokens to get rid of the above definition.

```
192 \global\let\do\noexpand
```

Use of `\AtBeginDocument` hook might mean that we are already in horizontal mode, so ignore the space after `\begin{document}`.

```
193 \ignorespaces
```

```
194 \@onlypreamble\document
```

### **\normalsfcodes**

The setting of `\@empty` is just a flag. This command may be defined in a class or package file. If it is still `\@empty` at `\begin{document}` it will be defined to be `\frenchspacing` or `\nonfrenchspacing`, depending on which of those appears to be in effect at that point.

```
195 \let\normalsfcodes\@empty
```

### **\nofiles**

Set `\@fileswfalse` which suppresses the places where L<sup>A</sup>T<sub>E</sub>X makes `\immediate` writes. The `\makeindex` and `\maketoc` are disabled. `\protected@write` is redefined not to write to the file specified, but rather to write a blank line to the log file. This ensures that a `\whatsit` node is still created, and so spacing is not affected by the `\nofiles` command; to ensure this more generally, the `\if@nobreak` test is needed.

```

216 \def\nofiles{%
217   \@fileswfalse
218   \typeout{No auxiliary output files.^^J}%
219   \long\def\protected@write##1##2##3{%
220     {\write\m@ne{}\if@nobreak\ifvmode\nobreak\fi\fi}%
221   \let\makeindex\relax
222   \let\maketoc\relax
223 }@\onlypreamble\nofiles

```

### \protected@write

This takes three arguments: an output stream, some initialization code, and some text to write. It then writes this, with appropriate handling of `\protect` and `\thepage`.

```

214 \long\def \protected@write#1#2#3{%
215   \begingroup
216   \let\thepage\relax
217   #2%
218   \let\protect\@unexpandable@protect
219   \edef\reserved@a{\write#1{#3}}%
220   \reserved@a
221   \endgroup
222   \if@nobreak\ifvmode\nobreak\fi\fi
223 }

```

```
214 \let\@auxout=\@mainaux
```

### \includeonly

```

215 \def\includeonly#1{%
216   \@partswtrue
217   \edef\@partlist{\zap@space#1 \@empty}
218 }@\onlypreamble\includeonly

```

### \include

In the definition of `\include`, `\def\reserved@b` changed to `\edef\reserved@b` to be consistent with the `\edef` in `\includeonly`. (Suggested by Rainer Schöpf & Frank Mittelbach. Change made 20 Jul 88.)

Changed definition of `\include` to allow space at end of file name – otherwise, typing `\include{foo }` would cause L<sup>A</sup>T<sub>E</sub>X to overwrite `foo.tex`. Change made 24 May 89, suggested by Rainer Schöpf and Frank Mittelbach

Made `\include` check for being used inside an `\include`'d file, as this will not work and cause surprising results.

```

219 \def\include#1{\relax
220   \ifnum\@auxout=\@partaux
221     \@latex@error{\string\include\space cannot be nested}\@eha
222   \else \@include#1 \fi}

```

### \@include

The definition of `\@include` is fairly straightforward less one puzzle, why would the `\clearpage` be issued and thus have a behaviour which is totally different from `\input`. As explained by egreg on TEX.SX this was to correct the references. David Carlisle added that floats can also get passed none included files, which is also an issue.<sup>1</sup>. This is a very subtle error and easily missed. David Carlisle added that: "...as a historical note it wasn't a "team" it has always done this so this is Leslie's doing before we got involved". Frank provided a more lengthy explanation which I quote:

The purpose of the `\include` mechanism is to allow for partially compiling the document when making a modest amount of changes without the need to recompile the full document and still get cross-references etc correctly resolved (even to parts outside the current part under the knife).

For this to work the part or parts that are included have to be selfcontained in the sense that changes to it do not automatically (and always) render the formatting of other parts not included invalid. To make this possible (at least for smaller changes) the following prerequisites are needed:

The mechanism need to ensure that small changes in text length in the part being compiles doesn't result in formatting changes in other parts not compiled Floats in the parts compiled need to be placed in the parts compiled If either of the above points is not valid then using `\include` would (nearly) always result in invalid documents whereas in the current scheme you can all include parts individually and still arrive and maintain a valid document. (Just for the record, when we produced the first edition of the LaTeX Companion it took ages to compile this book and even the second edition took about 30 minutes in 2004 to compile all examples + all pages and rerun the whole book (I think 5 times) to get all cross-references resolved successfully. So building out things chapter by chapter was essential and even then compiling took long :-)

Of course the first point will be invalid the moment a lot of text is added or removed such as the resulting document get one or more pages longer or shorter.

So using page breaks at the boundaries of the included parts is simply necessary to make the mechanism worth while in the first place and using `\clearpage` is needed to to ensure that the floats stay within the included part and not move in or out.

@egreg already gave the additional explanation that the mechanism to write aux file data works only on `\shipout` so that it wouldn't be possible (or at least not easy) to ensure that such things like cross-references or data for table of contents aren't lost. Technically one could think of a possibility to manage this, but using more than one aux file per include, but that wouldn't resolve the point above.

---

<sup>1</sup><http://tex.stackexchange.com/questions/108268/redefining-include>

Finally, this is not something the LaTeX Project team invented, it goes back to Leslie Lamport's original design and was in existence since LaTeX 2.08 (at least) so before 1986.

```

223 \def\@include#1 {%
224   \clearpage
225   \if@filesw
226     \immediate\write\mainaux{\string\@input{#1.aux}}%
227   \fi
228   \tempswatrue
229   \if@partsw
230     \tempswafalse
231     \edef\reserved@b{#1}%
232     \for\reserved@a:=\partlist\do
233       {\ifx\reserved@a\reserved@b\tempswatrue\fi}%
234   \fi
235   \if@tempswa
236     \let\auxout\partaux
237     \if@filesw
238       \immediate\openout\partaux #1.aux
239       \immediate\write\partaux{\relax}%
240     \fi
241     \input{#1.tex}%
242     \clearpage
243     \writeckpt{#1}%
244     \if@filesw
245       \immediate\closeout\partaux
246     \fi
247   \else

```

If the file is not included, reset `\deadcycles`, so that a long list of non-included files does not generate an 'Output loop' error.

```

248   \deadcycles\z@
249   \nameuse{cp@#1}%
250   \fi
251   \let\auxout\mainaux

```

### `\@writeckpt`

```

252 \def\@writeckpt#1{%
253   \if@filesw
254     \immediate\write\partaux{\string\@setckpt{#1}\@charlb}%
255     {\let\elt\wckptelt \cl@ckpt}%
256     \immediate\write\partaux{\@charrb}%
257   \fi}

```

### `\@wckptelt`

```

258 \def\@wckptelt#1{%
259   \immediate\write\partaux{%
260     \string\setcounter{#1}{\the\nameuse{c@#1}}}}

```

```

\@setckpt

261 \def\@setckpt#1{\global\@namedef{cp@#1}{}}

\@charlb
\@charrb

```

The following defines `\@charlb` and `\@charrb` to be { and }, respectively with `\catcode 11`.

```

262 {\catcode`[=1 \catcode`]=2
263 \catcode`{=11 \catcode`} =11
264 \gdef\@charlb[{}]
265 \gdef\@charrb[]{}}
266 ]% }brace matching

```

## 10.2 Safe Input Macros

### \IfFileExists

The predicate `\IfFileExists` tries to open the file by opening a stream `\@inputcheck`.

```

267 \long\def \IfFileExists#1#2#3{%
268   \openin\@inputcheck#1 %
269   \ifeof\@inputcheck
270     \ifx\input@path\@undefined
271       \def\reserved@a{#3}%
272     \else
273       \def\reserved@a{\@iffileonpath{#1}{#2}{#3}}%
274     \fi
275   \else
276     \closein\@inputcheck
277     \edef\@filef@und{#1}%
278     \def\reserved@a{#2}%
279   \fi
280   \reserved@a}

```

### \@iffileonpath

If the file is not found by `\openin`, and `\input@path` is defined, look in all the directories specified in `\input@path`. Note the use of `\@tfor89` and if found how to break using `\@break@tfor90`.

```

281 \long\def\@iffileonpath#1{%
282   \let\reserved@a\@secondoftwo
283   \expandafter\@tfor\expandafter\reserved@b\expandafter
284     :\expandafter=\input@path\do{%
285   \openin\@inputcheck\reserved@b#1 %
286   \ifeof\@inputcheck\else
287     \edef\@filef@und{\reserved@b#1 }%

```

```

288      \let\reserved@a\@firstoftwo%
289      \closein@\inputcheck
290      \@break@tfor
291      \fi}%
292      \reserved@a}

```

### \InputIfFileExists{<filename>}{{<true code>}}{{<false code>}}

Now define `\InputIfFileExists` to input #1 if it seems to exist. Immediately prior to the input, #2 is executed. If the file #1 does not exist, execute '#3'.

```

293 \long\def \InputIfFileExists#1#2{%
294   \IfFileExists{#1}{%
295     {#2\@addtofilelist{#1}\@@input \@filef@und}}}

```

### \input{<filename>}

Input a file: if the argument is given in braces use safe input macros, otherwise use TeX's primitive `\input` command (which is called `\@@input` in L<sup>A</sup>T<sub>E</sub>X).

```
296 \def\input{\@ifnextchar\bgroup\@iinput\@@input}
```

### \@iinput

Define `\@iinput` (i.e., `\input`) in terms of `\InputIfFileExists`.

```

297 \def\@iinput#1{%
298   \InputIfFileExists{#1}{}%
299   {\filename@parse{#1}%
300    \edef\reserved@a{\noexpand\@missingfileerror%
301    {\filename@area\filename@base}%
302    {\ifx\filename@ext\relax tex\else\filename@ext\fi}}%
303   \reserved@a}

```

### \@input

Define `\@input` in terms of `\IfFileExists`. So this is a 'safe input' command, but the files input are not listed by `\listfiles`. We don't want `.aux`, `.toc` files etc be listed by `\listfiles`. However, something like `.bb1` probably should be listed and thus should be implemented not by `\@input`.

```

304 \def\@input#1{%
305   \IfFileExists{#1}{\@@input\@filef@und}{\typeout{No file }%
306   {#1.}}}

```

### \@input@

Version of `\@input` that does add the file to `\@filelist`.

```
306 \def\@input@#1{\InputIfFileExists{#1}{}{\typeout{No file #1.}}}
```

### \@missingfileerror

This ‘error’ command avoids TeX’s primitive missing file loop. Missing file error. Prompt for a new filename, offering a default extension.

```

307 \gdef\@missingfileerror#1#2{%
308     \typeout{^^J! LaTeX Error: File `#1.#2' not found.^^J^^J%
309     Type X to quit or <RETURN> to proceed,^^J%
310     or enter new name. (Default extension: #2)^^^J}%
311     \message{Enter file name: }%
312     {\endlinechar\m@ne
313      \global\read\m@ne to\@gtempa}%
314     \ifx\@gtempa\@empty
315     \else
316         \def\reserved@a{x}\ifx\reserved@a\@gtempa\batchmode\@@end\fi
317         \def\reserved@a{X}\ifx\reserved@a\@gtempa\batchmode\@@end\fi
318         \filename@parse\@gtempa
319         \edef\filename@ext{%
320             \ifx\filename@ext\relax#2\else\filename@ext\fi}%
321         \edef\reserved@a{%
322             \noexpand\InputIfFileExists
323                 {\filename@area\filename@base.\filename@ext}%
324                 {}%
325                 {\noexpand\@missingfileerror
326                     {\filename@area\filename@base}{\filename@ext}}}%
327         \reserved@a
328     \fi}

```

### \@obsoletefile

For compatibility with L<sup>A</sup>T<sub>E</sub>X 2.09 document styles, we distribute files called **article.sty**, **book.sty**, **report.sty**, **slides.sty** and **letter.sty**. These use the command **\@obsoletefile**, which produces a warning message.

```

329 \def\@obsoletefile#1#2{%
330     \@latex@warning@no@line{inputting `#1' instead of %
331     \obsoleted `#2'}}%
331 \only@preamble\@obsoletefile

```

## 10.3 Listing files

### \@filelist

A list of files input so far. The initial value of **\@gobble** eats the comma before the first file name.

```
332 \let\@filelist\@gobble
```

### \@addtofilelist

Add to the list of files input so far. This ‘real’ definition is only used for ‘cfg’ files during initex. An initial definition of **\@gobble** has already been set.

```
333 \def\@addtolist#1{\xdef\@filelist{\@filelist,#1}}
```

### \listfiles

A preamble command to cause `\end{document}` to list files input from the main file.

```
334 \def\listfiles{%
335   \let\listfiles\relax
336   \def\@listfiles##1##2##3##4##5##6##7##8##9@@{%
337     \def\reserved@a{\}%
338     \atfor\reserved@c:=##1##2##3##4##5##6##7##8\do{%
339       \ifx\reserved@c\reserved@a
340         \edef\filename@area{ \filename@area}%
341       \fi}%
342 }
```

### \@dofilelist

```
342 \def\@dofilelist{%
343   \typeout{^^J *File List*}%
344   \@for\@currname:=\@filelist\do{%
345     \filename@parse\@currname
346     \edef\reserved@a{%
347       \filename@base.%%
348       \ifx\filename@ext\relax tex\else\filename@ext\fi}%
349     \expandafter\let\expandafter\reserved@b
350           \csname ver@\reserved@a\endcsname
351     \expandafter\expandafter\expandafter\@listfiles\expandafter
352           \filename@area\filename@base\\\\\\\\\\\\\\\\\\\\\\\\\\@%
353     \typeout{%
354       \filename@area\reserved@a
355       \ifx\reserved@b\relax\else@spaces\reserved@b\fi}}%
356   \typeout{ *****}%
357 }
```

The `\@filelist`<sup>→ σ 130</sup> will be de-activated if `\listfiles` does not appear in the preamble. `\begin{document}` contains code equivalent to the following:

```
\AtBeginDocument{%
  \ifx\@listfiles\@undefined
    \let\@filelist\relax
    \let\@addtolist\@gobble
  \fi}

357 \@onlypreamble\listfiles
      Set \@dofilelist to an initial value of \relax.
358 \let\@dofilelist\relax
```

Hope you are still with me and that the explanations have been adequate. I still think some design decisions should not be carried over to LaTeX3, such as the `\clearpage` before an `\include` file.

## ltoutenc

In this short file provided in the  $\text{\LaTeX}$  kernel the definitions for the basic commands for typesetting the logos for  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeX}_2\epsilon$  are developed.

These can be typeset using the macros  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeXe}$ .



## 11.1 Background

The Latin Modern fonts, created as a successor to Knuth’s Computer Modern fonts contain some 50,000 glyphs. The fonts were authored by Boguslaw Jakowski and Janusz M. Nowacki.<sup>1</sup> Their usage was described in an article in **Robertson2007**.<sup>2</sup> Modern engines such as  $\text{X}\text{\TeX}$  and  $\text{\LaTeX}$  do not have any difficulty in using Open Type fonts natively with thousands of glyphs, however using fonts while  $\text{\TeX}$  is frozen is a challenge. There are two major challenges that the  $\text{\LaTeX}$  Team and the community historically overcame.

1. Providing mechanisms to map 256 symbol fonts to encodings and hence permit combinations to be used.
2. Provide a comprehensive set of markup commands to handle thousands of symbols.

Representation as “font -encoding-specific” commands

The other way to represent characters internally in  $\text{\TeX}$  (and this covers the majority of characters) is with special  $\text{\LaTeX}$  commands (or command sequences) that remain unexpanded when written to a file or when placed into a moving argument. These special commands are sometimes referred to as *font-encoding-specific commands* because their meaning depends on the font encoding current when  $\text{\TeX}$  is ready to typeset them. Such commands are declared using special declarations, as discussed below. They usually require individual definitions for each font encoding. If no definition exists for the current encoding, either a default is used (if available) or an error message is presented to the user.

Technically, when the font encoding is changed at some point in the document, the definitions of the encoding-specific commands do not change immediately, as that would mean changing a large number of commands on the spot. Instead, these commands have been implemented in a such way that they notice, once they are used, if their current definition is no longer suitable for the font encoding in force. In such a case they call upon their counterparts in the current font encoding to do the actual work.

The set of “font-encoding-specific commands” is not fixed, but rather implicitly defined to be the union of all commands defined for individual font encodings. Thus, by adding new font encodings to  $\text{\TeX}$ , new “font-encoding-specific commands” might emerge.

## 11.2 Output encodings

Output encodings define the mapping from the LIGR to the glyphs (or constructs built from glyphs) available in the fonts used for typesetting. These mappings are referenced inside  $\text{\TeX}$  by two or three-letter names (e.g., OT1 and T3). We say that a certain font is in a certain encoding if the mapping corresponds to the positions of the glyphs in the font in question. So what are the exact components of such a mapping?

---

<sup>1</sup>boguslaw2003.

<sup>2</sup>Robertson2007.

Characters internally represented by ASCII characters are simply passed on to the font. In other words,  $\text{\TeX}$  uses the ASCII code to select a glyph from the current font. For example, the character "A" with ASCII code 65 will result in typesetting the glyph in position 65 in the current font. This is why  $\text{\TeX}$  requires that fonts for text contain all such ASCII letters in their ASCII code positions, as there is no way to interact with this basic  $\text{\TeX}$  mechanism (other than to disable it and do everything "manually"). Thus, for visible ASCII, a one-to-one mapping is implicitly present in all output encodings.

Characters internally represented as sequences of ASCII characters (e.g., "–"), are handled as follows: when the current font is first loaded,  $\text{\TeX}$  is informed that the font contains a number of so-called ligature programs. These define certain character sequences that are not to be typeset directly but rather to be replaced by some other glyphs from the font (the exact position of each replacement glyph is font dependent and not important otherwise). For example, when  $\text{\TeX}$  sees "–" in the input (Le., ASCII code 45 twice), a ligature program might direct it to use the glyph in position 123 instead (which then would hold the glyph "–"). Again, no interaction with this mechanism is possible. Some such ligatures are present for purely aesthetic reasons and may or may not be available in certain fonts (e.g., ff generating "ff" rather than IIf<sup>f</sup>). Others are supposed to be implemented for a certain encoding (e.g., "–" producing an –).

Nevertheless, the bulk of the internal character representation consists of "font-encoding-specific" commands. They are mapped using the declarations described below. All declarations have the same structure in their first two arguments: the font-encoding-specific command (or the first component of it, if it is a command sequence), followed by the name of the encoding. Any remaining arguments will depend on the type of declaration.

Thus, an encoding XYZ is defined by a number of declarations all having the name XYZ as their second argument. Of course, to be of any use, some fonts must be encoded in that encoding. In fact, the development of font encodings is normally done the other way around—namely, someone starts with an existing font and then provides appropriate declarations for using it. This collection of declarations is then given a suitable name, such as OT1. In the next section, we will take the font ecrmlooo, shown in Table 7.32 on the facing page, whose font encoding is called T1 in  $\text{\TeX}$ , and build appropriate declarations to access the glyphs from a font encoded in this way. The blue characters in this table are those that have to be present in the same positions in every text encoding, as they are transparently passed through  $\text{\TeX}$ .

### 11.2.1 Output encoding files

Like input encoding files, output encoding files are identified by the extension **.def**. However, the base name of the file is slightly more structured: the name of the encoding in lowercase letters, followed by the letters **enc** (e.g., **t1enc.def** for the **T1** encoding).

Such files should contain only the declarations described in the current section. As output encoding files might be read several times by  $\text{\TeX}$ , it is particularly important to adhere to this rule strictly and to refrain from using, for example, **\newcommand**, which prevents reading such a file multiple

times! For identification purposes an output encoding file should start with a **\ProvideFile** declaration describing the nature of the file. For example:

```
\ProvidesFile{tlenc.def}[2001/06/05 v1.94 Standard LaTeX file]
```

To be able to declare any encoding-specific commands for a particular encoding, we first have to make this encoding known to TeX. This is achieved via the **\DeclareFontEncoding**<sup>→ P. 189</sup> declaration. At this point it is also useful to declare the default substitution rules for the encoding with the help of the command **\DeclareFontSubstitution**<sup>→ P. 190</sup>; both declarations are described in detail in Section 7.10.5 starting on page 430.

## 11.3 Font encodings

This section of the kernel contains commands for declaring encoding-specific commands, such as accents. It also contains the code for some of the encoding files, including **omlenc.def**, **omsenc.def**, **t1enc.def** and **ot1enc.def** files, which define the OLM, OMS, T1 and OT1 encodings, and the **fontenc** package for selecting encodings.

The **fontenc** package has options for encodings, of which the last option is the default encoding. For example, to use the OT2, OT3 and T1 encodings, with T1 as the default, you say:

```
\usepackage[OT2,OT3,T1]{fontenc}
```

The standard kernel set-up loads font encoding files and selects an encoding as follows.

```
\input {omlenc.def}
\input {t1enc.def}
\input {ot1enc.def}
\input {omsenc.def}
\fontencoding{OT1}
```

Note that the files in the standard **inputenc** package depend on this behaviour of the kernel.

The syntax for declaring encoding-specific commands is:

```
\DeclareTextCommand{\command}{\encoding}{\number}{\default}{\commands}
```

This command is like **\newcommand**, except that it defines a command which is specific to one encoding. The resulting command is always robust, even if its definition is fragile. For example, the definition of **\l** in the OT1 encoding is:

```
\DeclareTextCommand{\l}{OT1}{\@xxxii l}
```

**\DeclareTextCommand** takes the same optional arguments as **\newcommand**.

```
\ProvideTextCommand{\command}{\encoding}{\number}{\default}{\commands}
```

This acts like `\DeclareTextCommand`, but does nothing if the command is already defined.

```
\DeclareTextSymbol{\<command>}{\<encoding>}{\<slot>}
```

This command defines a text symbol, with a particular slot in that encoding. The commands:<sup>3</sup>

```
\DeclareTextSymbol{\ss}{OT1}{25}
\DeclareTextCommand{\ss}{OT1}{\char25 }
```

have the same effect, but the `\DeclareTextSymbol` is faster.

```
\DeclareTextAccent{\<command>}{\<encoding>}{\<slot>}
```

This command declares a text accent. The commands:

```
\DeclareTextAccent{\"}{OT1}{127}
\DeclareTextCommand{\"}{OT1}{\add@accent {127}}
```

have the same effect.<sup>4</sup>

```
\DeclareTextComposite{\<command>}
{\<encoding>}{\<argument>}{\<slot>}
```

This command declares a composite letter, for example in the T1 encoding '\{a} is slot 225, which is declared by:

```
\DeclareTextComposite{\'}{T1}{a}{225}
```

<sup>5</sup> The *command* will normally have been declared with `\DeclareTextAccent`, or as a one-argument `\DeclareTextCommand`.

`\DeclareTextComposite` is the most common example of using the more general declaration `\DeclareTextCompositeCommand`, which can define a composite to be an arbitrary piece of text.

```
\DeclareTextCompositeCommand{\<command>}
{\<encoding>}{\<argument>}{\<text>}
```

For example, in the OT1 encoding Å has a hand-crafted definition this is declared as follows

```
\DeclareTextCompositeCommand{\r}{OT1}{A}
{\leavevmode\setbox\z@\hbox{!}\dimen@\ht\z@\advance\dimen@-
1ex%
\rlap{\raise.67\dimen@\hbox{\char23}}A}
```

<sup>3</sup>v1.9h 1997/12/17 Example corrected, braces removed.

<sup>4</sup>v1.8c 1996/10/27 Corrected syntax descriptions

<sup>5</sup>v1.8e 1996/11/23 Corrected description

<sup>6</sup> The *command* will normally have been declared with `\DeclareTextAccent`, or as a one-argument `\DeclareTextCommand`.

The commands defined using the above declarations can be used in two ways. Normally they are used by just calling the command in the appropriate encoding, for example `\ss`. However, sometimes you may wish to use a command in an encoding where it is not defined. If the command has no arguments, then you can use it in another encoding by calling `\UseTextSymbol`<sup>P. 145</sup>:

```
\UseTextSymbol{\encoding}{\command}
```

<sup>7</sup> For example, `\UseTextSymbol{OT1}{\ss}` has the same effect as:

```
{\fontencoding{OT1}\selectfont\ss}
```

If the command has one argument then you can use it in another encoding by calling `\UseTextAccent`:

```
\UseTextAccent{\encoding}{\command}{\text}
```

For example, if the current encoding is OT2 then `\UseTextAccent{OT1}{'}{a}` has the same effect as:

```
{\fontencoding{OT1}\selectfont'{\fontencoding{OT2}\selectfont a}}
```

<sup>8</sup> You can also declare a default definition for a text command, which will be used if the current encoding has no appropriate definition. Such use will also set the definition for this command in the current encoding to equal this default definition; this makes subsequent uses of the command much faster.

```
\DeclareTextCommandDefault{\command}{\definition}
```

For example, the default definition of the command `\textonequarter` (which produces the fraction  $\frac{1}{4}$ ) could be built using math mode:

```
\DeclareTextCommandDefault{\textonequarter}{\ensuremath {\frac{1}{4}}}
```

There is a matching `\Provide` command which will not override an existing default definition:

```
\ProvideTextCommandDefault{\command}{\definition}
```

The most common use for these commands is to use symbols from other encodings, so there are some optimizations provided:

```
\DeclareTextSymbolDefault{\command}{\encoding}
\DeclareTextAccentDefault{\command}{\encoding}
```

are short for:

---

<sup>6</sup>v1.8e 1996/11/23 Corrected description

<sup>7</sup>v1.9e 1997/08/05 Corrected order of arguments in `\UseTextSymbol` example.

<sup>8</sup>v1.8e 1996/11/23 Extended description

```
\DeclareTextCommandDefault{\command}
  {\UseTextSymbol{<encoding>}{{\i command}}}
\DeclareTextCommandDefault[1]{\i command}
  {\UseTextAccent{<encoding>}{{\i command}}{\#1}}
```

For example, to make `OT1` the default encoding for `\ss` and `\'` you say:

```
\DeclareTextSymbolDefault{\ss}{OT1}
\DeclareTextAccentDefault{\'}{OT1}
```

Note that you can use these commands on any zero- or one-argument commands declared with `\DeclareText*` or `\ProvideText*`, not just those defined using `\DeclareTextSymbol` or `\DeclareTextAccent`.

### 11.3.1 Removing encoding-specific commands

In some cases encoding definitions are given to provide some limited support since nothing better is available, for example, the definition for `\textdollar` in `OT1` is a hack since `$` and `£` actually share the same slot in this encoding. Thus if such a glyph becomes available in a different encoding (e.g., `TS1`) one would like to get rid of the flacky one and make the default definition point to the new encoding. In such a case defining

```
\DeclareTextSymbol{\textdollar}{TS1}{36}
\DeclareTextSymbolDefault{\textdollar}{TS1}
```

is not enough since if typesetting in `OT1` L<sup>A</sup>T<sub>E</sub>X will still find the encoding specific definition for `OT1` and therefore ignore the new default. Therefore to ensure that in this case the `TS1` version is used we have to remove the `OT1` declaration:

```
\UndeclareTextCommand{\textdollar}{OT1}
```

Since the `$` sign is a proper glyph in the `T1` encoding there is no point removing its definition and forcing L<sup>A</sup>T<sub>E</sub>X to pick up the `TS1` version if typesetting in this encoding. However, assume you want to use the variant dollar sign, i.e., `$` for your dollars. In that case you have to get rid of the `T1` declaration as well, e.g., the following would do that for you:

```
\UndeclareTextCommand{\textdollar}{OT1}
\UndeclareTextCommand{\textdollar}{T1}
\DeclareTextCommandDefault{\textdollar}
  {\UseTextSymbol{TS1}{textdollaroldstyle}}
```

### 11.3.2 The order of declarations

<sup>9</sup>

If an encoding-specific command is defined for more than one encoding, then it will execute fastest in the encoding in which it was defined last since its top-level definition will be set up to execute in that encoding without any overhead.

---

<sup>9</sup>v1.90 1998/03/20 Documentation added about order of decls

For this reason the file `fonttext.ltx` currently first loads the definitions for the T1 encoding and then those for the OT1 encoding so that typesetting in OT1 is optimized since that is (still) the default. However, when T1 is explicitly requested (via `\usepackage[T1]{fontenc}`) the top-level definitions are automatically changed to favour T1 since its declarations are reloaded in the process.

For the same reason default declarations should never come last since they are implemented as a special encoding themselves (with the name ?). Specifying them last would simply mean to make those encoding-specific commands equally inefficient in all encodings. Therefore the `textcomp` package, for example, first sets up all defaults to point to TS1 and then declares the commands in the TS1 encoding.

### 11.3.3 Docstrip modules

This `.dtx` file is be used to generate several related files containing font encoding definitions. The mutually exclusive docstrip options are listed here.

<b>T1</b>	generates <code>t1enc.def</code> for the Cork encoding.
<b>TS1</b>	generates <code>ts1enc.def</code> for the Text Companion encoding.
<b>TS1sty</b>	generates <code>textcomp.sty</code> , package that sets up use of the Text Companion encoding.
<b>OT1</b>	generates <code>ot1enc.def</code> for Knuth's CM encoding.
<b>OMS</b>	generates <code>omsenc.def</code> for Knuth's math symbol encoding.
<b>OML</b>	generates <code>omlenc.def</code> for Knuth's math letters encoding.
<b>OT4</b>	generates <code>ot4enc.def</code> for the Polish extension to the OT1 encoding, created by B. Jackowski and M. Ry��ko for use with the Polish version of Computer Modern and Computer Concrete.
<b>package</b>	generates <code>fontenc.sty</code> for selecting encodings.
<b>2ekernel</b>	for the kernel commands.

10 11 12 13 14 15 16 17 18

<sup>10</sup>1.0d 1993/07/17 changed `\catcoding @`

<sup>11</sup>1.0f 1993/08/13 Protected against active @ sign.

<sup>12</sup>1.0g 1993/08/16 Needs space after `\string`

<sup>13</sup>1.1 1993/12/07 Protected all special characters with `\string`.

<sup>14</sup>1.3 1993/12/17 Removed the catcode hackery, since the file is only read as a package in the preamble, and removed all the messages on the screen, which just confuse users. Replaced them by the appropriate `\ProvidesPackage` commands. Added XXXenc.

<sup>15</sup>1.3b 1993/12/18 Fixed typos with `\ProvidesPackage` lines. Added the `\NeedsTeXFormat` line. Added the last argument to `\DeclareEncoding`. Moved the use of the encodings to after their declaration.

<sup>16</sup>1.4a 1994/04/29 Removed Rokicki's OT1 variant encoding. Moved the driver to the top.

<sup>17</sup>1.5a 1994/05/11 Made T1 and OT1 generate packages rather than def files. Renamed the 'package' module to 'teststy'.

<sup>18</sup>1.5d 1994/05/14 Moved the driver to the top.

### 11.3.4 Definitions for the kernel

#### 11.3.40 Declaration commands

This section contains definitions for commands such as accents which depend on the current encoding. These commands will usually be kept in `.def` files, for example `ot1enc.def` contains the definitions for the OT1 encoding.

```

359 %<*2ekernel>
360 \message{font encodings,}

\DeclareTextCommand
\ProvideTextCommand
\DeclareTextSymbol
\@dec@text@cmd
\chardef@text@cmd
\@changed@cmd
\@changed@x
\TextSymbolUnavailable
\@inmathwarn

```

If you say:

```
\DeclareTextCommand{\foo}{T1}...
```

then `\foo` is defined to be `\T1-cmd \foo \T1\foo`, where `\T1\foo` is *one* control sequence, not two! We then call `\newcommand` to define `\T1\foo`.

```

361 \def\DeclareTextCommand{%
362   \@dec@text@cmd\newcommand}
363 \def\ProvideTextCommand{%
364   \@dec@text@cmd\providecommand}
365 \def\@dec@text@cmd#1#2#3{%
366   \expandafter\def\expandafter#2%
367   \expandafter{%
368     \csname#3-cmd\expandafter\endcsname
369     \expandafter#2%
370     \csname#3\string#2\endcsname
371   }%
372   \let\@ifdefinable\@rc@ifdefinable
373   \expandafter#1\csname#3\string#2\endcsname}

```

This command was introduced to fix a major bug in `\@dec@text@cmd` without changing that command itself. This was thought to be necessary because it is defined in more than one package. (Perhaps the more serious bug is to put complex low-level commands like this in packages?)

The problem it solves is that whereas both `\newcommand` and `\providetcommand` (used just above) both handle the resetting of `\@ifdefinable` (following its disabling in `\@dec@text@cmd`), the primitive `\chardef` neither needs the disabling, nor does the resetting.

```
374 \def\chardef@text@cmd{%
375   \let\@ifdefinable\@@ifdefinable
376   \chardef
377 }
378 \def\DeclareTextSymbol#1#2#3{%
379   \@dec@text@cmd\chardef@text@cmd#1{#2}#3\relax
380 }
```

The declarations are only available before `\begin{document}`.

```
381 \onlypreamble\DeclareTextCommand
382 \onlypreamble\DeclareTextSymbol
```

The sneaky bit in all this is what `\T1-cmd \foo \T1\foo` does. There are five possibilities, depending on the current values of `\protect`, `\cf@encoding` and `\ifmmode`:

- If `\protect` is `\@typeset@protect` and `\cf@encoding` is `T1`, then we execute `\T1\foo`. This should be the normal behaviour, and is optimized for speed.
- If `\protect` is `\@typeset@protect`, `\cf@encoding` is (say) `OT1`, and `\OT1\foo` is defined, then we execute `\OT1\foo`.
- If `\protect` is `\@typeset@protect`, `\cf@encoding` is (say) `OT1`, we're in text mode, and `\OT1\foo` is undefined, then we define `\OT1\foo` to be the default value of `\foo`, and execute `\OT1\foo`.
- If `\protect` is `\@typeset@protect`, `\cf@encoding` is (say) `OT1`, we're in math mode, and `\OT1\foo` is undefined, then we execute the default value of `\foo`. (This is necessary so that things like `$X_\copyright$` work properly.)
- If `\protect` is not `\@typeset@protect` then we execute `\noexpand\foo`. For example, if we are writing to a file, then this results in `\foo` being written. If we are in a `\mark`, then `\foo` will be put in the mark—since `\foo` is robust, it will then survive all the things which may happen to it whilst it's a `\mark`.

So after all that, we will either execute the appropriate definition of `\foo` for the current encoding, or we will execute `\noexpand\foo`.

The default value of `\foo` is `\?\foo` if it is defined, and an error message otherwise.

When the encoding is changed from `T1` to `OT1`, `\T1-cmd` is defined to be `\@changed@cmd` and `\OT1-cmd` is defined to be `\@current@cmd`. This means that the test for what the current encoding is can be performed quickly.

```

383 \def\@current@cmd#1{%
384   \ifx\protect\@typeset@protect
385     \inmathwarn#1%
386   \else
387     \noexpand#1\expandafter\@gobble
388   \fi}

389 \def\@changed@cmd#1#2{%
390   \ifx\protect\@typeset@protect
391     \inmathwarn#1%
392     \expandafter\ifx\csname\cf@encoding\string#1\endcsname\relax
393       \expandafter\ifx\csname ?\string#1\endcsname\relax
394         \expandafter\def\csname ?\string#1\endcsname{%
395           \TextSymbolUnavailable#1%
396         }%
397       \fi
398     \global\expandafter\let
399       \csname\cf@encoding \c
399       \string#1\expandafter\endcsname
400       \csname ?\string#1\endcsname
401     \fi
402     \csname\cf@encoding\string#1%
403       \expandafter\endcsname
404   \else
405     \noexpand#1%
406   \fi}

407 \gdef\TextSymbolUnavailable#1{%
408   \@latex@error{%
409     Command \protect#1 unavailable in encoding \cf@encoding%
410   }\@eha}

```

The command `\@inmathwarn` produces a warning message if we are currently in math mode. Note that since this command is used inside text commands, it can't call `\relax` before the `\ifmmode`. This means that it is possible for the warning to fail to be issued at the beginning of a row of an halign whose template enters math mode. This is probably a bad feature, but there's not much that can be done about it, since adding a `\relax` would break ligatures and kerning between text symbols.

A more efficient solution would be to make `\@inmathwarn` and `\@inmatherr` equal to `\@empty` and `\relax` by default, and to have `\everymath` reset them to their usual definitions. This is left for future investigation (for example it may break some third party code).

```

411 \def\@inmathwarn#1{%
412   \ifmmode
413     \@latex@warning{Command \protect#1 invalid in math mode}%
414   \fi}

```

#### `\DeclareTextCommandDefault`

These define commands with encoding ?. Note that `\DeclareTextCommandDefault` can only be used in the preamble, but that the `\Provide` version is allowed in inputenc .def files, so is allowed anywhere.

```

415 \def\DeclareTextCommandDefault#1{%
416   \DeclareTextCommand#1?}

\ProvideTextCommandDefault
417 \def\ProvideTextCommandDefault#1{%
418   \ProvideTextCommand#1?}

419 \@onlypreamble\DeclareTextCommandDefault
420 %\@onlypreamble\ProvideTextCommandDefault

    They require \?-cmd to be initialized as \changed@cmd.
421 \expandafter\let\csname?-cmd\endcsname\changed@cmd

```

### \DeclareTextAccent

This is just a disguise for defining a TeX `\accent` command.

```

422 \def\DeclareTextAccent#1#2#3{%
423   \DeclareTextCommand#1{#2}{\add@accent{#3}}}

424 \@onlypreamble\DeclareTextAccent

```

### \add@accent

To save space this code is shared between all text accents that are set using the `\accent` primitive. The argument is pre-set in a box so that any font loading that is needed is already done within the box. This is needed because font-loading involves grouping and that would prevent the accent mechanism from working so that the accent would not be positioned over the argument. Declarations that change the font should be allowed (only low-level ones are at present) inside the argument of an accent command, but not size changes, as they involve `\setbox` operations which also inhibit the mechanism of the `\accent` primitive. Note that the whole process is within a group. For a detailed discussion of this reimplemention and its deficiencies, see pr/3160.

```

425 \def\add@accent#1#2{\hmode@bgroup
    Turn off the group in \UseTextSymbol in case this is used inside the argument
    of \add@accent.

```

```

426   \let\hmode@start@before@group@\firstofone
427   \setbox\@tempboxa\hbox{#2}

```

When presetting the argument in a box we record its `\spacefactor` for later use after the accent got typeset. This way something like `\`A` gets the spacefactor of A (i.e., 999) rather than the default value of 1000.

```

428   \global\mathchardef\accent@spacefactor\spacefactor}%
429   \accent#1 #2\egroup\spacefactor\accent@spacefactor}

```

Default definition for `\accent@spacefactor` prevents a horrible death of the above macro inside an unprotected `\edef`.

```

430 \let\accent@spacefactor\relax

```

```

431 \def\hmode@bgroup{\leavevmode\bgroup}

```

```

\@text@composite
\@text@composite@x 432 \def\DeclareTextCompositeCommand#1#2#3#4{%
  \@strip@args 433   \expandafter\let\expandafter\reserved@a\csname#2\string#1\endcsname
  434   \expandafter\expandafter\expandafter\expandafter\ifx
  435   \expandafter\@car\reserved@a\relax\relax@nil %
    \expandafter\@text@composite \else
  436   \edef\reserved@b##1{%
  437     \def\expandafter\expandafter\noexpand
  438       \csname#2\string#1\endcsname####1{%
  439         \noexpand\@text@composite
  440           \expandafter\noexpand\csname#2\string#1\endcsname
  441             ####1\noexpand\@empty\noexpand\@text@composite
  442             {##1}}}%}
  443   \expandafter\expandafter\expandafter{\reserved@a{##1}}%
  444   \fi
  445   \expandafter\def\csname\expandafter\string\csname
  446     #2\endcsname\string#1-\string#3\endcsname{#4}}
  447 \onlypreamble\DeclareTextCompositeCommand

```

This all works because:

```
\@text@composite \T1\foo A\@empty \@text@composite {...}
```

expands to \\T1\\foo-A if \\T1\\foo-A has been defined, and {...} otherwise.

Note that `\@text@composite` grabs the first token of the argument and puts just that in the csname. This is so that `\{\textit{e}\}` will work—it checks whether \\T1\\'-\\textit{e} is defined (which presumably it isn't) and so expands to `\{accent 1 \textit{e}\}`.

This trick won't always work, for example `\{\{}{\itshape e\}\}` will expand to (with spaces added for clarity):

```
\csname \string \T1\` - \string {\itshape e\} \empty \endcsname
```

which will die pretty horribly. Unfortunately there's not much can be done about this if we're going to use `\csname` lookups as a fast way of accessing composites.

This has an unfortunate ‘misfeature’ though, which is that in the T1 encoding, `\{aa\}` produces á. This is not the expected behaviour, and should perhaps be fixed if the fix doesn't affect performance too badly.

Finally, it's worth noting that the `\empty` is used in `\@text@composite` so that accents will work even when the argument is empty. If you say `\{\}` then this looks up \\T1\\'-\\empty, which ought to be `\relax`, and so all is well. If we didn't include the `\empty`, then `\{\}` would expand to:

```
\csname \string \T1\` - \string \endcsname
```

so the `\endcsname` would be `\string`'ed and the whole of the rest of the document would be put inside the `\csname`. This would not be good.

```

448 \def\@text@composite#1#2#3\@text@composite{%
449   \expandafter\@text@composite@x
450   \csname\string#1-\string#2\endcsname}

```

Originally the `\@text@composite@x` macro had two arguments and if #1 was not `\relax` it was executed, otherwise #2 was executed. All this happened within the `\ifx` code so that neither #1 nor #2 could have picked up any additional arguments from the input stream. This has now been changed using the typical `\@firstoftwo / \@secondoftwo` coding. This way the final expansion will happen without any `\else` or `\fi` intervening in the case that we need to get a further token from the input stream.

```
451 \def\@text@composite@x#1{%
452   \ifx#1\relax
453     \expandafter\@secondoftwo
454   \else
455     \expandafter\@firstoftwo
456   \fi
457   #1}
```

The command `\DeclareTextComposite` uses `\DeclareTextCompositeCommand` to declare a command which expands out to a single glyph.

```
458 \catcode\z@=11\relax
459 \def\DeclareTextComposite#1#2#3#4{%
460   \def\reserved@a{\DeclareTextCompositeCommand#1{#2}{#3}}%
461   \bgroup
462     \lccode\z@#4%
463     \lowercase{%
464       \egroup
465       \reserved@a ^@}}
466 \catcode\z@=15\relax
467 \onlypreamble\DeclareTextComposite
```

(End definition for `\@text@composite`, `\@text@composite@x`, and `\@strip@args`.)

### \UseTextSymbol

These fragile commands access glyphs from different encodings. They use grotty low-level calls to the font selection scheme for speed, and in order to make sure that `\UseTextSymbol` doesn't do anything which you're not allowed to do between an `\accent` and its glyph.

For a detailed discussion of this reimplementation and its deficiencies, see pr/3160.

### \UseTextAccent

```
468 \def\UseTextAccent#1#2#3{%
469   \hmode@start@before@group
470   {%
```

Turn off the group in `\UseTextSymbol` in case this is used inside the arguments of `\UseTextAccent`.

```
471   \let\hmode@start@before@group\@firstofone
472   \let\@curr@enc\cf@encoding
473   \@use@text@encoding{#1}%
474   #2{\@use@text@encoding\@curr@enc#3}%
475 }
```

```

476 \def\UseTextSymbol#1#2{%
477     \hmode@start@before@group
478     {%
479         \def@\wrong@font@char{\MessageBreak
480             for \noexpand\symbol`\string#2'}%
481         \@use@text@encoding{#1}%
482         #2%
483     }%
484 }
485 \def@\use@text@encoding#1{%
486     \edef\f@encoding{#1}%
487     \xdef\font@name{%
488         \csname curr@fontshape/\f@size\endcsname}%
489     \pickup@font
490     \font@name
491     @@enc@update}

```

The `\hmode@start@before@group` starts hmode and should be immediately followed by an explicit `{...}`. Its purpose is to ensure that hmode is started before this group is opened. Inside `\add@accent` and `\UseTextAccent` it is redefined to remove this group so that it doesn't conflict with the `\accent` primitive.

For a detailed discussion see pr/3160.

```

492 \let\hmode@start@before@group\leavevmode
493 \def\DeclareTextSymbolDefault#1#2{%
494     \DeclareTextCommandDefault{#1}{\UseTextSymbol{#2}{#1}}}
495 \def\DeclareTextAccentDefault#1#2{%
496     \DeclareTextCommandDefault{#1}{\UseTextAccent{#2}{#1}}}
497 @onlypreamble\DeclareTextSymbolDefault
498 @onlypreamble\DeclareTextAccentDefault

```

This command safely removes and encoding specific declaration for a given encoding. It is helpful if one intends to use the default definition always and therefore wants to get rid of a declaration for some specific encoding.

```

499 \def\UndeclareTextCommand#1#2{%
500     \expandafter\ifx\csname#2\string#1\endcsname\relax
501     \else
502         \global\expandafter\let\csname#2\string#1\endcsname
503             \@undefined
504         \expandafter\expandafter\expandafter
505         \ifx\expandafter\@thirddofthree#1\@undefined
506             \expandafter\gdef\expandafter\expandafter#1\expandafter
507                 {\csname ?-\cmd\expandafter\endcsname\expandafter
508                     #1\csname?\string#1\endcsname}%
509         \fi
510     \fi
511 }
512 @onlypreamble\UndeclareTextCommand

```

### 11.3.40 Hyphenation

We redefine `\patterns` and `\hyphenation` to allow the use of commands declared with `\DeclareText*` to be used inside them.

```

513 %\let\@@patterns\patterns
514 %\let\@@hyphenation\hyphenation
515 %\def\patterns{%
516 %  \bgroup
517 %    \let\protect\@empty
518 %    \let\@typeset@protect\@empty
519 %    \let\@changed@x\@changed@x@mouth
520 %  \afterassignment\egroup
521 %  \@@patterns
522 %}
523 %\def\hyphenation{%
524 %  \bgroup
525 %    \let\protect\@empty
526 %    \let\@typeset@protect\@empty
527 %    \let\@changed@x\@changed@x@mouth
528 %  \afterassignment\egroup
529 %  \@@hyphenation
530 %}
531 \def@tabacckludge#1{\expandafter\@changed@cmd
532                                     \csname\string#1\endcsname\relax}
533 \let\@tabacckludge

```

### 11.3.5 Default encodings

We define the default encodings for most commands to be either OT1, OML or OMS. These defaults are in the kernel and therefore fonts with these encodings must be available unless these defaults are redefined elsewhere. Recall that the standard kernel loads the encoding files for these encodings, and also that for the T1 encoding.

The naming conventions in the kernel are not what we would use if we were starting from scratch... Those defined by DEK (like `\ae` and `\ss`) or by the TeX Users Group Technical Working Group on multi-lingual typesetting (like `\th` and `\ng`) have short names. Those which were added to the kernel in 1993 and early 1994 are named after their Adobe glyph names (like `\guillemotleft` and `\quotedblbase`). Unfortunately, this naming scheme won't work for all glyphs, since some names (like `\space`) are already used, and some (like `\endash`) are very likely to be defined by users. So we're now using the naming scheme of `\text` followed by the Adobe name, (like `\textendash` and `\textsterling`). Except that some glyphs don't have Adobe names, so we're using the names used by fontinst for those (like `\textcompwordmark`). Sigh. Some accents from OT1:

```

534 \DeclareTextAccentDefault{"}{OT1}
535 \DeclareTextAccentDefault{'}{OT1}
536 \DeclareTextAccentDefault{.}{OT1}
537 \DeclareTextAccentDefault{=}{OT1}
538 \DeclareTextAccentDefault{H}{OT1}

```

```

539 \DeclareTextAccentDefault{\^}{OT1}
540 \DeclareTextAccentDefault{\`}{OT1}
541 \DeclareTextAccentDefault{\b}{OT1}
542 \DeclareTextAccentDefault{\c}{OT1}
543 \DeclareTextAccentDefault{\d}{OT1}
544 \DeclareTextAccentDefault{\r}{OT1}
545 \DeclareTextAccentDefault{\u}{OT1}
546 \DeclareTextAccentDefault{\v}{OT1}
547 \DeclareTextAccentDefault{\~}{OT1}

```

Some symbols from OT1:

```

548 %\DeclareTextSymbolDefault{\AA}{OT1}
549 \DeclareTextSymbolDefault{\AE}{OT1}
550 \DeclareTextSymbolDefault{\L}{OT1}
551 \DeclareTextSymbolDefault{\OE}{OT1}
552 \DeclareTextSymbolDefault{\O}{OT1}
553 %\DeclareTextSymbolDefault{\aa}{OT1}
554 \DeclareTextSymbolDefault{\ae}{OT1}
555 \DeclareTextSymbolDefault{\i}{OT1}
556 \DeclareTextSymbolDefault{\j}{OT1}

557 \DeclareTextSymbolDefault{\ij}{OT1}
558 \DeclareTextSymbolDefault{\IJ}{OT1}

559 \DeclareTextSymbolDefault{\l}{OT1}
560 \DeclareTextSymbolDefault{\oe}{OT1}
561 \DeclareTextSymbolDefault{\o}{OT1}
562 \DeclareTextSymbolDefault{\ss}{OT1}
563 \DeclareTextSymbolDefault{\textdollar}{OT1}
564 \DeclareTextSymbolDefault{\textemdash}{OT1}
565 \DeclareTextSymbolDefault{\textendash}{OT1}
566 \DeclareTextSymbolDefault{\textexcldown}{OT1}
567 %\DeclareTextSymbolDefault{\texthyphenchar}{OT1}
568 %\DeclareTextSymbolDefault{\texthyphen}{OT1}
569 \DeclareTextSymbolDefault{\textquestiondown}{OT1}
570 \DeclareTextSymbolDefault{\textquotedblleft}{OT1}
571 \DeclareTextSymbolDefault{\textquotedblright}{OT1}
572 \DeclareTextSymbolDefault{\textquotelleft}{OT1}
573 \DeclareTextSymbolDefault{\textquoteright}{OT1}
574 \DeclareTextSymbolDefault{\textsterling}{OT1}

575 \DeclareTextSymbolDefault{\textasteriskcentered}{OMS}
576 \DeclareTextSymbolDefault{\textbackslash}{OMS}
577 \DeclareTextSymbolDefault{\textbar}{OMS}
578 \DeclareTextSymbolDefault{\textbardbl}{OMS}
579 \DeclareTextSymbolDefault{\textbraceleft}{OMS}
580 \DeclareTextSymbolDefault{\textbraceright}{OMS}
581 \DeclareTextSymbolDefault{\textbullet}{OMS}
582 \DeclareTextSymbolDefault{\textdaggerdbl}{OMS}
583 \DeclareTextSymbolDefault{\textdagger}{OMS}
584 \DeclareTextSymbolDefault{\textparagraph}{OMS}
585 \DeclareTextSymbolDefault{\textperiodcentered}{OMS}
586 \DeclareTextSymbolDefault{\textsection}{OMS}
587 \DeclareTextAccentDefault{\textcircled}{OMS}

588 \DeclareTextSymbolDefault{\textless}{OML}

```

```

589 \DeclareTextSymbolDefault{\textgreater}{OML}
590 \DeclareTextAccentDefault{\t}{OML}
591 \DeclareTextCommandDefault{\textcopyright}{\textcircled{c}}
592 % \expandafter\def\expandafter
593 %
594 \expandafter\expandafter{\expandafter\copyright}
595 \DeclareTextCommandDefault{\textasciicircum}{^{}}
596 \DeclareTextCommandDefault{\textasciitilde}{\~{}}
597 \DeclareTextCommandDefault{\textcompwordmark}{\leavevmode\kern\z@}
598 \DeclareTextCommandDefault{\textunderscore}{%
599 \leavevmode \kern.06em\vbox{\hrule\@width.3em}}
600 \DeclareTextCommandDefault{\textvisiblespace}{%
601 \mbox{\kern.06em}\vrule\@height.3ex}%
602 \vbox{\hrule\@width.3em}%
603 \hbox{\vrule\@height.3ex}}

```

Using `\fontdimen3` in the next definition is some sort of a kludge (since it is the interword stretch) but it makes the ellipsis come out right in mono-spaced fonts too (since there it is zero).

```

603 \DeclareTextCommandDefault{\textellipsis}{%
604 .\kern\fontdimen3\font
605 .\kern\fontdimen3\font
606 .\kern\fontdimen3\font}
607 %\DeclareTextCommandDefault{\textregistered}{\textcircled{\scshape r}}
608 \DeclareTextCommandDefault{\textregistered}{\textcircled{%
609 \check@mathfonts\fontsize\sf@size\z@\math@fontsfalse\selectfont}%
610 \R{}}
611 \DeclareTextCommandDefault{\texttrademark}{\textsuperscript{TM}}
612 \DeclareTextCommandDefault{\textordfeminine}{\textsuperscript{a}}
613 \DeclareTextCommandDefault{\textordmasculine}{\textsuperscript{o}}
614 \ DeclareRobustCommand{\$}{\ifmmode\mathdollar\else\textdollar\fi}
615 \ DeclareRobustCommand{\{}{\ifmmode\lbrace\else\textbraceleft\fi}
616 \ DeclareRobustCommand{\}}{\ifmmode\rbrace\else\textbraceright\fi}
617 \ DeclareRobustCommand{\P}{\ifmmode\mathparagraph\else\textparagraph\fi}
618 \ DeclareRobustCommand{\S}{\ifmmode\mathsection\else\textsection\fi}
619 \ DeclareRobustCommand{\dag}{\ifmmode{\dagger}\else\textdagger\fi}
620 \ DeclareRobustCommand{\ddag}{\ifmmode{\ddagger}\else\textdaggerdbl\fi}
621 \ DeclareRobustCommand{\_}{%
622 \ifmmode\nfss@text{\textunderscore}\else\textunderscore\fi}
623 \ DeclareRobustCommand{\copyright}{%
624 \ifmmode{\nfss@text{\textcopyright}}\else\textcopyright\fi}
625 \ DeclareRobustCommand{\pounds}{%
626 \ifmmode\mathsterling\else\textsterling\fi}
627 \ DeclareRobustCommand{\dots}{%
628 \ifmmode\mathellipsis\else\textellipsis\fi}
629 \let\ldots\dots
630 %</2ekernel>

```

### 11.3.6 Definitions for the OT1 encoding

The definitions for the ‘TeX text’ (OT1) encoding.

Declare the encoding.

```

631 %<*OT1>
632 \DeclareFontEncoding{OT1}{}{}

633 \DeclareTextAccent{"}{OT1}{127}
634 \DeclareTextAccent{'}{OT1}{19}
635 \DeclareTextAccent{.}{OT1}{95}
636 \DeclareTextAccent={}{OT1}{22}
637 \DeclareTextAccent^}{OT1}{94}
638 \DeclareTextAccent`}{OT1}{18}
639 \DeclareTextAccent~}{OT1}{126}
640 \DeclareTextAccentH}{OT1}{125}
641 \DeclareTextAccentu}{OT1}{21}
642 \DeclareTextAccentv}{OT1}{20}
643 \DeclareTextAccentr}{OT1}{23}

644 \DeclareTextCommand{\b}{OT1}[1]
645   {\hmode@bgroup\o@align{\relax#1\crcr\hidewidth\ltx@sh@ft{-3ex}%
646     \vbox to .2ex{\hbox{\char22}\vss}\hidewidth}\egroup}
647 \DeclareTextCommand{\c}{OT1}[1]
648   {\leavevmode\setbox\z@\hbox{\#1}\ifdim\ht\z@=1ex\accent24 #1%
649     \else{\ooalign{\unhbox\z@\crcr\hidewidth\char24\hidewidth}}\fi}
650 \DeclareTextCommand{\d}{OT1}[1]
651   {\hmode@bgroup
652     \o@align{\relax#1\crcr\hidewidth\ltx@sh@ft{-1ex}. \hidewidth}\egroup}

653 \DeclareTextSymbol{AE}{OT1}{29}
654 \DeclareTextSymbol{OE}{OT1}{30}
655 \DeclareTextSymbol{O}{OT1}{31}
656 \DeclareTextSymbol{ae}{OT1}{26}
657 \DeclareTextSymbol{i}{OT1}{16}
658 \DeclareTextSymbol{j}{OT1}{17}
659 \DeclareTextSymbol{oe}{OT1}{27}
660 \DeclareTextSymbol{o}{OT1}{28}
661 \DeclareTextSymbol{ss}{OT1}{25}
662 \DeclareTextSymbol{textemdash}{OT1}{124}
663 \DeclareTextSymbol{textendash}{OT1}{123}
```

Using the ligatures helps with OT1 fonts that have `\textexclamdown` and `\textquestiondown` in unusual positions.

```

664 \%{\DeclareTextSymbol{textexclamdown}{OT1}{60}
665 \%{\DeclareTextSymbol{textquestiondown}{OT1}{62}
666 \DeclareTextCommand{textexclamdown}{OT1}{!`}
667 \DeclareTextCommand{textquestiondown}{OT1}{?`}
668 \%{\DeclareTextSymbol{texthyphenchar}{OT1}{`-}
669 \%{\DeclareTextSymbol{texthyphen}{OT1}{`-}
670 \DeclareTextSymbol{textquotedblleft}{OT1}{92}
671 \DeclareTextSymbol{textquotedblright}{OT1}{`}
672 \DeclareTextSymbol{textquotel}{OT1}{``}
673 \DeclareTextSymbol{textquoter}{OT1}{`'`}
```

Some symbols which are faked from others:

```

674 % \DeclareTextCommand{\aa}{OT1}
675 %   {{\`{a}}}
676 \DeclareTextCommand{\L}{OT1}
677   {\leavevmode\setbox\z@\hbox{L}\hb@xt@\wd\z@{\hss@xxxii L}}
678 \DeclareTextCommand{\l}{OT1}
679   {\hmode@bgroup@xxxii l\egroup}
680 % \DeclareTextCommand{\AA}{OT1}
681 %   {`{\`{A}}}
682 %   {\leavevmode\setbox\z@\hbox{A}\dimen@\ht\z@\advance\dimen@-1ex%
683 %     \rlap{\raise.67\dimen@\hbox{\char23}}A}
684 \DeclareTextCompositeCommand{\r}{OT1}{A}
685   {\leavevmode\setbox\z@\hbox{!}\dimen@\ht\z@\advance\dimen@-1ex%
686   \rlap{\raise.67\dimen@\hbox{\char23}}A}
687 \DeclareTextCommand{\ij}{OT1}{%
688   \nobreak\hskip\z@skip i\kern-0.02em j\nobreak\hskip\z@skip}
689 \DeclareTextCommand{\IJ}{OT1}{%
690   \nobreak\hskip\z@skip I\kern-0.02em J\nobreak\hskip\z@skip}
691 \DeclareTextCommand{\textdollar}{OT1}{\hmode@bgroup
692   \ifdim \fontdimen@ne\font >\z@
693     \slshape
694   \else
695     \upshape
696   \fi
697   \char`\$\egroup}
698 \DeclareTextCommand{\textsterling}{OT1}{\hmode@bgroup
699   \ifdim \fontdimen@ne\font >\z@
700     \itshape
701   \else
702     \fontshape{ui}\selectfont
703   \fi
704   \char`\$\egroup}

```

Here we are adding some more composite commands to the **OT1** encoding. This makes the use of certain accents with **i** compatible with their use with the **T1** encoding; this enables them to become true **LATEX** internal representations. However, it will make these accents work a little less fast since a check will always be made for the existence of a composite.

```

704 \DeclareTextComposite{\.{i}}{OT1}{`i}
705 \DeclareTextComposite{\.{i}}{OT1}{`i}
706 \DeclareTextCompositeCommand{\`{i}}{OT1}{i}{\@tabacckludge`i}
707 \DeclareTextCompositeCommand{\'i}{OT1}{i}{\@tabacckludge'i}
708 \DeclareTextCompositeCommand{\^i}{OT1}{i}{^\i}
709 \DeclareTextCompositeCommand{\\"i}{OT1}{i}{\"i}
710 %</OT1>

```

### 11.3.7 Definitions for the T1 encoding

```

711 %<*T1>
712 \DeclareFontEncoding{T1}{}{}

```

```

713 \DeclareTextAccent{\`}{T1}{0}
714 \DeclareTextAccent{\'}{T1}{1}
715 \DeclareTextAccent{\^}{T1}{2}
716 \DeclareTextAccent{\~}{T1}{3}
717 \DeclareTextAccent{\"}{T1}{4}
718 \DeclareTextAccent{\H}{T1}{5}
719 \DeclareTextAccent{\r}{T1}{6}
720 \DeclareTextAccent{\v}{T1}{7}
721 \DeclareTextAccent{\u}{T1}{8}
722 \DeclareTextAccent{\=}{T1}{9}
723 \DeclareTextAccent{\.}{T1}{10}

724 \DeclareTextCommand{\b}{T1}[1]
725   {\hmode@bgroup\o@lign{\relax#1\crr\hidewidth\ltx@sh@ft{-3ex}%
726   \vbox to .2ex{\hbox{\char9}\vss}\hidewidth}\egroup}
727 \DeclareTextCommand{\c}{T1}[1]
728   {\leavevmode\setbox\z@\hbox{\#1}\ifdim\ht\z@=1ex\accent11 #1%
729   \else{\oalign{\unhbox\z@\crr
730   \hidewidth\char11\hidewidth}}\fi}
731 \DeclareTextCommand{\d}{T1}[1]
732   {\hmode@bgroup
733   \o@lign{\relax#1\crr\hidewidth\ltx@sh@ft{-1ex}. \hidewidth}\egroup}
734 \DeclareTextCommand{\k}{T1}[1]
735   {\hmode@bgroup\oalign{\null#1\crr\hidewidth\char12}\egroup}
736 \DeclareTextCommand{\textogonekcentered}{T1}[1]
737   {\hmode@bgroup\oalign{%
738     \null#1\crr\hidewidth\char12\hidewidth}\egroup}

```

Some symbols are constructed.

```

739 \DeclareTextCommand{\textperthousand}{T1}
740   {\%\char 24 } % space or `relax as delimiter?
741 \DeclareTextCommand{\textpertenthousand}{T1}
742   {\%\char 24\char 24 } % space or `relax as delimiter?

743 \% \ DeclareTextSymbol{\AA}{T1}{197}
744 \DeclareTextSymbol{\AE}{T1}{198}
745 \DeclareTextSymbol{\DH}{T1}{208}
746 \DeclareTextSymbol{\DJ}{T1}{208}
747 \DeclareTextSymbol{\L}{T1}{138}
748 \DeclareTextSymbol{\NG}{T1}{141}
749 \DeclareTextSymbol{\OE}{T1}{215}
750 \DeclareTextSymbol{\O}{T1}{216}
751 \DeclareTextSymbol{\SS}{T1}{223}
752 \DeclareTextSymbol{\TH}{T1}{222}
753 \% \ DeclareTextSymbol{\aa}{T1}{229}
754 \DeclareTextSymbol{\ae}{T1}{230}
755 \DeclareTextSymbol{\dh}{T1}{240}
756 \DeclareTextSymbol{\dj}{T1}{158}
757 \DeclareTextSymbol{\guillemotleft}{T1}{19}
758 \DeclareTextSymbol{\guillemotright}{T1}{20}
759 \DeclareTextSymbol{\guilsinglleft}{T1}{14}
760 \DeclareTextSymbol{\guilsinglright}{T1}{15}
761 \DeclareTextSymbol{\i}{T1}{25}
762 \DeclareTextSymbol{\j}{T1}{26}
763 \DeclareTextSymbol{\ij}{T1}{188}

```

```

764 \DeclareTextSymbol{\IJ}{T1}{156}
765 \DeclareTextSymbol{\l}{T1}{170}
766 \DeclareTextSymbol{\ng}{T1}{173}
767 \DeclareTextSymbol{\oe}{T1}{247}
768 \DeclareTextSymbol{\o}{T1}{248}
769 \DeclareTextSymbol{\quotedblbase}{T1}{18}
770 \DeclareTextSymbol{\quotesinglbase}{T1}{13}
771 \DeclareTextSymbol{\ss}{T1}{255}
772 \DeclareTextSymbol{\textasciicircum}{T1}{`^}
773 \DeclareTextSymbol{\textasciitilde}{T1}{`~}
774 \DeclareTextSymbol{\textbackslash}{T1}{`\\"}
775 \DeclareTextSymbol{\textbar}{T1}{`\|`}
776 \DeclareTextSymbol{\textbraceleft}{T1}{`\{`}
777 \DeclareTextSymbol{\textbraceright}{T1}{`\}`}
778 \DeclareTextSymbol{\textcompwordmark}{T1}{23}
779 \DeclareTextSymbol{\textdollar}{T1}{`\$`}
780 \DeclareTextSymbol{\textemdash}{T1}{22}
781 \DeclareTextSymbol{\textendash}{T1}{21}
782 \DeclareTextSymbol{\textexclamdown}{T1}{189}
783 \DeclareTextSymbol{\textgreater}{T1}{`>`}
784 %\DeclareTextSymbol{\texthyphenchar}{T1}{127}
785 %\DeclareTextSymbol{\texthyphen}{T1}{`-`}
786 \DeclareTextSymbol{\textless}{T1}{`<`}
787 \DeclareTextSymbol{\textquestiondown}{T1}{190}
788 \DeclareTextSymbol{\textquotedblleft}{T1}{16}
789 \DeclareTextSymbol{\textquotedblright}{T1}{17}
790 \DeclareTextSymbol{\textquotedbl}{T1}{`\\"}
791 \DeclareTextSymbol{\textquotel}{T1}{`\`}
792 \DeclareTextSymbol{\textquotr}{T1}{`\`}
793 \DeclareTextSymbol{\textsection}{T1}{159}
794 \DeclareTextSymbol{\textsterling}{T1}{191}
795 \DeclareTextSymbol{\textunderscore}{T1}{95}
796 \DeclareTextSymbol{\textvisiblespace}{T1}{32}
797 \DeclareTextSymbol{\th}{T1}{254}

798 \DeclareTextComposite{\.}{T1}{i}{`\i`}
799 \DeclareTextComposite{\.}{T1}{\i}{`\i`}

800 \DeclareTextComposite{\u}{T1}{A}{128}
801 \DeclareTextComposite{\k}{T1}{A}{129}
802 \DeclareTextComposite{\'}{T1}{C}{130}
803 \DeclareTextComposite{\v}{T1}{C}{131}
804 \DeclareTextComposite{\v}{T1}{D}{132}
805 \DeclareTextComposite{\v}{T1}{E}{133}
806 \DeclareTextComposite{\k}{T1}{E}{134}
807 \DeclareTextComposite{\u}{T1}{G}{135}

808 \DeclareTextComposite{\'}{T1}{L}{136}
809 \DeclareTextComposite{\v}{T1}{L}{137}
810 \DeclareTextComposite{\'}{T1}{N}{139}
811 \DeclareTextComposite{\v}{T1}{N}{140}
812 \DeclareTextComposite{\H}{T1}{O}{142}
813 \DeclareTextComposite{\'}{T1}{R}{143}

814 \DeclareTextComposite{\v}{T1}{R}{144}
815 \DeclareTextComposite{\'}{T1}{S}{145}

```

```

816 \DeclareTextComposite{\v}{T1}{S}{146}
817 \DeclareTextComposite{\c}{T1}{S}{147}
818 \DeclareTextComposite{\v}{T1}{T}{148}
819 \DeclareTextComposite{\c}{T1}{T}{149}
820 \DeclareTextComposite{\H}{T1}{U}{150}
821 \DeclareTextComposite{\r}{T1}{U}{151}

822 \DeclareTextComposite{"}{T1}{Y}{152}
823 \DeclareTextComposite{'}{T1}{Z}{153}
824 \DeclareTextComposite{\v}{T1}{Z}{154}
825 \DeclareTextComposite{.}{T1}{Z}{155}
826 \DeclareTextComposite{.}{T1}{I}{157}

827 \DeclareTextComposite{\u}{T1}{a}{160}
828 \DeclareTextComposite{\k}{T1}{a}{161}
829 \DeclareTextComposite{'}{T1}{c}{162}
830 \DeclareTextComposite{\v}{T1}{c}{163}
831 \DeclareTextComposite{\v}{T1}{d}{164}
832 \DeclareTextComposite{\v}{T1}{e}{165}
833 \DeclareTextComposite{\k}{T1}{e}{166}
834 \DeclareTextComposite{\u}{T1}{g}{167}

835 \DeclareTextComposite{'}{T1}{l}{168}
836 \DeclareTextComposite{\v}{T1}{l}{169}
837 \DeclareTextComposite{'}{T1}{n}{171}
838 \DeclareTextComposite{\v}{T1}{n}{172}
839 \DeclareTextComposite{\H}{T1}{o}{174}
840 \DeclareTextComposite{'}{T1}{r}{175}

841 \DeclareTextComposite{\v}{T1}{r}{176}
842 \DeclareTextComposite{'}{T1}{s}{177}
843 \DeclareTextComposite{\v}{T1}{s}{178}
844 \DeclareTextComposite{\c}{T1}{s}{179}
845 \DeclareTextComposite{\v}{T1}{t}{180}
846 \DeclareTextComposite{\c}{T1}{t}{181}
847 \DeclareTextComposite{\H}{T1}{u}{182}
848 \DeclareTextComposite{\r}{T1}{u}{183}

849 \DeclareTextComposite{"}{T1}{y}{184}
850 \DeclareTextComposite{'}{T1}{z}{185}
851 \DeclareTextComposite{\v}{T1}{z}{186}
852 \DeclareTextComposite{.}{T1}{z}{187}

853 \DeclareTextComposite{\`}{T1}{A}{192}
854 \DeclareTextComposite{'}{T1}{A}{193}
855 \DeclareTextComposite{\^}{T1}{A}{194}
856 \DeclareTextComposite{\~}{T1}{A}{195}
857 \DeclareTextComposite{"}{T1}{A}{196}
858 \DeclareTextComposite{\r}{T1}{A}{197}
859 \DeclareTextComposite{\c}{T1}{C}{199}

860 \DeclareTextComposite{\`}{T1}{E}{200}
861 \DeclareTextComposite{'}{T1}{E}{201}
862 \DeclareTextComposite{\^}{T1}{E}{202}
863 \DeclareTextComposite{"}{T1}{E}{203}
864 \DeclareTextComposite{\`}{T1}{I}{204}
865 \DeclareTextComposite{'}{T1}{I}{205}
866 \DeclareTextComposite{\^}{T1}{I}{206}

```

```

867 \DeclareTextComposite{"}{T1}{I}{207}
868 \DeclareTextComposite{"~}{T1}{N}{209}
869 \DeclareTextComposite{"`}{T1}{O}{210}
870 \DeclareTextComposite{"'}{T1}{O}{211}
871 \DeclareTextComposite{"^}{T1}{O}{212}
872 \DeclareTextComposite{"~}{T1}{O}{213}
873 \DeclareTextComposite{""}{T1}{O}{214}
874 \DeclareTextComposite{"`}{T1}{U}{217}
875 \DeclareTextComposite{"'}{T1}{U}{218}
876 \DeclareTextComposite{"^}{T1}{U}{219}
877 \DeclareTextComposite{""}{T1}{U}{220}
878 \DeclareTextComposite{"'}{T1}{Y}{221}
879 \DeclareTextComposite{"`}{T1}{a}{224}
880 \DeclareTextComposite{"'}{T1}{a}{225}
881 \DeclareTextComposite{"^}{T1}{a}{226}
882 \DeclareTextComposite{"~}{T1}{a}{227}
883 \DeclareTextComposite{""}{T1}{a}{228}
884 \DeclareTextComposite{"r}{T1}{a}{229}
885 \DeclareTextComposite{"c}{T1}{c}{231}
886 \DeclareTextComposite{"`}{T1}{e}{232}
887 \DeclareTextComposite{"'}{T1}{e}{233}
888 \DeclareTextComposite{"^}{T1}{e}{234}
889 \DeclareTextComposite{""}{T1}{e}{235}
890 \DeclareTextComposite{"`}{T1}{i}{236}
891 \DeclareTextComposite{"`}{T1}{\i}{236}
892 \DeclareTextComposite{"'}{T1}{i}{237}
893 \DeclareTextComposite{"'}{T1}{\i}{237}
894 \DeclareTextComposite{"^}{T1}{i}{238}
895 \DeclareTextComposite{"^}{T1}{\i}{238}
896 \DeclareTextComposite{""}{T1}{i}{239}
897 \DeclareTextComposite{""}{T1}{\i}{239}
898 \DeclareTextComposite{"~}{T1}{n}{241}
899 \DeclareTextComposite{"`}{T1}{o}{242}
900 \DeclareTextComposite{"'}{T1}{o}{243}
901 \DeclareTextComposite{"^}{T1}{o}{244}
902 \DeclareTextComposite{"~}{T1}{o}{245}
903 \DeclareTextComposite{""}{T1}{o}{246}
904 \DeclareTextComposite{"`}{T1}{u}{249}
905 \DeclareTextComposite{"'}{T1}{u}{250}
906 \DeclareTextComposite{"^}{T1}{u}{251}
907 \DeclareTextComposite{""}{T1}{u}{252}
908 \DeclareTextComposite{"'}{T1}{y}{253}
909 \DeclareTextCompositeCommand{k}{T1}{o}{\textogonekcentered{o}}
910 \DeclareTextCompositeCommand{k}{T1}{0}{\textogonekcentered{0}}
911 %</T1>
912 %<*OMS>
913 \DeclareFontEncoding{OMS}{}{}
914 % \footnotechanges{v1.99}{2004/02/02}{Added \cs{textbigcircle}}
915 % Note that slot 13 has in places been named |\Orb|: please root

```

```

916 %     out and destroy this impolity wherever you find it!
917 \begin{tex}
918 \DeclareTextSymbol{\textasteriskcentered}{OMS}{3}      % "03
919 \DeclareTextSymbol{\textbackslash}{OMS}{110}             % "6E
920 \DeclareTextSymbol{\textbar}{OMS}{106}                  % "6A
921 \DeclareTextSymbol{\textbardbl}{OMS}{107}              % "6B
922 \DeclareTextSymbol{\textbraceleft}{OMS}{102}            % "66
923 \DeclareTextSymbol{\textbraceright}{OMS}{103}           % "67
924 \DeclareTextSymbol{\textbullet}{OMS}{15}                % "0F
925 \DeclareTextSymbol{\textdaggerdbl}{OMS}{122}             % "7A
926 \DeclareTextSymbol{\textdagger}{OMS}{121}               % "79
927 \DeclareTextSymbol{\textparagraph}{OMS}{123}              % "7B
928 \DeclareTextSymbol{\textperiodcentered}{OMS}{1}          % "01
929 \DeclareTextSymbol{\textsection}{OMS}{120}               % "78
930 \DeclareTextSymbol{\textbigcircle}{OMS}{13}              % "0D
931 \DeclareTextCommand{\textcircled}{OMS}[1]{\hmode@bgroup
932     \oalign{%
933         \hfil \raise .07ex\hbox {\upshape#1}\hfil \crcr
934         \char 13 \% "0D
935     }%
936 \egroup}
937 %</OMS>

```

### 11.3.8 Definitions for the OML encoding

<sup>19</sup>

The definitions for the ‘ $\text{\TeX}$  math italic’ (OML) encoding. Even though this is meant to be a math font, it includes some of the standard  $\text{\LaTeX}$  text symbols. OML

Declare the encoding.

```

938 %<*OML>
939 \DeclareFontEncoding{OML}{}{}

```

Declare the symbols.

```

940 \DeclareTextSymbol{\textless}{OML}{`<}
941 \DeclareTextSymbol{\textgreater}{OML}{`>}
942 \DeclareTextAccent{\t}{OML}{127}  % "7F
943 %</OML>

```

### 11.3.9 Definitions for the OT4 encoding

These definitions are for the Polish extension to the ‘ $\text{\TeX}$  text’ (OT1) encoding. This encoding was created by B. Jackowski and M. Ryćko for use with the Polish version of Computer Modern and Computer Concrete. In positions 0–127 it is identical to OT1 but it contains some additional characters in the upper half. The  $\text{\LaTeX}$  support was developed by Mariusz Olko.

The PL fonts that use it are available as follows:

Metafont sources <ftp://ftp.gust.org.pl/TeX/language/polish/pl-mf.zip>;

Font files <ftp://ftp.gust.org.pl/TeX/language/polish/pl-tfm.zip>.

---

<sup>19</sup>v1.6d 1994/10/30 Added the OML encoding.

Declare the encoding.

```
944 %<*OT4>
945 \DeclareFontEncoding{OT4}{}{}
946 \DeclareFontSubstitution{OT4}{cmr}{m}{n}
```

Declare the accents.

```
947 \DeclareTextAccent{"}{OT4}{127}
948 \DeclareTextAccent{'}{OT4}{19}
949 \DeclareTextAccent{.}{OT4}{95}
950 \DeclareTextAccent{=}{OT4}{22}
951 \DeclareTextAccent{^}{OT4}{94}
952 \DeclareTextAccent{`}{OT4}{18}
953 \DeclareTextAccent{~}{OT4}{126}
954 \DeclareTextAccent{H}{OT4}{125}
955 \DeclareTextAccent{u}{OT4}{21}
956 \DeclareTextAccent{v}{OT4}{20}
957 \DeclareTextAccent{r}{OT4}{23}
```

The ogonek accent is available only under a e A & E. But we have to provide some definition for \k. Some other accents have to be built by hand as in OT1:

<sup>20</sup>

```
958 \DeclareTextCommand{\k}{OT4}[1]{%
959   \TextSymbolUnavailable{\k{#1}}#1}
```

In these definitions we no longer use the helper function `\sh@ft` from plain.tex since that now has two incompatible definitions. <sup>21</sup>

```
960 \DeclareTextCommand{\b}{OT4}[1]
961   {\hmode@bgroup\o@align{\relax#1\crcr\hidewidth\ltx@sh@ft{-3ex}%
962     \vbox to .2ex{\hbox{\char22}\vss}\hidewidth}\egroup}
963 \DeclareTextCommand{\c}{OT4}[1]
964   {\leavevmode\setbox\z@\hbox{\#1}\ifdim\ht\z@=1ex\accent24 #1%
965     \else\oalign{\unhbox\z@\crcr\hidewidth\char24\hidewidth}\fi}
966 \DeclareTextCommand{\d}{OT4}[1]
967   {\hmode@bgroup
968     \o@align{\relax#1\crcr\hidewidth\ltx@sh@ft{-1ex}.\hidewidth}\egroup}
```

Declare the text symbols.

```
969 \DeclareTextSymbol{\AE}{OT4}{29}
970 \DeclareTextSymbol{\OE}{OT4}{30}
971 \DeclareTextSymbol{\O}{OT4}{31}
972 \DeclareTextSymbol{\L}{OT4}{138}
973 \DeclareTextSymbol{\ae}{OT4}{26}
974 \DeclareTextSymbol{\guillemotleft}{OT4}{174}
975 \DeclareTextSymbol{\guillemotright}{OT4}{175}
976 \DeclareTextSymbol{\i}{OT4}{16}
977 \DeclareTextSymbol{\j}{OT4}{17}
978 \DeclareTextSymbol{\l}{OT4}{170}
979 \DeclareTextSymbol{\o}{OT4}{28}
980 \DeclareTextSymbol{\oe}{OT4}{27}
981 \DeclareTextSymbol{\quotedblbase}{OT4}{255}
982 \DeclareTextSymbol{\ss}{OT4}{25}
983 \DeclareTextSymbol{\textemdash}{OT4}{124}
```

<sup>20</sup>v1.9y 2000/01/30 Use `\hmode@bgroup` where applicable (pr/3160)

<sup>21</sup>v1.99g 2005/09/27 Replace `\sh@ft` by `\ltx@sh@ft`

```

984 \DeclareTextSymbol{\textendash}{OT4}{123}
985 \DeclareTextSymbol{\textexclamdown}{OT4}{60}
986 %\DeclareTextSymbol{\texthyphenchar}{OT4}{`\-}
987 %\DeclareTextSymbol{\texthyphen}{OT4}{`\-}
988 \DeclareTextSymbol{\textquestiondown}{OT4}{62}
989 \DeclareTextSymbol{\textquotedblleft}{OT4}{92}
990 \DeclareTextSymbol{\textquotedblright}{OT4}{`"}
991 \DeclareTextSymbol{\textquotelleft}{OT4}{``}
992 \DeclareTextSymbol{\textquoteright}{OT4}{``}
993 \DeclareTextCompositeCommand{\r}{OT4}{A}
994   {\leavevmode\setbox\z@\hbox{!}\dimen@ht\z@\advance\dimen@-1ex%
995   \rlap{\raise.67\dimen@\hbox{\char23}}A}
996 \DeclareTextCommand{\textdollar}{OT4}{\hmode@bgroup
997   \ifdim \fontdimen@ne\font >\z@
998     \sllshape
999   \else
1000     \upshape
1001   \fi
1002   \char`\$\egroup}
1003 \DeclareTextCommand{\textsterling}{OT4}{\hmode@bgroup
1004   \ifdim \fontdimen@ne\font >\z@
1005     \itshape
1006   \else
1007     \fontshape{ui}\selectfont
1008   \fi
1009   \char`\$\egroup}
1010 \DeclareTextComposite{\k}{OT4}{A}{129}
1011 \DeclareTextComposite{\'}{OT4}{C}{130}
1012 \DeclareTextComposite{\k}{OT4}{E}{134}
1013 \DeclareTextComposite{\'}{OT4}{N}{139}
1014 \DeclareTextComposite{\'}{OT4}{S}{145}
1015 \DeclareTextComposite{\'}{OT4}{Z}{153}
1016 \DeclareTextComposite{\.}{OT4}{Z}{155}
1017 \DeclareTextComposite{\k}{OT4}{a}{161}
1018 \DeclareTextComposite{\'}{OT4}{c}{162}
1019 \DeclareTextComposite{\k}{OT4}{e}{166}
1020 \DeclareTextComposite{\'}{OT4}{n}{171}
1021 \DeclareTextComposite{\'}{OT4}{s}{177}
1022 \DeclareTextComposite{\'}{OT4}{z}{185}
1023 \DeclareTextComposite{\.}{OT4}{z}{187}
1024 \DeclareTextComposite{\'}{OT4}{o}{211}
1025 \DeclareTextComposite{\'}{OT4}{o}{243}
1026 %</OT4>

```

### 11.3.10 Definitions for the TS1 encoding

```

1027 %<*TS1>
1028 \DeclareFontEncoding{TS1}{}{}
1029 \DeclareFontSubstitution{TS1}{cmr}{m}{n}
1030 \DeclareTextCommand{\capitalcedilla}{TS1}[1]
1031   {\hmode@bgroup

```

```

1032     \oalign{\null#1\crcr\hidewidth\char11\hidewidth}\egroup}
1033 \DeclareTextCommand{\capitalogonek}{TS1}[1]
1034   {\hmode@bgroup
1035     \oalign{\null#1\crcr\hidewidth\char12\hidewidth}\egroup}
1036 \DeclareTextAccent{\capitalgrave}{TS1}{0}
1037 \DeclareTextAccent{\capitalacute}{TS1}{1}
1038 \DeclareTextAccent{\capitalcircumflex}{TS1}{2}
1039 \DeclareTextAccent{\capitaltilde}{TS1}{3}
1040 \DeclareTextAccent{\capitaldieresis}{TS1}{4}
1041 \DeclareTextAccent{\capitalhungarumlaut}{TS1}{5}
1042 \DeclareTextAccent{\capitalring}{TS1}{6}
1043 \DeclareTextAccent{\capitalcaron}{TS1}{7}
1044 \DeclareTextAccent{\capitalbreve}{TS1}{8}
1045 \DeclareTextAccent{\capitalmacron}{TS1}{9}
1046 \DeclareTextAccent{\capitaldotaccent}{TS1}{10}

```

Tie accents.

The tie accent was borrowed from the **cmmi** font. The tc fonts now provide four tie accents, the first two are done in the classical way with assymetric glyphs hanging out of their boxes; the new ties are centered in their boxes like all other accents. They need a name: please tell us if you know what to call them.

```

1047 \DeclareTextAccent{\t}{TS1}{26}
1048 \DeclareTextAccent{\capitaltie}{TS1}{27}
1049 \DeclareTextAccent{\newtie}{TS1}{28}
1050 \DeclareTextAccent{\capitalnewtie}{TS1}{29}
1051 \DeclareTextSymbol{\textcapitalcompwordmark}{TS1}{23}
1052 \DeclareTextSymbol{\textascendercompwordmark}{TS1}{31}
1053 \DeclareTextSymbol{\textquotestraightbase}{TS1}{13}
1054 \DeclareTextSymbol{\textquotestraightdblbase}{TS1}{18}
1055 \DeclareTextSymbol{\texttwelveudash}{TS1}{21}
1056 \DeclareTextSymbol{\textthreequartersemdash}{TS1}{22}
1057 \DeclareTextSymbol{\textleftarrow}{TS1}{24}
1058 \DeclareTextSymbol{\textrightarrow}{TS1}{25}
1059 \DeclareTextSymbol{\textblank}{TS1}{32}
1060 \DeclareTextSymbol{\textdollar}{TS1}{36}
1061 \DeclareTextSymbol{\textquotesingle}{TS1}{39}
1062 \DeclareTextSymbol{\textasteriskcentered}{TS1}{42}
1063 \DeclareTextSymbol{\textdblhyphen}{TS1}{45}
1064 \DeclareTextSymbol{\textfractionsolidus}{TS1}{47}
1065 \DeclareTextSymbol{\textzerooldstyle}{TS1}{48}
1066 \DeclareTextSymbol{\textoneoldstyle}{TS1}{49}
1067 \DeclareTextSymbol{\texttwooldstyle}{TS1}{50}
1068 \DeclareTextSymbol{\textthreeoldstyle}{TS1}{51}
1069 \DeclareTextSymbol{\textfouroldstyle}{TS1}{52}
1070 \DeclareTextSymbol{\textfiveoldstyle}{TS1}{53}
1071 \DeclareTextSymbol{\textsixoldstyle}{TS1}{54}
1072 \DeclareTextSymbol{\textsevenoldstyle}{TS1}{55}

```

```

1073 \DeclareTextSymbol{\texteightholdstyle}{TS1}{56}
1074 \DeclareTextSymbol{\textnintholdstyle}{TS1}{57}
1075 \DeclareTextSymbol{\textlangle}{TS1}{60}
1076 \DeclareTextSymbol{\textminus}{TS1}{61}
1077 \DeclareTextSymbol{\texttriangle}{TS1}{62}
1078 \DeclareTextSymbol{\textmho}{TS1}{77}
1079 \DeclareTextSymbol{\textbigcircle}{TS1}{79}
1080 \DeclareTextCommand{\textcircled}{TS1}[1]{\hmode@bgroup
1081   \ooalign{%
1082     \hfil \raise .07ex\hbox {\upshape#1}\hfil \crcr
1083     \char 79 % '117 = "4F
1084   }%
1085 \egroup}
1086 \DeclareTextSymbol{\textohm}{TS1}{87}
1087 \DeclareTextSymbol{\textlbrackdbl}{TS1}{91}
1088 \DeclareTextSymbol{\textrbrackdbl}{TS1}{93}
1089 \DeclareTextSymbol{\textuparrow}{TS1}{94}
1090 \DeclareTextSymbol{\textdownarrow}{TS1}{95}
1091 \DeclareTextSymbol{\textasciigrave}{TS1}{96}
1092 \DeclareTextSymbol{\textborn}{TS1}{98}
1093 \DeclareTextSymbol{\textdivorced}{TS1}{99}
1094 \DeclareTextSymbol{\textdied}{TS1}{100}
1095 \DeclareTextSymbol{\textleaf}{TS1}{108}
1096 \DeclareTextSymbol{\textmarried}{TS1}{109}
1097 \DeclareTextSymbol{\textmusicalnote}{TS1}{110}
1098 \DeclareTextSymbol{\texttildelow}{TS1}{126}
1099 \DeclareTextSymbol{\textdblhyphenchar}{TS1}{127}
1100 \DeclareTextSymbol{\textasciibreve}{TS1}{128}
1101 \DeclareTextSymbol{\textasciicaron}{TS1}{129}
1102 \DeclareTextSymbol{\textacutedbl}{TS1}{130}
1103 \DeclareTextSymbol{\textgravedbl}{TS1}{131}
1104 \DeclareTextSymbol{\textdagger}{TS1}{132}
1105 \DeclareTextSymbol{\textdaggerdbl}{TS1}{133}
1106 \DeclareTextSymbol{\textbardbl}{TS1}{134}
1107 \DeclareTextSymbol{\textperthousand}{TS1}{135}
1108 \DeclareTextSymbol{\textbullet}{TS1}{136}
1109 \DeclareTextSymbol{\textcelsius}{TS1}{137}
1110 \DeclareTextSymbol{\textdollaroldstyle}{TS1}{138}
1111 \DeclareTextSymbol{\textcentoldstyle}{TS1}{139}
1112 \DeclareTextSymbol{\textflorin}{TS1}{140}
1113 \DeclareTextSymbol{\textcolonmonetary}{TS1}{141}
1114 \DeclareTextSymbol{\textwon}{TS1}{142}
1115 \DeclareTextSymbol{\textnaira}{TS1}{143}
1116 \DeclareTextSymbol{\textguarani}{TS1}{144}
1117 \DeclareTextSymbol{\textpeso}{TS1}{145}
1118 \DeclareTextSymbol{\textlira}{TS1}{146}
1119 \DeclareTextSymbol{\textrecipe}{TS1}{147}

```

```

1120 \DeclareTextSymbol{\textinterrobang}{TS1}{148}
1121 \DeclareTextSymbol{\textinterrobangdown}{TS1}{149}
1122 \DeclareTextSymbol{\textdong}{TS1}{150}
1123 \DeclareTextSymbol{\texttrademark}{TS1}{151}

1124 \DeclareTextSymbol{\textpertenthousand}{TS1}{152}
1125 \DeclareTextSymbol{\textpilcrow}{TS1}{153}
1126 \DeclareTextSymbol{\textbaht}{TS1}{154}
1127 \DeclareTextSymbol{\textnumero}{TS1}{155}

1128 \DeclareTextSymbol{\textdiscount}{TS1}{156}
1129 \DeclareTextSymbol{\textestimated}{TS1}{157}
1130 \DeclareTextSymbol{\textopenbullet}{TS1}{158}
1131 \DeclareTextSymbol{\textservicemark}{TS1}{159}

1132 \DeclareTextSymbol{\textlquill}{TS1}{160}
1133 \DeclareTextSymbol{\textrquill}{TS1}{161}
1134 \DeclareTextSymbol{\textcent}{TS1}{162}
1135 \DeclareTextSymbol{\textsterling}{TS1}{163}
1136 \DeclareTextSymbol{\textcurrency}{TS1}{164}
1137 \DeclareTextSymbol{\textyen}{TS1}{165}
1138 \DeclareTextSymbol{\textbrokenbar}{TS1}{166}
1139 \DeclareTextSymbol{\textsection}{TS1}{167}

1140 \DeclareTextSymbol{\textasciidieresis}{TS1}{168}
1141 \DeclareTextSymbol{\textcopyright}{TS1}{169}
1142 \DeclareTextSymbol{\textordfeminine}{TS1}{170}
1143 \DeclareTextSymbol{\textcopyleft}{TS1}{171}
1144 \DeclareTextSymbol{\textlnot}{TS1}{172}

1145 \DeclareTextSymbol{\textcircledP}{TS1}{173}
1146 \DeclareTextSymbol{\textregistered}{TS1}{174}
1147 \DeclareTextSymbol{\textasciimacron}{TS1}{175}

1148 \DeclareTextSymbol{\textdegree}{TS1}{176}
1149 \DeclareTextSymbol{\textpm}{TS1}{177}
1150 \DeclareTextSymbol{\texttwosuperior}{TS1}{178}
1151 \DeclareTextSymbol{\textthreesuperior}{TS1}{179}
1152 \DeclareTextSymbol{\textasciiacute}{TS1}{180}
1153 \DeclareTextSymbol{\textmu}{TS1}{181} % micro sign
1154 \DeclareTextSymbol{\textparagraph}{TS1}{182}
1155 \DeclareTextSymbol{\textperiodcentered}{TS1}{183}

1156 \DeclareTextSymbol{\textreferencemark}{TS1}{184}
1157 \DeclareTextSymbol{\textonesuperior}{TS1}{185}
1158 \DeclareTextSymbol{\textordmasculine}{TS1}{186}
1159 \DeclareTextSymbol{\texttsurd}{TS1}{187}
1160 \DeclareTextSymbol{\textonequarter}{TS1}{188}
1161 \DeclareTextSymbol{\textonehalf}{TS1}{189}
1162 \DeclareTextSymbol{\textthreequarters}{TS1}{190}
1163 \DeclareTextSymbol{\texteuro}{TS1}{191}

1164 \DeclareTextSymbol{\texttimes}{TS1}{214}

1165 \DeclareTextSymbol{\textdiv}{TS1}{246}
1166 %</TS1>

1167 %<*package>

```



```

1220      \update@uclc@with@cyrillic
1221      \fi
1222  \fi
1223 }
1224 \ProcessOptions*
1225 \fontencoding\encodingdefault\selectfont
1226 \let\update@uclc@with@cyrillic\relax
1227 \global\expandafter\let\csname ver@fontenc.sty\endcsname\relax
1228 \global\expandafter\let\csname opt@fontenc.sty\endcsname\relax
1229 \global\let\@ifl@ter@@\@ifl@ter
1230 \def\@ifl@ter#1#2#3#4#5{\global\let\@ifl@ter\@ifl@ter@@}
1231 %</package>

```

### 11.3.11 The `textcomp` package

This one is for the **TS1** encoding which contains text symbols for use with the **T1**-encoded text fonts. It therefore first inputs the file **TS1enc.def** and then sets (or resets) the defaults for the symbols it contains. The result of this is that when one of these symbols is accessed and the current encoding does not provide it, the symbol will be supplied by a silent, local change to this encoding.

```
1232 %<*TS1sty>
```

Since many PostScript fonts only implement a subset of **TS1** many commands only produce black blobs of ink. To resolve the resulting problems a number of options have been introduced and some code has been developed to distinguish sub-encodings.

The sub-encodings have a numerical id and are defined as follows for **TS1**:

**#5** those **TS1** symbols that are also in the ISO-Adobe character set; without **textcurrency**, which is often misused for the Euro. Older Type1 fonts from the non-**TeX** world provide only this subset.

**#4** = #5 + **\texteuro**. Most newer fonts provide this.

**#3** = #4 + **\textomega**. Can also be described as  $TS1 \cap (ISO\text{-}Adobe \cup MacRoman)$ . (Except for the missing "currency".)

**#2** = #3 + **\textestimated** + **\textcurrency**. Can also be described as  $TS1 \cap Adobe\text{-}Western\text{-}2$ . This may be relevant for OpenType fonts, which usually show the Adobe-Western-2 character set.

**#1** = **TS1** without **\textcircled** and **\t**. These two glyphs are often not implemented and if their kernel defaults are changed commands like **\copyright** unnecessarily fail.

**#0** = full **TS1**

And here a summary to go in the transcript file:

```

1233 \PackageInfo{textcomp}{Sub-encoding information:\MessageBreak
1234   \space\space 5 = only ISO-Adobe without
1235     \string\textcurrency\MessageBreak

```

```

1236   \space\space 4 = 5 + \string\textheuro\MessageBreak
1237   \space\space 3 = 4 + \string\textohm\MessageBreak
1238   \space\space 2 = 3 + \noexpand\textestimated+
1239           \string\textcurrency\MessageBreak
1240   \space\space 1 = TS1 - \noexpand\textcircled-
1241           \string\t\MessageBreak
1242   \space\space 0 = TS1 (full)\MessageBreak
1243   Font families with sub-encoding setting ?
1244       \implement\MessageBreak
1245   only a restricted character set as indicated.\MessageBreak
1246   Family '?' is the default used for unknown ?
1247       \fonts.\MessageBreak
1248   See the documentation for details@gobble}

```

\DeclareEncodingSubset {\encoding}{\family}{\subsetencoding}

An encoding subset to which a font family belongs is declared by the command \DeclareEncodingSubset that takes the major encoding as the first argument (e.g., TS1), the family name as the second argument (e.g., cmr), and the subset encoding id as a third, (e.g., 0 for cmr).

The default encoding subset to use when nothing is known about the current font family is named ?.

```

1247 \def\DeclareEncodingSubset#1#2#3{%
1248   \@ifundefined{#1:#2}{%
1249     {\PackageInfo{textcomp}{Setting #2 sub-encoding to %
1250       \#1/\#3}}%
1250     {\PackageInfo{textcomp}{Changing #2 sub-encoding to %
1251       \#1/\#3}}%
1251   \@namedef{#1:#2}{#3}%
1252   \@onlypreamble\DeclareEncodingSubset

```

The options for the package are the following:

**safe** for unknown font families enables only symbols that are also in the ISO-Adobe character set; without "currency", which is often misused for the Euro. Older Type1 fonts from the non-TeX world provide only this subset.

**euro** enables the "safe" symbols plus the \textheuro command. Most newer fonts provide this.

**full** enables all TS1 commands; useful only with fonts like EC or CM bright.

**almostfull** same as "full", except that \textcircled and \t are not redefined from their defaults to avoid that commands like \copyright suddenly no longer work.

**force** ignore all subset encoding definitions stored in the package itself or in the configuration file and always use the default subset as specified by one of the other options (seldom useful, only dangerous).

```
1253 \newif\iftc@forced \tc@forcedfalse
```

This is implemented by defining the default subset:

```

1254 \DeclareOption{full}{\DeclareEncodingSubset{TS1}{?}{0}}
1255 \DeclareOption{almostfull}{\DeclareEncodingSubset{TS1}{?}{1}}
1256 \DeclareOption{euro}{\DeclareEncodingSubset{TS1}{?}{4}}
1257 \DeclareOption{safe}{\DeclareEncodingSubset{TS1}{?}{5}}

```

The default is “almostfull” which means that old documents will work except that `\textcircled` and `\t` will use the kernel defaults (with the advantage that this also works if the current font (as often the case) doesn’t implement these glyphs.

The “force” option simply sets the switch to true.

```
1258 \DeclareOption{force}{\tc@forcedtrue}
```

The suggestions to user is to use the “safe” option always unless that balks in which case they could switch to “almostfull” but then better check their output manually.

```

1259 \def\tc@errorwarn{\PackageError}
1260 \DeclareOption{warn}{\gdef\tc@errorwarn#1#2#3{\PackageWarning{#1}{#2}}}
1261 \ExecuteOptions{almostfull}
1262 \ProcessOptions\relax

```

### \CheckEncodingSubset

The command `\CheckEncodingSubset` will check if the current font family has the right encoding subset to typeset a certain command. It takes five arguments as follows: first argument is either `\UseTextSymbol`, `\UseTextAccent` depending on whether or not the symbol is a text symbol or a text accent. The second argument is the encoding from which this symbol should be fetched. The third argument is either a fake accessor command or an error message. the code in that argument (if ever executed) receives two arguments: #2 and #5 of `\CheckEncodingSubset`.

Argument four is the subset encoding id to test against: if this value is higher than the subset id of the current font family then we typeset the symbol, i.e., execute #1{#2}#5 otherwise it runs #3#5, e.g., to produce an error message or fake the glyph somehow.

Argument five is the symbol or accent command that is being checked.

For usage examples see definitions below.

```

1263 \iftc@forced
1264 \def\CheckEncodingSubset#1#2#3#4#5{%
1265   \ifnum #4>%
1266     0\csname #2:?\endcsname
1267     \relax
1268   \expandafter\@firstoftwo
1269   \else
1270   \expandafter\@secondoftwo
1271 \fi
1272 {#1{#2}{#3}%
1273 #5%
1274 }
1275 \else
1276 \def\CheckEncodingSubset#1#2#3#4#5{%
1277   \ifnum #4>%

```

```

1278      \expandafter\ifx\csname #2:\f@family\endcsname\relax
1279          @\csname #2:?\endcsname
1280      \else
1281          \csname #2:\f@family\endcsname
1282      \fi
1283      \relax
1284      \expandafter\@firstoftwo
1285  \else
1286      \expandafter\@secondoftwo
1287  \fi
1288  {#1{#2}}{#3}%
1289  #5%
1290 }
1291 \fi

1292 \def\tc@subst#1{%
1293     \tc@errorwarn{textcomp}%
% should be latex error if general
1294     {Symbol \string#1 not provided by\MessageBreak
1295      font family \f@family\space
1296      in TS1 encoding.\MessageBreak Default family used }
      {instead}\@eha
1297 \bgroup\fontfamily{textcompsubstdefault}\selectfont#1\egroup
1298 }

1299 \def\textcompsubstdefault{cmr}

1300 % error commands take argument:
1301 % #1 symbol to be used
1302 \def\tc@error#1{%
1303     \PackageError{textcomp}%
% should be latex error if general
1304     {Accent \string#1 not provided by\MessageBreak
1305      font family \f@family\space
1306      in TS1 encoding}\@eha
1307 }

1308 \def\tc@fake@euro#1{%
1309     \leavevmode
1310     \PackageInfo{textcomp}{Faking \noexpand#1 for font family
1311                     \f@family\MessageBreak in TS1 }
                     {encoding}%
1312     \valign{##\cr
1313         \vfil\hbox to 0.07em{\dimen@\f@size\p@
1314                         \math@fontsfalse
1315                         \fontsize{.7\dimen@}\z@\selectfont=\hss}%
1316         \vfil\cr%
1317         \hbox{C}\crcr
1318     }%
1319 }

```

These are two abbreviations that we use below to check symbols and accents in TS1. Only there to save some space, e.g., we can then write

`\DeclareTextCommandDefault{\textcurrency}{\tc@check@symbol3\textcurrency}`

to ensure that `\textcurrency` is only typeset if the current font has a TS1 subset id of less than 3. Otherwise `\tc@error` is called telling the user that for this font family `\textcurrency` is not available.

```
1320 \def\tc@check@symbol{\CheckEncodingSubset\UseTextSymbol{TS1}\tc@subst}
1321 \def\tc@check@accent{\CheckEncodingSubset\UseTextAccent{TS1}\tc@error}
```

We start with the commands that are “safe” and which can be unconditionally set up, first the accents...

```
1322 \DeclareTextAccentDefault{\capitalcedilla}{TS1}
1323 \DeclareTextAccentDefault{\capitalogonek}{TS1}
1324 \DeclareTextAccentDefault{\capitalgrave}{TS1}
1325 \DeclareTextAccentDefault{\capitalacute}{TS1}
1326 \DeclareTextAccentDefault{\capitalcircumflex}{TS1}
1327 \DeclareTextAccentDefault{\capitaltilde}{TS1}
1328 \DeclareTextAccentDefault{\capitaldieresis}{TS1}
1329 \DeclareTextAccentDefault{\capitalhungarumlaut}{TS1}
1330 \DeclareTextAccentDefault{\capitalring}{TS1}
1331 \DeclareTextAccentDefault{\capitalcaron}{TS1}
1332 \DeclareTextAccentDefault{\capitalbreve}{TS1}
1333 \DeclareTextAccentDefault{\capitalmacron}{TS1}
1334 \DeclareTextAccentDefault{\capitaldotaccent}{TS1}
```

À

```
1335 \DeclareTextSymbolDefault{\textcapitalcompwordmark}{TS1}
1336 \DeclareTextSymbolDefault{\textascendercompwordmark}{TS1}
1337 \DeclareTextSymbolDefault{\textquotestraightbase}{TS1}
1338 \DeclareTextSymbolDefault{\textquotestraightdblbase}{TS1}
1339 \DeclareTextSymbolDefault{\texttwelveudash}{TS1}
1340 \DeclareTextSymbolDefault{\textthreequartersemdash}{TS1}
1341 \DeclareTextSymbolDefault{\textdollar}{TS1}
1342 \DeclareTextSymbolDefault{\textquotesingle}{TS1}
1343 \DeclareTextSymbolDefault{\textasteriskcentered}{TS1}
1344 \DeclareTextSymbolDefault{\textfractionsolidus}{TS1}
1345 \DeclareTextSymbolDefault{\textminus}{TS1}
1346 \DeclareTextSymbolDefault{\textlbrackdbl}{TS1}
1347 \DeclareTextSymbolDefault{\textrbrackdbl}{TS1}
1348 \DeclareTextSymbolDefault{\textasciigrave}{TS1}
1349 \DeclareTextSymbolDefault{\texttildelow}{TS1}
1350 \DeclareTextSymbolDefault{\textasciibreve}{TS1}
1351 \DeclareTextSymbolDefault{\textasciicaron}{TS1}
1352 \DeclareTextSymbolDefault{\textgravedbl}{TS1}
1353 \DeclareTextSymbolDefault{\textacutedbl}{TS1}
1354 \DeclareTextSymbolDefault{\textdagger}{TS1}
1355 \DeclareTextSymbolDefault{\textdaggerdbl}{TS1}
1356 \DeclareTextSymbolDefault{\textbardbl}{TS1}
1357 \DeclareTextSymbolDefault{\textperthousand}{TS1}
1358 \DeclareTextSymbolDefault{\textbullet}{TS1}
1359 \DeclareTextSymbolDefault{\textcelsius}{TS1}
1360 \DeclareTextSymbolDefault{\textflorin}{TS1}
1361 \DeclareTextSymbolDefault{\texttrademark}{TS1}
1362 \DeclareTextSymbolDefault{\textcent}{TS1}
1363 \DeclareTextSymbolDefault{\textsterling}{TS1}
1364 \DeclareTextSymbolDefault{\textyen}{TS1}
1365 \DeclareTextSymbolDefault{\textbrokenbar}{TS1}
1366 \DeclareTextSymbolDefault{\textsection}{TS1}
1367 \DeclareTextSymbolDefault{\textasciidieresis}{TS1}
1368 \DeclareTextSymbolDefault{\textcopyright}{TS1}
```

```

1369 \DeclareTextSymbolDefault{\textordfeminine}{TS1}
1370 \DeclareTextSymbolDefault{\textlnot}{TS1}
1371 \DeclareTextSymbolDefault{\textregistered}{TS1}
1372 \DeclareTextSymbolDefault{\textasciimacron}{TS1}
1373 \DeclareTextSymbolDefault{\textdegree}{TS1}
1374 \DeclareTextSymbolDefault{\textpm}{TS1}
1375 \DeclareTextSymbolDefault{\texttwosuperior}{TS1}
1376 \DeclareTextSymbolDefault{\textthreesuperior}{TS1}
1377 \DeclareTextSymbolDefault{\textasciacute}{TS1}
1378 \DeclareTextSymbolDefault{\textmu}{TS1}
1379 \DeclareTextSymbolDefault{\textparagraph}{TS1}
1380 \DeclareTextSymbolDefault{\textperiodcentered}{TS1}
1381 \DeclareTextSymbolDefault{\textonesuperior}{TS1}
1382 \DeclareTextSymbolDefault{\textordmasculine}{TS1}
1383 \DeclareTextSymbolDefault{\textonequarter}{TS1}
1384 \DeclareTextSymbolDefault{\textonehalf}{TS1}
1385 \DeclareTextSymbolDefault{\textthreequarters}{TS1}
1386 \DeclareTextSymbolDefault{\texttimes}{TS1}
1387 \DeclareTextSymbolDefault{\textdiv}{TS1}

1388 \DeclareTextCommandDefault{\texteuro}
1389   {\CheckEncodingSubset\UseTextSymbol{TS1}\tc@fake@euro5\texteuro}

1390 \DeclareTextCommandDefault{\textohm}{\tc@check@symbol4\textohm}

1391 \DeclareTextCommandDefault{\textestimated}%
1392   {\tc@check@symbol3\textestimated}
1393 \DeclareTextCommandDefault{\textcurrency}%
1394   {\tc@check@symbol3\textcurrency}

1395 \DeclareTextCommandDefault{\capitaltie}%
1396   {\tc@check@accent2\capitaltie}
1397 \DeclareTextCommandDefault{\newtie}%
1398   {\tc@check@accent2\newtie}
1399 \DeclareTextCommandDefault{\capitalnewtie}%
1400   {\tc@check@accent2\capitalnewtie}
1401 \DeclareTextCommandDefault{\textleftarrow}%
1402   {\tc@check@symbol2\textleftarrow}
1403 \DeclareTextCommandDefault{\textrightarrow}%
1404   {\tc@check@symbol2\textrightarrow}
1405 \DeclareTextCommandDefault{\textblank}%
1406   {\tc@check@symbol2\textblank}
1407 \DeclareTextCommandDefault{\textdblhyphen}%
1408   {\tc@check@symbol2\textdblhyphen}
1409 \DeclareTextCommandDefault{\textzerooldstyle}%
1410   {\tc@check@symbol2\textzerooldstyle}
1411 \DeclareTextCommandDefault{\textoneoldstyle}%
1412   {\tc@check@symbol2\textoneoldstyle}
1413 \DeclareTextCommandDefault{\texttwooldstyle}%
1414   {\tc@check@symbol2\texttwooldstyle}
1415 \DeclareTextCommandDefault{\textthreeoldstyle}%
1416   {\tc@check@symbol2\textthreeoldstyle}
1417 \DeclareTextCommandDefault{\textfouroldstyle}%
1418   {\tc@check@symbol2\textfouroldstyle}
1419 \DeclareTextCommandDefault{\textfiveoldstyle}%
1420   {\tc@check@symbol2\textfiveoldstyle}

```

```

1421 \DeclareTextCommandDefault{\textsixoldstyle}{%
1422   {\tc@check@symbol2\textsixoldstyle}%
1423 \DeclareTextCommandDefault{\textsevenoldstyle}{%
1424   {\tc@check@symbol2\textsevenoldstyle}%
1425 \DeclareTextCommandDefault{\texteightoldstyle}{%
1426   {\tc@check@symbol2\texteightoldstyle}%
1427 \DeclareTextCommandDefault{\textnineoldstyle}{%
1428   {\tc@check@symbol2\textnineoldstyle}%
1429 \DeclareTextCommandDefault{\textlangle}{%
1430   {\tc@check@symbol2\textlangle}%
1431 \DeclareTextCommandDefault{\textrangle}{%
1432   {\tc@check@symbol2\textrangle}%
1433 \DeclareTextCommandDefault{\textmho}{%
1434   {\tc@check@symbol2\textmho}%
1435 \DeclareTextCommandDefault{\textbigcircle}{%
1436   {\tc@check@symbol2\textbigcircle}%
1437 \DeclareTextCommandDefault{\textuparrow}{%
1438   {\tc@check@symbol2\textuparrow}%
1439 \DeclareTextCommandDefault{\textdownarrow}{%
1440   {\tc@check@symbol2\textdownarrow}%
1441 \DeclareTextCommandDefault{\textborn}{%
1442   {\tc@check@symbol2\textborn}%
1443 \DeclareTextCommandDefault{\textdivorced}{%
1444   {\tc@check@symbol2\textdivorced}%
1445 \DeclareTextCommandDefault{\textdied}{%
1446   {\tc@check@symbol2\textdied}%
1447 \DeclareTextCommandDefault{\textleaf}{%
1448   {\tc@check@symbol2\textleaf}%
1449 \DeclareTextCommandDefault{\textmarried}{%
1450   {\tc@check@symbol2\textmarried}%
1451 \DeclareTextCommandDefault{\textmusicalnote}{%
1452   {\tc@check@symbol2\textmusicalnote}%
1453 \DeclareTextCommandDefault{\textdblhyphenchar}{%
1454   {\tc@check@symbol2\textdblhyphenchar}%
1455 \DeclareTextCommandDefault{\textdollaroldstyle}{%
1456   {\tc@check@symbol2\textdollaroldstyle}%
1457 \DeclareTextCommandDefault{\textcentoldstyle}{%
1458   {\tc@check@symbol2\textcentoldstyle}%
1459 \DeclareTextCommandDefault{\textcolonmonetary}{%
1460   {\tc@check@symbol2\textcolonmonetary}%
1461 \DeclareTextCommandDefault{\textwon}{%
1462   {\tc@check@symbol2\textwon}%
1463 \DeclareTextCommandDefault{\textnaira}{%
1464   {\tc@check@symbol2\textnaira}%
1465 \DeclareTextCommandDefault{\textguarani}{%
1466   {\tc@check@symbol2\textguarani}%
1467 \DeclareTextCommandDefault{\textpeso}{%
1468   {\tc@check@symbol2\textpeso}%
1469 \DeclareTextCommandDefault{\textlira}{%
1470   {\tc@check@symbol2\textlira}%
1471 \DeclareTextCommandDefault{\textrecipe}{%
1472   {\tc@check@symbol2\textrecipe}%
1473 \DeclareTextCommandDefault{\textinterrobang}{%
1474   {\tc@check@symbol2\textinterrobang}%

```

```

1475 \DeclareTextCommandDefault{\textinterrobangdown}%
1476   {\tc@check@symbol2{textinterrobangdown}}
1477 \DeclareTextCommandDefault{\textdong}%
1478   {\tc@check@symbol2{textdong}}
1479 \DeclareTextCommandDefault{\textpertenthousand}%
1480   {\tc@check@symbol2{textpertenthousand}}
1481 \DeclareTextCommandDefault{\textpilcrow}%
1482   {\tc@check@symbol2{textpilcrow}}
1483 \DeclareTextCommandDefault{\textbaht}%
1484   {\tc@check@symbol2{textbaht}}
1485 \DeclareTextCommandDefault{\textnumero}%
1486   {\tc@check@symbol2{textnumero}}
1487 \DeclareTextCommandDefault{\textdiscount}%
1488   {\tc@check@symbol2{textdiscount}}
1489 \DeclareTextCommandDefault{\textopenbullet}%
1490   {\tc@check@symbol2{textopenbullet}}
1491 \DeclareTextCommandDefault{\textservicemark}%
1492   {\tc@check@symbol2{textservicemark}}
1493 \DeclareTextCommandDefault{\textlquill}%
1494   {\tc@check@symbol2{textlquill}}
1495 \DeclareTextCommandDefault{\textrquill}%
1496   {\tc@check@symbol2{textrquill}}
1497 \DeclareTextCommandDefault{\textcopyleft}%
1498   {\tc@check@symbol2{textcopyleft}}
1499 \DeclareTextCommandDefault{\textcircledP}%
1500   {\tc@check@symbol2{textcircledP}}
1501 \DeclareTextCommandDefault{\textreferencemark}%
1502   {\tc@check@symbol2{textreferencemark}}
1503 \DeclareTextCommandDefault{\textsurd}%
1504   {\tc@check@symbol2{textsurd}}
1505 \DeclareTextCommandDefault{\textcircled}%
1506   {\CheckEncodingSubset\UseTextAccent{TS1}%
1507   {\UseTextAccent{OMS}}1\textcircled}
1508 \DeclareTextCommandDefault{\t}%
1509   {\CheckEncodingSubset\UseTextAccent{TS1}%
1510   {\UseTextAccent{OML}}1\t}
1511 \input{ts1enc.def}
1512 \UndeclareTextCommand{\textsterling}{OT1}
1513 \UndeclareTextCommand{\textdollar} {OT1}
1514 %\UndeclareTextCommand{\textsterling}{OT4}
1515 %\UndeclareTextCommand{\textdollar} {OT4}
1516 \UndeclareTextCommand{\textperthousand}{T1}
1517 %\UndeclareTextCommand{\textpertenthousand}{T1}
1518 \DeclareRobustCommand\oldstylenums[1]{%
1519   \begingroup
1520   \ifmmode
1521     \mathgroup\symletters #1%
1522   \else
1523     \CheckEncodingSubset@\use@text@encoding{TS1}%
1524     {\PackageWarning{textcomp}%
1525       {Oldstyle digits unavailable for

```

```

1526         family \f@family.\MessageBreak
1527         Lining digits used instead} }%
1528         \tw@{\#1}%
1529     \fi
1530 \endgroup
1531 }
```

### 11.3.110 Subset encoding defaults

For many font families commonly used in the TeX world we provide the subset encoding data here. Users can add additional font families in the file `textcomp.cfg` if they own other fonts.

However, if the option “forced” was given then all subset encoding specifications are ignored, so there is no point in setting any of them up:

```

1532 \iftc@forced \else
1533 \DeclareEncodingSubset{TS1}{cmr} {0}
1534 \DeclareEncodingSubset{TS1}{cmss} {0}
1535 \DeclareEncodingSubset{TS1}{cmtt} {0}
1536 \DeclareEncodingSubset{TS1}{cmvtt} {0}
1537 \DeclareEncodingSubset{TS1}{cmbr} {0}
1538 \DeclareEncodingSubset{TS1}{cmtl} {0}
1539 \DeclareEncodingSubset{TS1}{ccr} {0}
1540 \DeclareEncodingSubset{TS1}{ptm} {4}
1541 \DeclareEncodingSubset{TS1}{pcr} {4}
1542 \DeclareEncodingSubset{TS1}{phv} {4}
1543 \DeclareEncodingSubset{TS1}{ppl} {3}
1544 \DeclareEncodingSubset{TS1}{pag} {4}
1545 \DeclareEncodingSubset{TS1}{pbk} {4}
1546 \DeclareEncodingSubset{TS1}{pnc} {4}
1547 \DeclareEncodingSubset{TS1}{pzc} {4}
1548 \DeclareEncodingSubset{TS1}{bch} {4}
1549 \DeclareEncodingSubset{TS1}{put} {5}
```

Other CTAN fonts (probably not complete):

```

1550 \DeclareEncodingSubset{TS1}{uag} {5}
1551 \DeclareEncodingSubset{TS1}{ugq} {5}
1552 \DeclareEncodingSubset{TS1}{ul8} {4}
1553 \DeclareEncodingSubset{TS1}{ul9} {4} % (LuxiSans, one day)
1554 \DeclareEncodingSubset{TS1}{augie} {5}
1555 \DeclareEncodingSubset{TS1}{dayrom} {3}
1556 \DeclareEncodingSubset{TS1}{dayroms} {3}
1557 \DeclareEncodingSubset{TS1}{pxr} {0}
1558 \DeclareEncodingSubset{TS1}{pxss} {0}
1559 \DeclareEncodingSubset{TS1}{pxtt} {0}
1560 \DeclareEncodingSubset{TS1}{txr} {0}
1561 \DeclareEncodingSubset{TS1}{txss} {0}
1562 \DeclareEncodingSubset{TS1}{txtt} {0}
```

Latin Modern and TeX Gyre: [22](#) [23](#) [24](#)

<sup>22</sup>v1.99k 2009/10/28 Added Latin Modern and TeX Gyre subsets

<sup>23</sup>v1.99l 2009/11/04 Added more Latin Modern and TeX Gyre subsets

<sup>24</sup>v1.99m 2015/02/16 Added lmtt (Heiko Oberdiek) latex/4415

```

1563 \DeclareEncodingSubset{TS1}{lmr}      {0}
1564 \DeclareEncodingSubset{TS1}{lmdh}     {0}
1565 \DeclareEncodingSubset{TS1}{lmss}      {0}
1566 \DeclareEncodingSubset{TS1}{lmssq}     {0}
1567 \DeclareEncodingSubset{TS1}{lmvtt}    {0}
1568 \DeclareEncodingSubset{TS1}{lmtt}      {0}

1569 \DeclareEncodingSubset{TS1}{qhv}      {0}
1570 \DeclareEncodingSubset{TS1}{qag}      {0}
1571 \DeclareEncodingSubset{TS1}{qbk}      {0}
1572 \DeclareEncodingSubset{TS1}{qcr}      {0}
1573 \DeclareEncodingSubset{TS1}{qcs}      {0}
1574 \DeclareEncodingSubset{TS1}{qpl}      {0}
1575 \DeclareEncodingSubset{TS1}{qtm}      {0}
1576 \DeclareEncodingSubset{TS1}{qzc}      {0}
1577 \DeclareEncodingSubset{TS1}{qhvc}    {0}

```

Fourier-GUTenberg:

```

1578 \DeclareEncodingSubset{TS1}{futs}     {4}
1579 \DeclareEncodingSubset{TS1}{futx}     {4}
1580 \DeclareEncodingSubset{TS1}{futj}     {4}

```

Y&Y's Lucida Bright

```

1581 \DeclareEncodingSubset{TS1}{hlh}      {3}
1582 \DeclareEncodingSubset{TS1}{hls}      {3}
1583 \DeclareEncodingSubset{TS1}{hlst}    {3}

```

The remaining settings for Lucida are conservative: the following fonts contain the `\textohm` character but not the `\texteuro`, i.e., belong to neither subset 4 nor subset 3. If you want to use the `\textohm` with these fonts copy these definition to `textcomp.cfg` and change the subset to 3. However in that case make sure that you do not use the `\texteuro`.

```

1584 \DeclareEncodingSubset{TS1}{hlct}     {5}
1585 \DeclareEncodingSubset{TS1}{hlx}       {5}
1586 \DeclareEncodingSubset{TS1}{hlce}     {5}
1587 \DeclareEncodingSubset{TS1}{hlcn}     {5}
1588 \DeclareEncodingSubset{TS1}{hlcw}     {5}
1589 \DeclareEncodingSubset{TS1}{hlcf}    {5}

```

Other commercial families...

```

1590 \DeclareEncodingSubset{TS1}{pplx}     {3}
1591 \DeclareEncodingSubset{TS1}{pplj}     {3}
1592 \DeclareEncodingSubset{TS1}{ptmx}     {4}
1593 \DeclareEncodingSubset{TS1}{ptmj}     {4}

```

If the file `textcomp.cfg` exists it will be loaded at this point. This allows to define further subset encodings for font families not covered by default.

```

1594 \InputIfFileExists{textcomp.cfg}
1595   {\PackageInfo{textcomp}{Local configuration file used}{}}
1596 \fi
1597 %</TS1sty>

```

# 12

## Counters and Lengths

In this short file provided in the  $\text{\LaTeX}$  kernel the definitions for the basic commands for typesetting the logos for  $\text{\TeX}$ ,  $\text{LaTeX}$  and  $\text{\LaTeX}_2\epsilon$  are developed. These can be typeset using the macros  $\text{\TeX}$ ,  $\text{LaTeX}$  and  $\text{\LaTeXe}$ .



## 12.1 Counters and Lengths

Commands for defining and using counters.

`\newcounter`<sup>→ P. 175</sup> To define a new counter.

`\setcounter` To set the value of counters.

`\addtocounter`<sup>→ P. 175</sup> Increase the counter #1 by the number #2.

### Example 1.1 test

```
1 \the\value{chapter}
```

```
12
```

```
2 %<*2ekernel>
```

### 12.1.1 Environment Counter Macros

An environment foo has an associated counter defined by the following control sequences:

`\c@foo` Contains the counter's numerical value. It is defined by `\newcount\foocounter`.

`\thefoo` Macro that expands to the printed value of `\foocounter`. For example, if sections are numbered within chapters, and section headings look like Section II-3. The Nature of Counters then `\thesection` might be defined by:

```
\def\thesection
  {@Roman{\c@chapter}-
  @arabic{\c@section}}
```

`\p@foo` Macro that expands to a printed 'reference prefix' of counter foo. Any `\ref` to a value created by counter foo will produce the expansion of `\p@foo\thefoo` when the `\label` command is executed. See file `ltxref.dtx` for an extension of this mechanism.

`\cl@foo` List of counters to be reset when foo stepped. Has format `@elt{counter_a}@elt{counter_b}@elt{counter_c}`.

#### NOTE:

`\thefoo` and `\p@foo` must be defined in such a way that `\edef\bar{\thefoo}` or `\edef\bar{\p@foo}` defines `\bar` so that it will evaluate to the counter value at the time of the `\edef`, even after `\foocounter` and any other counters have been changed. This will happen if you use the standard commands `@arabic`, `@Roman`, etc.

`\setcounter`

```
3 \def\setcounter#1#2{%
  4   \@ifundefined{c@#1}{%
```

```

5      {\@nocounterr{\#1}}%
6      {\global\csname c@\#1\endcsname#2\relax}

```

**\addtocounter**  
Globally increments **\foocounter** by *<val>*.

```

7 \def\addtocounter#1#2{%
8   \@ifundefined{c@#1}{%
9     {\@nocounterr{\#1}}%
10    {\global\advance\csname c@\#1\endcsname #2\relax}}

```

**\newcounter**

**\newcounter{<newctr>}[<oldctr>]** Defines *<newctr>* to be a counter, which is reset when counter *<oldctr>* is stepped. If *<newctr>* already defined

```

11 \def\newcounter#1{%
12   \expandafter\@ifndefinable \csname c@\#1\endcsname
13   {\@definecounter{\#1}}%
14   \@ifnextchar[{\@newctr{\#1}}{}}

```

**\value**

**\value{<ctr>}** produces the value of counter *<ctr>*, for use with a **\setcounter** or **\addtocounter** command.

```
15 \def\value#1{\csname c@\#1\endcsname}
```

**\@newctr**

```

16 \def\@newctr#1[#2]{%
17   \@ifundefined{c@#2}{\@nocounterr{\#2}}{\@addtoreset{\#1}{#2}}}

```

(End definition for **\@newctr**.)

**\stepcounter**

**\stepcounter{foo}** Globally increments counter **\c@FOO** and resets all subsidiary counters.

```

18 \def\stepcounter#1{%
19   \addtocounter{\#1}\@ne
20   \begingroup
21   \let\@elt\@stpelt
22   \csname cl@\#1\endcsname
23   \endgroup}

```

**\@stpelt**

Rather than resetting the “within” counter to zero we set it to  $-1$  and then run **\stepcounter** that moves it to 0 and also initiates resetting the next level down.

```

24 %</2ekernel>
25 %<latexrelease>\IncludeInRelease{2015/01/01}{\@stpelt}
26 %<latexrelease>
27 %<2ekernel|latexrelease>
28 \def\@stpelt#1{\global\csname c@#1\endcsname }
29 %<2ekernel|latexrelease>
30 %<2ekernel|latexrelease>
31 %<2ekernel|latexrelease>
32 %<2ekernel|latexrelease>
33 %<2ekernel|latexrelease>
34 %<2ekernel|latexrelease>
35 %<2ekernel>

\cl@@ckpt
36 \def\cl@@ckpt{\@elt{page}}


\@definecounter{counter name}

```

The command defines a new counter. It uses the TeX's `\newcount` to allocate a counter starting from `c@`. It then sets the counter to zero.

```

\@addtoreset{counter} {counter}
37 \def\@definecounter#1{\expandafter\newcount\csname
38   c@#1\endcsname
39   \setcounter{#1}\z@
40   \global\expandafter\let\csname cl@#1\endcsname\empty
41   \@addtoreset{#1}{\@ckpt}%
42   \global\expandafter\let\csname p@#1\endcsname\empty
43   \expandafter
44   \gdef\csname the#1\expandafter\endcsname\expandafter
45     {\expandafter\@arabic\csname c@#1\endcsname}}
46 \def\@addtoreset#1#2{\expandafter\@cons\csname
47   cl@#2\endcsname {#1}}}

```

Numbering commands for definitions of `\theCOUNTER` and `\list` arguments.

All commands can now be used in text and math mode.

```

\arabic
46 \def\arabic#1{\expandafter\@arabic\csname c@#1\endcsname}

\roman
47 \def\roman#1{\expandafter\@roman\csname c@#1\endcsname}

\Roman

```

```
48 \def\Roman#1{\expandafter\@Roman\csname c@#1\endcsname}
```

### \alph

Representation of `<counter>` as a lower-case letter: 1 = a, 2 = b, etc.

```
49 \def\alph#1{\expandafter\@alph\csname c@#1\endcsname}
```

### \Alph

```
50 \def\Alph#1{\expandafter\@Alph\csname c@#1\endcsname}
```

### \fnsymbol

Representation of `<COUNTER>` as a footnote symbol: 1 = \*, 2 = †, etc.

```
51 \def\fnsymbol#1{\expandafter\@fnsymbol\csname c@#1\endcsname}
```

### \@arabic

```
52 \def\@arabic#1{\number #1} %% changed 29 Apr 86
```

### \@roman

```
53 \def\@roman#1{\romannumeral #1}
```

### \@Roman

`\@Roman\FOOcounter` Representation of `\FOOcounter` as upper-case Roman numerals.

```
54 \def\@Roman#1{\expandafter\@slowromancap\romannumeral #1@}
```

### \@slowromancap

Fully expandable macro to change a roman number to uppercase.

```
55 \def\@slowromancap#1{\ifx @#1% then terminate
56   \else
57     \if i#1I\else\if v#1V\else\if x#1X\else\if l#1L\else\if
58       c#1C\else\if d#1D\else \if )
59         \m#1M\else#1\fi\fi\fi\fi\fi\fi\fi
60     \expandafter\@slowromancap
61   \fi
62 }
```

### \@alph

```
62 \def\@alph#1{%
63   \ifcase#1\or a\or b\or c\or d\or e\or f\or g\or h\or i\or j
64   \or k\or l\or m\or n\or o\or p\or q\or r\or s\or t\or u\or v\or w\or x\or
65   y\or z\else\@ctrerr\fi}
```

### \@Alph

\@Alph\FOOcounter Representation of \FOOcounter as an upper-case letter: 1 = A, 2 = B, etc.

```

66 \@def\@Alph#1{%
67   \ifcase#1\or A\or B\or C\or D\or E\or F\or G\or H\or I\or J\or
68   K\or L\or M\or N\or O\or P\or Q\or R\or S\or T\or U\or V\or W\or X\or
69   Y\or Z\else\@ctrerr\fi}

```

See also the dtx floats in L<sup>A</sup>T<sub>E</sub>X for further treatment of footnotes.

### \@fnsymbol

This macro is another example of an ever recurring problem in T<sub>E</sub>X: Determining if something is text-mode or math-mode. It is imperative for the decision between text and math to be delayed until the actual typesetting is done as the code in question may go through an \edef or \write where an \ifmmode test would be executed prematurely. Hence in the implementation below, \@fnsymbol is not robust in itself but the parts doing the actual typesetting are.

In the case of \@fnsymbol we make use of the robust command \TextOrMath which takes two arguments and typesets the first if in text-mode and the second if in math-mode. Note that in order for this command to make the correct decision, it must insert a \relax token if run under regular T<sub>E</sub>X, which ruins any kerning between the preceding characters and whatever awaits typesetting. If you use eT<sub>E</sub>X as engine for L<sup>A</sup>T<sub>E</sub>X (as recommended) this unfortunate side effect is not present.

```

70 %</2ekernel>
71 %<latexrelease>\IncludeInRelease{2015/01/01}{\@fnsymbol}{Use \%
72 %<2ekernel|latexrelease>
73 \@def\@fnsymbol#1{%
74   \ifcase#1\or \TextOrMath{textasteriskcentered}*\or
75   \TextOrMath{\textdagger}{\dagger}\or
76   \TextOrMath{\textdaggerdbl}{\ddagger}\or
77   \TextOrMath{\textsection}{\mathsection}\or
78   \TextOrMath{\textparagraph}{\mathparagraph}\or
79   \TextOrMath{\textbardbl}{\parallel}\or
80   \TextOrMath{ }{ }%
81   \TextOrMath{\textasteriskcentered}{\textasteriskcentered}**\or
82   \TextOrMath{\textdagger}{\dagger}\TextOrMath{\textdagger}{\dagger}\or
83   \TextOrMath{ }{ }%
84   \TextOrMath{\textdaggerdbl}{\ddagger}\TextOrMath{\textdaggerdbl}{\ddagger}\else
85   \TextOrMath{\textdaggerdbl}{\ddagger}\TextOrMath{\textdaggerdbl}{\ddagger}\fi
86 }%
87 %</2ekernel|latexrelease>
88 %<latexrelease>\EndIncludeInRelease
89 %<latexrelease>\IncludeInRelease{0000/00/00}{\@fnsymbol}{Use \%
90 %<latexrelease>\def\@fnsymbol#1{\ensuremath{%

```

```

89 %<latexrelease>  \ifcase#1\or *\or \dagger\or \ddagger\or \mathsection\or
90 %<latexrelease>  \mathparagraph\or \|\or **\or \dagger\dagger
91 %<latexrelease>  \or \ddagger\ddagger \else\@ctrerr\fi}}%
92 %<latexrelease>\EndIncludeInRelease
93 %<*2ekernel>

```

### \TextOrMath{*arg1*}{*arg2*}

When using regular  $\text{\TeX}$ , we make this command robust so that it always selects the correct branch in an  $\text{\ifmmode}$  switch with the usual disadvantage of ruining kerning. For the application we use it for here that shouldn't matter. The alternative would be to mimic  $\text{\IeC}$  from `inputenc` but then it will have the disadvantage of choosing the wrong branch if appearing at the beginning of an alignment cell. However, users of  $\text{e}\text{\TeX}$  will be pleasantly surprised to get the best of both worlds and no bad side effects.

First some code for checking if we are running  $\text{e}\text{\TeX}$  but making sure not to permanently turn  $\text{\protected}$  into  $\text{\relax}$ .

```

94 %</2ekernel>
95 %<latexrelease>\IncludeInRelease{2015/01/01}{\TextOrMath}{\TextOrMath}%
96 %<*2ekernel|latexrelease>
97 \begingroup\expandafter\expandafter\expandafter\endgroup
98 \expandafter\ifx\csname protected\endcsname\relax

```

In case of ordinary  $\text{\TeX}$  we define  $\text{\TextOrMath}$  as a robust command but make sure it always grabs its arguments. If we didn't do this it might very well gobble spaces in the input stream.

```

99 \DeclareRobustCommand\TextOrMath{%
100   \ifmmode  \expandafter\@secondoftwo
101   \else    \expandafter\@firstoftwo \fi}
102 \protected\edef\TextOrMath#1#2{\TextOrMath{#1}{#2}}
103 \else

```

For  $\text{e}\text{\TeX}$  the situation is similar. The robust macro is a hidden one so that we again avoid problems of gobbling spaces in the input.

```

104 \protected\expandafter\def\csname TextOrMath\space\endcsname{%
105   \ifmmode  \expandafter\@secondoftwo
106   \else    \expandafter\@firstoftwo \fi}
107 \edef\TextOrMath#1#2{%
108   \expandafter\noexpand\csname TextOrMath\space\endcsname
109   {#1}{#2}}
110 \fi
111 %</2ekernel|latexrelease>
112 %<latexrelease>\EndIncludeInRelease
113 %<latexrelease>\IncludeInRelease{0000/00/00}{\TextOrMath}{\TextOrMath}%
114 %<latexrelease>\let\TextOrMath\@undefined
115 %<latexrelease>\EndIncludeInRelease
116 %<*2ekernel>
117 %</2ekernel>

```

# 13

## Kernel Lengths

In this short file provided in the  $\text{\LaTeX}$  kernel the definitions for the basic commands for typesetting the logos for  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeX}_2\epsilon$  are developed.

These can be typeset using the macros  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeXe}$ .



A sign that my vision, rapid like all visions, if it had not lasted the space of an “amen,” as the saying goes, had lasted almost the length of a “*Dies irae*.”

Umberto Eco, “The Name of the Rose”, 1983

## 13.1 File n\_lengths and the Itlength.dtx

This class defines a number of user commands for manipulating lengths. the code is straightforward. The `\newlength` command allocates a new internal skip register using the `\newsip` command from the allocations module.

<code>\newlength</code>	Declare #1 to be a new length command.
<code>\setlength</code>	Set the length command, #1, to the value #2.
<code>\addtolength</code>	Increase the value of the length command, #1, by the value #2.
<code>\settowidth</code>	Set the length, #1 to the width of a box containing #2.
<code>\settoheight</code>	Set the length, #1 to the height of a box containing #2.
<code>\settodepth</code>	Set the length, #1 to the depth of a box containing #2.
<code>\@settodim</code>	internal macro
<code>\@settopoint</code>	internal macro

`\newlength{{<command name>}}`

The `\newlength` is just syntactic sugar for PlainTeX’s `\newsip`. The `\@ifdefinable` will produce an error message if the command has already been set.

<sup>118</sup> `\def\newlength#1{\@ifdefinable#1{\newsip#1}}`

`\setlength`

<sup>119</sup> `\def\setlength#1#2{#1#2\relax}`

`\addtolength`

<sup>120</sup> `\def\addtolength#1#2{\advance#1 #2\relax}`

### Example 1.1 Lengths

```
3 \bgroup
4 \newlength\alength
5 \setlength\alength{123.12pt}
6 \the\alength
```

```

7 \addtolength\alength{12.0pt}
8 \the\alength
9 \egroup
10
123.12pt
135.12pt

```

The `\setto` commands use a temporary box `\@tempboxa` to store the contents and then measure them using the internal macro `\@settodim` which boxes the contents and then uses TeX's `ht` and `wd`.

`\@settodim{<box>}{<box>}{<box>}`

Sets a length to another

```

11 \def\@settodim#1#2#3{\setbox\@tempboxa\hbox{#3}#2#1\@tempboxa
12 % Clear the memory afterwards (which might be a lot).
13 \setbox\@tempboxa\box\voidb@x}
14 \def\settodepth {\@settodim\dp}

```

`\settoheight{<dimen>}`

Sets the given length to the height of the box.

```
15 \def\settoheight{\@settodim\ht}
```

`\settowidth {<arg>}{{<material>}}`

Sets the width to be equal to the boxed content..

```
16 \def\settowidth {\@settodim\wd}
```

`\@settopoint{<skip register>}`

The `\@settopoint{<skip register>}` macro takes the contents of the skip register that is supplied as its argument and removes the fractional part to make it a whole number of points. This can be used in class files to avoid values like 45.455pt when calculating a dimension. The method of rounding is interesting. Also it is interesting that this macro, is not used in the kernel at all, but is defined here for use with the standard classes (it is used to round off dimensions for page calculations).

**Example 1.2 Rounding dimensions**

```

100 \bgroup
101  \makeatletter
102  \def\@settopoint#1{\divide#1\p@\multiply#1\p@}
103  \newlength\@test
104  \setlength\@test{19.5pt}
105  \@settopoint{\@test}
106  \the\@test
107  \makeatother
108 \egroup

19.opt

```

## 13.2 Redefinitions and Extensions by Packages

The commands `\setlength`<sup>→ P. 181</sup> and `\addtolength`<sup>→ P. 181</sup>, `\@settodim`<sup>→ P. 182</sup> have been reimplemented by the package `calc`

to enable infix calculations.<sup>1</sup> The package also implements a number of other useful commands which are described below. The `pgf` prefixes all the commands, so it has no impact on the kernel commands which can still be used. This is a much better approach.

<code>\newlength</code> <sup>→ P. 181</sup>	Declare #1 to be a new length command.
<code>\setlength</code> <sup>→ P. 181</sup>	Set the length command, #1, to the value #2.
<code>\addtolength</code> <sup>→ P. 181</sup>	Increase the value of the length command, #1, by the value #2.
<code>\settowidth</code> <sup>→ P. 182</sup>	Set the length, #1 to the width of a box containing #2.
<code>\settoheight</code> <sup>→ P. 182</sup>	Set the length, #1 to the height of a box containing #2.
<code>\settodepth</code>	Set the length, #1 to the depth of a box containing #2.
<code>\widthof{\text{}}</code>	Gets the natural width of <code>\text</code> .
<code>\heightof{\text{}}</code>	
<code>\depthof{\text{}}</code>	
<code>\maxof</code>	Select a maximum of two dimension expressions.
<code>\minof</code>	Select the minimum of two dimension expressions.
<code>\@settodim</code>	internal macro
<code>\@settopoint</code>	internal macro

---

<sup>1</sup>`calc`; `pkg-pgf`.

[2015/04/07 v3.1a LaTeX Kernel (NFSS Basic Macros)]

# 14

## The new font selection scheme for TeX macro packages

In this short file provided in the L<sup>A</sup>T<sub>E</sub>X kernel the definitions for the basic commands for typesetting the logos for TeX, LaTeX and L<sup>A</sup>T<sub>E</sub>X 2<sub>E</sub> are developed.

These can be typeset using the macros \TeX, \LaTeX and \LaTeXe.



This file has version number ? dated ?. The file credits It is currently maintained by the L<sup>A</sup>T<sub>E</sub>X Team. This file contains the main implementation of the ‘low level’ font selection commands. See other parts of the L<sup>A</sup>T<sub>E</sub>X distribution, or *The L<sup>A</sup>T<sub>E</sub>X Companion* for higher level documentation of the L<sup>A</sup>T<sub>E</sub>X ‘New’ Font Selection Scheme.

**Warning:** The macro documentation is still basically the documentation from the first NFSS release and therefore in some cases probably not completely accurate.

```
109 %<2ekernel>\expandafter\let\csname \ver@autofss1.sty\endcsname\fmtversion
```

## 14.1 Preliminary macros

We define a number of macros that will be used later.

\@nomath \@nomath is used by most macros that will have no effect in math mode. It issues a warning message.

```
110 <*2ekernel>
111 \def\@nomath#1{\relax\ifmmode
112   \@font@warning{Command \noexpand#1 invalid in math mode}\fi}

(End definition for \@nomath.)

113 \gdef\no@\alphabet@error#1{\relax\ifmmode
114   \@latex@error{Math\space alphabet\space identifier\space
115   \noexpand#1 is\space undefined\space in\space }
116   \math\space
117   version\space `\'{math@version}'%
118   {Your\space requested\space math\space alphabet\space
119   is\space undefined\space in\space the\space }
120   current\space
121   math\space version.^^JCheck\space the\space
122   spelling\space
123   or\space use\space the\space
124   \noexpand\SetMathAlphabet\space
125   command.}
126 \fi}

123 \%def\new@mathgroup{\alloc@8\mathgroup\chardef\sixt@n}
124 \let\mathgroup\fam
125 \%let\newfam\new@mathgroup
126 @onlypreamble\new@mathgroup
```

## 14.2 Macros for setting up the tables

\DeclareFontShape {⟨encoding⟩}{⟨family⟩}{⟨series⟩}{⟨shape⟩}{⟨loading-info⟩} {⟨loading-settings⟩}

Declares a font shape combination; ⟨loading-info⟩ contains the information that combines sizes with external fonts. The syntax is complex and is described in detail in Section 4.3 of **fntguide**.

```

\DeclareFontShape{OT1}{cmr}{m}{sl}{%
<5-8> sub * cmr/m/n
<8> cmsl8
<9> cmsl9
<10> <10.95> cmsl10
<12> <14.4> <17.28> <20.74> <24.88> cmsl12
}{}}

127 \def\DeclareFontShape{\begingroup
128   \nfss@catcodes
    We use \expandafter \endgroup to restore catcode in case something
    goes wrong with the argument parsing (suggested by Tim Van Zandt)
129   \expandafter\endgroup
130   \DeclareFontShape@}
    Using internal macros with camel case variables, I am not too sure if it is
    good practice. I don't suggest you do this in your own packages.

\DeclareFontShape@
131 \def\DeclareFontShape@#1#2#3#4#5#6{%
132   \expandafter\ifx\csname #1+#2\endcsname\relax
133     \@latex@error{Font family `#1+#2' unknown}\@eha
134   \else
135     \expandafter
136       \xdef\csname#1/#2/#3/#4\endcsname{\expandafter\noexpand
137         \csname #5\endcsname}%
138     \def\reserved@a{#6}%
139     \global
140     \expandafter\let\csname#5\expandafter\endcsname
141       \ifx\reserved@a\empty
142         \@\empty
143       \else
144         \reserved@a
145       \fi
146     \fi
147   }

```

(End definition for \DeclareFontShape@.)

### \DeclareFixedFont {⟨cmd⟩}{⟨encoding⟩}{⟨family⟩}{⟨series⟩}{⟨shape⟩}{⟨size⟩}

Define a direct font switch that avoids all overhead. Declares command hcmdi to be a font switch which selects the font that is specified by the attributes hencodingi, hfamilyi, hseriesi, hshapei, and hsziei.

The font is selected without any adjustments to baselineskip and other surrounding conditions.

This example makes {\picturechar .} select a small dot very quickly:

```
\DeclareFixedFont{\picturechar}{OT1}{cmr}{m}{n}{5}
```

```

148 \def\DeclareFixedFont#1#2#3#4#5#6{%
149   \begingroup
150     \math@fontsfalse
151     \every@math@size{}%
152     \fontsize{#6}\z@

```

```

153      \usefont{#2}{#3}{#4}{#5}%
154      \global\expandafter\let\expandafter#1\the\font
155  \endgroup
156 }

157 \def\do@subst@correction{%
158     \xdef\subst@correction{%
159         \font@name
160         \global\expandafter\font
161             \csname \curr@fontshape/\f@size\endcsname
162             \noexpand\fontname\font
163             \relax}%

```

Calling `\subst@correction` after the current group means calling it after we have loaded the substitution font which is done inside a group.

```

164     \aftergroup\subst@correction
165 }

```

### **\DeclareFontFamily {⟨encoding⟩}{⟨family⟩}{⟨loading-settings⟩}**

Declares a font family `⟨family⟩` to be available in encoding scheme `⟨encoding⟩`. The `⟨loading-settings⟩` are executed immediately after loading any font with this encoding and family.

Checks that `⟨encoding⟩` was previously declared. This example refers to the Computer Modern Typewriter font family in the Cork encoding:

```
\DeclareFontFamily{T1}{cmtt}{\hyphenchar\font=-1}
```

Each `.fd` file should contain exactly one `\DeclareFontFamily` combination.

```
166 \def\DeclareFontFamily#1#2#3{%
```

If we want fast checking for the encoding scheme we can just check for `\T@..` being defined.

```

167 % \@tempswafalse
168 % \def\reserved@a{#1}%
169 % \def\cdp@elt##1##2##3##4{\def\reserved@c{##1}%
170 %   \ifx\reserved@a\reserved@c \@tempswatrue\fi}%
171 % \cdp@list
172 % \if@tempswa
173  \@ifundefined{T@#1}%
174  {%
175    \@latex@error{Encoding scheme `#1' unknown}\@eha
176  }%
177  {%

```

Now we have to define the macro `\(#1)+(#2)` to contain `#3`. But since most of the time `#3` will be empty we use `\let` in a tricky way rather than a simple `\def` since this will save internal memory. We store the argument `#3` in a temporary macro `\reserved@a`.

```
178  \def\reserved@a{#3}%
```

We compare `\reserved@a` with `\@empty`. If these two are the same we `\let` the ‘extra’ macro equal to `\@empty` which is not the same as doing a `\let` to `\reserved@a` — the latter would blow one extra memory location rather than reusing the one from `\@empty`.

```

179   \global
180   \expandafter\let\csname #1+\#2\expandafter\endcsname
181     \ifx \reserved@a\empty
182       \empty
183     \else \reserved@a
184     \fi
185   }%
186 }

187 \let\cdp@list\empty
188 \@onlypreamble\cdp@list
189 \let\cdp@elt\relax
190 \@onlypreamble\cdp@elt

```

### \DeclareFontEncoding {⟨encoding⟩}{⟨text-settings⟩}{⟨math-settings⟩}

This function declares a new font encoding scheme.

The ⟨text-settings⟩ are declarations which are executed every time \selectfont changes the encoding to be ⟨encoding⟩.

The ⟨math-settings⟩ are similar but are for math alphabets. They are executed whenever a math alphabet with this encoding is called.

The command also saves the value of ⟨encoding⟩ in the macro \LastDeclaredEncoding<sup>→ P.190</sup>. Spaces within the arguments are ignored to avoid surplus spaces in the document.<sup>1</sup>

```
191 \def\DeclareFontEncoding{%
```

First we start with ignoring all blanks and newlines since every surplus space in the second or third argument will come out in a weird place in the document.

```

192 \begingroup
193 \nfss@catcodes
194 \expandafter\endgroup
195 \DeclareFontEncoding@}
196 \@onlypreamble\DeclareFontEncoding

197 \def\DeclareFontEncoding@#1#2#3{%
198   \expandafter
199   \ifx\csname T@\#1\endcsname\relax
200     \def\cdp@elt{\noexpand\cdp@elt}%
201     \xdef\cdp@list{\cdp@list\cdp@elt{#1}%
202                   {\default@family}{\default@series}%
203                   {\default@shape}}%

```

To support encoding dependent commands (like accents) we initialise the command

```

204   \expandafter\let\csname#1-\cmd\endcsname\@changed@cmd
205 \else
206   \@font@info{Redeclaring font encoding #1}%
207 \fi
208 \global\@namedef{T@\#1}{#2}%
209 \global\@namedef{M@\#1}{\default@M#3}%

```

---

<sup>1</sup>fntguide.

Keep a record of the last encoding being declared:

```
210 \xdef\LastDeclaredEncoding{#1}%
211 }
212 \@onlypreamble\DeclareFontEncoding@
```

**\LastDeclaredEncoding**

```
213 \def\LastDeclaredEncoding{}
```

### **\DeclareFontSubstitution** {*encoding*}{{*family*}{{*series*}{{*shape*}}}}

Declares the default values for font substitution which will be used when a font with encoding hencodingi should be loaded but no font can be found with the current attributes.

These substitutions are local to the encoding scheme because the encoding scheme is never substituted! They are tried in the order *<shape>* then *<series>* and finally *<family>*.

If no defaults are set up for an encoding, the values given by **\DeclareErrorFont** <sup>P. 198</sup> are used.

The font specification for hencodingihfamilyihseriesihshapei must have been defined by **\DeclareFontShape** <sup>P. 186</sup> before the **\begin{document}** is reached.

Example:

```
\DeclareFontSubstitution{T1}{cmr}{m}{n}

101 \def\DeclareFontSubstitution#1#2#3#4{%
102   \expandafter
103   \ifx\csname T#1\endcsname\relax
104     \@latex@error{Encoding scheme '#1' unknown}\@eha
105   \else
106     \begingroup
107       \edef\reserved@a{#1}%
108       \toks@{%
109         \def\cdp@elt##1##2##3##4{%
110           \def\reserved@b{##1}%
111           \ifx\reserved@a\reserved@b
112             \addto@hook\toks@{\cdp@elt{##1}{##2}{##3}{##4}}%
113           \else
114             \addto@hook\toks@{\cdp@elt{##1}{##2}{##3}{##4}}%
115           \fi}%
116         \cdp@list
117         \xdef\cdp@list{\the\toks@}%
118       \endgroup
119       \global
120       \namedef{D#1}{%
121         \def\default@family{#2}%
122         \def\default@series{#3}%
123         \def\default@shape{#4}%
124       }%
125     \fi
126   }
127 \@onlypreamble\DeclareFontSubstitution
```

```

\DeclareFontEncodingDefaults
128 \def\DeclareFontEncodingDefaults#1#2{%
129   \ifx\relax#1\else
130     \ifx\default@T\empty\else
131       \@font@info{Overwriting encoding scheme text defaults}%
132     \fi
133     \gdef\default@T{#1}%
134   \fi
135   \ifx\relax#2\else
136     \ifx\default@M\empty\else
137       \@font@info{Overwriting encoding scheme math defaults}%
138     \fi
139     \gdef\default@M{#2}%
140   \fi
141 }
142 \@onlypreamble\DeclareFontEncodingDefaults

143 \let\default@T\empty
144 \let\default@M\empty

\DeclarePreloadSizes
145 \def\DeclarePreloadSizes#1#2#3#4#5{%
146   \@ifundefined{T#1}{%
147     {\@latex@error{Encoding scheme '#1' unknown}@\eha}%
148   }%
149   \begingroup
150   \def\reserved@f##1,{%
151     \if>##1%
152       \let\reserved@f\relax
153     \else
154       \xdef\font@name{\csname#1/#2/#3/#4/#1\endcsname}%
155       \pickup@font
156       \global\expandafter\let\font@name\relax
157     \fi
158     \reserved@f}%
159   \reserved@f#5,,%
160   \endgroup
161 }%
162 }
163 \@onlypreamble\DeclarePreloadSizes

164 \newif\ifmath@fonts \math@fontstrue

\DeclareMathSizes
165 \def\DeclareMathSizes{%
166   \@ifstar{\@DeclareMathSizes\math@fontsfalse}{%
167     {\@DeclareMathSizes{}}}
168 }%
169 \@onlypreamble\DeclareMathSizes

```

```

169 %</2ekernel>
170 %<latexrelease>\IncludeInRelease{2015/01/01}{\@DeclareMathSizes}%
171 %<latexrelease>          {Arbitrary units in }
172 %<*2ekernel|latexrelease>
173 \def\@DeclareMathSizes #1#2#3#4#5{%
174   \@defaultunits\dimen@ #2pt\relax\@nnil
175   \if $#3$%
176     \expandafter\let\csname %
177     \S@\strip@pt\dimen@\endcsname\math@fontsfalse
178   \else
179     \@defaultunits\dimen@ii #3pt\relax\@nnil
180     \@defaultunits\@tempdima #4pt\relax\@nnil
181     \@defaultunits\@tempdimb #5pt\relax\@nnil
182     \toks@{\#1}%
183     \expandafter\xdef\csname S@\strip@pt\dimen@\endcsname{%
184       \gdef\noexpand\sf@size{\strip@pt\dimen@ii}%
185       \gdef\noexpand\sf@size{\strip@pt\@tempdima}%
186       \gdef\noexpand\sf@size{\strip@pt\@tempdimb}%
187       \the\toks@
188     }%
189   \fi
190 }%
191 %</2ekernel|latexrelease>
192 %<latexrelease>\EndIncludeInRelease
193 %<latexrelease>          {Arbitrary units in }
194 %<latexrelease>\def\@DeclareMathSizes#1#2#3#4#5{%
195 %<latexrelease>  \@defaultunits\dimen@#2pt\relax\@nnil
196 %<latexrelease>  \if$#3$%
197 %<latexrelease>    \expandafter \let
198 %<latexrelease>    \csname S@\strip@pt\dimen@\endcsname
199 %<latexrelease>    \math@fontsfalse
200 %<latexrelease>  \else
201 %<latexrelease>    \expandafter \gdef
202 %<latexrelease>    \csname S@\strip@pt\dimen@\endcsname
203 %<latexrelease>      {\gdef\sf@size{\#3}\gdef\sf@size{\#4}%
204 %<latexrelease>                  \gdef\sf@size{\#5}%
205 %<latexrelease>      #1%
206 %<latexrelease>    }%
207 %<latexrelease>  \fi}%
208 %<latexrelease>\EndIncludeInRelease
209 %<*2ekernel>
210 \onlypreamble\@DeclareMathSizes

```

\fontencoding *f@encoding* As we said in the introduction a font is described by four parameters. We first define macros to specify the wanted *family*, *series*, or *shape*. These are simply recorded in internal macros *\f@family*, *\f@series*, and *\f@shape*, resp. We use *\edef*'s so that the arguments can also be macros.

```

211 \DeclareRobustCommand\fontencoding[1]{%
212   \expandafter\ifx\csname T@\#1\endcsname\relax
213     \@latex@error{Encoding scheme '#1' unknown}\@eha

```

```

214     \else
215         \edef\f@encoding{#1}%
216         \ifx\cf@encoding\f@encoding

```

If the new encoding is the same as the old encoding we have nothing to do. However, in case we had a sequence of several encoding changes without a **\selectfont** in-between we can save processing by making sure that **\enc@update** is **\relax**.

```

217             \let\enc@update\relax
218         \else

```

If current and new encoding differ we define the macro **\enc@update** to contain all updates necessary at **\selectfont** time.

```

219             \let\enc@update\@@enc@update
220             \fi
221             \fi
222 }

```

*(End definition for **\fontencoding** and **\f@encoding**.)*

```

223 \def\@@enc@update{%
224     \expandafter
225     \let
226         \csname\cf@encoding -cmd\endcsname
227         \@changed@cmd
228     \expandafter
229     \let
230         \csname\f@encoding-cmd\endcsname
231         \@current@cmd
232     \default@T
233     \csname T@\f@encoding\endcsname
234     \csname D@\f@encoding\endcsname
235     \let\enc@update\relax
236     \let\cf@encoding\f@encoding
237 }
238 \let\enc@update\relax
239 \DeclareRobustCommand\fontfamily[1]{\edef\f@family{#1}}
240 \DeclareRobustCommand\fontseries[1]{\edef\f@series{#1}}
241 \DeclareRobustCommand\fontshape [1]{\edef\f@shape{#1}}

```

### \usefont

Some handy abbreviation if you want to get some particular font in the current size. If also the size should change one has to issue a **\fontsize** command first.

```

242 \def\usefont#1#2#3#4{\fontencoding{#1}\fontfamily{#2}%
243             \fontseries{#3}\fontshape{#4}\selectfont
244             \ignorespaces}
245 \DeclareRobustCommand\linespread[1]
246     {\set@fontsize{#1}\f@size\f@baselineskip}

```

```

247 \DeclareRobustCommand\fontsize[2]
248   {\set@fontsize\baselinestretch{\#1}{\#2}}
249 \let\f@family\empty
250 \let\f@series\empty
251 \let\f@shape\empty
252 \let\f@size\empty
253 \let\f@baselineskip\empty
254 \let\f@linespread\empty
255 \let\f@encoding\empty
256 \let\cf@encoding\empty
257 \def@\defaultunits{\afterassignment\remove@to@nnil}

```

**\strip@pt** This macro strips the characters **pt** produced by using **\the** on a dimen register.

```

258 \begingroup
259   \catcode`P=12
260   \catcode`T=12
261   \lowercase{
262     \def\x{\def\rem@pt##1.##2PT{##1\ifnum##2>\z@.##2\fi}}}
263   \expandafter\endgroup\x
264 \def\strip@pt{\expandafter\rem@pt\the}

```

(End definition for **\strip@pt** and **\rem@pt**.)

### \mathversion {<version>}

This command selects a math version; it can only be used outside math mode. For example, **\boldmath** is defined to be **\mathversion{bold}**.

```

265 \DeclareRobustCommand\mathversion[1]
266   {@nomath\mathversion
267    \expandafter\ifx\csname mv@\#1\endcsname\relax
268      @latex@error{Math version '#1' is not }
269      \defined}\@eha\else
270      \edef\math@version{\#1}%

```

We need to force a math font setup both now and at the point where we return to the previous math version. Forcing a math font setup can simply be done by setting **\glb@currsize** to an invalid value since this will trigger the setup when the formula starts.

```
270 \gdef\glb@currsize{}%
```

When the scope of the current **\mathversion** ends we need to restore the old setup. However this time we need to force it directly at least if we are inside math, otherwise we could wait. Another way to enhance this code here is to do the setting only if the version really has changed after all. This might be interesting in case of **amstext** and **boldsymbol**.

```

271   \aftergroup\glb@settings
272   \fi}
```

If TeX would support a hook just before the end of a formula (opposite of **\everymath** so to speak) the implementation of the algorithm would be much

simpler because in that case we would set up the correct math fonts at this point without having to worry about incorrect settings due to nesting. The same would be true if in L<sup>A</sup>T<sub>E</sub>X the use of \$ (as the primitive TeX command) would be impossible and instead only a higher-level interface would be available. Note that this does not mean that a \$ couldn't be the short-hand for starting and stopping that higher-level interface, it only means that the direct TeX function must be hidden.

Anyway, since we don't have this and won't have it in L<sup>A</sup>T<sub>E</sub>X<sub>2</sub> <sub>$\epsilon$</sub>  we need to implement it in a somewhat slower way.

We test for the current math font setup on entry of a formula, i.e., on the hooks \everymath and \everydisplay. But since these hooks may contain user data we provide ourselves with an internal version of these hooks which stays frozen.

```
\frozen@everymath      New internal names for \everymath and \everydisplay.  
\frozen@everydisplay 273 \let\frozen@everymath\everymath  
                      274 \let\frozen@everydisplay\everydisplay
```

(End definition for \frozen@everymath and \frozen@everydisplay.)

### \everymath

```
\everydisplay  
275 \newtoks\everymath  
276 \newtoks\everydisplay
```

(End definition for \everydisplay.)

```
277 \frozen@everymath = {\check@mathfonts  
278           \the\everymath}  
279 \frozen@everydisplay = {\check@mathfonts  
280           \the\everydisplay}
```

\curr@math@size This holds locally the current math size.

```
281 \let\curr@math@size\empty
```

(End definition for \curr@math@size.)

## 14.3 Macros for loading fonts

### \pickup@font

The macro \pickup@font which is used in \selectfont is very simple: if the font name is undefined (i.e. not known yet) it calls \define@newfont to load it.

```
282 \def\pickup@font{  
283   \expandafter\ifx\font@name\relax  
284     \define@newfont  
285   \fi}
```

### \split@name

\pickup@font assumes that \font@name is set but it is sometimes called when \f@family, \f@series, \f@shape, or \f@size may have the wrong settings (see, e.g., the definition of \getanddefine@fonts). Therefore we need a macro to extract font *family*, *series*, *shape*, and *size* from the font name. To this end we define \split@name which takes the font name as a list of characters of \catcode 12 (without the backslash at the beginning) delimited by the special control sequence \@nil. This is not very complicated: we first ensure that / has the right \catcode

286 {\catcode`\\=12

and define \split@name so that it will define our private \f@encoding, \f@family, \f@series, \f@shape, and \f@size macros.

287 \gdef\split@name#1/#2/#3/#4/#5@nil{\def\f@encoding{#1}%
  
288 \def\f@family{#2}%
  
289 \def\f@series{#3}%
  
290 \def\f@shape{#4}%
  
291 \def\f@size{#5}}}

### \curr@fontshape

Abbreviation which may get removed again for speed.

292 \def\curr@fontshape{\f@encoding/\f@family/\f@series/\f@shape}

#### Example 3.1 Currentfontshape

```
100 \makeatletter
101 \curr@fontshape
102 \makeatother
```

TU/Georgia(o)/m/n

### \define@newfont

Now we can tackle the problem of defining a new font.

103 \def\define@newfont{%

We have already mentioned that the token list that \split@name will get as argument must not start with a backslash. To reach this goal we will set the \escapechar to -1 so that the \string primitive will not generate an escape character. To keep this change local we open a group. We use \begingroup for this purpose since \define@newfont might be called in math mode, and an empty \bgroup...\egroup would add an empty Ord atom to the math list and thus affect the spacing.

Also locally redefine \typeout so that 'No file ...fd' Warnings become Font Info message just sent to the log file.

```
104 \begingroup
105 \let\typeout\@font@info
106 \escapechar\m@ne
```

Then we extract *encoding scheme*, *family*, *series*, *shape*, and *size* from the font name. Note the four `\expandafter`'s so that `\font@name` is expanded first, then `\string`, and finally `\split@name`.

```
107   \expandafter\expandafter\expandafter
108     \split@name\expandafter\string\font@name\@nil
```

If the `\curr@fontshape` combination is not available, (i.e. undefined) we call the macro `\wrong@fontshape` to take care of this case. Otherwise `\extract@font` will load the external font for us.

```
109   \expandafter\ifx
110     \csname\curr@fontshape\endcsname \relax
111       \try@load@fontshape % try always
112     \fi
113   \expandafter\ifx
114     \csname\curr@fontshape\endcsname \relax
115       \wrong@fontshape\else
```

To allow substitution we call the `curr@fontshape` macro which usually will expand to `\relax` but may hold code for substitution (see `\subst@fontshape` definition).

```
116   \csname\curr@fontshape\endcsname
117     \extract@font\fi
```

We are nearly finished and must only restore the `\escapechar` by closing the group.

```
118 \endgroup
119 \def\try@load@fontshape{%
120   \expandafter
121   \ifx\csname \f@encoding+\f@family\endcsname\relax
122     \@font@info{Try loading font information for
123                 \f@encoding+\f@family}%
124   \global\expandafter\let
125     \csname\f@encoding+\f@family\endcsname\empty
126   \nfss@catcodes
127   \let\nfss@catcodes\relax
128   \edef\reserved@a{%
129     \lowercase{%
130       \noexpand\InputIfFileExists{\f@encoding\f@family.fd}}%
131     \reserved@a\relax
132     {\@input{\f@encoding\f@family.fd}}%
133   \fi}
```

### \nfss@catcodes

This macro should contain the standard `\catcode` assignments to all characters which are used in the commands found in an .fd file and which might have special `\catcodes` in the middle of a document. If necessary, this list can be extended in a package file using a suitable number of `\expandafter`, i.e.,

```
\expandafter\def\expandafter\nfss@catcodes
  \expandafter{\nfss@catcodes <additional settings>}
```

Note, that this macro might get executed several times since it is also called by `\DeclareFontShape`, thus it probably should not be misused as a general purpose hook.

```
134 \def\nfss@catcodes{%
```

We start by making @ a letter and ignoring all blanks and newlines.

```
135   \makeatletter
136   \catcode`\ \ 9%
137   \catcode`\^^I9%
138   \catcode`\^^M9%
```

Then we set up \, {, }, # and % in case an .fd file is loaded during a verbatim environment.

```
139   \catcode`\\z@
140   \catcode`{\@ne
141   \catcode`{\}\tw@
142   \catcode`\#6%
143   \catcode`\^7%
144   \catcode`\%14%
```

The we make sure that the important syntax parts have the right `\catcode`.

```
145 \@makeother\<%
146 \@makeother\>%
147 \@makeother\*%
148 \@makeother\.%%
149 \@makeother\-%%
150 \@makeother\/%%
151 \@makeother\[%%
152 \@makeother\]%
153 \@makeother\`%
154 \@makeother\!'%
155 \@makeother\%"%
156 }
```

### \DeclareErrorFont

Declare the last resort shape! We assume that in this fontshape there is a 10pt font but it doesn't really matter. We only loose one macro name if the assumption is false. But at least the font should be there!

```
157 \def\DeclareErrorFont#1#2#3#4#5{%
158   \xdef\error@fontshape{%
159     \noexpand\expandafter\noexpand\split@name\noexpand\string
160     \expandafter\noexpand\csname#1/#2/#3/#4/#5\endcsname
161     \noexpand@nil}%
162 %
163   \gdef\f@encoding{#1}%
164   \gdef\default@family{#2}%
165   \gdef\default@series{#3}%
166   \gdef\default@shape{#4}%
167   \global\let\f@family\default@family
168   \global\let\f@series\default@series
169   \gdef\f@size{#5}%
170   \gdef\f@baselineskip{#5pt}%
171 }
172 \@onlypreamble\DeclareErrorFont
```

```

173 %</2ekernel>
174 %<latexrelease>\IncludeInRelease{2015/01/01}{\wrong@fontshape}%
175 %<latexrelease>                                {Font substituation in }
176 %<2ekernel|latexrelease>
177 \def\wrong@fontshape{%
178     \csname D@\f@encoding\endcsname      % install defaults %
179     \ifinmath
180         \edef\reserved@a{\csname curr@fontshape\endcsname}%
181         \ifx\last@fontshape\reserved@a
182             \errmessage{Corrupted NFSS tables}%
183             \error@fontshape
184         \else
185             \let\f@shape\default@shape
186             \expandafter\ifx\csname curr@fontshape\endcsname\relax
187                 \let\f@series\default@series
188                 \expandafter
189                 \ifx\csname curr@fontshape\endcsname\relax
190                     \let\f@family\default@family
191                     \begingroup
192                         \try@load@fontshape
193                     \endgroup
194                 \fi \fi
195             \font@warning{Font shape ` \expandafter\string\reserved@a'
196                             \expandafter\gobble\string@\undefined\MessageBreak
197                             using `curr@fontshape' %
198                             instead \wrong@font@char}%
199             \global\let\last@fontshape\reserved@a
200             \gdef\@defaultsubs{%
201                 \font@warning{Some font shapes were not available, %
202                             \defaults
203                             substituted.\gobbletwo}}%
204             \global\expandafter\expandafter\expandafter\let
205                 \expandafter\reserved@a
206                 \csname curr@fontshape\endcsname
207             \xdef\font@name{%
208                 \csname curr@fontshape/\f@size\endcsname}%
209             \pickup@font}
210 %</2ekernel|latexrelease>
211 %<latexrelease>\EndIncludeInRelease
212 %<latexrelease>\IncludeInRelease{0000/00/00}{\wrong@fontshape}%
213 %<latexrelease>                                {Font substituation in }
214 %<2ekernel|latexrelease>
215 \def\wrong@fontshape{%
216     \csname D@\f@encoding\endcsname      % %
217     \installdefaults if in math
218     \edef\reserved@a{\csname curr@fontshape\endcsname}%

```

```

215 %<latexrelease>  \ifx\last@fontshape\reserved@a
216 %<latexrelease>    \errmessage{Corrupted NFSS tables}%
217 %<latexrelease>    \error@fontshape
218 %<latexrelease>  \else
219 %<latexrelease>    \let\f@shape\default@shape
220 %<latexrelease>    )
221 %<latexrelease>    \expandafter\ifx\csname\curr@fontshape\endcsname\relax
222 %<latexrelease>      \let\f@series\default@series
223 %<latexrelease>      \expandafter
224 %<latexrelease>      )
225 %<latexrelease>      \ifx\csname\curr@fontshape\endcsname\relax
226 %<latexrelease>        \let\f@family\default@family
227 %<latexrelease>        \fi \fi
228 %<latexrelease>      \fi
229 %<latexrelease>      \@font@warning{Font shape }
230 %<latexrelease>      \expandafter\string\reserved@a'
231 %<latexrelease>      )
232 %<latexrelease>      \expandafter@gobble\string@\undefined\MessageBreak
233 %<latexrelease>        using `'\curr@fontshape' )
234 %<latexrelease>        \instead{@wrong@font@char}%
235 %<latexrelease>        \global\let\last@fontshape\reserved@a
236 %<latexrelease>        \gdef@\defaultsubs{%
237 %<latexrelease>          \@font@warning{Some font shapes were }
238 %<latexrelease>          {not available, defaults
239 %<latexrelease>          substituted.\@gobbletwo}}%
240 %<latexrelease>        )
241 %<*2ekernel>
242 \let@wrong@font@char@\empty
243 \let@\defaultsubs\relax
244 \def\strip@prefix#1(){}
245 \let\install@mathalphabet\gdef
246 \let\math@fonts@\empty
247 \%def\select@group#1#2#3{\relax\ifmmode
248 \% \begingroup
249 \% \escapechar\m@ne
250 \% \getanddefine@fonts{\csname
251 \% \c@mv@\math@version\endcsname}#3%
252 \% \globaldefs@\ne \math@fonts
253 \% \endgroup
254 \% \xdef#1{\noexpand\use@mathgroup\noexpand#2%
255 \% {\number\csname c@mv@\math@version\endcsname}}%

```

```

255 %      \expandafter\extract@alph@from@version
256 %          \csname mv@\math@version\expandafter\endcsname
257 %          \expandafter{\number\csname
258 %              \c@mv@\math@version\endcsname}%
259 %          #1%
260 %          \stepcounter{mv@\math@version}%
261 %\expandafter #1\fi}

\ct@alph@from@version
261 \def\extract@alph@from@version#1#2#3{%
262     \def\reserved@a##1\install@mathalphabet#3##2##3\@nil{%
263         \def\reserved@b{##2}%
264         \def\reserved@c####1{\gdef#1{##1####1##3}}%}
265     \expandafter\reserved@a##1\@nil
266     \def\reserved@a\select@group#3##1##2\@nil{%

```

This macro can now directly rebuild the math version definition by calling `\reserved@c`:

```

267     \reserved@c{%
268         \getanddefine@fonts{#2}##2%
269         \install@mathalphabet#3{%
270             \relax\ifmmode \else \non@alpherr#3\fi
271             \use@mathgroup##1{#2}}}%
```

In addition it defines the alphabet the way it should be used from now on.

```

272     \gdef#3{\relax\ifmmode \else \non@alpherr#3\fi
273         \use@mathgroup##1{#2}}}%
```

Finally, we only have to call this macro `\reserved@a` on the old definitions recorded in `\reserved@b`:

```

274     \expandafter\reserved@a\reserved@b\@nil
275 }
```

(End definition for `\extract@alph@from@version`.)

```

\math@bgroup
\math@egroup 276 \let\math@bgroup\bgroup
277 \def\math@egroup#1{\#1\egroup}
```

(End definition for `\math@bgroup` and `\math@egroup`.)

`calculate@math@sizes` Here is the default definition for `\calculate@math@sizes` a more elaborate interface is under testing in `mthscale.sty`.

```

278 \gdef\calculate@math@sizes{%
279     \@font@info{Calculating\space math\space sizes\space}%
280     \for\space
281         size\space <\f@size>%
282     \dimen@\f@size \p@
283     \tempdimb \defaultscriptratio \dimen@
284     \dimen@ \defaultscriptscriptratio \dimen@
```

```

284 \expandafter\xdef\csname S@\f@size\endcsname{%
285   \gdef\noexpand\sf@size{\f@size}%
286   \gdef\noexpand\sf@size{\strip@pt\@tempdimb}%
287   \gdef\noexpand\sf@size{\strip@pt\dimen@}%
288   \noexpand\math@fontstrue}}

```

(End definition for `\calculate@math@sizes.`)

`\defaultscriptratio` The default ratio for math sizes is:  
`\ultscriptscriptratio` 1 to `\defaultscriptratio` to `\defaultscriptscriptratio`.  
By default this is 1 to .7 to .5.  
289 `\def\defaultscriptratio{.7}`  
290 `\def\defaultscriptscriptratio{.5}`

(End definition for `\defaultscriptratio` and `\defaultscriptscriptratio`.)

```

291 \ifx\noaccents@\@undefined
292   \let\noaccents@\empty
293 \fi

```

### \showhyphens

The `\showhyphens` command must be redefined since the version in `plain.tex` uses `\tenrm`. We have also made some further adjustments for its use in L<sup>A</sup>T<sub>E</sub>X.

```

294 \gdef\showhyphens#1{%
295   \setbox0\vbox{%
296     \color@begingroup
297     \everypar{}%
298     \parfillskip\z@skip\hsize\maxdimen
299     \normalfont
300     \pretolerance\m@ne\tolerance\m@ne\hbadness\z@\showboxdepth\z@\
301     \color@endgroup}}

```

### \addto@hook

We need a macro to add tokens to a hook.

```
302 \long\def\addto@hook#1#2{\#1\expandafter{\the#1#2}}
```

### \@vpt

```
303 \def\@vpt{5}
```

### \@vipt

```
304 \def\@vipt{6}
```

### \@viipt

```
305 \def\@viipt{7}
```

```
\@viiipt  
306 \def\@viiipt{8}  
  
\@ixpt  
307 \def\@ixpt{9}  
  
\@xpt  
308 \def\@xpt{10}  
  
\@xiipt  
309 \def\@xiipt{10.95}  
  
\@xiipt  
310 \def\@xiipt{12}  
  
\@xivpt  
311 \def\@xivpt{14.4}  
  
\@xviipt  
312 \def\@xviipt{17.28}  
  
\@xxpt  
313 \def\@xxpt{20.74}  
  
\@xxvpt  
314 \def\@xxvpt{24.88}  
  
315 %</2ekernel>
```

## ltfsstrc

In this short file provided in the  $\text{\LaTeX}$  kernel the definitions for the basic commands for typesetting the logos for  $\text{\TeX}$ ,  $\text{LaTeX}$  and  $\text{\LaTeXe}$  are developed.

These can be typeset using the macros  $\text{\TeX}$ ,  $\text{\LaTeX}$  and  $\text{\LaTeXe}$ .



This package contains the code for tracing font loading and font changes. It basically overlays some of the low-level functions of NFSS with additional code used for tracing.

The package accepts the following options:

**errorshow** Write all information about font changes etc. only to the transcript file unless an error happens. This means that information about font substitution will not be shown on the terminal.

**warningshow** Show all NFSS warnings on the terminal. This setting corresponds to the default behaviour of NFSS if the `tracefnt` package is *not* loaded!

**infoshow** Show all NFSS warning and all NFSS info messages (that are normally only written to the transcript file) also on the terminal. This is the default if the `tracefnt` package is loaded.

**debugshow** In addition to `infoshow` show also changing of math fonts as far as possible (this option can produce a large amount of output).

**loading** Show the name of external fonts when they are loaded. This option shows only “newly” loaded fonts not those already preloaded in the format or the class file before the `tracefnt` package became active.

**pausing** Turn all font warnings into errors so that L<sup>A</sup>T<sub>E</sub>X will stop.

## 15.1 A driver for this document

## 15.2 The Implementation

**Warning:** Read the macro documentation with a grain of salt. It is still basically the documentation from the first NFSS release and therefore in some cases probably not completely accurate.

```

316 %<*package>
317 %\NeedsTeXFormat{LaTeX2e}
318 %\ProvidesPackage{tracefnt}[??/??/?? v?.??
319 %                                     Standard LATEX package (font )
320 %</package>
321 %<+debug> \input trace.sty

```

The debug module makes use of commands contained in a special package file named `trace.sty`.<sup>1</sup>

321 %<+debug> \input trace.sty

## 15.3 Handling Options

\tracingfonts

Here is the definition of the integer register for the font trace. As a default in a package file we use 1 to give error messages if fonts are substituted. If this code

---

<sup>1</sup>This package is not in distribution at the moment (and probably doesn't any longer work). Think of this part of the code as being historical artefacts.

is used for debugging or tracing reasons in the format file (i.e. in `fam.dtx`) we use 0 as the default. But if no font trace is used we build a definition that will produce a warning message.

```
322 %<*2ekernel>
323 \def\tracingfonts{%
324   \@font@warning{Command \noexpand\tracingfonts
325     not provided.\MessageBreak
326     Use the `tracefnt' package.\MessageBreak Command }
327     \count@}
328 %</2ekernel>
```

The `\count@` in the line above will remove the number after `\tracingfonts`. Note that this definition will be overwritten by the next line if one of these modules are included.

```
329 %<*package,trace,debug>
330 \newcount\tracingfonts
331 \tracingfonts=0
332 %</package,trace,debug>
```

*(End definition for \tracingfonts.)*

The option `errorshow` turns off all warnings so that only real errors are shown. `warningshow` corresponds to the NFSS default (when `tracefnt` is not loaded). `infoshow` is the default for this package here; and `debugshow`, `loading`, and `pausing` extend the amount of information even further.

```
333 %<*package>
334 \DeclareOption{errorshow}{%
335   \def\@font@info#1{%
336     \GenericInfo{(Font)}{@spaces{@spaces{@spaces\space\space}}%
337     {LaTeX Font Info: \space\space\space#1}}%
338   \def\@font@warning#1{%
339     \GenericInfo{(Font)}{@spaces{@spaces{@spaces\space\space}}%
340     {LaTeX Font Warning: #1}}%
341   }
342 \DeclareOption{warningshow}{%
343   \def\@font@info#1{%
344     \GenericInfo{(Font)}{@spaces{@spaces{@spaces\space\space}}%
345     {LaTeX Font Info: \space\space\space#1}}%
346   \def\@font@warning#1{%
347     \GenericWarning{(Font)}{@spaces{@spaces{@spaces\space\space}}%
348     {LaTeX Font Warning: #1}}%
349   }
350 \DeclareOption{infoshow}{%
351   \def\@font@info#1{%
352     \GenericWarning{(Font)}{@spaces{@spaces{@spaces\space\space}}%
353     {LaTeX Font Info: \space\space\space#1}}%
354   \def\@font@warning#1{%
355     \GenericWarning{(Font)}{@spaces{@spaces{@spaces\space\space}}%
356     {LaTeX Font Warning: #1}}%
357   }
358 \DeclareOption{loading}{%
```

```

359     \tracingfonts\tw@
360 }
361 \DeclareOption{debugshow}{%
362     \ExecuteOptions{infoshow}%
363     \tracingfonts\thr@@
364 }
365 \DeclareOption{pausing}{%
366     \def\@font@warning#1{%
367         \GenericError
368             {((Font)\@spaces\@spaces\@spaces\space\space}%
369             {LaTeX Font Warning: #1}%
370             {See the LaTeX Companion for details.}%
371             {I'll stop for every LaTeX Font Warning because
372                 you requested\MessageBreak the `pausing' option
373                 to the tracefn package.}%
374     }
375 \ExecuteOptions{infoshow}
376 \ProcessOptions
377 %</package>

```

We also need a default definition inside the kernel:

```

378 %<*2ekernel>
379 \def\@font@info#1{%
380     \GenericInfo{((Font)\@spaces\@spaces\@spaces\space\space}%
381             {LaTeX Font Info: \space\space\space#1}%
382 \def\@font@warning#1{%
383     \GenericWarning{((Font)\@spaces\@spaces\@spaces\space\space}%
384             {LaTeX Font Warning: #1}%
385 %</2ekernel>

```

### 15.3.1 General font loading

```

386 %<*2ekernel|package>
387 \def\extract@font{%
388     \get@external@font
389     \global\expandafter\font\font@name\external@font\relax
390 %<*trace>
391     \ifnum \tracingfonts >\@ne
392     \@font@info{External font `\external@font'
393                 loaded as\MessageBreak \font@name}\fi
394 %</trace>
395     \font@name \relax
396     \csname \f@encoding+\f@family\endcsname
397     \csname\curr@fontshape\endcsname
398     \relax
399 }
400 %</2ekernel|package>
401 %<*2ekernel>
402 \def\get@external@font{%

```

```

403   \let\external@font\@empty
404   \edef\font@info{\expandafter\expandafter\expandafter\string
405     \csname \curr@fontshape \endcsname}%
406   \try@size@range
407   \ifx\external@font\@empty
408     \try@size@substitution
409     \ifx\external@font\@empty
410       \@latex@error{Font \expandafter \%
411                     \string\font@name\space
412                     not found}\@eha
413       \error@fontshape
414       \get@external@font
415     \fi\fi
416   }
417 %<*2ekernel|package>
418 \DeclareRobustCommand\selectfont
419   {%
420 %<+debug> \pushtracing
421 %<+debug> \ifnum\tracingfonts<4 \tracingoff
422 %<+debug> \else \tracingon\p@selectfont \fi
423   \ifx\f@linespread\baselinestretch \else
424     \set@fontsize\baselinestretch\f@size\f@baselineskip \fi
425   \xdef\font@name{%
426     \csname\curr@fontshape/\f@size\endcsname}%
427   \pickup@font
428   \font@name
429 %<*trace>
430   \ifnum \tracingfonts>\tw@
431     \font@info{Switching to \font@name}\fi
432 %</trace>
433   \size@update
434   \enc@update
435 %<+debug> \poptracing
436   }
437 \def\set@fontsize#1#2#3{%
438   \@defaultunits@\tempdimb#2pt\relax\@nnil
439   \edef\f@size{\strip@pt\@tempdimb}%
440   \@defaultunits@\tempskipa#3pt\relax\@nnil
441   \edef\f@baselineskip{\the\@tempskipa}%
442   \edef\f@linespread{#1}%
443   \let\baselinestretch\f@linespread
444   \def\size@update{%
445     \baselineskip\f@baselineskip\relax
446     \baselineskip\f@linespread\baselineskip
447     \normalbaselineskip\baselineskip

```

```

448      \setbox\strutbox\hbox{%
449          \vrule@height.7\baselineskip
450          \@depth.3\baselineskip
451          \@width\z@}%
452 %<*trace>
453     \ifnum \tracingfonts>\tw@
454         \ifx\f@linespread\@empty
455             \let\reserved@a\@empty
456         \else
457             \def\reserved@a{\f@linespread x}%
458         \fi
459         \@font@info{Changing size to \f@size/\reserved@a
460                     \f@baselineskip}%
461         \aftergroup\type@restoreinfo \fi
462 %</trace>
463         \let\size@update\relax}%
464     }
465 \let\size@update\relax
466 %<*trace>
467     \def\type@restoreinfo{%
468         \ifx\f@linespread\@empty
469             \let\reserved@a\@empty
470         \else
471             \def\reserved@a{\f@linespread x}%
472         \fi
473         \@font@info{Restoring size to
474                     \f@size/\reserved@a\f@baselineskip}}%
475 %</trace>
476 \def\glb@settings{%
477     \expandafter\ifx\csname S@\f@size\endcsname\relax
478         \calculate@math@sizes
479     \fi
480     \csname S@\f@size\endcsname
481     \ifmath@fonts
482 %<*trace>
483         \ifnum \tracingfonts>\tw@
484             \atfont@info{Setting up math fonts for
485                         \f@size\f@baselineskip}\fi
486 %</trace>
487         \begingroup
488             \escapechar\m@ne
489             \csname mv@\math@version \endcsname
490             \globaldefs\@ne
491             \math@fonts
492             \let \glb@currsize \f@size
493         \endgroup
494         \the\every@math@size

```

```

495 %<*trace>
496     \else
497         \ifnum \tracingfonts>\tw@
498             \@font@info{No math setup for
499                 \f@size/\f@baselineskip}\fi
500 %</trace>
501     \fi
502 }
503 %</2ekernel|package>
504 %<*2ekernel>
505 \def\baselinestretch{1}
506 \newtoks\every@math@size
507 \every@math@size={}
508 %</2ekernel>
509 %<*2ekernel|package>
510 \def\check@mathfonts{%
511     \ifx \glb@currsize \f@size
512 %<*trace>
513     \ifnum \tracingfonts>\thr@@
514         \@font@info{*** MATH: no change \f@size\space
515             curr/global (\curr@math@size/\glb@currsize)}\fi
516 %</trace>
517     \else
518 %<*trace>
519     \ifnum \tracingfonts>\thr@@
520         \@font@info{*** MATH: setting up \f@size\space
521             curr/global (\curr@math@size/\glb@currsize)}\fi
522 %</trace>
523     \glb@settings
524     \init@restore@glb@settings
525     \fi
526     \let\curr@math@size\f@size
527     \def\init@restore@glb@settings{\aftergroup\restglb@settings}%
528 }
529 %<-trace>\let\init@restore@glb@settings\relax
530 %<*trace>
531 \def\init@restore@glb@settings{%
532     \ifnum \tracingfonts>\thr@@
533         \@font@info{*** MATH: no resetting (not in
534             nested math)}\fi
535 }
536 %</trace>
537 \def\restglb@settings{%
538 %<*trace>
539     \ifnum \tracingfonts>\thr@@
540         \@font@info{*** MATH: restoring}\fi
541 %</trace>
542     \begingroup
543         \let\f@size\curr@math@size
544         \ifx\glb@currsize \f@size
545 %<*trace>
546     \ifnum \tracingfonts>\thr@@

```

```

547     \@font@info{*** MATH: ... already okay (\f@size)}\fi
548 %</trace>
549     \else
550 %<*trace>
551     \ifnum \tracingfonts>\thr@@
552         \@font@info{*** MATH: ... to \f@size}\fi
553 %</trace>
554     \glb@settings
555     \fi
556     \endgroup
557 }
558 \def\use@mathgroup#1#2{\relax\ifmmode
559 %<*trace>
560     \ifnum \tracingfonts>\tw@
561         \count@#2\relax
562         \@font@info{Using \noexpand\mathgroup
563             (\the\count@) #2}\fi
564 %</trace>
565     \math@bgroup
566         \expandafter\ifx\csname M@\f@encoding\endcsname#1\else
567             #1\fi
568         \mathgroup#2\relax
569         \expandafter\math@egroup\fi}%
570 %<*trace>
571     \ifx\math@bgroup\bgroup
572         \def\math@egroup#1{#1\egroup
573             \ifnum \tracingfonts>\tw@
574                 \@font@info{Restoring \noexpand\mathgroup
575                     (\ifnum\mathgroup=\m@ne default\else \the\mathgroup \fi
576                         \fi)\fi}%
577     }\fi
578 %</trace>
579 \def\getanddefine@fonts#1#2{%
580 %<+debug> \pushtracing
581 %<+debug> \ifnum\tracingfonts<4 \tracingoff
582 %<+debug> \else \tracingon\getanddefine@fonts \fi
583 %<*trace>
584     \ifnum \tracingfonts>\tw@
585         \count@#1\relax
586         \@font@info{\noexpand\mathgroup (\the\count@) #1 \MessageBreak
587             \string#2 \tf@size/\sf@size/\ssf@size}\fi
588 %</trace>
589     \xdef\font@name{\csname \string#2/\tf@size\endcsname}%
590     \pickup@font \let\textfont@name\font@name
591     \xdef\font@name{\csname \string#2/\sf@size\endcsname}%
592     \pickup@font \let\scriptfont@name\font@name
593     \xdef\font@name{\csname \string#2/\ssf@size\endcsname}%
594     \pickup@font

```

```

595 \edef\math@fonts{\math@fonts
596     \textfont#1\textfont@name
597     \scriptfont#1\scriptfont@name
598     \scriptscriptfont#1\font@name}%
599 %<+debug> \poptracing
600 }
601 %</2ekernel|package>
602 %<*2ekernel>
603 \def\ifnot@nil#1{\def\reserved@a{#1}%
604   \ifx\reserved@a\@nnil \expandafter\@gobble
605   \else \expandafter\@firstofone\fi}
606 \def\remove@to@nnil#1\@nnil{}
607 \def\remove@angles#1>{\set@simple@size@args}
608 \def\remove@star#1*{#1}
609 \def\extract@sizefn#1*#2\@nil{%
610   \if>#2>\set@size@funct@args#1\@nil
611   \let\sizefn@info\@empty
612   \else\expandafter\set@size@funct@args\remove@star#2\@nil
613   \def\sizefn@info{#1}\fi
614 }
615 % % this could be replaced by \try@size@range making the >
616 %subst slower!
616 \def\try@simple@size{%
617   \def\reserved@a{\def\extract@fontinfo####1}%
618   \expandafter\reserved@a\expandafter<\f@size>##2<##3\@nnil{%
619     \ifnot@nil{##2}%
620     {\set@simple@size@args##2<##3\@nnil
621     \execute@size@function\sizefn@info
622     }%}
623   \expandafter\expandafter
624   \expandafter\extract@fontinfo\expandafter\font@info
625   \expandafter<\f@size>\@nil<\@nnil
626 }
627 \def\set@simple@size@args#1<%
628   \if<#1<%
629     \expandafter\remove@angles
630   \else
631     \extract@sizefn#1*\@nil
632     \expandafter\remove@to@nnil
633   \fi}
634 \def\extract@rangefontinfo#1<#2>{%
635   \is@range#2->\@nil#2>}
636 \def\is@range#1-#2\@nil{%
637   \if>#2\expandafter\check@single\else
638   \expandafter\check@range\fi}
639 \def\check@range#1-#2>#3<#4\@nnil{%
640   \ifnot@nil{#3}{%

```

```

641     \def\reserved@f{\extract@rangefontinfo<#4\@nnil}%
642     \upper@bound0#2\p@
643     \ifdim\upper@bound=\z@\upper@bound\maxdimen\fi
644     \ifdim\f@size\p@<\upper@bound
645         \lower@bound0#1\p@
646         \ifdim\f@size\p@<\lower@bound
647             \else
648                 \set@simple@size@args#3<#4\@nnil
649                 \execute@size@function\sizefn@info
650                 \ifx\external@font\@empty
651                     \else
652                         \let\reserved@f\@empty
653                     \fi
654                 \fi
655             \fi
656         \reserved@f\}}
657 \newdimen\lower@bound
658 \newdimen\upper@bound
659 \def\check@single#1>#2<#3\@nnil{%
660     \def\reserved@f{\extract@rangefontinfo<#3\@nnil}%
661     \ifdim\f@size\p@=#1\p@
662         \set@simple@size@args#2<#3\@nnil
663         \execute@size@function\sizefn@info
664         \ifx\external@font\@empty
665             \else
666                 \let\reserved@f\@empty
667             \fi
668         \fi
669     \reserved@f}
670 \def\set@size@funct@args{\@ifnextchar[%
671     \set@size@funct@args@{\set@size@funct@args@[]}}
672 \def\set@size@funct@args@[#1]#2\@nil{%
673     \def\mandatory@arg{#2}%
674     \def\optional@arg{#1}}
675 %</2ekernel>
676 %<*2ekernel>
677 \def\DeclareSizeFunction#1#2{\@namedef{s@fct@#1}{#2}}
678 \onlypreamble\DeclareSizeFunction
679 %</2ekernel>
680 %<*2ekernel|package>
681 \def\execute@size@function#1{%
682 %<*trace>
683     \@ifundefined{s@fct@#1}%
684         {\errmessage{Undefined font size function #1}%
685          \s@fct@}%
686         {\csname s@fct@#1\endcsname}%

```

```

687 %</trace>
688 %<-trace>      \csname s@fct@#1\endcsname
689 }
690 %</2ekernel|package>
691 %<*2ekernel>
692 \def\try@size@range{%
693   \expandafter\extract@rangefontinfo\font@info %
694   \relax\@nil\@nil
695 }
696 \gdef\try@size@substitution{%
697   \tempdimb \maxdimen
698   \let \best@size \empty
699 }
700 \def\font@submax{0pt}
701 \def\fontsubfuzz{.4pt}
702 %</2ekernel>
703 %<+package>\def\fontsubfuzz{0pt}

704 %<*2ekernel>
705 \gdef\try@simples#1<#2>{%
706   \tryif@simple#2->\tryif@simple}
707 \gdef\tryif@simple#1-#2\tryif@simple{%
708   \let \reserved@f \try@simples
709   \if>#2%
710     \dimen@ #1\p@
711     \ifdim \dimen@<\@M\p@
712       \ifdim \f@size\p@<\dimen@
713         \tempdimc \dimen@
714         \advance\tempdimc -\f@size\p@
715       \else
716         \tempdimc \f@size\p@
717         \advance\tempdimc -\dimen@
718       \fi
719       \ifdim \tempdimc<\tempdimb
720         \tempdimb \tempdimc
721         \def \best@size{\#1}%
722       \fi
723     \else
724     % \%subst@size          %% coded inline
725     % \%def\subst@size{%
726     \ifx \external@font\empty
727       \ifx \best@size\empty
728       \else
729         \ifdim \tempdimb>\font@submax \relax
730           \xdef \font@submax {\the\tempdimb}%
731         \fi
732       \let \f@user@size \f@size

```

```

733      \let \f@size \best@size
734      \ifdim \tempdime>\fontsubfuzz\relax
735          \font@warning{Font space shape}space
736              `curr@fontshape'space in space size space
737              <f@user@size>space not space
738                  available MessageBreak
739                  size space <f@size>space substituted}%
740      \fi
741      \try@simple@size
742      \do@subst@correction
743  \fi
744 % %

745      \let \reserved@f \remove@to@nnil
746  \fi
747  \fi
748 \reserved@f

749 \DeclareSizeFunction{}{\empty@sfcnt\font@warning}
750 \DeclareSizeFunction{s}{\empty@sfcnt\font@info}

751 \def\empty@sfcnt#1{%
752     \tempdime \f@size\p@
753     \ifx\optional@arg\empty
754     \else
755         \tempdime \optional@arg\tempdime
756         #1{Font space shape}space `curr@fontshape'space
757             will space be MessageBreak
758             scaled space to space size space \the\tempdime}%
759     \fi
760     \edef\external@font{\mandatory@arg\space}
761         \at\the\tempdime}%
762 \DeclareSizeFunction{gen}{\gen@sfcnt\font@warning}
763 \DeclareSizeFunction{sgen}{\gen@sfcnt\font@info}

764 \def\gen@sfcnt{%
765     \edef\mandatory@arg{\mandatory@arg\f@size}%
766     \empty@sfcnt}

767 \DeclareSizeFunction{genb}{\genb@sfcnt\font@warning}
768 \DeclareSizeFunction{sgenb}{\genb@sfcnt\font@info}

769 \def\genb@sfcnt{%
770     \edef\mandatory@arg{\mandatory@arg\expandafter\genb@x\f@size..\@@}%
771     \empty@sfcnt}

772 \def\genb@x#1.#2.#3@@{\two@digits{#1}\genb@y#200\@@}
773 \def\genb@y#1#2#3@@{\#1#2}

774 \DeclareSizeFunction{sub}{\sub@sfcnt\font@warning}
775 \DeclareSizeFunction{ssub}{\sub@sfcnt\font@info}

776 \def\sub@sfcnt#1{%
777     \edef\mandatory@arg{\f@encoding/\mandatory@arg}%
778     \begingroup
779         \expandafter\split@name\mandatory@arg/\@nil

```

```

779      \try@load@fontshape
780      \endgroup
781      \let\f@user@size\f@size

```

Then we check whether this new combination is defined and give an error message if not. In this case we also switch to `\error@fontshape`.

```

782      \expandafter
783      \ifx\csname\mandatory@arg\endcsname\relax
784          \errmessage{No\space declaration\space for\space
785                      shape\space \mandatory@arg}%
786          \error@fontshape
787      \else

```

Otherwise we warn the user about the substitution taking place.

```

788      #1{Font\space shape\space `\\curr@fontshape'\space }
    \in\space
789      size\space <\f@size>\space not\space
        \available\MessageBreak
790      Font\space shape\space `\\mandatory@arg'\space
        \tried\space
    instead}%
792      \expandafter\split@name\mandatory@arg/\@nil
793      \fi

```

Then we restart the font specification scan by calling `\get@external@font`.

```

794      \edef\f@size{\f@user@size}%
795      \get@external@font
796      \do@subst@correction
797  }

```

The `subf` size function allows substitution of another font. The mandatory argument is the external name of the font to be substituted, the optional argument a size scaling factor like in the default size function. The main difference to the default size function is the warning message.

```

798 \DeclareSizeFunction{subf}{\subf@sfcnt@\font@warning}
799 \DeclareSizeFunction{ssubf}{\subf@sfcnt@\font@info}

800 \def\subf@sfcnt#1{%
801     #1{Font\space shape\space `\\curr@fontshape'\space }
    \in\space
802     size\space \f@size\space not\space
        \available\MessageBreak
803     external\space font\space `\\mandatory@arg'\space used}%
804     \empty@sfcnt#1%
805 }

```

The `fixed` size function is for using a font at a different size than requested. A warning message is printed, and the external font to be used is taken from the mandatory argument. If an optional argument is present it is used as the ‘at’ size for the font. Otherwise the font is loaded at its design size.

```

806 \DeclareSizeFunction{fixed}{\fixed@sfcnt@\font@warning}
807 \DeclareSizeFunction{sfixed}{\fixed@sfcnt@\font@info}

```

```
808 \def\fixed@sfcnt#1{%
809   \ifx\optional@arg\empty
810     \let\external@font\mandatory@arg
811   \else
812     \edef\external@font{\mandatory@arg\space at\optional@arg }%
813   \c@pt}%
814 #1{External\space font\space `\\external@font'\space }%
815   \c@loaded\space
816   for\space size\MessageBreak
817   <\f@size>}%
818 %%</2ekernel>
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 16.1 Introduction

Selecting the right fonts for a book is a job best left to the book designer. Despise this good advice most  $\text{\LaTeX}$  authors get their hands dirty trying to play the role of the book designer. A word of advice is that most of them make a royal mess of it. Irrespective of the  $\text{\TeX}$  engine employed, being  $\text{\TeX}$ ,  $\text{\LaTeX}$ ,  $\text{\Lual\TeX}$  or  $\text{\Xe\TeX}$  there are two issues in using fonts. How to select them and specify them and what fonts to use. We will dwell on the technical aspects of font selection in this Chapter.

There is another more serious aspect in selecting fonts based on “physiological” considerations. Boris Veytsman in an article in TUGboat boris2012 reviewed the literature comparing fonts for readability as well as the “trustability” of the text based on different fonts. Experiments carried out by Morris<sup>1</sup> concluded that fonts affect the reader’s attitude towards the text. Baskerville scored the highest and Comic Sans the lowest. Interestingly Computer Modern, the default typeface of  $\text{\TeX}$ , scored high in the test. Other tests carried out by **boris2012a** also concluded that there are no noticeable differences between serif and non-serif fonts in reading comprehension for cyrillic adult readers and that comprehension and reading speed might be affected by factors other than the font serifs alone.

Of course the biggest effect on readers is when fonts are used for “branding” a product into consumers minds. Marketers have been brainwashing consumers for years through the use of fonts. In *Branding With Type* by Rogener, Pool, and Packhauser (1995), a fervent argument is made for unique but consistent typefaces as a crucial element of corporate branding. Rogener et al. describe the fonts used by IBM, Mercedes, Nivea, and Marlboro as instantly recognisable internationally, and imply that the significant investment by such companies in design and copyright of trademarked fonts is worthwhile.

For example, **rogener1995** discuss the Nivea Bold typeface developed in 1992 by Gunther Heinrich at advertising agency TBWA in Hamburg, Germany, for skincare brand Nivea, and claim that the Nivea Bold typeface has effectively embodied the Nivea brand’s ‘pure and simple’ product philosophy. They link the font directly to profitability and Nivea’s worldwide product category market share of 35%<sup>2</sup>.

## 16.2 The Choice of Typesetting Engine

If you use only  $\text{pdf}\text{\LaTeX}$  the range of fonts is rather limiting and I would highly recommend for any serious typesetting work to move onto  $\text{\Xe\TeX}$  and the use of the package **fontspec** `fontspec`. Another alternative is to use  $\text{\Lual\TeX}$ . The latter is becoming more stable and is production ready to a large extend. It is expected to be the successor to  $\text{pdf}\text{\TeX}$ .

One of the things I wanted to achieve with the **phd** package was to take care of different  $\text{\TeX}$  engines, and to ensure that the package can be used irrespective of the  $\text{\TeX}$  engine used.

---

<sup>1</sup>**morris2012a**.

<sup>2</sup>**rogener1995**.

Before we start outlining the scheme let us start, by demonstrating how to load one of the standard fonts provided by L<sup>A</sup>T<sub>E</sub>X. We will load the Computer Modern font.

### Example 2.1 How to load a font

```

100 \newcommand{\fontdemo}[4][OT1]{
101   \leavevmode
102   \textcolor{thefontname}{#2}
103   \fontencoding{#1}\fontfamily{#3}\selectfont#4 }
104 \bgroup
105 \fontdemo{CM}{cmtt}{\alphabet\par}
106
107 \fox
108 \egroup
109
110 \hrule
111 \vskip 1in
112 \centerline{\bf A SHORT STORY}
113 \vskip 6pt
114 \centerline{\sl by A. U. Thor} % !`?`?! (modified)
115 \vskip .5cm
116 Once upon a time, in a distant
117   galaxy called "O"o\c c,
118 there lived a computer
119 named R.\~J. Drofnats.
120
121 Mr.\~Drofnats---or ``R. J.,'' as
122 he preferred to be called---% error has been fixed!
123 was happiest when he was at work
124 typesetting beautiful documents.
125 \vskip 1in
126 \hrule
127 \%vfill\eject
128
129 \meaning\ttdefault

```

CM a b c d e f g h i j k l m n o p q r s t u v w x y z  
The quick brown fox jumps over the lazy dogs.

### A SHORT STORY

*by A. U. Thor*

Once upon a time, in a distant galaxy called Ööç, there lived a computer named R. J. Drofnats.

Mr. Drofnats—or “R. J.”, as he preferred to be called—was happiest when he was at work typesetting beautiful documents.

---

macro:->SourceCodePro(0)

In the example we have used a number of convenience commands that are provided by the **phd** package.

### \alphabet

Typesets the letters of the English alphabet

### \fox

Typesets the fox passage

The example creates a convenience command to call the `computer modern typewriter` font and to print the alphabet.<sup>3</sup> In this case we are asking L<sup>A</sup>T<sub>E</sub>X to load a font from the `cmtt` family.

To load a font two things are required the encoding scheme [OT1] in the example and the somewhat cryptic font family name [`cmtt`].

## 16.3 What is a character? And a glyph?

A character is an abstract concept: the letter “A” is a character, while any particular drawing of that character is a glyph. In many cases there is one glyph for each character and one character for each glyph, but not always.

The glyph used for the Latin letter “A” may also be used for the Greek letter “Alpha”, while in Arabic writing most Arabic letters have at least four different glyphs (often vastly more) depending on what other letters are around them.

## 16.4 What's a font?

As the **fontinst**

manual says: “Once upon a time, this question was easily answered: a font is a set of type in one size, style, etc. There used to be no ambiguity, because a font was a collection of chunks of type metal kept in a drawer, one drawer for each font” fontinst.

With digital typesetting, things are more complicated. What a font *is* isn’t easy to pin down. A typical use of a PostScript font with L<sup>A</sup>T<sub>E</sub>X might use these elements:

<sup>3</sup>The command `\alphabet` is provided by the **phd** package.

1. Type 1 printer font file
2. Bitmap screen font file
3. Adobe font metric file (afm file)
4.  $\text{\TeX}$  font metric file (tfm file)
5. Virtual font file (vf file)
6. font definition file (fd file)

Looked at from a particular point of view, each of these files *is* the font. So what's going on? Every text font in  $\text{\TeX}$  has five attributes:

## 16.5 The low-level interface

The low level commands are mainly used to define new commands in packages and classes. It is helpful to understand the internal organization of fonts in  $\text{\TeX}$ 's font selection scheme New Font Selection Scheme (NFSS). Although termed new, one needs to understand that this is now almost twenty years old.

One of the goals of  $\text{\TeX}$ 's font selection scheme was to allow a rational selection with algorithms guided by the principles of generic markup companion.

Internally the  $\text{\TeX}$  kernel keeps track of five independent attributes. The “current encoding”, the “current family”, the “current series”, the “current shape”, and the “current size”. This was introduced in NFSS release 2 after it became clear that real support in multiple languages would be possible only by maintaining the character-encoding scheme independently of the other font attributes.

### 16.5.1 Encoding Schemes

The *encoding* scheme (in the example **OT1**) provides information as to which glyph goes into what slot in a font table. These font tables can be printed using **fonttest.tex**. We show the test for **cmtt10** in Figure 16.1. The most common values for the font encoding are:

OT1	TEX text
T1	TEX extended text
OML	TEX math italic
OMS	TEX math symbols
OMX	TEX math large symbols
U	Unknown
L $\langle$ xx $\rangle$	A local encoding

**family** The name for a collection of fonts, usually grouped under a common name by the font foundry. For example, ‘Adobe Times’, ‘ITC Garamond’, and Knuth’s ‘Computer Modern Roman’ are all font families.

There are far too many font families to list them all, but some common ones are:

cmr	Computer Modern Roman
cmss	Computer Modern Sans
cmtt	Computer Modern Typewriter
cmm	Computer Modern Math Italic
cmsy	Computer Modern Math Symbols
cmex	Computer Modern Math Extensions
ptm	Adobe Times
phv	Adobe Helvetica
pcr	Adobe Courier

**series** How heavy or expanded a font is. For example, ‘medium weight’, ‘narrow’ and ‘bold extended’ are all series.

**shape** The form of the letters within a font family. For example, ‘italic’, ‘oblique’ and ‘upright’ (sometimes called ‘roman’) are all font shapes. The most common values for the font shape are:

n	Normal (that is ‘upright’ or ‘roman’)
it	Italic
sl	Slanted (or ‘oblique’)
sc	Caps and small caps
ui	upright italic shape
ol	outline shape

To change the shape attribute the fontshape is used to change the shape attribute. If you try this and it does not work, it means that the font you have selected does not have the font shape you have requested. You may need to specify an appropriate font family as well:

#### Example 5.2 `\usefont`

```
100 {\usefont{T1}{cmr}{m}{sc} \raggedright \lorem}
```

```
FUSCE ADIPISCING JUSTO NEC ANTE. NULLAM IN ENIM.  
PELLENTESQUE FELIS ORCI, SAGITTIS AC, MALESUADA ET, FACILISIS  
IN, LIGULA. NUNC NON MAGNA SIT AMET MI ALIQUAM DICTUM. IN  
MI. CURABITUR SOLlicitUDIN JUSTO SED QUAM ET QUADD.PAR
```

**size** The design size of the font, for example ‘10pt’. If no dimension is specified, ‘pt’ is assumed.

These five parameters specify every L<sup>A</sup>T<sub>E</sub>X font, for example:

LaTeX specification	Font	TEX font name
OT1 cmr m n 10	Computer Modern Roman 10 point	cmr10

OT1 cmss m sl 1pc	Computer Modern Sans Oblique 1 pica	cmssi12
OML cmm m it 10pt	Computer Modern Math Italic 10 point	cmmi10
T1 ptm b it 1in	Adobe Times Bold Italic 1 inch	ptmb8t at 1in

**Example 5.3 Th `usefont` command**

```

100 \bgroup
101 \fontsize{12}{14pt} \lorem
102 \lorem
103 \egroup

```

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par  
Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

When you get a font error or an underfull or overfull box  $\text{\TeX}$  always will print an error with the font specification in full as shown below:

```

LaTeX Font Warning: Font shape `EU1/cmr/m/sc' undefined
(Font)           using `EU1/cmr/m/n' instead on input line 160.

```

## 16.6 Setting several font attributes

Often it is required that several attributes of a particular font need to be set. For this task  $\text{\TeX}$  provides the command `usefont`. This command takes four arguments: the encoding, family, series, and shape. The command updates those and then calls `selectfont`. If you also need to change the size and baseline skip, place a `fontsize` command in front of it.

**Example 6.4 Th `usefont` command**

```

100 \bgroup
101 \fontsize{12}{14pt}\usefont{OT1}{cmdh}{bc}{it}
102 \lorem
103 \egroup

```

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

Do note that when you use the **hyperref**

, you will get a surprise, all the commands have been converted to "PU" encoding. This is mostly harmless and is done in order for **hyperref** to mark bookmarks<sup>4</sup> in a safe way.

#### Example 6.5 font encoding

```

100 \meaning{textasciitilde}\
101 \meaning"\"\
102 \meaning{NG}\
103 \meaning{k}\
104 \meaning{alpha}
105 \meaning{printfontparams}
106
107 \printfontparams

macro:->\TU-cmd \textasciitilde \TU\textasciitilde
macro:->\TU-cmd \"\TU\
macro:->\TU-cmd \NG \TU\NG
macro:->\TU-cmd \k \TU\k
\mathchar"010Bundefined

```

A peek at the **puenc.def** reveals the inner workings of the encoding mechanism.

```

\ProvidesFile{puenc.def}
[2003/01/20 v6.73l
Hyperref: PDF Unicode definition (HO)]
\DeclareFontEncoding{PU}{}{%
\DeclareTextCommand{\textLF}{PU}{\000A} % line feed
\DeclareTextCommand{\textCR}{PU}{\000D} % carriage return
\DeclareTextCommand{\textHT}{PU}{\0009} % horizontal tab
\DeclareTextCommand{\textBS}{PU}{\0008} % backspace
\DeclareTextCommand{\textFF}{PU}{\000C} % formfeed
\DeclareTextAccent{\`}{PU}{\textgrave}
\DeclareTextAccent{\'}{PU}{\textacute}
\DeclareTextAccent{\^}{PU}{\textcircumflex}

```

**LATEX** uses a number of other files to get to the particular file that contains the font metrics file **cmtt10** and to find the appropriate file. For the original Knuth fonts the filenames have been kept the same, essentially as a request from Knuth that one should not change them.

Most of the difficulty in selecting and using fonts is figuring the encoding scheme and the Karl Berry naming scheme. In the Example 2.1 we select the **\fontfamily cmtt** which is computer modern type writer and then we invoke the macros for the shape **\itshape** and print the **alphabet**. The macro **\alphabet** is build-in the **phd** package as we use it in a few places.

---

<sup>4</sup><http://tex.stackexchange.com/questions/198810/why-does-the-hyperref-package-change-encoding-of-font-commands>

Test of cmtt10 on August 23, 2014 at 0607

	'0	'1	'2	'3	'4	'5	'6	'7	
'00x	$\Gamma$	$\Delta$	$\Theta$	$\Lambda$	$\Xi$	$\Pi$	$\Sigma$	$\Tau$	"0x
'01x	$\Phi$	$\Psi$	$\Omega$	$\Upsilon$	$\Downarrow$	$\prime$	$i$	$\dot{z}$	"1x
'02x	$\imath$	$\jmath$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	"2x
'03x	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	"3x
'04x	$\square$	!	"	#	\$	%	&	,	"4x
'05x	(	)	*	+	,	-	.	/	"5x
'06x	0	1	2	3	4	5	6	7	"6x
'07x	8	9	:	;	<	=	>	?	"7x
'10x	@	A	B	C	D	E	F	G	
'11x	H	I	J	K	L	M	N	O	
'12x	P	Q	R	S	T	U	V	W	
'13x	X	Y	Z	[	\	]	^	-	
'14x	'	a	b	c	d	e	f	g	
'15x	h	i	j	k	l	m	n	o	
'16x	p	q	r	s	t	u	v	w	
'17x	x	y	z	{		}	-	..	
	"8	"9	"A	"B	"C	"D	"E	"F	

Figure 16.1: Output from testfont.tex for cmtt10 font

### **16.6.1 The Postscript fonts**

With Adobe reader a number of fonts come pre-packaged and these have been incorporated into L<sup>A</sup>T<sub>E</sub>X 2e. These fonts can be found in all T<sub>E</sub>X distributions. The *Times New Roman* is named **ptm**.

### Example 6.6 The Postscript fonts

```
100 \raggedright
101 \begin{tabular}{@{}>{\sffamily\bfseries}rl}
102 \fonttitle{The Adobe `LaserWriter 35', 10 typefaces in
103 a total of 35
104 different styles, standard on all PostScript printers}
105 \%the\font{Avant Garde
106 Book}{pag}{\fontsize{9}{9}\selectfont\sample}
107 \%the\font{Bookman Light}{pbk}{\sample}
108 \%the\font{Courier}{pcr}{\sample}
109 \%the\font{Helvetica}{phv}{\sample}
110 \%the\font{New Century Schoolbook}{pnc}{\sample}
111 \%the\font[U]{Symbol}{psy}{\sample}
112 \%the\font{Zapf Chancery Medium
113 Italic}{pzc}{\fontsize{12}{12}\selectfont\itshape\sample}
114 \%the\font[U]{Zapf Dingbats}{pzd}{\sample}
115 \end{tabular}
```

The Adobe ‘LaserWriter 35’, 10 typefaces in a total of 35 different styles, standard on all PostScript printers

Using the **phd** package we can come closer to the **fontspec** or LuaTeX way of doing things and use longer font names as those found in the operating system.

Activating the key will set the font to **pzc** and unless is within a group will typeset the rest of the document with this typeface.

**/key/font name** = {⟨*Zapf Chancery Medium Italic*⟩}

This is how it is typeset

/phd/font name = {*Old Standard*}

Setting the key to Old Standard will typeset the next sample in oldStandard-  
Regular, **Stylistic Set=2**.

Alice had never been in a court of justice before, but she had read about them in books, and she was quite pleased to find that she knew the name of nearly everything there. "That's the judge," she said to herself, "because of his great wig."

The judge, by the way, was the King, and as he wore his crown over the wig, (look at the frontispiece if you want to see how he did it,) he did not look at all comfortable, and it was certainly not becoming.

abcdefg

/phd/font name = {*Junicode*}

Setting the key to Junicode will typeset the next sample in Junicode, Stylistic Set=2.

*Alice had never been in a court of justice before, but she had read about them in books, and she was quite pleased to find that she knew the name of nearly everything there. "That's the judge," she said to herself, "because of his great wig":*

The judge, by the pay, par the King, and as he pope his chopp over the pig, (look at the frontispiece if you vant to see how he did it,) he did not look at all comfortable, and it par certainly not becoming.

abcdefxz

**/phd/font\_name** = {*<Bookman Light or bookman>*}

## Bookman Light or bookman

"And that's the jury-box," thought Alice, "and those twelve creatures," (she was obliged to say "creatures," you see, because some of them were animals, and some were birds) "I suppose they are the jurors." She said this last word two or three times over to herself being rather proud of it: for she thought, and rightly too, that very few little girls of her age knew the meaning of it at all. However, "jurymen" would have done just as well.

**/phd/font name** ={<*Utopia or utopia*>}

OATS are animals found in all sort of places. The paragraph has been set using the font family **utopia**. The comment about the goats was just to get the letter g. comfortable in mountain areas. I don't recall Alice They

Goats are among the earliest animals domesticated by humans. The most recent genetic analysis confirms the archaeological evidence that the wild Bezoar ibex of the Zagros Mountains are the likely origin of almost all domestic goats today. Neolithic farmers began to herd wild goats for easy access to milk and meat, primarily, as well as for their dung, which was used as fuel, and their bones, hair, and sinew for clothing, building, and tools. The earliest remnants of domesticated goats dating 10,000 years before present are found in Ganj Dareh in Iran. Goat remains have been found at archaeological sites in Jericho, Choga Mami Djeitun and Çayönü, dating the domestication of goats in Western Asia at between 8000 and 9000 years ago.<sup>5</sup>

As you have observed we did not change the normal size of paragraphs, but the examples demonstrate that differences in font families also affect the visual size of the typeset text. **Helvetica** is normally scaled down to 0.95 and **Chancery** is scaled a little bit up or we use a larger font size.

## 16.6.2 Additional free fonts for use with L<sup>A</sup>T<sub>E</sub>X

A number of archaic and other fonts are available in the L<sup>A</sup>T<sub>E</sub>X historical collection. These are very impressive. They also provide in most instances transliterations.

## The Historical Collection

### 16.6.3 Uncial fonts

## Peter Wilson's **uncial**

package provides a useful uncial font and is easily used by just including the file

<sup>5</sup>Text is from wikipedia's article for the domesticated goat.

## Example 6.7 Unical fonts example

```

100 \begin{center}
101 The Uncial Huge normal font. \\ \par
102 {\unclfamily\Huge \ABC\\ \alphabet\\ \punct{}\dashes\\
     \figs\\ \par }
103 \end{center}

```

The Uncial Huge normal font.

The image shows a large sample of the Unical font. It includes two sets of characters: a top set in a large, bold serif font and a bottom set in a smaller, regular version of the same font. The characters include letters from A to Z, numbers from 0 to 9, and various punctuation marks and ligatures. The font has a classic, slightly rounded appearance with distinct serifs.

## 16.7 Dingbat and Symbol Fonts

Fonts containing collections of special symbols, which are normally not found in a text font, are called *dingbats*. One such font, the PostScript font Zapf Dingbats, is available if you use the `pifont` package, originally written by Sebastian Rahtz, and now part of `PSNFSS`. This is loaded automatically by the `phd` package. (See also implementation code at Page ??).

The parameter for the `\ding` command is an integer that specifies the char-

acter to be typeset according to Table ?? . For example `\ding{38}` gives Ⓢ.

For Open Type fonts the **Wingdings** family can be found on Windows systems. The advent of Unicode and the universal character set allowed commonly used dingbats to be given their own character codes. Although fonts claiming Unicode coverage will contain glyphs for dingbats *in addition* to alphabetic characters continue to be popular, primarily for ease of input. Such fonts are sometimes known as *pi fonts*.

### 16.7.1 Unicode Dingbats block

The Dingbats block **U+2700–U+27BF** was added to the Unicode Standard in June, 1993, with the release of version 1.1. This code block contains decorative character variants, and other marks of emphasis and non-textual symbolism. Most of its characters were taken from Zapf Dingbats.

The Ornamental Dingbats block (**U+1F650–U+1F67F**) was added to the Unicode Standard in June 2014 with the release of version 7.0. This code block contains ornamental leaves, punctuation, and ampersands, quilt squares, and checkerboard patterns. It is a subset of dingbat fonts Webdings, Wingdings, and Wingdings 2.<sup>6</sup>

A font that we will be using for many of the X<sub>E</sub>LT<sub>E</sub>X examples is **code2000** and **code2001**. The fonts were designed by James Kas<sup>7</sup>. They are True type fonts. The fonts contain a respectable collection of more or less exotic Unicode characters both within the Basic Multilingual Plane (BMP). They were designed by James Kass and were freeware. Sadly the website is no longer available, but the files can be downloaded in the links I have provided. I have also included them in the distribution for the **phd** package, as they are such a useful tool.

#### `\codetwothousand`

Loads the TrueType font `code2000.ttf`

#### `\codetwothousandone`

Loads the TrueType font `code2001`

#### `\symbola`

Loads the TrueType font `symbola`

```
\newfontfamily{\codetwothousand}{code2000.ttf}
\newfontfamily{\codetwothousandone}{code2001.ttf}
\newfontfamily{\symbola}{symbola.ttf}
```

---

<sup>6</sup>See <http://std.dkuug.dk/jtc1/sc2/wg2/docs/n4115.pdf>

<sup>7</sup>They can be downloaded at <http://www.alanwood.net/downloads/index.html>

**Example 7.8 Wingdings**

```

100 \ifxetex
101   {\codetwothousand \symbol{9742} \symbol{9743}
102   Katakana (, )
103   \codetwothousandone \symbol{57508}
104   \symbola \symbol{9816}
105 }
106 \else
107   \ifluatex
108   {\codetwothousand \symbol{9742} \symbol{9743}
109   Katakana (, )
110   \codetwothousandone \symbol{57508}
111   \symbola \symbol{9816}
112 }
113 \else
114   Compile the document with XeTeX to see the example
115 \fi
116 \fi

```

Katakana (, ) 

Another useful font for experimenting if you are using a Windows computer is **Arial Unicode MS**.

The **Symbola Font** has many other symbols, including chess and even Mahjong symbols.<sup>8</sup> George Douros has packaged many of the fonts for archaic languages, but sadly the substitution mechanisms of L<sup>A</sup>T<sub>E</sub>X do not always map the fonts properly.

With **LuaLaTeX** and **XeLaTeX**, T<sub>E</sub>X has moved into the twenty-first century and its usefulness can now be extended to many other languages and fields.

## 16.8 Naming digital fonts

Commercial and Open Source fonts come as a set of several files. The **.pfb** file and less frequently, a **.pfa** file or other files depending on the type of font and the operating system and provider. The metric information file resides in an associated **.afm** file. Other files, with extensions **.inf** (information) and **.pfm** are irrelevant to L<sup>A</sup>T<sub>E</sub>X and T<sub>E</sub>X.

Fonts already have names given them by their designers. The problem lies in associating this name with the font files. Restriction of operating systems originally from PC-DOS dates, restricted to the initial part of file names to eight characters.

### 16.8.1 Karl Berry naming scheme

The original inspiration for Fontname was Frank Mittelbach and Rainer Schoepf's article in TUGboat 11(2) (June 1990). This led to an article by Karl

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<sup>8</sup><http://users.teilar.gr/~g1951d/Symbola.pdf>

Berry in TUGboat 11(4) (November pages 512-519).

Karl Berry then suggested a system—with many limitations, but perhaps the best that could have been done in its time, for mapping a lengthy font name into a file name that was eight or fewer characters long. If the font files are renamed accordingly then we can deduce the nature of the font by examining its file name. The scheme did not apply to the original Computer Modern fonts that retained their original names fontname.

This scheme assumes that only eight characters or fewer can be available for naming the font. These eight characters look like,

FNNW[S][V]7V

Some additional comments on this shorthand notation is in order. The most common foundry abbreviations are **p** for Adobe (from PostScript), **b** for Bit-Stream, and **m** Monotype. A font flouting this scheme will begin with a **z**.

The next two letters are reserved for the typeface name. The hundreds and hundred of available faces guarantees that many of these will be cryptic, even for the most common typefaces—Adobe Garamond is **ad**.

## 16.9 The phd package interface.

By design feature options for XeTeX/XeLaTeX have currently been restricted. The reason behind this decision is that I was concerned that I would have added a complicated interface with very little reason as to its use. I opted for a more semantic approach and expect the user to define custom macros to handle anything else.

**mainfont** = {*font1,font2,font3*} A comma separated list of one or more font-names.  
The main font will be set to the first font found.

**chapterfont** = {*font1,font2,font3*} A comma separated list of one or more font-names.  
The main font will be set to the first font found.

**sectionfont** = {*font1,font2,font3*} A comma separated list of one or more font-names.  
The main font will be set to the first font found.

**contentsfont** = {*font1,font2,font3*} A comma separated list of one or more font-names.  
The main font will be set to the first font found.

**/phd/bibliography font** = {*font1,font2,font3*}

A comma separated list of one or more font-names. The main font will be set to the first font found.

Note that the package will first check if is running under XeTeX. If it does it will execute the commands and load the macros, otherwise it will fall back on pdfLaTeX commands.

## 16.10 Viewing and selecting fonts

### 16.10.1 Typefaces that come with the standard L<sup>A</sup>T<sub>E</sub>X distribution

Computer Modern (CM), L<sup>A</sup>T<sub>E</sub>X's default typeface

<b>CM Roman</b>	Typographia Ars Artium Omnium
<b>CM Italic</b>	<i>Typographia Ars Artium Omnium</i>
<b>CM Slanted (Oblique)</b>	<i>The quick brown fox jumps over the lazy dogs.</i>
<b>CM Bold</b>	Typographia Ars Artium Omnium
<b>CM Bold Extended</b>	Typographia Ars Artium Omnium
<b>CM Bold Italic</b>	<i>Typographia Ars Artium Omnium</i>
<b>CM Bold Slanted</b>	<i>Typographia Ars Artium Omnium</i>
<b>CM Caps &amp; Small Caps</b>	TYPOGRAPHIA ARS ARTIUM OMNIUM
<b>CM Sans-Serif</b>	Typographia Ars Artium Omnium
<b>CM Sans-Serif Oblique</b>	<i>Typographia Ars Artium Omnium</i>
<b>CM Sans-Serif Bold</b>	<b>Typographia Ars Artium Omnium</b>
<b>CM Typewriter</b>	Typographia Ars Artium Omnium
<b>CM Typewriter Italic</b>	<i>Typographia Ars Artium Omnium</i>
<b>CM Typewriter Bold</b>	Typographia Ars Artium Omnium
<b>CM Typewriter C&amp;SC</b>	TYPOGRAPHIA ARS ARTIUM OMNIUM
<b>CM Mathematics</b>	$E = mc^2$
<b>CM 'Dunhill'</b>	Typographia Ars Artium Omnium
<b>CM 'Fibonacci'</b>	Typographia Ars Artium Omnium

## 16.11 Discussion

Unfortunately, even with the best will loading fonts will always be a difficult task in T<sub>E</sub>X. Hopefully the interface provided will result in better separation of presentation from content and offers consistency in the styling of documents. Nothing prevents you from adding normal macros to styles. Each style can be treated as a package in many respects.

## 16.12 XeLaTeX and LuaLaTeX

Verdana	<p>The quick brown fox jumps over the lazy dogs.</p> <pre>a b c d e f g h i j k l m n o p q r s t u v w x y z + ? /  </pre> <p>In olden times when wishing still helped one, there lived a king whose daughters were all beautiful, but the youngest was so beautiful that the sun itself, which has seen so much, was astonished whenever it shone in her face. Close by the king's castle lay a great dark forest, and under an old lime-tree in the forest was a well, and when the day was very warm, the king's child went out into the forest and sat down by the side of the cool fountain, and when she was bored she took a golden ball, and threw it up on a high and caught it, and this ball was her favorite plaything.</p>
Calibri	<p>The quick brown fox jumps over the lazy dogs.</p> <pre>a b c d e f g h i j k l m n o p q r s t u v w x y z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z + ? /  </pre> <p>In olden times when wishing still helped one, there lived a king whose daughters were all beautiful, but the youngest was so beautiful that the sun itself, which has seen so much, was astonished whenever it shone in her face. Close by the king's castle lay a great dark forest, and under an old lime-tree in the forest was a well, and when the day was very warm, the king's child went out into the forest and sat down by the side of the cool fountain, and when she was bored she took a golden ball, and threw it up on a high and caught it, and this ball was her favorite plaything.</p> <p>Θαμκυαμ πλαθονεμ ραθιονιβυς ναμ ει, δυις περπετυα σιθ αδ, νες ιδ δισυντ σοντεντιωνες. Κιι σινθ μυνδι εα, φιμ αν γραεσω ιαδισαβιτ, εραθ δολορ φιρθυθε υθ δυο. Συ νοσθερ οπθιων ευμ, μει ερος προβο φιερενθ ευ. Ιις μανδαμυς τωρκυαθος εξπεθενδις ιδ. Σεδ θε νιβχ νονυμυ δελισαθισιμι, φιμ νο νιβχ λαβωραμυς, σεα εα δισο ποσιμ αντιωπαμ.</p>

## 16.13 Utilities for testing fonts

The package **fonttable** is an extension and re-implementation of Donald Knuth's **testfont.tex**, which is available from CTAN. The package was developed by Peter Wilson and currently maintained by Will Robertsonfonttable. It provides a number of utility commands for typesetting font tables.

The `fonttable{<font>}` takes the font file as an argument and typesets it in a nice table.

A great tool to inspect a True Type font on the command line is `luaotfload-tool`:

```
117  luaotfload-tool --find="Iwona" --inspect
```

## 16.14 .tfm files

When you tell TeX that you will be using a particular font, it has to find out information about that font. This information is stored in a file with the extension `.tfm`. For example when you say:

```
\font a=cmr10
```

TeX looks for a file named `cmr10.tfm`. If this is not found then an error is issued `Lookup failed on file CMR10.TFM`

Generally speaking, a font's `.tfm` file contains information about the height, width and depth of all the characters in the font plus kerning and ligature information. So, `cmr10.tfm` might say that the lower-case "d" in CMR10 is 5.5 points wide, 6.94 points high, etc. This is the information that TeX uses to make its lowest-level boxes—those around characters. See the TeX manual for information about what TeX does with these boxes. Note the `.tfm` files do not contain any information that is device dependent. Only device-drivers read TeX's `dvi` output files can use that sort of information.

## 16.15 Fonts for Far East Languages

In internationalization, CJK is a collective term for the Chinese, Japanese, and Korean languages, all of which use Chinese characters and derivatives (collectively, CJK characters) in their writing systems. Occasionally, Vietnamese is included, making the abbreviation CJKV, since Vietnamese historically used Chinese characters as well. The characters are known as 漢字 in Chinese, kanji in Japanese, hanja in Korean, and Ch Nôm in Vietnamese.

### 16.15.1 Selecting a font

The easiest way is with Will Robertson's `fontspec` package. In this sample, we have used the `SimSun` font, which can be found on windows machines:

```
\usepackage{fontspec}
\setromanfont{SimSun}
```

in the preamble, to use a Far Eastern font as the initial default typeface.

## 16.16 Entering CJK text

You can just enter Unicode text directly in the document: . Don't use legacy L<sup>A</sup>T<sub>E</sub>X packages such as `inputenc` or `CJK`, as X<sup>E</sup>T<sub>E</sub>X reads the text as Unicode

characters, not the separate byte codes of UTF-8 sequences, and passes them directly to the Unicode font. (Actually, it would probably be possible to use `\XeTeXinputencoding "bytes"` and work with legacy L<sup>A</sup>T<sub>E</sub>X input encoding support. But then you're pretty much committed to all the old encoding and font machinery, and there's not much point in using the X<sub>E</sub>T<sub>E</sub>X engine at all.)

## 16.17 Changing the font size in L<sup>A</sup>T<sub>E</sub>X

Changing the font size in L<sup>A</sup>T<sub>E</sub>X can be done at two levels, affecting the whole document or elements within it. Using a different font size on a global level will affect all normal-sized text as well as the sizes of headings, footnotes, etc. By changing the font size locally, however, a single word, a few lines of text, a large table, or a heading throughout the document may be modified. Fortunately, there is no need for the writer to juggle with numbers when doing so. L<sup>A</sup>T<sub>E</sub>X provides a set of macros for changing the font size locally, taking into consideration the document's global font size. thurnherr2012

### 16.17.1 Changing the font size on the document-wide level

The standard classes article, report and book support three different font sizes: 10pt, 11pt, 12pt. By default, the font size is set to 10pt and can be modified by passing any of the previously-mentioned value as a class option. As an example, suppose you want to change the font size for normal text to 12pt throughout the document. For the class report, this is how you would do that:

```
\documentclass[12pt]{report}
```

In most cases, the available font sizes for the standard classes are sufficient and you do not have to bother about loading special packages that provide more options.

## 16.18 Changing the font size locally

A common scenario is that the author of a document needs to change the font size for a word or paragraph, decrease the font size of a large table to make it fit on a page or increase the size of a heading throughout the document. L<sup>A</sup>T<sub>E</sub>X implements a set of macros which allow changing font size from Huge to tiny, literally. That way, the author does not have to worry about numbers. The macros, including the exact font size in points, are summarized in table 1. A good rule of thumb is not to use too many different sizes and not to make things too small or too big.

L<sup>A</sup>T<sub>E</sub>X provides two different ways to use these font size modifier macros: inline or as an environment using `\begin{...}\end{...}`:

**Example 18.9 Changing the size locally**

```
100 {\Large This is some large text.\par}
101 \begin{footnotesize}
102 This is some footnote-sized text.
103 \end{footnotesize}
```

**This is some large text.**

This is some footnote-sized text.

The `\par` command at the end of the inline example adjusts baselineskip, the minimum space between the bottom of two successive lines

A number of packages exist **moresize**<sup>9</sup> **moresize**, **anyfont**<sup>10</sup> by **anyfont**. The standard classes, **memoir** **KOMA** classes and most journals also provide their own defined sizing commands.

Class option	10pt	11pt	12pt
<code>\Huge</code>	25pt	25pt	25pt
<code>\huge</code>	20pt	20pt	25pt
<code>\LARGE</code>	17pt	17pt	20pt
<code>\Large</code>	14pt	14pt	17pt
<code>\large</code>	12pt	12pt	14pt
<code>\normalsize</code> (default)	10pt	11pt	12pt
<code>\small</code>	9pt	10pt	11pt
<code>\footnotesize</code>	8pt	9pt	10pt
<code>\scriptsize</code>	7pt	8pt	8pt
<code>\tiny</code>	5pt	6pt	6pt

---

<sup>9</sup><http://www.ctan.org/pkg/moresize>

<sup>10</sup><http://www.ctan.org/pkg/anyfont>

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

*This file contains the top level L<sup>A</sup>T<sub>E</sub>X interface to the font selection scheme commands. See other parts of the L<sup>A</sup>T<sub>E</sub>X distribution, or The L<sup>A</sup>T<sub>E</sub>X Companion for higher level documentation of these commands.*

## 17.1 NFSS Initialisation

104 %&lt;\*2ekernel&gt;

### 17.1.1 Providing math versions

L<sup>A</sup>T<sub>E</sub>X provides two *versions*. We call them normal and bold, respectively.

```

105 \DeclareMathVersion{normal}
106 \DeclareMathVersion{bold}

107 \ DeclareRobustCommand\rmfamily
108     {\not@math@\alphabet\rmfamily\mathrm
109      \fontfamily\rmdefault\selectfont}
110 \ DeclareRobustCommand\sffamily
111     {\not@math@\alphabet\sffamily\mathsf
112      \fontfamily\sfdefault\selectfont}
113 \ DeclareRobustCommand\ttfamily
114     {\not@math@\alphabet\ttfamily\mathtt
115      \fontfamily\ttdefault\selectfont}

116 \ DeclareRobustCommand\bfseries
117     {\not@math@\alphabet\bfseries\mathbf
118      \fontseries\bfdefault\selectfont}
119 \ DeclareRobustCommand\mdseries
120     {\not@math@\alphabet\mdseries\relax
121      \fontseries\mddefault\selectfont}
122 \ DeclareRobustCommand\upshape
123     {\not@math@\alphabet\upshape\relax
124      \fontshape\updefault\selectfont}

125 \ DeclareRobustCommand\slshape
126     {\not@math@\alphabet\slshape\relax
127      \fontshape\sldefault\selectfont}
128 \ DeclareRobustCommand\scshape
129     {\not@math@\alphabet\scshape\relax
130      \fontshape\scdefault\selectfont}
131 \ DeclareRobustCommand\itshape
132     {\not@math@\alphabet\itshape\mathit
133      \fontshape\itdefault\selectfont}

134 %</2ekernel>
135 %<latexrelease>\IncludeInRelease{2015/01/01}{\eminnershape}{\eminnershape}%
136 %%<2ekernel|latexrelease>
137 \ DeclareRobustCommand\em
138     {@nomath\em \ifdim \fontdimen@ne\font >\z@
139      \eminnershape \else \itshape \fi}%
140 \def\eminnershape{\upshape}%
141 %</2ekernel|latexrelease>
142 %<latexrelease>\EndIncludeInRelease
143 %<latexrelease>\IncludeInRelease{0000/00/00}{\eminnershape}{\eminnershape}%

```

```

144 %<latexrelease>\DeclareRobustCommand\em
145 %<latexrelease>           {@nomath\em \ifdim }
146 %<latexrelease>           {\fontdimen@ne\font >\z@ } \upshape \else )
147 %<latexrelease>\let\eminnershape@\undefined
148 %<latexrelease>\EndIncludeInRelease
149 %<*2ekernel>

150 \def\not@math@alphabet#1#2{%
151     \relax
152     \ifmmode
153         \@latex@error{Command \noexpand#1invalid in math mode}%
154         {%
155             Please
156             \ifx#2\relax
157                 define a new math alphabet^{^J}%
158                 if you want to use a special font in math mode%
159             \else
160                 use the math alphabet \noexpand#2instead of
161                 the #1command%
162             \fi
163             .
164         }%
165     \fi}
166 \def\boldmath{@nomath\boldmath
167             \mathversion{bold}}
168 \def\unboldmath{@nomath\unboldmath
169             \mathversion{normal}}
170 \def\math@version{normal}
171 \def\newfont#1#2{@ifdefinable#1{\font#1=#2\relax}}
172 \def\symbol#1{\char #1\relax}
173 \def@setfontsize#1#2#3{@nomath#1%
174     \ifx\protect\@typeset@protect
175         \let\@currsize#1%
176     \fi
177     \fontsize{#2}{#3}\selectfont}
178 %<*compat>
179 \def@setsizes#1#2#3#4{@setfontsize#1{#4}{#2}}
180 %</compat>
181 \def\oldstylenums#1{%
182     \begingroup
183     \spaceskip\fontdimen\tw@\font
184     \usefont{OML}{\rmdefault}{\f@series}{it}%
185     \mathgroup\symletters #1%
186     \endgroup
187 }

```

To set up L<sup>A</sup>T<sub>E</sub>X's special math character definitions we first provide a macro to generate hexadecimal numbers. It is a rather simple `\ifcase`.

```
188 \def\hexnumber@#1{\ifcase\number#1
189   0\or 1\or 2\or 3\or 4\or 5\or 6\or 7\or 8\or
190   9\or A\or B\or C\or D\or E\or F\fi}
```

- \nfss@text In its simplest form `\nfss@text` is an `\mbox`. This will produce unbreakable text outside math and inside math you will get text with the same fonts as outside. The only drawback is that such item won't change sizes in subscripts. But this behavior can be easily changed. With the `amstex` style option one will get a sub style called `amstext` which will redefine the `\nfss@text` macro to produce correct text in all sizes.

We have to use `\def` instead of the shorter `\let` since `\mbox` is undefined when we reach this point.

```
191 \def\nfss@text#1{{\mbox{#1}}}
```

(End definition for `\nfss@text`.)

### \copyright

The definition of `\copyright` was changed so that it works in other type styles, and to make it robust. We leave the family untouched so that the copyright notice will come out differently if a different font family is in use. This command is commented out, since it is now defined in `ltoutenc.dtx`.

```
192 %\DeclareRobustCommand\copyright
193 %    {{\oalign{\hfil
194 %      \raise.07ex\hbox{\mdseries\upshape c}\hfil\crcr
195 %      \mathhexbox20D}}}
```

### \normalfont

The macro `\reset@font` is used in `LATEX` to switch to a standard font, in order to initialize the current font in situations where typesetting is done in a new visual context (e.g. in a footnote). We define it here to allow the test for the new `LATEX` version above but nevertheless are able to run all kind of mixtures. The user interface name for `\reset@font` is `\normalfont`: Added `\relax` after `\usefont`, as the latter eats up spaces.

```
196 \DeclareRobustCommand\normalfont
197         {\usefont\encodingdefault
198          \familydefault
199          \seriesdefault
200          \shapedefault
201          \relax}
202 \let\reset@font\normalfont
```

We left out the special `LATEX` fonts which are not automatically included in the base version of the font selection since these fonts contain only a few characters which are also included in the AMS fonts so anybody who is using these fonts doesn't need them. But for compatibility reasons we will define these symbols.

```
203 \def\not@base#1{@\latex@error
204   {Command \noexpand#1not provided in base LaTeX2e}%
```

```

205 {Load the latexsym or the amsfonts package to
206 define this symbol}
207 \def\mho{\not@base\mho}
208 \def\Join{\not@base\Join}
209 \def\Box{\not@base\Box}
210 \def\Diamond{\not@base\Diamond}
211 \def\leadsto{\not@base\leadsto}
212 \def\sqsubset{\not@base\sqsubset}
213 \def\sqsupset{\not@base\sqsupset}
214 \def\lhd{\not@base\lhd}
215 \def\unlhd{\not@base\unlhd}
216 \def\rhd{\not@base\rhd}
217 \def\unrhd{\not@base\unrhd}

```

We now initialize all variables set by `\DeclareErrorFont`. These values are not really important since they will be overwritten later on by the definition in `fontdef.ltx`.

However, if `fontdef.cfg` is corrupted then at least a hopefully suitable error font is present.

```

218 \DeclareErrorFont{OT1}{cmr}{m}{n}{10} %% don't modify this %
      setting
219                                     %% overwrite it in %
      fontdef.cfg
220                                     %% if necessary
221 \ifnum\inputlineno=\m@ne
222 \InputIfFileExists{fonttext.cfg}
223     {\typeout{=====
224         ^^^J%
225         Local config file fonttext.cfg used^ ^^J%
226         ^^^J%
227         =====}%
228     \def\@addtofilelist##1{\xdef\@filelist{\@filelist,##1}}%
229 }
230     {\typeout{!!!!!!!!!!!!!!^ ^^J%
231         !^^J%
232         ! You MUST use a fonttext.cfg file!^ ^^J%
233         ! As you are still using TeX2!!!!^ ^^J%
234         !^^J%
235         ! See the documentation file tex2.txt^ ^^J%
236         !^^J%
237         !!!!!!!^ ^^J%
238         !batchmode \@end}
239 \else
240 \InputIfFileExists{fonttext.cfg}
241     {\typeout{=====
242         ^^^J%
243         Local config file fonttext.cfg used^ ^^J%
244         ^^^J%
245         =====}%
246     \def\@addtofilelist##1{\xdef\@filelist{\@filelist,##1}}%
247 }
248     {\input{fonttext.ltx}}

```

```

249 \fi
250 \let\@addtolist\@gobble
      Ditto for math although I don't think that we will get a lot of customisation :-)
251 \InputIfFileExists{fontmath.cfg}
252   {\typeout{=====
253     ^^^J%
254       Local config file fontmath.cfg used^^J%
255     ^^^J%
256     =====}%
257   \def\@addtolist##1{\xdef\@filelist{\@filelist,##1}}%
258 }
259 {\input{fontmath.ltx}}
260 \let\@addtolist\@gobble

```

Then we preload several fonts. This file might be customized *without* changing the behavior of the format (i.e. necessary font definitions will be loaded at runtime if they are not preloaded). This is done in the file `preload.ltx`.

```

261 \InputIfFileExists{preload.cfg}
262   {\typeout{=====
263     ^^^J%
264       Local config file preload.cfg used^^J%
265     ^^^J%
266     =====}%
267   \def\@addtolist##1{\xdef\@filelist{\@filelist,##1}}%
268 }
269 {\input{preload.ltx}}
270 \let\@addtolist\@gobble
271 \let\accii\` \let\accii\` \let\acciii\=
272 %</2ekernel>

```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 18.1 Introduction

This file is used to generate the files `fonttext.ltx` (text font declarations) and `fontmath.ltx` (math font declarations), which are used during the format generation. It contains the declaration of the standard text encodings used at the site as well as a minimal subset of font shape groups that NFSS will look at to ensure that the specified encodings are valid.

The math part contains the setup for math encodings as well as the default math symbol declarations that belong to the encoding.

It is possible to change this setup (by using other fonts, or defaults) without losing the ability to process documents written at other sites. Portability in this sense means that a document will compile without errors. It does not mean, however, that identical output will be produced. For this it is necessary that the distributed setup is used at both installations.

## 18.2 The `fonttext.ltx` file

```

273 %<*text>
274 \typeout{== Don't modify this file, use a .cfg file instead }
           {==^^J}
275 \input {omlenc.def}
276 \input {t1enc.def}
277 \input {ot1enc.def}          % <- should come after T1 for speed
278 \input {omsenc.def}
279 \fontencoding{OT1}
280 \DeclareFontEncodingDefaults{}{}
281 \DeclareFontSubstitution{T1}{cmr}{m}{n}
282 \DeclareFontSubstitution{OT1}{cmr}{m}{n}
283 \begingroup
284 \nfss@catcodes
285 \input {t1cmr.fd}
286 \input {ot1cmr.fd}
287 \endgroup
288 \begingroup
289 \nfss@catcodes
290 \input {ot1cmss.fd}
291 \input {ot1cmtt.fd}
292 \endgroupfontdef
293 \DeclareErrorFont{OT1}{cmr}{m}{n}{10}
294 \newcommand\rmdefault{cmr}
295 \newcommand\sfdefault{cmss}
296 \newcommand\ttdefault{cmtt}
297 \newcommand\bfdefault{bx}
298 \newcommand\mddefault{m}
299 \newcommand\itdefault{it}
300 \newcommand\sldefault{sl}
```

```

301 \newcommand\scdefault{sc}
302 \newcommand\updefault{n}
303 \newcommand\encodingdefault{OT1}
304 \newcommand\familystyle{\rmdefault}
305 \newcommand\seriesdefault{\mddefault}
306 \newcommand\shapedefault{\updefault}
307 %</text>
308 %<*math>
309 \typeout{== Don't modify this file, use a .cfg file instead }
310 \typeout{<==^J}
311 \DeclareFontEncoding{OML}{}{}
312 \DeclareFontEncoding{OMS}{}{}
313 \DeclareFontEncoding{OMX}{}{}
314 \DeclareFontSubstitution{OML}{cmm}{m}{it}
315 \DeclareFontSubstitution{OMS}{cmsy}{m}{n}
316 \DeclareFontSubstitution{OMX}{cmex}{m}{n}
317 \DeclareFontSubstitution{U}{cmr}{m}{n}
318 \begingroup
319 \nfss@catcodes
320 \input {omlcmm.fd}
321 \input {omscmsy.fd}
322 \input {omxcmex.fd}
323 \input {ucmr.fd}
324 \endgroup
325 \DeclareSymbolFont{operators} {OT1}{cmr} {m}{n}
326 \DeclareSymbolFont{letters} {OML}{cmm} {m}{it}
327 \DeclareSymbolFont{symbols} {OMS}{cmsy}{m}{n}
328 \DeclareSymbolFont{largesymbols}{OMX}{cmex}{m}{n}
329 \SetSymbolFont{operators}{bold}{OT1}{cmr} {bx}{n}
330 \SetSymbolFont{letters} {bold}{OML}{cmm} {b}{it}
331 \SetSymbolFont{symbols} {bold}{OMS}{cmsy}{b}{n}

```

Below are the seven math alphabets which are defined by NFSS. Again they must be defined by this file. However, as before you can change the fonts used without losing portability, but you should be careful when changing the encoding since that may make documents come out wrong.

```

332 \DeclareSymbolFontAlphabet{\mathrm}{operators}
333 \DeclareSymbolFontAlphabet{\mathnormal}{letters}
334 \DeclareSymbolFontAlphabet{\mathcal}{symbols}
335 \DeclareMathAlphabet {\mathbf}{OT1}{cmr}{bx}{n}
336 \DeclareMathAlphabet {\mathsf}{OT1}{cmss}{m}{n}
337 \DeclareMathAlphabet {\mathit}{OT1}{cmr}{m}{it}
338 \DeclareMathAlphabet {\mathtt}{OT1}{cmtt}{m}{n}

```

Given the currently available fonts we cannot bold-en  $\mathbf$  and  $\mathtt$  but in principle one could use ‘ultra bold’ or something. The alphabets defined via `\DeclareSymbolFontAlphabet` will change automatically in a new math version if the corresponding symbol font changes.

```
339 \SetMathAlphabet{\mathsf}{bold}{OT1}{cmss}{bx}{n}
340 \SetMathAlphabet{\mathit}{bold}{OT1}{cmr}{bx}{it}
```

## 18.3 Math font sizes

For every *text* size NFSS maintains also three sizes that are used to typeset formulas.

The declarations below declare the text, script and scriptscript size to be used for each text font size.

All occurrences of sizes longer than a single character are replaced with the macro name that holds them, saving a number of tokens (but losing a bit of speed, so this may not stay this way).

```
341 \DeclareMathSizes{5}{5}{5}{5}
342 \DeclareMathSizes{6}{6}{5}{5}
343 \DeclareMathSizes{7}{7}{5}{5}
344 \DeclareMathSizes{8}{8}{6}{5}
345 \DeclareMathSizes{9}{9}{6}{5}
346 \DeclareMathSizes{@xpt}{@xpt}{7}{5}
347 \DeclareMathSizes{@xipt}{@xipt}{8}{6}
348 \DeclareMathSizes{@xipt}{@xiipt}{8}{6}
349 \DeclareMathSizes{@xivpt}{@xivpt}{@xpt}{7}
350 \DeclareMathSizes{@xviipt}{@xviipt}{@xiipt}{@xpt}
351 \DeclareMathSizes{@xxpt}{@xxpt}{@xivpt}{@xiipt}
352 \DeclareMathSizes{@xxvpt}{@xxvpt}{@xxpt}{@xvipt}
```

### 18.3.1 The math symbol assignments

We start by setting up math codes for most of the characters typed in directly from the keyboard. Most of them are normally already setup up in the same way by InI<sub>E</sub>X. However, we repeat them here to have a complete setup which can be exchanged with another if desired.

```
353 \DeclareMathSymbol{a}{\mathalpha}{letters}`a
354 \DeclareMathSymbol{b}{\mathalpha}{letters}`b
355 \DeclareMathSymbol{c}{\mathalpha}{letters}`c
356 \DeclareMathSymbol{d}{\mathalpha}{letters}`d
357 \DeclareMathSymbol{e}{\mathalpha}{letters}`e
358 \DeclareMathSymbol{f}{\mathalpha}{letters}`f
359 \DeclareMathSymbol{g}{\mathalpha}{letters}`g
360 \DeclareMathSymbol{h}{\mathalpha}{letters}`h
361 \DeclareMathSymbol{i}{\mathalpha}{letters}`i
362 \DeclareMathSymbol{j}{\mathalpha}{letters}`j
363 \DeclareMathSymbol{k}{\mathalpha}{letters}`k
364 \DeclareMathSymbol{l}{\mathalpha}{letters}`l
365 \DeclareMathSymbol{m}{\mathalpha}{letters}`m
366 \DeclareMathSymbol{n}{\mathalpha}{letters}`n
367 \DeclareMathSymbol{o}{\mathalpha}{letters}`o
368 \DeclareMathSymbol{p}{\mathalpha}{letters}`p
369 \DeclareMathSymbol{q}{\mathalpha}{letters}`q
370 \DeclareMathSymbol{r}{\mathalpha}{letters}`r
371 \DeclareMathSymbol{s}{\mathalpha}{letters}`s
372 \DeclareMathSymbol{t}{\mathalpha}{letters}`t
```

```

373 \DeclareMathSymbol{u}{\mathalpha}{letters}{`u}
374 \DeclareMathSymbol{v}{\mathalpha}{letters}{`v}
375 \DeclareMathSymbol{w}{\mathalpha}{letters}{`w}
376 \DeclareMathSymbol{x}{\mathalpha}{letters}{`x}
377 \DeclareMathSymbol{y}{\mathalpha}{letters}{`y}
378 \DeclareMathSymbol{z}{\mathalpha}{letters}{`z}

379 \DeclareMathSymbol{A}{\mathalpha}{letters}{`A}
380 \DeclareMathSymbol{B}{\mathalpha}{letters}{`B}
381 \DeclareMathSymbol{C}{\mathalpha}{letters}{`C}
382 \DeclareMathSymbol{D}{\mathalpha}{letters}{`D}
383 \DeclareMathSymbol{E}{\mathalpha}{letters}{`E}
384 \DeclareMathSymbol{F}{\mathalpha}{letters}{`F}
385 \DeclareMathSymbol{G}{\mathalpha}{letters}{`G}
386 \DeclareMathSymbol{H}{\mathalpha}{letters}{`H}
387 \DeclareMathSymbol{I}{\mathalpha}{letters}{`I}
388 \DeclareMathSymbol{J}{\mathalpha}{letters}{`J}
389 \DeclareMathSymbol{K}{\mathalpha}{letters}{`K}
390 \DeclareMathSymbol{L}{\mathalpha}{letters}{`L}
391 \DeclareMathSymbol{M}{\mathalpha}{letters}{`M}
392 \DeclareMathSymbol{N}{\mathalpha}{letters}{`N}
393 \DeclareMathSymbol{O}{\mathalpha}{letters}{`O}
394 \DeclareMathSymbol{P}{\mathalpha}{letters}{`P}
395 \DeclareMathSymbol{Q}{\mathalpha}{letters}{`Q}
396 \DeclareMathSymbol{R}{\mathalpha}{letters}{`R}
397 \DeclareMathSymbol{S}{\mathalpha}{letters}{`S}
398 \DeclareMathSymbol{T}{\mathalpha}{letters}{`T}
399 \DeclareMathSymbol{U}{\mathalpha}{letters}{`U}
400 \DeclareMathSymbol{V}{\mathalpha}{letters}{`V}
401 \DeclareMathSymbol{W}{\mathalpha}{letters}{`W}
402 \DeclareMathSymbol{X}{\mathalpha}{letters}{`X}
403 \DeclareMathSymbol{Y}{\mathalpha}{letters}{`Y}
404 \DeclareMathSymbol{Z}{\mathalpha}{letters}{`Z}

405 \DeclareMathSymbol{0}{\mathalpha}{operators}{`0}
406 \DeclareMathSymbol{1}{\mathalpha}{operators}{`1}
407 \DeclareMathSymbol{2}{\mathalpha}{operators}{`2}
408 \DeclareMathSymbol{3}{\mathalpha}{operators}{`3}
409 \DeclareMathSymbol{4}{\mathalpha}{operators}{`4}
410 \DeclareMathSymbol{5}{\mathalpha}{operators}{`5}
411 \DeclareMathSymbol{6}{\mathalpha}{operators}{`6}
412 \DeclareMathSymbol{7}{\mathalpha}{operators}{`7}
413 \DeclareMathSymbol{8}{\mathalpha}{operators}{`8}
414 \DeclareMathSymbol{9}{\mathalpha}{operators}{`9}

415 \DeclareMathSymbol{!}{\mathclose}{operators}{`21}
416 \DeclareMathSymbol{*}{\mathbin}{symbols}{`03} % \ast
417 \DeclareMathSymbol{+}{\mathbin}{operators}{`2B}
418 \DeclareMathSymbol{,}{\mathpunct}{letters}{`3B}
419 \DeclareMathSymbol{-}{\mathbin}{symbols}{`00}
420 \DeclareMathSymbol{.}{\mathord}{letters}{`3A}
421 \DeclareMathSymbol{:}{\mathrel}{operators}{`3A}
422 \DeclareMathSymbol{;}{\mathpunct}{operators}{`3B}
423 \DeclareMathSymbol{=}{\mathrel}{operators}{`3D}
424 \DeclareMathSymbol{?}{\mathclose}{operators}{`3F}

```

```

425 \%DeclareMathSymbol{{()}{\mathopen}{operators}{28}
426 \%DeclareMathSymbol{{)}{\mathclose}{operators}{29}
427 \%DeclareMathSymbol{/}{\mathord}{letters}{3D}
428 \%DeclareMathSymbol[]{\mathopen}{operators}{5B}
429 \%DeclareMathSymbol[]{\mathclose}{operators}{5D}
430 \%DeclareMathSymbol{|}{\mathord}{symbols}{6A}
431 \%DeclareMathSymbol{<}{\mathrel}{letters}{3C}
432 \%DeclareMathSymbol{>}{\mathrel}{letters}{3E}
433 \%DeclareMathSymbol{'\{}{\mathopen}{symbols}{66}
434 \%DeclareMathSymbol{'\}}{\mathclose}{symbols}{67}
435 \%DeclareMathSymbol{'\\}{\mathord}{symbols}{6E} % \backslash
436 \mathcode`\\ = "8000 % \space
437 \mathcode`'= "8000 % ^\prime
438 \mathcode`\_ = "8000 % \

```

### 18.3.2 Delimitercodes for characters

```

439 \DeclareMathDelimiter{{()}{\mathopen} }
  {{operators}{28}{largesymbols}{00}}
440 \DeclareMathDelimiter{{)}{\mathclose}{operators}{29}{largesymbols}{01}
441 \DeclareMathDelimiter{{[]}{\mathopen} }
  {{operators}{5B}{largesymbols}{02}}
442 \DeclareMathDelimiter{{}}{\mathclose}{operators}{5D}{largesymbols}{03}

```

The next two are considered to be relations when not used in the context of a delimiter! And worse, they do even represent different glyphs when being used as delimiter and not as delimiter. This is a user level syntax inherited from plain TeX. Therefore we explicitly redefine the math symbol definitions for these symbols afterwards.

```

443 \DeclareMathDelimiter{<}{\mathopen}{symbols}{68}{largesymbols}{0A}
444 \DeclareMathDelimiter{>}{\mathclose}{symbols}{69}{largesymbols}{0B}
445 \DeclareMathSymbol{<}{\mathrel}{letters}{3C}
446 \DeclareMathSymbol{>}{\mathrel}{letters}{3E}
447 \DeclareMathDelimiter{/}{\mathord}{operators}{2F}{largesymbols}{0E}
448 \DeclareMathSymbol{/}{\mathord}{letters}{3D}
449 \DeclareMathDelimiter{|}{\mathord}{symbols}{6A}{largesymbols}{0C}
450 \expandafter\DeclareMathDelimiter@backslashchar
  {\mathord}{symbols}{6E}{largesymbols}{0F}

```

### 18.3.3 Symbols accessed via control sequences

#### 18.3.4 Greek letters

```

452 \DeclareMathSymbol{\alpha}{\mathord}{letters}{0B}
453 \DeclareMathSymbol{\beta}{\mathord}{letters}{0C}
454 \DeclareMathSymbol{\gamma}{\mathord}{letters}{0D}
455 \DeclareMathSymbol{\delta}{\mathord}{letters}{0E}
456 \DeclareMathSymbol{\epsilon}{\mathord}{letters}{0F}
457 \DeclareMathSymbol{\zeta}{\mathord}{letters}{10}
458 \DeclareMathSymbol{\eta}{\mathord}{letters}{11}

```

```

459 \DeclareMathSymbol{\theta}{\mathord}{letters}{12}
460 \DeclareMathSymbol{\iota}{\mathord}{letters}{13}
461 \DeclareMathSymbol{\kappa}{\mathord}{letters}{14}
462 \DeclareMathSymbol{\lambda}{\mathord}{letters}{15}
463 \DeclareMathSymbol{\mu}{\mathord}{letters}{16}
464 \DeclareMathSymbol{\nu}{\mathord}{letters}{17}
465 \DeclareMathSymbol{\xi}{\mathord}{letters}{18}
466 \DeclareMathSymbol{\pi}{\mathord}{letters}{19}
467 \DeclareMathSymbol{\rho}{\mathord}{letters}{1A}
468 \DeclareMathSymbol{\sigma}{\mathord}{letters}{1B}
469 \DeclareMathSymbol{\tau}{\mathord}{letters}{1C}
470 \DeclareMathSymbol{\upsilon}{\mathord}{letters}{1D}
471 \DeclareMathSymbol{\phi}{\mathord}{letters}{1E}
472 \DeclareMathSymbol{\chi}{\mathord}{letters}{1F}
473 \DeclareMathSymbol{\psi}{\mathord}{letters}{20}
474 \DeclareMathSymbol{\omega}{\mathord}{letters}{21}
475 \DeclareMathSymbol{\varepsilon}{\mathord}{letters}{22}
476 \DeclareMathSymbol{\vartheta}{\mathord}{letters}{23}
477 \DeclareMathSymbol{\varpi}{\mathord}{letters}{24}
478 \DeclareMathSymbol{\varrho}{\mathord}{letters}{25}
479 \DeclareMathSymbol{\varsigma}{\mathord}{letters}{26}
480 \DeclareMathSymbol{\varphi}{\mathord}{letters}{27}
481 \DeclareMathSymbol{\Gamma}{\mathalpha}{operators}{00}
482 \DeclareMathSymbol{\Delta}{\mathalpha}{operators}{01}
483 \DeclareMathSymbol{\Theta}{\mathalpha}{operators}{02}
484 \DeclareMathSymbol{\Lambda}{\mathalpha}{operators}{03}
485 \DeclareMathSymbol{\Xi}{\mathalpha}{operators}{04}
486 \DeclareMathSymbol{\Pi}{\mathalpha}{operators}{05}
487 \DeclareMathSymbol{\Sigma}{\mathalpha}{operators}{06}
488 \DeclareMathSymbol{\Upsilon}{\mathalpha}{operators}{07}
489 \DeclareMathSymbol{\Phi}{\mathalpha}{operators}{08}
490 \DeclareMathSymbol{\Psi}{\mathalpha}{operators}{09}
491 \DeclareMathSymbol{\Omega}{\mathalpha}{operators}{0A}

```

### 18.3.5 Ordinary symbols

```

492 \DeclareMathSymbol{\aleph}{\mathord}{symbols}{40}
493 \def\hbar{{\mathchar'26\mkern-9mu h}}
494 \DeclareMathSymbol{\imath}{\mathord}{letters}{7B}
495 \DeclareMathSymbol{\jmath}{\mathord}{letters}{7C}
496 \DeclareMathSymbol{\ell}{\mathord}{letters}{60}
497 \DeclareMathSymbol{\wp}{\mathord}{letters}{7D}
498 \DeclareMathSymbol{\Re}{\mathord}{symbols}{3C}
499 \DeclareMathSymbol{\Im}{\mathord}{symbols}{3D}
500 \DeclareMathSymbol{\partial}{\mathord}{letters}{40}
501 \DeclareMathSymbol{\infty}{\mathord}{symbols}{31}
502 \DeclareMathSymbol{\prime}{\mathord}{symbols}{30}
503 \DeclareMathSymbol{\emptyset}{\mathord}{symbols}{3B}
504 \DeclareMathSymbol{\nabla}{\mathord}{symbols}{72}
505 \def\surd{{\mathchar"1270}}
506 \DeclareMathSymbol{\top}{\mathord}{symbols}{3E}
507 \DeclareMathSymbol{\bot}{\mathord}{symbols}{3F}
508 \def\angle{{\vbox{\ialign{$\m@th\scriptstyle##$\crcr
509 \not\mathrel{\mkern14mu}\crcr}}}}

```

```

510      \noalign{\nointerlineskip}
511      \mkern2.5mu\leaders\hrule
512      \atheight.34pt\hfill\mkern2.5mu\crcr}}}}
513 \DeclareMathSymbol{\forall}{\mathord}{symbols}{38}
514 \DeclareMathSymbol{\exists}{\mathord}{symbols}{39}
515 \DeclareMathSymbol{\neg}{\mathord}{symbols}{3A}
516     \let\lnot=\neg
517 \DeclareMathSymbol{\flat}{\mathord}{letters}{5B}
518 \DeclareMathSymbol{\natural}{\mathord}{letters}{5C}
519 \DeclareMathSymbol{\sharp}{\mathord}{letters}{5D}
520 \DeclareMathSymbol{\clubsuit}{\mathord}{symbols}{7C}
521 \DeclareMathSymbol{\diamondsuit}{\mathord}{symbols}{7D}
522 \DeclareMathSymbol{\heartsuit}{\mathord}{symbols}{7E}
523 \DeclareMathSymbol{\spadesuit}{\mathord}{symbols}{7F}

```

### 18.3.6 Large Operators

```

524 \DeclareMathSymbol{\coprod}{\mathop}{largesymbols}{60}
525 \DeclareMathSymbol{\bigvee}{\mathop}{largesymbols}{57}
526 \DeclareMathSymbol{\bigwedge}{\mathop}{largesymbols}{56}
527 \DeclareMathSymbol{\biguplus}{\mathop}{largesymbols}{55}
528 \DeclareMathSymbol{\bigcap}{\mathop}{largesymbols}{54}
529 \DeclareMathSymbol{\bigcup}{\mathop}{largesymbols}{53}
530 \DeclareMathSymbol{\intop}{\mathop}{largesymbols}{52}
531     \def\int{\intop\nolimits}
532 \DeclareMathSymbol{\prod}{\mathop}{largesymbols}{51}
533 \DeclareMathSymbol{\sum}{\mathop}{largesymbols}{50}
534 \DeclareMathSymbol{\bigotimes}{\mathop}{largesymbols}{4E}
535 \DeclareMathSymbol{\bigoplus}{\mathop}{largesymbols}{4C}
536 \DeclareMathSymbol{\bigodot}{\mathop}{largesymbols}{4A}
537 \DeclareMathSymbol{\ointop}{\mathop}{largesymbols}{48}
538     \def\oint{\ointop\nolimits}
539 \DeclareMathSymbol{\bigsqcup}{\mathop}{largesymbols}{46}
540 \DeclareMathSymbol{\smallint}{\mathop}{symbols}{73}

```

### 18.3.60 Binary symbols

```

541 \DeclareMathSymbol{\triangleleft}{\mathbin}{letters}{2F}
542 \DeclareMathSymbol{\triangleright}{\mathbin}{letters}{2E}
543 \DeclareMathSymbol{\bigtriangleup}{\mathbin}{symbols}{34}
544 \DeclareMathSymbol{\bigtriangledown}{\mathbin}{symbols}{35}
545     \let\varbigtriangledown\bigtriangledown
546     \let\varbigtriangleup\bigtriangleup

```

These last two synonyms are needed because the stamryrd package redefines them as Operators.

```

547 \DeclareMathSymbol{\wedge}{\mathbin}{symbols}{5E}
548     \let\land=\wedge
549 \DeclareMathSymbol{\vee}{\mathbin}{symbols}{5F}
550     \let\lor=\vee
551 \DeclareMathSymbol{\cap}{\mathbin}{symbols}{5C}
552 \DeclareMathSymbol{\cup}{\mathbin}{symbols}{5B}
553 \DeclareMathSymbol{\ddagger}{\mathbin}{symbols}{7A}
554 \DeclareMathSymbol{\dagger}{\mathbin}{symbols}{79}

```

```

555 \DeclareMathSymbol{\sqcap}{\mathbin}{symbols}{75}
556 \DeclareMathSymbol{\sqcup}{\mathbin}{symbols}{74}
557 \DeclareMathSymbol{\uplus}{\mathbin}{symbols}{5D}
558 \DeclareMathSymbol{\amalg}{\mathbin}{symbols}{71}
559 \DeclareMathSymbol{\diamond}{\mathbin}{symbols}{05}
560 \DeclareMathSymbol{\bullet}{\mathbin}{symbols}{0F}
561 \DeclareMathSymbol{\wr}{\mathbin}{symbols}{6F}
562 \DeclareMathSymbol{\div}{\mathbin}{symbols}{04}
563 \DeclareMathSymbol{\odot}{\mathbin}{symbols}{0C}
564 \DeclareMathSymbol{\oslash}{\mathbin}{symbols}{0B}
565 \DeclareMathSymbol{\otimes}{\mathbin}{symbols}{0A}
566 \DeclareMathSymbol{\ominus}{\mathbin}{symbols}{09}
567 \DeclareMathSymbol{\oplus}{\mathbin}{symbols}{08}
568 \DeclareMathSymbol{\mp}{\mathbin}{symbols}{07}
569 \DeclareMathSymbol{\pm}{\mathbin}{symbols}{06}
570 \DeclareMathSymbol{\circ}{\mathbin}{symbols}{0E}
571 \DeclareMathSymbol{\bigcirc}{\mathbin}{symbols}{0D}
572 \DeclareMathSymbol{\setminus}{\mathbin}{symbols}{6E}
573 \DeclareMathSymbol{\cdot}{\mathbin}{symbols}{01}
574 \DeclareMathSymbol{\ast}{\mathbin}{symbols}{03}
575 \DeclareMathSymbol{\times}{\mathbin}{symbols}{02}
576 \DeclareMathSymbol{\star}{\mathbin}{letters}{3F}

577 \DeclareMathSymbol{\propto}{\mathrel}{symbols}{2F}
578 \DeclareMathSymbol{\sqsubseteq}{\mathrel}{symbols}{76}
579 \DeclareMathSymbol{\sqsupseteq}{\mathrel}{symbols}{77}
580 \DeclareMathSymbol{\parallel}{\mathrel}{symbols}{6B}
581 \DeclareMathSymbol{\mid}{\mathrel}{symbols}{6A}
582 \DeclareMathSymbol{\dashv}{\mathrel}{symbols}{61}
583 \DeclareMathSymbol{\vdash}{\mathrel}{symbols}{60}
584 \DeclareMathSymbol{\nearrow}{\mathrel}{symbols}{25}
585 \DeclareMathSymbol{\searrow}{\mathrel}{symbols}{26}
586 \DeclareMathSymbol{\nwarrow}{\mathrel}{symbols}{2D}
587 \DeclareMathSymbol{\swarrow}{\mathrel}{symbols}{2E}
588 \DeclareMathSymbol{\Leftrightarrow}{\mathrel}{symbols}{2C}
589 \DeclareMathSymbol{\Leftarrow}{\mathrel}{symbols}{28}
590 \DeclareMathSymbol{\Rightarrow}{\mathrel}{symbols}{29}
591 \def\neq{\not=} \let\neq=\neq
592 \DeclareMathSymbol{\leq}{\mathrel}{symbols}{14}
593 \let\le=\leq
594 \DeclareMathSymbol{\geq}{\mathrel}{symbols}{15}
595 \let\ge=\geq
596 \DeclareMathSymbol{\succ}{\mathrel}{symbols}{1F}
597 \DeclareMathSymbol{\prec}{\mathrel}{symbols}{1E}
598 \DeclareMathSymbol{\approx}{\mathrel}{symbols}{19}
599 \DeclareMathSymbol{\succeq}{\mathrel}{symbols}{17}
600 \DeclareMathSymbol{\preceq}{\mathrel}{symbols}{16}
601 \DeclareMathSymbol{\supset}{\mathrel}{symbols}{1B}
602 \DeclareMathSymbol{\subset}{\mathrel}{symbols}{1A}
603 \DeclareMathSymbol{\supseteq}{\mathrel}{symbols}{13}
604 \DeclareMathSymbol{\subseteq}{\mathrel}{symbols}{12}
605 \DeclareMathSymbol{\in}{\mathrel}{symbols}{32}
606 \DeclareMathSymbol{\ni}{\mathrel}{symbols}{33}
607 \let\owns=\ni
608 \DeclareMathSymbol{\gg}{\mathrel}{symbols}{1D}

```

```

609 \DeclareMathSymbol{\ll}{\mathrel}{symbols}{1C}
610 \DeclareMathSymbol{\not}{\mathrel}{symbols}{36}
611 \DeclareMathSymbol{\leftrightarrow}{\mathrel}{symbols}{24}
612 \DeclareMathSymbol{\leftarrow}{\mathrel}{symbols}{20}
613   \let\gets=\leftarrow
614 \DeclareMathSymbol{\rightarrow}{\mathrel}{symbols}{21}
615   \let\to=\rightarrow
616 \DeclareMathSymbol{\mapstochar}{\mathrel}{symbols}{37}
617   \def\mapsto{\mapstochar\rightarrow}
618 \DeclareMathSymbol{\sim}{\mathrel}{symbols}{18}
619 \DeclareMathSymbol{\simeq}{\mathrel}{symbols}{27}
620 \DeclareMathSymbol{\perp}{\mathrel}{symbols}{3F}
621 \DeclareMathSymbol{\equiv}{\mathrel}{symbols}{11}
622 \DeclareMathSymbol{\asymp}{\mathrel}{symbols}{10}
623 \DeclareMathSymbol{\smile}{\mathrel}{letters}{5E}
624 \DeclareMathSymbol{\frown}{\mathrel}{letters}{5F}
625 \DeclareMathSymbol{\leftharpoonup}{\mathrel}{letters}{28}
626 \DeclareMathSymbol{\leftharpoondown}{\mathrel}{letters}{29}
627 \DeclareMathSymbol{\rightharpoonup}{\mathrel}{letters}{2A}
628 \DeclareMathSymbol{\rightharpoondown}{\mathrel}{letters}{2B}

629 \ DeclareRobustCommand
630   \cong{\mathrel{\mathpalette\@vereq\sim}} % congruence sign
631 \def\@vereq#1#2{\lower.5\p@\vbox{\lineskip\maxdimen\lineskip-.5\p@
632   \ialign{$\m@th#1\hfil##\hfil$\crcr#2\crcr=\crcr}}}
633 \ DeclareRobustCommand
634   \notin{\mathrel{\m@th\mathpalette\c@ncel\in}}
635 \def\c@ncel#1#2{\m@th\ooalign{$\hfil#1\mkern1mu/\hfil$\crcr$#1#2$}}
636 \ DeclareRobustCommand
637   \rightleftharpoons{\mathrel{\mathpalette\rlh@{}}}
638 \def\rlh@#1{\vcenter{\m@th\hbox{\ooalign{\raise2pt
639   \hbox{$\#1\rightharpoonup$}\crcr
640   $\#1\leftharpoondown$}}}}
641 \ DeclareRobustCommand
642   \doteq{\buildrel\textstyle.\over=}

```

### 18.3.60 Arrows

```

643 \ DeclareRobustCommand
644   \joinrel{\mathrel{\mkern-3mu}}
645 \ DeclareRobustCommand
646   \relbar{\mathrel{\smash-}} % \smash, because -
                           % has the same height as +
647

```

In contrast to plain.tex \Relbar got braces around the equal sign to guard against it being “math active” expanding to \futurelet.... This might be the case when packages are implementing shorthands for math, e.g. => meaning \Rightarrow etc. It would actually be better not to use = in such definitions but instead define something like \mathequalsign and use this. However we can’t do this now as it would break other math layouts where characters are in different places (since those wouldn’t know about the need for a new command name).

```

648 \ DeclareRobustCommand
649   \Relbar{\mathrel{=}}
650 \ DeclareMathSymbol{\lhook}{\mathrel}{letters}{2C}

```

```

651   \def\hookrightarrow{\lhook\joinrel\rightarrow}
652 \DeclareMathSymbol{\rhook}{\mathrel}{letters}{`2D}
653   \def\hookleftarrow{\leftarrow\joinrel\rhook}
654 \DeclareRobustCommand
655   \bowtie{\mathrel\triangleright\joinrel\mathrel\triangleleft}
656 \DeclareRobustCommand
657   \models{\mathrel{}|\mathrel{}\joinrel\Relbar}
658 \DeclareRobustCommand
659   \Longrightarrow{\Relbar\joinrel\rightarrow}
660 \DeclareRobustCommand\longrightarrow
661   {\relbar\joinrel\rightarrow}
662 \DeclareRobustCommand\longleftarrow
663   {\leftarrow\joinrel\relbar}
664 \DeclareRobustCommand
665   \Longleftarrow{\Leftarrow\joinrel\Relbar}
666 \DeclareRobustCommand
667   \longmapsto{\mapstochar\longrightarrow}
668 \DeclareRobustCommand
669   \longleftrightarrow{\leftarrow\joinrel\rightarrow}
670 \DeclareRobustCommand
671   \Longleftrightarrow{\Leftarrow\joinrel\rightarrow}
672 \DeclareRobustCommand
673   \iff{;}\Longleftrightarrow{;}

```

### 18.3.60 Punctuation symbols

```

674 \DeclareMathSymbol{\ldotp}{\mathpunct}{letters}{`3A}
675 \DeclareMathSymbol{\cdotp}{\mathpunct}{symbols}{`01}
676 \DeclareMathSymbol{\colon}{\mathpunct}{operators}{`3A}
677 %\def\@dots{\mathinner{\ldotp\ldotp\ldotp}}
678 %\ DeclareRobustCommand\ldots
679 %
680 \DeclareRobustCommand
681   \cdots{\mathinner{\cdotp\cdotp\cdotp}}
682 \DeclareRobustCommand
683   \vdots{\vbox{\baselineskip4\p@\lineskiplimit\z@
684   \kern6\p@\hbox{.}\hbox{.}\hbox{.}}}
685 \DeclareRobustCommand
686   \ddots{\mathinner{\mkern1mu\raise7\p@
687   \vbox{\kern7\p@\hbox{.}\mkern2mu
688   \raise4\p@\hbox{.}\mkern2mu\raise\p@\hbox{.}\mkern1mu}}}

```

### 18.3.60 Math accents

```

689 \DeclareMathAccent{\acute}{\mathalpha}{operators}{`13}
690 \DeclareMathAccent{\grave}{\mathalpha}{operators}{`12}
691 \DeclareMathAccent{\ddot}{\mathalpha}{operators}{`7F}
692 \DeclareMathAccent{\tilde}{\mathalpha}{operators}{`7E}
693 \DeclareMathAccent{\bar}{\mathalpha}{operators}{`16}
694 \DeclareMathAccent{\breve}{\mathalpha}{operators}{`15}
695 \DeclareMathAccent{\check}{\mathalpha}{operators}{`14}

```

```

696 \DeclareMathAccent{\hat}{\mathalpha}{operators}{5E}
697 \DeclareMathAccent{\vec}{\mathord}{letters}{7E}
698 \DeclareMathAccent{\dot}{\mathalpha}{operators}{5F}
699 \DeclareMathAccent{\widetilde}{\mathord}{largesymbols}{65}
700 \DeclareMathAccent{\widehat}{\mathord}{largesymbols}{62}

```

For some reason plain TeX never bothered to provide a ring accent in math (although it is available in the fonts), but since we got a request for it here we go:

```
701 \DeclareMathAccent{\mathring}{\mathalpha}{operators}{17}
```

### 18.3.60 Radicals

```
702 \DeclareMathRadical{\sqrtsign}{symbols}{70}{largesymbols}{70}
```

### 18.3.60 Over and under something, etc

```

703 \def\overrightarrow{\#1{\vbox{\m@th\ialign{##\crcr
704     \rightarrowfill\crcr\noalign{\kern-\p@\nointerlineskip}
705     $hfil\displaystyle{\#1}hfil$crcr}}}
706 \def\overleftarrow{\#1{\vbox{\m@th\ialign{##\crcr
707     \leftarrowfill\crcr\noalign{\kern-\p@\nointerlineskip}%
708     $hfil\displaystyle{\#1}hfil$crcr}}}
709 \def\overbrace{\#1{\mathop{\vbox{\m@th\ialign{##\crcr\noalign{\kern3\p@}%
710     \downbracefill\crcr\noalign{\kern3\p@\nointerlineskip}%
711     $hfil\displaystyle{\#1}hfil$crcr}}}\limits}
712 \def\underbrace{\#1{\mathop{\vtop{\m@th\ialign{##\crcr
713     $hfil\displaystyle{\#1}hfil$crcr
714     \noalign{\kern3\p@\nointerlineskip}%
715     \upbracefill\crcr\noalign{\kern3\p@}}}\limits}}
716 \def\skew{\#1\#2\#3{{\muskip\z@#1mu\divide\muskip\z@\tw@}
717     {\mkern\muskip\z@
718     \#2{\mkern-\muskip\z@{\#3}\mkern\muskip\z@}\mkern-\muskip\z@{}}
719     \rightarrowfill{$m@th\smash-\mkern-7mu%
720     \cleaders\hbox{$\mkern-2mu\smash-\mkern-2mu$}\hfill
721     \mkern-7mu\mathord\rightarrow$}
722     \leftarrowfill{$m@th\mathord\leftarrow\mkern-7mu%
723     \cleaders\hbox{$\mkern-2mu\smash-\mkern-2mu$}\hfill
724     \mkern-7mu\smash-$}
725     \ DeclareMathSymbol{\braceleft}{\mathord}{largesymbols}{7A}
726     \ DeclareMathSymbol{\braceright}{\mathord}{largesymbols}{7B}
727     \ DeclareMathSymbol{\bracel}{\mathord}{largesymbols}{7C}
728     \ DeclareMathSymbol{\bracer}{\mathord}{largesymbols}{7D}
729     \def\downbracefill{$m@th\setbox\z@\hbox{$\braceleft$}%
730     \braceleft\leaders\vrule\@height\ht\z@\hfill\bracer
731     \bracel\leaders\vrule\@height\ht\z@\hfill\bracer%
732     \bracel\leaders\vrule\@height\ht\z@\hfill\bracerd
733     \braceleft\leaders\vrule\@height\ht\z@\hfill\braceru$}

```

### 18.3.60 Delimiters

```

734 \DeclareMathDelimiter{\lmoustache}    % top from (, bottom )
      {from }
735   {\mathopen}{largesymbols}{7A}{largesymbols}{40}
736 \DeclareMathDelimiter{\rmoustache}    % top from ), bottom )
      {from (
737   {\mathclose}{largesymbols}{7B}{largesymbols}{41}
738 \DeclareMathDelimiter{\arrowvert}      % arrow without arrowheads
739   {\mathord}{symbols}{6A}{largesymbols}{3C}
740 \DeclareMathDelimiter{\Arrowvert}     % double arrow without )
      {arrowheads
741   {\mathord}{symbols}{6B}{largesymbols}{3D}
742 \DeclareMathDelimiter{\Vert}
743   {\mathord}{symbols}{6B}{largesymbols}{0D}
744 \let\|=Vert
745 \DeclareMathDelimiter{\vert}
746   {\mathord}{symbols}{6A}{largesymbols}{0C}
747 \DeclareMathDelimiter{\uparrow}
748   {\mathrel}{symbols}{22}{largesymbols}{78}
749 \DeclareMathDelimiter{\downarrow}
750   {\mathrel}{symbols}{23}{largesymbols}{79}
751 \DeclareMathDelimiter{\updownarrow}
752   {\mathrel}{symbols}{6C}{largesymbols}{3F}
753 \DeclareMathDelimiter{\Uparrow}
754   {\mathrel}{symbols}{2A}{largesymbols}{7E}
755 \DeclareMathDelimiter{\Downarrow}
756   {\mathrel}{symbols}{2B}{largesymbols}{7F}
757 \DeclareMathDelimiter{\Updownarrow}
758   {\mathrel}{symbols}{6D}{largesymbols}{77}
759 \DeclareMathDelimiter{\backslash}       % for double coset )
      {G\backslash H
760   {\mathord}{symbols}{6E}{largesymbols}{0F}
761 \DeclareMathDelimiter{\rangle}
762   {\mathclose}{symbols}{69}{largesymbols}{0B}
763 \DeclareMathDelimiter{\langle}
764   {\mathopen}{symbols}{68}{largesymbols}{0A}
765 \DeclareMathDelimiter{\rbrace}
766   {\mathclose}{symbols}{67}{largesymbols}{09}
767 \DeclareMathDelimiter{\lbrace}
768   {\mathopen}{symbols}{66}{largesymbols}{08}
769 \DeclareMathDelimiter{\rceil}
770   {\mathclose}{symbols}{65}{largesymbols}{07}
771 \DeclareMathDelimiter{\lceil}
772   {\mathopen}{symbols}{64}{largesymbols}{06}
773 \DeclareMathDelimiter{\rfloor}
774   {\mathclose}{symbols}{63}{largesymbols}{05}
775 \DeclareMathDelimiter{\lfloor}
776   {\mathopen}{symbols}{62}{largesymbols}{04}
777 \DeclareMathDelimiter{\lgroupt} % extensible ( with sharper tips
778   {\mathopen}{largesymbols}{3A}{largesymbols}{3A}
779 \DeclareMathDelimiter{\rgroupt} % extensible ) with sharper tips
780   {\mathclose}{largesymbols}{3B}{largesymbols}{3B}
781 \DeclareMathDelimiter{\bracevert} % the vertical bar that )

```

```
782     \c{extends braces}
    {\mathord{\{largesymbols\}}"3E{\mathord{\{largesymbols\}}"3E}
```

### 18.3.7 Math versions of text commands

The `\mathunderscore` here is really a text definition, so it has been put back into `ltoutenc.dtx` (by Chris, 30/04/97) and should be removed from here.

These symbols are the math versions of text commands such as `\P`, `\$`, etc.

```
\mathparagraph      These math symbols are not in plain TEX.
\mathsection
\mathdollar \mathparagraph
\mathsterling
\mathunderscore 783 \DeclareMathSymbol{\mathparagraph}{\mathord}{symbols}{7B}
```

#### `\mathsection`

The command produces § as compared to §.

```
784 \DeclareMathSymbol{\mathsection}{\mathord}{symbols}{78}
```

```
785 \DeclareMathSymbol{\mathdollar}{\mathord}{operators}{24}
786 \def\mathsterling{\mathit{\mathchar"7024}}
787 \def\mathunderscore{\kern.06em\vbox{\hrule@width.3em}}
```

(End definition for `\mathparagraph` and others.)

`\mathellipsis` This is plain T<sub>E</sub>X's `\ldots`.

```
788 \def\mathellipsis{\mathinner{\ldotp\ldotp\ldotp}}%
```

(End definition for `\mathellipsis`.)

### 18.3.8 Other special functions and parameters

#### 18.3.80 Biggggg

```
789 \def\big#1{{\hbox{$\left#1\vbox{to8.5\p@\right.\n@space$}$}}}
790 \def\Big#1{{\hbox{$\left#1\vbox{to11.5\p@\right.\n@space$}$}}}
791 \def\bigg#1{{\hbox{$\left#1\vbox{to14.5\p@\right.\n@space$}$}}}
792 \def\Bigg#1{{\hbox{$\left#1\vbox{to17.5\p@\right.\n@space$}$}}}
793 \def\n@space{\nulldelimiterspace\z@\m@th}
```

#### 18.3.9 The log-like functions

##### `\operator@font`

The `\operator@font` determines the symbol font used for log-like functions.

```
794 \def\operator@font{\mathgroup\symoperators}
```

### 18.3.10 Parameters

Lastly `\thinmuskip`, `\medmuskip` and `\thickmuskip` are set to initial values. It is not advisable to change these.

```
795 \thinmuskip=3mu
796 \medmuskip=4mu plus 2mu minus 4mu
797 \thickmuskip=5mu plus 5mu
```

This finishes the low-level setup in `fontmath.ltx`.

```
798 %</math>
```

## 18.4 Default cfg files

We provide default cfg files here to ensure that on installations that search large file trees we do not pick up some strange customisation files from somewhere.

```
799 %<*cfgtext|cfgmath|cfgprel>
800 %%
801 %%
802 %%
803 %% Load the standard setup:
804 %%
805 %<+cfgtext>\input{fonttext.ltx}
806 %<+cfgmath>\input{fontmath.ltx}
807 %<+cfgprel>\input{preload.ltx}
808 %%
809 %% Small changes could go here; see documentation in >
     <cfgguide.tex for
810 %% allowed modifications.
811 %%
812 %% In particular it is not allowed to misuse this >
     <configuration file
813 %% to modify internal LaTeX commands!
814 %%
815 %% If you use this file as the basis for configuration >
     <please change
816 %% the \ProvidesFile lines to clearly identify your >
     <modification, e.g.,
817 %%
818 %<+cfgtext>%> \ProvidesFile{fonttext.cfg}[2001/06/01
819 %<+cfgmath>%> \ProvidesFile{fonttext.cfg}[2001/06/01
820 %<+cfgprel>%> \ProvidesFile{preload.cfg}[2001/06/01
821 %%                                         Customised local font setup]
822 %%
823 %%
824 %</cfgtext|cfgmath|cfgprel>
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 19.1 Introduction

The preloading of fonts goes back to plain TeX and standardization.

, it is desirable on many computer systems to preload the information for most of the fonts that people will actually be using, since this saves a lot of machine time [350].

## 19.2 Overview

This file contains a number of possible settings for preloading fonts during installation of NFSS2 (which is used by L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub> ). It will be used to generate the following files:

preload.min	minimal subset of fonts necessary to run NFSS2
preload.ori	preload of CM fonts similar to the old <code>lfonts.tex</code>
preload.ltx	The standard selection of preloads
cmpreloa.xpt	preload of CM fonts for 10pt document size
cmpreloa.xip	preload of CM fonts for 11pt document size
cmpreloa.xii	preload of CM fonts for 12pt document size
depreloa.xpt	preload of DC fonts for 10pt size
depreloa.xip	preload of DC fonts for 11pt size
depreloa.xii	preload of DC fonts for 12pt size

These files are for installations that make use of Computer Modern fonts either old encoding (OT1) or Cork encoding (T1). The Computer Modern fonts with Cork encoding are known as DC-fonts.

Most important is `preload.ltx` which is used during format generation. You are *not* allowed to change this file.

## 19.3 Customization

You can customize the preloaded fonts in your L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub>  system by installing a file with the name `preload.cfg`. If this file exists it will be used in place of the system file `preload.ltx`. You can, for example, copy one of the files mentioned above (that can be generated from this source) to `preload.cfg`.

Or you can define completely other preloads. In that case start from `preload.min` since that contains the fonts that have to be preloaded by \*all\* L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub>  systems.

Avoid using `preload.ori`, it will load so many fonts that on most installations it is nearly impossible to load other font families afterwards. This file is only generated to show what fonts have been preloaded by L<sup>A</sup>T<sub>E</sub>X 2.09.

If you normally use other fonts than Computer Modern `preload.min` might be best.

**Warning:** If you preload fonts with encodings other than the normally supported encodings you have to declare that encoding in a `fontdef.cfg` configuration file (see the documentation in the file

`fontdef.dtx`). Adding an extra encoding to the format might produce non-portable documents, thus this should be avoided if possible.

## 19.4 Module switches for the `DOCSTRIP` program

The `DOCSTRIP` will generate the above file from this source using the following module directives:

driver	produce a documentation driver file
preload	produce a preload...file
cm	for OT1 encoded Computer Modern
dc	for T1 encoded Computer Modern
min	produce minimal subset
xpt	produce 10pt preloads
xipt	produce 11pt preloads
xiipt	produce 12pt preloads
ori	produce preloads similar to old <code>lfonts.tex</code>
tex	produce <code>preload.ltx</code>

A typical `DOCSTRIP` command file would then have entries like:

```
\generateFile{preload.min}{t}{\from{preload.dtx}{preload,min}}
```

for generating preload files.

## 19.5 A driver for this document

### 19.6 The code

We begin by loading the math extension font (`cmex10`) and the `LATEX` line and circle fonts. It is necessary to do this explicitly since these are used by `lplain.tex` and `latex.tex`. Since the internal font name contains / characters and digits we construct the name via `\csname`. These are the only fonts (!) that must be loaded in this file.

All `\DeclarePreloadSizes` can be removed or others can be added, they only influence the processing speed.

```

1 \expandafter\font\csname OMX/cmex/m/n/10\endcsname=cmex10\relax
2 \font\tenln =line10 \font\tenlnw =linew10\relax
3 \font\tencirc=lcircle10 \font\tencircw=lcirclew10\relax
4 \end{macrocode}
5 The above fonts should not be touched but anything below this
6 point here in the preload suggestions can be modified without any
7 problems.
8 % \begin{macrocode}
9 -tex%*****
10 -tex% Start any modification below this point **
11 -tex%*****

```

```

12 -tex
13 %%
14 %% Computer Modern Roman:
15 %%-----
16 *ori
17 \begin{tex}
18 \DeclarePreloadSizes{OT1}{cmr}{m}{n}
19 {5,6,7,8,9,10,10.95,12,14.4,17.28,20.74,24.88}
20 \DeclarePreloadSizes{OT1}{cmr}{bx}{n}{9,10,10.95,12,14.4,17.28}
21 \DeclarePreloadSizes{OT1}{cmr}{m}{sl}{10,10.95,12}
22 \DeclarePreloadSizes{OT1}{cmr}{m}{it}{7,8,9,10,10.95,12}
23 \end{tex}
24 /ori
25 +xpt&cm \DeclarePreloadSizes{OT1}{cmr}{m}{n}{5,7,10}
26 +xpt&dc \DeclarePreloadSizes{T1}{cmr}{m}{n}{5,7,10}
27 +xipt&cm \DeclarePreloadSizes{OT1}{cmr}{m}{n}{6,8,10.95}
28 +xipt&dc \DeclarePreloadSizes{T1}{cmr}{m}{n}{6,8,10.95}
29 +xipt&cm \DeclarePreloadSizes{OT1}{cmr}{m}{n}{6,8,12}
30 +xipt&dc \DeclarePreloadSizes{T1}{cmr}{m}{n}{6,8,12}
31 %%
32 %% Computer Modern Sans:
33 %%-----
34 +ori \DeclarePreloadSizes{OT1}{cmss}{m}{n}{10,10.95,12}
35 %%
36 %% Computer Modern Typewriter:
37 %%-----
38 +ori \DeclarePreloadSizes{OT1}{cmtt}{m}{n}{9,10,10.95,12}
39 %%
40 %% Computer Modern Math:
41 %%-----
42 *ori
43 \begin{tex}
44 \DeclarePreloadSizes{OML}{cmm}{m}{it}
45 {5,6,7,8,9,10,10.95,12,14.4,17.28,20.74}
46 \DeclarePreloadSizes{OMS}{cmsy}{m}{n}
47 {5,6,7,8,9,10,10.95,12,14.4,17.28,20.74}
48 \end{tex}
49 /ori

```

The math fonts are the same for both DC and CM fonts. So far there isn't an agreed on standard.

```

825 %<*xpt>
826 \DeclarePreloadSizes{OML}{cmm}{m}{it}{5,7,10}
827 \DeclarePreloadSizes{OMS}{cmsy}{m}{n}{5,7,10}
828 %</xpt>
829 %<*xipt>
830 \DeclarePreloadSizes{OML}{cmm}{m}{it}{6,8,10.95}
831 \DeclarePreloadSizes{OMS}{cmsy}{m}{n}{6,8,10.95}
832 %</xipt>
833 %<*xipt>
834 \DeclarePreloadSizes{OML}{cmm}{m}{it}{6,8,12}
835 \DeclarePreloadSizes{OMS}{cmsy}{m}{n}{6,8,12}
836 %</xipt>

```

```
837 %%  
838 %% LaTeX symbol fonts:  
839 %%-----  
840 %<*ori>  
841 \DeclarePreloadSizes{U}{lasy}{m}{n}  
842 {5,6,7,8,9,10,10.95,12,14.4,17.28,20.74}  
843 %</ori>  
844 %</preload>
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

*The commands defined in this file `ltfntcmd` are part of the kernel code for L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>/NFSS2.*

*It is also meant to serve as documentation for package writers since it demonstrates how to define high-level font changing commands using a small number of creator functions.*

## 20.1 Introduction

Font changes such as `\bfseries`, `\sffamily`, etc. are declarations; this means that their scope is delimited by the grouping structure, either by the next `\end` of some environment or by explicitly using a group, e.g., writing something like `{\bfseries...}` in the source. If you make the mistake of writing `\bfseries{...}` (thinking of `\bfseries` as a command with one argument) then the result is rather striking.

Font declarations are an artifact of the T<sub>E</sub>X system and for several reasons it is better to avoid them on the user level whenever possible. In L<sup>A</sup>T<sub>E</sub>X3 they will probably all be replaced by environments and by font commands taking one argument.

This file defines a creator function for such declarative font switches. This function creates commands which can be used in both math and text.

This file also defines a number of high-level commands (all starting with `\text..`) that have one argument and typeset this argument in the requested way. Thus these commands are for typesetting short pieces of text in a specific family, series or shape. These are all produced as examples of the use of a creator function which is itself also defined in this file.

Table 20.1 shows all these high-level commands in action. A further advantage of using these commands is that they automatically take care of any necessary italic correction on either side of their argument.

Thus, when using such commands, one does not have to worry about forgetting the italic correction when changing fonts. Only in very few situations is this additional space wrong but, for example, most typographers recommend omitting the italic correction if a small punctuation character, like a comma, directly follows the font change. Since the amount of correction required is partly a matter of taste, you can define in what situations the italic correction should be suppressed. This is done by putting the characters that should cancel a preceding italic correction in the list `\nocorrlist`.<sup>1</sup> The default definition for this list is produced by the following.

```
\newcommand \nocorrlist {,.}
```

It is best to declare the most often used characters first, because this will make the processing slightly faster. For example,

```
\emph{When using the \NFSS{} high-level commands,
```

---

<sup>1</sup>Any package that changes the `\catcode` of a character inside `\nocorrlist` must then explicitly reset the list. Otherwise the changed character will no longer be recognized by the suppression algorithm.

Table 20.1: Font-change commands with arguments

<i>Command</i>	<i>Corresponds to</i>	<i>Action</i>
<code>\textrm{...}</code>	<code>\rmfamily</code>	Typeset argument in roman family
<code>\textsf{...}</code>	<code>\sffamily</code>	Typeset argument in sans serif family
<code>\texttt{...}</code>	<code>\ttfamily</code>	Typeset argument in typewriter family
<code>\textmd{...}</code>	<code>\mdseries</code>	Typeset argument in medium series
<code>\textbf{...}</code>	<code>\bfseries</code>	Typeset argument in <b>bold</b> series
<code>\textup{...}</code>	<code>\upshape</code>	Typeset argument in normal shape
<code>\textit{...}</code>	<code>\itshape</code>	Typeset argument in <i>italic</i> shape
<code>\textsl{...}</code>	<code>\slshape</code>	Typeset argument in <i>slanted</i> shape
<code>\textsc{...}</code>	<code>\scshape</code>	Typeset argument in <i>SMALL CAPS</i> shape
<code>\emph{...}</code>	<code>\em</code>	Typeset argument <i>emphasized</i>

The font change commands provided here all start with `\text..` to emphasize that they are for use in normal text and to be easily memorable. They automatically take care of any necessary italic correction on either side of the argument.

the `\emph{proper}` use of italic corrections is automatically taken care of}. Only `\emph{sometimes}` one has to help `\LaTeX{}` by adding a `\verb=\nocorr=` command.

which results in:

*When using the NFSS high-level commands, the proper use of italic corrections is automatically taken care of. Only sometimes one has to help L<sup>A</sup>T<sub>E</sub>X by adding a \nocorr command.*

In contrast, the use of the declaration forms is often more appropriate when you define your own commands or environments.

```
\newenvironment{bfitemize}{\begin{itemize}\normalfont\bfseries
                           {\end{itemize}}
\begin{bfitemize}
\item This environment produces boldface items.
\item It is defined in terms of \LaTeX's
      \texttt{itemize} environment and NFSS
      declarations.
\end{bfitemize}
```

This gives:

- **This environment produces boldface items.**
- **It is defined in terms of L<sup>A</sup>T<sub>E</sub>X's `itemize` environment and NFSS declarations.**

In addition to global customization of when to insert the italic correction, it is of course sometimes necessary to explicitly insert one with  $\text{\it}$ .

It is also possible to suppress the italic correction in individual instances. For this, the command `\nocorr` is provided.

The `\nocorr` must appear as the first or last token inside the braces of the argument of the `\text...` commands, at that end of the text where you wish to suppress the italic correction.

It is worth pointing out here that inserting a  $\text{\it}$  in places where it can have no function (*i.e.* anywhere except immediately after a slanted letter) is not an error—it will just be silently ignored. Unfortunately this is not true if the redefinition of  $\text{\it}$  in `amstex.sty` is used as this version can cause space to be removed immediately before the  $\text{\it}$ .

## 20.2 The implementation

`\DeclareTextFontCommand {⟨cmd⟩}{⟨code⟩}`

This is the creator function for `\text..` commands. It gives a warning if `\foo` or `\fragfoo` is already defined.

In math mode it simply puts the font declaration and text into a box (possibly an automatically sized one).

Otherwise it first scans the text to see where `\nocorr` occurs within it. This sets the `\check@ic` commands to do what is necessary concerning the italic correction at both ends.

The algorithm for deciding whether to put in an italic correction is not very subtle: one is added whenever the newly current font is not itself positively sloped, unless the next token is a character in the ‘nocorr’ list. At the end of the text this is done after closing the group so as to check the ‘outer font’. Note that this will often result in adding an italic correction token after a character in an unsloped font; we believe (in early 2003) that this is perhaps inefficient but not dangerous.

It also now checks for empty contents of the text command and optimises this case. Some care is also taken to check that doing dangerous things in vertical mode is avoided.

The italic correction token is added to the horizontal list before (in the list) an immediately preceding non-zero glob of glue (skip) and any non-zero penalty preceding that since, in the typical case, this puts it immediately after the last character in the preceding word.

Note that it is necessary to put in the `\aftergroup\maybe@ic` at the end of the group so that it comes after any other aftergroup tokens and immediately before the following tokens. It is also necessary to remove the `\fi` from the token list before the group ends; this is done by adding an `\expandafter` just before the closing brace.

```
845 \def \DeclareTextFontCommand #1#2{%
846   \DeclareRobustCommand#1[1]{%
847     \ifmmode
848       \nfss@text{#2##1}%
849     \else
850       \expandafter\text{#2##1}%
851     \fi
852   }%
```

```

849     \else
850         \hmode@bgroup
851             \text@command{##1}%
852             #2\check@icl ##1\check@icr
853             \expandafter
854             \egroup
855     \fi
856 }%
857 }

\textrm{\text}

858 \DeclareTextFontCommand{\textrm}{\rmfamily}

859 \DeclareTextFontCommand{\textsf}{\sffamily}
860 \DeclareTextFontCommand{\texttt}{\ttfamily}
861 \DeclareTextFontCommand{\textnormal}{\normalfont}

862 \DeclareTextFontCommand{\textbf}{\bfseries}
863 \DeclareTextFontCommand{\textmd}{\mdseries}

864 \DeclareTextFontCommand{\textit}{\itshape}
865 \DeclareTextFontCommand{\textsl}{\slshape}
866 \DeclareTextFontCommand{\textsc}{\scshape}
867 \DeclareTextFontCommand{\textup}{\upshape}

868 \DeclareTextFontCommand{\emph}{\em}

869 \let \nocorr \relax
870 \let \check@icl \@empty
871 \let \check@icr \@empty

872 \def \text@command #1{%
873     \def \reserved@a {#1}%
874     \ifx \reserved@a \@empty
875         \let \check@icl \@empty
876         \let \check@icr \@empty
877     \else
878 %         \def \reserved@b { }%
879 %         \ifx \reserved@a \reserved@b
880             \ifx \reserved@a \space
881                 \let \check@icl \@empty
882                 \let \check@icr \@empty
883             \else
884                 \check@nocorr@ #1\nocorr@nil
885             \fi
886         \fi
887     }
888 \def \check@nocorr@ #1#2\nocorr#3@nil {%
889     \let \check@icl \maybe@ic
890     \def \check@icr {\ifvmode \else \aftergroup \maybe@ic \fi}%
891     \def \reserved@a {\nocorr}%
892     \def \reserved@b {#1}%
893     \def \reserved@c {#3}%
894     \ifx \reserved@a \reserved@b
895         \ifx \reserved@a \reserved@c \@empty

```

```

896      \let \check@icl \@empty
897      \else
898          \let \check@icl \@empty
899          \let \check@icr \@empty
900      \fi
901  \else
902      \ifx \reserved@c \@empty
903      \else
904          \let \check@icr \@empty
905          \fi
906      \fi
907  }
908 \newif\ifmaybe@ic
909 \def \maybe@ic {\futurelet@\let@token\maybe@ic@}
910 \def \maybe@ic@ {%
911     \ifdim \fontdimen@ne\font>\z@
912     \else
913         \maybe@ictrue
914         \expandafter\@tfor\expandafter\reserved@a\expandafter:\expandafter=%
915             \nocorrlist
916         \do \t@st@ic
917         \ifmaybe@ic \sw@slant \fi
918     \fi
919 }
920 \def \t@st@ic {%
921     \expandafter\let\expandafter\reserved@b\expandafter=\reserved@a\relax
922     \ifx\reserved@b\@let@token
923         \maybe@icfalse
924         \break@tfor
925     \fi
926 }
927 \def \sw@slant {%
928     \ifdim \lastskip=\z@
929         \fix@penalty
930     \else
931         \skip@ \lastskip
932         \unskip
933         \fix@penalty
934         \hskip \skip@
935     \fi
936 }
937 \def \fix@penalty {%
938     \ifnum \lastpenalty=\z@
939         \@@italiccorr
940     \else
941         \count@ \lastpenalty
942         \unpenalty

```

```

943     \@@italiccorr
944     \penalty \count@
945   \fi
946 }

947 \def \nocorrlist {,.}

948 \ifx \nfss@text\@undefined
949   \def \nfss@text {\leavevmode\hbox}
950 \fi

951 \def \DeclareOldFontCommand #1#2#3{%
952   \DeclareRobustCommand #1{\@fontswitch {#2}{#3}}%
953 }

954 \def \@fontswitch #1#2{%
955   \ifmmode
956     \let \math@bgroup \relax
957     \def \math@egroup {\let \math@bgroup \@@math@bgroup
958       \let \math@egroup \@@math@egroup}%
959     #2\relax
960   \else
961     #1%
962   \fi
963 }
964 \let \@@math@bgroup \math@bgroup
965 \let \@@math@egroup \math@egroup

966 \onlypreamble \DeclareTextFontCommand
967 \onlypreamble \DeclareOldFontCommand

```

### \normalsize

Initially this is defined to produce an error.

```

968 \def\normalsize{%
969   \@latex@error {The font size command @
970     \protect\normalsize\space
971       is not defined:\MessageBreak
972       there is probably something wrong with
973       the class file}\@eha
974 }

```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 21.1 Page Numbering

It is rather strange that this short piece of code is in its own dtx file. One would have expected it to perhaps be found in the file for counters. As expected page numbers are produced by a page counter, used just like any other counter. The only difference is that `\c@page` contains the number of the next page to be output (the one currently being produced), rather than one minus it. Thus, it is normally initialized to 1 rather than 0. `\c@page` is defined to be `\count0`, rather than a count assigned by `\newcount`.

`\pagenumbering` The user sets the pagenumber style with the `\pagenumbering{<foo>}` command, which sets the page counter to 1 and defines `\thepage` to be `\foo`. For example, `\pagenumbering{roman}` causes pages to be numbered i, ii, etc.

```
974 %<*2ekernel>
975 \message{page nos.,}
```

The `\cl@page` is set to empty. This is a list of counters to be reset, when the page is reset. If we had used the `\newcounter` control sequence from the Chapter on counters (see page 174) this would have been created automatically.

```
976 \countdef\c@page=0 \c@page=1
977 \def\cl@page{}
```

`\pagenumbering{<name>}`

Sets the page numbering style. This will be called later in the output routine, when L<sup>A</sup>T<sub>E</sub>X is building up the page and getting it ready to be typeset.

```
978 \def\pagenumbering#1{%
979   \global\c@page \z@ne \gdef\thepage{\csname
980     \c@#1\endcsname
981     \c@page}}
```

## 21.2 Modifications and additions by packages

The package `perpage` developed by David Kastrup adds the ability to reset counters per page and/or keep their occurrences sorted in order of appearance on the page. It works by attaching itself to the code for `\stepcounter`<sup>P.175</sup> and will then modify the given counter according to information written to the `.aux` file, which means that multiple passes may be needed. Since it uses the internals of the mechanism, the need for additional passes will get announced by L<sup>A</sup>T<sub>E</sub>X as “labels may have changed”.

The package provides commands to get the absolute number of a counter (even if it is reset) by creating a command `c@abs{counter}`. For example if we call, `AddAbsoluteCounter{page}` it will create the counter `c@abspage`, which can later be used as we require. This can be used for example to get the total pages of a document rather than the actual. The package `babel` might also interfere with counters.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 22.1 Cross Referencing

This section details the commands programmed in the L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub>  kernel that deal with cross-referencing.

## 22.2 Author commands

**\label<sup>→ σ 278</sup>** The user writes `\label{<foo>}` to define a reference by a name. the name can be any character, where foo can be any string of characters not containing ‘\’, ‘{’ or ‘}’. cross-references:

The command will write to the `.aux` file something like this:

```
\newlabel{<label>}{{<currentlabel>}{<page>}}
```

where `<label>` is what is supplied by the user and `currentlabel` is the current value of **\@currentlabel<sup>→ σ 278</sup>**, a macro that is usually updated whenever `refstepcounter` is called.

**\ref**

**\pageref{<name>}**

`\ref{<foo>}`: value of most recently incremented referencable counter. in the current environment. (Chapter, section, theorem and enumeration counters counters are referencable, footnote counters are not.)

`\pageref{<foo>}`: page number at which `\label{foo}` command appeared.

Note: The scope of the `\label` command is delimited by environments, so

```
\begin{theorem} \label{foo} ... \end{theorem} \label{bar}
```

defines `\ref{foo}` to be the theorem number and `\ref{bar}` to be the current section number.

Note: `\label` does the right thing in terms of spacing – i.e., leaving a space on both sides of it is equivalent to leaving a space on either side. [section 18](#)

The author commands referenced in [section 22.2](#)

Most of this section is just a historical note, as newer documents inevitably use **hyperref**, which modifies the commands and the method of generation of references extensively. If you check the `aux` file you will probably find label commands as:

```
\newlabel{authorcommands}{{1}{5}{Cross Referencing}{section.2.1}{}}
```

### 22.2.1 Cross Referencing

982 `\message{x-ref,}`

This is implemented as follows. A referencable counter CNT is incremented by the command `\refstepcounter{<cnt>}`, which sets `\@currentlabel = {<CNT>}{{eval(\p@cnt\theCNT)}}`. The command `\label{<FOO>}` then writes the following on file `\@auxout`:

```
\newlabel{FOO}{{eval(\@currentlabel)}{eval(\thepage)}}
```

```

1 \ref{<foo>} == begin
2   if \r@foo undefined then
3     @refundefined := G T
4     ??
5     Warning: 'reference foo on page ... undefined'
6   else
7     \@car \eval(\r@foo)\@nil
8   end
9 end
10 \pageref{<foo>} = begin
11   if \r@foo undefined then
12     @refundefined := G T
13     ??
14     Warning: 'reference foo on page ... undefined'
15   else
16     \@cdr \eval(\r@foo)\@nil
17   end
18 end

```

**Algorithm 2:** The referencing algorithm

### \@refundefined

This does not save on name-space (since `\G@refundefinedfalse` was never needed) but it does make the implementation of such one-way switches more consistent. The extra macro to make the change is used since this change appears several times.

**Note** despite its name, `\G@refundefinedtrue` does *not* correspond to an `\if` command, and there is no matching `...false`. It would be more natural to call the command `\G@refundefined` (as inspection of the change log will reveal) but unfortunately such a change would break any package that had defined a `\ref`-like command that mimicked the definition of `\ref`, calling `\G@refundefinedtrue`. Inspection of the TeX archives revealed several such packages, and so this command has been named `...true` so that the definition of `\ref` need not be changed, and the packages will work without change..

```

983 \newif\ifG@refundefined
984 \def\G@refundefinedtrue{\global\let\ifG@refundefined\iftrue}
985 \def\G@refdefinedfalse{\global\let\ifG@refundefined\iffalse}
986 \def\G@refundefinedtrue{%
987   \gdef\@refundefined{%
988     \@latex@warning@no@line{There were undefined references}}}
989 \let\@refundefined\relax

```

## \ref

## \@setref

made \ref and \pageref robust  
Added setting of refundefined switch.

```

991 \def\@setref#1#2#3{%
992   \ifx#1\relax
993     \protect\G@refundefinedtrue
994     \nfss@text{\reset@font\bfseries ??}%
995     \@latex@warning{Reference '#3' on page \thepage \space
996                   undefined}%
997   \else
998     \expandafter#2#1\null
999   \fi}
1000
1001 \def\ref#1{\expandafter\@setref\csname
1002   \c@#1\endcsname\@firstoftwo{#1}}
1003 \def\pageref#1{\expandafter\@setref\csname r@\#1\endcsname
1004   \@secondoftwo{#1}}

```

## \newlabel

Remove \@onlypreamble so still defined in new \enddocument This command will be written to the .aux file to pass label information from one run to another.

## \@newl@bel

The internal form of \newlabel and \bibcite. Note that this macro does it's work inside a group. That way the local assignments it needs to do don't clutter the save stack. This prevents large documents with many labels to run out of save stack.

```

1004 \def\@newl@bel#1#2#3{%
1005   \@ifundefined{#1@#2}%
1006     \relax
1007     {\gdef\@multiplelabels{%
1008       \@latex@warning@no@line{There were multiply-defined }
1009       \c@labels}%
1010       \@latex@warning@no@line{Label '#2' multiply defined}%
1011     \global\@namedef{#1@#2}{#3}}}
1012 \def\newlabel{\@newl@bel r}
1013 \@onlypreamble\@newl@bel

```

## \if@multipletables

## \@multipletables

This is redefined to produce a warning if at least one label is defined more than once. It is executed by the \enddocument command.

```
1013 \let\@multipletables\relax
```

### \label

#### \refstepcounter

The commands `\label` and `\refstepcounter` have been changed to allow `\protect`'ed commands to work properly. For example,

```

1014 \def\label#1{\@bsphack
1015   \protected@write\@auxout{}{%
1016     {\string\newlabel{#1}{{\@currentlabel}{\thepage}}}}%
1017   \@esphack}
1018 \def\refstepcounter#1{\stepcounter{#1}%
1019   \protected@edef\@currentlabel
1020     {\csname p@#1\endcsname\csname the#1\endcsname}%
1021 }

```

#### \@currentlabel

For `\label` commands that come before any environment

```
1022 \def\@currentlabel{}
```

### 22.2.2 An extension of counter referencing

At the moment a reference to a counter `foo` will generate the equivalent of `\p@foo\thefoo` although not quite in this form. For some applications it would be nice if one could have `\thefoo` being an argument to `\p@foo` to be able to put material before and after the number generated by `\thefoo`. This can be easily achieved with a small change to one of the kernel commands as follows:

```

\def\refstepcounter#1{\stepcounter{#1}%
  \protected@edef\@currentlabel
    {\csname p@#1\expandafter\endcsname\csname the#1\endcsname}%
}

```

The trick is to ensure that `\csname the#1\endcsname` is turned into a single token before `\p@...` is expanded further. This way, if the `\p@...` command is a macro with one argument it will receive `\the...`. With the kernel code (i.e., without the `\expandafter`) it will instead pick up `\csname` which would be disastrous.

Using `\expandafter` instead of braces delimiting the argument is better because, assuming that the `\p@...` command is not defined as a macro with one argument, the braces will stay and prohibit kerning that might otherwise happen between the glyphs generated by `\the...` and surrounding glyphs.

We have refrained from making this change in the kernel code although for existing documents it would be 100% backward compatible. The reason being

that any class or package making use of this functionality would then horribly fail with older L<sup>A</sup>T<sub>E</sub>X installations.

Instead we suggest that people who are interested in using this functionality in a document class or package add the redefinition to the class file. To ensure that this redefinition is properly applied they might want to test for the original definition first, e.g.

```
\CheckCommand*\refstepcounter[1]{\stepcounter{#1}%
  \protected@edef@\currentlabel
  {\csname p@#1\endcsname\csname the#1\endcsname}%
}
\renewcommand*\refstepcounter[1]{\stepcounter{#1}%
  \protected@edef@\currentlabel
  {\csname p@#1\expandafter\endcsname\csname the#1\endcsname}%
}
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

```
1023 %<*2ekernel>
1024 \message{environments,}
```

## 23.1 Environments

`\begin{foo}` and `\end{foo}` are used to delimit environment `foo`.

`\begin{foo}` starts a group and calls `\foo` if it is defined, otherwise it does nothing.

`\end{foo}` checks to see that it matches the corresponding `\begin` and if so, it calls `\endfoo` and does an `\endgroup`. Otherwise, `\end{foo}` does nothing.

If `\end{foo}` needs to ignore blanks after it, then `\endfoo` should globally set the `@ignore` switch true with `\@ignorettrue` (this will automatically be global).

NOTE: `\@@end` is defined to be the `\end` command of `TEX82`.

`\enddocument` is the user's command for ending the manuscript file.

`\stop` is a panic button — to end `TEX` in the middle.

**\@currenvir**(*environment name*)

The name of the current environment. Initialized to `document` to so that `\end{document}` works correctly.

```
1025 \def\@currenvir{document}
```

```
\if@ignore
\@ignorettrue
1026 \def\@ignorefalse{\global\let\if@ignore\iffalse}
\@ignorefalse
1027 \def\@ignorettrue {\global\let\if@ignore\iftrue}
1028 \@ignorefalse
```

(End definition for `\if@ignore`, `\@ignorettrue`, and `\@ignorefalse`.)

**ignorespacesafterend**

(End definition for `\ignorespacesafterend`.)

```
1029 \let\ignorespacesafterend\@ignorettrue
```

**\enddocument**

```
1030 \def\enddocument{%
```

The `\end{document}` hook is executed first. If necessary it can contain a `\clearpage` to output dangling floats first. In this position it can also contain something like `\end{foo}` so that the whole document effectively starts and ends with some special environment. However, this must be used with care, eg if two applications would use this without knowledge of each other the order of the environments will be wrong after all. `\AtEndDocument` is redefined at this point so that and such commands that get into the hook do not chase their tail...

```

1031 \let\AtEndDocument\@firstofone
1032 \@enddocumenthook
1033 \@checkend{document}%
1034 \clearpage
1035 \begingroup
1036   \if@filesw
1037     \immediate\closeout\mainaux
1038   \let\@setckpt\@gobbletwo
1039   \let\@newl@bel\@testdef

```

We use `\@@input` to load the `.aux` file, so that it doesn't show up in the list of files produced by `\listfiles`.

```

1040   \attempswafalse
1041   \makeatletter \@@input\jobname.aux
1042   \fi
1043 \dofilelist

```

First we check for font size substitution bigger than not a register.

```
1044 \ifdim \font@submax >\fontsubfuzz\relax
```

In case you wonder about the `\@gobbletwo` inside the message below, this is a horrible hack to remove the tokens `\on@line.` that are added by `\@font@warning` at the end.

```

1045   \atfont@warning{Size substitutions with }
   \differences\MessageBreak
1046   up to \font@submax\space have
   \occurred.\@gobbletwo}%
1047 \fi

```

The macro `\@defaultsubs` is initially `\relax` but gets redefined to produce a warning if there have been some default font substitutions.

```
1048 \atdefaultsubs
```

The macro `\@refundefined` is initially `\relax` but gets redefined to produce a warning if there are undefined refs.

```
1049 \atrefundefined
```

If a label is defined more than once, `\attempswa` will always be true and thus produce a “Label(s) may ...” warning. But since a rerun will not solve that problem (unless one uses a package like `varioref` that generates labels on the fly), we suppress this message.

```

1050 \if@filesw
1051   \ifx \atmultiplelabels \relax
1052     \attempswa
1053     \atlatex@warning@no@line{Label(s) may have changed.
   Rerun to get cross-references right}%
1054   \fi
1055 \else
1056   \atmultiplelabels
1057   \fi
1058 \fi
1059 \endgroup
1060 \deadcycles\z@\@@end}

```

```

\@testdef
1062 \def\@testdef #1#2#3{%
1063   \def\reserved@a{#3}\expandafter \ifx \csname #1\endcsname
1064   \reserved@a \else \tempswattrue \fi}

```

(End definition for \@testdef.)

```

\@writefile
1065 \long\def\@writefile#1#2{%
1066   \@ifundefined{tf@#1}\relax
1067   {\@temptokena{#2}%
1068    \immediate\write\csname tf@#1\endcsname{\the\@temptokena}%
1069   }%
1070 }

```

(End definition for \@writefile.)

```

\stop
1071 \def\stop{\clearpage\deadcycles\z@\let\par\@@par\@@end}

```

(End definition for \stop.)

```

1072 \everypar{\@nodocument} %% To get an error if text appears
  %% before the
1073 \nullfont           %% \begin{document}

```

## \begin

The `\begin` command takes one argument, checks if the argument is defined as a command and provides code to remember the line number. It also captures the environment name.

```

1074 \def\begin#1{%
1075   \@ifundefined{#1}%
1076   {\def\reserved@a{\@latex@error{Environment #1 }%
  \undefined}\@eha}%
1077   {\def\reserved@a{\def\@currenvir{#1}%
1078    \edef\@currenvline{\on@line}%
1079    \csname #1\endcsname}%
1080   \@ignorefalse
1081   \begingroup\@endpefalse\reserved@a}

```

### Example 1.1 Environment examples

```

10 \newenvironment{mytest}{}{%
11 \begin{mytest}%
12 \makeatletter%
13 % Typesets mytest%
14 Environment name: \@currenvir\%
15 % Typesets on input line 7%
16 Environment line: \on@line%

```

```

17
18 \ExplSyntaxOn
19 \cs_generate_variant:Nn \str_if_eq:nnTF {xnTF}
20 \str_if_eq:xnTF {\currenvir}{mytest}{\PASS}{\FAIL}
21 \ExplSyntaxOff
22 \makeatother
23 \end{mytest}
```

Environment name: mytest  
 Environment line: on input line 7  
**PASS**

**\end** The definition of **\end** is straight forward. It defines the end command for the environment such as **\end{myenvironment}**. Checks that we are in the same environment, if not will issue @badend error.

```

24 \def\end#1{%
25   \csname end#1\endcsname\@checkend{#1}%
26   \expandafter\endgroup\if@endpe\@doendpe\fi
27   \if@ignore\@ignorefalse\ignorespaces\fi}
```

(End definition for **\end**.)

**\@checkend**

```

28 \def\@checkend#1{\def\reserved@a{#1}\ifx
29   \reserved@a\currenvir \else\@badend{#1}\fi}
```

(End definition for **\@checkend**.)

**\@currenvline**

We do need a default value for **\@currenvline** on top-level since the document environment cancels the brace group. This means that a mismatch with **\begin{document}** will not produce a line number. Thus the outer default must be **\@empty** or we will end up with two spaces.<sup>1</sup>

```
30 \let\@currenvline\@empty
```

(End definition for **\@currenvline**.)

## 23.2 Center, Flushright, Flushleft

```
31 \message{center,}
```

**\@centercr**

```

32 \def\@centercr{\ifhmode \unskip\else \nolnerr\fi
33   \par\@ifstar{\nobreak\xcentercr}\@xcentercr}
```

(End definition for **\@centercr**.)

---

<sup>1</sup>v1.0q 1994/05/24 Use **\@empty** as outer default

```

{@xcentercr
34 \def{@xcentercr}{\addvspace{-\parskip}\ifnextchar
35   [@\icentercr\ignorespaces}

(End definition for {@xcentercr.}

{@icentercr
36 \def{@icentercr[#1]{\vskip #1\ignorespaces}

(End definition for {@icentercr.)

center We use \relax to prevent \item scanning too far.
37 \def{center}{\trivlist \centering\item\relax}
38 \def{endcenter}{\endtrivlist}

\centering
39 \def{\centering}{%
40   \let\\@centercr
41   \rightskip@\flushglue\leftskip@\flushglue
42   \parindent\z@\parfillskip\z@skip}

(End definition for \centering.)

{@rightskip
43 \newskip{@rightskip} \rightskip \z@skip

(End definition for {@rightskip.)
44 \def{@flushleft}{\trivlist \raggedright\item\relax}
45 \def{@endflushleft}{\endtrivlist}

\raggedright
46 \def{\raggedright}{%
47   \let\\@centercr\rightskip@\flushglue \rightskip@\rightskip
48   \leftskip\z@skip
49   \parindent\z@}

(End definition for \raggedright.)
50 \def{@flushright}{\trivlist \raggedleft\item\relax}
51 \def{@endflushright}{\endtrivlist}

\raggedleft
52 \def{@raggedleft}{%
53   \let\\@centercr
54   \rightskip\z@skip\leftskip@\flushglue
55   \parindent\z@\parfillskip\z@skip}

(End definition for \raggedleft.)
56 \message{verbatim,}

```

## 23.3 Verbatim

The verbatim environment uses the fixed-width `\ttfamily` font, turns blanks into spaces, starts a new line for each carriage return (or sequence of consecutive carriage returns), and interprets *every* character literally. I.e., all special characters `\`, `{`, `$`, etc. are `\catcode`'d to 'other'.

The command `\verb` produces in-line verbatim text, where the argument is delimited by any pair of characters. E.g., `\verb #...#` takes '`...`' as its argument, and sets it verbatim in `\ttfamily` font.

The `*-variants` of these commands are the same, except that spaces print as the TeXbook's space character instead of as blank spaces.

```
\@vobeyspaces
57 {\catcode`\ |=\active%
58 \gdef\@vobeyspaces{\catcode`\ |\active\let \xobeysp{}}
```

*(End definition for `\@vobeyspaces`.)*

```
\@xobeysp
```

*(End definition for `\@xobeysp`.)*

```
\@xverbatim
\@sxverbatim 59 \begingroup \catcode`|=0 \catcode`[=1
60 \catcode`]=2 \catcode`\\{=12 \catcode`\\}=12
61 \catcode`\\|=12 \gdef\xverbatim{\end{verbatim}[\#1]\end{verbatim}}
62 \gdef@sxverbatim{\end{verbatim*}[\#1]\end{verbatim*]}
63 \endgroup
```

*(End definition for `\@xverbatim` and `\@sxverbatim`.)*

```
\@verbatim
```

```
64 \def\@verbatim{\trivlist \item\relax
65   \if@minipage\else\vskip\parskip\fi
66   \leftskip\@totalleftmargin\rightskip\z@skip
67   \parindent\z@\parfillskip\@flushglue\parskip\z@skip}
```

Added `\@@par` to clear possible `\parshape` definition from a surrounding list (the verbatim guru says).

```
68   \@@par
69   \tempswafalse
70   \def\par{%
71     \if@tempswa
```

A `\leavevmode` added: needed if, for example, a blank verbatim line is the first thing in a list item (wow!).

```
72     \leavevmode \null \@@par\penalty\interlinepenalty
73   \else
74     \tempswatrue
75     \ifhmode\@@par\penalty\interlinepenalty\fi
76   \fi}%
```

To allow customization we hide the font used in a separate macro.<sup>2</sup> <sup>3</sup> <sup>4</sup> <sup>5</sup>

```
77 \let\do\@makeother \dospecials
78 \obeylines \verbatim@font \@noligs
79 \hyphenchar\font\m@ne
```

To avoid a breakpoint after the labels box, we remove the penalty put there by the list macros: another use of \unpenalty!

```
80 \everypar \expandafter{\the\everypar \unpenalty}%
81 }
```

*(End definition for \verbatim.)*

### \verbatim

#### \endverbatim

```
82 \def\verbatim{\@verbatim \frenchspacing\@vobeyspaces %
  \xverbatim}
83 \def\endverbatim{\if@newlist \leavevmode\fi\endtrivlist}
```

### \verbatim@font

```
84 \def\verbatim@font{\normalfont\ttfamily}
```

*(End definition for \verbatim@font.)*

```
85 \namedef{verbatim*}{\@verbatim\@sxverbatim}
86 \expandafter\let\csname endverbatim*\endcsname =\endverbatim
```

### \@makeother

```
87 \def\@makeother{\catcode`\#112\relax}
```

*(End definition for \@makeother.)*

### \verb@balance@group

```
88 \let\verb@balance@group\empty
```

*(End definition for \verb@balance@group.)*

### \verb@egroup

```
89 \def\verb@egroup{\global\let\verb@balance@group\empty\egroup}
```

*(End definition for \verb@egroup.)*

### \verb@eol@error

```
90 \begingroup
91 \obeylines%
92 \gdef\verb@eol@error{\obeylines%
93 \def^M{\verb@egroup\@latex@error{%
94 \noexpand\verb ended by end of line}\@ehc}}%
95 \endgroup
```

<sup>2</sup>vo.9a,1993/11/21,use \verb@font instead of \tt.

<sup>3</sup>vo.9h,1993/12/13,Readded \@noligs.

<sup>4</sup>v1.1d,1996/06/03,Exchanged the following two code lines so that \dospecials cannot reset the category code of characters handled by \@noligs..

<sup>5</sup>v1.1h,2000/01/07,Disable hyphenation even if the font allows it..

(End definition for `\verb@eol@error`.)

```
\verb
96 \def\verb{\relax\ifmmode\hbox\else\leavevmode\null\fi
97   \bgroup
98     \verb@eol@error \let\do\@makeother \dospecials
99     \verbatim@font\@noligs
100    \@ifstar\@sverb\@verb}
```

(End definition for `\verb`.)

```
\@sverb
101 \def\@sverb#1{%
102   \catcode`#1\active
103   \lccode`\~`#1%
104   \gdef\verb@balance@group{\verb@egroup
105     \@latex@error{\noexpand\verb illegal in command }%
106     \argument}\@ehc}%
107   \aftergroup\verb@balance@group
108   \lowercase{\let~\verb@egroup}}%
```

(End definition for `\@sverb`.)

```
\@verb
108 \def\@verb{\@vobeyspaces \frenchspacing \@sverb}
```

(End definition for `\@verb`.)

```
\verbatim@nolig@list
109 \def\verbatim@nolig@list{\do\`\do\<\do\>\do\,,\do\`\do\-\}
```

(End definition for `\verbatim@nolig@list`.)

```
\do@noligs
110 \def\do@noligs#1{%
111   \catcode`#1\active
112   \begingroup
113     \lccode`\~`#1\relax
114     \lowercase{\endgroup\def~{\leavevmode\kern\z@\char`#1}}}
```

(End definition for `\do@noligs`.)

```
\@noligs
115 \def\@noligs{\let\do\do@noligs \verbatim@nolig@list}
```

(End definition for `\@noligs`.)

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

This module is in **kernel-ltmath.dtx**. The file provides a number of math environments, and for the rest is mostly a copy of plain.

## 24.1 Math commands based on plain T<sub>E</sub>X

### 24.1.1 The log-like functions

Note that **\operator@font** is defined in the **fontdef.dtx** file (see chapter ??).

The standard operators:

```

116 \def\log{\mathop{\operator@font log}\nolimits}
117 \def\lg{\mathop{\operator@font lg}\nolimits}
118 \def\ln{\mathop{\operator@font ln}\nolimits}
119 \def\lim{\mathop{\operator@font lim}\nolimits}
120 \def\limsup{\mathop{\operator@font lim}\nolimits^+}
121 \def\liminf{\mathop{\operator@font lim}\nolimits^-}
122 \def\sin{\mathop{\operator@font sin}\nolimits}
123 \def\arcsin{\mathop{\operator@font arcsin}\nolimits}
124 \def\sinh{\mathop{\operator@font sinh}\nolimits}
125 \def\cos{\mathop{\operator@font cos}\nolimits}
126 \def\arccos{\mathop{\operator@font arccos}\nolimits}
127 \def\cosh{\mathop{\operator@font cosh}\nolimits}
128 \def\tan{\mathop{\operator@font tan}\nolimits}
129 \def\arctan{\mathop{\operator@font arctan}\nolimits}
130 \def\tanh{\mathop{\operator@font tanh}\nolimits}
131 \def\cot{\mathop{\operator@font cot}\nolimits}
132 \def\coth{\mathop{\operator@font coth}\nolimits}
133 \def\sec{\mathop{\operator@font sec}\nolimits}
134 \def\csc{\mathop{\operator@font csc}\nolimits}
135 \def\max{\mathop{\operator@font max}\nolimits}
136 \def\min{\mathop{\operator@font min}\nolimits}
137 \def\sup{\mathop{\operator@font sup}\nolimits}
138 \def\inf{\mathop{\operator@font inf}\nolimits}
139 \def\arg{\mathop{\operator@font arg}\nolimits}
140 \def\ker{\mathop{\operator@font ker}\nolimits}
141 \def\dim{\mathop{\operator@font dim}\nolimits}
142 \def\hom{\mathop{\operator@font hom}\nolimits}
143 \def\det{\mathop{\operator@font det}\nolimits}
144 \def\exp{\mathop{\operator@font exp}\nolimits}
145 \def\Pr{\mathop{\operator@font Pr}\nolimits}
146 \def\gcd{\mathop{\operator@font gcd}\nolimits}
147 \def\deg{\mathop{\operator@font deg}\nolimits}

```

#### \bmod

Some of the operators are hand crafted, for modular exponentiation **\bmod** is defined as. Note that **\nonscript** suppresses the following space in the script styles.

$$c = (b \cdot c) \bmod m$$

```

148 \def\bmod{%
149   \nonscript\mskip-\medmuskip\mkern5mu%

```

```

150 \mathbin{\operator@font mod}\penalty900\mkern5mu%
151 \nonscript\mskip-\medmuskip

\pmod
152 \def\pmod#1{%
153   \allowbreak\mkern18mu({\operator@font mod}\,,\,#1)}

```

### 24.1.2 Delimiters Biggggg

Note that `\big` and similar commands are defined by the `fontmath.dtx` module.

#### `\big`

Variants on `\big` and friends for use with delimiters:

```

154 \def\bigl{\mathopen\big}
155 \def\bigr{\mathrel\big}
156 \def\bigr{\mathclose\big}
157 \def\Bigl{\mathopen\Big}
158 \def\Bigr{\mathrel\Big}
159 \def\biggl{\mathopen\bigg}
160 \def\biggr{\mathclose\bigg}
161 \def\biggm{\mathrel\bigg}
162 \def\bigglr{\mathclose\bigg}
163 \def\Biggl{\mathopen\Bigg}
164 \def\Biggr{\mathrel\Bigg}
165 \def\Bigglr{\mathclose\Bigg}

```

### 24.1.20 The UNSORTED Rest

The other math commands are lifted from plain TeX.

#### `\jot`

```

166 \newdimen\jot
167 \jot=3pt

```

#### `\interdisplaylinepenalty`

```

168 \newcount\interdisplaylinepenalty
169 \interdisplaylinepenalty=100

```

#### `\choose`

```

170 \def\choose{\atopwithdelims()}

```

#### `\brack`

```

171 \def\brack{\atopwithdelims[]}

```

```

\brace
172 \def\brace{\atopwithdelims\{\}}

\mathpalette
173 \def\mathpalette#1#2{%
174   \mathchoice
175     {#1\displaystyle{#2}}%
176     {#1\textstyle{#2}}%
177     {#1\scriptstyle{#2}}%
178     {#1\scriptscriptstyle{#2}}}

\root
179 \newbox\rootbox

\rootbox
180 \def\root#1\of{%
181   \setbox\rootbox\hbox{$\mathop{\scriptscriptstyle #1}\limits^{\scriptscriptstyle #2}$}%
182   \mathpalette\r@@t}

183 \def\r@@t#1#2{%
184   \setbox\z@\hbox{$\mathop{\sqrt{\mathop{\scriptstyle #1}\limits^{\scriptstyle #2}}}\limits$}%
185   \dimen@\ht\z@\ \advance\dimen@-\dp\z@
186   \mkern5mu\raise.6\dimen@\copy\rootbox
187   \mkern-10mu\box\z@}

\phantom
188 \newif\ifv@
189 \newif\ifh@

190 \def\vphantom{\v@true\h@false\ph@nt}
191 \def\hphantom{\v@false\h@true\ph@nt}
192 \def\phantom{\v@true\h@true\ph@nt}

193 \def\ph@nt{%
194   \ifmmode
195     \expandafter\mathpalette\expandafter\mathph@nt
196   \else
197     \expandafter\makeph@nt
198   \fi}

199 \def\makeph@nt#1{%
200   \setbox\z@\hbox{\color@begingroup#1\color@endgroup}\finph@nt}
201 \def\mathph@nt#1#2{%
202   \setbox\z@\hbox{$\mathop{\scriptstyle #1}\limits^{\scriptstyle #2}$}\finph@nt}

```

```

203 \def\finph@nt{%
204   \setbox\tw@\null
205   \ifv@ \ht\tw@\ht\z@\dp\tw@\dp\z@\fi
206   \ifh@ \wd\tw@\wd\z@\fi \box\tw@}

\mathstrut
207 \def\mathstrut{\vphantom{}}

\smash
208 \def\smash{%
209   \relax % \relax, in case this comes first in \halign
210   \ifmmode
211     \expandafter\mathpalette\expandafter\mathsm@sh
212   \else
213     \expandafter\makesm@sh
214   \fi}
215 \def\makesm@sh#1{%
216   \setbox\z@\hbox{\color@begingroup#1\color@endgroup}\finsm@sh}
217 \def\mathsm@sh#1#2{%
218   \setbox\z@\hbox{$\m@th#1#2$}\finsm@sh}
219 \def\finsm@sh{\ht\z@\z@\dp\z@\z@\box\z@}

\buildrel
220 \def\buildrel#1\over#2{\mathrel{\mathop{\kern\z@#2}\limits^{#1}}}

\cases
221 \def\cases#1{\left.\right.,\vcenter{\normalbaselines\m@th
222   \ialign{$##\hfil$\&\quad\#\hfil\crcr\noalign{\kern-\baselineskip}#1\crcr\noalign{\kern-\baselineskip}}}\right.}

```

$$\begin{cases} x & \text{if } x > 0, \\ -x & \text{if } x \leq 0. \end{cases}$$

```

\matrix
223 \def\matrix#1{\null,\vcenter{\normalbaselines\m@th
224   \ialign{\hfil##\hfil\&\quad\hfil\#\hfil\crcr\noalign{\kern-\baselineskip}
225     \mathstrut\crcr\noalign{\kern-\baselineskip}#1\crcr\noalign{\kern-\baselineskip}}}\right.}
226   \mathstrut\crcr\noalign{\kern-\baselineskip}}\right.,}

```

```

\pmatrix
227 \def\pmatrix#1{\left(\matrix{#1}\right)}

```

$$M = \frac{A}{B} \begin{pmatrix} x & y \\ 1 & 0 \\ 0 & 1 \end{pmatrix}$$

## \bordermatrix

The `bordermatrix`

```

228 \def\bordermatrix#1{\begingroup \m@th
229   \@tempdima 8.75\p@
230   \setbox\z@\vbox{%
231     \def\cr{\crcr\noalign{\kern2\p@\global\let\cr\endline}}%
232     \ialign{$##$\hfil\kern2\p@\kern@\tempdima&\thinspace\hfil$##$\hfil
233       &&\quad\hfil$##$\hfil\crcr
234       \omit\strut\hfil\crcr\noalign{\kern-\baselineskip}%
235       #1\crcr\omit\strut\cr}%
236   \setbox\tw@\vbox{\unvcopy\z@\global\setbox\@ne\lastbox}%
237   \setbox\tw@\hbox{\unhbox\@ne\unskip\global\setbox\@ne\lastbox}%
238   \setbox\tw@\hbox{$\kern\wd\@ne\kern-\@tempdima\left(\kern-\wd\@ne
239     \global\setbox\@ne\vbox{\box\@ne\kern2\p@}%
240     \vcenter{\kern-\ht\@ne\unvbox\z@\kern-\baselineskip}\,,\right)$}%
241   \null\; \vbox{\kern\ht\@ne\box\tw@}\endgroup}
```

## \openup

```

242 \def\openup{\afterassignment\openup\dimen@}
243 \def\openup{\advance\lineskip\dimen@
244   \advance\baselineskip\dimen@
245   \advance\lineskiplimit\dimen@}
```

## \displaylines

```

246 \newif\ifdt@p
247 \def\displ@y{\global\dt@ptrue\openup\jot\m@th
248   \everycr{\noalign{\ifdt@p \global\dt@pfalse \else
249     \ifdim\prevdepth>-1000\p@
250       \vskip-\lineskiplimit \vskip\normallineskiplimit \fi
251     \else \penalty\interdisplaylinepenalty \fi}}}
251 \def@\ign{\tabskip\z@skip\everycr{}}
252 \def\displaylines#1{\displ@y \tabskip\z@skip
253   \halign{\hb@xt@\displaywidth{$\@ign\hfil\displaystyle##\hfil$}\crcr
254     #1\crcr}}
```

## \sp

## \sb

```

255 \let\sp=^
256 \let\sb=_
```

## \&gt;

## \;

## \!

```

257 %\def\,{\mskip\thinmuskip}           % already defined in ltspace
258 \def\>{\mskip\medmuskip}
259 \def\;{\mskip\thickmuskip}
260 \def\!{\mskip-\thinmuskip}

\*
261 \def\*{\discretionary{\thinspace}{\textfont2\char2}{}}{}}
```

\:

```

262 \let\:=\>

\active@math@prime
263 \def\active@math@prime{^\bgroup\prim@s}

\prime@s
264 {\catcode`\'=\active \global\let'\active@math@prime}
265 \def\prim@s{%
266   \prime@futurelet@\let@token\pr@m@s}
267 \def\pr@m@s{%
268   \ifx'\@let@token
269     \expandafter\pr@@@s
270   \else
271     \ifx^'\@let@token
272       \expandafter\expandafter\expandafter\pr@@@t
273     \else
274       \egroup
275     \fi
276   \fi}
277 \def\pr@@@s#1{\prim@s}
278 \def\pr@@@t#1#2{#2\egroup}

279 {\catcode`\_= \active \gdef_{{\_}}% _ in math is
280 % either subscript or \_

```

\(

\)

Produces \$...\$ with checks that \( isn't used in math mode, and that \) is only used in math mode begun with \(.

```

281 %</2ekernel>
282 %<latexrelease>\IncludeInRelease{2015/01/01}{{\Make \(\) \robust}}%
283 %<*2ekernel|latexrelease>
284 \DeclareRobustCommand\({%
285   \relax\ifmmode@\badmath\else$\fi}%
```

```

286 \DeclareRobustCommand\){%
287   \relax\ifmmode\ifinner$\else@\badmath\fi\else \@\badmath\fi}%
288 %</2ekernel|latexrelease>
289 %<latexrelease>\EndIncludeInRelease
290 %<latexrelease>\IncludeInRelease{0000/00/00}{\(){\Make \(\ %
291   \robust}%
292 %<latexrelease>\def\({%
293 %<latexrelease> \relax\ifmmode\@badmath\else$\fi}%
294 %<latexrelease>\def\){%
295 %<latexrelease> \relax\ifmmode\ifinner$\else@\badmath\fi\else \ %
296 %<2ekernel>
297 %</2ekernel>
298 %<latexrelease>\IncludeInRelease{2015/01/01}{\[]{\Make \[\ %
299   \robust}%
300 \DeclareRobustCommand\[\{%
301   \relax\ifmmode
302     \@badmath
303   \else
304     \ifvmode
305       \nointerlineskip
306       \makebox[.6\linewidth]{}%
307     \fi
308     $%%$ BRACE MATCH HACK
309   \fi
310 }%
311 \DeclareRobustCommand\]{%
312   \relax\ifmmode
313     \ifinner
314       \@badmath
315     \else
316       $%%$ BRACE MATCH HACK
317     \fi
318   \else
319     \@badmath
320   \fi
321   \ignorespaces
322 }%
323 %</2ekernel|latexrelease>
324 %<latexrelease>\EndIncludeInRelease
325 %<latexrelease>\IncludeInRelease{0000/00/00}{\[]{\Make \[\ %
326   \robust}%
327 %<latexrelease> \relax\ifmmode
328 %<latexrelease>   \@badmath

```

```

329 %<latexrelease>    \else
330 %<latexrelease>    \ifvmode
331 %<latexrelease>        \nointerlineskip
332 %<latexrelease>        \makebox[.6\linewidth]{}%
333 %<latexrelease>    \fi
334 %<latexrelease>    $%%$ BRACE MATCH HACK
335 %<latexrelease>    \fi
336 %<latexrelease>}%
337 %<latexrelease>\def\[]{%
338 %<latexrelease>    \relax\ifmmode
339 %<latexrelease>        \ifinner
340 %<latexrelease>            \@badmath
341 %<latexrelease>        \else
342 %<latexrelease>            $%%$ BRACE MATCH HACK
343 %<latexrelease>        \fi
344 %<latexrelease>    \else
345 %<latexrelease>        \@badmath
346 %<latexrelease>    \fi
347 %<latexrelease>    \ignorespaces
348 %<latexrelease>}%
349 %<latexrelease>\EndIncludeInRelease
350 %<2ekernel>

```

**math**

**displaymath** Disguises for  $\(\dots\)$  and  $\[\dots\]$ .

```

351 \let\math=\(
352 \let\endmath=\)

353 \def\displaymath{\[]}
354 \def\enddisplaymath{\}@\ignoretrue}

```

**equation** The equation environment.

**\c@equation**

Numbered equations, using the counter **c@equation**. Note: The document style must define **\theequation** etc., and do the appropriate **@addtoreset**. It should also redefine **\@eqnnum** if another format for the equation number is desired other than the standard (...), or to move the equation numbers to the flushleft. (See comment on the **\def** of **\@eqnnum**.)

```

355 \@definecounter{equation}
356 \def\equation{$$\refstepcounter{equation}}
357 \def\endequation{\eqno \hbox{\@eqnnum}$$\ignoretrue}

```

**\@eqnnum**

```
358 \def\@eqnnum{{\normalfont \normalcolor (\theequation)}}
```

**\stackrel**

```
359 \def\stackrel#1#2{\mathrel{\mathop{\#2}\limits^{#1}}}
```

### \frac

```
360 \def\frac#1#2{{\begingroup#1\endgroup\over#2}}
```

### \sqrt [*(nth root)*]

The **sqrt** macro extends the TeX macros to take an optional argument for the root. It uses the macros **\sqrtsign** and the construction **\root<value>\of**, through the auxiliary function **\@sqrt**. All the commands are robust in L<sup>A</sup>T<sub>E</sub>X 2015. The **\sqrtsign** is defined in the **mathdef.dtx** file

### \@sqrt

Add an optional argument to plain's **\sqrt** to give the *n*th root of an expression  $\sqrt[n]{e}$ .

```
361 \DeclareRobustCommand\sqrt{@ifnextchar[\@sqrt\sqrtsign}
362 \def\@sqrt[#1]{\root #1\of{}}
```

### \@eqcnt

#### \@eqpen

#### \if@eqnsw

#### \@eqnse

```
363 \newcount\@eqcnt
364 \newcount\@eqpen
365 \newif\if@eqnsw\@eqnswtrue
366 \newskip\@centering
367 \@centering = 0pt plus 1000pt

368 \def\eqnarray{%
369   \stepcounter{equation}%
370   \def\@currentlabel{\p@equation\theequation}%
371   \global\@eqnswtrue
372   \m@th
373   \global\@eqcnt\z@
374   \tabskip\@centering
375   \let\\=\@eqncr
376   $$\everycr{}\halign to\displaywidth\bgroup
377     \hskip\@centering$\displaystyle\tabskip\z@skip##\$@\eqnse
378     &\global\@eqcnt\@ne\hskip \tw@\arraycolsep \hfil\hfil##
379     &\global\@eqcnt\tw@\hskip \tw@\arraycolsep
380     \$\displaystyle##\$ \hfil\tabskip\@centering
381     &\global\@eqcnt\thr@@ \hb@xt@\z@\bgroup\hss##\egroup
382     \tabskip\z@skip
383   \cr
384 }
```

```

385 \def\endeqnarray{%
386     @@eqncr
387     \egroup
388     \global\advance\c@equation\m@ne
389     $$\@ignoretrue
390 }
391 \let\@eqnse=\relax

\nonumber
392 \def\nonumber{\global\@eqnswfalse}

\@eqncr
\@xeqncre
\@yeqncre
393 \def\@eqncre{%
394     {\ifnum0=`}\fi
395     \ifstar{%
396         \global\@eqopen@\M\@yeqncre
397     }{%
398         \global\@eqopen\interdisplaylinepenalty \@yeqncre
399     }%
400 }
401 \def\@yeqncre{\@testopt\@xeqncre\z@skip}
402 \def\@xeqncre[#1]{%
403     \ifnum0=`{\fi}%
404     \@eqncre
405     \noalign{\penalty\@eqopen\vskip\jot\vskip #1\relax}%
406 }

407 \def\@eqncre{\let\reserved@a\relax
408     \ifcase\@eqcnt \def\reserved@a{& &} \or
409         \def\reserved@a{&}%
410     \or \def\reserved@a{&} \else
411         \let\reserved@a\empty
412         \@latex@error{Too many columns in eqnarray }%
413             \environment\@ehc\fi
413     \reserved@a \if@eqnsw\@eqnnum\stepcounter{equation}\fi
413     \global\@eqnswtrue\global\@eqcnt\z@\cr

\@seqncre
414 \let\@seqncre=\@eqncre
415 \namedef{eqnarray*}{\def\@eqncre{\nonumber\@seqncre}\eqnarray}
416 \namedef{endeqnarray*}{\nonumber\endeqnarray}

\lefteqn

```

```

417 \def\lefteqn#1{\rlap{$\displaystyle #1$} }

    \ensuremath
418 \DeclareRobustCommand{\ensuremath}{%
419   \ifmmode
420     \expandafter\@firstofone
421   \else
422     \expandafter\@ensuredmath
423   \fi}

    \@ensuredmath
424 \long\def\@ensuredmath#1{$\relax#1$}

425 %</2ekernel>

```

### 24.1.20 Left equation numbering

#### \@eqnnum

To put the equation number on the left side of an equation we have to use a little trick. The number is shifted `\displaywidth` to the left inside a box of (approximately) zero width. This fails when the equation is too wide, the equation number than may overprint the equation itself.

```

426 %<*leqno>
427 \renewcommand{\eqnnum}{\hb@xt@.01\p@{}%
428   \rlap{\normalfont\normalcolor
429   \hskip -\displaywidth(\theequation)}}
430 %</leqno>

```

### 24.1.20 Flush left equations

To get the displayed math environments to print the contents flush left (with an indentation) we have to redefine all of  $\text{\LaTeX}_2\epsilon$ 's displayed math environments.

#### \mathindent{<length>}

The amount of indentation of the equations is stored in a register. Currently in this document it is

```

431 %<*fleqn>
432 \newdimen\mathindent

```

The setting of `\mathindent` has to be deferred until the class file has been processed, because `\leftmargini` is still opt wide at the moment `fleqn.clo` is read in.

```
433 \AtEndOfClass{\mathindent\leftmargini}
```

## \[

The \[ is defined here to begin display math. Note that in the later releases it has been made robust.

```

434 \IncludeInRelease{2015/01/01}{\[]}{\Make \[\ robust}%
435 \DeclareRobustCommand\[\relax
436   \ifmmode\@badmath
437   \else
438     \begin{trivlist}%
439       \begin{parpenalty}\predisplaypenalty
440       \end{parpenalty}\postdisplaypenalty
441       \item[]\leavevmode
442         \hb@xt@\linewidth\bgroup \$\m@th\displaystyle %$
443         \hskip\mathindent\bgroup
444     \fi}
445 \EndIncludeInRelease

```

Restore in earlier releases as:

```

446 \IncludeInRelease{0000/00/00}{\[]}{\Make \[\ robust}%
447 \renewcommand\[\relax
448   \ifmmode\@badmath
449   \else
450     \begin{trivlist}%
451       \begin{parpenalty}\predisplaypenalty
452       \end{parpenalty}\postdisplaypenalty
453       \item[]\leavevmode
454       \hb@xt@\linewidth\bgroup %
455         \$\m@th\displaystyle %$
456       \hskip\mathindent\bgroup
457     \fi}
458 \EndIncludeInRelease

```

**Example 1.1 Check if is robust**

```

10 \meaning\[
\long macro:->\begin {linenomath}\LN@displaymath

```

## \]

The end display math is defined in a similar fashion to the begin math command.

```

11 \IncludeInRelease{2015/01/01}{\]}{\Make \] robust}%
12 \DeclareRobustCommand\]\relax
13   \ifmmode
14     \egroup \$\hfil% $
15     \egroup
16   \end{trivlist}%
17   \else \@badmath
18   \fi}
19 \EndIncludeInRelease

```

```

20 \IncludeInRelease{0000/00/00}{}{}{Make \] robust}%
21 \renewcommand{\relax}{\relax
22     \ifmmode
23         \egroup $\hfil\$ $
24         \egroup
25     \end{trivlist}%
26     \else \@badmath
27     \fi}
28 \EndIncludeInRelease

\begin{equation}
<environment content>
\end{equation}

```

The equation environment

```

29 \renewenvironment{equation}%
30     {\begin{parpenalty}\predisplaypenalty
31      \endparpenalty\postdisplaypenalty
32      \refstepcounter{equation}%
33      \trivlist \item[]\leavevmode
34      \hb@xt@\linewidth\bgroup \$\m@th\$ %
35      \displaystyle
36      \hskip\mathindent}%
37      { \$\hfil\$ %
38      \displaywidth\linewidth\hbox{\@eqnnum}%
39      \egroup
40      \endtrivlist}

```

```

\begin{eqnarray}
<environment content>
\end{eqnarray}

```

```

41 \renewenvironment{eqnarray}%
42     \stepcounter{equation}%
43     \def\@currentlabel{\p@equation\theequation}%
44     \global\@eqnswtrue\m@th
45     \global\@eqcnt\z@
46     \tabskip\mathindent
47     \let\=\@eqncr
48     \setlength\abovedisplayskip{\topsep}%
49     \ifvmode
50     \addtolength\abovedisplayskip{\partopsep}%
51     \fi

```

When the documentclass uses a non-zero `\parskip` setting the `\topsep` might have a negative value to compensate for that. Therefore we add `\parskip` to `\abovedisplayskip`.

```

52     \addtolength\abovedisplayskip{\parskip}%
53     \setlength\belowdisplayskip{\abovedisplayskip}%
54     \setlength\belowdisplayshortskip{\abovedisplayskip}%
55     \setlength\abovedisplayshortskip{\abovedisplayskip}%

```



phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 25.1 List, and related environments

This section of the kernel is interesting in order to understand the underlying general design decisions of the L<sup>A</sup>T<sub>E</sub>X Team.

The kernel source can be considered as a framework, upon which classes build. All L<sup>A</sup>T<sub>E</sub>X lists are aware of their environment and can be included in other lists. You can also even if you want include sections within enumerated or itemized lists and they will not break. You can include boxes or minipages.

This section of the kernel creates generic factory commands for the creation of list environments. These list environments `\env:enumerate \env:itemize` are defined in the kernel, whereas others are normally defined in the class files (see 46 on page 594, 46.16 on page 621 and 46.3 on page 607).

To understand how lists are created we need to understand that they are shaped paragraphs. Lamport's decision to shape them with `\parshape`, has produced a flexible system, used later on by standard classes to create numerous environments. The complexity of the code is necessary to make sure that at every item the `\parshape` is used and also in any following paragraphs. Remember that `\parshape` will only act on one paragraph. As Knuth said the L<sup>A</sup>T<sub>E</sub>X Team did some nifty tricks with `\parshape`.

A sideline is that the code can be used to add vertical and bottom space to content as well as adjust the left and right margins of text blocks. In the L<sup>A</sup>T<sub>E</sub>X classes they are used to define the environments for quotations, quotes 46.6 on page 609, verse section 46.5 and verbatim environments.

## 25.2 Generic Command

The `\list` is the generic command that is used to create other lists. Think of it as the `\newcommand` for new list environments. The command takes two arguments.

```
\list{\label}{\commands} ... \endlist
```

which can be invoked by the user as the `list` environment. The `\label` argument specifies item labeling. `\commands` contains commands for changing the horizontal and vertical spacing parameters.

Each item of the environment is begun by the command `\item[item label]` which produces an item labeled by `\itemlabel`. If the argument is missing, then the `\label` argument of the `\list` command is used as the item label. This enables the user to type `\item` or `\item[some label]`.

The label is formed by putting `\makelabel{\ITEMLABEL}` in an hbox whose width is either its natural width or else `\labelwidth`, whichever is larger. The `\list` command defines `\makelabel`<sup>P.325</sup> to have the default definition:

```
\makelabel{\arg} == BEGIN \hfil arg END
```

which, for a label of width less than `\labelwidth`<sup>P.315</sup>, puts the label flushright, `\labelsep`<sup>P.315</sup> to the left of the item's text. However, `\makelabel`

can be `\let` to another command by the `\list`<sup>P.319</sup>'s `<commands>` argument.

A `\usecounter`<sup>P.326</sup>{`<foo>`} command in the second argument causes the counter `foo` to be initialized to zero, and stepped by every `\item` command without an argument. (`\label` commands within the list refer to this counter.)

When you leave a list environment, returning either to an enclosing list or normal text mode, LATEX begins a new paragraph if and only if you leave a blank line after the `\end` command. This is accomplished by the `\@endparenv`<sup>P.322</sup> command.

Blank lines are ignored every other reasonable place—i.e.:

- Between the `\begin{list}` and the first `\item`,
- Between the `\item` and the text of that item,
- Between the end of the last item and the `\end{list}`.

For an environment like `quotation`, in which items are not labeled, the entire environment is a single item. It is defined by letting `\quotation == \list{}{\...}\item\relax`. (Note the `\relax`, there in case the first character in the environment is a '['.) The spacing parameters provide a great deal of flexibility in designing the format, including the ability to let the indentation of the first paragraph be different from that of the subsequent ones.

The trivlist environment is equivalent to a list environment whose second argument sets the following parameter values:

`\leftmargin`<sup>P.315</sup> = **o**: causes no indentation of left margin

`\labelwidth`<sup>P.315</sup> = **o**: see below for precise effect this has.

`\itemindent`<sup>P.315</sup> = **o**: with a null label, makes first paragraph have no indentation. Succeeding paragraphs have `\parindent` indentation. To give first paragraph same indentation, set `\itemindent = \parindent` before the `\item[]`.

Every `\item` in a trivlist environment must have an argument—in many cases, this will be the null argument (`\item[]`). The trivlist environment is mainly used for paragraphing environments, like `verbatim`, in which there is no margin change. It provides the same vertical spacing as the list environment, and works reasonably well when it occurs immediately after an `\item` command in an enclosing list.

#### Example 2.1 understanding how lists are being build

```

10
11 \makeatletter
12 \def\mybullet{$\bullet$}
13 \leftskip0pt \rightskip0pt
14
15 \newlength\lmargin

```

```

16 \newlength\rmargin
17 \newlength\lnwidth
18 \setlength\lnwidth{\linewidth}
19
20 \setlength\lmargin{30pt}
21 \setlength\rmargin{30pt}
22 \setlength\lnwidth{\textwidth}
23 \advance\lnwidth-2\rmargin\relax %
24
25 \hskip-\lmargin\hbox to \lmargin{\hfill\mybullet}%
26 \parshape 1 \dimexpr\lmargin\relax \lnwidth\relax
27 \lorem
28
29 % Second list level
30 \addtolength\lmargin{30pt}\relax
31 \hskip-\lmargin\hbox to \lmargin{\hfill\mybullet}%
32 \parshape 1 \dimexpr\lmargin\relax
   \dimexpr\linewidth-3\rmargin\relax
33 \lorem
34
35 % Third list level
36 \addtolength\lmargin{30pt}\relax
37 \hskip-\lmargin\hbox to \lmargin{\hfill\mybullet}%
38 \parshape 1 \dimexpr\lmargin\relax
   \dimexpr\linewidth-5\rmargin\relax
39 \lorem
40
41 \makeatother

```

- Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par
  - Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par
    - Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

The above were manually defined so that you can understand how the code builds the list. These can be abstracted into a macro similar to `\item` to typeset the text. The label can be typeset with a new macro `\mklabel`. We will do this first and change it to an enumerated list. I will use a counter that is already defined for this book and use a macro `\inc` to step it up.

**Example 2.2 understanding how lists are being build**

```

10 \makeatletter
11 \def\mybullet{{\itshape\large\text{. }}}
12 \leftskip0pt \rightskip0pt
13 \setlength\lmargin{0pt}
14 \setlength\rmargin{0pt}
15
16 \def\itm{%
17   \setlength\lmargin{0pt}
18   \setlength\rmargin{0pt}
19   \hskip-\lmargin\hbox to \lmargin{\hfill\mybullet}%
20   \parshape 1 \dimexpr\lmargin\relax
21     \dimexpr\linewidth-\rmargin\relax}
21
22 % First level
23 \itm \lorem
24
25 % Second list level
26 \itm \lorem
27
28 % Third list level
29 \itm \lorem
30
31 \makeatother

```

**1**Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

**2**Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

**3**Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

Remember that L<sup>A</sup>T<sub>E</sub>X defines all lengths to be global lengths, so we didn't have to redeclare them above, just reset them to the values we needed them.

### 25.2.1 List and Trivlist

The following variables are used inside a list environment:

**\@totalleftmargin**<sup>→ P. 315</sup> The distance that the prevailing left margin is indented from the outermost left margin,

**\ linewidth**<sup>→ P. 315</sup> The width of the current line. Must be initialized to **\ hsize**.

**\@listdepth**<sup>→ P. 316</sup> A count for holding current list nesting depth.

**\makelabel**<sup>→ P. 325</sup> A macro with a single argument, used to generate the label from the argument (given or implied) of the **\ item** command. Initialized

to `\@mklab` by the `\list` command. This command must produce some stretch—i.e., an `\hfil`.

`\if@inlabel→ P. 316` A switch that is false except between the time an `\item` is encountered and the time that TeX actually enters horizontal mode. Should be tested by commands that can be messed up by the list environment’s use of `\everypar`.

`\@labels→ P. 316` When `@inlabel = true`, it holds the labels to be put out by `\everypar`.

`\if@noperitem→ P. 316` A switch set by `\list` when `@inlabel = true`. Handles the case of a `\list` being the first thing in an item.

`\if@noperlist→ P. 317` A switch set true for a list that begins an item. No `\topsep` space is added before or after `\item`’s such a list.

`\if@newlist→ P. 317` Set true by `\list`, set false by the first text (by `\everypar`).

`\if@noitemarg→ P. 317` Set true when executing an `\item` with no explicit argument. Used to save space. To save time, make two separate `\@item→ P. 323` commands.

`\if@nmbrlist→ P. 317` Set true by `\usecounter` command, causes list to be numbered.

`noskipsec` A switch set true by a sectioning command when it is creating an in-text heading with `\everypar`.

Throughout a list environment, `\hsize` is the width of the current line, measured from the outermost left margin to the outermost right margin. Environments like tabbing should use `\ linewidth→ P. 315` instead of `\hsize`.

Here are the parameters of a list that can be set by commands in the `\list`’s `(commands)` argument. These parameters are all TeX skips or dimensions (defined by `\newskip` or `\newdimen`), so the usual TeX or L<sup>A</sup>T<sub>E</sub>X commands can be used to set them. The commands will be executed in vmode if and only if the `\list` was preceded by a `\par` (or something like an `\end{list}`), so the spacing parameters can be set according to whether the list is inside a paragraph or is its own paragraph.

### Vertical Spacing (skips)

`\topsep→ P. 310` Space between first item and preceding paragraph.

`\partopsep→ P. 310` Extra space added to `\topsep→ P. 310` when environment starts a new paragraph (is called in vmode).

`\itemsep→ P. 310` Space between successive items.

`\parsep→ P. 311` Space between paragraphs within an item – the `parskip` for this environment.

### Penalties

`\@beginparpenaltyP. 316` put at the beginning of a list

`\@endparpenaltyP. 316` put at end of list

`\@itempenaltyP. 316` put between items.

### 25.2.2 Horizontal Spacing (dimens)

`\leftmarginP. 315` space between left margin of enclosing environment (or of page if top level list) and left margin of this list. Must be nonnegative.

`\rightmarginP. 315` analogous.

`\listparindentP. 315` extra indentation at beginning of every paragraph of a list except the one started by the `\itemP. 323` command. May be negative! Usually, labeled lists have `\listparindentP. 315` equal to zero.

`\itemindentP. 315` extra indentation added right BEFORE an item label.

`\labelwidthP. 315` nominal width of box that contains the label. If the natural width of the label  $\leq \labelwidth<sup>P. 315</sup>$ , then the label is flushed right inside a box of width `\labelwidthP. 315` (with an `\hfil`). Otherwise, a box of the natural width is employed, which causes an indentation of the text on that line.

`\labelsepP. 315` space between end of label box and text of first item.

### 25.2.3 Default Values

Defaults for the list environment are set as follows. First, `\rightmarginP. 315`, `\listparindentP. 315` and `\itemindentP. 315` are set to opt. Then, one of the commands `??P. ??`, `@listii,...,@listvi` is called, depending upon the current level of the list. The `@list...` commands should be defined by the document style. A convention that the document style should follow is to set `\leftmarginP. 315` to `leftmargini,...,leftmarginiv` for the appropriate level. Items that aren't changed may be left alone, but everything that could possibly be changed must be reset.

The `\endlistP. 321` simply adjusts the listdepth counter and ends the `\trivlistP. 321`.

The `\@trivlistP. 320` is define as,

The definition of item, is fairly simple deferring the complexity to `\@itemP. 323` which follows.

#### `\topsep<dim>`

The space between the first item and the preceding paragraph.

#### `\partopsep<dim>`

The space between the first item and the preceding paragraph.

```

1 \list→ P. 319{⟨LABEL⟩}{⟨COMMANDS⟩} ==
2 begin
3   if \@listdepth→ P. 316 > 5 then
4     | LaTeX error: ‘Too deeply nested’
5   else
6     | \@listdepth→ P. 316 :=G \@listdepth→ P. 316 + 1
7   end
8   \rightmargin→ P. 315 := opt
9   \listparindent→ P. 315 := opt
10  \itemindent→ P. 315 := opt
11  eval(@list ??→ P. ??? \@listdepth→ P. 316)
12  \@itemlabel→ P. 317 :=L LABEL
13  \makelabel→ P. 325 == \@mklab→ P. 323
14  @nmbrlist :=L false
15  SETTING COMMANDS
16  \@trivlist→ P. 320
17  parskip :=L \parsep→ P. 311
18  parindent :=L \listparindent→ P. 315
19  \linewidth→ P. 315 :=L \linewidth→ P. 315 - \rightmargin→ P. 315
20  - \leftmargin→ P. 315
21  \@totallleftmargin→ P. 315 :=L \@totallleftmargin→ P. 315 +
22  \leftmargin→ P. 315
23  parshape 1 \@totallleftmargin→ P. 315 \linewidth→ P. 315
24  \ignorespaces
25 end

```

**Algorithm 3:** The `\list→ P. 319` environment

```

1 \endlist→ P. 321 ==
2 begin
3   | \@listdepth→ P. 316 :=G \@listdepth→ P. 316 -1
4   | \endtrivlist→ P. 321
5 end

```

**\itemsep⟨dim⟩**

The space between the first item and the preceding paragraph.

**\@itemsep⟨dim⟩**

The space between the first item and the preceding paragraph.

**\@topsepadd⟨dim⟩**

The space between the first item and the preceding paragraph.

**\outerparskip⟨dim⟩**

The space between the first item and the preceding paragraph.

```

1 \trivlistP.320 ==
2 begin
3   if @newlist = T then
4     | \noitemerrP.102
5   end
6   This command removed for some forgotten reason.
7   \topsepadd :=L \topsep
8   if @noskipsec then
9     | leave vertical mode
10  end
11  if vertical mode then
12    | \topsepadd :=L \topsepadd + \partopsep
13  else
14    | \unskip \par
15  end
16  if @inlabel = true then
17    | @noparitem :=L true @noparlist :=L true
18  else
19    | @noparlist :=L false ??P.?? :=L \topsepadd
20  end
21  ??P.?? :=L ??P.?? + ??P.??
22  Restore paragraphing parameters
23  \leftskip :=L opt
24  \rightskip :=L ??P.??
25  \parfillskip :=L opt + 1fil
26  NOTE: \setpar called on every \listP.319 in case \par has
27  been
28  temporarily munged before the \listP.319 command.
29  \setpar if @newlist = false then \par fi
30  \newlist :=G T
31  \outerparskip :=L \parskip
31 end

```

```

1 \trivlistP.321 ==
2 begin
3   \parsepP.311 := \parskip
4   \nmblist := false
5   \trivlistP.320
6   \labelwidthP.315 := 0
7   \leftmarginP.315 := 0
8   \itemindentP.315 := ??P.??
9   \itemlabelP.317 :=L "empty"
10  \makelabelP.325{\{LABEL\}} == LABEL
11 end

```

```

1 \endtrivlistP.321 ==
2 begin
3   if @inlabel = T then
4     ??P.??
5   end
6   if horizontal mode then
7     ??P.?? ??P.??
8   end
9   if @noparlist = true then
10  else
11    if ??P.?? > 0 then
12      ??P.?? := ??P.?? ??P.?? - ??P.?? ??P.?? ??P.??
13      - ??P.?? + ??P.??
14    end
15    \endparenvP.322
16 end
17

18 \endparenvP.322 == begin
19   \addpenaltyP.113{(@endparpenalty)}
20   \addvspaceP.113{(@topsepadd)}
21   ends the \beginP.283 command's ??P.??
22   \endgroup
23   \par == begin
24     ??P.??
25     \everypar \par
26   end
27   ??P.?? == begin
28     | remove ??P.?? ??P.??
29   end
30   to match the ??P.?? commands ??P.??
31   ??P.??
32 end
33

34 \item == begin
35   if math mode then
36     | issue warning
37   end
38   if next char = [ then
39     | \itemP.323
40   else
41     | @noitemarg := true
42     | \itemP.323[@itemlabelP.317]
43   end
44 end
45

```

**Algorithm 4:** The algorithm for \item

```

1  \itemP.323[LAB] == begin
2  if @noperitem = true then
3    @noperitem := false ??P.?? \@labelsP.316 :=G
4    ??P.?? begin
5      hskip -\leftmarginP.315
6      box
7      refCom@labels
8      hskip \leftmarginP.315
9    end
10   if @minipage = false then
11     ??P.?? := ??P.??
12     ??P.?? -??P.??
13     ??P.?? ??P.?? + ??P.?? - ??P.??
14   end
15 else
16   if @inlabel = true then
17     then ??P.?? ??P.??
18   end
19   if hmode then
20     then 2 ??P.??'s
21     ??P.??
22   end
23   if if @newlist = T then
24     if @nobreak = T then
25       \addvspaceP.113{<??P.?? - ??P.??>}
26     else
27       \addpenaltyP.113{(\@beginparpenaltyP.316)}
28       \addvspaceP.113{<??P.??>}
29       \addvspaceP.113{<-??P.??>}
30     end
31   else
32     \addpenaltyP.113{(\@itempenaltyP.316)}
33     \addvspaceP.113{(\@itemsep)}
34   end
35   @inlabel :=G true
36 end
37 ??P.??{ @minipage :=G F
38 @newlist :=G F
39 if @inlabel = true then
40   @inlabel :=G false ??P.?? -??P.??
41   ??P.?? \@labelsP.316
42   ??P.?? O
43   ??P.?? \@labelsP.316 :=G null
44 end
45 ??P.??{}
46 @nobreak :=G false
47 if @noitemarg = true then
48   @noitemarg := false
49   ??P.?? phddoc
50   | \refstepcounterP.278{??P.??}
51   end
52 end
53 ??P.?? :=L ??P.??{(\makelabelP.325{(LAB)})}
54 ??P.?? \@labelsP.316 :=G
55 \@labelsP.316 ??P.?? \itemindentP.315
56 ??P.?? - (\labelwidthP.315 + \labelsepP.315)
57 if ??P.?? ??P.?? > \labelwidthP.315 then

```

January 26, 2019

phddoc



```

1 \makelabel→ P.325{⟨LABEL⟩} == ERROR
2 default to catch lonely \item→ P.323
3 \usecounter→ P.326{⟨CTR⟩} == begin
4   @nbrlist := L true
5   @listctr == CTR
6   setcounter{⟨CTR⟩}{⟨o⟩}
7 end

```

### \parsep⟨dim⟩

The space between the first item and the preceding paragraph.

The skip registers `\topskip`, `\partopsep`, `\itemsep`, `\parsep`, `\@topsep`, `\@topsepadd`, `\outerparskip` are created.

```

32 \newskip\partopsep
33 \newskip\itemsep
34 \newskip\parsep
35 \newskip\@topsep
36 \newskip\@topsepadd
37 \newskip\@outerparskip

```

### \leftmargin⟨dim⟩

`\newdimen\leftmargin`

### \rightmargin⟨dim⟩

`\newdimen\rightmargin`

### \listparindent⟨dim⟩

`\newdimen\listparindent`

### \labelwidth⟨dim⟩

`\newdimen\labelwidth`

### \labelsep⟨dim⟩

`\newdimen\labelsep`

### \linewidth⟨dim⟩

`\newdimen\linewidth`

### \itemindent⟨dim⟩

`\newdimen\itemindent`

### \@totalleftmargin⟨dim⟩

`\newdimen\@totalleftmargin \@totalleftmargin=\z@`

```

\leftmargini 〈dim〉
38 \newdimen\leftmargini

\leftmarginii 〈dim〉
39 \newdimen\leftmarginii

\leftmarginiii 〈dim〉
40 \newdimen\leftmarginiii

\leftmarginiv 〈dim〉
41 \newdimen\leftmarginiv
42 \newdimen\leftmarginv

\@listdepth
\@itempenalty
\@beginparpenalty
\@endparpenalty<penalty>
\newcount\@endparpenalty

43 \newcount\@listdepth \@listdepth=0
44 \newcount\@itempenalty
45 \newcount\@beginparpenalty

\@labels 〈box〉
47 \newbox\@labels

\if@inlabel
  \@inlabel true and false
48 \newif\if@inlabel \@inlabelfalse

\if@newlist
49 \newif\if@newlist \@newlistfalse

```

```

\if@newlistfalse
\if@newlisttrue
\if@noperitem
\if@noperitemtrue
\if@noperitemfalse
50 \newif\if@noperitem \@noperitemfalse
\if@noperlist
\if@noperlistfalse
\if@noperlisttrue
51 \newif\if@noperlist \@noperlistfalse
\if@noitemarg
\if@noitemargtrue
\if@noitemargfalse
52 \newif\if@noitemarg \@noitemargfalse
\if@newlist
\if@newlisttrue
\if@newlistfalse
\@newlist
\if@nmbrlist
    Checks if the list is to be numbered or not
53 \newif\if@nmbrlist \@nmbrlistfalse
\@itemlabel
    Temporary definition to store the label.

```

## 25.3 The `\list` environment

Notice that the list takes two arguments the first parameter contains instructions as to how to typeset items, that do not have an `\item[]`. If we need to step a counter we tell it here

**Example 3.3 The list**

```

10  \@ifundefined{c@steps}{\newcounter{steps}{}}
11  \begin{list}{\bfseries\upshape Step \arabic{steps}:}
12  {%
13  \usecounter{steps}
14  \setlength{\labelwidth}{2cm}\setlength{\leftmargin}{2.6cm}
15  \setlength{\labelsep}{0.5cm}\setlength{\rightmargin}{1cm}
16  \setlength{\parsep}{0.5ex plus0.2ex minus0.1ex}
17  \setlength{\itemsep}{0ex plus0.2ex minus0pt}\relax
    \slshape %
18 }
19 \item Understand how they are being build
20 \item Define your own environment
21 \item[Has Own] test
22 \end{list}
23
24
25 \newenvironment{myplain}
26 {
27   \list{\bfseries\arabic{steps}}
28     {\usecounter{steps}\bfseries } }
29
30
31 \begin{myplain}
32 \item \lorem
33
34 \item[Something] \lorem
35 \end{myplain}

```

{ifundefinedc@steps

**Step 1:** *Understand how they are being build*

**Step 2:** *Define your own environment*

*Has Own test*

**1 Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par**

**Something** **Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par**

Looking at the **list** environment differently it is actually a settings environment, it sets what to do if the item has no argument and also sets the counter to be used the current levels. It ends issuing a parshape command that is going to shape the paragraph that follows. Next we need to see how item works in more detail. The calculations and some of the work is delegated to trivlist.

The code follows:

```
\list{\itemlabel} {\commands}
```

List takes two arguments and is factory command for building other lists.

Check that the list is not nested too far.

```
36 \def\list#1#2{%
37   \ifnum \listdepth >5\relax
38     \toodeep
39   \else
40     \global\advance\listdepth@ne
41   \fi
```

Initialize all margins to opt in case the user did not specify anything.

#### Example 3.4

```
10  \rightmargin\z@
11  \listparindent\z@
12  \itemindent\z@
13  \csname @list\romannumeral\the\listdepth\endcsname
14  \end{tex}
15
16 Define the item label here, if it is empty it will be
   defined to empty
17  \begin{texcode}
18    % store the itemlabel
19  \def\@itemlabel{\#1}%
20  \let\makelabel\@mklab
21  \@nmbrlistfalse
22  % insert other parameters, spaces, fonts etc
23  #2\relax
24  % call trivlist to do some calculations
25  % and set conditionals
26  \atrvlist
27
28  % redefine parskip and parindent
29  \parskip\parsep
30  \parindent\listparindent
31
32  % set the linewidth
33  \advance\linewidth -\rightmargin
34  \advance\linewidth -\leftmargin
35  \advance\@totalleftmargin \leftmargin
```

Finally set the parshape commands. This is perhaps the most misunderstood line in the whole routine. As you see we cannot do any typesetting as yet. Both parameters are just commands to be entered before the text is typeset. Probably you guessed, but what follows is \item. At this point it will just activate an error if it is missing.

```
37  \parshape \one \atotalleftmargin \linewidth
38  \ignorespaces}
```

**\par@deathcycles**

```
39 \newcount\par@deathcycles
```

### \@trivlist

Auxiliary macro call by trivlist.

Because `\par` is sometimes made a no-op it is possible for a missing `\item` to produce a loop that does not fill memory and so never gets trapped by TeX. We thus need to trap this here by setting `\par` to count the number of times a paragraph ii is called with no progress being made started.

```
40 \def\@trivlist{%
41   \if@noskipsec \leavevmode \fi
42   \@topsepadd \topsep
43   \ifvmode
44     \advance\@topsepadd \partopsep
45   \else
46     \unskip \par
47   \fi
48   \if@inlabel
49     \@noparitemtrue
50     \@noparlisttrue
51   \else
52     \if@newlist \@noitemerr \fi
53     \@noparlistfalse
54     \@topsep \@topsepadd
55   \fi
56   \advance\@topsep \parskip
57   \leftskip \z@skip
58   \rightskip \z@skip
59   \parfillskip \z@skip
60   \par@deathcycles \z@
61   \@setpar{\if@newlist
62     \advance\par@deathcycles \one
63     \ifnum \par@deathcycles >\@m
64       \ifnoitemerr
65         {\@par}%
66       \fi
67     \else
68       {\@par}%
69     \fi}%
70   \global \@newlisttrue
71   \@outerparskip \parskip}
```

The function of a `trivlist` is very simple, it sets numbering to false and initializes all widths to zero, thus at this stage it will default to a normal paragraph then it calls the auxiliary function `\@trivlist`, which will set the top and bottom skips and other paragraphing parameters, if set.

### Example 3.5 Trivlist

```
10 \lorem
11 \begin{trivlist}
```

```

12 \item[] \lorem
13
14 \end{trivlist}
15 \lorem

```

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

### \trivlist *<void>*

```

17 \def\trivlist{%
18   \parsep\parskip
19   \@nmbrlistfalse
20   \@trivlist
21   \labelwidth\z@
22   \leftmargin\z@
23   \itemindent\z@

```

We initialise \@itemlabel so that a trivlist with an \item not having an optional argument doesn't produce an error message.

### \makelabel{\iitem label}

```

24 \let\@itemlabel\@empty
25 \def\makelabel##1{##1}

```

### \endlist *<void>*

ends the list environment

```

26 \def\endlist{%
27   \global\advance\@listdepth\m@ne
28   \endtrivlist}

```

The definition of \trivlist used to be in ltxspace.dtx so that other commands could be 'let to it'. They now use ??<sup>P.??</sup>.

### \endtrivlist

```

29 \def\endtrivlist{%
30   \if@inlabel
31     \leavevmode
32     \global \let\inlabelfalse
33   \fi
34   \if@newlist
35     \let\noitemerr
36     \global \let\newlistfalse
37   \fi
38   \ifhmode\unskip \par

```

We also check if we are in math mode and issue an error message if so (hoping that `\@currenvir` resolves suitably). Otherwise the usual “perhaps a missing item” error will get triggered later which is confusing.<sup>1</sup>

```

39   \else
40     \ifinmatherr{\end{\@currenvir}}%
41   \fi
42   \if@noparlist \else
43     \ifdim\lastskip >\z@
44       \tempskipa\lastskip \vskip -\lastskip
45       \advance\tempskipa\parskip \advance\tempskipa 2
46         \outerparskip
47       \vskip\tempskipa
48     \fi
49   \fi
50 }

```

### \@endparenv

```

51 \def\@endparenv{%
52   \addpenalty\endparpenalty\addvspace\topsepadd\endptrue}

```

### \@doendpe

To suppress the paragraph indentation in text immediately following a paragraph-making environment, `\everypar` is changed to remove the space, and `\par` is redefined to restore `\everypar`. Instead of redefining `??P.??` and `\everypar`, `\@endparenv` was changed to set the `??P.??` switch, letting `end` redefine `par` and `\everypar`. This allows paragraph-making environments to work right when called by other environments.

)

```

53 \def\@doendpe{\endptrue
54   \def\par{\@restorepar\everypar{}}
55   \par\endpfalse}\everypar
56   {{\setbox\z@\lastbox}\everypar{}\endpfalse}}

```

Use `\setbox0=\lastbox` instead of `\hskip -\parindent` so that a `\noindent` becomes a no-op when used before a line immediately following a list environment(23 Oct 86).<sup>2</sup>

---

<sup>1</sup>v1.0s,2002/10/28,Check for math mode (pr/3437).

<sup>2</sup>v1.0k,1995/11/07,Enclosed `??P.??` assignment by a group so that it leaves the contents of box 0 intact. .

```
\if@endpe
  \endpe\true
  57 \newif\if@endpe
  58 \endpe\false
```

```
\@mklab
  59 \def\@mklab#1{\hfil #1}
    3 4 5
```

## 25.4 Typesetting the label

\item[<label>]

```
60 \def\item{%
  61   \inmatherr\item
  62   \ifnextchar [\@item{\@noitemargtrue \@item[\@itemlabel]}}}
```

\@donoparitem

```
63 \def\@donoparitem{%
  64   \noperitemfalse
  65   \global\setbox\@labels\hbox{\hskip -\leftmargin
  66     \unhbox\@labels
  67     \hskip \leftmargin}%
  68   \ifminipage
  69     \else
  70       \tempskip\lastskip
  71       \vskip -\lastskip
  72       \advance\tempskip\outerparskip
  73       \advance\tempskip -\parskip
  74       \vskip\tempskip
  75   \fi}
```

\@item[<label>]

```
76 \def\@item[#1]{%
  77   \ifnoperitem
  78     \donoparitem
  79   \else
  80     \ifinlabel
  81       \indent \par
  82     \fi}
```

---

<sup>3</sup>LaTeX2.09,1992/09/18,(RmS) Added warning if \item is used in math mode.

<sup>4</sup>v1.0c,1994/04/28,Replaced ??→P.?? by \inmatherr→P.102.

<sup>5</sup>v1.0d,1994/05/03,Removed superfluous braces.

```

83     \ifhmode
84         \unskip\unskip \par
85     \fi
86     \if@newlist
87         \if@nobreak
88             \@nbitem
89         \else
90             \addpenalty\@beginparpenalty
91             \addvspace\@topsep
92             \addvspace{-\parskip}%
93         \fi
94     \else
95         \addpenalty\@itempenalty
96         \addvspace\itemsep
97     \fi
98     \global\@inlabeltrue
99   \fi
100 \everypar{%
101   \@minipagefalse
102   \global\@newlistfalse

```

This `\if@inlabel` check is needed in case an item starts of inside a group so that `\everypar` does not become empty outside that group. `nobreakfalse`, etc etc.

```

103 \if@inlabel
104   \global\@inlabelfalse

```

The paragraph indent is now removed by using `\setbox...` since this makes `\noindent` a no-op here, as it should be. Thus the following comment is redundant but is left here for the sake of future historians: this next command was changed from an `hskip` to a `kern` to avoid a break point after the parindent box: the skip could cause a line-break if a very long label occurs in `raggedright` setting.<sup>6 7 8</sup> If `\noindent` was used after `\item` want to cancel the `\itemindent` skip. This case can be detected as the indentation box will be void.

```

105   {\setbox\z@\lastbox
106    \ifvoid\z@
107      \kern-\itemindent
108    \fi}%
109   \box\@labels
110   \penalty\z@
111 \fi

```

This code is intended to prevent a page break after the first line of an item that comes immediately after a section title. It may be sensible to always forbid a page break after one line of an item? As with all such settings of `\clubpenalty` it is local so will have no effect if the item starts in a group.

Only resetting `@nobreak` when it is true is now essential since now it is sometimes set locally.<sup>9</sup>

<sup>6</sup>v1.od,1994/05/03,??<sup>→P.??</sup> changed to ??<sup>→P.??</sup>.

<sup>7</sup>v1.om,1996/10/23,??<sup>→P.??</sup> changed to ??<sup>→P.??</sup>.

<sup>8</sup>v1.or,1997/02/21,??<sup>→P.??</sup> check added for ??<sup>→P.??</sup>. latex/2414.

<sup>9</sup>v1.om,1996/10/23,Added setting of ??<sup>→P.??</sup> and set ??<sup>→P.??</sup> only when necessary.

```

112      \if@nobreak
113          \@nobreakfalse
114          \clubpenalty \@M
115      \else
116          \clubpenalty \clubpenalty
117          \everypar{}%
118      \fi}%
10 11

119  \if@noitemarg
120      \@noitemargfalse
121      \if@nmbrlist
12
122          \refstepcounter\@listctr
123          \fi
124      \fi

```

Before the label is typeset it is placed in a box. The latex Team used an `\sbox` so that colour commands can be supported. It calls `\makelabel` with the item parameters.

```

125  \sbox\@tempboxa{\makelabel{#1}}%
126  \global\setbox\@labels\hbox{%
127      \unhbox\@labels
128      \hskip \itemindent
129      \hskip -\labelwidth
130      \hskip -\labelsep
131      \ifdim \wd\@tempboxa >\labelwidth
132          \box\@tempboxa
133      %
134 % \changes{LaTeX2.09}{1991/11/22}
135 %     { (RmS) Changed second call to \refCom{makelabel} to
136 %       \refCom{unhbox}\refCom{@tempboxa}.
137 %     Avoids problems with side effects in \refCom{makelabel} and is
138 %     more efficient.}
139 % \begin{tex}
140 \else
141     \hbox to\labelwidth {\unhbox\@tempboxa}%
142 \fix
143     \hskip \labelsep}%
144 \ignorespaces

```

### \makelabel

Initial definition of `\makelabel` set to produce the infamous and often encountered error, if it has not been defined by one of the paragraphing environments.

---

<sup>10</sup>v1.0l,1996/07/26,Remove unnecessary  $\mathbf{??}^{\rightarrow P. ??}$  before  $\mathbf{??}^{\rightarrow P. ??}$ .

<sup>11</sup>v1.0m,1996/10/23, $\mathbf{??}^{\rightarrow P. ??}$  moved into the  $\mathbf{??}^{\rightarrow P. ??}$  and not executed unconditionally, see above.

<sup>12</sup>v1.0g,1995/05/17,Removed surplus braces.

```

145 \def\makelabel#1{%
146   \@latex@error{Lonely \string\item--perhaps a missing
147     list environment}\@ehc}

\nbitem

13

148 \def@\nbitem{%
149   \tempskipa\@outerparskip
150   \advance\tempskipa -\parskip
151   \addvspace\tempskipa}

\usecounter

152 \def\usecounter#1{\@nmbrlisttrue\def@\listctr{#1}\setcounter{#1}\z@}

```

## 25.5 Enumerate

Enumeration is done with four counters: `enumi`, `enumii`, `enumiii` and `enumiv`, where `enumN` controls the numbering of the Nth level enumeration. The label is generated by the commands  $\ref{P.277}$  ... `\labelenumiv`, which should be defined by the document style.

Note that `\p@enumN \theenumN` defines the output of a  $\ref{P.277}$  command. A typical definition might be:

```

\def\theenumii{\alph{enumii}}
\def\p@enumii{\theenumii}
\def\labelenumii{(\theenumii)}

```

which will print the labels as ‘(a)’, ‘(b)’, ...and print a  $\ref{P.277}$  as ‘3a’.

The item numbers are moved to the right of the label box, so they are always a distance of  $\labelsep$ <sup>P.315</sup> from the item.

`\@enumdepth` holds the current enumeration nesting depth.

Itemization is controlled by four commands: `\labelitemi`, `\labelitemii`, `\labelitemiii`, and `\labelitemiv`. To cause the second-level list to be bulleted, you just define `\labelitemii` to be `$\bullet$`. `@itemspacing` and `\@itemdepth`<sup>P.327</sup> are the analogs of `@enumspacing` and `\@enumdepth`. These are not defined in the kernel, their definition is delegated to the classes and to another extend to the users.

### \@enumdepth

The enumeration depth.

---

<sup>13</sup>v1.og,1995/05/17,Removed surplus braces.

```
153 \newcount\@enumdepth \@enumdepth = 0
```

Next the counters for the `\env{enumerate}` environment, `c@enumi`, `c@enumii`, `c@enumiii` and `c@enumiv` are created.

```
154 \@definecounter{enumi}
155 \@definecounter{enumii}
156 \@definecounter{enumiii}
157 \@definecounter{enumiv}
```

```
\begin{enumerate}
  {environment content}
\end{enumerate}
```

The `enumerate` environment enumerates the list. The macro is written very efficiently and defines the basic structure. The typesetting parameters are left for the class files such as book to define them.

```
158 \def\enumerate{%
159   \ifnum \@enumdepth >\thr@@\@toodeep\else
160     \advance\@enumdepth\@ne
161     \edef\@enumctr{enum\romannumeral\the\@enumdepth}%
162     \expandafter
163     \list
164       \csname label\@enumctr\endcsname
165       {\usecounter\@enumctr\def\makelabel##1{\hss\llap{##1}}}%
166   \fi}
167 \let\endenumerate=\endlist
```

```
\@itemdepth
```

```
168 \newcount\@itemdepth \@itemdepth = 0
```

## 25.6 The itemize environment

Finally the `itemize` environment is defined. This is defined in the kernel to have a limit of 4 levels only.

Itemization is controlled by four commands, which are defined in the standard classes: `\labelitemi`, `\labelitemii`, `\labelitemiii`, and `\labelitemiv`, which define the labels of the various itemization levels: the symbols used in the standard classes are bullet, bold en-dash, centered asterisk and centred dot.

```
\begin{itemize}
  {environment content}
\end{itemize}
```

```
169 \def\itemize{%
170   \ifnum \@itemdepth >\thr@@\@toodeep\else
171     \advance\@itemdepth\@ne
172     \edef\@itemitem{\labelitem\romannumeral\the\@itemdepth}%
  }
```

The **\I** is a hack to create the `\@itemi...``\@itemv` names. How it works is that the `\romannumeral` will expand until it finds a number and leave the letter `i` etc. in the stream.

#### Example 6.6 Creating a suffix with Roman Numerals

```

10 \newcounter{tempcounter}
11 \setcounter{tempcounter}{5}
12 \edef\itemtest{\labelitem\romannumeral\thetempcounter}
13 % the replacement
14 \meaning\itemtest
15
16 \itemtest

macro:->labelitemv
labelitemv

```

A `romannumeral` just returns nothing if it encounters the number `0` or a negative number.

#### Example 6.7 Creating a suffix with Roman Numerals

```

10 % counter has been created globally
11 % commented out.
12 \%newcounter{tempcounter}
13 \setcounter{tempcounter}{0}
14 \edef\itemtest{\labelitem\romannumeral\thetempcounter}
15 % the replacement
16 \meaning\itemtest\par
17 \itemtest

macro:->labelitem
labelitem

```

Call the `\listP.319` sets all parameters and defines a `\makelabelP.325` for this particular environment. This is a good place to also hook other items to decorate the label, if necessary. Remember also that the `\@itemitem`, defined above is just there to facilitate calling `labelitemi ... labelitemn` depending on the level.

```

\expandafter
\list

\csname\@itemitem\endcsname
{\def\makelabel##1{\hss\llap{##1}}}\%
\fi}

```

The astute reader will notice at this point that although we defined the name of `labeli` etc, they still have no meaning. As mentioned earlier there is still some work to be done before we have full lists. These are defined in the standatrd

revised 13-06-2018 classes and the definitions are shown below.

```
24 \newcommand{\labelitemi}{\textbullet}
25 \newcommand{\labelitemii}{\normalfont\bfseries \textendash}
26 \newcommand{\labelitemiii}{\textasteriskcentered}
27 \newcommand{\labelitemiv}{\textperiodcentered}
```

Finally the end of the environment is defined.

```
28 \let\enditemize =\endlist
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

We will make our products work out of the box.

Steve Balmer

## 26.1 Typesetting boxed content

Boxes are an important part of T<sub>E</sub>X's typography and L<sup>A</sup>T<sub>E</sub>X provides numerous macros for handling these, both at the user level, as well as the kernel level. This section of the kernel deals with both storing material in a box to be typeset at a later stage, as well as providing commands for typesetting text within framed or unframed boxes.

R 13/01/2018

Many packages exist that modify these commands and providing settings to typeset a bewildering variety of boxed content. Perhaps the best one so far is **tcolorbox**.

`\makebox→ P.332[⟨wid⟩][⟨pos⟩]{⟨obj⟩}`

Puts ⟨obj⟩ in an **\hbox** of width ⟨wid⟩, positioned by ⟨pos⟩.

The possible ⟨pos⟩ are:

- s** stretched,
- l** flushleft,
- r** flushright,
- c** (default) centred.

If ⟨wid⟩ is missing, then ⟨pos⟩ is also missing and ⟨obj⟩ is put in an **\hbox** of its natural width.

`\makebox(⟨x⟩,⟨y⟩)[⟨pos⟩]{⟨obj⟩}`

Puts ⟨obj⟩ in an **\hbox** of width  $x * \unitlength$  and height  $y * \unitlength$ . ⟨pos⟩ arguments are **s**, **l**, **r** or **c** (default) for stretched, flushleft, flushright or centred, and **t** or **b** for top, bottom – or combinations like **tr** or **rb**. Default for horizontal and vertical are centered. Note that in this picture mode version of **\makebox** a [b] aligns on the *bottom* of the text as documented. If you want to align on the *baseline* use **\makebox( , )[b]{\raisebox{0pt}{\height}[0pt]{xyz}}** or **\makebox( , )[b]{\smash{xyz}}**

### Example 1.1 `makebox`

```

10 \bgroup
11 \parindent0pt
12 \makebox[2\width][l]{example box} \\
13 \makebox[2\width][c]{example box} \\
14 \makebox[2\width][r]{example box} \\
15 \framebox[2\width][s]{example box}
16 \egroup

```

```

example box
example box
example box

```

example box

??<sup>→ P.??</sup> \underline{<text>} : Makes an underlined \hbox with <text> in it.

```
17 %<*2ekernel>
18 \message{boxes,}
```

\makebox

```
19 %</2ekernel>
20 %<latexrelease>\IncludeInRelease{2015/01/01}%
21 %<latexrelease>           {\makebox}{\Make \makebox }%
22 %<*2ekernel|latexrelease>
23 \DeclareRobustCommand\makebox{%
24   \leavevmode
25   \@ifnextchar(%)
26   { \@makepicbox
27   { \@ifnextchar[\@makebox\mbox}{%
28 %<2ekernel|latexrelease>
29 %<latexrelease>\EndIncludeInRelease
30 %<latexrelease>\IncludeInRelease{0000/00/00}%
31 %<latexrelease>           {\makebox}{\Make \makebox }%
32 %<latexrelease>\def\makebox{%
33 %<latexrelease>  \leavevmode
34 %<latexrelease>  \@ifnextchar(%)
35 %<latexrelease>    \@makepicbox
36 %<latexrelease>    { \@ifnextchar[\@makebox\mbox}{%
37 %<latexrelease>\expandafter\let\csname makebox \%
38 %<latexrelease>\endcsname@\undefined
39 %<2ekernel>
```

\mbox{<material>}

The basic horizontal box command for L<sup>A</sup>T<sub>E</sub>X. This starts a paragraph and puts its contents in an \hbox. As expected it will not wrap its text.

```
40 \long\def\mbox#1{\leavevmode\hbox{#1}}
```

**Example 1.2** **mbox**

```
10 \mbox{\fox}
```

The quick brown fox jumps over the lazy dogs.

\@makebox Look for a possible second optional argument (defaults to c).

```

11 \def\@makebox[#1]%
12   \@ifnextchar [{\@imakebox[#1]}{\@imakebox[#1][c]}}

```

(End definition for `\@makebox`.)

`\@begin@tempboxa` Helper macro for supporting `\height`, `\width` etc. Grab #1 into `\@tempboxa` and measure it.

```

13 \long\def\@begin@tempboxa#1{%
14   \begingroup
15     \setbox\@tempboxa#1{\color@begingroup#2\color@endgroup}%
16     \def\width{\wd\@tempboxa}%
17     \def\height{\ht\@tempboxa}%
18     \def\depth{\dp\@tempboxa}%
19     \let\totalheight\ovr
20     \totalheight\height
21     \advance\totalheight\depth}

```

(End definition for `\@begin@tempboxa`.)

`\@end@tempboxa` End the group started by `\@begin@tempboxa`, so that the scope of `\height` only includes the ‘length’ argument to the user-command.

```
22 \let\@end@tempboxa\endgroup
```

(End definition for `\@end@tempboxa`.)

`\bm@c` Set up spacing.

```

\bm@l 23 \def\bm@c{\hss\unhbox\@tempboxa\hss}
\bm@r 24 \def\bm@l{\unhbox\@tempboxa\hss}\let\bm@t\bm@l
\bm@s 25 \def\bm@r{\hss\unhbox\@tempboxa}\let\bm@b\bm@r
\bm@t 26 \def\bm@s{\unhbox\@tempboxa}
\bm@b

```

(End definition for `\bm@c` and others.)

`\@imakebox`

```

27 \long\def\@imakebox[#1][#2]#3{%
28   \@begin@tempboxa\hbox{#3}%
29     \setlength\@tempdima{#1}%      support calc
30     \hb@xt@\@tempdima{\csname\csname\bm@#2\endcsname\endcsname}%
31   \@end@tempboxa}

```

(End definition for `\@imakebox`.)

`\@makepicbox` Picture mode form of `\makebox`.

```

32 \def\@makepicbox(#1,#2){%
33   \@ifnextchar [{\@imakepicbox(#1,#2)}{\@imakepicbox(#1,#2)[[]]}}

```

(End definition for `\@makepicbox`.)

`\@imakepicbox` picture mode version

```

34 \long\def\@imakepicbox(#1,#2)[#3]{%
35   \vbox to#2\unitlength
36   { \let\mb@b\vss \let\mb@l\hss \let\mb@r\hss
37     \let\mb@t\vss
38     \atfor\reserved@a :=#3\do{%
39       \if s\reserved@a
40         \let\mb@l\relax\let\mb@r\relax
41       \else
42         \expandafter\let\csname mb@\reserved@a\endcsname\relax
43       \fi}%
44     \mb@t
45     \hb@xt@ #1\unitlength{\mb@l #4\mb@r}%
46   \mb@b

```

This kern ensures that a **b** option aligns on the bottom of the text rather than the baseline. this is the documented behaviour in the L<sup>A</sup>T<sub>E</sub>XBook. The kern is removed in compatibility mode.

```
47   \kern\z@}}
```

*(End definition for \@imakepicbox.)*

**\set@color** This macro is initially a no-op, but the colour package will redefine it to insert a **\special**.

```
48 \let\set@color\relax
```

*(End definition for \set@color.)*

**\color@begingroup** **\color@endgroup** **\color@setgroup** **\normalcolor** These macros are initially a no-op, but the colour package will redefine them to be **\begingroup**, **\endgroup**, **\begingroup\set@color**, **\hbox\bgroup\color@begingroup**, **\color@endgroup\egroup**. and **<set to main document colour>** respectively.

```

\color@hbox 49 \let\color@begingroup\relax
\color@vbox 50 \let\color@endgroup\relax
\color@endbox 51 \let\color@setgroup\relax
52 \let\normalcolor\relax
53 \let\color@hbox\relax
54 \let\color@vbox\relax
55 \let\color@endbox\relax

```

*(End definition for \color@begingroup and others.)*

## 26.2 Saving material in a box

To save material in a variable we can use the **\newsavebox** to create the variable and the **\savebox**<sup>→ P. 335</sup> to save it.

**\newsavebox**

Allocate a new ‘savebox’.

```
56 \def\newsavebox#1{\@ifdefinable{#1}{\newbox#1}}
```

**\savebox**

Save #1 in a box register.

```

57 %</2ekernel>
58 %<latexrelease>\IncludeInRelease{2015/01/01}%
59 %<latexrelease>          {\savebox}{\Make \savebox }%
60 {robust}%
61 \DeclareRobustCommand\savebox[1]{%
62   \@ifnextchar(%)
63     {\@savepicbox#1}{\@ifnextchar[\{\@savebox#1{\sbox#1}\}}%
64 %<2ekernel|latexrelease>
65 %<latexrelease>\EndIncludeInRelease
66 %<latexrelease>\IncludeInRelease{0000/00/00}%
67 %<latexrelease>          {\savebox}{\Make \savebox }%
68 {robust}%
69 %<latexrelease>\def\savebox#1{%
70 %<latexrelease>  \@ifnextchar(%)
71 %<latexrelease>    )%
72   {\@savepicbox#1}{\@ifnextchar[\{\@savebox#1{\sbox#1}\}}%
73 %<2ekernel>
74 %<2ekernel>\expandafter\let\csname savebox \endcsname\undefined
75 %<2ekernel>\EndIncludeInRelease
76 %<2ekernel>
```

**\sbox{(box register)}**

Save #1 in a box register.

```

74 \long\def\sbox#1#2{\setbox#1\hbox{%
75   \color@setgroup#2\color@endgroup}%
76 \def\@savebox#1[#2]{%
77   \@ifnextchar [\{\@isavebox#1[#2]\}{\@isavebox#1[#2][c]}%
78 \long\def\@isavebox#1[#2][#3]#4{%
79   \sbox#1{\@imakebox[#2][#3]{#4}}%
80 \def\@savepicbox#1(#2,#3){%
81   \@ifnextchar [%]
82     {\@isavepicbox#1(#2,#3)}{\@isavepicbox#1(#2,#3)[[]]}%
83 \long\def\@isavepicbox#1(#2,#3)[#4]#5{%
84   \sbox#1{\@imakepicbox(#2,#3)[#4]{#5}}}
```

**\begin{lrbox}{(material)}(environment content)\end{lrbox}**

**lrbox:** the new environment form of **\sbox**. Use **\aftergroup** tricks to enable a *local* assignment to be made to the box, in a way that it still has an effect *outside* the **lrbox** environment.

```

85 \def\lrbox#1{%
86   \edef\reserved@a{%
87     \endgroup
88     \setbox#1\hbox{%
```

```

89      \begingroup\aftergroup}%
90          \def\noexpand{@currenvir{\@currenvir}%
91          \def\noexpand@currenline{\on@line}}%
92 \reserved@a
93     \@endpefalse
94     \color@setgroup
95     \ignorespaces}

\endlrbox
96 \def\endlrbox{\unskip\color@endgroup}

```

*(End definition for \endlrbox.)*

### \usebox{<name>}

Convenience command to typeset the box contents. It uses copy so that it does not destroy the contents of the \box.

```
97 \def\usebox#1{\leavevmode\copy #1\relax}
```

\frame The following definition of \frame was written by Pavel Curtis

```

98 \long\def\frame#1{%
99   \leavevmode
100  \hbox{%
101    \hskip-\@wholewidth
102    \vbox{%
103      \vskip-\@wholewidth
104      \hrule\@height\@wholewidth
105      \hbox{%
106        \vrule\@width\@wholewidth
107        #1%
108        \vrule\@width\@wholewidth}%
109      \hrule\@height\@wholewidth
110      \vskip-\@wholewidth}%
111    \hskip-\@wholewidth}}

```

*(End definition for \frame.)*

### \fboxrule

User macro to set the width of the \fbox rule.

### \fboxsep

User level macro to set the padding of an \fbox.

```

112 \newdimen\fboxrule
113 \newdimen\fboxsep

```

### \fbox

```

114 \long\def\fbox#1{%
115   \leavevmode
116   \setbox\@tempboxa\hbox{%
117     \color@begingroup
118     \kern\fboxsep{#1}\kern\fboxsep
119     \color@endgroup}%
120   \@frameb@x\relax}

\framebox{{<material>}}
121 %</2ekernel>
122 %<latexrelease>\IncludeInRelease{2015/01/01}%
123 %<latexrelease>          {\framebox}{\Make \framebox } %
124           \robust}%
125 %<*2ekernel|latexrelease>
126 \DeclareRobustCommand\framebox{%
127   \@ifnextchar(%)
128     \@framepicbox{\@ifnextchar[\@framebox\fbox}{}}%
129 %</2ekernel|latexrelease>
130 %<latexrelease>\EndIncludeInRelease
131 %<latexrelease>          {\framebox}{\Make \framebox } %
132           \robust}%
133 %<latexrelease>  \@ifnextchar(%)
134 %<latexrelease>    \%
135           \(\@framepicbox{\@ifnextchar[\@framebox\fbox}{}}\%
136 %<latexrelease>\expandafter\let\csname framebox \%
137           \endcsname\@undefined
138 %<latexrelease>\EndIncludeInRelease
139 %<*2ekernel>

```

\@framebox Deal with optional arguments.

```

138 \def\@framebox[#1]{%
139   \@ifnextchar[%]
140     {\@iframebox[#1]}%
141     {\@iframebox[#1][c]}}

```

(End definition for \@framebox.)

\@iframebox The handling the optional arguments. In order to set the whole box, including the frame to the specified dimension, we first determine that dimension from the natural size of the text, #3. calculated width.

```

142 \long\def\@iframebox[#1][#2]{#3}{%
143   \leavevmode
144   \begin{tempboxa}\hbox{#3}%
145     \setlength\@tempdima{#1}%
146     \setbox\@tempboxa\hb@xt@\@tempdima
147       \kern\fboxsep\csname bm@#2\endcsname\kern\fboxsep}%
148     \frameb@x{\kern-\fboxrule}%
149   \end{tempboxa}

```

(End definition for \@iframebox.)

```

150 \def\@frameb@#1{%
151   \@tempdima\fboxrule
152   \advance\@tempdima\fboxsep
153   \advance\@tempdima\dp\@tempboxa
154   \hbox{%
155     \lower\@tempdima\hbox{%
156       \vbox{%
157         \hrule\@height\fboxrule
158         \hbox{%
159           \vrule\@width\fboxrule
160           #1%
161           \vbox{%
162             \vskip\fboxsep
163             \box\@tempboxa
164             \vskip\fboxsep}%
165           #1%
166           \vrule\@width\fboxrule}%
167           \hrule\@height\fboxrule}%
168         }%
169       }%
170   }
171 \def\@framepicbox[#1,#2]{%
172   \@ifnextchar[\{\@framepicbox(#1,#2)\}{\@framepicbox(#1,#2)[[]]}
173 \long\def\@framepicbox[#1,#2][#3]#4{%
174   \frame{\@imakepicbox(#1,#2)[#3]{#4}}}
175 %</2ekernel>
176 %<latexrelease>\IncludeInRelease{2015/01/01}%
177 %<latexrelease>          {\parbox}{\Make \parbox robust}%
178 %<2ekernel|latexrelease>
179 \DeclareRobustCommand\parbox{%
180   \@ifnextchar[%]
181   \iparbox
182   {\@iiparbox c\relax[s]}%
183 %</2ekernel|latexrelease>
184 %<latexrelease>\EndIncludeInRelease
185 %<latexrelease>\IncludeInRelease{0000/00/00}%
186 %<latexrelease>          {\parbox}{\Make \parbox robust}%
187 %<latexrelease>\def\parbox{%
188 %<latexrelease>  \@ifnextchar[%]
189 %<latexrelease>    \iparbox
190 %<latexrelease>    {\@iiparbox c\relax[s]}%
191 %<latexrelease>\expandafter\let\csname parbox \%
192   \endcsname\@undefined
193 %<2ekernel>
194 \def\@iparbox[#1]{%
195   \@ifnextchar[%]
196   {\@iiparbox{#1}}%
197   {\@iiparbox{#1}\relax[s]}}
198 \def\@iiparbox#1[#2]{%
199   \@ifnextchar[%]
200   {\@iiparbox{#1}{#2}}%

```

```

201      {\@iiparbox{\#1}{\#2}[\#1]}}
202 \let\@parboxto\empty
203 \long\def\@iiparbox#1#2[#3]#4#5{%
204   \leavevmode
205   \@pboxswfalse
206   \setlength{\tempdima{#4}%
207   \begin{tempboxa}\vbox{\hsize\tempdima\parboxrestore#5\@par}%
208     \ifx\relax#2\else
209       \setlength{\tempdimb{#2}%
210       \edef\@parboxto{to\the\tempdimb}%
211     \fi
212     \if#1b\vbox
213     \else\if #1t\vtop
214     \else\ifmmode\vcenter
215     \else\@pboxswtrue \$\vcenter
216     \fi\fi\fi
217     \parboxto{\let\hss\vss\let\unhbox\unvbox
218       \csname bm@\#3\endcsname}%
219     \if@pboxsw \m@th\$ \fi
220   \end{tempboxa}}
221 %</2ekernel>
222 %<latexrelease>\IncludeInRelease{2017-04-15}%
223 %<latexrelease>          {\normallineskip}
224 %<latexrelease>          {reset \lineskip}%
225 %<2ekernel|latexrelease>
226 \def\@arrayparboxrestore{%
227   \let\ifnobreak\iffalse
228   \let\ifnoskipsec\iffalse
229   \let\par\@@par
230   \let\-\@dischyp
231   \let'\@acci\let`\@acci\let\=@acci
232   \parindent\z@ \parskip\z@skip
233   \everypar{}%
234   \linewidth\hsize
235   \totallleftmargin\z@
236   \leftskip\z@skip \rightskip\z@skip \rightskip\z@skip
237   \parfillskip\@flushglue
238   \lineskip\normallineskip
239   \lineskip\lineskip\normallineskip
240   \baselineskip\normalbaselineskip
241   \sloppy}
242 %</2ekernel|latexrelease>
243 %<latexrelease>\EndIncludeInRelease
244 %<latexrelease>\IncludeInRelease{0000-00-00}%
245 %<latexrelease>          {\normallineskip}
246 %<latexrelease>          {reset \lineskip}%
247 %<latexrelease>\def\@arrayparboxrestore{%
248 %<latexrelease> \let\ifnobreak\iffalse
249 %<latexrelease> \let\ifnoskipsec\iffalse
250 %<latexrelease> \let\par\@@par
251 %<latexrelease> \let\-\@dischyp

```

```

252 %<latexrelease> \let'\@acci\let`\@acci\let\=@acci
253 %<latexrelease> \parindent\z@\parskip\z@skip
254 %<latexrelease> \everypar{}%
255 %<latexrelease> \linewidth\hsize
256 %<latexrelease> \@totallleftmargin\z@
257 %<latexrelease> \leftskip\z@skip \rightskip\z@skip %
258 %<latexrelease> \parfillskip\@flushglue %
259 %<latexrelease> \lineskip\normalineskip
260 %<latexrelease> \sloppy}
261 %<latexrelease>\EndIncludeInRelease
262 %<*2ekernel>
263 \def\@parboxrestore{\@arrayparboxrestore\let\\=\@normalcr}

```

**\if@minipage** Switch that is true at the start of a minipage.

```

264 \def\@minipagefalse{\global\let\if@minipage\iffalse}
265 \def\@minipagetrue {\global\let\if@minipage\iftrue}
266 \global\if@minipagefalse

```

(End definition for `\if@minipage`.)

**\minipage** Essentially an environment form of `\parbox`.

```

267 \def\minipage{%
268   \ifnextchar[%]
269     \imminipage
270     {\iiiminipage c\relax[s]}}

```

(End definition for `\minipage`.)

**@imminipage** Optional argument handling.

```

271 \def\@imminipage[#1]{%
272   \ifnextchar[%]
273     {\iiiminipage[#1]}%
274     {\iiiminipage[#1]\relax[s]}}

```

(End definition for `\@imminipage`.)

**@iiiminipage** Optional argument handling.

```

275 \def\@iiiminipage#1[#2]{%
276   \ifnextchar[%]
277     {\iiiminipage[#1]{#2}}%
278     {\iiiminipage[#1]{#2}[#1]}}

```

(End definition for `\@iiiminipage`.)

**\iiiminipage**

```

279 \def\@iiiminipage#1#2[#3]{%
280   \leavevmode
281   \pboxswfalse

```

```

282   \setlength{\tempdima{#4}}%
283   \def\@mpargs{{#1}{#2}[#3]{#4}}%
284   \setbox\@tempboxa\vbox\bgroup
285     \color@begingroup
286       \hsize\@tempdima
287       \textwidth\hsize \columnwidth\hsize
288       \parboxrestore
289       \def\@mpfn{mpfootnote}\def\thempfn{\thempfootnote}\c@mpfootnote\z@
290       \let\@footnotetext\@mpfootnotetext
291       \let\@listdepth\@mplistdepth \mplistdepth\z@
292       \minipagerestore
293     \setminipage

```

*(End definition for \@iiiminipage.)*

\@minipagerestore Hook so that other styles can reset other commands in a minipage.

```
294 \let\@minipagerestore=\relax
```

*(End definition for \@minipagerestore.)*

### \endminipage

```

295 \def\endminipage{%
296   \par
297   \unskip
298   \ifvoid\@mpfootins\else
299     \vskip\skip\@mpfootins
300     \normalcolor
301     \footnoterule
302     \unvbox\@mpfootins
303   \fi
304   \minipagetrue %% added 24 May 89
305   \color@endgroup
306   \egroup
307   \expandafter\@iiparbox\@mpargs{\unvbox\@tempboxa}}

```

\@mplistdepth

```
308 \newcount\@mplistdepth
309 \newinsert\@mpfootins
```

*(End definition for \@mplistdepth and \@mpfootins.)*

```

310 \long\def\@mpfootnotetext#1{%
311   \global\setbox\@mpfootins\vbox{%
312     \unvbox\@mpfootins
313     \reset@font\footnotesize
314     \hsize\columnwidth
315     \parboxrestore
316     \protected@edef\@currentlabel
317       {\csname p@mpfootnote\endcsname\@thefnmark}%
318     \color@begingroup
319       \makefntext{%
320         \rule\z@\footnotesep\ignorespaces#1\@finalstrut\strutbox}%
321     \color@endgroup}

```

```

322 \newif\if@pboxsw
323 %</2ekernel>
324 %<latexrelease>\IncludeInRelease{2015/01/01}%
325 %<2ekernel>                                {\rule}{\rule robust}%
326 %<2ekernel|latexrelease>
327 \DeclareRobustCommand\rule{\@ifnextchar[\@rule{\@rule[\z@]}{%
328 %</2ekernel|latexrelease>
329 %<2ekernel>\EndIncludeInRelease
330 %<2ekernel>\IncludeInRelease{0000/00/00}%
331 %<2ekernel>                                {\rule}{\rule robust}%
332 %<2ekernel>\def\rule{\@ifnextchar[\@rule{\@rule[\z@]}{%
333 %<2ekernel>\expandafter\let\csname rule %
334 %<2ekernel>\endcsname\@undefined
335 %<2ekernel>
336 \def\rule[#1]{%
337   \leavevmode
338   \hbox{%
339     \setlength\@tempdima{#1}%
340     \setlength\@tempdimb{#2}%
341     \setlength\@tempdimc{#3}%
342     \advance\@tempdimc\@tempdima
343     \vrule\@width\@tempdimb\@height\@tempdimc\@depth-\@tempdima}%
344 \let\@underline\underline
345 \def\underline#1{%
346   \relax
347   \ifmmode\@underline{#1}%
348   \else \$\@underline{\hbox{#1}}\m@th\$ \relax\fi}
349 %</2ekernel>
350 %<2ekernel>\IncludeInRelease{2015/01/01}%
351 %<2ekernel>                                {\raisebox}{\raisebox } %
352 %<2ekernel|latexrelease>
353 \DeclareRobustCommand\raisebox[1]{%
354   \leavevmode
355   \@ifnextchar[\{\@rsbox{#1}\}{\@irsbox{#1}[]]}
356 %<2ekernel|latexrelease>
357 %<2ekernel>\EndIncludeInRelease
358 %<2ekernel>\IncludeInRelease{0000/00/00}%
359 %<2ekernel>                                {\raisebox}{\raisebox } %
360 %<2ekernel>\def\raisebox#1{%
361 %<2ekernel>   \leavevmode
362 %<2ekernel>   \@ifnextchar[\{\@rsbox{#1}\}{\@irsbox{#1}[]}]
363 %<2ekernel>\expandafter\let\csname raisebox %
364 %<2ekernel>\endcsname\@undefined
365 %<2ekernel>
366 \def\@rsbox#1[#2]{%
367   \@ifnextchar[\{\@irsbox{#1}[#2]\}{\@irsbox{#1}[#2]}}}
```

```

368 \long\def\@irsbox#1[#2]#3{%
369   \begin{tempboxa}\hbox{#3}%
370     \setlength{\tempdima}{#1}%
371     \ifx\#2\else\setlength{\tempdimb}{#2}\fi
372     \setbox\@tempboxa\hbox{\raise\tempdima\box\@tempboxa}%
373     \ifx\#2\else\ht\@tempboxa\@tempdimb\fi
374     \box\@tempboxa
375   \end{tempboxa}
376 \long\def\@iirsbox#1[#2][#3]{%
377   \begin{tempboxa}\hbox{#4}%
378     \setlength{\tempdima}{#1}%
379     \setlength{\tempdimb}{#2}%
380     \setlength{\dimen@}{#3}%
381     \setbox\@tempboxa\hbox{\raise\tempdima\box\@tempboxa}%
382     \ht\@tempboxa\@tempdimb
383     \dp\@tempboxa\dimen@
384     \box\@tempboxa
385   \end{tempboxa}

```

- \@finalstrut** This macro adds a special strut the *depth* of the box given as #1, and height and width opt. It is used for ensuring that the last line of a paragraph has the correct depth in ‘p’ columns of tables and in footnotes. In vertical mode nothing is done, as adding the strut (as done in 2.09) would start a new paragraph. It would be possible to inspect `\prevdepth` to check the depth of the just-completed paragraph, but we do not do that here. The `\nobreak` was added (1995/10/31) to allow hyphenation of the final word of the paragraph.

```

386 \def\@finalstrut#1{%
387   \unskip\ifhmode\nobreak\fi\vrule\@width\z@\@height\z@\@depth\dp#1}

```

(End definition for `\@finalstrut`.)

### 26.2.1 Some low-level constructs

The following commands are basically inherited from plain T<sub>E</sub>X. Note the use of `\@@line` to refer to the original Plain T<sub>E</sub>X macros.

**\leftline{<material>}**

```
388 \def\leftline#1{\@@line{#1\hss}}
```

**\rightline** These macros place text on a full line either centred or left or right adjusted.

```

\centerline 389 \def\@line{\hbox{\hsize}
\@@line 390 \def\rightline#1{\@@line{\hss#1}}
391 \def\centerline#1{\@@line{\hss#1\hss}}

```

(End definition for `\rightline`, `\centerline`, and `\@@line`.)

Finally the lapping macros are defined.

**\rlap** These macros place text to the left or right of the current reference point without taking up space.

```
392 \def\rlap{\hbox@xt@\z@{\#1\hss}}  
393 \def\llap{\hbox@xt@\z@{\hss\#1}}
```

(End definition for `\rlap` and `\llap`.)

## 26.3 Concluding remarks

The macros just defined are really core concepts introduced in L<sup>A</sup>T<sub>E</sub>X 2e. Many package authors have produced similar macros to improve the looks of the boxing commands. The L<sup>A</sup>T<sub>E</sub>X 3 Team is currently working to produce some of these concepts as part of the `xpackages`. However many of what has been described here will probably substantially change at the author level, through the use of templates.

```
394 %</2ekernel>
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

This section deals with ‘Lining It Up in Columns’. First the **tabbing** environment is defined, and then in second part, **tabular** together with its variants, **tabular\*** and **array**. Note that the **tabular** defined here is essentially the original L<sup>A</sup>T<sub>E</sub>X 2.09 version, not the extended version described in *The L<sup>A</sup>T<sub>E</sub>X Companion*. Use the **array** package to obtain the extended version.

### 27.0.1 tabbing

- \a The accents \` , \' , and \= that have been redefined inside a tabbing environment can be called by typing \a` , \a' , and \a=. The macro \a is defined in **ltoutenc.dtx**.

(End definition for \a.)

```

395 %<2ekernel>\expandafter\let\csname \over@autotabg.sty\endcsname\fmtversion
396 %<>2ekernel>
397 \newdimen\@gtempa
398 \chardef\firstab=\the\allocationnumber
399 \newdimen\@gtempa\newdimen\@gtempa\newdimen\@gtempa\newdimen\@gtempa
400 \newdimen\@gtempa\newdimen\@gtempa\newdimen\@gtempa\newdimen\@gtempa
401 \newdimen\@gtempa\newdimen\@gtempa\newdimen\@gtempa\newdimen\@gtempa
402 \newdimen\@gtempa
403 \chardef\maxtab=\the\allocationnumber
404 \dimen\firstab=0pt
405 \newcount\@nxttabmar
406 \newcount\@curtabmar
407 \newcount\@curtab
408 \newcount\@hightab
409 \newcount\@tabpush
410 \newbox\@curline
411 \newbox\@curfield
412 \newbox\@tabfbox
413 \newif\if@rjfield
414 \gdef\@startline{%
415   \ifnum\@nxttabmar>\@hightab
416     \@badtab
417     \global\@nxttabmar\@hightab
418   \fi
419   \global\@curtabmar\@nxttabmar
420   \global\@curtab\@curtabmar
421   \global\setbox\@curline\hbox{}%
422   \@startfield
423   \strut}
424 \gdef\@stopline{%
425   \unskip
426   \@stopfield}
```

```

427  \if@rjfield
428    \global\@rjfieldfalse
429    \tempdima\@totalleftmargin
430    \advance\tempdima\ linewidth
431    \hb@xt@\tempdima{%
432      \itemfudge\hskip\dimen\@curtabmar
433      \box\@curline
434      \hfil
435      \box\@curfield}%
436  \else
437    \addfield
438    \hbox{\itemfudge\hskip\dimen\@curtabmar\box\@curline}%
439  \fi}
440 \gdef\@startfield{%
441   \global\setbox\@curfield\hbox\bgroup\color@begingroup}
442 \gdef\@stopfield{%
443   \color@endgroup\egroup}
444 \gdef\@contfield{%
445   \global\setbox\@curfield\hbox\bgroup\color@begingroup
446   \unhbox\@curfield}
447 \gdef\@addfield{\global\setbox\@curline\hbox{\unhbox
448   \@curline\unhbox\@curfield}}
449 \gdef\@ifatmargin{\ifdim \wd\@curline =\z@}
450 \gdef\@tabcr{\@stopline \ifstar{\penalty \M@D
451   \x@tabcr}\x@tabcr}
452 \gdef\@itabcr[#1]{\vskip #1\@startline\ignorespaces}
453 \gdef\kill{\@stopfield\@startline\ignorespaces}
454 \gdef\tabbing{\lineskip \z@
455   \z@skip\let\@rtab\let\<\@ltab\let\=\@settab
456   \let\+\@tabplus\let\-\@tabminus\let\`{\@tabrj\let\'{\@tablab
457   \let\=\@tabcr
458   \hightab\@firsttab
459   \global\@nxtabmar\@firsttab
460   \dimen\@firsttab\@totalleftmargin
461   \global\@tabpush\z@ \global\@rjfieldfalse
462   \trivlist \item\relax
463   \if@minipage\else\vskip\parskip\fi
464   \setbox\@tabfbox\hbox{%
465     \rlap{\hskip\@totalleftmargin\ indent\ the\everypar}}%
466   \atopline\ignorespaces}
467 \gdef\endtabbing{%
468   \atopline\ifnum\@tabpush >\z@ \badpoptabs \fi\endtrivlist}
469 \gdef\@rtab{\@stopfield\@addfield\ifnum \curtab<\hightab
470   \global\advance\@curtab \one \else\badtab\fi
471   \tempdima\dimen\@curtab

```

```

472     \advance@\tempdima -\dimen@\curtabmar
473     \advance@\tempdima -\wd@\curline
474     \global\setbox@\curline\hbox{\unhbox@\curline\hskip@\tempdima}%
475     @startfield\ignorespaces}
476 \gdef\@settab{\@stopfield\@addfield
477   \ifnum \@curtab < \@maxtab
478     \ifnum \@curtab = \@hightab
479       \advance@\hightab \@ne
480     \fi
481     \global\advance@\curtab \@ne
482   \else
483     \@latex@error{Tab overflow}\@ehd
484   \fi
485   \dimen@\curtab \dimen@\curtabmar
486   \advance\dimen@\curtab \wd@\curline
487   @startfield
488   \ignorespaces}
489 \gdef\@ltab{@ifatmargin\ifnum@\curtabmar > \@firsttab
490   \global\advance@\curtab \m@ne }
491   \global\advance@\curtabmar\m@ne\else
492   \@badtab\fi\else
493   \@latex@error{\string<\space in mid }
494   \line}\@ehd\fi\ignorespaces}
495 \gdef\@tabplus{%
496   \ifnum@\nxttabmar<@\hightab
497     \global\advance@\nxttabmar\@ne
498   \else
499     \@badtab
500   \fi
501   \ignorespaces}
502 \gdef\@tabminus{%
503   \ifnum@\nxttabmar>@\firsttab
504     \global\advance@\nxttabmar\m@ne
505   \else
506     \@badtab
507   \fi
508   \ignorespaces}
509 \gdef\@tabrj{%
510   \@stopfield
511   \global\setbox@\curline\hbox{%
512     \box@\curline
513     \hskip-\wd@\curfield \hskip-\tabbingsep
514     \box@\curfield
515     \hskip\tabbingsep}%
516   @startfield
517   \ignorespaces}
518 \gdef\pushtabs{%
519   \@stopfield\@addfield\global\advance@\tabpush \@ne }
520   \begingroup

```

```

520      \@contfield}
521 \gdef\poptabs{\@stopfield\@addfield
522   \ifnum \@tabpush >\z@
523     \endgroup
524     \global\advance\@tabpush \m@ne
525   \ifnum \@curtab >\@hightab
526     \global \@curtab \@hightab
527     \@badtab
528   \fi
529 \else
530   \@badpoptabs
531 \fi
532 \@contfield}
533 \newdimen\tabbingsep

```

## 27.1 array and tabular environments

```

534 \def\extracolsep#1{\tabskip #1\relax}
535 \def\array{\let\@acol\@arrayacol \let\@classz\@arrayclassz
536 \let\@classiv\@arrayclassiv
537 \let\\@\arraycr\let\@halignto\@empty\@tabarray}
538 \def\endarray{\crcr\egroup\egroup}
539 \def\endtabular{\crcr\egroup\egroup \$\egroup}
540 \expandafter \let \csname endtabular*\endcsname = \endtabular
541 \def\tabular{\let\@halignto\@empty\@tabular}
542 \namedef{tabular*}{#1}{%
543   \setlength\dimen@{#1}%
544   \edef\@halignto{to\the\dimen@}\@tabular}
545 \def\@tabular{\leavevmode \hbox \bgroup \$\let\@acol\@tabacol
546 \let\@classz\@tabclassz
547 \let\@classiv\@tabclassiv \let\\@\tabularcr\@tabarray}
548 \def\@tabarray{\m@th\@ifnextchar[\@array{\@array[c]}}
549 \def\@array[#1]{%
550   \if #1t\vtop \else \if#1b\vbox \else \vcenter \fi\fi
551   \bgroup
552   \setbox\@arstrutbox\hbox{%
553     \vrule \height\arraystretch\ht\strutbox
554     \depth\arraystretch \dp\strutbox
555     \width\z@}%
556   \mkpream{#2}%
557   \edef\@preamble{%
558     \ialign \noexpand\@halignto
559     \bgroup \arstrut \preamble \tabskip\z@skip \cr}%
560   \let\@startpbox\@startpbox \let\@endpbox\@endpbox
561 \let\tabularnewline\\%
562   \let\par\empty

```

```

563   \let\@sharp##%
564   \set@typeset@protect
565   \lineskip\z@skip\baselineskip\z@skip
566   \ifhmode \@preamerr\z@ \@@par\fi
567   \@preamble}

568 \def\@arraycr{%
569   ${\{\ifnum0=\ }}\fi\@ifstar\@xarraycr\@xarraycr}
570 \def\@xarraycr{\@ifnextchar[\@argarraycr{\ifnum0=\{\fi}{}{\cr}}}
571 \def\@argarraycr[#1]{%
572   \ifnum0=\{\fi}{}{\ifdim #1>\z@ \@xargarraycr[#1]\else
573   \@yargarraycr[#1]\fi}
574 \let\tabularnewline\relax
575 \def\@tabularcr{%
576   {\ifnum0=\ }}\fi\@ifstar\@xtabularcr\@xtabularcr}
577 \def\@xtabularcr{\@ifnextchar[\@argtabularcr{\ifnum0=\{\fi}\cr}}
578 \def\@argtabularcr[#1]{%
579   \ifnum0=\{\fi}%
580   \ifdim #1>\z@
581   \unskip\@xargarraycr[#1]%
582   \else
583   \@yargarraycr[#1]%
584   \fi}
585 \def\@xargarraycr#1{\@tempdima #1\advance\@tempdima \dp \arstrutbox
586   \vrule \height\z@ \depth\@tempdima \width\z@ \cr}
587 \def\@yargarraycr#1{\cr\noalign{\vskip #1}}
588 \long\def\multicolumn#1#2#3{\multispan{#1}\begingroup
589   \mkpream{#2}%
590   \def\@sharp{#3}\set@typeset@protect
591   \let\@startpbox\@@startpbox\let\@endpbox\@@endpbox
592   \arstrut \preamble\hbox{}\endgroup\ignorespaces}
593 \def\xexnoop #1@@{%
594 \def\@expast#1{\@xexpast #1*0x@@}
595 \def\@xexpast#1*#2#3#4@@{%
596   \edef\reserved@a{\#1}%
597   \tempcnta#2\relax
598   \ifnum\tempcnta>\z@
599   \whilenum\tempcnta>\z@\do
600     {\edef\reserved@a{\reserved@a#3}\advance\tempcnta \m@ne}%
601   \let\reserved@b\@xexpast
602   \else
603   \let\reserved@b\@xexnoop
604   \fi
605   \expandafter\reserved@b\reserved@a #4@@}
606 \newif\if@firstamp

```

```

607 \def\@addamp{%
608   \if@firstamp
609     \@firstampfalse
610   \else
611     \edef\@preamble{\@preamble &}%
612   \fi}
613 \def\@arrayacol{\edef\@preamble{\@preamble \hskip 2
614   \arraycolsep}}
614 \def\@tabacol{\edef\@preamble{\@preamble \hskip \tabcolsep}}
615 \def\@ampacol{\@addamp \@acol}
616 \def\@acolampacol{\@acol\@addamp\@acol}
617 \def\@mkpream#1{\@firstamptrue\@lastchclass6
618   \let\@preamble\empty
619   \let\protect\unexpandable@protect
620   \let\sharp\relax
621   \let\startpbox\relax\let\endpbox\relax
622   \expast{\#1}%
623   \expandafter\@tfor \expandafter
624     \nextchar \expandafter:\expandafter=\reserved@a\do
625       {\@testpach\@nextchar
626        \ifcase \chclass \classz \or \classi \or \classii \or
627          \or \classiii
628        \or \classiv \or \classv \fi\@lastchclass\chclass}%
629   \ifcase \@lastchclass \acol
630     \or \or \preamerr \ne \or \preamerr \tw@ \or \or
631       \acol \fi}
630 \def\@arrayclassz{\ifcase \lastchclass \acolampacol \or
631   \or \or \@addamp \or
632   \or \acolampacol \or \if@firstampfalse \acol \fi
633 \edef\@preamble{\@preamble
634   \ifcase \chnum
635     \hfil\relax\sharp\hfil \or \$\relax\sharp\$hfil
636     \or \hfil\relax\sharp\$ \fi}}
637 \def\@tabclassz{%
638   \ifcase\lastchclass
639     \acolampacol
640   \or
641     \ampacol
642   \or
643   \or
644   \or
645     \addamp
646   \or
647     \acolampacol
648   \or
649     \if@firstampfalse\acol
650   \fi
651 \edef\@preamble{%
652   \@preamble%
653   \ifcase\chnum
654     \hfil\ignorespaces\sharp\unskip\hfil

```

```

655      \or
656          \hskip1sp\ignorespaces\@sharp\unskip\hfil
657      \or
658          \hfil\hskip1sp\ignorespaces\@sharp\unskip
659      \fi}}}

660 \def\@classif{%
661   \ifcase\@lastchclass
662     \@acol\@arrayrule
663   \or
664     \@addtopreamble{\hskip \doublerulesep}\@arrayrule
665   \or
666   \or
667   \or
668     \@arrayrule
669   \or
670     \@acol\@arrayrule
671   \or
672     \@arrayrule
673   \fi}

674 \def\@classii{%
675   \ifcase\@lastchclass
676   \or
677     \@addtopreamble{\hskip .5\arrayrulewidth}%
678   \fi}

679 \def\@classiii{\ifcase\@lastchclass \@acolampacol \or
680   \@addamp\@acol \or
681   \or \or \@addamp \or
682   \@acolampacol \or \@ampacol \fi}

683 \def\@tabclassiv{\@addtopreamble\@nextchar}
684 \def\@arrayclassiv{\@addtopreamble{$\@nextchar$}}
685 \def\@classv{\@addtopreamble{@startpbox{\@nextchar}\ignorespaces
686   \@sharp\@endpbox}}
687 \def\@addtopreamble#1{\edef\@preamble{\@preamble #1}}
688 \newcount\@chclass
689 \newcount\@lastchclass
690 \newcount\@chnum
691 \newdimen\arraycolsep
692 \newdimen\tabcolsep
693 \newdimen\arrayrulewidth
694 \newdimen\doublerulesep
695 \def\arraystretch{1}    % Default value.
696 \newbox\@arstrutbox
697 \def\@arstrut{%
698   \relax\ifmmode\copy\@arstrutbox\else\unhccopy\@arstrutbox\fi}
699 \def\@arrayrule{\@addtopreamble{\hskip -.5\arrayrulewidth
700   \vrule \@width \arrayrulewidth\hskip -.5\arrayrulewidth}}

```

```

701 \def\@testpach#1{\@chclass \ifnum \@lastchclass=\tw@ 4 \else
702     \ifnum \@lastchclass=3 5 \else
703         \z@ \if #1c\@chnum \z@ \else
704             \if #1l\@chnum \@ne \else
705                 \if #1r\@chnum \tw@ \else
706                     \@chclass \if #1|\@ne \else
707                         \if #1@\tw@ \else
708                             \if #1p3 \else \z@ \@preamerr 0\fi
709                         \fi \fi \fi \fi \fi \fi
710 \fi}

711 \def\hline{%
712     \noalign{\ifnum0=`}\fi\hrule \@height \arrayrulewidth \futurelet
713     \reserved@a\@xhline}

714 \def\@xhline{\ifx\reserved@a\hline
715     \vskip\doublerulesep
716     \vskip-\arrayrulewidth
717     \fi
718     \ifnum0=`{\fi} }

719 \def\vline{\vrule \@width \arrayrulewidth}

720 \def\cline#1{\@cline#1\@nil}

721 \def\@cline#1-#2\@nil{%
722     \omit
723     \@multicnt#1%
724     \advance\@multispan\m@ne
725     \ifnum\@multicnt=\@ne\@firstofone{&\omit}\fi
726     \@multicnt#2%
727     \advance\@multicnt-#1%
728     \advance\@multispan\@ne
729     \leaders\hrule\@height\arrayrulewidth\hfill
730     \cr
731     \noalign{\vskip-\arrayrulewidth}}
732 \def\multispan{\omit\@multispan}

733 \def\@multispan#1{%
734     \@multicnt#1\relax
735     \loop\ifnum\@multicnt>\@ne \sp@n\repeat}
736 \def\sp@n{\span\omit\advance\@multicnt\m@ne}

{@startpbox Helper macros for 'p' columns.
{@endpbox  \@startpbox{\width} text \egroup is essentially \parbox{\width}{(text)}
          \@endpbox is essentially \unskip \strut \par \egroup\hfil
737 \def\@startpbox#1{\vtop\bgroup \setlength\hsize{#1}\arrayparboxrestore}
          \def\@endpbox{\@finalstrut\arstrutbox\par\egroup\hfil}

738 \def\@endpbox{\@finalstrut\arstrutbox\par\egroup\hfil}
```

(End definition for \@startpbox and \@endpbox.)

```
\@@startpbox
\@@endpbox 739 \let\@@startpbox=\@startpbox
740 \let\@@endpbox=\@endpbox
```

(End definition for \@@startpbox and \@@endpbox.)

```
741 %</2ekernel>
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 28.1 Introduction

When TeX was developed, the notion of graphic output was very limited, although Knuth presented a method using boxes to draw primitive commands at any point on the page. This of course is achieved using zero width or height `\hbox` or `\vbox` commands. LaTeX uses a similar approach with the picture environment. The `picture` environment comes straight out of the box and can be used to draw simple figures. For more sophisticated graphics `TikZ` is a better choice. It can be used in package documentation and simple tasks. The learning curve for using it is minimal.

Using the picture environment is much easier to code for drawing shapes or rulers around sectioning commands. This type of heading is very popular in many modern books. Figure 28.1

---

**Example 1.3:** A corrosion study was made in order to determine whether coating an aluminum metal with a corrosion retardation substance reduced the amount of corrosion. The coating is a protectant that is advertised to minimize fatigue damage in this type of material. Also of interest is the influence of humidity on the amount of corrosion. A corrosion measurement can be expressed in thousands of cycles to failure. Two levels of coating, no coating and chemical corrosion coating, were used. In addition, the two relative humidity levels are 20% relative humidity and 80% relative humidity.

Figure 28.1: A section with some fancy lines around the text. From *Probabilities and Statistics for Engineers and Scientists*, by Walpole *et.al*, 2011.

Of course this is also achievable without the picture environment, simply using TeX commands or with tikZ. From graphics point of view, the environment is also useful for short mathematical diagrams.

## 28.2 The Basic Commands

```
\begin{picture}
  <environment content>
\end{picture}
```

The `picture` environment is created using one of two commands.

742 `\begin{picture}(x, y). . . \end{picture}`

or

10 `\begin{picture}(x, y)(x0,y0). . . \end{picture}`

`\unitlength{<dim>}`

Most people prefer the first type which they combine, with a `setlength` command that sets the `\unitlength`.

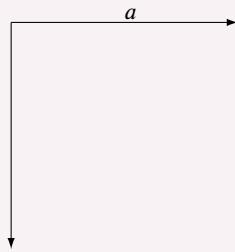
The optional argument gives the coordinates of the point at the lower-left corner of the picture (thereby determining the origin). For example, if `\unitlength` has been set to 1mm, the command

**Example 2.1**

```

10  \setlength{\unitlength}{1mm}
11  \begin{picture}(40,40)(0,0)
12    \put(10,30){\vector(0,-1){30}}
13    \put(10,30){\vector(1,0){30}}
14    \put(25,30.5){$a$}
15  \end{picture}

```



produces a picture of width 100 millimeters and height 200 millimeters, whose lower-left corner is the point (10,20) and whose upper-right corner is therefore the point (110,220). When you first draw a picture, you will omit the optional argument, leaving the origin at the lower-left corner. If you then want to modify your picture by shifting everything, you just add the appropriate optional argument.

### 28.3 Text and Formulae

Text and formulas can be written into a picture environment with the  $\text{?}^{\rightarrow p.??}$  command in the usual way. The line thickness can be set by using  $\text{?}^{\rightarrow p.??}\{\langle dim \rangle\}$ . The command  $\text{\thicklines}$  is half the thickness of the  $\text{\linethickness}$  dimension and  $\text{\thicklines}$  is the current line width. The  $\text{\linethickness}$  does not change width of slanted lines or circles as it is drawn using a font and would render badly.

**Example 3.2 Text and Formulae**

```

10 \setlength{\unitlength}{0.8cm}
11 \begin{picture}(6,5)
12 \thicklines
13 \put(1,0.5){\line(2,1){3}}
14 \put(4,2){\line(-2,1){2}}
15 \put(2,3){\line(-2,-5){1}}
16 \put(0.7,0.3){$A$}
17 \put(4.05,1.9){$B$}
18 \put(1.7,2.95){$C$}
19 \put(3.1,2.5){$a$}

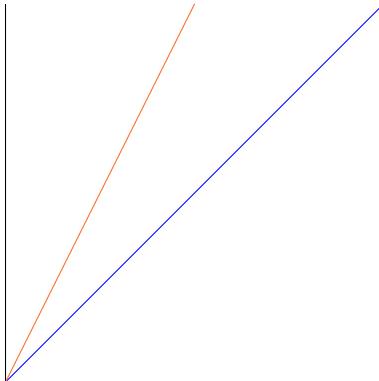
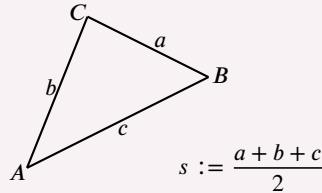
```

```

20  \put(1.3,1.7){$b\$}
21  \put(2.5,1.05){$c\$}
22  \put(0.3,4){$F=}
23  \sqrt{s(s-a)(s-b)(s-c)}\$
24  \put(3.5,0.4){$\displaystyle s:=\frac{a+b+c}{2}$}
25
26 \end{picture}

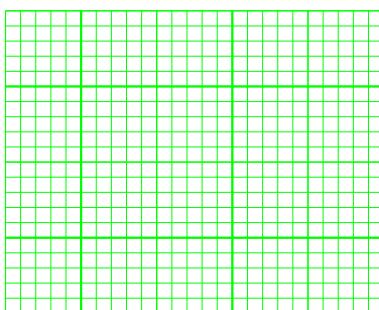
```

$$F = \sqrt{s(s-a)(s-b)(s-c)}$$



## 28.4 multiput and linethickness

The `\multiput` is used to place multiple objects onto the picture. It has the general format shown below:



`\multiput(x,y) (Dx, Dy) {<n>} {<object>}`

The command `\multiput` allows to repeat a `\put` a number of times.

$$F = \sqrt{s(s-a)(s-b)(s-c)}$$

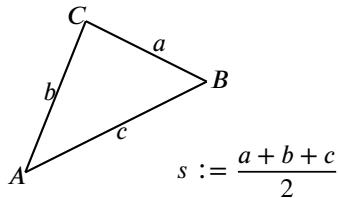


Figure 28.2: Figures can have captions, if you enclose in a figure environment

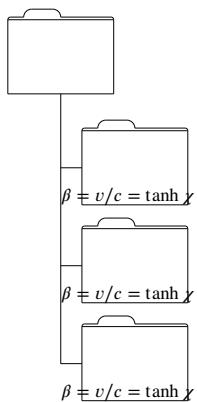


Figure 28.3: Pictures can be scaled using \scalebox.

## 28.5 Some examples

Any vertex-symmetric graph is regular, but edge-symmetric graphs need not be regular. For example,

```
$$\unitlength=10pt
\def\putdisk(#1,#2){\put(#1,#2){\disk{.4}}}
\vcenter{
\hbox{\begin{picture}(2,1.5)(0,0)
\putdisk(0,0)
\putdisk(2,0)
\putdisk(1,.5)
\putdisk(1,1.5)
\put(0,0){\line(2,1){1}}
\put(2,0){\line(-2,1){1}}
\put(1,.5){\line(0,1){1}}
\endpicture}}
\quad&\hbox{is edge-symmetric, not vertex-symmetric;}\cr
\noalign{\smallskip}
\vcenter{
```

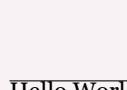
```
\hbox{\begin{picture}(2,2)(0,0)
\putdisk(1,0)
\putdisk(1,2)
\putdisk(0,.5)
\putdisk(0,1.5)
\putdisk(2,.5)
\putdisk(2,1.5)
\put(0,.5){\line(2,1){2}}
\put(2,.5){\line(-2,1){2}}
\put(0,.5){\line(2,3){1}}
\put(2,.5){\line(-2,3){1}}
\put(0,.5){\line(1,0){2}}
\put(0,1.5){\line(1,0){2}}
\put(1,0){\line(-2,3){1}}
\put(1,0){\line(2,3){1}}
\put(1,0){\line(0,1){2}}
\endpicture}
\quad&\hbox{is vertex-symmetric, not edge-symmetric.}\quad
(\vcenter{\hbox{\begin{picture}(1,2)(0,0)
\putdisk(.5,0)\putdisk(.5,2)\put(.5,0){\line(0,1){2}}\endpicture}}
\hbox{ is a maximal clique})\cr}$$
```

## 28.6 picture package

The **picture** package by Heiko Oberdiek redefines the default **picture** macros and adds code that detects whether such an argument is given as number or as length. In the latter case, the length is used directly without multiplying with **\unitlength**. The following example is from the documentation of the package.

**Example 6.3 Picture package example**

```
10 \setlength{\unitlength}{1pt}
11 \begin{picture}(\widthof{Hello World}, 10mm)
12   \put(0, 0){\makebox(0,0)[lb]{Hello World}}%
13   \put(0, \heightof{Hello World} + \fboxsep){%
14     \line(1, 0){\widthof{Hello World}}%
15   }%
16   \put(\widthof{Hello World}, 10mm){%
17     \line(0, -1){10mm}%
18   }%
19   \put(0,0){\line(966,259){8}}
20 \end{picture}
```



The package **calc** is used for calculations or etex. The picture package re-

quires that the package `calc` is loaded before the `picture` package and is loaded correctly by `phd`.

The package also supports the packages `pspicture` and `pict2e`, but they must be loaded before package `picture`.

## 28.7 pict2e

The package `pict2e` by Hubert Gäßlein, Rolf Niepraschk and Joseph Tkadlec extends the existing LATEX picture environment, using the familiar technique (cf. the graphics and color packages) of driver files. In the user-level part of this documentation there is a fair number of examples of use, showing where things are improved by comparison with the standard LATEX picture environment.

The package is loaded automatically by `phd`.

## 28.8 xpicture

The package `xpicture` introduces several new graphical instructions, and some enriched versions of standard instructions used inside the `picture` environment. The picture environment establishes a rectangular coordinate system, so that all graphic objects are placed in the picture using the canonical coordinates of the plane.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

Picture mode commands. In addition to the commands available in L<sup>A</sup>T<sub>E</sub>X2.09, This section adds the new `\qbezier` command for drawing curves.

`\linethickness{dim}` : Sets the width of horizontal and vertical lines in a picture to DIM. Does not change width of slanted lines or circles. Width of all lines reset by `\thinlines` and `\thicklines`

`\shortstack{<POS>}{<TEXT>}` : Makes a `\vbox` containing TEXT stacked as a one-column array, positioned l, r or c as indicated by POS.

#### Example 0.1 shortstack

```
10 \shortstack{Predefined\\Process}
11 \hspace{1cm}
12 \shortstack[r]{Predefined\\Process}
13 \shortstack[c]{Predefined\\Process}
```

Predefined Process	Predefined Process	Predefined Process
-----------------------	-----------------------	-----------------------

The ‘2ekernel’ code ensures that a `\usepackage{autopict}` is essentially ignored if a ‘full’ format is being used that has picture mode already in the format.

```
14 %<2ekernel>\expandafter\let\csname \over@autopict.sty\endcsname\fmtversion
```

```
@wholewidth
@halfwidth 15 %<*2ekernel>
16 \newdimen@wholewidth
17 \newdimen@halfwidth
```

(End definition for `@wholewidth` and `@halfwidth`.)

```
\unitlength
18 \newdimen\unitlength \unitlength =1pt
```

(End definition for `unitlength`.)

```
@picbox
@picht 19 \newbox@picbox
20 \newdimen@picht
```

(End definition for `@picbox` and `@picht`.)

```
\begin{picture}
<environment content>
\end{picture}
```

This is the main environment for drawing picture macros.

```

21 \long\gdef\picture#1{\pictur@#1}
22 \gdef\pictur@(#1){%
23   \@ifnextchar({\@picture(#1)}{\@picture(#1)(0,0)}}

\pictur@
\@picture 24 \gdef\@picture(#1,#2)(#3,#4){%
25   \@picht#2\unitlength
26   \setbox\@picbox\hb@xt@#1\unitlength\bgroup
27   \hskip -#3\unitlength
28   \lower #4\unitlength\hbox\bgroup
29   \ignorespaces}

(End definition for \pictur@ and \@picture.)

\endpicture
30 \gdef\endpicture{%
31   \egroup\hss\egroup
32   \ht\@picbox\@picht\dp\@picbox\z@
33   \mbox{\box\@picbox}{}}

(End definition for \endpicture.)

In the definitions of \put and \multiput, \hskip was replaced by \kern
just in case arg #3 = "plus". (Bug detected by Don Knuth. changed 20 Jul 87).

34 \long\gdef\put(#1,#2)#3{%
35   \@killglue\raise#2\unitlength
36   \hb@xt@\z@{\kern#1\unitlength #3\hss}%
37   \ignorespaces}

\multiput
38 \gdef\multiput(#1,#2)#3{%
39   \@xdim #1\unitlength
40   \@ydim #2\unitlength
41   \@multiput{}}

(End definition for \multiput.)

\multiput
42 \long\gdef\@multiput(#1,#2)#3#4{%
43   \@killglue\@multicnt #3\relax
44   \@whilenum \@multicnt >\z@\do
45     {\raise\@ydim\hb@xt@\z@{\kern\@xdim #4\hss}%
46      \advance\@multicnt\m@ne
47      \advance\@xdim#1\unitlength\advance\@ydim#2\unitlength}%
48   \ignorespaces}

(End definition for \multiput.)

{@killglue
49 \gdef\@killglue{\unskip\@whiledim \lastskip >\z@\do{\unskip}}}

(End definition for \@killglue.)

```

```

\thinlines
\thicklines 50 \gdef\thinlines{\let\@linefnt\tenln \let\@circlefnt\tencirc
51   \@wholewidth\fontdimen8\tenln \halfwidth .5\@wholewidth}
52 \gdef\thicklines{\let\@linefnt\tenlnw \let\@circlefnt\tencircw
53   \@wholewidth\fontdimen8\tenlnw \halfwidth .5\@wholewidth}

(End definition for \thinlines and \thicklines.)
```

\linethickness

```

54 \gdef\linethickness#1{\@wholewidth #1\relax \halfwidth 2
55   .5\@wholewidth}
```

(End definition for \linethickness.)

\isshortstack

```

55 \gdef\shortstack{\@ifnextchar[\@shortstack{\@shortstack[c]}}
```

(End definition for \isshortstack.)

\@isshortstack

```

56 \gdef@\shortstack[#1]{%
57   \leavevmode
58   \vbox\bgroup
59     \baselineskip-\p@\lineskip 3\p@
60     \let\mb@l\hss\let\mb@r\hss
61     \expandafter\let\csname mb@#1\endcsname\relax
62     \let\\@\stackcr
63     \@isshortstack}
```

(End definition for \@isshortstack.)

\@isshortstack

```

64 \gdef@\isshortstack#1{\ialign{\mb@l {##}\unskip\mb@r\cr
65   #1\crcr}\egroup}
```

(End definition for \@isshortstack.)

\@stackcr

\@ixstackcr

```

65 \gdef@\stackcr{\@ifstar\@ixstackcr\@ixstackcr}
66 \gdef@\ixstackcr{\@ifnextchar[\@istackcr{\cr\ignorespaces}}}
```

(End definition for \@stackcr and \@ixstackcr.)

\@istackcr

```

67 \gdef@\istackcr[#1]{\cr\noalign{\vskip #1}\ignorespaces}
```

(End definition for \@istackcr.)

\if@negarg

```

68 \newif\if@negarg
```

(End definition for \if@negarg.)

## \line

The reason why we cannot use TeX's \line

```

69 \gdef\line(#1,#2){\@xarg #1\relax \@yarg #2\relax
70   \@linelen #3\unitlength
71   \ifdim@\linelen<\z@\@badlinearg\else
72     \ifnum@\xarg =\z@\@vline
73       \else \ifnum@\yarg =\z@\@hline \else \@sline\fi
74     \fi
75   \fi}

\@sline
76 \gdef@\sline{%
77   \ifnum@\xarg<\z@\@negargtrue \@xarg -\@xarg \@yyarg -\@yarg
78   \else \@negargfalse \@yyarg \@yarg \fi
79 \ifnum \@yyarg >\z@\@tempcpta\@yyarg \else \@tempcpta %
80   \z@\@yyarg \fi
81 \ifnum@\tempcpta>6 \@badlinearg\@tempcpta\z@\fi
82 \ifnum@\xarg>6 \@badlinearg\xarg \@ne \fi
83 \setbox@\linechar\hbox{\@linefnt\@getlinechar(\@xarg,\@yyarg)}%

```

If we have something like \line(5,5){30} the \@linechar will not contain a char and later on we will end in an infinite loop. So we check the width of the box and put in something as an emergency fix if necessary.

```

83 \ifdim\wd@\linechar=\z@
84   \setbox@\linechar\hbox{.}%
85   \@badlinearg
86 \fi
87 \ifnum \@yarg >\z@\let\@upordown\raise \@clnht\z@
88   \else\let\@upordown\lower \@clnht \ht\@linechar\fi
89 \@clnwd \wd@\linechar
90 \if@negarg
91   \hskip -\wd@\linechar \def\reserved@a{\hskip %
92   \z-2\wd@\linechar}%
93 \else
94   \let\reserved@a\relax
95 \fi
96 \@whiledim \@clnwd <\@linelen \do
97   {\@upordown\@clnht\copy@\linechar
98   \reserved@a
99   \advance\@clnht \ht\@linechar
100 \advance\@clnwd \wd@\linechar}%
101 \advance\@clnht -\ht\@linechar
102 \advance\@clnwd -\wd@\linechar
103 \@tempdima\@linelen\advance\@tempdima -\@clnwd
104 \@tempdimb\@tempdima\advance\@tempdimb -\wd@\linechar
105 \if@negarg \hskip -\@tempdimb \else \hskip \@tempdimb \fi
106 \multiply\@tempdima \m@n
107 \@tempdima \wd@\linechar \divide\@tempcpta \@tempdima
108 \@tempdima \ht@\linechar \multiply\@tempdima \@tempcpta
109 \divide\@tempdima \m@n
110 \advance\@clnht \@tempdima

```

```

111 \ifdim \@linelen <\wd\@linechar
112   \hskip \wd\@linechar
113 \ifdim \@linelen = \z@
114   \else
115     \@picture@warn
116   \fi
117 \else\@upordown\@clnht\copy\@linechar\fi}

```

(End definition for `\@sline`.)

### \@hline

```

118 \gdef\@hline{\ifnum \@xarg <\z@ \hskip -\@linelen \fi
119 \vrule \@height \@halfwidth \@depth \@halfwidth \@width 2
120   \z@\@linelen
121 \ifnum \@xarg <\z@ \hskip -\@linelen \fi}

```

(End definition for `\@hline`.)

### \getlinechar

```

121 \gdef\@getlinechar(#1,#2){\@tempcpta#1\relax\multiply\@tempcpta 2
122   \z@%
123   \advance\@tempcpta -9\ifnum #2>\z@ \advance\@tempcpta 2
124   \z@#2\relax\else
125   \advance\@tempcpta -#2\relax\advance\@tempcpta 64 \fi
126   \char\@tempcpta}

```

(End definition for `\getlinechar`.)

### \vector

```

125 \gdef\vector(#1,#2){\@xarg #1\relax \@yarg #2\relax
126   \@tempcpta \ifnum\@xarg<\z@ -\@xarg\else\@xarg\fi
127   \ifnum\@tempcpta<5\relax
128     \z@\@linelen #3\unitlength
129     \ifdim\@linelen<\z@\@badlinearg\else
130       \ifnum\@xarg =\z@ \@vvector
131         \else \ifnum\@yarg =\z@ \@hvector \else \@svector\fi
132       \fi
133     \fi
134   \else\@badlinearg\fi}

```

(End definition for `\vector`.)

### \@hvector

```

135 \gdef\@hvector{\@hline\hb@xt@\z@{\{} \@linefnt
136   \ifnum \@xarg <\z@ \@getlarrow(1,0)\hss\else
137     \hss\@getrarrow(1,0)\fi\}}

```

(End definition for `\@hvector`.)

### \@vvector

```

138 \gdef\@vvector{\ifnum \@yarg <\z@ \@downvector \else
139   \z@\@upvector \fi}

```

(End definition for `\@vvector.`)

```

\@svector
139 \gdef\@svector{\@sline
140   \@tempcnta\@yarg \ifnum \@tempcnta <\z@ \@tempcnta >
141   \ifnum \@tempcnta <5%
142     \hskip -\wd\@linechar
143     \@upordown\@clnht \hbox{\@linefnt \if@negarg
144     \@getlarrow(\@xarg,\@yyarg)\else \if@getrarrow(\@xarg,\@yyarg)\fi\fi}%
145   \else\@badlinearg\fi}

```

(End definition for `\@svector.`)

```

\@getlarrow
146 \gdef\@getlarrow(#1,#2){\ifnum #2=\z@ \@tempcnta 27 \% '33
147   \else
148   \@tempcnta #1\relax\multiply\@tempcnta \sixt@n
149   \advance\@tempcnta -9 \@tempcntb \if#2\relax\multiply\@tempcntb \tw@
150   \ifnum \@tempcntb >\z@ \advance\@tempcnta \@tempcntb
151   \else\advance\@tempcnta -\@tempcntb\advance\@tempcnta 64
152   \fi\fi\char\@tempcnta}

```

(End definition for `\@getlarrow.`)

```

\@getrarrow
153 \gdef\@getrarrow(#1,#2){\@tempcntb #2\relax
154 \ifnum \@tempcntb <\z@ \@tempcntb -\@tempcntb\relax\fi
155 \ifcase \@tempcntb\relax \@tempcnta 45 \% '55
156 \or
157 \ifnum #1<\thr@@ \@tempcnta #1\relax\multiply\@tempcnta
158 24\advance\@tempcnta -6 \else \ifnum #1=\thr@@ \@tempcnta 49
159 \else\@tempcnta 58 \fi\fi\or
160 \ifnum #1<\thr@@ \@tempcnta=#1\relax\multiply\@tempcnta
161 24\advance\@tempcnta -\thr@@ \else \@tempcnta 51 \fi\or
162 \@tempcnta #1\relax\multiply\@tempcnta
163 \sixt@n \advance\@tempcnta -\tw@ \else
164 \@tempcnta #1\relax\multiply\@tempcnta
165 \sixt@n \advance\@tempcnta 7 \fi\ifnum #2<\z@ \if
166 \advance\@tempcnta 64 \fi
167 \char\@tempcnta}

```

(End definition for `\@getrarrow.`)

```

\@vline
167 \gdef\@vline{\ifnum \@yarg <\z@ \@downline \else \@upline\fi}

```

(End definition for `\@vline.`)

```

\@upline
168 \gdef\@upline{%
169   \hb@xt@\z@{\hskip -\@halfwidth \vrule \@width \wholewidth
170     \height \linelen \depth \z@\hss}}
(End definition for \@upline.)

\@downline
171 \gdef\@downline{%
172   \hb@xt@\z@{\hskip -\@halfwidth \vrule \@width \wholewidth
173     \height \z@ \depth \linelen \hss}}
(End definition for \@downline.)

\@upvector
174 \gdef\@upvector{\@upline\setbox\tempboxa\hbox{\linefnt\char 2
175   \raise \linelen \hb@xt@\z@{\lower 2
176   \ht\tempboxa\box\tempboxa\hss}}
(End definition for \@upvector.)

\@downvector
176 \gdef\@downvector{\@downline\lower \linelen
177   \hb@xt@\z@{\linefnt\char 63 % '77
178   \hss}}
(End definition for \@downvector.)

\dashbox
179 \gdef\dashbox#1(#2,#3){\leavevmode\hb@xt@\z@{\baselineskip \z@skip
180 \lineskip \z@skip
181 \dashdim #2\unitlength
182 \dashcnt \dashdim \advance\dashcnt 200
183 \dashdim #1\unitlength\divide\dashcnt \dashdim
184 \ifodd\dashcnt\@dashdim \z@
185 \advance\dashcnt \ne \divide\dashcnt \tw@
186 \else \divide\dashdim \tw@ \divide\dashcnt \tw@
187 \advance\dashcnt \m@ne
188 \setbox\dashbox \hbox{\vrule \height \halfwidth \depth \z@halfwidth
189 \width \dashdim}\put(0,0){\copy\dashbox}%
190 \put(0,#3){\copy\dashbox}%
191 \put(#2,0){\hskip-\dashdim\copy\dashbox}%
192 \put(#2,#3){\hskip-\dashdim\box\dashbox}%
193 \multiply\dashdim \thr@@
194 \fi
195 \setbox\dashbox \hbox{\vrule \height \halfwidth \depth \z@halfwidth
196 \width #1\unitlength\hskip #1\unitlength}\tempcpta\z@
197 \put(0,0){\hskip\dashdim \whilenum \tempcpta <\dashcnt
198 \do{\copy\dashbox\advance\tempcpta \ne } }\tempcpta\z@

```

```

199 \put(0,#3){\hskip\@dashdim \@whilenum \@tempcnta <\@dashcnt
200 \do{\copy\@dashbox\advance\@tempcnta \@ne }{%
201 \@dashdim #3\unitlength
202 \@dashcnt \@dashdim \advance\@dashcnt 200
203 \@dashdim #1\unitlength\divide\@dashcnt \@dashdim
204 \ifodd\@dashcnt \@dashdim \z@
205 \advance\@dashcnt \@ne \divide\@dashcnt \tw@
206 \else
207 \divide\@dashdim \tw@ \divide\@dashcnt \tw@
208 \advance\@dashcnt \m@ne
209 \setbox\@dashbox\hbox{\hskip -\halfwidth
210 \vrule \@width \wholewidth
211 \@height \@dashdim}\put(0,0){\copy\@dashbox}%
212 \put(#2,0){\copy\@dashbox}%
213 \put(0,#3){\lower\@dashdim\copy\@dashbox}%
214 \put(#2,#3){\lower\@dashdim\copy\@dashbox}%
215 \multiply\@dashdim \thr@@
216 \fi
217 \setbox\@dashbox\hbox{\vrule \@width \wholewidth
218 \@height #1\unitlength}\@tempcnta\z@
219 \put(0,0){\hskip -\halfwidth \vbox{\@whilenum \@tempcnta >
220 <\@dashcnt
221 \do{\vskip #1\unitlength\copy\@dashbox\advance\@tempcnta >
222 <\@ne }{%
223 \vskip\@dashdim}}\@tempcnta\z@
224 \put(#2,0){\hskip -\halfwidth \vbox{\@whilenum >
225 <\@tempcnta<\@dashcnt
226 \do{\vskip #1\unitlength\copy\@dashbox\advance\@tempcnta >
227 <\@ne }{%
228 \vskip\@dashdim}}\@makepicbox(#2,#3)}

```

(End definition for `\dashbox`.)

## 29.1 Circles and ovals

`\circle{<D>}` Produces the circle with the diameter as close as possible to  $D * \unitlength$ . `\put(X,Y){\circle{D}}` puts the circle with its center at  $(X, Y)$ .

`\oval(X,Y)` Makes an oval as round as possible that fits in the rectangle of width  $X * \unitlength$  and height  $Y * \unitlength$ . The reference point is the center.

```

\if@ovt If producing the Top Bottom Left or Right of an oval.
\if@ovb 225 \newif\if@ovt
\if@owl 226 \newif\if@ovb
\if@ovr 227 \newif\if@ovl
228 \newif\if@ovr

```

(End definition for `\if@ovt` and others.)

```
\@ovxx
\@ovyy 229 \newdimen\@ovxx
\@ovdx 230 \newdimen\@ovyy
\@ovdy 231 \newdimen\@ovdx
\@ovro 232 \newdimen\@ovdy
\@ovri 233 \newdimen\@ovro
234 \newdimen\@ovri
```

(End definition for \@ovxx and others.)

\advance\@tempdima 2pt\relax added 1 Nov 88 to fix bug in which size of drawn circle not monotonic function of argument of \circle, caused by different rounding for dimensions of large and small circles.

```
\@getcirc
235 \gdef\@getcirc#1{\@tempdima #1\relax \advance\@tempdima 2\p@
236   \tempcnta\@tempdima
237   \tempdima 4\p@\divide\tempcnta\@tempdima
238   \ifnum \tempcnta >10\relax
239     \picture@warn
240     \tempcnta 10\relax
241   \fi
242   \ifnum \tempcnta >z\@ \advance\tempcnta\m@ne
```

Warn if requirements for oval or circle can't be met.<sup>1</sup>

```
243   \else \picture@warn \fi
244   \multiply\tempcnta 4\relax
245   \setbox \tempboxa \hbox{\circle{#1}}
246   \char \tempboxa\@tempdima \wd \tempboxa}
```

(End definition for \@getcirc.)

\@picture@warn Generic warning for lines, vectors (used in \sline) and oval or circle (used in \@getcirc) are not available at right size.

```
247 \def\@picture@warn{\@latex@warning{%
248   \string\oval, \string\circle, or \string\line\space
249   size unavailable}}
```

(End definition for \@picture@warn.)

```
\@put
250 \gdef\@put#1#2#3{\raise #2\hb@xt@z{\hskip #1#3\hss}}
```

(End definition for \@put.)

```
\oval
251 \gdef\oval(#1,#2){\ifnextchar[{\oval(#1,#2)}{\oval(#1,#2)[]}}
```

(End definition for \oval.)

---

<sup>1</sup>v1.1g 1997/09/15 Warn if lines become invisible pr/2524

```

252 %</2ekernel>
253 %<latexrelease>\IncludeInRelease{2016/03/31}%
254 %<latexrelease>           {\@ovhlinetrue}%
255 %<latexrelease>           {Avoid almost zero length }%
256 %<2ekernel|latexrelease>

```

\if@ovvline Tests whether horizontal or vertical lines are needed.

```

\if@ovhline 257 \newif\if@ovvline \@ovvlinetrue
             \newif\if@ovhline \@ovhlinetrue

```

*(End definition for \if@ovvline and \if@ovhline.)*

\oval

```

259 \gdef\@oval(#1,#2)[#3]{\begingroup\boxmaxdepth \maxdimen
260   \@ovttrue \@ovbtrue \@ovltrue \@ovrtrue
261   \@ovvlinefalse \@ovhlinefalse
262   \@tfor\reserved@a :=#3\do{\csname @ov\reserved@a \relax
263     \false\endcsname}%
263   \@ovxx #1\unitlength
264   \@ovyy #2\unitlength
265   \@tempdimb \ifdim \@ovyy >\@ovxx \@ovxx \@ovvlinetrue
266   \else \@ovyy \ifdim \@ovyy =\@ovxx \else \@ovhlinetrue \fi\fi
267   \advance \@tempdimb -2\p@
268   \@getcirc \@tempdimb
269   \@ovro \ht\@tempboxa \@ovri \dp\@tempboxa
270   \@ovdx\@ovxx \advance\@ovdx -\@tempdima \divide\@ovdx \tw@
271   \@ovdy\@ovyy \advance\@ovdy -\@tempdima \divide\@ovdy \tw@
272   \ifdim \@ovdx >\z@ \@ovhlinetrue \fi
273   \ifdim \@ovdy >\z@ \@ovvlinetrue \fi
274   \@circlefnt \setbox\@tempboxa
275   \hbox{\if@ovr \@ovvert32\kern -\@tempdima \fi
276   \if@ovl \kern \@ovxx \else\kern -\@tempdima \kern \relax
277   \fi-\@ovxx \fi
277   \if@ovt \kern -\@ovxx \fi
278   \if@ovb \raise \@ovyy \kern -\@ovhorz \fi\advance\@ovdx\@ovro
279   \advance\@ovdy\@ovro \ht\@tempboxa\z@ \dp\@tempboxa\z@
280   \put{-\@ovdx}{-\@ovdy}{\box\@tempboxa}%
281   \endgroup}

```

*(End definition for \oval.)*

\ovvert

```

282 \gdef\@ovvert#1#2{\vbox to\@ovyy{%
283   \if@ovb \tempcntb \tempcnta \advance \tempcntb \#1\relax
284   \kern -\@ovro \hbox{\char \tempcntb}\nointerlineskip
285   \else \kern \@ovri \kern \@ovdy \fi
286   \if@ovvline \leaders\hrule \width \wholewidth \fi

```

```

287   \vfil \nointerlineskip
288   \if@ovt \atempcntb \atempcnta \advance \atempcntb #2\relax
289     \hbox{\char \atempcntb}%
290   \else \kern \ovdy \kern \ovro \fi}

```

(End definition for \ovvert.)

\ovhorz

```

291 \gdef\ovhorz{\hb@xt@\ovxx{\kern \ovro
292   \if@ovr \else \kern \ovdx \fi
293   \if@ovhline \leaders \hrule \height \wholewidth \fi
294   \hfil
295   \if@ovl \else \kern \ovdx \fi
296   \kern \ovri}}

```

(End definition for \ovhorz.)

```

297 %</2ekernel|latexrelease>
298 %<latexrelease>\EndIncludeInRelease
299 %<latexrelease>\IncludeInRelease{0000/00/00}%
300 %<latexrelease>           {\ovlinetrue}%
301 %<latexrelease>           {Avoid almost zero length }%
302 %<latexrelease>\let\if@ovvline\undefined
303 %<latexrelease>\let\if@ovhline\undefined
304 %<latexrelease>\gdef\oval(#1,#2)[#3]{\begingroup\boxmaxdepth \maxdimen
305 %<latexrelease>  \ovtrue \ovbtrue \ovltrue \ovrtrue
306 %<latexrelease>  \tfor\reserved@a :=#3\do
307 %<latexrelease>    {\csname @ov\reserved@a \endcsname}%
308 %<latexrelease>  \ovxx #1\unitlength
309 %<latexrelease>  \ovyy #2\unitlength
310 %<latexrelease>  \tempdimb \ifdim \ovyy >\ovxx \ovxx\else \ovyy \fi
311 %<latexrelease>  \advance \tempdimb -\p@
312 %<latexrelease>  \getcirc \tempdimb
313 %<latexrelease>  \ovro \ht\tempboxa \ovri \dp\tempboxa
314 %<latexrelease>  \ovdx\ovxx \advance\ovdx -\tempdima \divide\ovdx \tw@
315 %<latexrelease>  \ovdy\ovyy \advance\ovdy -\tempdima \divide\ovdy \tw@
316 %<latexrelease>  \circlefont \setbox\tempboxa
317 %<latexrelease>  \hbox{\if@ovr \ovvert32\kern -\tempdima \fi
318 %<latexrelease>  \if@ovl
319 %<latexrelease>  \kern \ovxx \ovvert01\kern -\tempdima \ovxx
320 %<latexrelease>  \fi
321 %<latexrelease>  \if@ovt \ovhorz \kern -\ovxx \fi
322 %<latexrelease>  \if@ovb \raise \ovyy \ovhorz \fi
323 %<latexrelease>  \advance\ovdy\ovro \ht\tempboxa\z@ \dp\tempboxa\z@

```

```

324 %<latexrelease>  \@put{-\@ovdx}{-\@ovdy}{\box\@tempboxa}%
325 %<latexrelease>  \endgroup}
326 %<latexrelease>\gdef\@ovvert#1#2{\vbox to\@ovyy{%
327 %<latexrelease>  \if@ovb \@tempcntb \@tempcnda \advance \fi
328 %<latexrelease>  \relax
329 %<latexrelease>  \kern -\@ovro \hbox{\char \fi
330 %<latexrelease>  \nointerlineskip
331 %<latexrelease>  \else \kern \@ovri \kern \@ovdy \fi
332 %<latexrelease>  \leaders\vrule \@width \wholewidth\vfil \nointerlineskip
333 %<latexrelease>  \if@ovt \@tempcntb \@tempcnda \advance \fi
334 %<latexrelease>  \relax
335 %<latexrelease>  \hbox{\char \@tempcntb}%
336 %<latexrelease>  \else \kern \@ovdy \kern \@ovro \fi
337 %<latexrelease>  \gdef\@ovhorz{\hb@xt@\@ovxx{\kern \@ovro
338 %<latexrelease>  \if@ovr \else \kern \@ovdx \fi
339 %<latexrelease>  \leaders \hrule \@height \wholewidth \hfil
340 %<latexrelease>  \if@ovl \else \kern \@ovdy \fi
341 %<latexrelease>  \kern \@ovri\}}
342 %<latexrelease>\EndIncludeInRelease
343 %<2ekernel>

```

\circle  
341 \gdef\circle{\@inmatherr\circle@ifstar\@dot\@circle}

(End definition for \circle.)

\@circle  
342 \gdef\@circle#1{%
343 \begingroup \boxmaxdepth \maxdimen \@tempdimb #1\unitlength
344 \ifdim \@tempdimb >15.5\p@ \getcirc\@tempdimb
345 \@ovro\ht\@tempboxa
346 \setbox\@tempboxa\hbox{\@circlefnt
347 \advance\@tempcnda\tw@ \char \@tempcnda
348 \advance\@tempcnda\m@ne \char \@tempcnda \kern \fi
349 \tw@ \@tempdima
350 \advance\@tempcnda\tw@
351 \raise \@tempdima \hbox{\char\@tempcnda}\raise \@tempdima
352 \box\@tempboxa\ht\@tempboxa\z@\dp\@tempboxa\z@
353 \@put{-\@ovro}{-\@ovro}{\box\@tempboxa}%
354 \else \@circ\@tempdimb{96}\fi\endgroup}

(End definition for \@circle.)

\@dot Internal form of \circle\*.

354 \gdef\@dot#1{\@tempdimb #1\unitlength \@circ\@tempdimb{112}}

(End definition for \@dot.)

\@circ  
355 \gdef\@circ#1#2{\@tempdima #1\relax \advance\@tempdima .5\p@
356 \@tempcnda\@tempdima \@tempdima \p@}

```

357   \divide\@tempcnta\@tempdima
358   \ifnum\@tempcnta >15\relax \atempcnta 15\relax \fi
359   \ifnum \atempcnta >\z@ \advance\atempcnta\m@ne\fi
360   \advance\atempcnta #2\relax
361   \atcirclefnt \char\atempcnta}

```

(End definition for `\@circ.`)

```

\@xarg
\@yarg 362 \newcount\@xarg
\@yyarg 363 \newcount\@yarg
364 \newcount\@yyarg

```

(End definition for `\@xarg`, `\@yarg`, and `\@yyarg`.)

```

\@multicnt
365 \newcount\@multicnt

```

(End definition for `\@multicnt`.)

```

\@xdim
\yxdim 366 \newdimen\@xdim
367 \newdimen\@ydim

```

(End definition for `\@xdim` and `\yxdim`.)

```

\@linechar
368 \newbox\@linechar

```

(End definition for `\@linechar`.)

```

\@linelen
369 \newdimen\@linelen

```

(End definition for `\@linelen`.)

```

\@clnwd
\@clnht 370 \newdimen\@clnwd
371 \newdimen\@clnht

```

(End definition for `\@clnwd` and `\@clnht`.)

```

\@dashdim
\@dashbox 372 \newdimen\@dashdim
\@dashcnt 373 \newbox\@dashbox
374 \newcount\@dashcnt

```

(End definition for `\@dashdim`, `\@dashbox`, and `\@dashcnt`.)

Initialization: “`\thinline`”<sup>2</sup>

```

375 \let\@linefnt\tenln
376 \let\@circlefnt\tencirc
377 \wholewidth\fontdimen8\tenln
378 \halfwidth .5\wholewidth

```

---

<sup>2</sup>v1.1f 1995/10/27 Move initialisation to kernel from autoload file

## 29.2 Curves

The new `\qbezier` command, based on the old `\bezier` defined in `bezier.sty`.<sup>3</sup>

`\qbeziermax` The maximum number of points to plot.

379 `\gdef\qbeziermax{500}`

(End definition for `\qbeziermax`.)

`\qbezier`

380 `\newcommand\qbezier[2][0]{\bezier{\#1}{\#2}}`

(End definition for `\qbezier`.)

`\bezier`

381 `\gdef\bezier#1#2(#3){\@bezier#1)(#3)()}`

```
\@bezier 382 \gdef \@bezier#1(#2,#3)(#4,#5)(#6,#7){%
 383   \ifnum #1=\z@%
 384     \ovxx #4\unitlength%
 385     \advance\ovxx -#2\unitlength%
 386     \ifdim \ovxx<\z@ \ovxx -\ovxx \fi%
 387     \ovdx #6\unitlength%
 388     \advance\ovdx -#4\unitlength%
 389     \ifdim \ovdx<\z@ \ovdx -\ovdx \fi%
 390     \ifdim \ovxx<\ovdx \ovxx \ovdx \fi%
 391     \ovyy #5\unitlength%
 392     \advance\ovyy -#3\unitlength%
 393     \ifdim \ovyy<\z@ \ovyy -\ovyy \fi%
 394     \ovdy #7\unitlength%
 395     \advance\ovdy -#5\unitlength%
 396     \ifdim \ovdy<\z@ \ovdy -\ovdy \fi%
 397     \ifdim \ovyy<\ovdy \ovyy \ovdy \fi%
 398     \@multicnt%
 399     \ifdim \ovxx>\ovyy \ovxx \else \ovyy \fi%
 400     \ovxx .5@\halfwidth \divide\@multicnt\ovxx%
 401     \ifnum \qbeziermax<\@multicnt %
 402       \multicnt\qbeziermax\relax \fi%
 403     \else \@multicnt#1\relax \fi%
 404     \tempcnta\@multicnt \advance\tempcnta@ne%
 405     \ovdx #4\unitlength \advance\ovdx -#2\unitlength%
 406     \multiply\ovdx \tw@%
 407     \ovxx #6\unitlength \advance\ovxx -#2\unitlength%
 408     \advance\ovxx -\ovdx \divide\ovxx\@multicnt%
 409     \ovdy #5\unitlength \advance\ovdy -#3\unitlength%
 410     \multiply\ovdy \tw@%
 411     \ovyy #7\unitlength \advance\ovyy -#3\unitlength%
 412     \advance\ovyy -\ovdy \divide\ovyy\@multicnt%
```

<sup>3</sup>vo.1c 1994/04/28 bezier curves added

Fix pr/3566<sup>4</sup>

```

412 \setbox\@tempboxa\hbox{%
413     \hskip -\@halfwidth
414     \vrule \height\@halfwidth
415         \depth \@halfwidth
416         \width \@wholewidth}%
417 \put(#2,#3){%
418     \count@\z@
419     \@whilenum{\count@<\@tempcnta}\do
420         {\@xdim\count@\@ovxx
421             \advance\@xdim\@ovdx
422             \divide\@xdim\@multicnt
423             \multiply\@xdim\count@
424             \@ydim\count@\@ovyy
425             \advance\@ydim\@ovdy
426             \divide\@ydim\@multicnt
427             \multiply\@ydim\count@
428             \raise\@ydim
429             \hb@xt@\z@{\kern\@xdim
430                 \unhcopy\@tempboxa\hss}%
431             \advance\count@\@ne}}}
432 %</2ekernel>

```

(End definition for `\bezier` and `\@bezier`.)

---

<sup>4</sup>v1.1k 2003/08/27 added missing displacement pr/3566

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

The user creates his own theorem-like environments with the command

```
\newtheorem{<name>}{{<text>}}[<counter>] or  
\newtheorem{<name>}[<oldname>]{{<text>}}
```

This defines the environment *<name>* to be just as one would expect a theorem environment to be, except that it prints *<text>* instead of “Theorem”.

If *<oldname>* is given, then environments *<name>* and *<oldname>* use the same counter, so using a *<name>* environment advances the number of the next *<name>* environment, and vice-versa.

If *<counter>* is given, then environment *<name>* is numbered within *<counter>*.

E.g., if *<counter>* = **subsection**, then the first *<name>* in subsection 7.2 is numbered *<text>* 7.2.1.

The way *<name>* environments are numbered can be changed by redefining **\the<name>**.

#### Example 0.1 newtheorem

```

10 \newtheorem{theorem}{Theorem}[section]
11
12 \newtheorem{lemma}[theorem]{Lemma}
13
14 %\newtheorem{proposition}[theorem]{Proposition}
15 %\newtheorem{corollary}[theorem]{Corollary}
16 %\newenvironment{proof}[1][Proof]{\begin{trivlist}}
17 %\item[\hskip \labelsep {\bfseries #1}]\end{trivlist}}
18 \newenvironment{definition}[1][Definition]{\begin{trivlist}}
19 \item[\hskip \labelsep {\bfseries #1}]\end{trivlist}}
20
21 %\newenvironment{example}[1][Example]{\begin{trivlist}}
22 %\item[\hskip \labelsep {\bfseries #1}]\end{trivlist}}
23
24 %\newenvironment{remark}[1][Remark]{\begin{trivlist}}
25 %\item[\hskip \labelsep {\bfseries #1}]\end{trivlist}}
26 %
27 %\newcommand{\qed}{\nobreak \ifvmode \relax \else
28 %    \ifdim\lastskip<1.5em \hskip-\lastskip
29 %    \hskip1.5em plus0em minus0.5em \fi \nobreak
30 %    \vrule height0.75em width0.5em depth0.25em\fi}
31 \begin{theorem}
32 \begin{definition}
33 Let $H$ be a subgroup of a group~$G$. A \emph{left
            coset}
34 of $H$ in $G$ is a subset of $G$ that is of the form
            $xH$,
35 where $x$ \in $G$ and $xH = \{ x : h \in H \}$.
36 Similarly a \emph{right coset} of $H$ in $G$ is a subset
            of $G$ that is of the form $Hx$, where
37 $Hx = \{ hx : h \in H \}$
38 \end{definition}
39 \end{definition}
40
41 Note that a subgroup~$H$ of a group $G$ is itself a

```

```

42 left coset of  $\$H\$$  in  $\$G\$$ .
43
44 \begin{lemma}
45 \label{LeftCosetsDisjoint}
46 Let  $\$H\$$  be a subgroup of a group  $\$G\$$ , and let  $\$x\$$  and
47  $\$y\$$  be
48 elements of  $\$G\$$ . Suppose that  $\$xH \cap yH\$$  is
49 non-empty.
50 Then  $\$xH = yH\$$ .
51 \end{lemma}
52 \begin{proof}
53 Let  $\$z\$$  be some element of  $\$xH \cap yH\$$ . Then  $\$z = xa\$$ 
54 for some  $\$a \in H\$$ , and  $\$z = yb\$$  for some  $\$b \in H\$$ .
55 If  $\$h\$$  is any element of  $\$H\$$  then  $\$ah \in H\$$  and
56  $\$a^{-1}h \in H\$$ , since  $\$H\$$  is a subgroup of  $\$G\$$ .
57 But  $\$zh = x(ah)\$$  and  $\$xh = z(a^{-1}h)\$$  for all  $\$h \in H\$$ .
58 Therefore  $\$zh \subset xH\$$  and  $\$xH \subset zh\$$ , and thus
59 as required.\qed
60 \end{proof}
61
62 \begin{lemma}
63 \label{SizeOfLeftCoset}
64 Let  $\$H\$$  be a finite subgroup of a group  $\$G\$$ . Then each
65 left
66 coset of  $\$H\$$  in  $\$G\$$  has the same number of elements as
67  $\$H\$$ .
68 \end{lemma}
69 \begin{proof}
70 Let  $\$H = \{ h_1, h_2, \dots, h_m \}$ , where
71  $\$h_1, h_2, \dots, h_m\$$  are distinct, and let  $\$x\$$  be an
72 element of  $\$G\$$ . Then the left coset  $\$xH\$$  consists of
73 the elements  $\$x h_j\$$  for  $\$j = 1, 2, \dots, m\$$ .
74 Suppose that  $\$j\$$  and  $\$k\$$  are integers between
75  $\$1\$$  and  $\$m\$$  for which  $\$x h_j = x h_k\$$ . Then
76  $\$h_j = x^{-1} (x h_j) = x^{-1} (x h_k) = h_k\$$ ,
77 and thus  $\$j = k\$$ , since  $\$h_1, h_2, \dots, h_m\$$ 
78 are distinct. It follows that the elements
79  $\$x h_1, x h_2, \dots, x h_m\$$  are distinct.
80 We conclude that the subgroup  $\$H\$$  and the left
81 coset  $\$xH\$$  both have  $\$m\$$  elements,
82 as required.
83 \end{proof}
84 \begin{theorem}
85 \emph{(Lagrange's Theorem)}
86 \label{Lagrange}
87 Let  $\$G\$$  be a finite group, and let  $\$H\$$  be a subgroup
88 of  $\$G\$$ . Then the order of  $\$H\$$  divides the order of  $\$G\$$ .

```

```

89 \end{theorem}
90
91 \begin{proof}
92 Each element~$x$ of $G$ belongs to at least one left
93 coset
94 of $H$ in $G$ (namely the coset $xH$), and no element
95 can belong to two distinct left cosets of $H$ in $G$
96 (see Lemma~\ref{LeftCosetsDisjoint}). Therefore every
97 element of $G$ belongs to exactly one left coset of $H$.
98 Moreover each left coset of $H$ contains $|H|$ elements
99 (Lemma~\ref{SizeOfLeftCoset}). Therefore $|G| = n |H|$, where $n$ is the number of left cosets of $H$ in $G$.
100 The result follows.
101 \end{proof}
102 \end{theorem}

```

**Theorem 30.0.1. Definition** Let  $H$  be a subgroup of a group  $G$ . A left coset of  $H$  in  $G$  is a subset of  $G$  that is of the form  $xH$ , where  $x \in G$  and  $xH = \{xh : h \in H\}$ . Similarly a right coset of  $H$  in  $G$  is a subset of  $G$  that is of the form  $Hx$ , where  $Hx = \{hx : h \in H\}$ .

Note that a subgroup  $H$  of a group  $G$  is itself a left coset of  $H$  in  $G$ .

**Lemma 30.0.2.** Let  $H$  be a subgroup of a group  $G$ , and let  $x$  and  $y$  be elements of  $G$ . Suppose that  $xH \cap yH$  is non-empty. Then  $xH = yH$ .

*Proof.* Let  $z$  be some element of  $xH \cap yH$ . Then  $z = xa$  for some  $a \in H$ , and  $z = yb$  for some  $b \in H$ . If  $h$  is any element of  $H$  then  $ah \in H$  and  $a^{-1}h \in H$ , since  $H$  is a subgroup of  $G$ . But  $zh = x(ah)$  and  $xh = z(a^{-1}h)$  for all  $h \in H$ . Therefore  $zH \subset xH$  and  $xH \subset zH$ , and thus  $xH = zH$ . Similarly  $yH = zH$ , and thus  $xH = yH$ , as required.  $\square$

**Lemma 30.0.3.** Let  $H$  be a finite subgroup of a group  $G$ . Then each left coset of  $H$  in  $G$  has the same number of elements as  $H$ .

*Proof.* Let  $H = \{h_1, h_2, \dots, h_m\}$ , where  $h_1, h_2, \dots, h_m$  are distinct, and let  $x$  be an element of  $G$ . Then the left coset  $xH$  consists of the elements  $xh_j$  for  $j = 1, 2, \dots, m$ . Suppose that  $j$  and  $k$  are integers between 1 and  $m$  for which  $xh_j = xh_k$ . Then  $h_j = x^{-1}(xh_k) = x^{-1}(xh_k) = h_k$ , and thus  $j = k$ , since  $h_1, h_2, \dots, h_m$  are distinct. It follows that the elements  $xh_1, xh_2, \dots, xh_m$  are distinct. We conclude that the subgroup  $H$  and the left coset  $xH$  both have  $m$  elements, as required.  $\square$

**Theorem 30.0.4.** (Lagrange's Theorem) Let  $G$  be a finite group, and let  $H$  be a subgroup of  $G$ . Then the order of  $H$  divides the order of  $G$ .

*Proof.* Each element  $x$  of  $G$  belongs to at least one left coset of  $H$  in  $G$  (namely the coset  $xH$ ), and no element can belong to two distinct left cosets of  $H$  in  $G$  (see Lemma 30.0.2). Therefore every element of  $G$  belongs to exactly one left coset of  $H$ . Moreover each left coset of  $H$  contains  $|H|$  elements (Lemma 30.0.3). Therefore  $|G| = n|H|$ , where  $n$  is the number of left cosets of  $H$  in  $G$ . The result follows.  $\square$

Example from [source](#)

\newtheorem \newtheorem ought really be allowed only in the preamble. Which would be good document style, and allow some main memory to be saved by declaring these commands to be \onlypreamble. Unfortunately the L<sup>A</sup>T<sub>E</sub>X book indicates that \newtheorem may be used anywhere in the document...

```
103 %<*2ekernel>
104 \def\newtheorem#1{%
105   \@ifnextchar[{\@othm{#1}}{\@nthm{#1}}}
```

(End definition for \newtheorem.)

\@nthm

```
106 \def@\nthm#1#2{%
107   \@ifnextchar[{\@xnthm{#1}{#2}}{\@ynthm{#1}{#2}}}
```

(End definition for \@nthm.)

\@xnthm

```
108 \def@\xnthm#1#2[#3]{%
109   \expandafter\@ifdefinable\csname #1\endcsname
110   {\@definecounter{#1}\@newctr{#1}[#3]%
111     \expandafter\xdef\csname the#1\endcsname{%
112       \expandafter\noexpand\csname the#3\endcsname %
113         \the\@thmcntersep
114           \the\@thmcnter{#1}%
115     \global\@namedef{#1}{\@thm{#1}{#2}}%
116     \global\@namedef{end#1}{\@endtheorem}}}
```

(End definition for \@xnthm.)

\@ynthm

```
116 \def@\ynthm#1#2{%
117   \expandafter\@ifdefinable\csname #1\endcsname
118   {\@definecounter{#1}%
119     \expandafter\xdef\csname
120       \the#1\endcsname{\@thmcnter{#1}}%
121     \global\@namedef{#1}{\@thm{#1}{#2}}%
122     \global\@namedef{end#1}{\@endtheorem}}}
```

(End definition for \@ynthm.)

\@othm

```
122 \def@\othm#1[#2]{%
123   \@ifundefined{c@#2}{\@nocounterr{#2}}%
124   {\expandafter\@ifdefinable\csname #1\endcsname
125     {\global\@namedef{the#1}{\@nameuse{the#2}}%
126     \global\@namedef{#1}{\@thm{#2}{#3}}%
127     \global\@namedef{end#1}{\@endtheorem}}}}
```

(End definition for \@othm.)

\@thm

```
128 \def@\thm#1#2{%
129   \refstepcounter{#1}%
130   \@ifnextchar[{\@ythm{#1}{#2}}{\@xthm{#1}{#2}}}
```

(End definition for `\@thm`.)

```
\@xthm
\@ythm 131 \def\@xthm#1#2{%
 132   \begin{theorem}{#2}{\csname the#1\endcsname}\ignorespaces}
 133 \def\@ythm#1#2[#3]{%
 134   \opargbegintheorem{#2}{\csname the#1\endcsname}{#3}\ignorespaces}
```

(End definition for `\@xthm` and `\@ythm`.)

Default values

```
\@thmcnter
\@thmcntersep 135 \def\@thmcnter#1{\noexpand\arabic{#1}}
 136 \def\@thmcntersep{.}
```

(End definition for `\@thmcnter` and `\@thmcntersep`.)

```
\@begintheorem Providing theorem defaults.
\@opargbegintheorem 137 \def\@begintheorem#1#2{\trivlist
 138   \item[\hskip \labelsep\bfseries #1\ #2]\itshape}
 139
 140 \def\@opargbegintheorem#1#2#3{\trivlist
 141   \item[\hskip \labelsep\bfseries #1\ #2\ (#3)]\itshape}
 142 \def\@endtheorem{\endtrivlist}
 143 %</2ekernel>
```

(End definition for `\@begintheorem`, `\@opargbegintheorem`, and `\@endtheorem`.)

## 30.1 AmS Improvements

The package **amsthm** provides numerous facilities to authors to enable styling of theorem-like environments to be customized.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 31.1 Introduction

This file defines the declarations such as `\author` which are used by `\maketitle`. `\maketitle` itself is defined by each class, not in the L<sup>A</sup>T<sub>E</sub>X kernel.

The second part of the file defines the generic commands used for defining sectioning commands such as `\chapter`. Again the actual document level commands are defined in the class files, in terms of these commands.

The final part provides a framework for adding material to a table of contents. The basic author commands provided here are shown below. Most of the balance commands are aimed at the class or package writer.

Table 31.1: User commands defined in file ltsec.

---

<code>\title</code>	defines the title and author
<code>\author</code>	author name
<code>\thanks</code>	adds thanks as a footnote
<code>\and</code>	
<code>\date</code>	typesets a date

---

```
144 %<*2ekernel>
145 \message{title,}
```

## 31.2 The Title

- `\title` The user defines the title and author by the declarations `\title{<name>}`, `\author \author{<name>}`
- `\date` Similarly the date is declared with `\date{<date>}`.
- `\thanks` Inside these, the `\thanks{<footnote text>}` command may be used to make acknowledgements, notice of address, etc. in a footnote. If there are multiple authors, they have to be separated with the `\and` command.
- `\maketitle` And finally, the `\maketitle` command produces the actual title, using the information previously saved with the other commands.

`\title` <sup>1</sup> `\title` for use in `\maketitle`. If not given `\maketitle` will produce an error message.

```
146 \def\title#1{\gdef\@title{#1}}
147 \def\@title{\@latex@error{No \noexpand\title given}\@ehc}
```

(End definition for `\title` and `\@title`.)

- `\author` <sup>2</sup> `\author` for use in `\maketitle`. If not given `\maketitle` will produce a warning message.

---

<sup>1</sup>LaTeXe 1993/12/11 Added default  
<sup>2</sup>LaTeXe 1993/12/11 Added default

```
148 \def\author#1{\gdef\@author{#1}}
149 \def\@author{\@latex@warning@no@line{No \noexpand\author }
  {given}}
```

(End definition for `\author` and `\@author`.)

`\date`    `\date` for use in `\maketitle`. If not given `\maketitle` will produce `\today`  
`\@date`    as the default.

```
150 \def\date#1{\gdef\@date{#1}}
151 \gdef\@date{\today}
```

(End definition for `\date` and `\@date`.)

3

`\thanks`

```
152 \def\thanks#1{\footnotemark
153   \protected@xdef\@thanks{\@thanks
154     \protect\footnotetext[\the\c@footnote]{#1}}%
155 }
```

(End definition for `\thanks`.)

`\@thanks`

```
156 \let\@thanks\empty
```

(End definition for `\@thanks`.)

`\and`

```
157 \def\and%                                % \begin{tabular}
158   \end{tabular}%
159   \hskip 1em \@plus.17fil%
160   \begin{tabular}[t]{c}%

```

(End definition for `\and`.)

```
161 \message{sectioning,}
```

### 31.3 Sectioning

`\@secpenalty`

```
162 \newcount\@secpenalty
163 \@secpenalty = -300
```

(End definition for `\@secpenalty`.)

`\if@noskipsec`    Way back in 1991 (08/26) FMi & RmS set the `\@noskipsec` switch to true for  
`\@noskipsectrue`    the preamble and to false in `\document`. This was done to trap lists and related  
 text in the preamble but it does not catch everything.

```
164 \newif\if@noskipsec \@noskipsectrue
```

---

<sup>3</sup>1.oh 1994/11/04 (ASAJ) Added `\protected@xdef` to `\thanks`.

(End definition for `\if@noskipsec` and `\@noskipsectrue`.)

**\@startsection** The `\@startsection{\name}{\level}{\indent}{\beforeskip}{\afterskip}{\style}{\altheading}{\heading}` command is the mother of all the user level sectioning commands. The part after the `*`, including the `*` is optional.

**name:** e.g., 'subsection'

**level:** a number, denoting depth of section – e.g., chapter = 0, section = 1, etc.

**indent:** Indentation of heading from left margin

**beforekip:** Absolute value = skip to leave above the heading. If negative, then paragraph indent of text following heading is suppressed.

**afterskip:** if positive, then skip to leave below heading, else negative of skip to leave to right of run-in heading.

**style:** Commands to set style. Since June 1996 release the `last` command in this argument may be a command such as `\MakeUppercase` or `\fbox` that takes an argument. The section heading will be supplied as the argument to this command. So setting #6 to, say, `\bfseries\MakeUppercase` would produce bold, uppercase headings.

If '`*`' is missing, then increment the counter. If it is present, then there should be no `[\altheading]` argument. The command uses the counter 'secnumdepth'. It contains a pointer to the highest section level that is to be numbered.

**Warning:** The `\@startsection` command should be at the same or higher grouping level as the text that follows it. For example, you should *not* do something like

```
\def\foo{ \begingroup ...
          \paragraph{...}
        \endgroup}
```

Pseudocode for the `\@startsection` command

```
165 \def\@startsection#1#2#3#4#5#6{%
166   \if@noskipsec \leavevmode \fi
167   \par
168   \tempskipa #4\relax
169   \afterindenttrue
170   \ifdim \tempskipa <\z@
171     \tempskipa -\tempskipa \afterindentfalse
172   \fi
173   \nobreak
174   \everypar{}%
175   \else
176     \addpenalty\secpenalty\addvspace\tempskipa
177   \fi
```

```

178   \ifstar
179     {@sect{#3}{#4}{#5}{#6}}%
180   {@dblarg{@sect{#1}{#2}{#3}{#4}{#5}{#6}}}}

```

(End definition for `\@startsection`.)

```

\@sect
181 \def{@sect#1#2#3#4#5#6[#7]#8{%
182   \ifnum #2>\c@secnumdepth
183     \let{@svsec}\empty
184   \else
185     \refstepcounter{#1}%

```

Since `\@seccntformat` might end with an improper `\hskip` which is scanning forward for `plus` or `minus` we end the definition of `\@svsec` with `\relax` as a precaution.

```

186   \protected@edef{@svsec{@seccntformat{#1}\relax}%
187   \fi
188   @tempskipa #5\relax
189   \ifdim @tempskipa>\z@
190     \begingroup
191       #6{%
192         \hangfrom{\hskip #3\relax\@svsec}%
193         \interlinepenalty \M#8\@par}%
194     \endgroup
195     \csname #1mark\endcsname{#7}%
196     \addcontentsline{toc}{#1}{%
197       \ifnum #2>\c@secnumdepth \else
198         \protect\numberline{\csname the#1\endcsname}%
199       \fi
200       #7}%
201   \else
202     \def{@svsechd{%
203       #6{\hskip #3\relax
204       \@svsec #8}%
205       \csname #1mark\endcsname{#7}%
206       \addcontentsline{toc}{#1}{%
207         \ifnum #2>\c@secnumdepth \else
208           \protect\numberline{\csname the#1\endcsname}%
209         \fi
210         #7}%
211     \fi
212   \@xsect{#5}}

```

(End definition for `\@sect`.)

```

\@xsect
213 \def{@xsect#1{%
214   @tempskipa #1\relax
215   \ifdim @tempskipa>\z@
216     \par \nobreak
217     \vskip \@tempskipa

```

```

218     \@afterheading
219   \else
220     \@nobreakfalse
221     \global\@noskipsectrue
222     \everypar{%
223       \if@noskipsec
224         \global\@noskipsecfalse
225         {\setbox\z@\lastbox}%
226         \clubpenalty\@M
227         \begingroup \svsechd \endgroup
228         \unskip
229         \tempskipa #1\relax
230         \hskip -\tempskipa
231       \else
232         \clubpenalty \clubpenalty
233         \everypar{}%
234       \fi}%
235   \fi
236   \ignorespaces

```

*(End definition for \@xsect.)*

\@secntformat This command formats the section number including the space following it.

```
237 \def\@secntformat#1{\csname the#1\endcsname\quad}
```

*(End definition for \@secntformat.)*

```

\@ssect
238 \def\@ssect#1#2#3#4#5{%
239   \tempskipa #3\relax
240   \ifdim \tempskipa>\z@
241     \begingroup
242       #4{%
243         \hangfrom{\hskip #1}%
244         \interlinepenalty \M#5\@@par}%
245     \endgroup
246   \else
247     \def\svsechd{#4{\hskip #1\relax #5}}%
248   \fi
249   \@xsect{#3}}

```

*(End definition for \@ssect.)*

```

\if@afterindent
\@afterindenttrue 250 \newif\if@afterindent \@afterindenttrue

```

*(End definition for \if@afterindent and \@afterindenttrue.)*

\@afterheading This hook is used in setting up custom-built headings in classes.dtx.

```

251 \def\@afterheading{%
252   \@nobreaktrue
253   \everypar{%
254     \if@nobreak
255       \nobreakfalse
256       \clubpenalty \zM
257       \if@afterindent \else
258         {\setbox\z@\lastbox}%
259       \fi
260     \else
261       \clubpenalty \clubpenalty
262       \everypar{}%
263     \fi}%

```

(End definition for `\@afterheading`.)

`\@hangfrom` `\@hangfrom{\text}` : Puts `\text` in a box, and makes a hanging indentation of the following material up to the first `\par`. Should be used in vertical mode.

```

264 \def\@hangfrom#1{\setbox\@tempboxa\hbox{{#1}}%
265   \hangindent \wd\@tempboxa\noindent\box\@tempboxa}

```

(End definition for `\@hangfrom`.)

`\c@secnumdepth`  
`\c@tocdepth`

```

266 \newcount\c@secnumdepth
267 \newcount\c@tocdepth

```

(End definition for `\c@secnumdepth` and `\c@tocdepth`.)

`\secdef` `\secdef{\unstarcmds}{\unstarcmds}{\starcmds}`  
When defining a `\chapter` or `\section` command without using `\@startsection`, you can use `\secdef` as follows:

1. `\def\chapter{ ... \secdef \starcmd \unstarcmd }`
  2. `\def\starcmd[#1]{ ... } % Command to define \chapter[...]{...}`
  3. `\def\unstarcmd[#1]{ ... } % Command to define \chapter*{...}`
- ```

268 \def\secdef#1#2{\@ifstar{#2}{\@dblarg{#1}}}

```

(End definition for `\secdef`.)

### 31.3.1 Initializations

```

\sectionmark
\subsectionmark
269 \let\sectionmark\@gobble
\subsubsectionmark
270 \let\subsectionmark\@gobble
\paragraphmark
271 \let\subsubsectionmark\@gobble
\subparagraphmark
272 \let\paragraphmark\@gobble
273 \let\subparagraphmark\@gobble

```

(End definition for `\sectionmark` and others.)

```

274 \message{contents,}

```

## 31.4 Table of Contents etc.

### 31.4.1 Convention

`\tf@{foo}` = file number for output for table *foo*. The file is opened only if `@filesw = true`.

### 31.4.2 Commands

A `\l@{type}{{entry}}{page}` Macro needs to be defined by document style for making an entry of type *type* in a table of contents, etc. E.g., the document style should define `\l@chapter`, `\l@section`, etc.

**Note:** When the `\protect` command is used in the *entry* or *text* of one of the commands below, it causes the following control sequence to be written on the file without being expanded. The sequence will be expanded when the table of contents entry is processed.

**Surprise:** Inside an `\addcontentsline` or `\addtocontents` command argument, the commands: `\index`, `\glossary`, and `\label` are no-ops . This could cause a problem if the user puts an `\index` or `\label` into one of the commands he writes, or into the optional ‘short version’ argument of a `\section` or `\caption` command.

`\@starttoc` The `\@starttoc{ext}` command is used to define the commands: `\tableofcontents`, `\listoffigures`, etc.

For example: `\@starttoc{lof}` is used in `\listoffigures`. This command reads the `.{ext}` file and sets up to write the new `.{ext}` file.

```

275 \def\@starttoc#1{%
276   \begingroup
277   \makeatletter
278   \@input{\jobname.\#1}%
279   \if@filesw
280     \expandafter\newwrite\csname tf@#1\endcsname
281     \immediate\openout \csname tf@#1\endcsname @@
282     \jobname.\#1\relax
283   \fi
284   \nobreakfalse
285 }
```

(End definition for `\@starttoc`.)

`\addcontentsline` The `\addcontentsline{table}{{type}}{entry}` command allows the user to add his/her own entry to a table of contents, etc. The command adds the entry `\contentsline{{type}}{entry}{page}` to the `.{table}` file.

This macro is implemented as an application of `\addtocontents`. Note that `\thepage` is not expandable during `\protected@write` therefore one gets the page number at the time of the `\shipout`.

```

285 %%</2ekernel>
286 %%<*2ekernel|latexrelease>
287 %%<latexrelease>\IncludeInRelease{2018/12/01}%

```

```

288 %<latexrelease>           {\addcontentsline}{Mask line }
289   \def\addcontentsline#1#2#3{%
290     \addtocontents{#1}{\protect\contentsline{#2}{#3}{\thepage}%
291                           \protected@file@percent}}
292 %</2ekernel|latexrelease>
293 %<latexrelease>\EndIncludeInRelease
294 %<latexrelease>\IncludeInRelease{0000/00/00}%
295 %<latexrelease>           {\addcontentsline}{Mask line }
296   \def\addcontentsline#1#2#3{%
297     \addtocontents{#1}{\protect\contentsline{#2}{#3}{\thepage}}}
298 %<latexrelease>\EndIncludeInRelease
299 %<2ekernel>

```

(End definition for `\addcontentsline`.)

**\addtocontents** The `\addtocontents{<table>}{{<text>}}` command adds `<text>` to the `.<table>` file, with no page number.

```

300 \long\def\addtocontents#1#2{%
301   \protected@write\@auxout
302     {\let\label\@gobble \let\index\@gobble \%
303      \let\glossary\@gobble}%
304     {\string\@writefile{#1}{#2}}}

```

(End definition for `\addtocontents`.)

**\contentsline** The `\contentsline{<type>}{{<entry>}}{{<page>}}` macro produces a `<type>` entry in a table of contents, etc. It will appear in the `.toc` or other file. For example, The entry for subsection 1.4.3 in the table of contents for example, might be produced by:

```

\contentsline{subsection}
  {\makebox[30pt][r]{1.4.3} Gnats and Gnus}{22}

```

The `\protect` command causes command sequences to be written without expanding them.

```
304 \def\contentsline#1{\csname l@#1\endcsname}
```

(End definition for `\contentsline`.)

`@dottedtocline{<level>}{{<indent>}}{{<numwidth>}}{{<title>}}{{<page>}}`: Macro to produce a table of contents line with the following parameters:

**level** If `<level>` > `\c@tocdepth`, then no line produced.

**indent** Total indentation from the left margin.

**numwidth** Width of box for number if the `<title>` has a `\numberline` command. As of 25 Jan 1988, this is also the amount of extra indentation added to second and later lines of a multiple line entry.

**title** Contents of entry.

**page** Page number.

Uses the following parameters, which must be set by the document style. They should be defined with `\def`'s.

**pnumwidth** Width of box in which page number is set.

**tocrmarg** Right margin indentation for all but last line of multiple-line entries.

**dotsep** Separation between dots, in mu units. Should be `\def`'d to a number like 2 or 1.7

```

305 %</2ekernel>
306 %<*2ekernel|latexrelease>
307 %<latexrelease>\IncludeInRelease{2018/12/01}%
308 %<latexrelease>
309 \def{@dottedtocline#1#2#3#4#5{%
310   \ifnum #1>\c@tocdepth \else
311     \vskip \z@ \@plus.2\p@
312     {\leftskip #2\relax \rightskip \atocrmarg \parfillskip \relax
313      \parindent #2\relax\afterindenttrue
314      \interlinepenalty@M
315      \leavevmode
316      \tempdima #3\relax

```

Changes<sup>4</sup>

```

317   \advance\leftskip \tempdima \null\nobreak\hskip \relax
318   \leftskip \dotsep \nobreak
319   \leaders\hbox{$\mathbf{m@th}$}

```

If a document uses fonts other than computer modern, the use of a dot from math can be very disturbing despite the fact that this might be the only place in a document that then uses computer modern. Therefore we surround the dot with an `\hbox` to escape to the surrounding text font.

```

320   \mkern \dotsep \mu\hbox{.}\mkern \dotsep
321   \mu$\}\hfill
322   \nobreak
323   \hb@xt@\pnumwidth{\hfil\normalfont \normalcolor #5%

```

We finish off by preventing any protrusion if that is enabled. If protrusion happens the number may shift to the right and as a result you may end up with an additional dot in the toc line in some situations.

```

324   \kern-\p@\kern\p@\%
325   \par}%
326   \fi}

```

(End definition for `\@dottedtocline`.)

---

<sup>4</sup>v1.0Z 1996/12/20 Added `\nobreak` for latex/2343

- \noprotrusion** This command, if placed directly to the right (or left) of a word, will prevent prevent protrusion of that word into the margin. It is used in the toc entry lines as they shouldn't protrude. It is implemented as to kerns that cancel each other but being there hide the word so that protrusion is not added. Note that a zero kern or an empty box would not work as the protrusion mechanism will skip over those.

```
327 \DeclareRobustCommand\noptrusion{\leavevmode\kern-\p@\kern\p@}
```

(End definition for \noptrusion.)

```
328 %</2ekernel|latexrelease>
329 %<latexrelease>\EndIncludeInRelease
330 %<latexrelease>\IncludeInRelease{0000/00/00}%
331 %<latexrelease>           {\@dottedtocline}{Prevent }{%
332 %<latexrelease>\def\@dottedtocline#1#2#3#4#5{%
333 %<latexrelease> \ifnum #1>\c@tocdepth \else
334 %<latexrelease>   \vskip \z@ \@plus.2\p@
335 %<latexrelease>   {\leftskip #2\relax \rightskip \atocrmarg {%
336 %<latexrelease>     \parfillskip -\rightskip
337 %<latexrelease>     \parindent #2\relax\@afterindenttrue
338 %<latexrelease>     \interlinepenalty\@M
339 %<latexrelease>     \leavevmode
340 %<latexrelease>     \tempdima #3\relax
341 %<latexrelease>     \advance\leftskip \tempdima {%
342 %<latexrelease>       \null\nobreak\hskip -\leftskip
343 %<latexrelease>       {\#4}\nobreak
344 %<latexrelease>       \leaders\hbox{$\m@th
345 %<latexrelease>         \mkern \dotsep \mu\hbox{.}\mkern }{%
346 %<latexrelease>           \normalcolor #5}%
347 %<latexrelease>           \par}%
348 %<latexrelease>   \fi}
349 %<latexrelease>
350 %<latexrelease>\let\noptrusion\undefined
351 %<latexrelease>\EndIncludeInRelease
352 %<2ekernel>
```

**Note:** \nobreak's added 7 Jan 86 to prevent bad line break that left the page number dangling by itself at left edge of a new line.

Changed 25 Jan 88 to use \leftskip instead of \hangindent so leaders of multiple-line contents entries would line up properly.

- \numberline** \numberline{<number>}: For use in a \contentsline command. It puts <number> flushleft in a box of width \tempdima (Before 25 Jan 88 change, it also added \tempdima to the hanging indentation.)

```
353 \def\numberline#1{\hb@xt@\tempdima{#1\hfil}}
354 %</2ekernel>
```

(End definition for \numberline.)

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 32.1 Float types

The different types of floats are identified by a `<type>` name, which is the name of the counter for that kind of float. For example, figures are of type ‘figure’ and tables are of type ‘table’. Each `<type>` has associated a positive `<type number>`, which is a power of two e.g., figures might be have type number 1, tables type number 2, programs type number 4, etc. See [//tex.stackexchange.com/questions/39017/how-to-influence-the-position-of-a-figure](https://tex.stackexchange.com/questions/39017/how-to-influence-the-position-of-a-figure)

The locations where a float can go are specified by a `<placement specifier>`, which is a list of the possible locations, each denoted by a letter as follows:

- `! : bang` — indicates that some restrictions should be ignored
- `h : here` — at the current location in the text.
- `t : top` — at the top of a text page.
- `b : bottom` — at the bottom of a text page.
- `p : page` — on a separate float page

In addition, in conjunction with these, you can use ‘!’ which means that the current values of the float positioning parameters are ignored for this float. (Has no effect on ‘p’, float page positioning.)

For example, ‘pht’ specifies that the float can appear in any of three locations: page, here or top. The order of specifying the placement specifiers is irrelevant to the float algorithm.

However, if a letter is not present then the corresponding area will not be tried at all.

### 32.1.1 Floating Environments

355 `\message{floats,}`

Where floats may appear on a page, and how many may appear there are specified by the following float placement parameters. The numbers are named like counters so the user can set them with the ordinary counter-setting commands.

|                                               |                                                                                                               |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <code>\c@topnumber</code>                     | Number of floats allowed at the top of a column.                                                              |
| <code>\topfraction</code>                     | Fraction of column that can be devoted to floats. <code>\c@dbltopnumber</code> , <code>\dbltopfraction</code> |
| <code>\c@bottomnumber, \bottomfraction</code> | Same as above, but for double-column floats.                                                                  |
| <code>\c@totalnumber</code>                   | Same as above for bottom of page.                                                                             |
| <code>\textfraction</code>                    | Number of floats allowed in a single column, including in-text floats.                                        |
| <code>\floatpagefraction</code>               | Minimum fraction of column that must contain text.                                                            |
|                                               | Minimum fraction of page that must be taken up by float page.                                                 |

|                                    |                                          |
|------------------------------------|------------------------------------------|
| <code>\dblfloatpagefraction</code> | Same as above, for double-column floats. |
|------------------------------------|------------------------------------------|

The document class must define the following.

|                                   |                                                                                                                                                                                           |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>\fps@{TYPE}</code>          | The default placement specifier for floats of type TYPE.                                                                                                                                  |
| <code>\ftype@{TYPE}</code>        | The type number for floats of type TYPE.                                                                                                                                                  |
| <code>\ext@TYPE</code>            | The file extension indicating the file on which the contents list for float type TYPE is stored. For example, <code>\ext@figure = 'lof'</code> .                                          |
| <code>\fnum@TYPE</code>           | A macro to generate the figure number for a caption. For example, <code>\fnum@TYPE == \Figure\the\figure</code> .                                                                         |
| <code>\@makecaptionNUMTEXT</code> | A macro to make a caption, with NUM the value produced by <code>\fnum@...</code> and TEXT the text of the caption. It can assume it's in a <code>\parbox</code> of the appropriate width. |

### Example 1.1 Type parameters

```

10  \makeatletter
11  \fps@figure \\
12  \ftype@figure
13  \makeatother

tbp
1

```

The command is designed to be called by the class in a new environment definition, for example in AmS classes figure is defined as:

The `\@float` will take care of the basic structure of the float and to set penalties so as to be able to pass this information to the `output` routine.

```

14  \@float{TYPE}[PLACEMENT] ==
15  BEGIN
16  if hmode then \@bsphack
17  else          \@floatpenalty := -10002
18  else          \@floatpenalty := -10003
19  fi
20  \@capttype ==L TYPE
21  \@dblflset
22  \@fps    ==L PLACEMENT
23  \@onelvel@sanitize \@fps
24  add default PLACEMENT if at most ! in PLACEMENT == 2
      \@\fpsadddefault

```

```

25      if inner
26          then LaTeX Error: 'Not in outer paragraph mode.'
27              \@floatpenalty := 0
28      else if \@freelist nonempty
29          then \@currbox :=L head of \@freelist
30              \@freelist :=G tail of \@freelist
31              \count\@currbox :=G 32*\f@type@TYPE +
32                  bits determined by \f@placement
33          else \@floatpenalty := 0
34              LaTeX Error: 'Too many unprocessed floats'
35      fi
36  fi
37  \@currbox :=G \color@vbox
38          \normalcolor
39          \vbox{
40              %% 15 Dec 87 --
41              %% removed \boxmaxdepth :=L 0pt
42              %% that made box 0 depth because \it screwed
43              %% things up. Instead, added \vskip0pt at end
44              \hsize = \columnwidth
45          \parboxrestore
46          \@floatboxreset
47  END
48
49  \caption ==
50  BEGIN
51      \refstepcounter{\@c@type}
52      \dbl@arg{\caption{\@c@type}}
53  END
54
55 In following definition, \par moved from after \addcontentsline to
56 before \addcontentsline because the \write could cause
57 an extra blank line to be added to the paragraph above the
58 caption. (Change made 12 Jun 87)
59
60  \@caption{TYPE}[STEXT]{TEXT} ==
61  BEGIN
62      \par
63      \addcontentsline{\ext@TYPE}{TYPE}{\numberline{\theTYPE}{STEXT}}
64      \begingroup
65          \parboxrestore
66          \normalsize
67          \makecaption{\f@num@TYPE}{TEXT}
68          \par
69      \endgroup
70  END
71
72
73  \@dblfloat{TYPE}[PLACEMENT] : Macro to begin a float
    \environment for

```

---

```

74      a double-column float of type TYPE with PLACEMENT as >
75          <the placement
76      specifier. The default value of PLACEMENT is 'tp'
77      The environment is ended by \end@dblfloat.
78      E.g., \figure* == \@dblfloat{figure},
79          \endfigure* == \end@dblfloat.
80
81      \@dblfloat[TYPE][PLACEMENT] ==
82          Identical to \@float[TYPE][PLACEMENT] except \hsize and >
83              &\ linewidth
84      are set to \textwidth.

```

**\@floatpenalty** The float penalty is saved in a counter to enable ease of use.

(End definition for **\@floatpenalty**.)

```

83 \newcount\@floatpenalty

```

### \caption[<short caption text>]{<long caption text>}

This is set to be an error message outside a float since no capttype is defined there; this may need to be changed by some classes. Note if the caption is outside a float it triggers an error.

```

84 \def\caption{%
85     \ifx\@capttype\@undefined
86         \@latex@error{\noexpand\caption outside float}\@ehd
87         \expandafter\@gobble
88     \else
89         \refstepcounter\@capttype
90         \expandafter\@firstofone
91     \fi
92     {\@dblarg{\@caption\@capttype}}%
93 }

```

The paragraph setting parameters are normalised at this point, however **\@parboxrestore** resets **\everypar** which is not correct in this context so **\@setminipage** is called if needed.

The float mechanism, like minipage, sets the flag **@minipage** true before executing the user-supplied text. Many L<sup>A</sup>T<sub>E</sub>X constructs test for this flag and do not add vertical space when it is true. The intention is that this emulates T<sub>E</sub>X's 'top of page' behaviour. The flag must be set false at the start of the first paragraph. This is achieved by a redefinition of **\everypar**, but the call to **\@parboxrestore** removes that redefinition, so it is re-inserted if needed. If the flag is already false then the **\caption** was not the first entry in the float, and so some other paragraph has already activated the special **\everypar**. In this case no further action is needed.

```

94     \@parboxrestore
95     \if@minipage
96         \@setminipage
97     \fi

```

```

98      \normalsize
99      \@makecaption{\csname fnum@\#1\endcsname}{\ignorespaces }
100     \ignorespaces \#3\par
100   \endgroup

```

### \@float{<float specifier>}

Just a reminder that this is used to define new floating environments, such as *figure* and *table*. The **fps@#1** has been defined in the standard classes and defines the default float specifier. In **book.cls** is defined as **\def\fps@figure{tbp}**.

#### Example 1.2 The definition of float

```

10  \makeatletter
11  \meaning\fps@figure
12  \makeatother

macro:->tbp

```

### \@dblflset

```

13 \def\@float#1{%
14   \@ifnextchar[%
15     {\@xfloat{#1}}%
16     {\edef\reserved@a{\noexpand\@xfloat{#1}[\csname %
17       \ignorespaces \#1\endcsname ]}%
17     \reserved@a}

```

### \@dblfloat

(End definition for \@dblfloat.)

```

18 \def\@dblfloat{%
19   \if@twocolumn\let\reserved@a\@dbf@l\else\let\reserved@a\@float\fi
20   \reserved@a}

```

**\fps@dbl** Note that all double floats have default fps ‘tp’.

(End definition for \fps@dbl.)

**\@setfps** This sets the fps, dealing with error conditions by adding the default.

(End definition for \@setfps.)

**\@xfloat** The first part of this sets the count register that stores all the information about the type and fps of the float.

We assume here that the default specifiers already contain no active characters.

It may be better to store the defaults as numbers, rather than symbol strings.

The `\@nocument` is defined in the ltxerror and is the error produced if paragraphs are typeset in the preamble. So here LaTeX is checking if a float was specified in a preamble. Why here, is because we cannot rely on user defined environments to carry out these tests.

What does the ! do? This goes to default, so it is interesting to find out why the bang was specified in the first place. It just starts overrides all the constraints.

```
(End definition for \@xfloat.)  
21 \def\@xfloat #1[#2]{%  
22   \@nocument  
23   \def \@capttype {#1}%">  
24   \def \@fps {#2}%">  
25   \@onelvel@sanitize \@fps  
26   \def \reserved@b {!}%">  
27   \ifx \reserved@b \@fps  
28     \@fpsadddefault  
29   \else  
30     \ifx \@fps \@empty  
31       \@fpsadddefault  
32     \fi  
33   \fi  
34 %   \end{macrocode}  
35 % As discussed earlier, floats will set different penalties >  
% if it is in horizontal mode  
36 % from that of other modes.  
37 %   \begin{macrocode}  
38   \ifhmode  
39     \bsphack  
40     \@floatpenalty -\@Mii  
41   \else  
42     \@floatpenalty-\@Miii  
43   \fi  
44 % If inner obviously we cannot float out of a box, issue an >  
% error  
45   \ifinner  
46     \parmoderr@\@floatpenalty\z@  
47   \else  
48 %  
49   \@next\@currbox\@freelist  
50   {  
51     % holds the type of float start at 16. Note the same >  
% count is used in  
52     % the output routine to set the bits.  
53     \@tempcnta \sixt@@n  
54  
55     % iterate through the specification and set the bitmap  
56     \expandafter \tfor \expandafter \reserved@a  
57     \expandafter :\expandafter =\@fps  
58     \do  
59     {  
60       % This is the first position reading from the right.  
61       \if \reserved@a h%
```

```

62          \ifodd \atempcnta
63          \else
64              % 17 is here float
65              \advance \atempcnta \@ne
66          \fi
67      \fi
68      \if \reserved@a t%
69          % position 2
70          \@setfpsbit \tw@
71
72      \fi
73      \if \reserved@a b%
74
75          \@setfpsbit 4%
76      \fi
77      \if \reserved@a p%
78          \@setfpsbit 8%
79      \fi
80      \if \reserved@a !%
81          \ifnum \atempcnta>15
82              \advance\atempcnta -\sixt@n\relax
83          \fi
84      \fi
85  }%
86  \atempcntb \csname ftype@\@capttype \endcsname
87
88  % multiply by 32 by the ftype@\capttype
89  \multiply \atempcntb \xxxii
90  \advance \atempcnta \atempcntb
91
92  % define globally count |\@currbox| as |\@tempcnta|
93  \global \count\@currbox \atempcnta
94  }%
95  \@fltovf %This is for too many floats error for marginpars
96  \fi

```

The remainder sets up the box in which the float is typeset, and the typesetting environment to be used. It is essential to have the extra box to avoid the unwanted space that would otherwise often be put at the top of the float.

It ends with a hook; not sure how useful this is but it is needed at present to deal with double-column floats.

```

97  \global \setbox\@currbox
98  \color@vbox
99  \normalcolor
100 \vbox \bgroup
101 \hsize\columnwidth
102 \parboxrestore
103 \floatboxreset
104 }

```

**\@floatboxreset** The rational for allowing these normally global flags to be set locally here, via **\@parboxrestore**, was stated originally by Donald Arseneau and extended by Chris Rowley. It is because these flags are only set globally to true by sec-

tion commands, and these should never appear within marginals or floats or, indeed, in any group; and they are only ever set globally to false when they are definitely true.

If anyone is unhappy with this argument then both flags should be treated as in `\set@nobreak`; otherwise this command will be redundant. Added local settings of flags: dangerous!!

```
(End definition for \@floatboxreset.)  
105 \def \@floatboxreset {  
106   \reset@font  
107   \normalsize  
108   \setminipage  
109 }  
  
\@setnobreak  
110 \def \@setnobreak{  
111   \if@nobreak  
112     \let\outer@nobreak\@nobreaktrue  
113     \@nobreakfalse  
114   \fi  
115 }  
  
(End definition for \@setnobreak.)  
  
\@setminipage  
116 \def \@setminipage{  
117   \minipagetrue  
118   \everypar{\@minipagetrue\everypar{}%  
119 }  
  
(End definition for \@setminipage.)  
  
\end@float  
  
120 \def\end@float{  
121   \endfloatbox  
122   \ifnum@\floatpenalty <\z@  
123     \largefloatcheck  
124     \cons@\currlist@\currbox  
125     \ifnum@\floatpenalty <-\@Mi  
126       \penalty -\@Miv  
127     \tempdima\prevdepth  
128     \vbox{}%  
129     \prevdepth\tempdima  
130     \penalty\floatpenalty
```

We make sure that we never exceed `\textheight`, otherwise float will never get typeset (91/03/15 FMi).

```
123   \largefloatcheck  
124   \cons@\currlist@\currbox  
125   \ifnum@\floatpenalty <-\@Mi  
126     \penalty -\@Miv
```

Saving and restoring `\prevdepth` added 26 May 87 to prevent extra vertical space when used in vertical mode.

```
127   \tempdima\prevdepth  
128   \vbox{}%  
129   \prevdepth\tempdima  
130   \penalty\floatpenalty
```

```

131      \else
132          \vadjust{\penalty -\@Miv }
133              \vbox{} \penalty\@floatpenalty}\@Ephack
134      \fi
135  }

```

```

\end@dblfloat
136 \def\end@dblfloat{%
137 \if@twocolumn
138     \endfloatbox
139     \ifnum\@floatpenalty <\z@

```

We make sure that we never exceed `\textheight`, otherwise float will never get typeset (91/03/15 FMi).

```

140     \@largefloatcheck
141     \@cons\@dbldeferlist\@currbox
142     \fi

```

RmS 92/03/18 changed `\@esphack` to `\@Ephack`.

```

143     \ifnum \@floatpenalty =-\@Mi \@Ephack\fi
144 \else
145     \end@float
146 \fi
147 }

```

(End definition for `\end@dblfloat`.)

### \@endfloatbox

This macro is not intended to be a hook; it is designed to help maintain the integrity of this code, which is used twice and, as can be seen, is subject to frequent changes.

```

148 \def \@endfloatbox{%
149     \par\vskip\z@skip      %% \par\vskip\z@ added 15 Dec 87
150     \@minipagefalse
151     \outer@nobreak
152     \egroup                %% end of vbox
153     \color@endbox
154 }

```

```

\outer@nobreak
155 \let\outer@nobreak\empty

```

(End definition for `\outer@nobreak`.)

### \@largefloatcheck

(End definition for `\@largefloatcheck`.)

This calculates by how much a float is oversize for the page and prints this in a warning message.

```

156 \def \@largefloatcheck{%
157   \ifdim \ht\@currbox>\textheight
158     \tempdima -\textheight
159     \advance \tempdima \ht\@currbox
160     \@latex@warning {Float too large for page by >
161       \the\tempdima}%
162     \ht\@currbox \textheight
163   \fi
164 }
165
166 \def \@dblfloat#1[#2]{%
167   \xfloat{#1}{#2}\hsize\textrmwidth\linewidth\textrmwidth}

```

*(End definition for \@dbflt and \@dblfloat.)*

```

168 \newcount\c@topnumber
169 \newcount\c@dbltopnumber
170 \newcount\c@bottomnumber
171 \newcount\c@totalnumber

```

An analysis of \@floatplacement:

This should be called whenever \colht has been set.

```

172   % Textpage bit, global:
173   \global\@toproom \topfraction\colht
174   \global\@botnum \c@bottomnumber
175   \global\@botroom \bottomfraction\colht
176   \global\@colnum \c@totalnumber
177   % Floatpage bit, local:
178   \fpm\floatpagefraction\colht

```

\@dblfloatplacement This should be called only within a group. Now changed to provide extra checks in \addtodbcol, needed when processing a BANG float.

```

179 \def \@dblfloatplacement {%

```

Textpage bit: global, but need not be.

```

180   \global \dbltopnum \c@dbltopnumber
181   \global \dbltoproom \dbltopfraction\colht

```

This new bit uses \textmin to locally store the amount of extra room in the column.

```

182   \textmin \colht
183   \advance \textmin -\dbltoproom

```

Floatpage bit: must be local.

```

184   \fpm\dblfloatpagefraction\textheight
185   \fptop \dblftop
186   \fpsep \dblfpsep
187   \fpbot \dblfpbot
188 }

```

*(End definition for \@dblfloatplacement.)*

left  
right

## 32.2 Marginal Notes

Marginal notes use the same mechanism as floats to communicate with the `\output`<sup>P. 475</sup> routine. Marginal notes are distinguished from floats by having a negative placement specification. The command `\marginpar[<L>]{<RTEXT>}` generates a marginal note in a parbox, and using LTEXT if it's on the left and RTEXT if it's on the right. (Default is RTEXT = LTEXT.) It uses the following parameters.

|                              |                                                                                                                                                                                                            |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>\marginparwidth</code> | Width of marginal notes.                                                                                                                                                                                   |
| <code>\marginparsep</code>   | Distance between marginal note and text. The page layout to determine how to move the marginal note into the margin. E.g., <code>\@leftmarginskip == \hskip -\marginparwidth \hskip -\marginparsep.</code> |
| <code>\marginparpush</code>  | Minimum vertical separation between <code>\marginpar</code> 's                                                                                                                                             |

Marginal notes are normally put on the outside of the page if `\@mparswitch` = true, and on the right if `\@mparswitch` = false. The command `\reversemarginpar` reverses the side where they are put. `\normalmarginpar` undoes `\reversemarginpar`. These commands have no effect for two-column output.

SURPRISE: if two marginal notes appear on the same line of text, then the second one could appear on the next page, in a funny position. (I was unable to reproduce the error).

```
\marginpar [LTEXT]{RTEXT} ==
BEGIN
  if hmode then \@bsphack
    \@floatpenalty := -10002
  else \@floatpenalty := -10003
  fi
  if inner
    then LaTeX Error: 'Not in outer paragraph mode.'
    \@floatpenalty := 0
  else if \@freelist has two elements:
    then get \@marbox, \@currbox from \@freelist
      \count \@marbox :=G -1
    else \@floatpenalty := 0
      LaTeX Error: 'Too many unprocessed floats'
      \@currbox, \@marbox := \@tempboxa %%use \def
    fi
  fi
  if optional argument
  then %% \@xmpar ==
    \@savemarbox{\@marbox{LTEXT}}
    \@savemarbox{\@currbox{RTEXT}}
  else %% \@ympar ==

```

```

        \@savemarbox\@marbox{RTEXT}
        \box\@currbox :=G \box\@marbox
    fi
    \@xmpar
END

\reversemarginpar == BEGIN \mparbottom :=G 0
                     @reversemargin :=G true
END

\normalmarginpar == BEGIN \mparbottom :=G 0
                     @reversemargin :=G false
END

```

### \marginpar

```

189 \def\marginpar{%
190   \ifhmode
191     \bsphack
192     \floatpenalty -\Mii
193   \else
194     \floatpenalty-\Miii
195   \fi
196   \ifinner
197     \parmoderr
198     \floatpenalty\z@
199   \else
200     \next\@currbox\@freelist{}{}%
201     \next\@marbox\@freelist{\global\count\@marbox\m@ne}%
202     {\floatpenalty\z@
203      \fltovf\def\@currbox{\tempboxa}\def\@marbox{\tempboxa}}%
204   \fi
205   \ifnextchar [\@xmpar\@ympar}

```

### \@xmpar

```

206 \long\def\@xmpar[#1]#2{%
207   \@savemarbox\@marbox{#1}%
208   \@savemarbox\@currbox{#2}%
209   \@xmpar}

```

(End definition for \@xmpar.)

This is the main macro for a marginpar command that does not have left or right text. Note it call \@xmpar

### \@ympar

```

210 \long\def\@ympar#1{%
211   \@savemarbox\@marbox{#1}%
212   \global\setbox\@currbox\copy\@marbox
213   \@ympar}

```

(End definition for \@ympar.)

\@savemarbox Sets up the vboxes including a color@vbox to correctly handle colour.

```

214 \long\def \@savemarbox #1#2{%
215   \global\setbox #1%
216   \color@vbox
217   \vtop{%
218     \hsize\marginparwidth
219     \parboxrestore
220     \marginparreset
221     #2%
222     \minipagetrue
223     \outer@nobreak
224     }%
225   \color@endbox
226 }
```

(End definition for \@savemarbox.)

\@marginparreset The rational for allowing these normally global flags to be set locally here, via \parboxrestore was stated originally by Donald Arsenau and extended by Chris Rowley. It is because these flags are only set globally to true by section commands, and these should never appear within marginals or floats or, indeed, in any group; and they are only ever set globally to false when they are definitely true.

If anyone is unhappy with this argument then both flags should be treated as in \set@nobreak; otherwise this command will be redundant.

```

227 \def \@marginparreset {%
228   \reset@font
229   \normalsize
230 %   \let\if@nobreak\iffalse
231 %   \let\if@noskipsec\iffalse
232 %   \setnobreak
233   \setminipage
234 }
```

(End definition for \@marginparreset.)

\@xmpar

```

235 \def \@xmpar{%
236   \ifnum@\floatpenalty <\z@\@cons\@currlist\@marbox\fi
237   \setbox\@tempboxa
238   \color@vbox
239   \vbox \bgroup
240   \end@float
241   \ignorefalse
242   \esphack
243 }
```

(End definition for \@xmpar.)

\reversemarginpar

```

\normalmarginpar 244 \def\reversemarginpar{\global\@mparbottom\z@ \l
\@reversemargintrue}
```

```

245 \def\normalmarginpar{\global\@mparbottom\z@ >
  \reversemarginfalse}

(End definition for \reversemarginpar and \normalmarginpar.)

246 \message{footnotes,}

```

## 32.3 Footnotes

We start with a summary of all user commands.

|                               |                                                                                                                                                                                                                                                      |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| \footnote{<text>}             | User command to insert a footnote.                                                                                                                                                                                                                   |
| \footnote[<I>]{<NUM>}{<NOTE>} | User command to insert a footnote numbered, NUM, where NUM is a number – 1, 2, etc. For example, if footnotes are numbered *, **, etc. within pages, then \footnote[2]{...} produces footnote '**'. This command does not step the footnote counter. |

\footnotemark[<number>]

Command to produce just the footnote mark in the text, but no footnote. With no argument, it steps the footnote counter before generating the mark.

\footnotetext[<number>]{<text>}

Command to produce the footnote but no mark. \footnote is equivalent to \footnotemark \footnotetext.

In a minipage environment, \footnote and \footnotetext are redefined so that

- (a) they use the counter mpfootnote
- (b) the footnotes they produce go at the bottom of the minipage.

The switch is accomplished by letting \mpfn == \footnote or \mpfootnote

```

10 \footnote{NOTE} ==
11 BEGIN
12   \stepcounter{\@mpfn}
13   \begingroup
14     \protect == \noexpand
15     \@thefnmark :=G eval (\thempfn)
16   \endgroup
17   \@footnotemark
18   \@footnotetext{NOTE}
19 END

```

\footins L<sup>A</sup>T<sub>E</sub>X uses the same insert for footnotes as PLAIN.

20 \newinsert\footins

L<sup>A</sup>T<sub>E</sub>X leaves these initializations for the \footins insert.

```

1 \footnotetext[NUM] ==
2 begin
3   begingroup
4   counter \mpfn := L NUM
5   \protect == \noexpand
6   \@thefnmark := G eval(\thempfn)
7   endgroup
8   \footnotetext
9 end

```

```

21 \skip\footins=\bigskipamount
22 \count\footins=1000
23 \dimen\footins=8in

```

(End definition for `\footins`.)

**\footnoterule** L<sup>A</sup>T<sub>E</sub>X keeps PLAIN T<sub>E</sub>X's `\footnoterule` as the default. This is also redefined in the standard classes.

```

24 \def\footnoterule{\kern-3\p@
25   \hrule \width 2in \kern 2.6\p@} % the \hrule is .4pt high

```

(End definition for `\footnoterule`.)

**\thefootnote**

```

26 \@definecounter{footnote}
27 \def\thefootnote{\arabic{c}@\footnote}

```

(End definition for `\thefootnote`.)

**\thempfootnote** The default display for the footnote counter in minipages is to use italic letters. We use `\itshape` not `\textit` as the latter would add an italic correction.

```

28 \@definecounter{mpfootnote}
29 \def\thempfootnote{{\itshape\alph{c}}@\mpfootnote}}

```

(End definition for `\thempfootnote`.)

**\@makefnmark**

```

30 \def\@makefnmark{\hbox{$^{\normalfont\@thefnmark}$}}
31 \def\@makefnmark{\hbox{\textsuperscript{\normalfont\@thefnmark}}}

```

(End definition for `\@makefnmark`.)

**\textsuperscript** This command provides superscript characters in the current text font. It's implementation might change!!!

```

32 \DeclareRobustCommand*\textsuperscript[1]{%
33   \textsuperscript{\selectfont#1}}

```

(End definition for `\textsuperscript`.)

**\@textsuperscript** This command should not be used directly, but may be used to define other commands **\textsuperscript**, **\@makefnmark**. #1 should always start with a font selection command, to activate the font size switch.

```
34 \def\@textsuperscript#1{%
35   {\m@th\ensuremath{{}^{\{\,\,\,\mathrm{mbox}\{\,\mathrm{fontsize}\,\mathrm{sf@size}\,\mathrm{z@#1}\}\,\,\,\}}}}
```

(End definition for **\@textsuperscript**.)

**\footnotesep** See the geometry chapter for the value of **\footnotesep**. In this book it was set as 6.65pt.

```
36 \newdimen\footnotesep
```

(End definition for **\footnotesep**.)

### \footnote

The **LATEX** **footnote** command takes an optional parameter.

```
37 \def\footnote{\@ifnextchar[\@xfootnote{\stepcounter\@mpfn
38   \protected@xdef\@thefnmark{\thempfn}%
39   \@footnotemark\@footnotetext}}
```

As packages tend to modify almost everything in **LATEX** I was curious to check the definition of footnote.

#### Example 3.3 The meaning of footnote

```
10 The meaning of footnote command.\footnote[13]{This is a
      footnote.}
11
12 \texttt{\meaning\footnote}
```

The meaning of footnote command.<sup>m</sup>

```
macro:->\@ifnextchar [\@xfootnote {\stepcounter \@mpfn \protected@xdef
\@thefnmark {\thempfn }@\footnotemark \@footnotetext }
```

<sup>m</sup>This is a footnote.

### \@xfootnote

```
13 \def\@xfootnote[#1]{%
14   \begingroup
15     \csname c@\@mpfn\endcsname #1\relax
16     \unrestored@protected@xdef\@thefnmark{\thempfn}%
17   \endgroup
18   \@footnotemark\@footnotetext}
```

(End definition for **\@xfootnote**.)

### \@footnotetext

```

19 \long\def\@footnotetext#1{\insert\footins{%
20   \reset@font\footnotesize
21   \interlinepenalty\interfootnotelinepenalty
22   \splittopskip\footnotesep
23   \splitmaxdepth \dp\strutbox \floatingpenalty \z@MM
24   \hsize\columnwidth \@parboxrestore
25   \protected@edef@\currentlabel{%
26     \csname p@footnote\endcsname\@thefnmark
27   }%
28   \color@begingroup
29     \color@makefntext{%
30       \rule\z@\footnotesep\ignorespaces#1\@finalstrut\strutbox}%
31   \color@endgroup}%

```

### \footnotemark[<number>]

The footnote mark is defined here. See also the book class.

```

32 \def\footnotemark{%
33   \@ifnextchar[\@xfootnotemark
34   {\stepcounter{footnote}%
35     \protected@edef@\thefnmark{\thefootnote}%
36   \@footnotemark}%

```

### \@xfootnotemark

```

37 \def\@xfootnotemark[#1]{%
38   \begingroup
39     \c@footnote #1\relax
40     \unrestored@protected@xdef@\thefnmark{\thefootnote}%
41   \endgroup
42   \@footnotemark}

```

\@footnotemark Add \nobreak to allow hyphenation. latex/1605

```

43 \def\@footnotemark{%
44   \leavevmode
45   \ifhmode\edef\x@sf{\the\spacefactor}\nobreak\fi
46   \color@makefnmark
47   \ifhmode\spacefactor\x@sf\fi
48   \relax}

```

(End definition for \@footnotemark.)

### \footnotetext

```

49 \def\footnotetext{%
50   \@ifnextchar [\@xfootnotenext
51     {\protected@edef@\thefnmark{\thempfn}%
52   \@footnotetext}%

```

(End definition for \footnotetext.)

```
\@xfootnotenext
53 \def\@xfootnotenext[#1]{%
54   \begingroup
55     \csname c@\@mpfn\endcsname #1\relax
56     \unrestored@protected@xdef\@thefnmark{\thempfn}%
57   \endgroup
58   \@footnotetext}
```

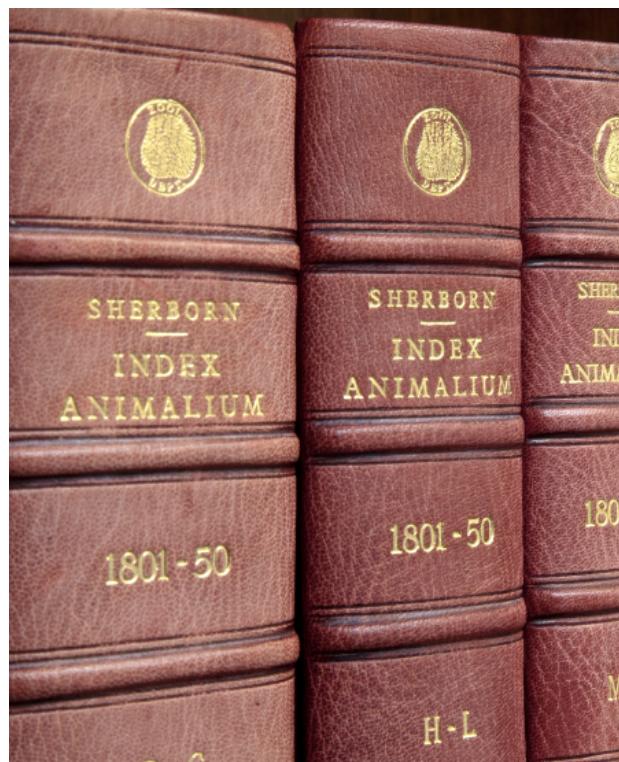
*(End definition for \@xfootnotenext.)*

```
\thempfn
\@mpfn 59 \def\@mpfn{footnote}
60 \def\thempfn{\thefootnote}
```

*(End definition for \thempfn and \@mpfn.)*

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.





Sherborn's 'Index Animalium'. Credit Natural History Museum, London<sup>a</sup>

## PREPAR- ING INDEXES

And in such indexes, although small pricks  
To their subsequent volumes, there is seen  
The baby figure of the giant mass  
Of things to come at large.

—Shakespeare

from  
*Troilus and Cressida*



**SELF-  
PORTRAIT** Handwritten  
cards compiled by Sherborn  
for his publication *Index  
Animalium*

THE first English Language index, appeared in Christopher Marlowe's *Hero and Leander* in 1593. At that period, as often as not, by an "index to a book" was meant what we should now call a table of contents. Among the first indexes—in the modern sense—to a book in the English language was one in Plutarch's Parallel Lives, in Sir Thomas North's 1595 translation.<sup>b</sup>

A section entitled "An

Alphabetical Table of the most material contents of the whole book"<sup>c</sup> may be found in Henry Scobell's Acts and Ordinances of Parliament of 1658. This section comes after "An index of the general titles comprised in the ensuing Table". Both of these indexes predate the index to Alexander Cruden's Concordance (1737) see Farrows<sup>c</sup>, which is erroneously held to be the earliest index found in an English book.

<sup>a</sup>This monumental publication became the basis for all zoological nomenclature work having gathered together all the relevant data in one place, just as an online database does today.

<sup>b</sup>Borko, Harold & Bernier, Charles L. (1978). *Indexing Concepts and Methods*, ISBN 0-12-118660-1.

<sup>c</sup>farrow96.

## 33.1 Preparing an index

In order to produce an index, we need to load the package `makeidx`, mark the indices we need using `\index` and compile the document using `\makeindex`.<sup>1</sup> At the place where we want the index to be printed, we use `\printindex`.

In  $\text{\LaTeX}$ , we include a word in the index by using the command `\index{arg}`, so if the word Kroll should be included in the index, we should use the command `\index{Kroll}`.

If the word is to be printed in bold, we use

```

62 \documentclass{article}
63 \usepackage{makeidx}
64 \makeindex
65 \begin{document}
66   To prepare an index,
67   just include the
68   package\index{package}
69 \printindex
70 \end{document}

```

When the input file is processed with one of the  $\text{\LaTeX}$  engines the `\index` command writes an appropriate index with the current page number, to a special file. The file has the same name as the  $\text{\LaTeX}$  input file, but with the extension (`.idx`). This file can then be processed with the `makeindex` program by typing in the command line:

`makeindex filename`

Note that you do not have to type the `filename` extension. The program will look for a `filename.idx` and use that. The `makeindex` program generates a sorted index with the same base file name, but this time with

<sup>1</sup>You will also need to at least run the file once using `MakeIndex` on `MiK\TeX`. Check your distribution if you getting problems.

the extension `.ind`. If now the  $\text{\LaTeX}$  input file is processed again, this sorted index gets included into the document at the point where  $\text{\LaTeX}$  finds `\printindex`.

There is a special character @ which is used to denote that what appears on its left side must be typeset as it appears on its right side. The first occurrence of perl will also be used by the sorting algorithm. is is very useful since what is used for sorting and what will be printed may be different! For example, we may want to have the name Donald Knuth under the letter K., we should write

```
\index{Knuth@{Donald Knuth}}
```

Another thing we may want to change is the way that the page number is typeset. If we want, for example, to have the page number in bold, we would write `\index{perl|textbf}`. Notice that we wrote "textbf" without the backslash. Of course, the above can be combined with the command:

```
\index{perl@\textbf{perl}|textit}
```

will print the word perl in the index (the entry will be typeset in boldface type) sorted as "perl", and its page number will be italic. A common application of this is through the command . If we want to send the reader to another index entry, say, to send the reader from the `$\omega` to the `$\Omega` command, we can write

```
\index{\omega@\$\omega|\see{\$\Omega}}
```

Here, we ask for the entry to be sorted according to the word omega and, in its place, the program must use

```
11 \$\omega|\see{\$\\Omega}
```

If a word is used repeatedly in a range of pages and we want to have

this range in the index, we do not write the relative `index` command all of the time. Instead, we write `\index{\{convex\}\|()}` at the place where we have the first occurrence and `\index{\{convex\})\}` at the place where we have the last occurrence. This will produce a page range in the index for the word "convex".

### 33.1.1 Subindices

Subindices can be produced using an exclamation mark. If we want the word 'Zeus' to appear in the category of Greek which is in the category of Gods, we will write:

`\index{Gods!Greek!Zeus}`

The actual symbol used will depend on the `.ist` file used when the file is compiled. For example in the `ltxdoc` and `phddoc` classes this is redefined as > and the above should be written as:

```
\index{Gods>Greek>Zeus}
```

The symbol to be used is called **index level** and is defined in the `.ist` file that is used in conjunction with the `MakeIndex` program to produce the index.

## 33.2 Multi-page Indexing

To perform multi-page indexing, add a ( `and` ) to the end of the `\index` command, as in .

```
\index{Quantum Mechanics!History|()}
```

In 1901, Max Planck released his theory of radiation dependant on quantized energy. While this explained the ultraviolet catastrophe in the spectrum of blackbody radiation, this had far larger consequences as the beginnings of quantum mechanics....

```
\index{Quantum Mechanics>History|})}
```

## 33.3 Summary of commands

| Example                                  | Index Entry         | Comment                |
|------------------------------------------|---------------------|------------------------|
| <code>\index{hello}</code>               | hello, 1            | Plain entry            |
| <code>\index{hello!Peter}</code>         | Peter, 3            | Subentry under 'hello' |
| <code>\index{Sam@\textsl{Sam}}</code>    | Sam, 2              | Formatted entry        |
| <code>\index{Lin@\textbf{Lin}}</code>    | <b>Lin</b> , 7      | Same as above          |
| <code>\index{Jenny\textbf{Jenny}}</code> | Jenny, 3            | Formatted page number  |
| <code>\index{Joe\textit{textit}}</code>  | Joe, 5              | Same as above          |
| <code>\index{ecole@\école}</code>        | école, 4            | Handling of accents    |
| <code>\index{Peter see{hello}}</code>    | Peter, see hello    | Cross-references       |
| <code>\index{Jen see also{Jenny}}</code> | Jen, see also Jenny | Same as above          |

## 33.4 Indexing Class Documentation

Indexing `LATEX 2e` classes or package documentation produced with the `ltxdoc` is normally achieved using the `doc`<sup>2</sup> and `docstrip`<sup>3</sup> program, which are sometime difficult to use, if you need to deviate from their standard methods. The

<sup>2</sup>Mittelbach, Frank (May 2018). *The doc and shortverb package*.

<sup>3</sup>Mittelbach, Frank et al. (May 2018). *The DocStrip Program*. Version v2.5g.

important thing here to remember is that you need to use different characters  
= > \*.

| normal | doc |
|--------|-----|
| @      | =   |
| !      | >   |

```
\index{Indexing=\textbf}
\index{Indexing>general}
\index{Indexing>doc}
```

This manual, was build using a large **ltxdoc** class and these problems appeared while I was developing it. As normal with such problems, they were very time consuming to debug. There are still issues in some parts and one day, I am hoping to come back and correct them. One needs at this point to query the need to use the **doc** and **docstrip** method of documenting macros and if it shouldn't have a pre-processor written in a higher language to ease development.

#### Example 4.1 Checking usage and main

```
10 \meaning\main \\
11 \meaning\usage

macro:#1->{\color {red}\uline {\#1}}
macro:#1->\textit {\#1}
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

The makeindex program was developed by Pehong Chen and Michael Harrison<sup>1</sup> in the eighties and is still used by L<sup>A</sup>T<sub>E</sub>X. It is a remarkable, flexible program, found on most distributions. It is also used in GNU EMACS.

The input format consists of a list of  $\langle \text{specifier}, \text{attribute} \rangle$  tuples. These are the essential tokens and delimiters needed in scanning the input index file. There are numerous such specifiers (you can think of them as the names of functions or variables) and the attributes as their value.

Table 34.1: Index input style parameters

| S/No | Specifier              | Attribute | Default        | Meaning                      |
|------|------------------------|-----------|----------------|------------------------------|
| 4    | <b>keyword</b>         | string    | "\\indexentry" | index command                |
| 5    | <b>arg_open</b>        | char      | '{'            | argument opening delimiter   |
| 6    | <b>arg_close</b>       | char      | '}'            | argument closing delimiter   |
| 7    | <b>range_open</b>      | char      | '('            | page range opening delimiter |
| 8    | <b>range_close</b>     | char      | ')'            | page range closing delimiter |
| 9    | <b>level</b>           | char      | '!'            | index level delimiter        |
| 10   | <b>actual</b>          | char      | '@'            | actual key designator        |
| 11   | <b>encap</b>           | char      |                | page number encapsulator     |
| 12   | <b>quote</b>           | char      | ''''           | quote symbol                 |
| 13   | <b>escape</b>          | char      | '\\'           | symbol which escapes quote   |
| 14   | <b>page_compositor</b> | string    | "-"            | composite page delimiter     |

**page range** The two range delimiters **range\_open** and **range\_close** are used with the **encap** operator. When **range\_open** immediately follows **encap** (i.e., `\index{...|(...)}`), it tells the index processor that an explicit range is starting. Conversely **range\_close** signals the closing of a range. In our design, three or more successive page numbers are abbreviated as a range implicitly. This *implicit* range formation can be turned off if an indexed term represents logically distinct concepts in different pages. When the implicit range is disabled, *explicit* page ranges can be enforced by using the two range delimiters **range\_open** and **range\_close**. Therefore, it is possible to index an entire section or a large piece of text related to a certain concept without having to insert an index command in every single page.

**quote** The **quote** operator is used to escape symbols. Thus `\index{foo@goo}` means a sort key of `foo@goo` rather than a sort key of `foo"` and an actual key of `goo`. As an exception, **quote**, when preceded by **escape** (i.e. `\index{...\"...}`), does not escape its succeeding letter. This special case is included because `\"` is the umlaut command in T<sub>E</sub>X. Requiring **quote** itself to be quoted in this case (i.e. `\""`) is feasible but somewhat awkward; **quote** and **escape** must be distinct.

<sup>1</sup>Chen, Pehong (1986). *GNU Emacs T<sub>E</sub>X -mode*. Tech. rep. 87/316. University of California.  
URL: <http://digitalassets.lib.berkeley.edu/techreports/ucb/text/CSD-87-347.pdf>.

**composite page delimiter** A page number can be a composite of one or more fields separated by a certain delimiter bound to a *page\_compositor* e.g. II-13 for page 13 of Chapter II. This attribute allows the lexical analyzer of the makeindex program to separate these fields, making the sorting of page numbers easier.

## 34.1 Output format

Table 34.3 summarizes the output style parameters. Again, it is a list of *<specifier, attribute>* pairs. In the default column, ‘\n’ and ‘\t’ denote a new line and a tab, respectively. These parameters can be further divided into the following groups:

**Context**. Together, **preamble** and **postamble** define the context in which the index is to be formatted.

**Starting Page**. The starting page number can either be supplied by the user or retrieved automatically from the document transcript. In either case, this number can be enclosed with **setpage\_prefix** and **setpage\_suffix** to yield a page number initializing command.

**New Group/Letter**. The string bound to **group\_skip** denotes the extra vertical space needed when a group is started. For a group beginning with a different letter, the parameters **lethead\_prefix** and **lethead\_suffix** (both with a default nil string) denote the group heading. The flag **lethead\_flag** has a default value of 0, which means other than **group\_skip** nothing else will be inserted before the group. On the other hand, if this flag is positive, the strings bound to **lethead\_prefix** and **lethead\_suffix** will be inserted with an instance of the new letter in uppercase in between. Similarly, a lowercase letter will be inserted if the flag is negative.

**Entry Separators**. This group includes everything with the **item\_** prefix. First, **item\_i** denotes the command and indentation to be inserted when a key is started from a level greater than or equal to *i*. Second, **item\_ij** has a similar meaning, but with *i* = *j* - 1. Finally, the two **item\_xj**'s are included to handle the situation where the parent level has no page numbers. Some styles require cases like these to be different from those with page numbers.

Table 34.3 depicts a system that supports three levels of subindexing. In general, suppose *n* is the number of index levels supported, there will be *n* **item\_i**'s ( $0 \leq i \leq n - 1$ ),  $(n - 1)$  **item\_ij**'s ( $1 \leq j \leq n - 1, i = j - 1$ ), and  $(n - 1)$  **item\_xj**'s ( $1 \leq j \leq n - 1$ ).

**Page Delimiters** Each level has a key/page delimiter that defines what is to be inserted between a key and its first page number. The inter-page delimiter is specified by **delim\_n**, while the range designator is given by **delim\_r**.

**Page Encapsulator** The attributes of **encap\_prefix**, **encap\_infix**, and **encap\_suffix** form what is to be placed into the output when an en-

capsulator is specified for a certain entry. Suppose **foo** is the specified encapsulator and **N** is the page number, the output sequence is

```
encap_prefix foo encap_infix N encap_suffix
```

**Page Precedence** Five different types of numerals are supported by most systems for page numbering. These are lowercase roman (**r**), numeric or arabic (**n**), lowercase alphabetic (**a**), uppercase roman (**R**), and uppercase alphabetic (**A**). The string bound to **page\_precedence** (default "**rnaRA**") specifies their order.

**Line Wrapping** In the output index file, the merged list of page numbers can be wrapped in multiple lines, if it is longer than **line\_max**. The newly wrapped line is indented by **indent\_space** whose length is **indent\_length**. This artificial line wrapping does not make any difference in formatting, but does provide increased readability for the pre-formatted final index. This feature may seem somewhat trivial at first glance, but if no formatters are involved whatsoever, the readability of the verbatim output index is important.

## 34.2 Processing

The output format is governed by an index style **.ist**. Writing new ones is a black art.

The file **gind.ist** is shown below

```

12 actual '='
13 encap '|'
14 level '>'
15 quote '!'
16 preamble
17 "\n \\begin{theindex} \n \\makeatletter\\scan@allowfalse\n"
18 postamble
19 "\n\n \\end{theindex}\n"
20 item_x1 "\\efill \n \\subitem "
21 item_x2 "\\efill \n \\subsubitem "
22 delim_0 "\\pfill "
23 delim_1 "\\pfill "
24 delim_2 "\\pfill "
25 % The next lines will produce some warnings when
26 % running Makeindex as they try to cover two different
27 % versions of the program:
28 %lethead_prefix "\\bfseries\\hfil "
29 %lethead_suffix "\\hfil}\\nopagebreak\n"
30 %lethead_flag 1
31 heading_prefix "\\bfseries\\hfil "
32 heading_suffix "\\hfil}\\nopagebreak\n"
33 headings_flag 1
34 % Remove R so I is treated in sequence I J K not I II III
35 page_precedence "rnaA"
36 %%
37 %%
38 %% End of file `gind.ist'.

```

| <i>specifier</i>             | <i>attribute</i>    | <i>default</i>                          | <i>meaning</i>                |
|------------------------------|---------------------|-----------------------------------------|-------------------------------|
| <code>preamble</code>        | <code>string</code> | <code>"\\begin{theindex}\\n"</code>     | index preamble                |
| <code>postamble</code>       | <code>string</code> | <code>"\\n\\n\\end{theindex}\\n"</code> | index postamble               |
| <code>setpage_prefix</code>  | <code>string</code> | <code>"\\n \\setcounter{page}{"</code>  | page setting command prefix   |
| <code>setpage_suffix</code>  | <code>string</code> | <code>"}\\n"</code>                     | page setting command suffix   |
| <code>group_skip</code>      | <code>string</code> | <code>"\\n\\n \\indexspace\\n"</code>   | intergroup vertical space     |
| <code>lethead_prefix</code>  | <code>string</code> | <code>""</code>                         | new letter heading prefix     |
| <code>lethead_suffix</code>  | <code>string</code> | <code>""</code>                         | new letter heading suffix     |
| <code>lethead_flag</code>    | <code>number</code> | <code>0</code>                          | flag designating new letter   |
| <code>item_0</code>          | <code>string</code> | <code>"\\n \\item "</code>              | level 0 item separator        |
| <code>item_1</code>          | <code>string</code> | <code>"\\n \\subitem "</code>           | level 1 item separator        |
| <code>item_2</code>          | <code>string</code> | <code>"\\n \\subsubitem "</code>        | level 2 item separator        |
| <code>item_01</code>         | <code>string</code> | <code>"\\n \\subitem "</code>           | levels 0/1 separator          |
| <code>item_x1</code>         | <code>string</code> | <code>"\\n \\subitem "</code>           | levels x/1 separator          |
| <code>item_12</code>         | <code>string</code> | <code>"\\n \\subsubitem "</code>        | levels 1/2 separator          |
| <code>item_x2</code>         | <code>string</code> | <code>"\\n \\subsubitem "</code>        | levels x/2 separator          |
| <code>delim_0</code>         | <code>string</code> | <code>“, ”</code>                       | level 0 key/page delimiter    |
| <code>delim_1</code>         | <code>string</code> | <code>“, ”</code>                       | level 1 key/page delimiter    |
| <code>delim_2</code>         | <code>string</code> | <code>“, ”</code>                       | level 2 key/page delimiter    |
| <code>delim_n</code>         | <code>string</code> | <code>“, ”</code>                       | inter page number delimiter   |
| <code>delim_r</code>         | <code>string</code> | <code>--"</code>                        | page range designator         |
| <code>encap_prefix</code>    | <code>string</code> | <code>"\\\"</code>                      | page encapsulator prefix      |
| <code>encap_infix</code>     | <code>string</code> | <code>"{"</code>                        | page encapsulator infix       |
| <code>encap_suffix</code>    | <code>string</code> | <code>"}".</code>                       | page encapsulator suffix      |
| <code>page_precedence</code> | <code>string</code> | <code>"rnaRA"</code>                    | page type precedence          |
| <code>line_max</code>        | <code>number</code> | <code>72</code>                         | maximum line length           |
| <code>indent_space</code>    | <code>string</code> | <code>"\\t\\t"</code>                   | indentation for wrapped lines |
| <code>indent_length</code>   | <code>number</code> | <code>16</code>                         | length of indentation         |

Table 34.3: Output style parameters.

### 34.3 Customization

When creating an index with `makeindex` one can create a `sample.ist` file that can be used together with the `makeidx` program to customize the way the index will look.

```

40 heading_prefix "{\\bfseries\\hfil "
41 heading_suffix "\\hfil}\\nopagebreak\\n"
42 headings_flag 1
43 delim_0 "\\dotfill"
44 delim_1 "\\dotfill"
45 delim_2 "\\dotfill"

```

This will write the first alphabet symbol in bold font, and uses dots as delimiters.  
This file is generally used jointly with `makeindex` using

```
46 makeindex -s sample.ist filename.idx
```

where `filename.idx` has been created by executing `latex` or one of the other engine commands such as `pdflatex` on `filename.tex`.

According to `gabora`, you may use

```
47 sort_rule ". \"\\b.\""
```

```
48 sort_rule "\:" "\b\:"
49 sort_rule "\," "\b\,"
```

## 34.4 Writing custom indexing commands

For complex documents it is easier to write a number of macros to assist with indexing and to also provide consistency. For example if you want to index the Devanagari alphabet we might need to get quite creative as to how to both index it as well as get the symbols in the index.

## 34.5 Multiple indices

The **multind**<sup>2</sup> extends the **makeidx** macros to enable multiple indices. The commands are the same as those for **mkidx**, but you have to pass an extra parameter **name** as the first argument to the commands.

*printindex*

```
\usepackage{multind}
\makeindex{books}
\makeindex{authors}
...
\index{books}{A book to index}
\index{authors}{Put this author in the index}
...
\printindex{books}{The Books index}
\printindex{authors}{The Authors index}
```

This package has multiple issues. It is not found in normal TeX distributions and also has compatibility issues with *AMS* classes and packages. It is also fairly old, as it was written for *LATEX* 2.09. A series of newer packages are now available.

The package **imakeidx**<sup>3</sup> by Enrico Gregorio

## 34.6 How to I add index to the table of contents?

By default *LATEX* will not show in Table of Contents. It can be added manually. To add index as a chapter, use the control sequence **\addcontentsline**, as shown below:

```
19 \clearpage
20 \addcontentsline{toc}{chapter}{Index}
21 \printindex

22 \clearpage
23 \addcontentsline{toc}{chapter}{Index}
24 \printindex
```

---

<sup>2</sup>**multind**.

<sup>3</sup>Gregorio, Enrico (Oct. 2016). *The package imakeidx*. Version v1.3e.

## 34.7 Limitations of the `MakelIndex` index processor

The `MakeIndex` program has served the `LATEX` community well for many years. With the newer engines it struggles with indexing `utf` documents and this is its major limitation. Its limitations with multiple indexing can be by-passed using the `imakeidx` package.

## 34.8 The `xindy` index processor

A more recent index processor is `xindy`.

`xindy` means flexible **i**ndexing **s**ystem. It is an indexing system that can be used to generate book-like indexes for arbitrary document preparation systems. This term includes systems such as TeX and LaTeX, the Nroff-family or SGML-based systems (e.g. HTML) that process some kind of text and generate indexing information. It is not fixed to any specific system, but can be configured for a wide variety of purposes.

Authors sometimes wish to include an index into their document, but very often their document preparation systems aren't able to produce indexes on their own, or the capabilities of the built-in indexers are insufficient and produce ugly looking results. More often they use separate specialized tools for this purpose, sometimes called index processors.

In comparison to other index processors has several powerful features that make it an ideal framework for describing and generating complex indexes. Its most interesting features are

### 34.8.1 Internationalization

`xindy` can be configured to process indexes for many languages with different letter sets and different sorting rules. For example, many roman languages such as Italian, French, Portuguese or Spanish contain accentuated letters such as Ä, Å, ñ. Other languages from northern Europe have letters like Å, Ø, æ or ß which often can't even be processed by many index processors let alone sorting them correctly into an index. The `xindy` system can be configured to process these alphabets by defining sort and merge rules that allow expressing language specific rules. One example of such a rule would be

(sort-rule "ä" "ae")

defining that a word containing the umlaut-a will be sorted as if it contained the letters ae instead. This is one form of how the umlaut-a ("ä") is sorted into german indexes. With an appropriate set of rules one can express the complete rules of a specific language.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

Index and Glossary commands.

```

\makeindex      A preamble command to turn on indexing.
\makeglossary   A preamble command to turn on making glossary entries.
    \index       Make an index entry for #1.
    \glossary    Make a glossary entry for #1.

25  %<*2ekernel>
26  \message{index,}

\makeindex
    Opens the jobname.idx file for writing. This must appear before the
    \begin{document} command.1

27 \def\makeindex{%
28   \newwrite\@indexfile
29   \immediate\openout\@indexfile=\jobname.idx
30   \def\index{\@bsphack\begingroup
31     \@sanitize
32     \wrindex\typeout
33     {Writing index file \jobname.idx}%
34   \let\makeindex\empty
35 }
36 \onlypreamble\makeindex

\@wrindex
    \def\@wrindex#1{%
37   \protected@write\@indexfile{}{%
38     \string\indexentry{#1}{\thepage}}%
39   \endgroup
40   \esphack}
41

(End definition for \@wrindex.)
```

\index

```

42 \def\index{\@bsphack\begingroup \@sanitize\@index}
```

(End definition for \index.)

\@index

```

43 \def\@index#1{\endgroup\esphack}
```

(End definition for \@index.)

\makeglossary

```

44 \def\makeglossary{%
45   \newwrite\@glossaryfile
46   \immediate\openout\@glossaryfile=\jobname.glo
47   \def\glossary{\@bsphack\begingroup
48     \@sanitize
49     \wrglossary\typeout
50     {Writing glossary file \jobname.glo }%
```

<sup>1</sup>v1.1b,1994/11/04,Removed \if@filesw from \makeindex.

<sup>2</sup> Opening the write channel should be done only once since on some OS multiple opens are forbidden and in any case it is useless. So we turn this into a no-op after use.

```
51   \let\makeglossary\@empty
52 }
53 \@onlypreamble\makeglossary
```

(End definition for `\makeglossary`.)

`\@wrglossary`

```
54 \def\@wrglossary#1{%
55   \protected@write\@glossaryfile{}{%
56     {\string\glossaryentry{\#1}{\thepage}}%
57   \endgroup
58   \esphack}
```

(End definition for `\@wrglossary`.)

`\glossary`

```
59 \def\glossary{\@bsphack\begingroup\@sanitize\@index}
```

(End definition for `\glossary`.)

```
60 %</2ekernel>
```

---

<sup>2</sup>v1.1e,1996/01/20,Make no-op after use pr/2048.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 36.1 Introduction

This section of the kernel deals with citations and bibliographies. With the exception of some journals and short papers and packages, it is unlikely that some package such as **natbib** or **biblatex** will be loaded.

The class was written and maintained by Johannes Braams, David Carlisle, Alan Jeffrey, Leslie Lamport, Frank Mittelbach, Chris Rowley, Rainer Schöpf.

## 36.2 Bibliography Generation

A bibliography is created by the **thebibliography** environment, which generates a title such as “References”, and a list of entries. The BIBTEX program will create a file containing such an environment, which will be read in by the **\bibliography** command. With BIBTEX, the following commands will be used.

**\bibliography{<file<sub>1</sub>,<file<sub>2</sub>,<file<sub>3</sub>, ...,<file<sub>n</sub>}**

**\bibliography{<file1,<file2, ...,<filen>}** : specifies the bibdata files. Writes a **\bibdata** entry on the **.aux** file and tries to read in **mainfile.bbl**.

**\bibliographystyle**    **\bibliographystyle{<style>}** : Writes a **\bibstyle** entry on the **.aux** file.

**thebibliography**    The **thebibliography** environment is a list environment. To save the use of an extra counter, it should use **enumiv** as the item counter. Instead of using **\item**, items in the bibliography are produced by the following commands:  
**\bibitem{<name>}** : Produces a numbered entry cited as **<name>**.  
**\bibitem[<label>]{<name>}** : Produces an entry labeled by **<Label>** and cited by **<name>**.

The former is used for bibliographies with citations like [1], [2], etc.; the latter is used for citations like [Knuth82].

The document class must define the **thebibliography** environment. This environment has a single argument, which is the widest bibliography label—e.g., if the [Knuth67] is the widest entry, then this argument will be Knuth67. The **\thebibliography** command must begin a list environment, which the **\endthebibliography** command ends.

**\cite**    Entries are cited by the command **\cite{<name>}**.

**\nocite**    **\nocite{<citations>}** puts information on the **.aux** file that causes BIBTEX to include the **{<citations>}** list in the bibliography, but puts nothing in the text.

**\nocite{\*}** is special: it tells BIBTEX to put the whole of a collection of references into the bibliography.

```

61
62 \message{bibliography,}
63   PARAMETERS
64
65   \@cite  : A macro such that \@cite{LABEL1,LABEL2}{NOTE}
66           produces the output for a \citet{NOTE}{FOO1,FOO2} command,
67           where entry FOOi is defined by \bibitem[LABELi]{FOOi}.

```

```
68 The switch @tempswa is true if the optional >
69   \NOTE argument
70 is present.
71 The default definition is :
72   \@cite{LABELS}{NOTE} ==
73     BEGIN [LABELS]
74       IF @tempswa = T THEN , NOTE FI
75     ]
76   END
77
78 \@biblabel : A macro to produce the label in the >
79   \bibliography
80   entry. For \bibitem[LABEL]{NAME}, the label is
81   generated by \@biblabel{LABEL}. It has the >
82   \default
83   definition \@biblabel{LABEL} -> [LABEL].
84 CONVENTION
85
86 \b@FOO : The name or number of the reference created by >
87   \cite{FOO}
88   E.g., if \cite{FOO} -> [17] , then \b@FOO -> 17.
```

\bibitem

```
86 \def\bibitem{\@ifnextchar[\@lbibitem\@bibitem}
```

## \@bibitem

```

87 \def\@lbibitem[#1]{\item[\@biblabel{#1}\hfill]\if@filesw
88     {\let\protect\noexpand
89      \immediate
90      \write\@auxout{\string\bibcite{#2}{#1}}}\fi\ignorespaces}

```

\@bibitem

```
91 \def\@bibitem{\item\if@filesw \immediate\write\auxout
92     {\string\bibcite{\#1}{\the\value{\@listctr}}}\fi\ignorespaces}
```

## \bibcite

93 \def\bibcite{\@newl@bel b}

## \citation

94 \let\citation\@gobble

\cite

```
95 \DeclareRobustCommand{\cite}{%
96   \@ifnextchar{%
97     \{{\@tempswatrue\@citex}{\@tempswafalse\@citex[]}\}}
```

\@citex

```

97 \def\@citex[#1]{\leavevmode
98   \let\@citea\empty
99   \@cite{\@for\@citeb:=#2\do
100     {\@citea\def\@citea{,\penalty\@m\ }%
101      \edef\@citeb{\expandafter\@firstofone\@citeb\empty}%
102      \if@filesw\immediate\write\@auxout{\string\citation{\@citeb}}\fi

```

Using `\hbox` instead of `\mbox` is fine because of the `\leavevmode` above. In fact the use of a box around the citation contents is more than questionable in my view (FMi), but within 2e I have to keep that for compatibility reasons as it would probably change too many existing documents. Its main reason is to avoid hyphenation of labels such as [FOOB89] into [FOO-B89] so in certain styles it makes sense; but, for example, in author year citations it becomes more than questionable.

So Chris added yet another hook here, as suggested by, at least, Donald Arsenau. Note that this one is inside the first argument of the `\@cite` hook. This decouples the top-level typesetting of the citation from the details of the other business conducted here. All this really needs a complete rethink to get the right modularity.

```

103   \ifundefined{b@\@citeb}{\hbox{\reset@font\bfseries ?}}%
104     \G@refundefinedtrue
105     \@latex@warning
106       {Citation `'\@citeb' on page \thepage \space
107         \undefined}%
108     {\@cite@ofmt{\csname b@\@citeb\endcsname}}}}{#1}}

```

### \bibdata

#### \bibstyle

```

108 \let\bibdata=\gobble
109 \let\bibstyle=\gobble

```

### \bibliography

```

110 \def\bibliography#1{%
111   \if@filesw
112     \immediate\write\@auxout{\string\bibdata{#1}}%
113   \fi
114   \input{\jobname.bbl}

```

### \bibliographystyle

```

115 \def\bibliographystyle#1{%
116   \ifx\@begindocumenthook\@undefined\else
117     \expandafter\AtBeginDocument
118   \fi
119   {\if@filesw
120     \immediate\write\@auxout{\string\bibstyle{#1}}%
121   \fi}

```

### \nocite

```

122 \def\nocite#1{\@bsphack

```

```

123 \ifx\@onlypreamble\document
124   \@for\@citeb:=#1\do{%
125     \edef\@citeb{\expandafter\@firstofone\@citeb}%
126     \if@filesw\immediate\write\@auxout{\string\citation{\@citeb}}\fi
127     \@ifundefined{b@\@citeb}{\G@refundefinedtrue
128       \@latex@warning{Citation `\'{a}\@citeb' undefined}}{}%}
129   \else
130     \@latex@error{Cannot be used in preamble}\@eha
131     % \AtBeginDocument{\nocite{#1}}
132   \fi
133   \@esphack}
134 \expandafter\let\csname b@\endcsname\empty

```

### 36.2.1 Default definitions

This hook determines the ‘relative formatting’ of the two logical parts of a citation with comment.

```

\@cite
135 \def\@cite#1#2{{#1\if@tempswa , #2\fi}}
\@cite@ofmt
136 \let\@cite@ofmt\hbox
\@biblabel
137 \def\@biblabel#1{#1}

```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 37.1 Introduction

This chapter explains how the  $\text{\LaTeX}$  kernel defines commands and styles for running headings. It is mostly an extract from the kernel listing with some additional explanations. It can be found in the file `ltpage.dtx`. It also deals with other commands and environments that can affect the final layout of a page. Some of these commands are only used by the output routine.

## 37.2 Page Style Commands

`\pagestyle{<style>}` : sets the page style of the current and succeeding pages to *style*

`\thispagestyle{<style>}` : sets the page style of the current page only to *style*.

To define a page style *style*, you must define `\ps@style` to set the page style parameters.

## 37.3 How a page style makes running heads and feet

The `\ps@...` command defines the macros `\@oddhead`, `\@oddfoot`, `\@evenhead`, and `\@evenfoot` to define the running heads and feet. (See output routine.) To make headings determined by the sectioning commands, the page style defines the commands `\chaptermark`, `\sectionmark`, etc., where `\chaptermark{<text>}` is called by `\chapter` to set a mark. The `\...mark` commands and the `\...head` macros are defined with the help of the following macros.

(All the `\...mark` commands should be initialized to no-ops.)

## 37.4 marking conventions

$\text{\LaTeX}$  extends  $\text{\TeX}$ 's `\mark` facility by producing two kinds of marks a ‘left’ and a ‘right’ mark, using the following commands:

`\markboth{<left>}{<right>}` : Adds both marks.

`\markright{<right>}` : Adds a ‘right’ mark.

`\leftmark` : Used in the output routine, gets the current ‘left’ mark. Works like  $\text{\TeX}$ 's `\botmark`.

`\rightmark` : Used in the output routine, gets the current ‘right’ mark. Works like  $\text{\TeX}$ 's `\firstmark`.

The marking commands work reasonably well for right marks “numbered within” left marks—e.g., the left mark is changed by a `\chapter` command and the right mark is changed by a `\section` command.

However, it does produce somewhat anomalous results if 2 `\markboth`'s occur on the same page.

Commands like `\tableofcontents` that should set the marks in some page

styles use a `\@mkboth` command, which is `\let` by the pagestyle command (`\ps@...`) to `\markboth` for setting the heading or to `\@gobbletwo` to do nothing.

138 %<\*2ekernel>

### `\pagestyle{<page style name>}`

User command to set the page style for this and following pages.

```
139 \def\pagestyle#1{%
140   \@ifundefined{ps@#1}{%
141     \undefinedpagestyle
142     {@nameuse{ps@#1}}}}
```

`\thispagestyle` User command to set the page style for this page only.

```
143 \def\thispagestyle#1{%
144   \@ifundefined{ps@#1}{%
145     \undefinedpagestyle
146     {@global\@specialpagetrue\gdef\@specialstyle{#1}}}}
```

(End definition for `\thispagestyle`.)

### `\ps@empty`

The empty page style: No head or foot line.

```
147 \def\ps@empty{%
148   \let\@mkboth\@gobbletwo\let\@oddhead\@empty\let\@oddfoot\@empty
149   \let\@evenhead\@empty\let\@evenfoot\@empty}
```

### `\ps@plain`

The plain page style: No head, centred page number in foot.

```
150 \def\ps@plain{\let\@mkboth\@gobbletwo
151   \let\@oddhead\@empty\def\@oddfoot{\reset@font\hfil\thepage
152   \hfil}\let\@evenhead\@empty\let\@evenfoot\@oddfoot}
```

`\@leftmark` We implement `\@leftmark` and `\@rightmark` in terms of already defined  
`\@rightmark` commands to save token space. We can't get rid of them since they are sometimes used in applications.

```
153 \let\@leftmark\@firstoftwo
154 \let\@rightmark\@secondoftwo
```

(End definition for `\@leftmark` and `\@rightmark`.)

`\markboth` User commands for setting L<sup>A</sup>T<sub>E</sub>X marks.

```
155 \def\markboth#1#2{%
156   \begingroup
157   \let\label\relax\let\index\relax\let\glossary\relax
158   \unrestored@protected\xdef\@themark{{#1}{#2}}%
159   \temptokena\expandafter{\@themark}%
160   \mark{\the\temptokena}%
161   \endgroup
162   \if@nobreak\ifvmode\nobreak\fi\fi}
163 \def\markright#1{%
164   \begingroup
165   \let\label\relax\let\index\relax\let\glossary\relax
```

```

166      \expandafter\@markright\@themark {#1}%
167      \@temptokena \expandafter{\@themark}%
168      \mark{\the\@temptokena}%
169  \endgroup
170  \if@nobreak\ifvmode\nobreak\fi\fi}

```

(End definition for `\markboth` and `\markright`.)

**\@markright**

```

\leftmark 171 \def\@markright#1#2#3{\@temptokena {#1}%
\rightmark 172   \unrestored@protected@xdef\@themark{{\the\@temptokena}{#3}}%
173 \def\leftmark{\expandafter\@leftmark\botmark\empty\empty}%
174 \def\rightmark{\expandafter\@rightmark\firstmark\empty\empty}

```

(End definition for `\@markright`, `\leftmark`, and `\rightmark`.)

**\@themark** Initialise L<sup>A</sup>T<sub>E</sub>X's marks without setting a T<sub>E</sub>X mark (*whatsit*).

```

175 \def\@themark{{}{}{}}

```

(End definition for `\@themark`.)

**\mark** Test versions of L<sup>A</sup>T<sub>E</sub>X 2<sub>E</sub> initialised T<sub>E</sub>X's `\mark` system at this point, but this was removed before the first release.<sup>1</sup> <sup>2</sup>

```
\AtBeginDocument{\mark{{}{}{}}
```

(End definition for `\mark`.)

### \raggedbottom

Typesets pages with no vertical stretch, so they have their natural height instead of all being exactly the same height. (Uses a space of .0001fil to avoid interfering with the 1fil space of `\newpage`<sup>→ P. 472</sup>.) See also `\@textbottom`<sup>→ P. 481</sup> deep in the output routine.

```

176 \def\raggedbottom{%
177   \def\@textbottom{\vskip \z@ %
\@plus.0001fil}\let\@texttop\relax}

```

### \flushbottom

Inverse of `\raggedbottom`. Makes all pages the same height.

```

178 \def\flushbottom{%
179   \let\@textbottom\relax \let\@texttop\relax}

```

### \sloppy

`\sloppy` will never (well, hardly ever) produce overfull boxes, but may produce underfull ones. (14 June 85)

---

<sup>1</sup>LaTeX2e,1993/12/16,Init `\mark` at begin document.

<sup>2</sup>LaTeX2e,1993/12/17,Removed init `\mark` at begin document, since it doesn't work..

```

180 \def\sloppy{%
181   \tolerance 9999%
182   \emergencystretch 3em%
183   \hfuzz .5\p@
184   \vfuzz\hfuzz}

```

May be this environment does not belong here, but here it is. I would have placed it with `\par` changing environments, perhaps with the lists module.

**sloppypar** A sloppypar environment is equivalent to `{\par \sloppy ... \par}`.

```

185 \def\sloppypar{\par\sloppy}
186 \def\endsloppypar{\par}

```

#### Example 4.1 Sloppy Paragraph

```

10 \begin{sloppypar}
11 \hsize=2in
12 \alicei
13 \end{sloppypar}
14
15 \bgroup
16 \hsize2in
17 \hrule
18 \alicei\par
19 \egroup

```

The King and Queen of Hearts were seated on their throne when they arrived, with a great crowd assembled about them — all sorts of little birds and beasts, as well as the whole pack of cards: the Knave was standing before them, in chains, with a soldier on each side to guard him; and near the King was the White Rabbit, with a trumpet in one hand, and a scroll of parchment in the other. In the very middle of the court was a table, with a large dish of tarts upon it: they looked so good, that it made Alice quite hungry to look at them — “I wish they’d get the trial done,” she thought, “and hand round the refreshments!”. But there seemed to be no chance of this, so she began looking at everything about her to pass away the time.

The King and Queen of Hearts were seated on their throne when they arrived, with a great crowd assembled about them — all sorts of lit-

tle birds and beasts, as well as the whole pack of cards: the Knave was standing before them, in chains, with a soldier on each side to guard him; and near the King was the White Rabbit, with a trumpet in one hand, and a scroll of parchment in the other. In the very middle of the court was a table, with a large dish of tarts upon it: they looked so good, that it made Alice quite hungry to look at them — “I wish they’d get the trial done,” she thought, “and hand round the refreshments!”. But there seemed to be no chance of this, so she began looking at everything about her to pass away the time.

### \fussy

Resets TeX’s parameters to their normal finicky values.

```
21 \def\fussy{%
22   \emergencystretch{z@%
23   \tolerance 200%
24   \hfuzz .1\p@%
25   \vfuzz\hfuzz}
```

### \overfullrule{\dimen}

TeX default is no overfull box rule. Changed by document class option.

```
26 \overfullrule 0pt
27 %</2ekernel>
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

In this chapter we discuss one of the most mysterious aspects of  $\text{\TeX}$  the output routine.

Sherlock Holmes in “The sign of four”: “My mind,” he said, “rebels at stagnation. Give me problems, give me work, give me the most abstruse cryptogram or the most intricate analysis, and I am in my own proper atmosphere.”

An output routine, most often now abbreviated as OR is the responsible part of the  $\text{\TeX}$  algorithm to divide the document material in pages.

The output routine is considered as one of the more mysterious pieces of  $\text{\TeX}$ . David Salomon wrote<sup>1</sup> that advanced users hardly need to be convinced that an understanding of ORs is important, since they must be used whenever, special output is desired. The chapter of the  $\text{\TeX}book$  discussing output routines claims that designing output routines makes one: ...achieve the level of a ‘ $\text{\TeX}$  Grandmaster’. As is so often the case, mastery of the concept of an output routine in plain  $\text{\TeX}$  will only barely prepare you for the complexities awaiting you with  $\text{\LaTeX}$ ’s variant of an output routine.

The subject is considered complex for the following reasons:

1. ORs are asynchronous with the rest of  $\text{\TeX}$  (this is explained later) and involve difficult concepts such as splitting boxes and insertions.
2. Certain features, which could be useful in ORs are not supported by  $\text{\TeX}$ . Specifically there are no commands to identify marks, rules and **whatsits** in a box and to break up a line of text into individual characters.

$\text{\TeX}$ ’s page breaking algorithm is simpler than the line breaking one. The reason for this is that global optimization of page breakpoints, the way is done in the paragraph algorithm is prohibitively in terms of memory (especially in the 1980s).

Theoretically, page breaking is a more complicated<sup>2</sup> than line breaking. First we will briefly discuss the algorithms that  $\text{\TeX}$  actually uses.

## 38.1 Page breaking algorithm

The problem of page breaking has two components. One is that of stretching or shrinking available glue (mostly around display math or section headings) to find typographically desirable breakpoints. The other is that of placing ‘floating’ material, such as tables and figures. These are typically placed at the top or the bottom of a page, on or after the first page where they are referenced. These ‘inserts’, as they are called in  $\text{\TeX}$ , considerably complicate the page breaking algorithms, as well as the theory.

First we start with some definitions:

---

<sup>1</sup>TUGboat/tb-11-1/tb27salomon.pdf

<sup>2</sup><http://www.cs.utk.edu/~eijkhout/594-LaTeX/handouts/breaking/page-tutorial.pdf>

1. The *main vertical list* is where TeX collects the material that has not yet been printed. The material on the vertical list is logically divided into two parts:
  - (a) The *current page*. This is the material TeX intends to print on the current page.
  - (b) The *recent contributions*. This is the material, that will be committed to the current page at a later stage.

### 38.1.1 Typographical constraints

There are various typographical guidelines for what a page should look like, and TeX has mechanisms that can encourage, if not always enforce, this behaviour.

1. The first line of every page should be at the same distance from the top. This changes if the page starts with a section heading which is a larger type size.
2. The last line should also be at the same distance, this time from the bottom. This is easy to satisfy if all pages only contain text, but it becomes harder if there are figures, headings, and display math on the page. In that case, a ‘ragged bottom’ can be specified.
3. A page may absolutely not be broken between a section heading and the subsequent paragraph or subsection heading.
4. It is also desirable that:
  - (a) the top of the page does not have the last line of a paragraph started on the preceding page
  - (b) the bottom of the page does not have the first line of a paragraph that continues on the next page.

For ordinary purposes you will probably find that TeX’s automatic method of page breaking is satisfactory. And when it occasionally gives unpleasant results, you can force the machine to break at your favorite place by typing `\eject`. But be careful: `eject` will cause TeX to stretch the page out, if necessary, so that the top and bottom baselines agree with those on other pages. If you want to eject a short page, filling it with blank space at the bottom, type `\vfill\eject` instead.

## 38.2 The current page and the recent contributions list

The main vertical list of TeX is divided in two parts: the *current page* and the list of *recent contributions*. Any material that is added to the main vertical list is appended to the recent contributions; the act of moving the recent contributions to the current page is known as *exercising the page builder*.

Every time something is moved to the current page, TeX computes the cost of breaking the page at that point. If it decides that it is past the optimal point,

the current page up to the best break so far is put in **box255** and the remainder of the current page is moved back on top of the recent contributions. If the page is broken at a penalty, that value is recorded in **outputpenalty**, and a penalty of size 10 000 is placed on top of the recent contributions; otherwise, **outputpenalty** is set to 10 000.

If the current page is empty, discardable items that are moved from the recent contributions are discarded. This is the mechanism that lets glue disappear after a page break and at the top of the first page. When the first non-discardable item is moved to the current page, the **topskip** glue is inserted;

### 38.3 When is the page builder activated?

The page builder comes into play in the following circumstances.

1. Around paragraphs: after the **\everypar** tokens have been inserted, and after the paragraph has been added to the vertical list. See the end of this chapter for an example.
2. Around display formulas: after the **\everydisplay** tokens have been inserted, and after the display has been added to the list.
3. After **\par** commands, boxes, insertions, and explicit penalties in vertical mode.
4. After an output routine has ended.

In these places the page builder moves the recent contributions to the current page. Note that TeX need not be in vertical mode when the page builder is exercised. In horizontal mode, activating the page builder serves to move preceding vertical glue (for example, **\parskip**, **\abovedisplayskip**) to the page.

The **\end** command – which is only allowed in external vertical mode – terminates a TeX job, but only if the main vertical list is empty and **\deadcycles** = 0. If this is not the case the combination  
**\hbox{} \vfill \penalty+ \$-2^{30}**  
 is appended, which forces the output routine to act.

### 38.4 The depth of the current page

The depth of the page is important since normally in good typesetting successive pages should have the same (or almost the same vertical size. (flushbottom). The height of a page is controlled and set exactly by TeX equal to **\vsize**. Consider a large **vbox** with lines of text, glue and penalties. The depth of this box, is the depth of the last component [80]. If the last component is a glue or penalty, the depth is zero. If it is a box, then its depth becomes the depth of the entire **vbox**, except that it is limited to the value of parameter **\boxmaxdepth**.

If **\boxmaxdepth=1pt** and the depth of the bottom box is 1.94444pt, then the depth of the entire **vbox** will be 1pt and its height will be incremented by .94444pt. This is equivalent to lowering the reference point (or, equivalently, the baseline) of the **vbox** by .94444pt. In the plain format, **\boxmaxdepth=\maxdimen** [348], so it has no effect on the depths of boxes.

However, `\boxmaxdepth` can always be changed by the user<sup>3</sup>

If the last line on a page, contains letters that happen to not have any depth, the page depth will be zero. Try for example this:

```
28 ...
29 \showthe\pagedepth
30 \bye
```

You can also try it with a L<sup>A</sup>T<sub>E</sub>X minimal and will produce the same output.

## 38.5 The height of a box of text

Following the literature we denote the value of `\baselineskip` (which is normally 12pt) by  $b$ . A large `\vbox` with text consists mainly of lines of text, each an `\hbox`, separated by glues of glue, normally in the (varying) amounts necessary to separate baselines by exactly  $b$ , but sometimes just the amount `\lineskip`. We assume a simple case where no large characters or equations are used. In such a case, all lines of text are separated by  $b$ . The height of the box is thus:

$$b(n - 1) + \text{the height of the first line} \quad (38.1)$$

where  $n$  is the number of text lines. Remember that the first line is a special case and adjustments can be made using the value of `\topskip`.

## 38.6 The height of `\box255`

In the case of `\box255`, enough glue is placed above the first line of text to reach to `\topskip` from the first baseline. We denote the value of `\topskip` by  $h$  (10pt in plain). So if the baseline of the first line is now  $h$  below the top of the page, the height  $H$  of `\box255` should be  $b(n - 1) + h$  (Fig. 3). However, the height of `\box255` is always set, by the page builder, to `\vsize`. The difference between the two heights is usually supplied by the flexible glues on the page, the most common of which is `\parskip`

### 38.6.1 Dead cycles.

An execution of the OTR without shipping any material is called a *dead cycle*. Dead cycles, have their uses and we will explain this a bit later on. However, long iterations that just return *dead cycles* is an indication of an error somewhere. T<sub>E</sub>X counts the number of dead cycles in a counter named `\deadcycles` and stops the run if `\deadcycles >= \maxdeadcycles`. In the *plain* format `\maxdeadcycles` is set as 25 and in L<sup>A</sup>T<sub>E</sub>X as 0. `\maxdeadcycles = 100` is 200. Each time `\shipout` is invoked, it resets `\deadcycles` to zero.

---

<sup>3</sup>This `\boxmaxdepth` setting is to ensure that deep footnotes do not overwrite the footer (on account of the negative skip added later): it should use `\@maxdepth` otherwise the change is pointless when there are footnotes. But see also its use when combining floats. L<sup>A</sup>T<sub>E</sub>X uses a value of 5.5pt whereas plain a value of 4pt [348].

```

10 If the file is not included, reset \deadcycles, so that a >
   <long list of non-included
11 files does not generate an 'Output loop' error.
12 115 \deadcycles\z@%
13 116 \@nameuse{cp@\#1}%
14 117 \fi
15 118 \let\@auxout\@mainaux}

```

### 38.6.2 $\text{\TeX}$ 's Page Number.

The page number can come from any source. Salomon provides an example where the OTR typesets a page number from a `\count` variable. This is typeset centered below the printed area.

Notice that the output macro, just passes the contents of the box to `\shipout`. This is not actually a very good method, but is shown here to illustrate a point.

Note the `\tenrm` in the preceding example. It is necessary because of the asynchronous nature of the OTR. When the OTR is invoked,  $\text{\TeX}$  can be anywhere on the next page. Specifically, it could be inside a group where a different font is used. Without the `\tenrm`, that font (the current font) would be used in the otr. In the plain format, the `\count0` variable serves as the page number, and the following two macros are especially useful.

### 38.6.3 The `\vsplit` operation.

Supposed you have inserted the material required to go on a page on a big `\vbox`, but the material is a bit extra that what is required to fill a page exactly. You would need an operation to split the box in two. The `vsplit` operation does that. It is important to the understanding of OTR operations to have an intimate knowledge of `\vsplit`. Its syntax is:

`\vsplit<box number> to <dim>`

The result of the operation is a box. Most often it appears in an assignment such as:

`\setbox1=\vsplit0 to2.6in`

This sets `\box1` to a height of 2.6in, moves material from the top of `\box0` to `\box1`, and keeps the remainder in `\box0`.

`\loremlines` It is important to remember that most of  $\text{\TeX}$ 's commands work with  $\text{\LaTeX}$  as well. In Example 6.1, we define a box to hold `lipsum` text in a two column layout. We want to define a macro that can split the box in as many lines as we require.

(End definition for `\loremlines`.)

**Example 6.1 Splitting a vbox**

```

10 \newbox\one
11 \newbox\two
12 \long\gdef\loremlines#1#2{%
13   \setbox\one=\vbox {#2}
14   \setbox\two=\vsplit\one to #1\baselineskip
15   \unvbox\two
16   \gdef\boxone{#2}
17 }
18 \begin{multicols}{2}
19 \small
20 \loremlines{16}{\onepar}
21 \end{multicols}
22 \boxone
23
24 \setbox\one=\vbox{100}
25 \the\ht\one \\
26 \the\baselineskip
27 \the\splittopskip

```

In olden times when wishing still helped one, there lived a king whose daughters were all beautiful, but the youngest was so beautiful that the sun itself, which has seen so much, was astonished whenever it shone in her face. Close by the king's castle lay a great dark forest, and under an

old lime-tree in the forest was a well, and when the day was very warm, the king's child went out into the forest and sat down by the side of the cool fountain, and when she was bored she took a golden ball, and threw it up on a high and caught it, and this ball was her favorite play-

In olden times when wishing still helped one, there lived a king whose daughters were all beautiful, but the youngest was so beautiful that the sun itself, which has seen so much, was astonished whenever it shone in her face. Close by the king's castle lay a great dark forest, and under an old lime-tree in the forest was a well, and when the day was very warm, the king's child went out into the forest and sat down by the side of the cool fountain, and when she was bored she took a golden ball, and threw it up on a high and caught it, and this ball was her favorite plaything.

4.85596pt  
11.0pt10.0pt

TE<sub>X</sub> assumes that the new `\box1` may have to be shipped out as part of the page. It therefore places a glue similar to *h* at the top of `\box1`. This glue is called `\splittopskip` and has a plain format value of `10pt` [348].

One important thing to note is that a box can only be split *between* lines of text. If we split a box to another size, `\box1` will come out underfull.

Here is an OTR which splits the page, ships out the top part and returns the rest to the MVL (actually, to the recent contributions):

```

29 \output={\setbox0=\vsplit255 to1in
30 \shipout\box0 \unvbox255}

```

## 38.7 Communicating with the OTR: Marks

The user can pass information to the output routine through *marks*. Marks have the syntax

31 `\mark{mark text}`

which is put in a mark item on the current vertical list. The mark text is subject to expansion as in `\edef`. If the mark is given in horizontal mode it migrates to the surrounding vertical lists like an insertion item (see page Text By Topic 77); however, if this is not the external vertical list, the output routine will not find the mark.

Marks are the main mechanism through which the output routine can obtain information about the contents of the currently broken-off page, in particular its top and bottom. TEX sets three variables:

`\botmark` the last mark occurring on the current page;  
`\firstmark` the first mark occurring on the current page;  
`\topmark` the last mark of the previous page, that is, the value of `\botmark` on the previous page.

If no marks have occurred yet, all three are empty; if no marks occurred on the current page, all three variables are equal to the `\botmark` of the previous page.

Marks can be used to get a section heading into the headline or footline of the page.

```
\def\section#1{ ... \mark{#1} ... }
\def\rightheadline{\hbox to \hsize
  {\headlinefont \botmark\hfil\pagename}}
\def\leftheadline{\hbox to \hsize
  {\headlinefont \pagename\hfil\firstmark}}
```

This places the title of the first section that starts on a left page in the left headline, and the title of the last section that starts on the right page in the right headline. Placing the headlines on the page is the job of the output routine; see below.

It is important that no page breaks can occur in between the mark and the box that places the title:

32 `\def\section#1{ ...`  
33     `\penalty\beforesectionpenalty`  
34     `\mark{#1}`  
35     `\hbox{ ... #1 ...}`  
36     `\nobreak`  
37     `\vskip\aftersections skip`  
38     `\noindent}`

However, useful these marks, sometimes an output routine (such as those found in L<sup>A</sup>T<sub>E</sub>X) needs to know why it was invoked. Knuth discusses in the another method that involves the value of the `\outputpenalty`. By testing for this value, it is possible to see what penalty occurred at a breakpoint; any penalty of -10000, -10001, -10002, or less, forces the output routine

TeXbook: 396

to act, hence different penalty values can be used to pass different messages. (When the output routine puts material back on the list of contributions, it need not restore the penalty at the breakpoint.) If output has been forced by a highly negative value of `\outputpenalty`, the output routine can use `\vbox{\unvcopy255}` to discover how full the page-so-far actually is. Underfull and overfull boxes are not reported when `\box255` is packaged for use by the output routine, so there's no harm in ejecting a page prematurely if you want to pass a signal. (Set `\holdinginserts` positive to pass a signal when the contents of `\box255` will be sent back through the page builder again, if any insertions are present.)

Knuth also suggested another method that he called the *dirtiest trick of all* that uses the depth of `\box255`.

## 38.8 Insertions

Insertions are considered one of the most complex topics in TeX. Many users master topics such as tokens, file I/O, macros, and even OTRS before they dare tackle insertions. The reason is that insertions are complex, and The TeXbook, while covering all the relevant material, is somewhat cryptic regarding insertions, and lacks simple examples. The main discussion of insertions takes place on [115-125], where TeX's registers are also discussed. Examples of insertions are shown, mostly without explanations, on [363-364, 423-424]. A lot of what is described here is based on an article in TUGboat by David Salomon<sup>4</sup>

Many users understand the idea of floats. Certain material to be typeset needs to be held in a buffer and inserted at different points on a page, for example a figure that does not fit on a page it has to be inserted at the top of the next page. An *insertion* is just a piece of a document that is generated at a certain point but appears at another point. Common examples are figures, footnotes and endnotes. Quoting Knuth:

This algorithm is admittedly complicated, but no simpler mechanism seems to do nearly as much.

## 38.9 \shipout

The primitive control sequence `\shipout` is TeX's end game. Its syntax is quite simple:

```
\shipout<box>
```

From TeXbook, Chapter 23: Output Routines, page 254:

TeX's primitive command `\shipout<box>` is what actually causes output. It sends the contents of the box to the `dvi` file, which is TeX's main output file; after TeX has finished, the `dvi` file will contain a compact device-independent encoding of instructions that specify exactly what should be printed. When a box is shipped out, TeX displays the values of `\count0` through `\count9` on your terminal, as explained in Chapter 15; these ten counters

---

<sup>4</sup><http://www.tug.org/TUGboat/Articles/tb11-4/tb30salomon.pdf>

---

  Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

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---

**Sample:** This is a Test for shipout

are also recorded in the dvi file, where they can be used to identify the page. All of the `\openout`, `\closeout`, and `\write` commands that appear inside of the box are performed in their natural order as that box is being shipped out. Since a `\write` command expands macros, as explained in Chapter 21, TeX's scanning mechanism might detect syntax errors while a `\shipout` is in progress. If `\tracingoutput` is nonzero at the time of a `\shipout`, the contents of the box being shipped are written into your log file in symbolic form. You can say `\shipout` anywhere, not only in an output routine.

We can say:

```

39 \shipout\vbox{%
40   \hrule
41   \medskip
42   \lipsum[1-5]
43   \medskip
44
45   This is a Test for shipout
46
47   \hrule
48 }
```

Since the output box handled by TeX still holds material the page is shown in the previous page. There is no page numbers or headers and it just shows he lorem-ipsum text and a primitive caption at the bottom. I have written the example to show the difference between the logical and actual pages. TeX does not care how the page will look, it will assemble it put headers, page numbers and pass it on to shipout. Shipout will then insert it to the dvi file, which will hold all teh instructions to print a real page.

We can modify the example to add our head and foot.

### Example 9.2 Shipout

```

10 This will print by the normal routine
11
12 \long\gdef\boxit#1#2{\hbox{\vrule
13   \vbox{\hrule\kern#2pt\hbox{%
14     \kern#2pt\vbox{#1}\kern#2pt}\kern#2pt\hrule}\vrule}}
15 \makeatletter
16 \shipout\vbox {%
17   \vskip\topsep\relax
18   \vskip\headsep
19   @thehead
20   \vskip30pt
21   \boxit{
22     \lipsum[1-5]
23     }{2}
24   \vskip30pt
25   @thefoot
```

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```

26 }
27 \makeatother

```

*L<sup>A</sup>T<sub>E</sub>X*'s output routine takes care of all the page geometry, the details to set up the headers and footers, but most importantly intercepts the contents of the output box measure it, cuts it inserts the inserts such as footnotes and figures, margin notes, separates the text in two columns if necessary and so on.

An output routine will prepare the virtual page and pass it onto a

Here is an OTR for a *framed* page. It surrounds the page with double rules on all sides, and centers the page number below the double box. Note that the page shipped out is wider and taller than `\box255`. The value of `\hsize` in this case is, therefore, not the width of the final page shipped out, but the width of the text lines in `\box255`.

Macro `\frameit` typesets text and surrounds it with 4 rules (see [Ex. 21.3]). Parameter #2 is the space between the rules and the text. #1 is a box containing the text.

#### Example 9.3 Example of simple output routine

```

10 \def\frameit#1#2{%
11   \vbox{\hrule
12     \hbox{%
13       \vrule \kern#2pt
14       \vbox{\kern#2pt #1
15         \kern#2pt}%
16       \kern#2pt\vrule}
17 \hrule}}
18
19 \output= {
20   \shipout\vbox{
21     \boxit{\frameit{\box255}{9}
22       \medskip
23       \centerline{Test Framed Page}}
24   \advancepageno}

```

So far we did not care if the height of the page is right or not. In production code the shipout holds a box, which has been produced by TeX. Any material we add to it, must not affect the dimensions of the box. If we do and is too big the drivers will probably clip it.

Plain TeX has an output routine that takes care of simple things like page numbering and insertions using `\footnote` and `\topinsert`.

So far we have examined the TeX OTR in detail. I hope it has given you enough understanding, not only to write your own output routine, but also to now be ready to study the *L<sup>A</sup>T<sub>E</sub>X* output routine, which is much more complicated. We have so far seen that when TeX is typesetting pages of continuous text, it will gather material until it can find a least-cost page break intended to make the gathered material fit the `\pagegoal` size. The gathered material will then be placed into `\box255` and the output routine stored in the token register `\output` will be processed in a group of its own.

Usually it will arrange the gathered material in some way, add headers, foot-lines and page numbers, and ship the gathered results out in typeset form with the `\shipout` command. At the time of the `\shipout` command all `\open` and `\write` commands stored in the box shipped out are expanded and written out. This is what makes it possible to have page labels corresponding to the actual page numbers at the time of shipout: the corresponding info is written to the `.aux` file at that time. The output routine may decide to place material back on the main vertical list instead of shipping it out. Its job is to check if it can have a break, if it can it will ship the page out. If it cannot it will place the material back on the main vertical list.

## 38.10 L<sup>A</sup>T<sub>E</sub>X output routines

L<sup>A</sup>T<sub>E</sub>X output routine is described in `ltoutput.dtx`. You should also have a look at `ltxfloat.dtx`. The algorithm is revisited in L<sup>A</sup>T<sub>E</sub>X 3 and Frank Mittelbach, published a paper <sup>5</sup> in which he explains some of the problems facing the team, when dealing with the output routine.

Information on the output routine is rather scarce. Best source is a series of articles in the TUGBoat by David Salomon.

[Output Routines: Examples and Techniques. Part I: Introduction and Examples.](#)

[Output Routines: Examples and Techniques. Part II: OTR Techniques](#)

[Output Routines: Examples and Techniques. Part III: Insertions](#)

[Output routines: Examples and techniques Part IV: Horizontal techniques](#)

David Kastrup's article [Output Routine Requirements for Advanced Typesetting Tasks](#) (Proceedings of EuroTEX 2003) outlined some of the difficult areas and specifications for generic routines

The standard blocks are well described above and most tasks could be accomplished by rather working from standard building blocks like *insertion lists*, *here points*, default mechanisms for *margin notes* and so on.

## 38.11 Packages

OTR routines are notoriously difficult to debug and define. Some of the available packages at CTAN can make the programming job easier.

The `everypage` package by Sergio Callegari provides hooks into the L<sup>A</sup>T<sub>E</sub>X internal commands to do actions on every page or on the current page. Specifically, actions are performed *before* the page is shipped, so they can be used to put watermarks *in the background* of a page, or to set the page layout.

The package provides two hooks:

```
25 \AddEverypageHook{Test}
26 \AddThisPageHook
```

The package reminds in some sense `bobhook`

by Karsten Tinnefeld, but it differs in the way in which the hooks are implemented, as detailed in the following. In some sense it may also be related to the package `everyshi`

by Martin Schroeder, but again the implementation is different.

---

<sup>5</sup><http://www.latex-project.org/papers/xo-pffloat.pdf>

This program adds two  $\text{\LaTeX}$  hooks that get run when document pages are finalized and output to the `.dvi` or `.pdf` file. Specifically, one hook gets executed on every page, while the other is executed for the current page. Hook actions are performed *before* the page is output on the medium, and this is important to be able to play with the page layout or to put things *behind* the page contents (e.g., watermarks such as an image, framing, the “DRAFT” word, and the like).

The package reminds in some sense **bobhook** by Karsten Tinnefeld, but it differs in the way in which the hooks are implemented:

1. there is no formatting inherent in the hooks. If one wants to put some watermark on a page, it is his own duty to put in the hook the code to place the watermark in the right position. Also note that the hooks code should *eat up no space* in the page. Again, if the hooks are meant to place some material on the page, it is the duty of the hook programmer to put code in the hooks to pretend that the material has zero width and zero height. The implementation is *lighter* than the **bobhook**

one, and possibly more flexible, since one is not limited by any pre-coded formatting for the hooks. On the other hand it is possibly more difficult to use. Nonetheless, it is easy to think of other packages relying on **everypage**

to deliver more user-friendly and *task specific* interfaces. Already there are a couple of them: the package **flippdf**

produces mirrored pages in a PDF document and **draftwatermark** watermarks document pages.

2. similarly to **bobhook**

and **watermark**

, the package relies on the manipulation of the internal  $\text{\LaTeX}$  macro `\@begindvi` to do the job. However, the redefinition of `\@begindvi` is here postponed as much as possible, striving to avoid interference with other packages using `\AtBeginDvi` or anyway manipulating `\@begindvi`. Specifically **everypage**

makes no special assumption on the initial code that `\@begindvi` might contain.

Also in some sense **everypage** can be related to package **everyshi** by Martin Schröder **everyshi**, but it differs radically from it in the implementation. In fact, **everypage** operates by manipulation of the `\@begindvi` macro, rather than at the lower level `\shipout` macro.

## 38.12 hooking at `shipout`

`\EveryShipout`

`\AtNextShipout`

This package provides the hooks `\EveryShipout` and `\AtNextShipout` whose arguments are executed after the output routine has constructed `\box255`, and before `\shipout` is called.

An example application for this package would be a package for adding text to the bottom of each page. The `prelim2e`<sup>6</sup> package adopts this method `prelim2e`.<sup>6</sup>

The solution uses is based on code developed in `quire.tex` by Marcel R. van der Goot.<sup>7</sup>

### The `prelim2e`

intercepts and modifies the `\box255`.

```

27 44 \newcommand{\@Prelim@EveryShipout}{%
28 45 \bgroup
29 % First we save the dimensions of \box255: height, width and %
   % depth; and calculate
30 % the total height of \box255.
31 46 \dimen\z@=\wd\@cclv
32 47 \dimen\@ne=\ht\@cclv
33 48 \dimen\tw@=\dp\@cclv
34 49 \dimen\thr@@=\dimen1
35 50 \advance\dimen\thr@@ by \dimen\tw@
36 % Then we set \box255: A \vbox to the total height of %
   % \box255. In this a \hbox to
37 % the width of \box255 is included, in which \box255 is set.
38 51 \global\setbox\@cclv\vbox to \dimen\thr@@{%
39 52 \hb@xt@\dimen\z@{%
40 53 \box\@cclv%
41 54 \hss
42 55 }%

```

To this we append the text produced by `\PrelimText`. It is put in a `\vbox to 0pt` in which a `\hbox` to the width of `\box255` is included, in which `\PrelimText` is set. We have to reset `\protect` because it is set to `\noexpand` by the output routine.

```

43 56 \vbox to \z@{%
44 57   \hb@xt@\dimen\z@{%
45 58     \let\protect\relax
46 59     \hfill\PrelimText\hfill
47 60   }%
48 61   \vss
49 62 }%
50 63 \vss
51 64 }%

```

Finally we set the dimensions of `\box255` to the values they had before `\@Prelim@EveryShipout`.

```

52 65 \wd\@cclv=\dimen\z@
53 66 \ht\@cclv=\dimen\@ne
54 67 \dp\@cclv=\dimen\tw@
55 68 \egroup

```

---

<sup>6</sup>`prelim2e`.

<sup>7</sup>`quire`.

```

56 69}
Once the command is defined, it is hooked into the system via
\EveryShipout when it is in draft mode.
57 70 \if@prelim@draft
58 71 \EveryShipout{@Prelim@EveryShipout}
59 72 \fi

```

### 38.13 How to place a background image

One can use *TikZ* to place a background image or some text on a page

First we define some utility macros:

```

60 \def\bg@contents{Draft}
61 \def\bg@color{red!45}
62 \def\bg@angle{60}
63 \def\bg@opacity{.5}
64 \def\bg@scale{15}
65 \def\bg@position{current page.center}
66 \def\bg@anchor{}
67 \def\bg@hshift{0}
68 \def\bg@vshift{0}

```

A new command is then developed to describe the background material

```

69 \newcommand\bg@material{%
70   \begin{tikzpicture}[remember picture,overlay]
71     \node [
72       rotate=\bg@angle,scale=\bg@scale,opacity=\bg@opacity,%
73       xshift=\bg@hshift,yshift=\bg@vshift,color=\bg@color]
74     at (\bg@position) [\bg@anchor] {\bg@contents};
    \end{tikzpicture}%

```

Once the background material has been defined we can place it on the page by simply calling:

```
75 \newcommand\BgThispage{\AddThispageHook{\bg@material}}
```

The **background**

<sup>8</sup> package by has capitalized on two good packages the *TikZ* and the **every-page**

<sup>9</sup> As most of modern *TeX* programming works with **pdf** files, package developers prefer to use *TikZ* methods for hooking directly into the pdf and thus avoid a trip into the output routine. If it is required then it hooks via the dvi or shipout commands.<sup>10</sup>

---

<sup>8</sup>**background.**

<sup>9</sup>**everypage.**

<sup>10</sup>These packages are loaded automatically by the **phd-pkgmanager**

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 39.1 Introduction

In Chapter 38, we described the mechanics of output routines both as found in Plain TeX and in L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub> . This is a longer treatise of the subject and includes commentary on the actual listing as found in L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub> . The Output Routine (OR) or (OTR) as is sometimes denoted in the literature, is the procedure by which L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub>  assembles the material that makes a page by combining text and floats, adding any other inserts such as footnotes, headers and footers and then ships out the page to produce a .dvi or with some TeX engines to be translated straight into .pdf output. It is a very complex process as it has to keep a lot of different material in different lists and boxes.

The output routine as defined in the kernel covers a lot of functionality.

1. Defines page geometry parameters.
2. Positions floats.
3. Adds headers and footers.
4. Adds hooks.

## 39.2 Floats

The interesting and complicated part of the OR is its algorithm for handling floats. The floating environments are defined by the standard classes. For example the **book** class defines both the figure as well as the table environments. It is instructive to start the discussion of the algorithm from this point.

The class defines the default float placement specifier using \fps@figure and then goes on to define the figure environment with the help of \@float<sup>P.400</sup> and \end@float<sup>P.403</sup>, which are defined in the generic float.dtx in the kernel.

```

76 \def\ftype@figure{1}
77 \def\ext@figure{lof}
78 \def\fnum@figure{\figurename\nobreakspace\thefigure}
79 \newenvironment{figure}
80   {\@float{figure}}
81   {\end@float}
82 \newenvironment{figure*}
83   {\@dblfloat{figure}}
84   {\end@dblfloat}
```

A float specifier is made of two parts the float type, which is a power of two—e.g., figures in the case of the book class are type 1 and tables type 2 and the *placement specification* describing where the float can be placed. The type is defined in powers of two due to the way the specifiers are represented using a binary representation internally.

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50

So a new float will need to be shifted in powers of two. The kernel defines routines to check for various combinations. This has simplified the programming although it may not be easy to follow. The float specifier is encoded as follows, where bit 0 is the least significant bit.

|   |   |   |   |   |   |   |      |
|---|---|---|---|---|---|---|------|
| 1 | 1 | 0 | 0 | 1 | 0 |   | = 50 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | = 82 |

Figure 39.1: Binary representation of float specifiers. Top is for figure with [t] option and the bottom is for table with the [t] option.

| Bit | Meaning                                             |
|-----|-----------------------------------------------------|
| 0   | 1 if the float may go where it appears in the text. |
| 1   | 1 if the float may go on the top of a page.         |
| 2   | 1 if the float may go on the bottom of a page.      |
| 3   | 1 if the float may go on a float page.              |
| 4   | 1 unless the <i>placement</i> includes a !          |
| 5   | 1 if a type 1 float                                 |
| 6   | 1 if a type 2 float etc.                            |

If a number is odd denotes a here placement specification [h] and if it is negative a marginpar. Since TeX's number limit of  $2^{31} - 1$  and the first 5 bits are taken by the float identifiers there remain 26 available float types for the adventurous. <http://tex.stackexchange.com/questions/32359/what-is-the-exact-purpose-of-ftypetype>.

We have seen so far how a float is defined in the standard classes and what type of parameters are coded. Once  $\text{\LaTeX}_2\epsilon$  sees the environment it will execute the macro \@float which is defined in the **float.dtx**.

Once in \@float the bits are set as well as the relevant penalties. The penalties are distinct in order to signal to the output routines the type of float.

One needs to remember that the floats are placed based on constraints and page sizing parameters.

### 39.3 Page Layout Parameters

|                 |                                                                                                                                 |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------|
| \topmargin      | Extra space added to top of page.                                                                                               |
| \@twoside       | boolean. T if two-sided printing                                                                                                |
| \oddsidemargin  | IF @twoside = T THEN extra space added to left of odd-numbered pages. ELSE extra space added to left of all pages.              |
| \evensidemargin | IF @twoside = T THEN extra space added to left of even-numbered pages.                                                          |
| \headheight     | height of head                                                                                                                  |
| \headsep        | separation between head and text                                                                                                |
| \footskip       | distance separation between baseline of last line of text and baseline of foot. Note difference between \footSKIP and \headSEP. |
| \textheight     | height of text on page, excluding head and foot                                                                                 |
| \textwidth      | width of printing on page                                                                                                       |
| \columnsep      | IF @twocolumn = T THEN width of space between columns                                                                           |

|                             |                                                                                                                                                                                                                                                  |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>\columnseprule</code> | IF @twocolumn = T THEN width of rule between columns (0 if none).                                                                                                                                                                                |
| <code>\columnwidth</code>   | IF @twocolumn = T THEN<br>$(\textwidth - \columnsep)/2$ ELSE<br><code>\textwidth</code> It is set by the <code>\twocolumn</code> and <code>\onecolumn</code> commands.                                                                           |
| <code>\@textbottom</code>   | Command executed at bottom of vbox holding text of page (including figures). The <code>\raggedbottom</code> command almost \let's this to <code>\vfil</code> (actually sets it to <code>\vskip \z@ plus.0001fil</code> ). Should have depth opt. |
| <code>\@texttop</code>      | Command executed at top of vbox holding text of page (including figures). Used by letter style; can also be used to produce centered pages. Let to <code>\relax</code> by <code>\raggedbottom</code> and <code>\flushbottom</code> .             |

Page layout must initialize `\colht` and `\colroom` to `\textheight`.

## 39.4 Page Style Parameters

|                                                                                |                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>\floatsep</code>                                                         | Space left between floats.                                                                                                                                                                                                                                            |
| <code>\textfloatsep</code>                                                     | Space between last top float or first bottom float and the text.                                                                                                                                                                                                      |
| <code>\topfigrule</code>                                                       | Command to place rule (or whatever) between floats at top of page and text. Executed in inner vertical mode right before the <code>\textfloatsep</code> skip separating the floats from the text. Must occupy zero vertical space. (See <code>\footnoterule</code> .) |
| <code>\botfigrule</code>                                                       | Same as <code>\topfigrule</code> , but put after the <code>\textfloatsep</code> skip separating text from the floats at bottom of page.                                                                                                                               |
| <code>\intextsep</code>                                                        | Space left on top and bottom of an in-text float.                                                                                                                                                                                                                     |
| <code>\dblfloatsep</code>                                                      | Space between double-column floats.                                                                                                                                                                                                                                   |
| <code>\dbltextfloatsep</code>                                                  | Space between top double-column floats and text.                                                                                                                                                                                                                      |
| <code>\dblfigrule</code>                                                       | Similar to <code>\topfigrule</code> , but for double-column floats.                                                                                                                                                                                                   |
| <code>\@fptop</code>                                                           | Glue to go at top of float column – must be opt + stretch                                                                                                                                                                                                             |
| <code>\@fpsep</code>                                                           | Glue to go between floats in a float column.                                                                                                                                                                                                                          |
| <code>\@fpbot</code>                                                           | Glue to go at bottom of float column – must be opt + stretch                                                                                                                                                                                                          |
| <code>\@dblftop,</code><br><code>\@dblfpsep,</code><br><code>\@dblfpbot</code> | Analogous for double-column float page in two-column format.                                                                                                                                                                                                          |
| <code>@twocolumn</code>                                                        | Boolean. T if two columns per page globally.                                                                                                                                                                                                                          |
| <code>@oddhead</code>                                                          | IF @twoside = T THEN macro to generate head of odd-numbered pages. ELSE macro to generate head of all pages.                                                                                                                                                          |

|                             |                                                                                                                                                                                                                                                                                                  |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>\@evenhead</code>     | IF @twoside = T THEN macro to generate head of even-numbered pages.                                                                                                                                                                                                                              |
| <code>\@oddfoot</code>      | IF @twoside = T THEN macro to generate foot of odd-numbered pages. ELSE macro to generate foot of all pages.                                                                                                                                                                                     |
| <code>\@evenfoot</code>     | IF @twoside = T THEN macro to generate foot of even-numbered pages.                                                                                                                                                                                                                              |
| <code>@specialpage</code>   | boolean. T if current page is to have a special format.                                                                                                                                                                                                                                          |
| <code>\@specialstyle</code> | If its value is foo then IF @specialpage = T THEN the command <code>\ps@foo</code> is executed to temporarily reset the page style parameters before composing the current page. This command should execute only <code>\def</code> 's and <code>\edef</code> 's, making only local definitions. |

## 39.5 Float placement parameters

The following parameters are set by the macro `\@floatplacement`. When `\@floatplacement` is called, `\@colht` is the height of the page or column being built. I.e.:

- \* For single-column page it equals `\textheight`.
- \* For double-column page it equals `\textheight - height of double-column floats on page`.

Note that some are set globally and some locally:

`\@topnum` = G Maximum number of floats allowed on the top of a column.

`\@toproom` := G Maximum amount of top of column devoted to floats – excluding `\textfloatsep` separation below the floats and `\floatsep` separation between them. For two-column output, should be computed as a function of `\@colht`.

|                                  |                                                                                                                                 |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <code>\@botnum, \@botroom</code> | Analogous to above.                                                                                                             |
| <code>\@colnum</code>            | G Maximum number of floats allowed in a column, including in-text floats.                                                       |
| <code>\@textmin</code>           | L Minimum amount of text (excluding footnotes) that must appear on a text page. It is used locally in processing double floats. |
| <code>\@fpmin</code>             | L Minimum height of floats in a float column.                                                                                   |

The macro `\@dblfloatplacement` sets the following parameters.

|                           |                                                                                   |
|---------------------------|-----------------------------------------------------------------------------------|
| <code>\@dbltopnum</code>  | G Maximum number of double-column floats allowed at the top of a two-column page. |
| <code>\@dbltoproom</code> | G Maximum height of double-column floats allowed at top of two-column page.       |
| <code>\@fpmin</code>      | L Minimum height of floats in a float column.                                     |

It should also perform the following local assignments where necessary – i.e., where the new value differs from the old one:

|                      |                            |
|----------------------|----------------------------|
| <code>\@fptop</code> | L <code>\@dblfpptop</code> |
| <code>\@fpsep</code> | L <code>\@dblfpsep</code>  |
| <code>\@fpbot</code> | L <code>\@dblfpbot</code>  |

## 39.6 Output Routine Variables

|                                 |                                                                                                                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>\@colht</code>            | The total height of the current column. In single column style, it equals <code>\textheight</code> . In two-column style, it is <code>\textheight</code> minus the height of the double-column floats on the current page. MUST BE INITIALIZED TO <code>\textheight</code> . |
| <code>\@colroom</code>          | The height available in the current column for text and footnotes. It equals <code>\@colht</code> minus the height of all floats committed to the top and bottom of the current column.                                                                                      |
| <code>\@textfloatsheight</code> | The total height of in-text floats on the current page.                                                                                                                                                                                                                      |
| <code>\footins</code>           | Footnote insertion number.                                                                                                                                                                                                                                                   |
| <code>\@maxdepth</code>         | Saved value of TeX's <code>\maxdepth</code> . Must be set when any routine sets <code>\maxdepth</code> .                                                                                                                                                                     |

## 39.7 Calling the output routine

The output routine is called either by TeX's normal page-breaking mechanism, or by a macro putting a penalty  $\leq -10000$  in the output list. In the latter case, the penalty indicates why the output routine was called, using the following code.

Note that a float or marginpar puts the following sequence in the output list:

1. a penalty of -10004,
2. a null `\vbox`
3. a penalty of -10002 or -10003.

This solves two special problems:

1. If the float comes right after a `\newpage` or `\clearpage`, then the first penalty is ignored, but the second one invokes the output routine.

| Penalty | Reason                                                  |
|---------|---------------------------------------------------------|
| -10000  | \pagebreak<br>\newpage                                  |
| -10001  | \clearpage (\penalty -10000<br>\vbox{} \penalty -10001) |
| -10002  | float insertion, called from horizontal mode            |
| -10003  | float insertion, called from vertical mode.             |
| -10004  | float insertion.                                        |

Table 39.4: Penalties when calling the output routine.

2. If there is a split footnote on the page, the second 'page' puts out the rest of the footnote.

## 39.8 Functions used in the output routine

### \@outputpage

\@outputpage : Produces an output page with the contents of box \@outputbox as the text part. Also sets \@colht := G \textheight. The page style is determined as follows:

```

1 begin
2   | if \@thispagestyle = true then
3   |   | use \@thispagestyle style
4   | end
5   | use ordinary page style.
6 end

```

### \@tryfcolumn

\@tryfcolumn\FLIST tries to form a float column composed of floats from \FLIST (if nonempty) with the following parameters see 629:

|         |                                     |
|---------|-------------------------------------|
| \@colht | height of box                       |
| \@fpmin | minimum height of floats in the box |
| \@fpsep | interfloat space                    |
| \@fptop | glue at top of box                  |
| \@fpbot | glue at bottom of box.              |

If it succeeds, then it does the following:

|             |                                  |
|-------------|----------------------------------|
| \@outputbox | L the composed float box.        |
| @fcollmade  | G true                           |
| \FLIST      | G \FLIST - floats put in box     |
| \@freelist  | G \@freelist + floats put in box |

If it fails, then:

@fcollmade G false NOTE: BIT MUST BE A SINGLE TOKEN!

### \@makefcolumn

`\@makefcolumn` `\FLIST` is similar to `\@tryfcolumn` except that it fails to make a float column only if `\FLIST` is empty. Otherwise, it makes a float column containing at least the first box in `\FLIST`, disregarding `\@fpmmin`.

#### `\@startcolumn`

`\@startcolumn` Calls `\@tryfcolumn\@deferlist`. If `\@tryfcolumn` returns with (globally set) `@fcemade = false`, then:

Globally sets `\@toplist` and `\@botlist` to floats from `\@deferlist` to go at top and bottom of column, deleting them from `\@deferlist`. It does this using `\@colht` as the total height, the page style parameters `\@floatsep` and `\@textfloatsep`, and the float placement parameters `\@topnum`, `\@toproom`, `\@botnum`, `\@botroom`, `\@colnum` and `\textfraction`.

Globally sets `\@colroom` to `\@colht` minus the height of the added floats.

#### `\@startdblcolumn`

Calls `\@tryfcolumn\@dbldeferlist{8}`. If `\@tryfcolumn` returns with (globally set) `@fcemade = false`, then:

\* Globally sets `\@dbltoplist` to floats from `\@dbldeferlist` to go at top and bottom of column, deleting them from `\@dbldeferlist`. It does this using `\textheight` as the total height, and the parameters `\@dblfloatsep`, etc.

\* Globally sets `\@colht` to `\textheight` minus the height of the added floats.

#### `\@combinefloats`

`\@combinefloats` Combines the text from box `\@outputbox` with the floats from `\@toplist` and `\@botlist`, putting the new box in `\@outputbox`. It uses `\floatsep` and `\textfloatsep` for the appropriate separations. It puts the elements of `\TOPLIST` and `\BOTLIST` onto `\@freelist`, and makes those lists null.

#### `\@makecol`

`\@makecol` Makes the contents of `\box255` plus the accumulated footnotes, plus the floats in `\@toplist` and `\@botlist`, into a single column of height `\@colht` (unless the page height has been locally changed), which it puts into box `\@outputbox`. It puts boxes in `\@midlist` back onto `\@freelist` and restores `\maxdepth`.

#### `\@opcol`

`\@opcol` Outputs a column whose text is in box `\@outputbox`

## 39.9 User commands that call affect the output routine

#### `\newpage`

```

85 \newpage == BEGIN \par\vfil\penalty -10000 END

\clearpage

== BEGIN \newpage
    \write -1{}      % Part of hack to make sure no
    \vbox{}          % \write's get lost.
    \penalty -10001
END

\cleardoublepage == BEGIN \clearpage
    if @twoside = true and c@page is even
        then \hbox{} \newpage fi
END

\twocolumn[BOX] : starts a new page, changing to twocolumn setting
and puts BOX in a parbox of width \textwidth across the top.
Useful for full-width titles for double-
column pages.
SURPRISE: The stretch from \@dbltextfloatsep will be inserted
between the BOX and the top of the two columns.

```

## 39.10 Float-handling mechanisms

The float environment obtains an insertion number B from the `\@freelist` (see below for a description of list manipulation), puts the float into box B and sets `\count B` to a FLOAT SPECIFIER. For a normal (not double-column) float, it then causes a page break in one of the following two ways:

- In outer hmode: `\vadjust{\penalty -10002}`
- In vmode : `\penalty -10003`.

For a double-column float, it puts B onto the `\@dbldeferlist`.

The float specifier has two components:

- \* A PLACEMENT SPECIFICATION, describing where the float may be placed.
- \* A TYPE, which is a power of two—e.g., figures might be type 1 floats, tables type 2 floats, programs type 4 floats, etc.

The float specifier is encoded as follows, where bit 0 is the least significant bit.

| Bit | Meaning                                             |
|-----|-----------------------------------------------------|
| 0   | 1 if the float may go where it appears in the text. |
| 1   | 1 if the float may go on the top of a page.         |
| 2   | 1 if the float may go on the bottom of a page.      |
| 3   | 1 if the float may go on a float page.              |
| 4   | 1 unless the PLACEMENT includes a !                 |
| 5   | if a type 1 float                                   |
| 6   | 1 if a type 2 float etc.                            |

A negative float specifier is used to indicate a marginal note.

## 39.11 Macros and data structures for processing floats

A *float list* consisting of the floats in boxes `\boxa ... \boxN` has the form:

```
\@elt \boxa ... \@elt \boxN
```

where `\boxI` is defined by:

```
\newinsert\boxI
```

Normally, `\@elt` is `\let` to `\relax`. A test can be performed on the entire float list by locally `\def`'ing `\@elt` appropriately and executing the list.

This is a lot more efficient than looping through the list.

The following macros are used for manipulating float lists. Of interest here—and a bit difficult to follow is `\@next` see 16.

```
\@next \CS \LIST {NONEEMPTY}{EMPTY} == %% NOTE: ASSUME \@elt = \relax
BEGIN assume that \LIST == \@elt \B1 ... \@elt \Bn
  if n = 0
    then EMPTY
    else \CS := L \B1
      \LIST := G \@elt \B2 ... \@elt \Bn
      NONEEMPTY
  fi
END
```

`\@bitor{<num>}{<list>}`

`\@bitor\NUM\LIST` Globally sets switch `@test` to the disjunction for all I of bit  $\log_2 \NUM$  of the float specifiers of all the floats in `\LIST`.

I.e., `@test` is set to true iff there is at least one float in `\LIST` having bit  $\log_2 \NUM$  of its float specifier equal to 1.

```
% Note:  $\log_2 [(\text{count } I)/32]$  is the bit number corresponding to the
% type of float I. To see if there is any float in \LIST having
% the same type as float I, you run \@bitor with
%
% \NUM = [(\text{count } I)/32] * 32.
%
% \@bitor\NUM\LIST ==
% BEGIN
%   @test := G false
%   { \@elt \CTR == if \NUM <> 0 then
%     if \count\CTR / \NUM is odd
%       then @test := true      fi fi
%   \LIST
%   }
% END
```

```
%  
%  
% \@cons\LIST\NUM : Globally sets \LIST := \LIST * \@elt \NUM  
%  
% \@cons\LIST\NUM ==  
%   BEGIN { \@elt == \relax  
%             \LIST :=G \LIST \@elt \NUM  
%           }  
%
```

## 39.12 Box lists for float-placement algorithms

The **fixltx2e** the now redundant package—as it was incorporated into the fixes provided by **fixltx2e**—modify the output routine to correct a problem with synchronizing floats in double column texts with those in single column **fix2col**; **fixltx2e**. Here we will describe the normal behaviour. Additional commentary on the changes is discussed later on.

|                |                                                          |
|----------------|----------------------------------------------------------|
| \@freelist     | List of empty boxes for placing new floats.              |
| \@toplist      | List of floats to go at top of current column.           |
| \@midlist      | List of floats in middle of current column.              |
| \@botlist      | List of floats to go at bottom of current column.        |
| \@deferlist    | List of floats to go after current column.               |
| \@dbltoplist   | List of double-col. floats to go at top of current page. |
| \@dbldeferlist | List of double-column floats to go on subsequent pages.  |

### Example 12.1 Meaning toplist

```
10 \makeatletter  
11 \meaning \@freelist\\  
12 \meaning \@toplist  
13 \makeatother
```

```
macro:-> \@elt \bx@G \@elt \bx@H \@elt \bx@I \@elt \bx@J \@elt \bx@K  
\@elt \bx@L \@elt \bx@M \@elt \bx@N \@elt \bx@O \@elt \bx@P \@elt  
\bx@Q \@elt \bx@R \@elt \bx@S \@elt \bx@T \@elt \bx@V \@elt \bx@W  
\@elt \bx@X \@elt \bx@Y \@elt \bx@Z \@elt \bx@AA \@elt \bx@BB \@elt  
\bx@CC \@elt \bx@DD \@elt \bx@EE \@elt \bx@FF \@elt \bx@GG \@elt  
\bx@U \@elt \bx@HH \@elt \bx@II \@elt \bx@JJ \@elt \bx@KK \@elt  
\bx@LL \@elt \bx@MM \@elt \bx@NN \@elt \bx@OO \@elt \bx@PP \@elt  
\bx@QQ \@elt \bx@RR \@elt \bx@SS \@elt \bx@TT \@elt \bx@UU \@elt  
\bx@VV \@elt \bx@WW \@elt \bx@XX \@elt \bx@YY \@elt \bx@ZZ \@elt
```

```
\bx@A \@elt \bx@B \@elt \bx@C \@elt \bx@D \@elt \bx@E \@elt \bx@F
macro:->
```

## 39.13 Float-Placement algorithms

### \@addtobot

Tries to put insert \currbox on \botlist. Called only when:

- \* \ht BOX < \colroom
- \* type of \currbox not on \deferlist
- \* \colnum > 0
- \* @insert = false

If it succeeds, then:

sets @insert true

decrements \botroom by \ht BOX

decrements \botnum and \colnum by 1

decrements \colroom by \ht BOX + either \floatsep or \textfloatsep, as appropriate.

sets \maxdepth to opt

### \@addtoporbot

Tries to put insert \currbox on \toplist or \botlist.

Called only under same conditions as \@addtobot.

If it succeeds, then:

- \* sets @insert true
- \* decrements \toproom or \botroom by \ht BOX
- \* decrements \colnum and either \topnum or \botnum by 1
- \* decrements \colroom by \ht BOX + \floatsep or \textfloatsep, as appropriate.

### \@addtocurcol

Tries to add \currbox to current column, setting @insert true if it succeeds, false otherwise. It will add \currbox to top only if bit 0 of \count \currbox is 0, and to the bottom only if bit 0 = 0 or an earlier float of the same type is put on the bottom.

If the float is put in the text, then \penalty\interlinepenalty is put right after the float, before the following \vskip, and

\outputpenalty :=L 0.

### \@addtonextcol

Tries to add \currbox to the next column, setting @insert true if it succeeds, false otherwise.

## \@addtobdblcol

Tries to add `\@currbox` to the next double-column page, adding it to `\@dbltoplist` if it succeeds and `\@dbldeferalist` if it fails.

Floats and marginpars add a lot of dead cycles.

```

14 \maxdeadcycles = 100
15 \let\@elt\relax

\@next
16 \def\@next#1#2#3#4{\ifx#2\empty #4\else
17   \expandafter\@xnext #2\@#1#2#3\fi}

18 \def\@xnext \@elt #1#2\@#3#4{\def#3{#1}\gdef#4{#2}}
19 \def\@testfalse{\global\let\if@test\iffalse}
20 \def\@testtrue {\global\let\if@test\iftrue}
21 \@testfalse
1
22 \def\@bitor#1#2{\@testfalse {\let\@elt\@xbitor
23   \tempcnta #1\relax #2}}
24 \def\@xbitor #1{\tempcntb \count#1
25   \ifnum \tempcnta =\z@
26   \else
27     \divide\tempcntb\tempcnta
28     \ifodd\tempcntb \@testtrue\fi
29   \fi}
```

## 39.14 Definition of Float Boxes (inserts)

All boxes are defined using `\newinsert→ P.44`. A total of eighteen insertions are defined here and later on inserted in the freelist (See line 36).

```

30 \newinsert\bx@A \newinsert\bx@B \newinsert\bx@C
31 \newinsert\bx@D \newinsert\bx@E \newinsert\bx@F
32 \newinsert\bx@G \newinsert\bx@H \newinsert\bx@I
33 \newinsert\bx@J \newinsert\bx@K \newinsert\bx@L
34 \newinsert\bx@M \newinsert\bx@N \newinsert\bx@O
35 \newinsert\bx@P \newinsert\bx@Q \newinsert\bx@R
```

$\text{\TeX}$  allows 255 classes of insertions `\insert0` to `\insert254`. It is important to remember that every insert is tied to other registers of the same number. For example, `\insert100` is connected with `\count100`, `\dimen100`, `\skip100` and `\box100`. plain  $\text{\TeX}$  provides an allocation function for insertions as it does for registers. Appendix B includes the command:

`\newinsert\footins`

which defines `\footins` as the number for footnote insertions.

$\text{\LaTeX}$  2e adopts similar definitions (see Chapter 2). In the latest versions allocations are extended with `\extrafloats`.

The `\@freelist` is defined next. Notice that `\@elt` is included here to enable the manipulation of the list later on.

---

<sup>1</sup>v1.1v 1996/07/26 remove `\global` before `\@test...`

```

36 \gdef\@freelist{@elt\bx@A@elt\bx@B@elt\bx@C@elt\bx@D@elt\bx@E }
37   @elt\bx@F@elt\bx@G@elt\bx@H@elt\bx@I@elt\bx@J
38   @elt\bx@K@elt\bx@L@elt\bx@M@elt\bx@N
39   @elt\bx@O@elt\bx@P@elt\bx@Q@elt\bx@R}

```

The rest of the lists are defined below and they are initialized as empty lists.

```

40 \gdef\@toplist{}
41 \gdef\@botlist{}
42 \gdef\@midlist{}
43 \gdef\@currlist{}
44 \gdef\@deferlist{}
45 \gdef\@dbltoplist{}
46 \gdef\@dbldeferlist{}

```

#### Example 14.2 Current list

```

10 \makeatletter
11 \meaning\@currlist
12
13 \meaning \bx@A
14
15 \the\bx@A
16
17 \the\dimen252
18
19 \the\count252
20
21 \the\skip252
22
23
24 \makeatother

macro:->
\char"FC
252
o.opt
-1
o.opt

```

## 39.15 Page layout parameters

The page layout parameters (all taking values by the standard classes later on) are defined here. They are important in building up the page calculations.

```

25 \newdimen\topmargin
26 \newdimen\oddsidemargin
27 \newdimen\evensidemargin
28 \let\@themargin=\oddsidemargin
29 \newdimen\headheight
30 \newdimen\headsep
31 \newdimen\footskip

```

```

32 \newdimen\texttheight
33 \newdimen\textwidth
34 \newdimen\columnwidth
35 \newdimen\columnsep
36 \newdimen\columnseprule
37 \newdimen\marginparwidth
38 \newdimen\marginparsep
39 \newdimen\marginparpush

```

After these preliminary definitions are made a box is defined to hold material that is inserted before the dvi file is produced. This is a general hook and widely used by package authors.

### \AtBeginDvi{*contents*}

Uses a box register in which to put stuff that must appear before anything else in the **.dvi** file.

The stuff in the box should not add any typeset material to the page when it is unboxed.

```

40 \newbox\@begindvibox
41 \def \AtBeginDvi #1{%
42   \global \setbox \@begindvibox
43   \vbox{\unvbox \@begindvibox #1}%
44 }

```

### \@maxdepth

This is not the right place to set this; it needs to be set in a class/style file when **\maxdepth** is set.

Also, many settings to **\maxdepth** should be to **\@maxdepth**, probably?

```

45 \newdimen\@maxdepth
46 \@maxdepth = \maxdepth

```

### \paperheight

### \paperwidth

Although earlier on, page parameters have been defined, we also need to define the paper height and width.

```

47 \newdimen\paperheight
48 \newdimen\paperwidth

```

The following nine switches have to be defined to keep track of various options.

```

\if@insert
\if@fcolmade
\if@specialpage
\if@firstcolumn

```

```
\if@twocolumn

\if@twoside

\if@reversemarginpar

\if@mparswitch

\col@number

Local switches first:

49 \newif \if@insert
      These should definitely be global:

50 \newif \if@fcolmade
51 \newif \if@specialpage \@specialpagefalse
      These should be global but are not always set globally in other
      files.

52 \newif \if@firstcolumn \@firstcolumntrue
53 \newif \if@twocolumn \@twocolumnfalse
      Not sure about these: two questions. Should things which must
      apply to a whole document be local or global (they probably should
      be ‘preamble only’ commands)? Are these three such things?

54 \newif \if@twoside \@twosidefalse
55 \newif \if@reversemargin \@reversemarginfalse
56 \newif \if@mparswitch \@mparswitchfalse
      This counter has been imported from ‘multicol’.

57 \newcount \col@number
58 \col@number \@ne
```

## 39.16 Internal registers

```
59 \newcount\@topnum
60 \newdimen\@toproom
61 \newcount\@dbltopnum
62 \newdimen\@dbltoproom
63 \newcount\@botnum
64 \newdimen\@botroom
65 \newcount\@colnum
66 \newdimen\@textmin
67 \newdimen\@fpmin
68 \newdimen\@colht
69 \newdimen\@colroom
70 \newdimen\@pageht
71 \newdimen\@pagedp
72 \newdimen\@mparbottom \@mparbottom\z@
73 \newcount\@currtype
74 \newbox\@outputbox
75 \newbox\@leftcolumn
76 \newbox\@holdpg
```

The page headers and page footers are initialized to their odd values, this makes sense as a document always starts at an odd number.

```
77 \def\@thehead{\@oddhead} %
78 \def\@thefoot{\@oddfoot}
\clearpage
```

The tests at the beginning are an experimental attempt to avoid a completely empty page after a `\twocolumn[...]`. This prevents the text from the argument vanishing into a float box, never to be seen again. We hope that it does not produce wrong formatting in other cases.

```
79 \def\clearpage{%
80   \ifvmode
81     \ifnum \@dbltopnum =\m@ne
82       \ifdim \pagetotal <\topskip
83         \hbox{}%
84       \fi
85     \fi
86   \fi
87   \newpage
88   \write\m@ne{}%
89   \vbox{}%
90   \penalty -\@Mi
91 }
```

### \cleardoublepage

```
92 \def\cleardoublepage{\clearpage\if@twoside \ifodd\c@page\else
93   \hbox{}\newpage\if@twocolumn\hbox{}\newpage\fi\fi\fi}
```

### \onecolumn

```
94 \def\onecolumn{%
95   \clearpage
96   \global\columnwidth\textwidth
97   \global\hsize\columnwidth
98   \global\linewidth\columnwidth
99   \global\@twocolumnfalse
100  \col@number \@ne
101  \floatplacement{}}
```

### \newpage

The two checks at the beginning ensure that an item label or run-in section title immediately before a `\newpage` get printed on the correct page, the one before the page break.

All three tests are largely to make error processing more robust; that is why they all reset the flags explicitly, even when it would appear that this would be done by a `\leavevmode`.

```
102 \def \newpage {%
103   \if@noskipsec
104     \ifx \nodocument\relax
105       \leavevmode
106       \global \nobreak\allowbreak\relax
107     \fi
108   \fi
109 }
```

```

107      \fi
108    \fi
109  \if@inlabel
110    \leavevmode
111    \global \let\inlabelfalse
112  \fi
113 \if@nobreak \let\nobreakfalse \everypar{}\fi
114 \par
115 \vfil
116 \penalty -\@M}

```

### \@emptycol

It may be better to use an invisible rule rather than an empty box here.

```
117 \def \@emptycol {\vbox{}\penalty -\@M}
```

### \twocolumn

#### \@topnewpage

There are several bug fixes to the two-column stuff here.

```

118 \def \twocolumn {%
119   \clearpage
120   \global \columnwidth\textwidth
121   \global \advance \columnwidth-\columnsep
122   \global \divide \columnwidth\tw@
123   \global \hsize\columnwidth
124   \global \linewidth\columnwidth
125   \global \twocolumntrue
126   \global \firstcolumntrue
127   \col@number \tw@

```

There is no reason to put a \dblfloatplacement here since  
 \@topnewpage ignores these settings. The \floatplacement is  
 needed in case this comes after some changes.

```
128 \ifnextchar [\@topnewpage\@floatplacement
129 }
```

Note that here, getting a box from the freelist can assume success since  
 this comes just after a \clearpage.

```

130 \long\def \@topnewpage [#1]{%
131   \nodocument
132   \next@\currbox\freelist{}{}%
133   \global \setbox\currbox
134   \color@vbox
135   \normalcolor
136   \vbox {%
137     \hsize\textwidth
138     \parboxrestore
139     \col@number \ne
140     #1%
141     \vskip -\dbltextfloatsep
142     }%
143   \color@endbox

```

Added size test and warning message; perhaps we should use an error message.

```
144 \ifdim \ht@\currbox>\textheight
145   \ht@\currbox \textheight
146 \fi
```

This next line is not essential but it is more robust to make this value non-zero, in case of weird errors.

This next bit is what is needed from `\@addtobblcol`, plus some extra checks for error trapping.

```
147 \global \count@\currbox \tw@
148 \@tempdima -\ht@\currbox
149 \advance \atempdima -\dbltextfloatsep
150 \global \advance \colht \atempdima
151 \ifx \dbltoplist \empty
152 \else
153   \@latexerr{Float(s) lost}\@ehb
154   \let \dbltoplist \empty
155 \fi
156 \cons \dbltoplist \currbox
```

This setting of `\@dbltopnum` is used only to change the typesetting in `\@combinedblfloats`.

```
157 \global \dbltopnum \m@ne
158 %<*trace>
159 \tr@ce{\dbltopnum set to -1 (= \the \dbltopnum) >
  \topnewpage}%
160 %</trace>
```

At points such as this we need to check that there is still a minimal amount of room left on the page; this uses an arbitrary small value at present; but note that this value is larger than that used when checking that page is too full of normal floats.

If there is little room left we just force a page-break, OK? This involves producing two empty columns. The second empty column may be produced by `\output`, in which case an extra, misleading, warning will be generated, OK? (This happens only when there is too little room left on the page for any float.) Otherwise (ie if the size is such that it is allowed as a normal float) the extra `\@emptycol` will be invoked in the second column by the conditional code guarded by the `\if@firstcolumn` test.

I now think that the cut-off point here should be `3\baselineskip`, but we make it a bit less so that 3 lines of text will be allowed, OK?

Since this happens only when there is nothing on the page but the ‘top-box’, the empty box should not cause any problem other than some overfull box messages, which is not entirely misleading.

Here we need two page-ends since both columns need to be empty.

```
161 \ifdim \colht<2.5\baselineskip
162   \@latex@warning@no@line {Optional argument of \noexpand\twocolumn
  too tall on page \thepage}%
163   \emptycol
164 \if@firstcolumn
```

```

166     \else
167         \@emptycol
168     \fi
169 \else
170     \global \vsize \@colht
171     \global \@colroom \@colht
172     \@floatplacement
173 \fi
174 }

```

## 39.17 The `\output` routine

We now arrive at the interesting part. The `\output` is a token register that holds instructions as to how the page is to be typeset. This is called automatically by TeX. Think of it as the main function.

### `\output`

This needs some small adjustments. We cannot guarantee that the float mechanism will interact correctly with this stuff, but that mechanism does not always work properly with footnotes already.

The reset of `\par` to the output routine. This avoids problems when the output routine is called within a list where `\par` may be a no-op.

```

175 \output {%
176   \let \par \@@par
177   \ifnum \outputpenalty<-\@M
178     \@specialoutput
179   \else
180     \@makecol
181     \@opcol
182     \@startcolumn
183     \@whilesw \if@fcolmade \fi
184     {\@opcol\@startcolumn}%
185   \fi
186   \ifnum \outputpenalty>-\@Miv
187     \ifdim \@colroom<1.5\baselineskip
188       \ifdim \@colroom<\textheight
189         \@latex@warning@no@line {Text page \thepage\space
190                           contains only floats}%
191       \@emptycol
192     \else
193       \global \vsize \@colroom
194     \fi
195   \else
196     \global \vsize \@colroom
197   \fi
198 \else
199   \global \vsize \maxdimen
200 \fi
201 }

```

### `\@specialoutput`

```

202 \gdef\@specialoutput{%
203   \ifnum \outputpenalty<-@\Mii
204     \@doclearpage
205   \else
206     \ifnum \outputpenalty<-\@Miii
207       \ifnum \outputpenalty<-\@MM \deadcycles \z@ \fi
208       \global \setbox\@holdpg \vbox {\unvbox\@cclv}%
209     \else
210       \global \setbox\@holdpg \vbox{%
211         \unvbox\@holdpg
212         \unvbox\@cclv
213         \setbox\@tempboxa \lastbox
214         \unskip
215       }%
216     \pagedp \dp\@holdpg
217     \pageht \ht\@holdpg
218     \unvbox \@holdpg
219     \next\@currbox\@currlist{%
220       \ifnum \count\@currbox>\z@
221         \advance \pageht \pagedp
222         \ifvoid\footins \else
223           \advance \pageht \ht\footins
224           \advance \pageht \skip\footins
225           \advance \pageht \dp\footins
226         \fi
227         \ifvbox \@kludgeins
228           \ifdim \wd\@kludgeins=\z@
229             \advance \pageht \ht\@kludgeins
230           \fi
231         \fi
232         \reinserts
233         \addtocurcol
234       \else
235         \reinserts
236         \addmarginpar
237       \fi
238     } \@latexbug
239     \ifnum \outputpenalty<\z@
240       \ifnobreak
241         \nobreak
242       \else
243         \addpenalty \interlinepenalty
244       \fi
245     \fi
246   \fi
247 }
248 }

```

\@doclearpage

This is a very much an emergency action, just dumping everything: footnotes first then floats. A more sophisticated version is needed; but even more urgent is a bug-free version (see, for example, pr/3528). Also, it puts any left-over non-boxes (writes, specials, etc.) back after any float pages created: this is a very bad bug since, for example, a kludge insert will be in quite the wrong place and, worse, be irremovable and uncancellable.

```

249 \def \@doclearpage {%
250   \ifvoid\footins
251     \ifvbox\@kludgeins
252       {\setbox\@tempboxa \box\@kludgeins}%
253     \fi
254     \setbox\@tempboxa\vsplit\@cclv to\z@ \unvbox\@tempboxa
255     \setbox\@tempboxa\box\@cclv
256     \xdef\@deferlist{\@toplist\@botlist\@deferlist}%
257     \global \let \@toplist \@empty
258     \global \let \@botlist \@empty
259     \global \@colroom \@colht
260     \ifx \@currlist\@empty
261     \else
262       \@latexerr{Float(s) lost}\@ehb
263       \global \let \@currlist \@empty
264     \fi
265     \@makefcolumn\@deferlist
266     \@whilesw\if@fcolmade \fi
267       \fi{\@opcol\@makefcolumn\@deferlist}%
268     \if@twocolumn
269       \if@firstcolumn
270         \xdef\@dbldeferlist{\@dbltoplist\@dbldeferlist}%
271         \global \let \@dbltoplist \@empty
272         \global \@colht \textheight
273         \begingroup
274           \@dblfloatplacement
275           \@makefcolumn\@dbldeferlist
276           \@whilesw\if@fcolmade \fi{\@outputpage
277             \atop\@makefcolumn\@dbldeferlist}%
278           \endgroup
279         \vbox{}\clearpage
280       \fi
281     \fi
282   \else
283     \setbox\@cclv\vbox{\box\@cclv\vfil}%
284     \atop\@makecol\@opcol
285     \clearpage
286   \fi
287 }

\@opcol
288 \def \@opcol {%
289   \if@twocolumn
290     \atop\@outputdblcol

```

```

291 \else
292   \atoutputpage
293 \fi
These do not need to be done every time \atopcol is used: they should be
grouped together since they all need to be done at the end of the non-special
output routine, or at the end of a clearpage one.
294 \global \mparbottom \z@ \global \textfloatsheight \z@
295 \floatplacement
296 }

```

### \@makecol

We must rewrite this macro to allow for variations in page-makeup required by changes in page-length.

This uses a different macro if a special-length column is being produced.

```

297 \gdef \@makecol {%
298   \ifvoid\footins
299     \setbox\@outputbox \box\@cclv
300   \else
301     \setbox\@outputbox \vbox {%

```

This \boxmaxdepth setting is to ensure that deep footnotes do not overwrite the footer (on account of the negative skip added later): it should use \atmaxdepth otherwise the change is pointless when there are footnotes. But see also its use when combining floats.

Macro \newinsert computes a number (counting down from 254) and allocates a box, a count, a dimen, and a skip register with that number. The reason for allocating from 254 instead of 255 is that \box255 is reserved for special OTR use. The reason for allocating downwards is that registers \count0, \count1.. are used for the page number, and many people tend to use registers \box0, \box1.. for temporary storage.

#### Example 17.3 footins

```

10
11 \the\footins
12
13 \the\skip\footins
14
15 \the\dimen\footins
16
17 \the\count\footins

253
9.0pt plus 4.0pt minus 2.0pt
578.15999pt
1000

```

```

19   \boxmaxdepth \atmaxdepth
20   % unbox
21   \unvbox \@cclv
22   % skip
23   \vskip \skip\footins

```

```

24      \color@begingroup
25          \normalcolor
26          % draw rule
27          \footnoterule
28
29
30          % unbox footins
31          \unvbox \footins
32          \color@endgroup
33      }%
34  \fi
35  \let\@elt\relax
36  \xdef\@freelist{\@freelist\@midlist}%
37  \global \let \@midlist \empty
38  \@combinefloats
39  \ifvbox\@kludgeins
40      \makespecialcolbox
41  \else
42      \setbox\@outputbox \vbox to\@colht {%
43          \atexttop
44          \dimen@\dp\@outputbox
45          \unvbox \@outputbox
46          \vskip -\dimen@
47          \atextbottom
48      }%
49  \fi
50  \global \maxdepth \maxdepth
51 }

```

### \@reinserts

This is the code which reinserts the inserts. It puts them all in one place; this can make some of them come out on the wrong page. It has been put into a separate macro to expedite experimentation.

```

52 \gdef \@reinserts{%
53   \ifvoid\footins\else\insert\footins{\unvbox\footins}\fi
54 }

```

### \@makespecialcolbox

This implements certain variations in page-makeup.

```
55 \gdef \@makespecialcolbox {%
```

First we find the natural height of the column. See above for discussion of what is happening here. This needs further investigation, especially in this ‘special case’.

```

56  \setbox\@outputbox \vbox {%
57      \atexttop
58      \dimen@\dp\@outputbox
59      \unvbox\@outputbox
60      \vskip-\dimen@
61  }%
62  \tempdima \@colht
63  \ifdim \wd\@kludgeins>\z@

```

Note that in this case (the \*-version), the height of the `\@kludgeins` box is not used since its value is somewhat arbitrary: it need only be big enough to ensure that the page-break is not taken prematurely.

Here we calculate how much vertical space needs to be added in order to enable the column to fit into a box of size `\@colht` using the best information we have about the amount of shrink available (another thing which is known internally about a box, but cannot be accessed at the TeX level!).

This needs TeX3 otherwise `\pageshrink` is zero anyway; it may not be exactly the figure we wish as it is the total available from the all the material collected before the page-break decision is made. It will, we think, always be an overestimate of the actual shrink in the box; therefore this should always force the shortest possible column with the possibility of an overfull box.

This should work for both the flush- and ragged-bottom setting since it makes the contents no smaller than the size (`\@colht`) of the box into which they are put.

There should perhaps be an upper limit, of opt?, on the extra space added to force shrinking.

See above for a discussion of the `\boxmaxdepth` setting here.

```

64   \advance \tempdima -\ht\outputbox
65   \advance \tempdima \pageshrink
66   \setbox\outputbox \vbox to \@colht {%
67     \unvbox\outputbox
68     \vskip \tempdima
69     \textbottom
70   }%
```

For the unstarred version, the final size of the page is precisely specified. Therefore, at least for the flush-bottom case, we need to ensure that, visually, it has this size exactly.

Thus we calculate this size and set the material in a box of this size, which is then put into a box of size `\@colht` with `\vss` at the bottom.

```

71 \else
72   \advance \tempdima -\ht\kludgeins
```

This type of final packaging could be done always; this may simplify all of this page-makeup.

It is not necessary to set `\boxmaxdepth` here since the `\outputbox` ends with glue.

```

73   \setbox\outputbox \vbox to \@colht {%
74     \vbox to \tempdima {%
75       \unvbox\outputbox
76       \textbottom}%
77     \vss}%
78 \fi
```

Finally we need to explicitly make the insert box void.

```
79 {\setbox\tempboxa \box\kludgeins}%
```

The following macros are just hooks and can be set to add top and bot-

tom glue on all pages.<sup>23</sup> They are currently used in the definition of `\raggedbottom`<sup>→ P. 438</sup> and `\flushbottom`<sup>→ P. 438</sup>.

### `\@texttop`

Does nothing by default, otherwise add glue at the top on all pages.

```
80 \let \@texttop \relax
```

### `\@textbottom`

Can be used to add glue at the bottom of a page.

```
81 \let \@textbottom \relax
```

### `\@resetactivechars`

#### `\@activechar@info`

added hook to protect against certain active characters in the output routine. Default checks are for active space and end-of-line.

```
82 \def\@activechar@info #1{%
83   \@latex@info@no@line {Active #1 character found while
84   output routine is active
85   \MessageBreak
86   This may be a bug in a package file
87   you are using}%
88 }
```

Do not put any spaces in this next bit!

```
89 \begingroup
90 \obeylines\obeyspaces%
91 \catcode`\'\active%
92 \gdef\@resetactivechars{%
93 \def^M{\@activechar@info{EOL}\space}%
94 \def {\@activechar@info{\space}\space}%
95 \let'\active@math@prime}%
96 \endgroup
```

### `\@outputpage`

The `\color@hbox` hooks here are used to avoid putting just a colour special into an otherwise empty box (in a header or footer). These boxes are often set to be completely empty and so adding a special produces a very underfull box message.

There has been extensive tidying up of the old code here; including the removal of a level of grouping.

The setting of `\protect` immediately before the `\shipout` is needed so that protected commands within `\writes` are handled correctly.

Within shipout's vbox it is reset to its default value, `\relax`.

---

<sup>23</sup><http://tex.stackexchange.com/questions/40469/use-of-texttop-and-textbottom-for-vertical-positioning>

<sup>3</sup><https://tex.stackexchange.com/questions/131871/vertically-centering-page-with-texttop-and-textbottom>

Resetting it to its default value after the shipout has been completed (and the contents of the writes have been expanded) must be done by use of **\aftergroup**. This is because it must have the value **\relax** before macros coming from other uses of **\aftergroup** within this box are expanded.

Putting this into the **\aftergroup** token list does not affect the definition used in expanding the **\writes** because the aftergroup token list is only constructed when popping the save-stack, it is not expanded until after the shipout is completed.

Question: should things from an **\aftergroup** within the shipped out box be executed in the environment set up for the writes, or after it finishes?

A lot of this code has been in-lined to prevent mis-use of internal commands as hooks.

```
\@outputpage{<void>}
```

This essentially calls **\shipout**

```
97 \def\@outputpage{%
98 \begingroup % the \endgroup is put in by \aftergroup
```

Now all the set-up stuff has been in-lined for Frank.

First the stuff for the writes.

From here ... was in the command **\@writesetup**.

```
472 \let \protect \noexpand
```

RmS 93/08/19: Redefined accents to allow changes in font encoding; but exactly why was this needed?

The **\catcode`\\ = 10** was removed as it was considered useless (presumably because nothing gets tokenised during shipout).

This was put in as some error produced active spaces in a mark, I think.

Why was the hyphen reset?

```
473 \@resetactivechars
```

If a page break happens between the start of a list and its first item the **@newlist** will be true and this will mess up any list that is used in the header or footer of the page. So we have to reset that flag.

```
474 \global\let\@if@newlist\if@newlist
475 \global\@newlistfalse
```

with the new encoding setup they can use **\let**. It could also use the new internal commands? This next hook replaces the following:

```
\let\-\@dischyp
\let\'\@acci\let`\@accii\let\=\@acciii
\let\\@\normalcr
\let\par@@par %% 15 Sep 87 (this was once inside the box)
```

```
%      \parindent\z@
%      \parskip\z@skip
%      \everypar{ }%
%      \leftskip\z@skip
%      \rightskip\z@skip
%      \parfillskip@\flushglue
```

```

%      \lineskip\normalineskip
%      \baselineskip\normalbaselineskip
%      \sloppy

476  \@parboxrestore
Finally we are ready to \shipout the box.
477  \shipout \vbox{%
478    \set@typeset@protect
479    \aftergroup \endgroup
480    \aftergroup \set@typeset@protect
481    % correct? or just restore ?
482    % by ending
483    % the group?
484
Now the setup inside the shipped out box; this should contain all the stuff that
could only affect typesetting; other stuff may need to be reset for the writes also.
From here ... was in the command \@shipoutsetup.
The \especialpage picks up the pagestyle using the ps@
483  \if@specialpage
484    \global\@specialpagefalse\@nameuse{ps@\@specialstyle}%
485  \fi
486  \if@twoside
487    \ifodd\count\z@ \let\@thehead\@oddhead \else \let\@thehead\@evenhead \fi
488    \let\@thefoot\@oddfoot \else \let\@thefoot\@evenfoot \fi
489    \let\@themargin\oddsidemargin \else \let\@themargin\evensidemargin \fi
490  \else \let\@thehead\@evenhead \let\@thefoot\@evenfoot \let\@themargin\evensidemargin \fi
491  \fi
492  \fi
The rest was always inside the box.
493  \reset@font
RmS 93/08/06 Added \lineskiplimit=0pt to guard against it being non-
zero: e.g. by \offinterlineskip being in effect.
There are probably lots of other things that may need resetting.
494  \normalsize
Reset the space factors. Call \normalsfcodes (from patch file) latex/2404
495  \normalsfcodes
Reset these here (previously reset separately for head and foot)
496  \let\label@gobble
497  \let\index@gobble
498  \let\glossary@gobble
499  \baselineskip\z@skip \lineskip\z@skip \lineskiplimit\z@
... to here was in the command \@shipoutsetup.
500  \@begindvi ①
501  \vskip \topmargin
502  \moveright\@themargin \vbox {%
503    \setbox\@tempboxa \vbox to\headheight{%
504      \vfil
505      \color@hbox

```

```

506      \normalcolor
507      \hb@xt@\textwidth{\@thehead}%
508      \color@endbox
509      }%                                %% 22 Feb 87
510      \dp@\tempboxa \z@
511      \box@\tempboxa
512      \vskip \headsep
513      \box@\outputbox
514      \baselineskip \footskip
515      \color@hbox
516      \normalcolor
517      \hb@xt@\textwidth{\@thefoot}%
518      \color@endbox
519      }%
520      }%
\endgroup now inserted by \aftergroup
Restore \if@newlist
521 \global\let\if@newlist@@\if@newlist
522 \global \colht \textheight
523 \stepcounter{page}%

```

It is now clear that this does something useful, thanks to Piet van Oostrum. It is needed because a float page is made without using TeX's page-builder; thus the output routine is never called so the marks are not updated.

```

524 \let\firstmark\botmark
525 }

```

At ① the `@begindvi` was inserted for the material taht it holds. This in reality is a hook, used to place anything we want at the page, provided it holds material that do not take any space.

### 53.opt



### \@begindvi

This unboxes stuff that must appear before anything else in the `.dvi` file, then returns that box register to the free list and cancels itself.

The stuff in the box should not add any typeset material to the page. Provided that you inserting material which is absolutely positioned, this is a good place to hook-in.

```

526 \def \begindvi{%
527   \unvbox \begindvibox
528   \global\let \begindvi \empty
529 }

```

The combining of the floats happens here.

### \@combinefloats



## \@cflb

The `\boxmaxdepth` setting here was not made local to a box so was dangerous. It is needed only within the box made by `\@cflt` (and not normally even there), so it has been moved there; this also agrees with the original pseudocode.

The `\@combinefloat` function will add the top and bottom floats if their lists are not empty. `\cf<lt>` is or top and `\lb` for bottom.

```

530 \def \@combinefloats {%
531   \ifx \@toplist\@empty \else \@cflt \fi
532   \ifx \@botlist\@empty \else \@cflb \fi
533 }
      First define the \@elt
534 \def \@cflt{%
535   \let \@elt \@comflelt
536   \setbox\@tempboxa \vbox{%
537     \@toplist
538     \setbox\@outputbox \vbox{%
539       \boxmaxdepth \maxdepth
540       \unvbox\@tempboxa
541       \vskip -\floatsep
542       \topfigrule
543       \vskip \textfloatsep
544       \unvbox\@outputbox
545     }%
546
547   % reset |\@elt| to |\relax|
548   \let\@elt\relax
549
550   % return |\@toplist| to the |\@freelist|
551   \xdef\@freelist{\@freelist\@toplist}%
552
553   % empty the |\@toplist|
554   \global\let\@toplist\@empty
555 }

556 \def \@cflb {%
557   \let\@elt\@comflelt
558   \setbox\@tempboxa \vbox{%
559     \@botlist
560     \setbox\@outputbox \vbox{%
561       \unvbox\@outputbox
562       \vskip \textfloatsep
563       \botfigrule
564       \unvbox\@tempboxa
565       \vskip -\floatsep
566     }%
567   \let\@elt\relax
568   \xdef\@freelist{\@freelist\@botlist}%
569   \global \let \@botlist\@empty
570 }

```

## \@comflelt

```

  \comdblflelt
    \combinedblfloats
571 \def \comflelt#1{\setbox@tempboxa
572   \vbox{\unvbox@\tempboxa\box #1\vskip\floatsep}}
573 \def \comdblflelt#1{\setbox@\tempboxa
574   \vbox{\unvbox@\tempboxa\box #1\vskip\dblfloatsep}}
575 \def \combinedblfloats{%
576   \ifx \dbltoplist \empty
577   \else
578     \setbox@\tempboxa \vbox{}%
579     \let \elt \comdblflelt
580     \atdbltoplist
581     \let \elt \relax
582     \xdef \freelist {\freelist\atdbltoplist}%
583     \global\let \atdbltoplist \empty
584     \setbox@\outputbox \vbox to\textheight
585       {%
586         \boxmaxdepth\maxdepth %% probably not needed, CAR
587         \unvbox@\tempboxa\vskip-\dblfloatsep
588         \ifnum \atdbltopnum>\m@ne
589           \dblfigrule
590         \fi
591         \vskip \dbltextfloatsep
592         \box@\outputbox
593       }%
594   \fi
595 }

```

### \startcolumn

We could combine (most of) these two into `\startcol <list>`. This is not quite as efficient but it now has the same structure as `\startdblcolumn`. The empty-list test has been moved to `\tryfcolumn`.

```

595 \def \startcolumn {%
596   \global \colroom \colht
597   \tryfcolumn \deferlist
598   \if@fcollmade
599     %<*trace>
600     \tr@ce{PAGE: float \if@twocolumn column \else page \fi
601           completed}%
602   %</trace>
603   \else
604     \begingroup
605       \let \reserved@b \deferlist
606       \global \let \deferlist \empty
607       \let \elt \scolelt
608       \reserved@b
609     \endgroup
610   \fi
611 }

```

```

612 \def \@startdblcolumn {%
613 % \global \@colht \textheight
614   \@tryfcolumn \@dbldeferlist
615   \if@fcolmade
616 %<*trace>
617   \tr@ce{PAGE: double float page completed}%
618 %</trace>
619   \else
620     \begingroup
621       \let \reserved@b \@dbldeferlist
622       \global \let \@dbldeferlist \@empty
623       \let \@elt @sdblcolelt
624       \reserved@b
625     \endgroup
626   \fi
627 }

```

### \@tryfcolumn

Now tests if its list is empty before any further exertion.

```

628 \def \@tryfcolumn #1{%
629   \global \@fcolmadefalse
630   \ifx #1\@empty
631   \else
632 %<*trace>
633   \tr@ce{PAGE: try float \if@twocolumn column/page\else \page\fi
634           ---\string #1\%}
635   \tr@ce{----- \string #1: #1\%}
636 %</trace>
637   \xdef\@trylist{\string #1\%}
638   \global \let \@failedlist \@empty
639   \begingroup
640     \let \@elt \@xtryfc \@trylist
641   \endgroup
642   \if@fcolmade
643     \vtryfc #1%
644   \fi
645 \fi
646 }

```

### \@scolelt

```
647 \def\@scolelt#1{\def\@currbox{#1}\@addtonextcol}
```

### \@sdblcolelt

```
648 \def\@sdblcolelt#1{\def\@currbox{#1}\@addtobtblcol}
```

### \@vtryfc

```

649 \def\@vtryfc #1{%
650   \global\setbox\@outputbox\vbox{}%
651   \let\@elt\@wtryfc
652   \@flsucceed
653   \global\setbox\@outputbox \vbox to\@colht{%
654     \vskip \@fptop
655     \vskip -\@fpsep
656     \unvbox \@outputbox
657     \vskip \@fpbot}%
658   \let\@elt\relax
659   \xdef #1{\@failedlist\@flfail}%
660   \xdef\@freelist{\@freelist\@flsucceed}%

\@wtryfc

661 \def\@wtryfc #1{%
662   \global\setbox\@outputbox\vbox{%
663     \unvbox\@outputbox
664     \vskip\@fpsep
665     \box #1}%
666
667 \def\@xtryfc #1{%
668   \@next\reserved@a\@trylist{}{}%
669   \@currtype \count #1%
670   \divide\@currtype\@xxxii
671   \multiply\@currtype\@xxxii
672   \@bitor \@currtype \@failedlist
673   \@testfp #1%
674   \ifdim \ht #1>\@colht
675     \@testtrue
676   \fi
677   \@if@test
678     \@cons\@failedlist #1%
679   \else
680     \@ytryfc #1%
681   \fi}

\@ytryfc

681 \def\@ytryfc #1{%
682   \begingroup
683     \gdef\@flsucceed{\@elt #1}%
684     \global\let\@flfail\@empty
685     \@tempdima\ht #1%
686     \let\@elt\@ztryfc
687     \@trylist
688     \ifdim \@tempdima >\@fpmin
689       \global\@fcolmadetrue
690     \else
691       \@cons\@failedlist #1%
692     \fi
693   \endgroup

```

```

694   \if@fcollmade
695     \let\@elt\@gobble
696   \fi}

\@ztryfc

697 \def\@ztryfc #1{%
698   \@tempcnta \count#1%
699   \divide\@tempcnta\@xxxii
700   \multiply\@tempcnta\@xxxii
701   \bitor\@tempcnta {\@failedlist \@flfail}%
702   \@testfp #1%
703   \tempdimb\@tempdima
704   \advance\tempdimb \ht#1%
705   \advance\tempdimb\@fpsep
706   \ifdim \tempdimb >\@colht
707     \testtrue
708   \fi
709   \if@test
710     \cons\@flfail #1%
711   \else
712     \cons\@flsucceed #1%
713     \tempdima\tempdimb
714   \fi}

```

The major changes for float suppression and the changes to the float mechanism to make it conform to the documentation are in these next macros.

```

\@addtobot

715 %<*2ekernel|autoload|fltrace>
716 \def\@addtobot {%
717   \getfpsbit 4\relax
718   \ifodd\@tempcnta
719     \fsetnum\@botnum
720     \ifnum\@botnum>\z@
721       \tempswafalse
722       \flcheckspace\@botroom\@botlist
723       \if@tempswa
724         \global\maxdepth\z@
725         \flupdates\@botnum\@botroom\@botlist
726         \inserttrue
727       \fi
728 %<*trace>
729   \else
730     \tr@ce{Fail: botnum = \the\@botnum:
731           fpstype \the\@fpstype=ORD?}%
732     \ifnum\@fpstype<\sixt@n
733       \tr@ce{ERROR: !b float not successful (addtobot)}%
734     \fi
735 %</trace>
736   \fi
737   \fi
738 }

```

```

\@addtotoporbot
739 \def \@addtotoporbot {%
740 %<*trace>
741   \tr@ce{***Start addtotoporbot}%
742 %</trace>
743   \getfpsbit \tw@
744 %<*trace>
745   \tr@ce{fpstype \ifodd \tempcnta OK \else not \fi top:
746           \the \c@fpstype}%
747 %</trace>
748   \ifodd \tempcnta
749     \flsetnum \topnum
750     \ifnum \topnum > \z@
751       \tempswafalse
752       \flcheckspace \toproom \topl
753       \if@tempswa
754         \bitor \currtype{\midlist\botlist}%
755 %<*trace>
756         \tr@ce{(\mid+bot)list: \midlist, \botlist:
757                 (addtotoporbot-before)}%
758 %</trace>
759       \if@test
760 %<*trace>
761         \tr@ce{type already on list: mid or bot---sent to \addtobot}%
762 %</trace>
763       \else
764         \flupdates \topnum \toproom \topl
765 %<*trace>
766         \tr@ce{colroom (after-top) = \the \colroom}%
767         \tr@ce{colnum (after-top) = \the \colnum}%
768         \tr@ce{topnum (after-top) = \the \topnum}%
769         \tr@ce{***Success: top}%
770 %</trace>
771       \inserttrue
772     \fi
773   \fi
774 %<*trace>
775   \else
776     \tr@ce{Fail: topnum = \the \topnum: fpstype
777             \the \c@fpstype=ORD?}%
778     \ifnum \fpstype < \sixt@n
779       \tr@ce{ERROR: ! float not successful \c��(addtotoporbot)}%
780     \fi
781 %</trace>
782     \fi
783   \fi
784   \if@insert
785   \else
786 %<*trace>
787     \tr@ce{sent to addtobot (addtotoporbot)}%

```

```

788 %</trace>
789     \@addtobot
790     \fi
791 }
792 %</2ekernel|autoload|fltrace>

793 %<*2ekernel|autoload|fltrace|flafter>
794 \def \@addtocurcol {%
795 %<*trace>
796   \tr@ce{***Start addtocurcol}%
797 %</trace>
798   \@insertfalse
799   \@setfloattypecounts
800   \ifnum \@fpstype=8
801 %<*trace>
802     \tr@ce{fpstype !p only (addtocurcol): \the \@fpstype = 2
803       \z@?}%
804   %</trace>
805   \else
806     \ifnum \@fpstype=24
807 %<*trace>
808     \tr@ce{fpstype p only (addtocurcol): \the \@fpstype = 2
809       \z@?}%
810   %</trace>
811   \else
812     \@flsettextmin
813 %<*trace>
814     \tr@ce{textfloatsheight (before) = \the \z@?}%
815 %</trace>
816     \advance \textmin \textfloatsheight
817     \reqcolroom \pageht
818     \advance \reqcolroom \pagedp
819 %<*trace>
820     \tr@ce{textmin + textfloatsheight: \the \textmin}%
821     \tr@ce{page-so-far: \the \reqcolroom}%
822 %</trace>
823     \ifdim \textmin>\reqcolroom
824       \reqcolroom \textmin
825 %<*trace>
826     \tr@ce{ORD? textmin being used}%
827     \fi
828     \advance \reqcolroom \ht\currbox
829 %<*trace>
830     \tr@ce{float size = \the \ht \currbox (addtocurcol)}%
831     \tr@ce{colroom = \the \colroom (addtocurcol)}%
832     \tr@ce{reqcolroom = \the \reqcolroom (addtocurcol)}%
833 %</trace>
834     \ifdim \colroom>\reqcolroom
835       \flsetnum \colnum
836       \ifnum \colnum>\z@
837         \bitor\currtype\deferlist

```

```

837 %<*trace>
838         \tr@ce{deferlist: \@deferlist: }%
839             \tr@ce{addtocurcol-before)}%
840         \if@test
841             \tr@ce{type already on list: defer (addtocurcol)}%
842         \else
843             \tr@ce{botlist: \@botlist: (addtocurcol-before)}%
844             \if@test
845                 \tr@ce{type already on list: bot---sent to }%
846                     \tr@ce{addtobot}%
847             \else
848                 \tr@ce{fpstype \ifodd \tempcnta OK \else not }%
849                     \fi
850                     here: \the \fpstype}%
851             \ifodd \count\currbox
852                 \advance \reqcolroom \intextsep
853                 \ifdim \colroom\reqcolroom
854                     \global \advance \colnum \m@ne
855                     \global \advance \textfloatsheight }%
856                     \ht\currbox
857             \global \advance \textfloatsheight }%
858                 \intextsep
859             \cons \midlist \currbox
860             \tr@ce{***Success: here}%
861             \tr@ce{textfloatsheight (after-here) = }%
862                 \the \textfloatsheight}%
863             \tr@ce{colnum (after-here) = \the \colnum}%
864
865         \if@nobreak
866             \nobreak
867             \nobreakfalse
868             \everypar{}%
869         \else
870             \addpenalty \interlinepenalty
871             \fi
872             \vskip \intextsep
873             \box\currbox
874             \penalty\interlinepenalty
875             \vskip\intextsep
876             \ifnum\outputpenalty <- \Mii \vskip }%
877                 \parskip\fi

```

```

884          \outputpenalty \z@
885          \@inserttrue
886 %<*trace>
887          \else
888          \tr@ce{Fail---no room at 2nd test of colroom
889          (addtocorcol )
890          (\string\intextsep)}%
890 %</trace>
891          \fi
892          \fi
893          \if@insert
894          \else
895 %<*2ekernel|autoload|fltrace>
896 %<*trace>
897          \tr@ce{not here: sent to addtotoporbot}%
898 %</trace>
899          \@addtotoporbot
900 %</2ekernel|autoload|fltrace>
901 %<!2ekernel&!autoload&!fltrace>
902 %<*trace>
903          \tr@ce{not here: sent to addtobot}%
904 %</trace>
905          \@addtobot
906 %<!2ekernel&!autoload&!fltrace>
907          \fi
908          \fi
909          \fi
910 %<*trace>
911          \else
912          \tr@ce{Fail: colnum = \the \colnum:
913          fpstype \the \fpstype=ORD?}%
914          \ifnum \fpstype<\sixt@n
915          \tr@ce{ERROR: BANG float not successful }
916          (addtocurcol)}%
916          \fi
917 %</trace>
918          \fi
919 %<*trace>
920          \else
921          \tr@ce{Fail---no room: fl box ht: \the \ht \currbox
922          (addtocurcol)}%
923 %</trace>
924          \fi
925          \fi
926          \fi
927          \if@insert
928          \else
929          \@resethfps
930 %<*trace>
931          \tr@ce{put on deferlist (addtocurcol)}%
932 %</trace>
933          \@cons\@deferlist\currbox
934 %<*trace>
935          \tr@ce{deferlist: \@deferlist: (addtocurcol-after)}%

```

```

936 %</trace>
937     \fi
938 }
939 %<2ekernel|autoload|fltrace|flafter>

    \@addtonextcol

940 %<*2ekernel|autoload|fltrace>
941 \def\@addtonextcol{%
942     \begingroup
943 %<*trace>
944     \tr@ce{***Start addtonextcol}%
945 %</trace>
946     \@insertfalse
947     \@setfloattypecounts
948     \ifnum \@fpstype=8
949 %<*trace>
950     \tr@ce{fpstype not curcol: \the \@fpstype = 8?}%
951 %</trace>
952     \else
953     \ifnum \@fpstype=24
954 %<*trace>
955     \tr@ce{fpstype not curcol: \the \@fpstype = 24?}%
956 %</trace>
957     \else
958     \@flsettextmin
959 %<*trace>
960     \tr@ce{text-so-far: Opt (top of col)}%
961 %</trace>
962     \@reqcolroom \ht\@currbox
963 %<*trace>
964     \tr@ce{float size: \the \@reqcolroom (addtonextcol)}%
965 %</trace>
966     \advance \@reqcolroom \@textmin
967 %<*trace>
968     \tr@ce{colroom = \the \@colroom (addtonextcol)}%
969     \tr@ce{reqcolroom = \the \@reqcolroom (addtonextcol)}%
970 %</trace>
971     \ifdim \@colroom>\@reqcolroom
972     \@flsetnum \@colnum
973     \ifnum@\colnum>\z@
974     \@bitor@\currtype@\deferlist
975 %<*trace>
976     \tr@ce{deferlist: \@deferlist: }%
977     \left( addtonextcol-before \right)%
978 %</trace>
979 %<*trace>
980     \tr@ce{type already on list: defer }%
981     \left( addtonextcol \right)%
982 %</trace>
983 %<*trace>
984     \tr@ce{sent to addtotoporbot (addtonextcol)}%

```

```

985 %</trace>
986           \addtotoporbot
987       \fi
988   \fi
989 %<*trace>
990   \else
991     \tr@ce{Fail---no room: fl box ht: \the \ht \currbox
992                           (addtonextcol)}%
993 %</trace>
994   \fi
995   \fi
996   \fi
997   \if@insert
998   \else
999 %<*trace>
1000   \tr@ce{put back on deferlist (addtonextcol)}%
1001 %</trace>
1002   \@cons\@deferlist\currbox
1003 %<*trace>
1004   \tr@ce{deferlist: \@deferlist: (addtonextcol-after)}%
1005 %</trace>
1006   \fi
1007 %<*trace>
1008   \tr@ce{End of addtonextcol -- locally counts:}%
1009   \tr@ce{ col: \the \colnum. top: \the \topnum. bot: \the \botnum.}%
1010 %</trace>
1011   \endgroup
1012 %<*trace>
1013   \tr@ce{End of addtonextcol -- globally counts:}%
1014   \tr@ce{col: \the \colnum. top: \the \topnum. bot: \the \botnum.}%
1015 %</trace>
1016 }

1017 \def\@addtobblcol{%
1018   \begingroup
1019 %<*trace>
1020   \tr@ce{***Start addtobblcol}%
1021 %</trace>
1022   \insertfalse
1023   \setfloattypecounts
1024   \getfpsbit \tw@
1025 %<*trace>
1026   \tr@ce{fpstype \ifodd \tempcnta OK \else not \fi dbltop:
1027                           \the \efpsstyle}%
1028 %</trace>
1029   \ifodd\tempcnta
1030     \flsetnum \dbltopnum
1031     \ifnum \dbltopnum>\z@
1032       \tempswafalse
1033       \ifdim \dbltoproom>\ht\currbox
1034         \tempswatrue
1035 %<*trace>

```

```

1036           \tr@ce{Space OK: \@dbltoproom =
1037                   \the \@dbltoproom > \the \ht \currbox
1038   (\dbltoproom)}%
1039 %</trace>
1040         \else
1041 %<*trace>
1042     \tr@ce{fpstype: \the \@fpstype (addtoblc)}%
1043 %</trace>
1044     \ifnum \@fpstype<\sixt@n
1045 %<*trace>
1046         \tr@ce{BANG float ignoring \@dbltoproom}%
1047         \tr@ce{\@spaces \@dbltoproom = \the \@dbltoproom.
1048                           Ht float: \the \ht \currbox-BANG}%
1049 %</trace>
1050         \advance \@dbltoproom \textmin
1051 %<*trace>
1052     \tr@ce{Local value of texmin: \the\textmin}%
1053     \tr@ce{\@spaces space on page = \the \@dbltoproom.
1054                           Ht float: \the \ht \currbox-BANG}%
1055 %</trace>
1056     \ifdim \@dbltoproom>\ht\currbox
1057         \tempswatru
1058 %<*trace>
1059     \tr@ce{Space OK BANG: space on page = \the \ht \dbltoproom >
1060                           \the \ht \currbox}%
1061     \else
1062         \tr@ce{fpstype: \the \@fpstype}%
1063         \tr@ce{Fail---no room dbltoproom-BANG?:}%
1064         \tr@ce{\@spaces space on page = \the \@dbltoproom.
1065                           Ht float: \the \ht \currbox}%
1066 %</trace>
1067     \fi
1068     \advance \@dbltoproom -\textmin
1069 %<*trace>
1070     \else
1071         \tr@ce{fpstype: \the \@fpstype}%
1072         \tr@ce{Fail---no room dbltoproom-ORD?:}%
1073         \tr@ce{\@spaces \@dbltoproom = \the \@dbltoproom.
1074                           Ht float: \the \ht \currbox}%
1075 %</trace>
1076     \fi
1077     \fi
1078     \if@tempswa
1079         \bitor \currtype \dbldeferlist
1080 %<*trace>
1081     \tr@ce{dbldeferlist: \dbldeferlist: (before)}%
1082 %</trace>
1083     \if@test
1084 %<*trace>
1085         \tr@ce{type already on list: dbldefer}%
1086 %</trace>
1087     \else

```

```

1088      \atempdima -\ht\@currbox
1089      \advance\atempdima
1090      -\ifx \dbltoplist\empty \dbltextfloatsep \else
1091          \dblfloatsep \fi
1092      \global \advance \dbltoproom \atempdima
1093      \global \advance \colht \atempdima
1094      \global \advance \dbltopnum \m@ne
1095      \cons \dbltoplist \@currbox
1096 %<*trace>
1097     \tr@ce{dbltopnum (after) = \the \dbltopnum}%
1098     \tr@ce{***Success: dbltop}%
1099 %</trace>
1100     \inserttrue
1101     \fi
1102     \fi
1103 %<*trace>
1104     \else
1105     \tr@ce{Fail: dbltopnum = \the \dbltopnum: fpstype
1106                           \the \c@fpstype=ORD?}%
1107     \ifnum \fpstype<\sixt@n
1108         \tr@ce{ERROR: !t float not successful (addtodblcol)}%
1109     \fi
1110 %</trace>
1111     \fi
1112     \fi
1113     \if@insert
1114     \else
1115 %<*trace>
1116     \tr@ce{put on dbldeferlist}%
1117 %</trace>
1118     \cons\@dbldeferlist\@currbox
1119 %<*trace>
1120     \tr@ce{dbldeferlist: \@dbldeferlist: (after)}%
1121 %</trace>
1122     \fi
1123 %<*trace>
1124     \tr@ce{End of addtobdblcol -- locally count:}%
1125     \tr@ce{ dbltop: \the \dbltopnum.}%
1126 %</trace>
1127     \endgroup
1128 %<*trace>
1129     \tr@ce{End of addtobdblcol -- globally count:}%
1130     \tr@ce{ dbltop: \the \dbltopnum.}%
1131 %</trace>
1132 }
1133 %</2ekernel|autoload|fltrace>

    \addmarginpar
    Defining the marginpar placement function

1134 %<*2ekernel|autoload>

```

```

1135 \def\@addmarginpar{\@next\@marbox\@currlist{\@cons\@freelist\@marbox
1136   \@cons\@freelist\@currbox}\@latexbug\@tempcnta\@ne
1137   \if@twocolumn
1138     \if@firstcolumn \atempcnta\m@ne \fi
1139   \else
1140     \if@mparswitch
1141       \ifodd\c@page \else\atempcnta\m@ne \fi
1142     \fi
1143     \if@reversemargin \atempcnta -\atempcnta \fi
1144   \fi
1145   \ifnum\atempcnta <\z@ 
1146     \global\setbox\@marbox\box\@currbox \fi
1147   \atempdima\@mparbottom
1148   \advance\atempdima -\pageht
1149   \advance\atempdima\ht\@marbox
1150   \ifdim\atempdima >\z@
1151     \atex@warning{no@line {Marginpar on page }%
1152     \the\page\space moved}%
1153   \else
1154     \atempdima\z@
1155   \fi
1156   \global\@mparbottom\@pageht
1157   \global\advance\@mparbottom\@tempdima
1158   \global\advance\@mparbottom\dp\@marbox
1159   \global\advance\@mparbottom\marginparpush
1160   \advance\atempdima -\ht\@marbox

```

Putting box movement inside the ‘marbox’:

```

1159   \global\setbox \@marbox
1160     \vbox {\vskip \atempdima
1161       \box \@marbox}%
1162   \global \ht\@marbox \z@
1163   \global \dp\@marbox \z@

1164   \kern -\pagedp
1165   \nointerlineskip
1166   \hb@xt@\columnwidth
1167   {\ifnum \atempcnta >\z@
1168     \hskip\columnwidth \hskip\marginparsep
1169   \else
1170     \hskip -\marginparsep \hskip -\marginparwidth
1171   \fi
1172   \box\@marbox \hss}%

1173   \nointerlineskip
1174   \hbox{\vrule \height\z@ \width\z@ \depth\pagedp}}
1175 %</2ekernel|autoload>

```

### 39.17.1 Kludgeins

This part of the file is part of the implementation of the following two new commands for L<sup>A</sup>T<sub>E</sub>X2e.

```
\enlargethispage{<dim>}
```

Adds `<dim>` to the height of the current column only. On the printed page the bottom of this column is extended downwards by exactly `<dim>` without having any effect on the placement of the footer; this may result in an overprinting.

```
\enlargethispage{<dim>}
```

Similar to `\enlargethispage` but it tries to squeeze the column to be printed in as small a space as possible, ie it uses any shrinkability in the column. If the column was not explicitly broken (*e.g.* with `\pagebreak`) this may result in an overfull box message but except for this it will come out as expected (if you know what to expect).

The star form of this command is dedicated to Leslie Lamport, the other we need for ourselves (FMi, CAR).

These commands may well have unwanted effects if used soon before a `\clearpage`: please give them clear of such places.

### \@kludgeins

The insert which makes TeX do a lot of the necessary work. All we need to put into it is the amount by which the pagegoal should be changed.

```
1176 %<*2ekernel|def1>
1177 \newinsert \@kludgeins
1178 \global\dimen@\@kludgeins \maxdimen
1179 \global\count@\@kludgeins 1000
1180 %</2ekernel|def1>

1181 %<*2ekernel|def1>
1182 \gdef \enlargethispage {%
1183   \@ifstar
1184   {%
1185     %<*trace>
1186     \tr@ce{Enlarging page height * }%
1187   %</trace>
1188   \enlargepage{\hbox{\kern\p@}}%
1189   {%
1190     %<*trace>
1191     \tr@ce{Enlarging page height exactly---}%
1192   %</trace>
1193   \enlargepage{\empty}%
1194 }
1195 %</2ekernel|def1>
1196 %<*autoload>
1197 \def\enlargethispage{\@autoload{out1}\enlargethispage}
1198 %</autoload>

1199 %<*2ekernel|def1>
1200 \gdef\enlargepage#1#2{%
1201   %<*trace>
1202   \tr@ce{@spaces@spaces by #2}%
1203   %</trace>
1204   \tempskipa#2\relax
1205   \ifdim \tempskipa.5\maxdimen
1206     \latexerr{Suggested space extra space height\space}
```

```

1207          (\the\@tempskipa)\space dangerously\space
1208          large}\@eha
1209      \else
1210          \ifdim \vsize<.5\maxdimen
1211 %<*trace>
1212          \tr@ce {Kludgeins added--pagegoal before: }%
1213          \the\pagegoal}%
1214      \@bsphack
1215          \insert\@kludgeins{\#1\vskip-\@tempskipa}%
1216      \@esphack
1217 %<*trace>
1218      \ifvmode \par
1219          \tr@ce {Kludgeins added--pagegoal after: \the }%
1220          \pagegoal}%
1221      \fi
1222 %</trace>
1223      \else
1224          \@latexerr{Page\space height\space already\space
1225          too\space large}\@eha
1226      \fi
1227 }
1228 %</2ekernel|def1>

```

## 39.18 Float control

This part implements controllable floats and other changes to the float mechanism.

It provides, at the document level, the following command for inclusion in L<sup>A</sup>T<sub>E</sub>X2e.

```

1229 %<*trace>
1230 \def \@tracemessage #1{\typeout{LaTeX2e: #1}}
1231 \def \tracefloats{\let \tr@ce \@tracemessage}
1232 \def \notrace {\let \tr@ce \@gobble}
1233 \notrace
1234 \def \@traceval #1{\tr@ce{\string #1 = \the #1}}
1235 \def \tracefloatvals{%
1236     \@dblfloatplacement
1237     \@floatplacement
1238     \@traceval\@colnum
1239     \@traceval\@colroom
1240     \@traceval\@topnum
1241     \@traceval\@toproom
1242     \@traceval\@botnum
1243     \@traceval\@botroom
1244     \@traceval\@fpmin
1245     \tr@ce{\string\textfraction = \textfraction}%
1246     \@traceval\@dbltopnum
1247     \@traceval\@dbltoproom
1248 }
1249 %</trace>

```

```
1250 %<*flafter>
1251 \providedeclaration\tr@ce[1]{}
1252 %</flafter>
```

### \suppressfloats

#### \@flstop

Float suppression commands: these set the relevant counter globally to zero. Thus they are overridden for a particular float by an ! specifier.

```
1253 \def \suppressfloats {%
1254   \@ifnextchar [%
1255     \@flstop
1256     {\global \@colnum \z@}%
1257 }
```

Maybe this should be a loop over #1?

```
1258 \def \@flstop [#1]{%
1259   \if t#1%
1260     \global \@topnum \z@
1261   \fi
1262   \if b#1%
1263     \global \@botnum \z@
1264   \fi
1265 }
```

Manipulation of float placement and type; both their strings and the corresponding count registers.

### \@fpstype

### \@reqcolroom

### \@textfloatsheight

First a new count register to go with \currtype.

Then a new skip register, for information needed to remove the \@maxsep conservatism: it is possible that this could use a temporary register.

Finally a dimension register to hold the total height of in-text floats on the current page. This is needed to implement a major change in the functionality of \addtocurcol which is, nevertheless, a bug fix. It is not local and therefore cannot be a temporary register.

```
1266 \@newcount \@fpstype
1267 \@newdimen \@reqcolroom
1268 \@newdimen \@textfloatsheight

1269 %<*2ekernel|autoload|fltrace>
1270 \def \@fpsadddefault {%
1271 %<*trace>
1272   \tr@ce{fps changed from: \@fps}%
1273 %</trace>
1274   \edef \@fps {\@fps\csname fps@\@captop\endcsname}%
}
```

```

1275   \@latex@warning {%
1276     No positions in optional float specifier.\MessageBreak
1277     Default added (so using '\@fps')}%
1278 }

1279 \def \@setfloattypecounts {%
1280   \@currtype \count@\currbox
1281   \@fpstype \count@\currbox
1282   \divide \@currtype\@xxxii \multiply \@currtype\@xxxii
1283   \advance \@fpstype -\@currtype
1284 %<*trace>
1285   \tr@ce{(\mod 32) fpstype: \the \@fpstype}%
1286   \tr@ce{(mult of 32) currtype: \the \@currtype}%
1287 % Tracing only: but some should be changed into real
% errors/warnings?
1288   \ifnum \@fpstype<\sixt@n
1289     \ifnum \@fpstype=\z@
1290       \tr@ce{ERROR: no PLACEMENT, fpstype = \the \@fpstype = 2
%0?}%
1291     \fi
1292     \ifnum \@fpstype=\@ne
1293       \tr@ce{WARNING: only h, fpstype = \the \@fpstype = 1?}%
1294     \fi
1295     \tr@ce{BANG float}%
1296   \else
1297     \ifnum \@fpstype=\sixt@n
1298       \tr@ce{ERROR: no PLACEMENT, fpstype = \the \@fpstype = 2
%16?}%
1299     \fi
1300     \ifnum \@fpstype=17
1301       \tr@ce{WARNING: only h, fpstype = \the \@fpstype = 17?}%
1302     \fi
1303     \tr@ce{ORD float}%
1304   \fi
1305 %</trace>
1306 }

```

Macros for getting, testing and setting bits of the fps.

### \@getfpsbit

Sets \@tempcnta to required bit of \count@\currbox.

```

1307 \def \@getfpsbit {%
1308   \@boxfpsbit \currbox
1309 }

```

### \@boxfpsbit

Used above.

```

1310 \def \@boxfpsbit #1#2{%
1311   \@tempcnta \count#1%
1312   \divide \@tempcnta #2\relax
1313 }

```

### \@testfp

New definition of the float page test.

```

1314 \def \@testfp #1{%
1315   \@boxfpsbit #18\relax % Really '#1 8' for human readers!
1316   \ifodd \@tempcnta
1317   \else
1318     \@testtrue
1319   \fi
1320 }

```

### \@setfpsbit

Sets required bit of \@tempcnta (to 1). <sup>4</sup>. This is used earlier by the @float command to set the bitset of a particular float.

```

1321 \def \@setfpsbit #1{%
1322   \@tempcntb \@tempcnta
1323   \divide \@tempcntb #1\relax
1324   \ifodd \@tempcntb
1325   \else
1326     \advance \@tempcnta #1\relax
1327   \fi
1328 }

```

### \@resethfps

Globally adds t as a possible location for an h or !h only placement: this must be done using the count.

Although it will leave \@fpstype set to 17 even if it was originally 1, this does not matter since it is the last thing in \@addtocurcol.

```

1329 \def \@resethfps {%
1330   \let\reserved@a\empty
1331   \ifnum \@fpstype=\@ne
1332     \def \reserved@a {!}%
1333     \@fpstype 17
1334   \fi
1335   \ifnum \@fpstype=17
1336     \global \advance \count@\currbox \tw@
1337     \@latex@warning@no@line {%
1338       '\reserved@a h' float specifier changed to %
1339       '\reserved@a ht'}%
1340   \fi
1341 }

```

Special stuff for BANG floats.

### \@flsetnum

Ignores any zero float counter value in case BANG.

It uses a local assignment to the normally global counter: a bit naughty, perhaps?

These assignments are safe so long as the counter involved is only consulted once (*i.e.* only for the ‘bang float’) with the changed value. This is the case within \@addtocurcol because it is used only once within a call of the output routine (which forms a group).

---

<sup>4</sup>v1.of,1993/12/05,Command added.

For `\@addtonextcol` this is achieved by putting a group around its code; this is needed because it is called (by `\@startcolumn`) for each float which was on the deferlist. Almost identical considerations pertain to `\@addtobblcol`. There may be more efficient ways to handle this, but the group seems to be the simplest.

```

1341 \def \@flsetnum #1{%
1342 %<*trace>
1343   \tr@ce{fpstype: \the \@fpstype (flsetnum \string#1)}%
1344 %</trace>
1345   \ifnum \@fpstype<\sixt@n
1346     \ifnum #1=\z@
1347 %<*trace>
1348   \tr@ce{BANG float resetting \string#1 to 1}%
1349 %</trace>
1350   #1\@ne
1351   \fi
1352   \fi
1353 %<*trace>
1354   \tr@ce{\#1 (before) = \the #1}%
1355 %</trace>
1356 }

```

### `\@flsettextmin`

This ignores `\textfraction` space restriction in case BANG.

```

1357 \def \@flsettextmin {%
1358 %<*trace>
1359   \tr@ce{fpstype: \the \@fpstype (flsettextmin)}%
1360 %</trace>
1361   \ifnum \@fpstype<\sixt@n
1362 %<*trace>
1363   \tr@ce{BANG ignoring textmin}%
1364 %</trace>
1365   \@textmin \z@
1366   \else
1367   \@textmin \textfraction\@colht
1368 %<*trace>
1369   \tr@ce{ORD textmin = \the \@textmin}%
1370 %</trace>
1371   \fi
1372 }

```

### `\@flcheckspace`

This ignores space restriction in case BANG; this is still slightly conservative since it does not allow for the fact that, if there is no text in the column then `\textfloatsep` is not needed. Sets `@tempswa` true if there is room for `\currbox`.

```

1373 \def \@flcheckspace #1#2{%
1374   \advance \@reqcolroom
1375   \ifx #2\empty \textfloatsep \else \floatsep \fi
1376 %<*trace>

```

```

1377      \tr@ce{colroom = \the \@colroom (flcheckspace \string#1 )
1378          \string#2)}%
1379      \tr@ce{reqcolroom = \the \@reqcolroom
1380          (flcheckspace \string#1 )
1381          \string#2)}%
1380 %</trace>
1381      \ifdim \@colroom>\@reqcolroom
1382          \ifdim #1>\ht\@currbox
1383              \tempswattrue
1384 %<*trace>
1385          \tr@ce{Space OK: #1 = \the #1 > \the \ht \@currbox
1386              (flcheckspace \string#1 )
1387              \string#2)}%
1387 %</trace>
1388      \else
1389 %<*trace>
1390      \tr@ce{fpstype: \the \@fpstype
1391          (flcheckspace \string#1 )
1392          \string#2)}%
1392 %</trace>
1393      \ifnum \@fpstype<\sixt@n
1394 %<*trace>
1395          \tr@ce{BANG float ignoring #1
1396              (flcheckspace \string#1 )
1397                  \string#2):}%
1397          \tr@ce{\@spaces #1 = \the #1. Ht float: \the \ht }
1398              \@currbox
1399 %</trace>
1400          \tempswattrue
1401 %<*trace>
1402          \else
1403              \tr@ce{Fail---no room (flcheckspace \string#1 )
1404                  \string#2)
1405                      (fpstype \the \@fpstype=ORD?):}%
1405          \tr@ce{\@spaces #1 = \the #1. Ht float: \the \ht }
1406              \@currbox
1407 %</trace>
1408          \fi
1409      \fi
1410 %<*trace>
1411      \else
1412          \tr@ce{Fail---no room at 2nd test of colroom
1413              (flcheckspace \string#1 \string#2)}%
1414 %</trace>
1415      \fi
1416  }

```

### {@flupdates}

This updates everything when a float is placed.

```

1417 \def \@flupdates #1#2#3{%
1418     \global \advance #1\m@ne

```

```

1419   \global \advance \colnum \m@ne
1420   \@tempdima -\ht\currbox
1421   \advance \tempdima
1422     -\ifx #3\empty \textfloatsep \else \floatsep \fi
1423   \global \advance #2\@tempdima
1424   \global \advance \colroom \@tempdima
1425   \@cons #3\currbox
1426 }

```

Interesting facts about float mechanisms past and present, together with a summary of various features, some unresolved:

1. The value **\textfraction** does not affect the processing of doublecol floats: this seems sensible, but should be documented.
2. **\twocolumn** floatplacement was wrong: dbl not needed, ord needed.
3. **\@floatplacement** was not called after **\@startdblcol** or **\@topnewpage**. This has been changed; it is clearly a bug fix.
4. The use **\@topnewpage** when **\dblfigrule** is non-trivial produced a rule in the wrong place. This has been fixed by not using **\dblfigrule** when processing the ‘float’ from **\@topnewpage**.
5. If the specifier was just h and the float could not be put here, it went on the deferlist and stayed there until a clearpage. It now gets changed to a ‘th’: this is only an error-recovery action, putting just h or !h should be deprecated.
6. **\@dblmaxsep** was ‘the maximum of **\dblfloatsep** and **\dbltexfloatsep**’. But it was never used! Now gone completely, like **\@maxsep**.
7. After an h float is put on a page, it was counted as text when applying the **\textfraction** test; this is possibly too big a change although it is a bug fix?
8. Two consecutive h floats are separated by twice **\intextsep**: this could be changed to one by use of **\addvspace**, OK? Note that it would also mean that less space is put in if an h float immediately follows other spaces. This is also possibly too big a change, at least for compatibility mode? Or it may be simply wrong! It has not been changed.
9. Now **\@addtocurcol** checks first for just p fps. I think that this is an increase in efficiency, but maybe the coding should be made even more efficient.
10. **\@tryfcolumn** now tests if the list is empty first, otherwise lots of wasted time! Thus this test has been removed from **\@startcolumn**. As Frank pointed out, this makes **\@startcolumn** less efficient. But it is now the same as **\@startdblcolumn**: I can see no reason why they should be different, but which is best?
11. Why is **\@colroom** set in **\@doclearpage**?

12. Should `\@maxdepth` store the setting of `\maxdepth` from `lplain`? Or should we provide a proper interface to class files for setting these?

```

1427 \def\@makefcolumn #1{%
1428   \begingroup
1429     \@fpmmin \z@
1430     \let \@testfp \@gobble
1431     \@tryfcolumn #1%
1432   \endgroup
1433 }

```

This will line up the last baselines in the two columns provided they are constructed in the normal way: *i.e.* ending in a skip of minus the original depth, with `\@textbottom` adding nothing.

Thus again it is essential for `\@textbottom` to have depth opt.<sup>5</sup>

```

1434 \def\@outputdblcol{%
1435   \if@firstcolumn
1436     \global \firstcolumnfalse
1437     \global \setbox\@leftcolumn \box\@outputbox
1438 %<*trace>
1439   \tr@ce{PAGE: first column boxed}%
1440 %</trace>
1441   \else
1442     \global \firstcolumntrue
1443     \setbox\@outputbox \vbox {%
1444       \hb@xt@\textwidth {%
1445         \hb@xt@\columnwidth {%
1446           \box\@leftcolumn \hss}%
1447           \hfil
1448           {\normalcolor\vrule \vphantom{A}%
1449             \hbox{\rule{\@width}{\columnseprule}}%
1450           \hfil
1451           \hb@xt@\columnwidth {%
1452             \box\@outputbox \hss}%
1453           }%
1454 }%
1455 %<*trace>
1456   \tr@ce{PAGE: second column also boxed}%
1457 %</trace>
1458   \combinedblfloats
1459 %<*trace>
1460   \tr@ce{PAGE: two column page completed}%
1461 %</trace>
1462   \begingroup
1463     @dblfloatplacement
1464     @startdblcolumn
1465     @whilesw@if@fcollmade \fi
1466     {\outputpage
1467 %<*trace>
1468   \tr@ce{PAGE: double float page completed}%
1469 %</trace>

```

---

<sup>5</sup>1.2g 2000/07/12 Ensure that rule is in `\normalcolor`

```

1470     \@startdblcolumn}%
1471     \endgroup
1472   \fi
1473 }

```

### 39.18.00 Float placement parameters

The main purpose of this section is to ensure that all the float-placement parameters which need to be set in a class file or package have been declared. It also describes their use and sets values for them which are reasonable for typical documents using US letter or A4 sized paper. Unlike many other parameters that L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub>  leaves to be determined by the classes default values are entered here.

#### 39.18.00 Limits for the placement of floating objects

##### \c@topnumber

This counter holds the maximum number of floats that can appear at the top of a text page or column.

```

1475 \newcount\c@topnumber
1476 \setcounter{topnumber}{2}

```

##### \topfraction

This macro holds the maximum proportion (as a decimal number) of a text page or column that can be occupied by floats at the top. In the **phd** package, we set this as **.85**. Many of the images we use are quite high and a value of **.85** is more appropriate.

```
1477 \newcommand\topfraction{.7}
```

##### \c@bottomnumber

This counter holds the maximum number of floats that can appear at the bottom of a text page or column. Lamport's value to allow only one is reasonable for many publications, but fails in many others. In the **phd** package we allowed a much larger number as we are aiming for more compact documents.

```

1478 \newcount\c@bottomnumber
1479 \setcounter{bottomnumber}{1}

```

##### \bottomfraction

This macro holds the maximum proportion (as a decimal number) of a text page or column that can be occupied by floats at the bottom.

```
1480 \newcommand\bottomfraction{.3}
```

##### \c@totalnumber

This counter holds the maximum number of floats that can appear on any text page or column.

```
1481 \newcount\c@totalnumber
1482 \setcounter{totalnumber}{3}
```

### \textfraction

This macro holds the minimum proportion (as a decimal number) of a text page or column that must be occupied by text.

```
1483 \newcommand\textfraction{.2}
```

### \floatpagefraction

This macro holds the minimum proportion (as a decimal number) of a page or column that must be occupied by floating objects before a ‘float page’ is produced.

```
1484 \newcommand\floatpagefraction{.5}
```

### \c@dbltopnumber

This counter holds the maximum number of double-column floats that can appear on the top of a two-column text page.

```
1485 \newcount\c@dbltopnumber
1486 \setcounter{dbltopnumber}{2}
```

### \dbltopfraction

This macro holds the maximum proportion (as a decimal number) of a two-column text page that can be occupied by double-column floats at the top.

```
1487 \newcommand\dbltopfraction{.7}
```

### \dblfloatpagefraction

This macro holds the minimum proportion (as a decimal number) of a page that must be occupied by double-column floating objects before a ‘double-column float’ is produced.

```
1488 \newcommand\dblfloatpagefraction{.5}
```

## 39.18.1 Floats on a text page

### \floatsep

### \textfloatsep

### \intextsep

When a floating object is placed on a page with text, these parameters control the separation between the float and the other objects on the page. These parameters are used for both one-column mode and single-column floats in two-column mode. They are all rubber lengths.

\floatsep is the space between adjacent floats that are placed at the top or bottom of the text page or column.

\textfloatsep is the space between the main text and floats at the top or bottom of the page or column.

\intextsep is the space between in-text floats and the text.

```

1489 \newskip\floatsep
1490 \newskip\textfloatsep
1491 \newskip\intextsep
1492 \setlength\floatsep {12\p@ \oplus 2\p@ \minus 2\p@}
1493 \setlength\textfloatsep{20\p@ \oplus 2\p@ \minus 4\p@}
1494 \setlength\intextsep {12\p@ \oplus 2\p@ \minus 2\p@}

```

### \dblfloatsep

#### \dbltextfloatsep

When double-column floats (floating objects that span the whole `\textwidth`) are placed at the top of a text page in two-column mode, the separation between the float and the text is controlled by `\dblfloatsep` and `\dbltextfloatsep`. They are rubber lengths. `\dblfloatsep` is the space between adjacent double-column floats placed at the top of the text page.

`\dbltextfloatsep` is the space between the main text and double-column floats at the top of the page.

```

1495 \newskip\dblfloatsep
1496 \newskip\dbltextfloatsep
1497 \setlength\dblfloatsep {12\p@ \oplus 2\p@ \minus 2\p@}
1498 \setlength\dbltextfloatsep{20\p@ \oplus 2\p@ \minus 4\p@}

```

## 39.18.2 Floats on their own page or column

When floating objects are placed on a separate page or column this is called a ‘float page’, the layout of the page is controlled by these parameters, which are rubber lengths.

### \@fptop

#### \@fpsep

#### \@fpbot

At the top of the page `\@fptop` is inserted; typically this supplies some stretchable whitespace. At the bottom of the page `\@fpbot` is inserted. Between adjacent floats `\@fpsep` is inserted.

These parameters are used for all floating objects on a ‘float page’ in one-column mode, and for single-column floats in two-column mode.

Note that at least one of the two parameters `\@fptop` and `\@fpbot` should contain a `plus ... fil` so as to fill the remaining empty space.

```

1499 \newskip@\fptop
1500 \newskip@\fpsep
1501 \newskip@\fpbot
1502 \setlength@\fptop{0\p@ \oplus 1fil}
1503 \setlength@\fpsep{8\p@ \oplus 2fil}
1504 \setlength@\fpbot{0\p@ \oplus 1fil}

```

```

\@dblftop
1505   \newskip\@dblftop

\@dblfpsep

\@dblfpbot
Double-column ‘float pages’ in two-column mode use similar parameters.

1506
1507 \newskip\@dblfpsep
1508 \newskip\@dblfpbot
1509 \setlength{\@dblftop}{0\p@ \oplus 1fil}
1510 \setlength{\@dblfpsep}{8\p@ \oplus 2fil}
1511 \setlength{\@dblfpbot}{0\p@ \oplus 1fil}

\topfigrule
\botfigrule
\dblfigrule

The macros can be used to put in rules between floats and text; whatever
they insert should be vertical mode material which takes up zero space.

1512 \let\topfigrule=\relax
1513 \let\botfigrule=\relax
1514 \let\dblfigrule=\relax

```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

First there was one user and I took a lot of time to satisfy myself. Then I had 10 users, and a whole new level of difficulties arose. Then I had a hundred users and another level of things happened. I had a thousand users, I had ten thousand each of those were special phases in the development, important. I couldn't have gone with ten thousand until I'd done it with a thousand. But each time a new wave of changes came along, the idea was to have TeX get better, and not get more diverse as it needed to handle new things.

Donald Knuth

## 40.1 Introduction

To *make* a book is an interesting and somewhat involved process<sup>1</sup>. The text is set in type and printed on pages, the pages are gathered and folded into signatures and these are gathered and folded into signatures and these are then bound and covered. Many of the aspects of this process that has passed down to us by previous generations is discussed extensively in other sections of this book. Class authors have to distill this knowledge in a set of typographical rules to be described in a class file. The first thing such an author must do is to describe the *rationale* of developing such a class. The **octavo**<sup>2</sup> class was developed to enable printing books in dimensions that follow traditional styles. The<sup>3</sup> class to offer a flexible system on which other classes could be based and so does<sup>4</sup>. The **tufte-book** and **tufte-handout** classes to provide a style that resembles those found in Tufte books. Many Universities offer *Thesis* classes to standardize the way these are produced. Many of these Universities, translated the styles previously typed and the results are a typographical disaster, only mitigated by the ability to display beautiful mathematics. As these are printed on standard *photocopy paper* one cannot do much with the layout.

## 40.2 What is a class?

A class is simply a file with the extension `cls` containing a set of macros. A class can load another class.

## 40.3 Identifying your class

The first thing a class must do is to identify any other formats it needs and to announce its name. This is accomplished using the two commands `\NeedsTeXFormat`<sup>→ P. 543</sup> and `\ProvidesClass`<sup>→ P. 539</sup>.

The following example, declares the version of  $\text{\LaTeX} 2_{\varepsilon}$  that it requires and then gives the class name. It can be found in the preable of most well written classes. You should also put some remarks to identify you as the author, the

---

<sup>1</sup>**town**.

<sup>2</sup>**octavo**.

<sup>3</sup>**memoir**.

<sup>4</sup>**koma**.

version number and other similar details. These are discussed in more detail in the next Chapter, where you will see how to automate documentation for your class.

```
1515 \NeedsTeXFormat{LaTeX2e}[1994/06/01]
1516 \ProvidesClass{myclass-book}[2010/12/11 v3.5.0 myclass-book]
```

The above syntax must be followed exactly so that this information can be used by `LoadClass` or `documentclass` (for classes) or `\RequirePackage` or `\sepackage` (for packages) to test that the release is not too old. The whole of this *<release - info>* information is displayed by `\listfiles` and should therefore not be too long.

```
1517 % Load the common style elements
1518 \input{myclass-common.def}
```

Another command that can be used is `\ProvidesFile`. This is similar to the two previous commands except that here the fullname, including the extension, must be given. It is used for declaring any files other than main class and package files.

This is useful, if you decide to have your main definitions in a separate file.

## 40.4 Class Options

Before we see in detail how to add options to a class, we need to review a package called `xkeyval`

. Unless you are in the business of re-discovering wheels, this is an absolute must for developing, readable and maintainable code and your class is to provide many options.

```
1519 \usepackage[textcolor=red,font=times]{mypack}
```

Class options are best set by using booleans `\newboolean`.

We first set a new boolean that we `name@myclass@afourpaper`. This is used using the package `ifthen`<sup>5</sup> Then we can `DecalreOptionX` and we set the boolean to default to true. If the user then types

`myclass[a4paper]`

The `a4paper` options will be set. This is a much better and concise way of defining options. `\ewboolean`

```
1520 \newboolean{@myclass@afourpaper}
1521 \DeclareOptionX[myclass]<common>{a4paper}
1522 {
1523   \setboolean{@myclass@afourpaper}
1524   {true}
1525 }
```

Note that the command provide by `ifthen` `\setboolean` takes true or false, as #2, and sets #1 accordingly. In the above code we set the option as true.

It is much easier and most programmers use the `ifthen` package to check for option booleans

```
1526 \ifthenelse{\boolean{@myclass@afourpaper}}
1527   {\geometry{
1528     a4paper,
```

---

<sup>5</sup>The `ifthen` package was developed by David Carlisle, can be downloaded at  
<http://www.ifi.uio.no/it/latex-links/ifthen.pdf>

```

1529     left=24.8mm,
1530     top=27.4mm,
1531     headsep=2\baselineskip,
1532     textwidth=107mm,
1533     marginparsep=8.2mm,
1534     marginparwidth=49.4mm,
1535     textheight=49\baselineskip,
1536     headheight=\baselineskip
1537   }
1538 }
1539 {}

```

## 40.5 Set-up the font sizes

LaTeX does not provide definitions of all the font-sizes. Unless you are extending an existing class, this is one of the first tasks you need to do in your new class.

Normally class authors will define all the commonly defined size commands, such as `\small`, `\ormalsize` and other similar commands.

In the example shown below, we first start by defining the `\ormalsize` font size. In this book the `\normalsize` is defined as 14pt. We also define the vertical spaces that we need to have above display and below display skip. These are all very difficult to remember and once you have something you are happy with, just copy from class to class or even define a small definition file to keep them all together.

Helvetica looks like this and Palatino looks like this.

The user has access to a number of commands which change the size of the font, relative to the ‘main’ size used for the bulk of the text.

These `\size` commands issue a `\setfontsize` command.

```
1540 \setfontsize{font-size}{baselineskip} where:
```

`font-size` The absolute size of the font to use from now on.

`baselineskip` The normal value of `\aselineskip` for the size of the font selected. (The actual value will be

A number of commands, defined in the `\@setfontsize` kernel, shorten the following definitions and are used throughout. These are:

|                       |       |                      |    |                      |      |
|-----------------------|-------|----------------------|----|----------------------|------|
| <code>\@vpt</code>    | 5     | <code>\@vipt</code>  | 6  | <code>\@viipt</code> | 7    |
| <code>\@viiipt</code> | 8     | <code>\@ixpt</code>  | 9  | <code>\@xpt</code>   | 10   |
| <code>\@xipt</code>   | 10.95 | <code>\@xiipt</code> | 12 | <code>\@xivpt</code> | 14.4 |
| ...                   |       |                      |    |                      |      |

### 40.5.1 Setting up the `normalsize`

The user command to obtain the ‘main’ size is `\ormalsize`. `\@setfontsize` uses `\normalsize` when referring to the main size and maintains this value even if `\normalsize` is redefined. The `\normalsize` macro also sets values for `\bovedisplayskip`, `\bovedisplayshortskip` and `\elowdisplayshortskip`.

```

1541 %%
1542 % Set the font sizes and baselines to match Tufte's books
1543 % normalsize
1544 %%
1545 \renewcommand\normalsize{%
1546   \@setfontsize\normalsize\@xpt{14}%
1547   \abovedisplayskip 10\p@ \@plus2\p@ \@minus5\p@
1548   \abovedisplayshortskip \z@ \@plus3\p@
1549   \belowdisplayshortskip 6\p@ \@plus3\p@ \@minus3\p@
1550   \belowdisplayskip \abovedisplayskip
1551   \let\@listi\@listI}
1552
1553 \normalbaselineskip=14pt
1554 \normalsize

1555 \renewcommand\small{%
1556   \@setfontsize\small\@ixpt{12}%
1557   \abovedisplayskip 8.5\p@ \@plus3\p@ \@minus4\p@
1558   \abovedisplayshortskip \z@ \@plus2\p@
1559   \belowdisplayshortskip 4\p@ \@plus2\p@ \@minus2\p@
1560   \def\@listi{\leftmargin\leftmargini
1561     \topsep 4\p@ \@plus2\p@ \@minus2\p@
1562     \parsep 2\p@ \@plus\p@ \@minus\p@
1563     \itemsep \parsep}%
1564   \belowdisplayskip \abovedisplayskip
1565 }
1566 \renewcommand\footnotesize{%
1567   \@setfontsize\footnotesize\@viiipt{10}%
1568   \abovedisplayskip 6\p@ \@plus2\p@ \@minus4\p@
1569   \abovedisplayshortskip \z@ \@plus\p@
1570   \belowdisplayshortskip 3\p@ \@plus\p@ \@minus2\p@
1571   \def\@listi{\leftmargin\leftmargini
1572     \topsep 3\p@ \@plus\p@ \@minus\p@
1573     \parsep 2\p@ \@plus\p@ \@minus\p@
1574     \itemsep \parsep}%
1575   \belowdisplayskip \abovedisplayskip
1576 }
1577 \renewcommand\scriptsize{@setfontsize\scriptsize\@viipt\@viiipt}
1578 \renewcommand\tiny{@setfontsize\tiny\@vpt\@vpt}
1579 \renewcommand\large{@setfontsize\large\@xipt{15}}
1580 \renewcommand\Large{@setfontsize\Large\@xiipt{16}}
1581 \renewcommand\LARGE{@setfontsize\LARGE\@xivpt{18}}
1582 \renewcommand\huge{@setfontsize\huge\@xxpt{30}}
1583 \renewcommand\Huge{@setfontsize\Huge{24}{36}}
1584
1585 %% Define a HUGE for fun
1586 \newcommand\HUGE{@setfontsize\Huge{38}{47}}

```

## 40.6 Adjusting paragraph parameters

The parameters which control TeX's behaviour when typesetting paragraphs receive a bit of a tweak here. Contrary to the usual behaviour of modifying the grid with glue when difficulties are encountered with vertical space, here we shall

try to counteract these tendencies and enforce as much as possible uniformity of the grid of lines.

A good value for paragraph indentation is `\parindent 0.5pt`, for vertical spacing between paragraphs that are indented use `\opt{}`. At this point if you are using any marginals it is a good idea to allow hyphenation with the `ragged2e` package. Since marginals use very narrow paragraphs you may get a very funny looking marginal text. Using the package, adjustments can be made to hyphenate the marginal text.

```

1587 %%
1588 % \RaggedRight allows hyphenation
1589
1590 \RequirePackage{ragged2e}
1591 \setlength{\RaggedRightRightskip}{\z@ plus 0.08\hsize}
1592 \setlength{\RaggedRightParindent}{1pc}
1593
1594 % Paragraph indentation and separation for normal text
1595 \newcommand{\@tufte@reset@par}{%
1596   \setlength{\RaggedRightParindent}{1.0pc}%
1597   \setlength{\parindent}{1pc}%
1598   \setlength{\parskip}{0pt}%
1599 }
1600 \@tufte@reset@par
1601
1602 % Paragraph indentation and separation for marginal >
1603 \newcommand{\@tufte@margin@par}{%
1604   \setlength{\RaggedRightParindent}{0.5pc}%
1605   \setlength{\parindent}{0.5pc}%
1606   \setlength{\parskip}{0pt}%
1607 }
```

## 40.7 Formatting Chapters and Sections

The section on Chapters etc, has more on this, but we will touch on it briefly. Most recent class developers use the `titlesec` and `titletoc` package to handle the complexity of these commands. With the `phd` package this is unnecessary.

```

1608 \titleformat{\subsection}{%
1609   [hang]%
1610   {\normalfont\large}%
1611   {\thesubsection}%
1612   {1em}%
1613   {}%
1614 }
```

These are normally followed by the “titlespacing” commands to define the space around these sections.

```

1615 %% We set the titlespacing using the package titlesec >
    &and titletoc
1616 %
1617 \titlespacing*{\chapter}{0pt}{20pt}{40pt}
1618 \titlespacing*{\section}{0pt}{3.5ex plus 1ex minus }
    {.2ex}{2.3ex plus .2ex}
1619 \titlespacing*{\subsection}{0pt}{3.25ex plus 1ex }
    {minus .2ex}{1.5ex plus .2ex}

```

## 40.8 Adjusting the Index

For classes representing books, the index is treated like a chapter whereas for others it is normally treated like a section. Whatever your document ends up like, indices are best done in a multi-column environment. One possibility is shown below, using the package "multicol".

```

1620 \RequirePackage{multicol}
1621 \renewenvironment{theindex}
1622   {\begin{fullwidth}%
1623     \small%
1624     \ifthenelse{\equal{\@tufte@class}{book}}{%
1625       {\chapter{\indexname}}%
1626       {\section*{\indexname}}%
1627       \parskip0pt%
1628       \parindent0pt%
1629       \let\item@\idxitem%
1630       \begin{multicols}{3}%
1631     }%
1632     {\end{multicols}%
1633   }%
1634   \renewcommand\@idxitem{\par\hangindent 2em}
1635   \renewcommand\subitem{\par\hangindent 3em\hspace*{1em}}
1636   \renewcommand\subsubitem{%
1637     \par\hangindent 4em\hspace*{2em}%
1638   }%
1639   \renewcommand\indexspace{%
1640     \par\addvspace{%
1641       1.0\baselineskip plus 0.5ex minus 0.2ex}\relax
1642   }%
1643 %we now swallow the letter heading in the index
1644 \newcommand{\lettergroup}[1]{}

```

The code, renews the "theindex" environment, with minor tweaks and defines it as a three column layout at "fullwidth".

## 40.9 Provide some hooks

It is useful at the end of the class to allow for localization of the class by importing a local file. This is easily achieved by checking if the file exists and then loading it. If there is a `myclass-book-local.sty` file, load it.

```
1646 \IfFileExists{myclass-book-local.tex}{%
1647   \input{myclass-book-local}%
1648   \MyClassInfoNL{Loading myclass-book-local.tex}}%
1649 }
```

If you intent to publish your class, you may also want to consider adding a hook for a patch-file.

## 40.10 The final act of kindness to your users

Many common classes, such as the `memoir` use such a tactic to avoid breaking old code.

```
1650 \IfFileExists{mypatch.sty}{%
1651   \RequirePackage{mypatch}}{}
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

In the previous chapter we have outlined the main sections that you probably need to define in your class. In the examples we have used we just typed the examples as `example.cls` or `package.sty`.

In this chapter we will go over the packaging of the class and automating the generation of user documentation, using the `doc` and `DocStrip`<sup>1</sup> programs in files with an extension `.dtx`. The DocStrip program is an amazing piece of code that was originally created by Frank Mittelbach to accompany the `doc` package. The idea behind it was to remove comment lines in order to reduce the execution time of the program. Having created the DocStrip program to remove comment lines from programs it became feasible to do more than just strip comments. Wouldn't it be nice to have a way to include parts of the code only when some condition is set true? Wouldn't it be as nice to have the possibility to split the source of a `TEX` program into several smaller files and combine them later into one 'executable'? Both these wishes have been implemented in the DocStrip program.

You should also be familiar with "LaTeX2e" for Class and Package Writers", which is available from CTAN (<http://www.ctan.org>) and comes with most LaTeX2e" distributions in a file called `clsguide.dvi`.<sup>2</sup> Finally, you should know how to install packages that are shipped as a `.dtx` file plus a `.ins` file.

style (.sty) file is primarily a collection of macro and environment definitions. One or more style files (e.g., a main style file that `\input` or `\RequirePackage` multiple helper files) is called a package. Packages are loaded into a document with `\usepackage{<main .sty file>}`. In the rest of this document, we use the notation `<package>` to represent the name of your package.

**Motivation** The important parts of a package are the code, the documentation of the code, and the user documentation. Using the `Doc` and `DocStrip` programs, it's possible to combine all three of these into a single, documented LATEX(.dtx) file. The primary advantage of a `.dtx` file is that it enables you to use arbitrary LATEX constructs to comment your code. Hence, macros, environments, code stanzas, variables, and so forth can be explained using tables, figures, mathematics, and font changes. Code can be organized into sections using LATEX's sectioning commands. `Doc` even facilitates generating a unified index that indexes both macro definitions (in the LATEX code) and macro descriptions (in the user documentation).

This emphasis on writing verbose, nicely typeset comments for code—essentially treating a program as a book that describes a set of algorithms—is known as literate programming `literate` and has been in use since the early days of `TEX`.

Furthermore, this tutorial shows how to write a single file that serves as both documentation and driver file, which is a more typical usage of the `Doc` system than using separate files.

### 41.0.1 The `.ins` file

The first step in preparing a package for distribution is to write an installer (`.ins`) file. An installer file extracts the code from a `.dtx` file, uses `docstrip` to

---

<sup>1</sup>Mittelbach et al. (2018).

<sup>2</sup>pakin2004.

strip off the comments and documentation, and outputs a `.sty` file. The good news is that a `.ins` file is typically fairly short and doesn't change significantly from one package to another.

**License** The `.ins` files usually start with comments specifying the copyright and license information:

```
%%
%% Copyright (C) year by your name %%
%% This file may be distributed and/or modified under the
%% conditions of the LaTeX Project Public License, either
%% version 1.2 of this license or (at your option) any later
%% version. The latest version of this license is in:
%%
%% http://www.latex-project.org/lppl.txt
%%
%% and version 1.2 or later is part of all distributions of
%% LaTeX version 1999/12/01 or later.
%%
```

The LATEX Project Public License (LPPL) is the license under which most packages—and LATEX itself—are distributed. Of course, you can release your package under any license you want; the LPPL is merely the most common license for LATEX packages. The LPPL specifies that a user can do whatever he wants with your package—including sell it and give you nothing in return. The only restrictions are that he must give you credit for your work, and he must change the name of the package if he modifies anything to avoid versioning confusion. The next step is to load DocStrip:

```
1652 %%\input docstrip.tex
1653 %%\keepsilent
```

By default, DocStrip gives a line-by-line account of its activity. These messages aren't terribly useful, so most people turn them off, by using the command `\keepsilent`:

```
1654 \keepsilent
```

A system administrator can specify the base directory under which all TEX-related files should be installed, e.g., `/usr/share/texmf`. (See `\BaseDirectory` in the DocStrip manual.) The `.ins` file specifies where its files should be installed relative to that. The following is typical:

```
1655 \usedir{tex/latex/packagename}
1656 \preamble
1657 \texti \endpreamble
```

The next step is to specify a preamble, which is a block of commentary that will be written to the top of every generated file:

```
\preamble
```

---

```
phddoc --- A class to typeset LaTeX code.
```

```
E-mail: yannislaz@gmail.com
Released under the LaTeX Project Public License v1.3c or later
See http://www.latex-project.org/lppl.txt
```

---

\endpreamble

The preceding preamble would cause `package.sty` to begin as follows:

```
%%
%% This is file `phddoc.cls',
%% generated with the docstrip utility.
%%
%% The original source files were:
%%
%% phddoc.dtx (with options: `class')
%%
%% -----
%% phddoc --- A class to typeset LaTeX code.
%% E-mail: yannislaz@gmail.com
%% Released under the LaTeX Project Public License v1.3c or later
%% See http://www.latex-project.org/lppl.txt
%% -----
```

---

We now reach the most important part of a `.ins` file: the specification of what files to generate from the `.dtx` file. The following tells DocStrip to generate `hpackagei.sty` from `hpackagei.dtx` by extracting only those parts marked as ‘package’ in the `.dtx` file. (Marking parts of a `.dtx` file is described later on.)

1658 `\generate{\file{<package>.sty}{\from{<package>.dtx}{package}}}`

`\generate` can extract any number of files from a given `.dtx` file. It can even extract a single file from multiple `.dtx` files. See the DocStrip manual for details.

Personally I also generate `README.md` files in `markdown` format as well, so that when they get uploaded to `github` they can be rendered nicely.

`\generate{\file{\jobname.md}{\from{\jobname.dtx}{readmemd}}}`

The text has to be written using ‘guards’ with the tag `readmd`

```
%<*readmemd>
# The `phddoc` LaTeXe class

The `phd` latex package and the class with the same name provide
convenient methods to create new styles for books, reports
and articles. It also loads the most commonly used packages
and resolves conflicts.
%</readmemd>
```

### 41.0.2 Generating messages

The next part of a `.ins` file consists of commands to output a message to the user, telling him what files need to be installed and reminding him how to produce the user documentation. The following set of `\sg` commands is typical:

---

```

1 \obeyspaces
2 \Msg{*****}
3 \Msg{* *}
4 \Msg{* To finish the installation you have to move the *}
5 \Msg{* following file into a directory searched by TeX: *}
6 \Msg{* *}
7 \Msg{* packagei.sty *}
8 \Msg{* *}
9 \Msg{* To produce the documentation run the file *}
10 \Msg{* package.dtx through LaTeX. *}
11 \Msg{* *}
12 \Msg{* Happy TeXing! *}
13 \Msg{* *}
14 \Msg{*****}
15 Note the use of \obeyspaces to inhibit \tex from collapsing multiple spaces
16 into one.
17 \endbatchfile

```

---

Appendix A.1 lists a complete, skeleton .ins file. Appendix A.2 is similar but contains slight modifications intended to produce a class (.cls) file instead of a style (.sty) file

## 41.1 What to put in a .dtx file

We started describing the .ins install file first. The next file we will describe is the .dtx file. This holds both the code definitions as well as the user documentation.

A dtx file contains both the commented source code and the user documentation for the package. Running a dtx file through `latex` typesets the user documentation, which usually also includes a nicely typeset version of the commented source code.

Due to some Doc trickery, a dtx file is actually evaluated twice. The first time, only a small piece of L<sup>A</sup>T<sub>E</sub>X driver code is evaluated. The second time, comments in the dtx file are evaluated, as if there were no '%' preceding them. This can lead to a good deal of confusion when writing dtx files and occasionally leads to some awkward constructions. Fortunately, once the basic structure of a dtx file is in place, filling in the code is fairly straightforward.

**Guards** If you open any .dtx file you will notice that the lines either start with a % sign or sometimes with a percentage sign and <guard>. The latter is called a guard and they are in a way like html tags. They have a starting and an ending tag. In the example below there are two different guards <\*10pt>...</10pt> and <\*11pt></11pt>. Unlike html tags guards are boolean expressions! You can use:

|! &

The | stands for disjunction (OR), the & stands for conjunction (AND) and the ! (NOT) stands for negation. The terminal is any sequence of letters and evaluates to true iff it occurs in the list of options that have to be included.

```
%<*10pt|11pt|12pt>
... code
%</10pt|11pt|12pt>
```

A longer example from KOMA shows the concept better.

---

```
1 %      \begin{macrocode}
2 \def\normalsize{%
3 %<*10pt>
4   \@setfontsize\normalsize\@xipt\@xipt
5   \abovedisplayskip 10\p@ \@plus2\p@ \@minus5\p@
6   \abovedisplayshortskip \z@ \@plus3\p@
7   \belowdisplayshortskip 6\p@ \@plus3\p@ \@minus3\p@
8 %</10pt>
9 %<*11pt>
10  \@setfontsize\normalsize\@xipt{13.6}%
11  \abovedisplayskip 11\p@ \@plus3\p@ \@minus6\p@
12  \abovedisplayshortskip \z@ \@plus3\p@
13  \belowdisplayshortskip 6.5\p@ \@plus3.5\p@ \@minus3\p@
14 %</11pt>
15 ...
16 %      \end{macrocode}
```

---

If the guards only contain a one line of text, then a short form is provided as `<10pt>`. It is unnecessary to provide a closing tag and the ‘\*’ is omitted. The example below from the KOMA classes shows a quite ingenious way of writing the `\ProvidesFile` macro in the different files; one for each tag. Two kinds of optional code are supported: one can either have optional code that is on one line of tex code.

To distinguish both kinds of optional code the ‘guard modifier’ has been introduced. The ‘guard modifier’ is one character that immediately follows the < of the guard. It can be either \* for the beginning of a block of code, or / for the end of a block of code. The beginning and ending guards for a block of code have to be on a line by themselves.

When a block of code is not included, any guards that occur within that block are not evaluated.

```
%      \begin{macrocode}
\ProvidesFile{%
%<10pt>  scrsize10pt.clo%
%<11pt>  scrsize11pt.clo%
%<12pt>  scrsize12pt.clo%
}[\KOMAScriptVersion\space font size class option %
%<10pt>  (10pt)%
%<11pt>  (11pt)%
%<12pt>  (12pt)%
]
%      \end{macrocode}
```

In the `.ins` file one could write to generate the various `.clo` files.:

```
\generate{\usepreamble\defaultpreamble
  \file{scrsize10pt.clo}{%
    \from{scrkernel-version.dtx}{clo,10pt}%
    \from{scrkernel-fonts.dtx}{clo,10pt}%
    \from{scrkernel-paragraphs.dtx}{clo,10pt}%
  }%
  \file{scrsize11pt.clo}{%
    \from{scrkernel-version.dtx}{clo,11pt}%
    \from{scrkernel-fonts.dtx}{clo,11pt}%
    \from{scrkernel-paragraphs.dtx}{clo,11pt}%
  }%
  \file{scrsize12pt.clo}{%
    \from{scrkernel-version.dtx}{clo,12pt}%
    \from{scrkernel-fonts.dtx}{clo,12pt}%
    \from{scrkernel-paragraphs.dtx}{clo,12pt}%
  }%
}
```

Becareful not to introduce spurious empty lines in your generated files by having empty lines in no-man's land, that is between tags.<sup>3</sup>

```
%</install>
%<install>\endbatchfile
```

**The character table check** The second mechanism that Doc uses to ensure that a **dtx** file is uncorrupted is a character table. If you put the following command verbatim into your **dtx** file, then **Doc** will ensure that no unexpected character translation took place in transport:

---

```
1 % \CharacterTable
2 % {Upper-case A\B\C\D\E\F\G\H\I\J\K\L\M\N\O\P\Q\R\S\T\U\V\W\X\Y\Z
3 % Lower-case a\b\c\d\e\f\g\h\i\j\k\l\m\l\o\p\q\r\s\t\u\v\w\x\y\z
4 % Digits \0\1\2\3\4\5\6\7\8\9
5 % Exclamation ! Double quote " Hash (number) #
6 % Dollar \$ Percent % Ampersand &
7 % Acute accent ' Left paren \( Right paren )
8 % Asterisk * Plus + Comma ,
9 % Minus - Point . Solidus /
10 % Colon : Semicolon ;
11 % Less than <
12 % Equals = Greater than > Question mark ?
13 % Commercial at @ Left bracket [
14 % Backslash \\
15 % Right bracket ] Circumflex ^ Underscore _
16 % Grave accent ` Left brace {
17 % Vertical bar |
18 % Right brace } Tilde ~}

A success message looks like this:
*****
* Character table correct *
```

---

<sup>3</sup>In the phd package, I automatically generate the default settings from the **.dtx** files. In this case pgf will complain.

---

```

19 ****
20
21 and an error message looks like this:
22 ! Package doc Error: Character table corrupted.

```

---

**DoNotIndex** When producing an index, **doc** normally indexes every control sequence (i.e., backslashed word or symbol) in the code. The problem with this level of automation is that many control sequences are uninteresting from the perspective of understanding the code. For example, a reader probably doesn't want to see every location where `\if` is used—or `\the` or `\let` or `\begin` or any of numerous other control sequences.

As its name implies, the `\DoNotIndex` command gives **Doc** a list of control sequences that should not be indexed. `\DoNotIndex` can be used any number of times, and it accepts any number of control sequence names per invocation:

---

```

1 \DoNotIndex{\#, \$, %, &, @, \\", \{, \}, \^, \_, \~, \ }
2 \DoNotIndex{@ne}
3 \DoNotIndex{advance, begingroup, catcode, closein}
4 \DoNotIndex{closeout, day, def, edef, else, empty, endgroup}

```

---

### 41.1.1 User documentation

We can finally start writing the user documentation. A typical beginning looks like this:

---

```

1 % \title{The \textsf{package} package} \thanks{This document
2 % corresponds to \textsf{package}\~\fileversion,
3 % dated\~\filedate.}
4 % \author{your name \\ \texttt{your e-mail address}}
5 %
6 % \maketitle

```

---

The title can certainly be more creative, but note that it's common for package names to be typeset with `\textsf` and for `\thanks` to be used to specify the package version and date. This yields one of the advantages of literate programming: Whenever you change the package version (the optional second argument to `\ProvidesPackage`), the user documentation is updated accordingly. Of course, you still have to ensure manually that the user documentation accurately describes the updated package.

Write the user documentation as you would any **LATEX** document, except that you have to precede each line with a `\%`. Note that the `ltxdoc` document class is derived from `article`, so the top-level sectioning command is `\section`, not `\chapter`.

## 41.2 General tips for defining a Class

Evaluate, if there is a class that is nearer to what you wish to achieve. If not do a set of requirements.

Book structure - start with book or **Octavo** if you need to hack extensively.  
If not use memoir, koma or **tufte-book**.

- Paragraph looks
- Lists
- Figures
- Bibliography and citations
- Footnotes
- Index
- Title pages
- Book Cover
- Language support
- Mathematics
- Graphs and figures
- Typography - fonts, indentations fontsize etc
- headers and footers

## 41.3 Declaring Options

Most classes or packages will have a good deal of options. These are declared using the **\DeclareOption** command. In this part no package loading should take place.

**\DeclareOption** {*<option>*} {*<code>*}

The argument *option* is the name of the option being declared and the {*code*} is the code that will execute if this option is requested.

**\DeclareOption\*** {*<code>*}

The argument *code* in the star version of the command specifies the action to be taken if an unknown option is specified. Within this argument the **\CurrentOption** refers to the name of the option in question.

For example one could pass all such options to another package, using:

```
\DeclareOption*{\PassOptionsToPackage{\CurrentOption}{A}}
```

## 41.4 Executing Options

Normally after the options have been defined, one would need to provide default values and the options need to be executed.

**\ExecuteOptions** {*<option list>*}

You can also **\ExecuteOptions** when declaring other options. There is one caveat. This command can only be executed prior to executing the **\ProcessOptions** command because, as one of its last actions, the latter command reclaims all of the memory taken up by the code for the declared options.

**\ProcessOptions\***

For some packages it is preferable or essential to process options in the order they appear in the `\usepackage` commands rather than using the order given through the sequence of the `\DeclareOption→ σ 540` commands. In this case it one has to use the star version of the command, i.e., `\ProcessOptions*` rather than `\ProcessOptions`.

## 41.5 Special Commands for class files

It is sometimes preferable to define a new class based on another and hence to extend it. To support this concept the L<sup>A</sup>T<sub>E</sub>X kernel provides two commands, `\LoadClass` and `\PassOptionsToClass`. These two commands can then be used to develop a new class, by adding and extending the functionality of the loaded class.

`\LoadClass→ P. 542 [⟨option list⟩]{⟨class⟩}[⟨release⟩]`

For example the `ltxdoc` class loads the standard `article` class. The `tufte-book` class loads the `book` class. The best way to understand the concepts discussed here is to study these classes.

## 41.6 A minimal class

### Example 6.1 Model Class

```

472
473 \begin{filecontents}{phdex ampleclass.cls}
474 \NeedsTeXFormat{LaTeX2e}
475 \ProvidesClass{phdex ampleclass}[2015/07/07]
476 \renewcommand\normalsize{\ fontsize{}{10pt}{12pt}\selectfont}
477 \setlength\textwidth{6.5in}
478 \setlength\textheight{5in}
479 \pagenumbering{arabic}
480 \end{filecontents}
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 42.1 Introduction

This part of the kernel implements the class and package mechanisms, including the handling of options. It replaced the  $\text{\LaTeX} 2.09 \backslash\text{documentstyle}$  in  $\text{\LaTeX} 2_{\epsilon}$  documents. Provisions were made for backwards compatibility so that old documents containing  $\text{\documentstyle}$  could still be run using a compatibility option. Backwards compatibility has always been one of the primary objectives of the  $\text{\LaTeX}$  Team making  $\text{\LaTeX}$  an excellent resource for archival purposes.

The  $\text{\LaTeX}$  kernel on its own does not provide the necessary functionality to typeset a document. It is a framework upon which classes can define the necessary elements and the instructions as to how they are formatted. Packages can then be used to extend even further the functionality of the classes or even the kernel. Classes and packages can be loaded with options.

## 42.2 User interface

$\text{\documentclass}[\langle\text{main-option-list}\rangle]\{\langle\text{class}\rangle\}[\langle\text{version}\rangle]$

There must be exactly one such declaration, and it must come first. The  $\langle\text{main-option-list}\rangle$  is a list of options which can modify the formatting of elements which are defined in the  $\langle\text{class}\rangle$  file as well as in all following  $\text{\usepackage}$  declarations (see below). The  $\langle\text{version}\rangle$  is a version number, beginning with a date in the format  $YYYY/MM/DD$ . If an older version of the class is found, a warning is issued.

$\text{\documentstyle}[\langle\text{main-option-list}\rangle]\{\langle\text{class}\rangle\}[\langle\text{version}\rangle]$

The  $\text{\documentstyle}$  declaration is kept in order to maintain upward compatibility with  $\text{\LaTeX} 2.09$  documents. It is similar to  $\text{\documentclass}$ , but it causes all options in  $\langle\text{main-option-list}\rangle$  that the  $\langle\text{class}\rangle$  does not use to be passed to  $\text{\RequirePackage}$  after the options have been processed. This maintains compatibility with the 2.09 behaviour. Also a flag is set to indicate that the document is to be processed in  $\text{\LaTeX} 2.09$  compatibility mode. As far as most packages are concerned, this only affects the warnings and errors  $\text{\LaTeX}$  generates. This flag does affect the definition of font commands, and  $\text{\sloppy}$ .

$\text{\usepackage}[\langle\text{package-option-list}\rangle]\{\langle\text{package-list}\rangle\}[\langle\text{version}\rangle]$

There can be any number of these declarations. All packages in  $\langle\text{package-list}\rangle$  are called with the same options.

Each  $\langle\text{package}\rangle$  file defines new elements (or modifies those defined in the  $\langle\text{class}\rangle$ ), and thus extends the range of documents which can be processed.

The  $\langle\text{package-option-list}\rangle$  is a list of options which can modify the formatting of elements defined in the  $\langle\text{package}\rangle$  file. The  $\langle\text{version}\rangle$  is a version number, beginning with a date in the format  $YYYY/MM/DD$ . If an older version of the package is found, a warning is issued.

Each package is loaded only once. If the same package is requested more than once, nothing happens, unless the package has been requested with options that were not given the first time it was loaded, in which case an error is produced.

As well as processing the options given in the  $\langle\text{package-option-list}\rangle$ , each package processes the  $\langle\text{main-option-list}\rangle$ . This means that options that affect all of the packages can be given globally, rather than repeated for every package.

Note that class files have the extension `.cls`, packages have the extension `.sty`.

The environment `\filecontents`<sup>P.549</sup> is intended for passing the contents of packages, options, or other files along with a document in a single file.

It has one argument, which is the name of the file to create. If that file already exists (maybe only in the current directory if the OS supports a notion of a ‘current directory’ or ‘default directory’) then nothing happens (except for an information message) and the body of the environment is bypassed. Otherwise, the body of the environment is written verbatim to the file name given as the first argument, together with some comments about how it was produced.

The environment is allowed only before `\documentclass`<sup>P.542</sup> to ensure that all packages or options necessary for this particular run are present when needed. The begin and end tags should each be on a line by itself. There is also a star-form; this does not write extra comments into the file.

### 42.2.1 Option processing

When the options are processed, they are divided into two types: *local* and *global*:

- For a class, the options in the `\documentclass` command are local.
- For a package, the options in the `\usepackage` command are local, and the options in the `\documentclass` command are global.

The options for `\documentclass` and `\usepackage` are processed in the following way:

1. The local and global options that have been declared (using `\DeclareOption`<sup>P.540</sup> as described below) are processed first.

In the case of `\ProcessOptions`, they are processed in the order that they were declared in the class or package.

In the case of `\ProcessOptions*`, they are processed in the order that they appear in the option-lists. First the global options, and then the local ones.

2. Any remaining local options are dealt with using the default option (declared using the `\DeclareOption*` declaration described below). For document classes, this usually does nothing, but records the option on a list of unused options. For packages, this usually produces an error.

Finally, when `\begin{document}` is reached, if there are any global options which have not been used by either the class or any package, the system will produce a warning.

## 42.3 Class and Package interface

### 42.3.1 Class name and version

A class can identify itself with the `\ProvidesClass`<sup>P.539</sup> `{<name>} [<version>]` command. The `<version>` should begin with a date in the format `YYYY/MM/DD`.

### 42.3.2 Package name and version

A package can identify itself with the `\ProvidesPackage`<sup>P.538</sup>{⟨name⟩}{⟨version⟩} command. The ⟨version⟩ should begin with a date in the format YYYY/MM/DD.

### 42.3.3 Requiring other packages

Packages or classes can load other packages using `\RequirePackage`<sup>P.542</sup>[⟨options⟩]{⟨name⟩}{⟨version⟩}. If the package has already been loaded, then nothing happens unless the requested options are not a subset of the options with which it was loaded, in which case an error is called.

`\LoadClass`<sup>P.542</sup> is similar to `\RequirePackage`, but for classes, may not be used in package files.

`\PassOptionsToPackage` Packages can pass options to other packages using:

`\PassOptionsToPackage{⟨options⟩}{⟨package⟩}`.

`\PassOptionsToClass` This adds the ⟨options⟩ to the options list of any future `\RequirePackage` or `\usepackage` command. For example:

```
\PassOptionsToPackage{foo,bar}{fred}
\RequirePackage[baz]{fred}
```

is the same as:

```
\RequirePackage[foo,bar,baz]{fred}
```

`\LoadClassWithOptions`{⟨name⟩}{⟨version⟩}:

This is similar to `\LoadClass`, but it always calls class ⟨name⟩ with exactly the same option list that is being used by the current class, rather than an option explicitly supplied or passed on by `\PassOptionsToClass`.

`\RequirePackageWithOptions`<sup>P.543</sup> is the analogous command for packages.

This is mainly intended to allow one class to simply build on another, for example:

```
\LoadClassWithOptions{article}
```

This should be contrasted with the slightly different construction

```
\DeclareOption*{\PassOptionsToClass{\CurrentOption}{article}}
\ProcessOptions
\LoadClass{article}
```

As used here, the effects are more or less the same, but the version using `\LoadClassWithOptions` is slightly quicker (and less to type). If, however, the class declares options of its own then the two constructions are different; compare, for example:

```
\DeclareOption{landscape}{...}
\ProcessOptions
\LoadClassWithOptions{article}
```

with:

```
\DeclareOption{landscape}{...}
\DeclareOption*{\PassOptionsToClass{\CurrentOption}{article}}
\ProcessOptions
\LoadClass{article}
```

In the first case, the article class will be called with option `landscape` precisely when the current class is called with this option; but in the second example it will not as in that case article is only passed options by the default option handler, which is not used for `landscape` as that option is explicitly declared.

`\@ifpackageloaded`<sup>P.537</sup> To find out if a package has already been loaded.  
`\@ifclassloaded`<sup>P.537</sup> To find out if a class has already been loaded.  
`\@ifpackageloaded`<sup>P.537</sup> {⟨⟨package⟩⟩} {⟨⟨true⟩⟩} {⟨⟨false⟩⟩} To find out if a package has been loaded.  
`\@ifpackagelater`<sup>P.537</sup><sup>1</sup> To find out if a package has already been loaded with a version equal to or more recent than ⟨version⟩.  
`\@ifclasslater`<sup>P.537</sup> `\@ifpackagelater`{⟨⟨package⟩⟩} {⟨⟨version⟩⟩} {⟨⟨true⟩⟩} {⟨⟨false⟩⟩}.  
`\@ifpackagewith`<sup>P.538</sup> To find out if a package has already been loaded with at least the options ⟨options⟩, use  
`\@ifclasswith`<sup>P.538</sup> `\@ifpackagewith`{⟨⟨package⟩⟩} {⟨⟨options⟩⟩} {⟨⟨true⟩⟩} {⟨⟨false⟩⟩}.

There exists one package that can't be tested with the above commands: the `fontenc` package pretends that it was never loaded to allow for repeated reloading with different options (see `ltoutenc.dtx` for details).

#### 42.3.4 Declaring new options

Options for classes and packages are built using the same macros.

`\DeclareOption`<sup>P.540</sup> {⟨⟨name⟩⟩} {⟨⟨code⟩⟩}. To define a builtin option, use  
`\DeclareOption*`<sup>P.540</sup> To define the default action to perform for local options which have not been declared, use `\DeclareOption*`{⟨⟨code⟩⟩}.

Note: there should be no use of

`\RequirePackage`,    `\DeclareOption`,    `\DeclareOption*`    or  
`\ProcessOptions`  
inside `\DeclareOption` or `\DeclareOption*`.

Possible uses for `\DeclareOption*` include:

`\DeclareOption*`<sup>P.540</sup> {} Do nothing. Silently accept unknown options. (This suppresses the usual warnings.)

`\DeclareOption*`{⟨⟨unkownoptionerror⟩⟩}  
Complain about unknown local options. (The initial setting for package files.)

`\DeclareOption*`{⟨⟨PassOptionsToPackage{⟨⟨CurrentOption⟩⟩}{⟨⟨pkg-name⟩⟩}⟩}  
Handle the the current option by passing it on to the package ⟨pkg-name⟩,

---

<sup>1</sup>v1.ii 2013/07/07 Correctly describe how the date in `\@ifpackagelater` is used

which will presumably be loaded via `\RequirePackage` later in the file. This is useful for building ‘extension’ packages, that perhaps handle a couple of new options, but then pass everything else on to an existing package.

```
\DeclareOption*{\InputIfFileExists{xx-
  \CurrentOption.yyy}%
  {}%
  {\OptionNotUsed}}
```

Handle the option `foo` by loading the file `xx-foo.yyy` if it exists, otherwise do nothing, but declare that the option was not used. Actually the `\OptionNotUsed`<sup>→ P.540</sup> declaration is only needed if this is being used in class files, but does no harm in package files.

### 42.3.5 Safe Input Macros

`\InputIfFileExists`<sup>→ P.129</sup> {`\file`} {`\then`} {`\else`}

Inputs `\file` if it exists. Immediately before the input, `\then` is executed. Otherwise `\else` is executed. Note that these macros are not defined in this file, but rather in the `ltfiles` module (see Chapter 10).

`\IfFileExists`<sup>→ P.128</sup> is similar to the above, but does not input the file.

One thing you might like to put in the `\else` clause is `\@missingfileerror`<sup>→ P.130</sup>. This starts an interactive request for a filename, supplying default extensions. Just hitting return causes the whole input to be skipped and entering `x` quits the current run,

`\input`<sup>→ P.129</sup> This has been redefined from the L<sup>A</sup>T<sub>E</sub>X2.09 definition, in terms of the new commands `\InputIfFileExists` and `\@missingfileerror`.

`\listfiles`<sup>→ σ131</sup> Giving this declaration in the preamble causes a list of all files input via the ‘safe input’ commands to be listed at the end. Any strings specified in the optional argument to

`\ProvidesPackage`<sup>→ σ538</sup> are listed alongside the file name. So files in standard (and other non-standard) distributions can put informative strings in this argument.

## 42.4 Implementation

```
482 %<*2ekernel>
\if@compatibility
483 \newif\if@compatibility

{@documentclasshook
484 \def{@documentclasshook}{%
485   \ifx\@normalsize\@undefined
486     \let\@normalsize\normalsize
487   \fi
488 }}
```

## \@declaredoptions

This list is automatically built by \DeclareOption. It is the list of options (separated by commas) declared in the class or package file and it defines the order in which the corresponding \ds@*option* commands are executed. All local *option*s which are not declared will be processed in the order defined by the optional argument of \documentclass or \usepackage.

```
489 \let\@declaredoptions\@empty
```

## \@classoptionslist

```
490 \let\@classoptionslist\relax
491 \@onlypreamble\@classoptionslist
```

## \@unusedoptionlist

```
492 \let\@unusedoptionlist\@empty
493 \@onlypreamble\@unusedoptionlist
```

## \CurrentOption

Name of current package or option.

```
494 \let\CurrentOption\@empty
```

## \@currname

Name of current package or option.

```
495 \let\@currname\@empty
```

## \@currext

```
496 \global\let\@currext=\@empty
```

## \@clsextension

## \@pkgextension

```
497 \def\@clsextension{cls}
498 \def\@pkgextension{sty}
499 \@onlypreamble\@clsextension
500 \@onlypreamble\@pkgextension
```

## \@pushfilename

## \@popfilename

## \@currnamestack

Commands to push and pop the file name and extension.

#1 current name.

#2 current extension.

#3 current catcode of @.

#4 Rest of the stack.

```

501 \def\@pushfilename{%
502   \xdef\@currnamestack{%
503     {\@currname}%
504     {\@currext}%
505     {\the\catcode`\@}%
506     {@currnamestack}}%
507   \@onlypreamble\@pushfilename
508 \def\@popfilename{\expandafter\@p@pfilename\@currnamestack\@nil}
509   \@onlypreamble\@popfilename
510 \def\@p@pfilename#1#2#3#4\@nil{%
511   \gdef\@currname{#1}%
512   \gdef\@currext{#2}%
513   \catcode`\@#3\relax
514   \gdef\@currnamestack{#4}}%
515   \@onlypreamble\@p@pfilename
516 \gdef\@currnamestack{}
517 \@onlypreamble\@currnamestack

\@optionlist
518 \def\@optionlist#1{%
519   @ifundefined{opt@#1}\@empty{\csname opt@#1\endcsname}%
520   \@onlypreamble\@optionlist

```

The following two commands check to see if a class or a package has been loaded. The test is done by checking that `ver@pkgname.sty` or `ver@classname.cls` are defined. The test is carried comparing to `\relax`.

`\@ifpackageloaded <package name><true code><false code>`

`\@ifclassloaded <class name><true code><false code>`

`\@ifpackageloaded{<name>}` Checks to see whether a file has been loaded.

```

521 \def\@ifpackageloaded{\@ifl@aded\@pkgextension}
522 \def\@ifclassloaded{\@ifl@aded\@clsextension}
523 \@onlypreamble\@ifpackageloaded
524 \@onlypreamble\@ifclassloaded

525 \def\@ifl@aded#1#2{%
526   \expandafter\ifx\csname ver@#2.#1\endcsname\relax
527     \expandafter\@secondoftwo
528   \else
529     \expandafter\@firstoftwo
530   \fi}
531 \@onlypreamble\@ifl@aded

```

`\@ifpackagelater`

`\@ifclasslater`

```

532 \def\@ifpackagelater{\@ifl@ter\@pkgextension}
533 \def\@ifclasslater{\@ifl@ter\@clsextension}
534 \@onlypreamble\@ifpackagelater
535 \@onlypreamble\@ifclasslater

```

```

536 \def\@ifl@ter#1#2{%
537   \expandafter\@ifl@t@r
538   \csname ver@#2.#1\endcsname}
539 \onlypreamble\@ifl@ter
540 \def\@ifl@t@r#1#2{%
541   \ifnum\expandafter\@parse@version#1//00\@nil<%
542     \expandafter\@parse@version#2//00\@nil
543     \expandafter\@secondoftwo
544   \else
545     \expandafter\@firstoftwo
546   \fi}
547 \onlypreamble\@ifl@t@r
548 \def\@parse@version#1/#2/#3#4#5\@nil{#1#2#3#4 }
549 \onlypreamble\@parse@version

@ifpackagewith

@ifclasswith

550 \def\@ifpackagewith{\@ifoptions\@pkgextension}
551 \def\@ifclasswith{\@ifoptions\@clsextension}
552 \onlypreamble\@ifpackagewith
553 \onlypreamble\@ifclasswith
554 \def\@ifoptions#1#2{%
555   \@expandtwoargs\@ifpti@ns{\@optionlist{#2.#1}}}
556 \onlypreamble\@ifoptions
557 \def\@ifpti@ns#1#2{%
558   \let\reserved@a\@firstoftwo
559   \@for\reserved@b:=#2\do{%
560     \ifx\reserved@b\@empty
561     \else
562       \expandafter\in@\expandafter{\expandafter,\reserved@b,}{,#1,}%
563       \ifin@
564       \else
565         \let\reserved@a\@secondoftwo
566       \fi
567     \fi
568   }%
569   \reserved@a
570 \onlypreamble\@ifpti@ns

```

### \ProvidesPackage

Checks that the current filename is correct, and defines \ver@filename.

```

571 \def\ProvidesPackage#1{%
572   \xdef\@gtempa{#1}%
573   \ifx\@gtempa\@currname\else
574     \@latex@warning@no@line{You have requested
575       \@cls@pkg\space `@\currname', \MessageBreak
576       but the \@cls@pkg\space provides '#1'}%
577   \fi
578   \@ifnextchar[\@pr@videopackage{\@pr@videopackage[]}]%
579 \onlypreamble\ProvidesPackage

```

```

580 \def\@pr@videopackage[#1]{%
581   \expandafter\xdef\csname \ver@\@currname.\@currext\endcsname{#1}%
582   \ifx\@currext\@clsextension
583     \typeout{Document Class: \@gtempa\space#1}%
584   \else
585     \wlog{Package: \@gtempa\space#1}%
586   \fi}
587 \onlypreamble\@pr@videopackage

\ProvidesClass
588 \let\ProvidesClass\ProvidesPackage
589 \onlypreamble\ProvidesClass

\ProvidesFile
\@providesfile
590 \def\ProvidesFile#1{%
591   \begingroup
592     \catcode`\_ 10 %
593     \ifnum \endlinechar<256 %
594       \ifnum \endlinechar>\m@ne
595         \catcode\endlinechar 10 %
596       \fi
597     \fi
598     \makeother\%
599     \makeother\&%
600   \kernel@ifnextchar[{\@providesfile{#1}}{\@providesfile{#1}[]}}

```

## 42.5 Passing Options

With the basic commands behind us, the passing of options to a package or class is done through two commands `\PassOptionsToPackage` and `\PassOptionsToClass`.

`\PassOptionsToPackage`

`\PassOptionsToClass`

If the package has been loaded, we check that it was first loaded with the options. Otherwise we add the option list to that of the package.

```

601 \def\@pass@ptions#1#2#3{%
602   \expandafter\xdef\csname opt@#3.#1\endcsname{%
603     \ifundefined{opt@#3.#1}\empty
604       {\csname opt@#3.#1\endcsname,}%
605     \zap@space#2 \empty}
606 \onlypreamble\@pass@ptions
607 \def\PassOptionsToPackage{\@pass@ptions\@pkgextension}
608 \def\PassOptionsToClass{\@pass@ptions\@clsextension}
609 \onlypreamble\PassOptionsToPackage
610 \onlypreamble\PassOptionsToClass

```

## 42.6 Declaring Options

Options are declared using the `\DeclareOption` command.

`\DeclareOption`

`\DeclareOption*`

Adds an option as a `\ds@` command, or the default `\default@ds` command.

```
611 \def\DeclareOption{%
612   \let\@fileswith@pti@ns\@badrequireerror
613   \@ifstar{\def\defdefault@ds{\declareoption}}
614
615 \long\def\@declareoption#1#2{%
616   \xdef\@declaredoptions{\@declaredoptions,#1}%
617   \toks@\{#2\}%
618   \expandafter\edef\csname ds@#1\endcsname{\the\toks@}%
619
620 \long\def\@defdefault@ds#1{%
621   \toks@\{#1\}%
622   \edef\default@ds{\the\toks@}%
623
624 \@onlypreamble\DeclareOption
625 \@onlypreamble\@declareoption
626 \@onlypreamble\@defdefault@ds
```

`\OptionNotUsed`

```
627 \def\OptionNotUsed{%
628   \ifx\@currext\@clsextension
629     \xdef\@unusedoptionlist{%
630       \ifx\@unusedoptionlist\empty\else\@unusedoptionlist,\fi
631       \CurrentOption}%
632   \fi}
633 \@onlypreamble\OptionNotUsed
```

`\default@ds`

```
634 % \let\default@ds\OptionNotUsed
```

`\ProcessOptions`

`\ProcessOptions*`

`\ProcessOptions` calls `\ds@option` for each known package option, then calls `\default@ds` for each option on the local options list. Finally resets all the declared options to `\relax`. The empty option does nothing, this has to be reset on the off chance it's set to `\relax` if an empty element gets into the `\@declaredoptions` list.

The star form is similar but executes options given in the order specified in the document, not the order they are declared in the file. In the case of packages, global options are executed before local ones.

```

635 \def\ProcessOptions{%
636   \let\ds@\empty
637   \edef\@curroptions{\@optionlist{\@currname.\@currext}}%
638   \@ifstar\xprocessoptions\@processoptions
639   \@onlypreamble\ProcessOptions

640 \def\@processoptions{%
641   \@for\CurrentOption:=\@declaredoptions\do{%
642     \ifx\CurrentOption\empty\else
643       \@expandtwoargs\in@\{,\CurrentOption,{\}%
644       ,\ifx\@currext\@clsextension\else\@classoptionslist,\fi
645       \@curroptions,{\}%
646     \ifin@
647       \@use@option
648       \expandafter\let\csname \ds@\CurrentOption\endcsname\empty
649     \fi
650   \fi}%
651   \@process@pti@ns}
652 \@onlypreamble\@processoptions

653 \def\xprocessoptions{%
654   \ifx\@currext\@clsextension\else
655     \@for\CurrentOption:=\@classoptionslist\do{%
656       \ifx\CurrentOption\empty\else
657         \@expandtwoargs\in@\{,\CurrentOption,{\},\@declaredoptions,{\}%
658       \ifin@
659         \@use@option
660         \expandafter\let\csname \ds@\CurrentOption\endcsname\empty
661       \fi
662     \fi}%
663   \fi
664   \@process@pti@ns}
665 \@onlypreamble\xprocessoptions

```

The common part of `\ProcessOptions` and `\ProcessOptions*`.

```

666 \def\@process@pti@ns{%
667   \@for\CurrentOption:=\@curroptions\do{%
668     \@ifundefined{\ds@\CurrentOption}{%
669       {\@use@option
670       \default@ds}}%

```

There should not be any non-empty definition of `\CurrentOption` at this point, as all the declared options were executed earlier. This is for compatibility with 2.09 styles which use `\def\ds@...` directly, and so have options which do not appear in `\@declaredoptions`.

```
671   {\@use@option}}%
```

Clear all the definitions for option code. First set all the declared options to `\relax`, then reset the ‘default’ and ‘empty’ options. and the list of declared options.

```

672   \@for\CurrentOption:=\@declaredoptions\do{%
673     \expandafter\let\csname \ds@\CurrentOption\endcsname\relax}%
674   \let\CurrentOption\empty

```

```

675   \let\@fileswith@pti@ns\@@fileswith@pti@ns
676   \AtEndOfPackage{\let\@unprocessedoptions\relax}
677 \onlypreamble\process@pti@ns

\@options
678 \def\@options{\ProcessOptions*}
679 \onlypreamble\@options

\use@ption
680 \def\use@ption{%
681   @expandtwoargs\removeelement\CurrentOption
682   \unusedoptionlist\unusedoptionlist
683   \csname ds@\CurrentOption\endcsname}
684 \onlypreamble\use@ption

\ExecuteOptions
685 \def\ExecuteOptions#1{%
686   \def\reserved@a##1\@nil{%
687     @for\CurrentOption:=#1\do{\csname
688       \CurrentOption\endcsname}%
689     \edef\CurrentOption{##1}}%
690   \expandafter\reserved@a\CurrentOption\@nil}
690 \onlypreamble\ExecuteOptions

```

The top-level commands, which just set some parameters then call the internal command, `\@fileswithoptions`.

### \documentclass

The main new-style class declaration.

```

691 \def\documentclass{%
692   \let\documentclass@twoclasseserror
693   \if@compatibility\else\let\usepackage\RequirePackage\fi
694   \fileswithoptions@\clsextension}
695 \onlypreamble\documentclass

```

### \documentstyle

```

696 \def\documentstyle{%
697   \makeatletter\input{latex209.def}\makeatother
698   \documentclass}
699 \onlypreamble\documentstyle

```

### \RequirePackage

```

700 \def\RequirePackage{%
701   \fileswithoptions@\pkgextension}
702 \onlypreamble\RequirePackage

```

### \LoadClass

```

703 \def\LoadClass{%
704   \ifx@\currxt\@pkextension
705     \@latex@error
706       {\noexpand\LoadClass in package file}%
707       {You may only use \noexpand\LoadClass in a class file.}%
708   \fi
709   \@fileswithoptions\@clsextension}
710 \onlypreamble\LoadClass

{@loadwithoptions

711 \def\@loadwithoptions#1#2#3{%
712   \expandafter\let\csname opt@#3.#1\expandafter\endcsname
713     \csname opt@\@currname.\@currxt\endcsname
714   #2{#3}}
715 \onlypreamble\@loadwithoptions

\LoadClassWithOptions

716 \def\LoadClassWithOptions{%
717   \@loadwithoptions\@clsextension\LoadClass}
718 \onlypreamble\LoadClassWithOptions

\RequirePackageWithOptions

719 \def\RequirePackageWithOptions{%
720   \AtEndOfPackage{\let\unprocessedoptions\relax}%
721   \@loadwithoptions\@pkextension\RequirePackage}
722 \onlypreamble\RequirePackageWithOptions

\usepackage

723 \def\usepackage#1#{%
724   \@latex@error
725     {\noexpand \usepackage before \string\documentclass}%
726     {\noexpand \usepackage may only appear in the document
727       preamble, i.e.,\MessageBreak
728       between \noexpand\documentclass and
729       \string\begin{document}.}%
730   \@gobble}
731 \onlypreamble\usepackage

```

### \NeedsTeXFormat {⟨format name⟩}[⟨version⟩]

Check that the document is running on the correct system. The command checks first that the format that is processing the file is the same as that requested by the argument to \NeedsTeXFormat and if it passes it calls \needsformat<sup>→ P.544</sup> to process the argument in square brackets.<sup>2 3 4</sup>

<sup>2</sup>vo.2a 1993/11/14 made more robust for alternative syntax for other formats.

<sup>3</sup>vo.2c 1993/11/17 Name changed from \NeedsFormat

<sup>4</sup>vo.2d 1993/11/18 \fmtname \fmtversion not \@...

```

732 \def\NeedsTeXFormat#1{%
733   \def\reserved@a{\#1}%
734   \ifx\reserved@a\fmtname
735     \expandafter\@needsformat
736   \else
737     \@latex@error{This file needs format `'\reserved@a'%
738       \MessageBreak but this is `'\fmtname'}{%
739         The current input file will not be processed
740         further,\MessageBreak
741         because it was written for some other flavor of
742         TeX.\MessageBreak\@ehd}%
743   \endinput \fi}
744 \onlypreamble\NeedsTeXFormat

```

If the file is not meant to be processed by  $\text{\LaTeX}$   $2_e$  inputting is stopped, without ending the run. It just ends inputting the current file.<sup>5</sup>

### \@needsformat

As described earlier `\@needsformat` process the ‘[]’ by first checking it is available and then calling `\@needsf@rmat`. The latter compares the release and issues a warning if the version is not available and an earlier one is being used.

```

745 \def\@needsformat{%
746   \@ifnextchar[%
747     \@needsf@rmat
748   {}}
749 \onlypreamble\@needsformat
750 \def\@needsf@rmat[#1]{%
751   \@ifl@t@r\fmtversion{#1}{}%
752   {\@latex@warning@no@line
753     {You have requested release `#1' of \LaTeX,\MessageBreak
754      but only release `'\fmtversion' is available}}}
755 \onlypreamble\@needsf@rmat

```

### \zap@space

`\zap@space foo<space>\@empty` removes all spaces from `foo` that are not protected by `{ }` groups.

```

756 \def\zap@space#1 #2{%
757   #1%
758   \ifx#2\@empty\else\expandafter\zap@space\fi
759   #2}

```

### \@fileswithoptions

The common part of `\documentclass` and `\usepackage`. This is the most important part of the code, since when you say `\documentclass` it will start processing the document.

```

760 \def\@fileswithoptions#1{%
761   \@ifnextchar[%
762     {\@fileswithoptions#1}%
763     {\@fileswithoptions#1[]}}
764 \onlypreamble\@fileswithoptions

```

---

<sup>5</sup>v1.oh 1994/05/23 Don't stop completely when format is wrong

Chages<sup>6</sup><sup>7</sup>

```
765 \def\@fileswith@ptions#1[#2]#3{%
766   \@ifnextchar[%]
767   { \@fileswith@pti@ns#1[#2]#3}%
768   { \@fileswith@pti@ns#1[#2]#3[]}}
769 \@onlypreamble\@fileswith@ptions
```

Then we do some work.

First of all, we define the global variables. Then we look to see if the file has already been loaded. If it has, we check that it was first loaded with at least the current options. If it has not, we add the current options to the package options, set the default version to be `0000/00/00`, and load the file if we can find it. Then we check the version number.

Finally, we restore the old file name, reset the default option, and we set the catcode of @.

For classes, we can immediately process the file. For other types, #2 could be a comma separated list, so loop through, processing each one separately.<sup>8</sup><sup>9</sup><sup>10</sup>

<sup>11</sup><sup>12</sup>

```
770 \def\@fileswith@pti@ns#1[#2]#3[#4]{%
771   \ifx#1\@clsextension
772     \ifx\@classoptionslist\relax
773       \xdef\@classoptionslist{\zap@space#2 \empty}%
774     \def\reserved@a{%
775       \@onefilewithoptions#3[#2][#4]#1%
776       \@documentclasshook}%
777   \else
778     \def\reserved@a{%
779       \@onefilewithoptions#3[#2][#4]#1}%
780   \fi
781 \else
782   \def\reserved@b##1{%
783     \ifx\@nil##1\relax\else
784       \ifx\relax##1\relax\else
785         \noexpand\@onefilewithoptions##1[#2][#4]%
786         \noexpand\@pkextension
787       \fi
788       \expandafter\reserved@b
789     \fi}%
790   \edef\reserved@a{\zap@space#3 \empty}%
791   \edef\reserved@a{\expandafter\reserved@b\reserved@a,\@nil,}%
792 \fi
793 \reserved@a
794 \@onlypreamble\@fileswith@pti@ns
```

<sup>6</sup>vo.2f 1993/11/22 Made the default [] not [\@unknowversion]

<sup>7</sup>v1.1h 2007/08/05 Prevent loss of brackets PR/3965

<sup>8</sup>vo.2q 1993/12/17 Add \@compatibility hook

<sup>9</sup>vo.2s 1994/01/17 Modify to reduce parameter stack usage

<sup>10</sup>vo.2y 1994/02/07 Run \@compatibility on the first class to start (not the first to finish)

<sup>11</sup>vo.2z 1994/02/10 Renamed \@compatibility to \@documentclasshook. ASA.J.

<sup>12</sup>v1.1h 2007/08/05 Prevent loss of brackets PR/3965

Have the main argument as #1, so we only need one `\expandafter` above.<sup>13</sup>  
<sup>14</sup> <sup>15</sup>

```

795 \def\@onefilewithoptions#1[#2][#3]#4{%
796   \pushfilename
797   \xdef\@currname{#1}%
798   \global\let\@currext#4%
799   \expandafter\let\csname\@currname.\@currext-h@@k\endcsname\@empty
800   \let\CurrentOption\@empty
801   \@reset@ptions
802   \makeatletter

803   \def\reserved@a{%
804     \@ifl@aded\@currext{#1}%
805     {\@if@ptions\@currext{#1}{#2}{}}%
806     {\@latex@error
807       {Option clash for \cls@pkg\space #1}%
808       {The package #1 has already been loaded
809        with options:\MessageBreak
810        \space\space[\@optionlist{#1.\@currext}]\MessageBreak
811        There has now been an attempt to load it
812        with options\MessageBreak
813        \space\space[#2]\MessageBreak
814        Adding the global options:\MessageBreak
815        \space\space
816        \@optionlist{#1.\@currext},#2\MessageBreak
817        to your \noexpand\documentclass declaration may }
818        {fix this.}%
819        \MessageBreak
820        Try typing \space <return> \space to proceed.}}}}%
821     {\@pass@ptions\@currext{#2}{#1}%
822       \global\expandafter
823       \let\csname ver@\@currname.\@currext\endcsname\@empty
824       \InputIfFileExists
825         {\@currname.\@currext}%
826         {}%
827         {\@missingfileerror\@currname\@currext}%
828       \@unprocessedoptions will generate an error for each specified option in a
829       package unless a \ProcessOptions has appeared in the package file.
830       \let\@unprocessedoptions\@unprocessedoptions
831       \csname\@currname.\@currext-h@@k\endcsname
832       \expandafter\let\csname\@currname.\@currext-h@@k\endcsname
833         \@undefined
834       \@unprocessedoptions}
835     \@ifl@ter\@currext{#1}{#3}{}}%

```

<sup>13</sup>vo.2a 1993/11/14 Moved resetting of `\default@ds`, `\ds@` and `\@declaredoptions` here, from the end of `\ProcessOptions`.

<sup>14</sup>vo.2f 1993/11/22 Made the initial version [] not [`\@unknownversion`]

<sup>15</sup>vo.2m 1993/12/07 Reset `\CurrentOption`

<sup>16</sup>vo.2s 1994/01/17 Modify to reduce parameter stack usage

<sup>17</sup>v1.1b 1998/05/07 Modify help message for latex/2805

```

833     {\@latex@warning@no@line
834         {You have requested, \on@line,
835          version\MessageBreak
836          '#3' of \@cls@pkg\space #1, \MessageBreak
837          but only version\MessageBreak
838          '\csname ver@\#1.\@currext\endcsname'\MessageBreak
839          is available}}%
840
841     \ifx\@currext\@clsextension\let\LoadClass@twoloadclasserror\fi
842     \@popfilename
843     \@reset@ptions}%
844     \reserved@a}
845 \onlypreamble\onefilewithoptions

```

### \@@files with@pti@ns

Save the definition (for error checking). <sup>18</sup>

```

845 \let\@@files with@pti@ns\@files with@pti@ns
846 \onlypreamble\@@files with@pti@ns

```

### \@reset@ptions

Reset the default option, and clear lists of declared options.

```

847 \def\@reset@ptions{%
848   \global\ifx\@currext\@clsextension
849     \let\default@ds\OptionNotUsed
850   \else
851     \let\default@ds\@unknownoptionerror
852   \fi
853   \global\let\ds@\@empty
854   \global\let\@declaredoptions\@empty}
855 \onlypreamble\@reset@ptions

```

## 42.6.1 Hooks

Allow code do be saved to be executed at specific later times.

Save things in macros, I considered using toks registers, (and \addto@hook from the NFSS code, that would require stacking the contents in the case of required packages, so just generate a new macro for each package.

### \@begindocumenthook

### \@enddocumenthook

Stuff to appear at the beginning or end of the document.

```

856 \ifx\@begindocumenthook\@undefined
857   \let\@begindocumenthook\@empty
858 \fi
859 \let\@enddocumenthook\@empty

```

### \g@addto@macro

Globally add to the end of a macro.

---

<sup>18</sup>vo.2c 1993/11/17 Macro added

```

860 \long\def\g@addto@macro#1#2{%
861   \begingroup
862     \toks@\expandafter{#1#2}%
863     \xdef#1{\the\toks@}%
864   \endgroup}

\AtEndOfPackage

\AtEndOfClass

\AtBeginDocument

\AtEndDocument

865 \def\AtEndOfPackage{%
866   \expandafter\g@addto@macro\csname@\currname.\@currext-h@@k\endcsname}
867 \let\AtEndOfClass\AtEndOfPackage
868 \@onlypreamble\AtEndOfPackage
869 \@onlypreamble\AtEndOfClass

870 \def\AtBeginDocument{\g@addto@macro\@begindocumenthook}
871 \def\AtEndDocument{\g@addto@macro\@enddocumenthook}
872 \@onlypreamble\AtBeginDocument

\@cls@pkg

The current file type. Name changed to avoid clash with output routine.

873 \def\@cls@pkg{%
874   \ifx\@currext\@clsextension
875     document class%
876   \else
877     package%
878   \fi}
879 \@onlypreamble\@cls@pkg

\@unknownonoptionerror

Bad option.

880 \def\@unknownonoptionerror{%
881   \@latex@error
882     {Unknown option `\\CurrentOption' for \\space`\\currname'}%
883     {The option `\\CurrentOption' was not declared in
884      \\space`\\currname', perhaps you\\MessageBreak
885      misspelled its name.
886      Try typing \\space <return>
887      \\space to proceed.}}
888 \@onlypreamble\@unknownonoptionerror

\@unprocessedoptions

889 \def\@unprocessedoptions{%
890   \ifx\@currext\@pkgextension
891     \edef\@curroptions{\@optionlist{\@currname.\@currext}}%
892     \@for\CurrentOption:=\@curroptions\do{%

```

```

893     \ifx\CurrentOption\empty\else\@unknownoptionerror\fi}%
894     \fi}
895 \@onlypreamble\@unprocessedoptions
896 \@onlypreamble\@unprocessedoptions

\@badrequireerror
897 \def\@badrequireerror#1[#2]#3[#4]{%
898   \@latex@error
899   {\noexpand\RequirePackage or \noexpand\LoadClass
900     in Options Section}%
901   {The \cls@pkg\space `@\currname' is %
902    defective.\MessageBreak
903    It attempts to load '#3' in the options section, %
904    i.e.,\MessageBreak
905    between \noexpand\DeclareOption and %
906    \string\ProcessOptions.}%
907 }%
908 \@onlypreamble\@badrequireerror

\@twoloadclasserror
Two \LoadClass in a class.
905 \def\@twoloadclasserror{%
906   \@latex@error
907   {Two \noexpand\LoadClass commands}%
908   {You may only use one \noexpand\LoadClass in a class file}}
909 \@onlypreamble\@twoloadclasserror

\@twoclasseserror
Two \documentclass or \documentstyle.19
910 \def\@twoclasseserror#1#{%
911   \@latex@error
912   {Two \noexpand\documentclass or \noexpand\documentstyle %
913    commands}%
914   {The document may only declare one class.}\@gobble}
915 \@onlypreamble\@twoclasseserror

```

## 42.6.2 Providing shipment

### \two@digits

Prefix a number less than 10 with ‘o’.

```
915 \def\two@digits#1{\ifnum#1<10 0\fi\number#1}
```

### \filecontents

### \endfilecontents

---

<sup>19</sup>vo.2h 1993/11/28 Macro added

This environment implements inline files. The star-form does not write extra comments into the file. <sup>20 21 22 23 24 25</sup>

```

916 \begingroup%
917 \catcode`*=11 %
918 \catcode`\^M\active%
919 \catcode`\^L\active\let^\L\relax%
920 \catcode`\^I\active%
921 \gdef\filecontents{@tempswatrue\filec@ntents}%
922 \gdef\filecontents*{@tempswafalse\filec@ntents}%
923 \gdef\filec@ntents#1{%
924   \openin\@inputcheck#1 %
925   \ifeof\@inputcheck%
926     \@latex@warning@no@line%
927     {Writing file `@\currdir#1'}%
928     \chardef\reserved@c15 %
929     \ch@ck7\reserved@c\write%
930     \immediate\openout\reserved@c#1\relax%
931   \else%
932     \closein\@inputcheck%
933     \@latex@warning@no@line%
934     {File `#1' already exists on the %
935      \system.\MessageBreak%
936      Not generating it from this source}%
937     \let\write\@gobbletwo%
938     \let\closeout\@gobble%
939   \fi%
940   \if@tempswa%
26
940   \immediate\write\reserved@c{%
941     @percentchar@percentchar\space%
942     \expandafter\gobble\string\LaTeXe file `#1'^^J%
943     @percentchar@percentchar\space generated by the %
944     '@currenvir' %
945     \expandafter\gobblefour\string\newenvironment^^J%
946     @percentchar@percentchar\space from source %
947     ``\jobname' on %
948     \number\year/\two@digits\month/\two@digits\day.^^J%
949     @percentchar@percentchar}%
948   \fi%
949   \let\do\@makeother\dospecials%
27
950   \edef\E{@backslashchar end\string{@currenvir\string}}%
951   \edef\reserved@b{%

```

<sup>20</sup>vo.2h 1993/11/28 Don't globally allocate a write stream (always use 15)

<sup>21</sup>vo.2r 1993/12/19 Different message when ignoring a file

<sup>22</sup>vo.3g 1994/04/11 Add star form, dont write \endinput at the end of the file.

<sup>23</sup>v1.0c 1994/05/11 Add checks for form feed and tab

<sup>24</sup>v1.0m 1995/04/21 Close input check stream: latex/1487

<sup>25</sup>v1.0p 1995/05/25 Delete \filec@ntents after preamble

<sup>26</sup>v1.0y 1997/10/10 \@currenvir in banner

<sup>27</sup>v1.0y 1997/10/10 Check for text before or after \end environment. latex/2636

```

952      \def\noexpand\reserved@b%
953          #####1\E#####2\E#####3\relax}%
954 \reserved@b{%
955     \ifx\relax##3\relax%
956
957     There was no \end{filecontents}
958         \immediate\write\reserved@c{##1}%
959     \else%
960
961     There was a \end{filecontents}, so stop this time.
962         \edef^M{\noexpand\end{@currenvir}%
963             \ifx\relax##1\relax%
964             \else%
965
966             Text before the \end, write it with a warning.
967                 @latex@warning{Writing text `##1' before %
968                     \string\end{@currenvir}\MessageBreak as last }
969                     \line of #1}%
970             \immediate\write\reserved@c{##1}%
971             \fi%
972             \ifx\relax##2\relax%
973             \else%
974
975             Text after the \end, ignore it with a warning.
976                 @latex@warning{%
977                     Ignoring text `##2' after \string\end{@currenvir}}%
978                     \fi%
979                     ^M]%
980
981             \catcode`\^^L\active%
982             \let\L@\undefined%
983             \def^^L{\@ifundefined L^^J^^J^^J}%
984             \catcode`\^^I\active%
985             \let\I@\undefined%
986             \def^^I{\@ifundefined I\space\space}%
987             \catcode`\^^M\active%
988             \edef^M##1^^M{%
989                 \noexpand\reserved@b##1\E\E\relax}%
990
991             \endgroup%
992
993             \begingroup
994             \catcode`|= \catcode`\'%
995             \catcode`\%=12
996             \catcode`\*=11
997             \gdef\@percentchar{%
998                 \immediate\closeout\reserved@c
999                 \def\T##1##2##3{|%
1000                 \ifx##1\@undefined\else
1001                     @latex@warning@no@line{##2 has been converted to Blank }
1002                     \line{##3}|
1003                 \fi}|
1004                 \T\L{Form Feed}{Lin}|
1005                 \T\I{Tab}{Spac}|
1006                 \immediate\write\@unused{}}
1007             \global\let\endfilecontents*\endfilecontents

```

```

997 \@onlypreamble\filecontents
998 \@onlypreamble\endfilecontents
999 \@onlypreamble\filecontents*
1000 \@onlypreamble\endfilecontents*
1001 \endgroup
1002 \@onlypreamble\filecontents

1003 %</2ekernel>

```

## 42.7 After Preamble

Finally we declare a package that allows all the commands declared above to be `\@onlypreamble` to be used after `\begin{document}`.

```

1004 %<*afterpreamble>
1005 \NeedsTeXFormat{LaTeX2e}
1006 \ProvidesPackage{pkgindoc}
1007 [1994/10/20 v1.1 Package Interface in Document (DPC)]
1008 \def\reserved@a{\do@classoptionslist#2\do\filecontents#3\relax%
1009   \gdef\@preamblecmds{\#1#3}}
1010 \expandafter\reserved@a\@preamblecmds\relax
1011 %</afterpreamble>

```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

This file contains the code for loading hyphenation patterns into L<sup>A</sup>T<sub>E</sub>X. Most of this will end up in a file called `hyphen.ltx`. If you wish to customize your L<sup>A</sup>T<sub>E</sub>X system in respect of hyphenation patterns, write a file `hyphen.cfg`. If this file exists, it will be loaded instead of `hyphen.ltx`. See the comments below for additional information.

```
1012 %<*>driver>
1013 %\documentclass{ltxdoc}
1014 %\begin{document}
1015 %\DocInput{lthyphen.dtx}
1016 %\end{document}
1017 %</driver>
```

The default file `hyphen.ltx` loads hyphenation patterns for US english. If you want to load additional or other hyphenation patterns, you should create a file `hyphen.cfg`. This is best done by starting from `hyphen.ltx`.

For backward compatibility, the default file, `hyphen.ltx`, first tries to load the file `hyphen.tex`. If this file exists, an information message is issued and the appropriate defaults for T<sub>E</sub>X's internal parameters are set: `\language` is initialized to 0, and `\lefthyphenmin` and `\righthyphenmin` to 2 and 3, respectively, to disallow x- or -xx breaks.

```
1018 %<*>default>
1019 \InputIfFileExists{hyphen.tex}%
1020   {\message{Loading hyphenation patterns for US }%
1021    \language=0%
1022    \lefthyphenmin=2 \righthyphenmin=3 }%
1023   {\errhelp{The configuration for hyphenation is }%
1024    \incorrectly%
1025    \installed.^^J%
1026    \If you don't understand this error }%
1027    \message{you need }%
1028    \to seek^Jexpert advice.}%
1029   \errmessage{OOPS! I can't find any hyphenation }%
1030   \patterns for %
1031     US english.^^J \space Think of %
1032     \getting some or the %
1033     \latex2e setup will never %
1034     \succeed}\@@end}%
1035 %</default>
```

The following example describes the possible contents of a file `hyphen.cfg` that will load both US English and German hyphenation patterns, making the former the default. It sets `\language` to 0 for the US patterns and to 1 for the German patterns. Then `\language` is set to 0 to make this the default and the default values of `\lefthyphenmin` and `\righthyphenmin` are set.

```
\language=0
\input hyphen % (or \input ushyphen1 if the file has been renamed)
\language=1
```

```
\input ghyp31
\language=0
\lefthyphenmin=2
\righthyphenmin=3
\endinput
```

Another possibility is to use the package **babel**, by Johannes Braams. That package is distributed with a suitable **hyphen.cfg** file.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

This section contains the final settings for L<sup>A</sup>T<sub>E</sub>X. It initialises some debugging and typesetting parameters, sets the default \catcodes and uc/lc codes, and inputs the hyphenation file.

The latest version also take care of some necessary XeLaTeX parameters.

#### 44.0.1 Debugging

By default, L<sup>A</sup>T<sub>E</sub>X shows statistics:

```
1031 %<*2ekernel>
1032 \tracingstats1
```

#### 44.0.2 Typesetting parameters

\@lowpenalty These are penalties used internally.

```
\@medpenalty
1033 \@lowpenalty
\@highpenalty
1034 \@medpenalty
1035 \@highpenalty
```

(End definition for \@lowpenalty, \@medpenalty, and \@highpenalty.)

\newmarks Allocate extended marks types if etex is active. Placed here at the end of the format to increase compatibility with count allocations in earlier releases.

```
1036 %</2ekernel>
1037 %<*2ekernel|latexrelease>
1038 %<latexrelease>\IncludeInRelease{2015/01/01}%
1039 %<latexrelease>
1040           {\newmarks}{Extended }
           {Allocation}%

```

If eTeX is available, an allocation command is made available. \marks is an etex primitive command. It extends the ??<sup>P.??</sup> command of the original tex. You can use it to store text on the current page which you want to use at shipout in the headers.

```
1040 \ifx\marks@undefined\else
1041 \def\newmarks{%
1042   \e@alloc\marks \e@alloc@chardef{\count256}\m@ne\e@alloc@top}
1043 \fi
1044 \documentclass{article}
1045 \usepackage{etex}
1046 \newmarks\mymark
1047 \usepackage{fancyhdr}
1048 \pagestyle{fancy}
1049 \fancyhf{}
1050 \lhead{\topmarks\mymark, \botmarks\mymark, \firstmarks\mymark}
1051 \begin{document}
1052 text
1053 \marks\mymark{A first mark}
1054
1055 \marks\mymark{A second mark}
1056
1057 \newpage
1058
```

```

1059 text \marks\mymark{A third mark}
1060 \end{document}

See TX.SX
macro:->\e@alloc \marks \e@alloc@chardef {\count 256}\m@ne \e@al-
loc@top

1061 %%</2ekernel|latexrelease>
1062 %%<latexrelease>\EndIncludeInRelease
1063 %%<latexrelease>\IncludeInRelease{0000/00/00}%
1064 %%<latexrelease>           {\newmarks}{Extended }%
    {Allocation}%
1065 %%<latexrelease>\let\newmarks@\undefined
1066 %%<latexrelease>\EndIncludeInRelease
1067 %%<*2ekernel>

        (End definition for \newmarks.)

1068 %%</2ekernel>
1069 %%<*2ekernel|latexrelease>
1070 %%<latexrelease>\IncludeInRelease{2015/01/01}%
1071 %%<latexrelease>           %
    {\newXeTeXintercharclass}{Extended Allocation}%

1072 \ifx\XeTeXcharclass@\undefined
1073 \else
1074 \ifdim\the\XeTeXversion\XeTeXrevision\p@>0.99993\p@
1075   \chardef\e@alloc@intercharclass@top=4095
1076 \else
1077   \chardef\e@alloc@intercharclass@top=255
1078 \fi
1079 \def\newXeTeXintercharclass{%
1080   \e@alloc\XeTeXcharclass
1081   \chardef\xe@alloc@intercharclass@m@ne\e@alloc@intercharclass@top}
1082 \fi

1083 %%</2ekernel|latexrelease>
1084 %%<latexrelease>\EndIncludeInRelease
1085 %%<latexrelease>\IncludeInRelease{0000/00/00}%
1086 %%<latexrelease>           %
    {\newXeTeXintercharclass}{Extended Allocation}%
1087 %%<latexrelease> \ifx\XeTeXcharclass@\undefined
1088 %%<latexrelease> \else
1089 %%<latexrelease>   %
    {\def\xe@alloc@#1#2#3#4#5{\global\advance#1@ne
1090 %%<latexrelease>     \xe@ch@ck#1#4#2%
1091 %%<latexrelease>     \allocationnumber#1%
1092 %%<latexrelease>     \global#3#5\allocationnumber
1093 %%<latexrelease>   %
    {\wlog{\string#5=\string#2\the\allocationnumber}}%
1094 %%<latexrelease>   \def\xe@ch@ck#1#2#3{%
1095 %%<latexrelease>     \ifnum#1<#2\else
1096 %%<latexrelease>       \errmessage{No room for a new #3}%
1097 %%<latexrelease>     \fi}%
1098 %%<latexrelease>   \def\newXeTeXintercharclass{%
1099 %%<latexrelease>     \xe@alloc@\xe@alloc@intercharclass

```

```

1100 %<latexrelease>           >
    {\XeTeXcharclass\chardef\@cclv}
1101 %<latexrelease> \fi
1102 %<latexrelease>\EndIncludeInRelease
1103 %<*2ekernel|latexrelease>
1104 %<latexrelease>\IncludeInRelease{2016/02/01}%
1105 %<latexrelease> {\xe@alloc@intercharclass}{Start of XeTeX >
    {class allocator}%
1106 \ifx\XeTeXcharclass\@undefined
1107 \else
1108     \countdef\xe@alloc@intercharclass=257
1109     \xe@alloc@intercharclass=\z@
1110 \fi
1111 %</2ekernel|latexrelease>
1112 %<latexrelease>\EndIncludeInRelease
1113 %<latexrelease>\IncludeInRelease{2015/01/01}%
1114 %<latexrelease> {\xe@alloc@intercharclass}{Start of XeTeX >
    {class allocator}%
1115 %<latexrelease> \ifx\XeTeXcharclass\@undefined
1116 %<latexrelease> \else
1117     \xe@alloc@intercharclass=\thr@@
1118 %<latexrelease> \fi
1119 %<latexrelease>\EndIncludeInRelease
1120 %<latexrelease>\IncludeInRelease{0000/00/00}%
1121 %<latexrelease> {\xe@alloc@intercharclass}{Start of XeTeX >
    {class allocator}%
1122 %<latexrelease> \ifx\XeTeXcharclass\@undefined
1123 %<latexrelease> \else
1124     \newcount\xe@alloc@intercharclass
1125     \xe@alloc@intercharclass=\thr@@
1126 %<latexrelease> \fi
1127 %<latexrelease>\EndIncludeInRelease
1128 %<*2ekernel>

1129 \unitlength = 1pt
1130 \fboxsep = 3pt
1131 \fboxrule = .4pt

1132 \@maxdepth      = \maxdepth
\vsized initialized because a \clearpage with \vsized < \topskip causes
trouble. \@colroom and \@colht also initialized because \vsized may be set
to them if a \clearpage is done before the \begin{document}

1133 \vsized = 1000pt
1134 \@colroom = \vsized
1135 \@colht = \vsized
    Initialise \textheight \textwidth and page style, to avoid internal errors
    if they are not set by the class.

1136 \textheight=.5\maxdimen
1137 \textwidth=\textheight
1138 \ps@empty

```

### 44.0.3 Lccodes for hyphenation

For 7- and 8-bit engines the assumption of T1 encodings is the basis for the hyphenation patterns. That's not the case for the Unicode engines, where the assumption is engine-native working. The common loader system provides access to data from the Unicode Consortium covering not only `\lccode` but also other related data. The `\lccode` part of that at least needs to be loaded before hyphenation is tackled: XeTeX follows the standard TeX route of building patterns into the format. LuaTeX doesn't require this data be loaded *here* but it does need to be loaded somewhere. Rather than test for the Unicode engines by name, the approach here is to look for the extended math mode handling both provide: any other engine developed in this area will presumably also provide `\Umathcode`.

```

1139 \ifnum 0%
1140   \ifx\Umathcode\@undefined\else 1\fi
1141   \ifx\XeTeXmathcode\@undefined\else 1\fi
1142   >\z@
1143   \message{ Unicode character data,}
1144   \input{load-unicode-data}
1145 %%</2ekernel>
1146 %<latexrelease>\IncludeInRelease{2016/02/01}%
1147 %<latexrelease> {\XeTeXintercharclasses}{XeTeX character }
  {classes}%
1148 %<latexrelease> \ifx\XeTeXinterchartoks\undefined
1149 %<latexrelease> \else
1150 %<latexrelease> \begin{group}
1151 %<latexrelease>   \chardef\XeTeXcharclassID = 0 %
1152 %<latexrelease>   \chardef\XeTeXcharclassOP = 0 %
1153 %<latexrelease>   \chardef\XeTeXcharclassCL = 0 %
1154 %<latexrelease>   \chardef\XeTeXcharclassEX = 0 %
1155 %<latexrelease>   \chardef\XeTeXcharclassIS = 0 %
1156 %<latexrelease>   \chardef\XeTeXcharclassNS = 0 %
1157 %<latexrelease>   \chardef\XeTeXcharclassCM = 0 %
1158 %<latexrelease>   \input{load-unicode-xetex-classes}
1159 %<latexrelease> \end{group}
1160 %<latexrelease> \global\let\xtxHanGlue\undefined
1161 %<latexrelease> \global\let\xtxHanSpace\undefined
1162 %<latexrelease> \global\XeTeXinterchartoks 0 1 = {}
1163 %<latexrelease> \global\XeTeXinterchartoks 0 2 = {}
1164 %<latexrelease> \global\XeTeXinterchartoks 0 3 = {}
1165 %<latexrelease> \global\XeTeXinterchartoks 1 0 = {}
1166 %<latexrelease> \global\XeTeXinterchartoks 2 0 = {}
1167 %<latexrelease> \global\XeTeXinterchartoks 3 0 = {}
1168 %<latexrelease> \global\XeTeXinterchartoks 1 1 = {}
1169 %<latexrelease> \global\XeTeXinterchartoks 1 2 = {}
1170 %<latexrelease> \global\XeTeXinterchartoks 1 3 = {}
1171 %<latexrelease> \global\XeTeXinterchartoks 2 1 = {}
1172 %<latexrelease> \global\XeTeXinterchartoks 2 2 = {}
1173 %<latexrelease> \global\XeTeXinterchartoks 2 3 = {}
1174 %<latexrelease> \global\XeTeXinterchartoks 3 1 = {}
1175 %<latexrelease> \global\XeTeXinterchartoks 3 2 = {}
1176 %<latexrelease> \global\XeTeXinterchartoks 3 3 = {}
1177 %<latexrelease> \fi

```

```

1178 %<latexrelease>\EndIncludeInRelease
1179 %<latexrelease>\IncludeInRelease{0000/00/00}%
1180 %<latexrelease> {\XeTeXintercharclasses}{XeTeX character }%
  {classes}%
1181 %<latexrelease> \ifx\XeTeXinterchartoks\undefined
1182 %<latexrelease> \else
1183 %<latexrelease> \input{load-unicode-xetex-classes}
1184 %<latexrelease> \gdef\xtxHanGlue{\hskip0pt plus 0.1em\relax}
1185 %<latexrelease> \gdef\xtxHanSpace{\hskip0.2em plus 0.2em }%
  {minus 0.1em\relax}
1186 %<latexrelease> \global\XeTeXinterchartoks 0 1 = %
  {{\xtxHanSpace}}
1187 %<latexrelease> \global\XeTeXinterchartoks 0 2 = %
  {{\xtxHanSpace}}
1188 %<latexrelease> \global\XeTeXinterchartoks 0 3 = %
  {{\nobreak\xtxHanSpace}}
1189 %<latexrelease> \global\XeTeXinterchartoks 1 0 = %
  {{\xtxHanSpace}}
1190 %<latexrelease> \global\XeTeXinterchartoks 2 0 = %
  {{\nobreak\xtxHanSpace}}
1191 %<latexrelease> \global\XeTeXinterchartoks 3 0 = %
  {{\xtxHanSpace}}
1192 %<latexrelease> \global\XeTeXinterchartoks 1 1 = %
  {{\xtxHanGlue}}
1193 %<latexrelease> \global\XeTeXinterchartoks 1 2 = %
  {{\xtxHanGlue}}
1194 %<latexrelease> \global\XeTeXinterchartoks 1 3 = %
  {{\nobreak\xtxHanGlue}}
1195 %<latexrelease> \global\XeTeXinterchartoks 2 1 = %
  {{\nobreak\xtxHanGlue}}
1196 %<latexrelease> \global\XeTeXinterchartoks 2 2 = %
  {{\nobreak\xtxHanGlue}}
1197 %<latexrelease> \global\XeTeXinterchartoks 2 3 = %
  {{\xtxHanGlue}}
1198 %<latexrelease> \global\XeTeXinterchartoks 3 1 = %
  {{\xtxHanGlue}}
1199 %<latexrelease> \global\XeTeXinterchartoks 3 2 = %
  {{\xtxHanGlue}}
1200 %<latexrelease> \global\XeTeXinterchartoks 3 3 = %
  {{\nobreak\xtxHanGlue}}
1201 %<latexrelease> \fi
1202 %<latexrelease>\EndIncludeInRelease
1203 %<2ekernel>
1204 \lccode`\-=`\-\ % default hyphen char
1205 \else

```

We set things up so that hyphenation files can assume that the default (T1) lc-codes are in use (at present this also sets up the uccodes). We temporarily define `\reserved@a` to apply `\reserved@c` to all the numbers in the range of its arguments.

```

1206 \def\reserved@a#1#2{%
1207   @_tempcnta#1\relax
1208   @_tempcntb#2\relax

```

```

1209     \reserved@b
1210 }
1211 \def\reserved@b{%
1212     \ifnum\@tempcnta>\@tempcntb\else
1213         \reserved@c\@tempcnta
1214         \advance\@tempcnta\@ne
1215         \expandafter\reserved@b
1216     \fi
1217 }

```

Depending on the TeX version, we might not be allowed to do this for non-ASCII characters.

```

1218 \def\reserved@c{%
1219     \count@=#1\advance\count@ by -"20
1220     \uccode#1=\count@
1221     \lccode#1=#1
1222 }
1223 \reserved@a{\`a}{\`z}
1224 \reserved@a{"A0}{"BC}
1225 \reserved@a{"E0}{"FF}

```

The upper case characters need their `\uccode` and `\lccode` values set, and their `\sfcode` set to 999.

```

1226 \def\reserved@c{%
1227     \count@=#1\advance\count@ by "20
1228     \uccode#1=#1
1229     \lccode#1=\count@
1230     \sfcode#1=999
1231 }
1232 \reserved@a{\`A}{\`Z}
1233 \reserved@a{"80}{"9C}
1234 \reserved@a{"C0}{"DF}

1235 \uccode`\^Y=\`I      % dotless i
1236 \lccode`\^Y=\`^Y    % dotless i
1237 \uccode`\^Z=\`J      % dotless j, ae in OT1
1238 \lccode`\^Z=\`^Z    % dotless j, ae in OT1
1239 \lccode`\^9d=\`i      % dotted I
1240 \uccode`\^9d=\`^9d    % dotted I
1241 \lccode`\^9e=\`^9e    % d-bar
1242 \uccode`\^9e=\`^d0    % d-bar

1243 \lccode`\^=[`\^[

```

And we also set the `\lccode` of `\-` and `\textcompwordmark` so that they do not prevent hyphenation in the remainder of the word (as suggested by Lars Helström).

```

1244 \lccode`\- =`\-    % default hyphen char
1245 \lccode 127=127    % alternate hyphen char
1246 \lccode 23 =23    % textcompwordmark in T1

```

End of the conditional to select either Unicode or T1 encoding defaults.

```
1247 \fi
```

This is as good a place as any to active a few XeTeX-specific settings

```

1248 \ifx\XeTeXuseglyphmetrics\undefined
1249 \else

```

```

1250   \XeTeXuseglyphmetrics=1 %
1251   \XeTeXdashbreakstate=1 %
1252 \fi

```

## 44.1 Hyphenation

The following code will be compiled into the format file. It checks for the existence of `hyphen.cfg` in inputs that file if found. Otherwise it inputs `hyphen.ltx`. Note that these are loaded in *before* the `\catcodes` are set, so local hyphenation files can use 8-bit input. We try to load the customized hyphenation description file.

```

1253 \InputIfFileExists{hyphen.cfg}
1254   {\typeout{=====
1255     Local configuration file hyphen.cfg }
1256     \used^{}}%
1257   \def\@addtofilelist##1{\xdef\@filelist{\@filelist,##1}}%
1258 }
1259   {\input{hyphen.ltx}}
1260 \let\@addtofilelist\@gobble
1261 \ifx\l@nohyphenation \@undefined
1262   \newlanguage\l@nohyphenation
1263 \fi

```

`ent@default@language` Default document language. `-1` acts as language `o`, but used as a flag in `\document` to see if it has been set in the preamble.

```
1264 \let\document@default@language\m@ne
```

(End definition for `\document@default@language`.)

### 44.1.1 Font loading

Fonts loaded during the formatting process might already have changed the `\font@submax` from `0pt` to something higher. If so, we put out a bold warning.

```

1265 \ifdim \font@submax >\z@
1266   \@font@warning{Size substitutions with }
   \differences\MessageBreak
1267   up to \font@submax\space have
   \occurred.\MessageBreak
1268   \MessageBreak
1269   Please check the transcript file
   carefully\MessageBreak
1270   and redo the format generation if necessary!
   \@gobbletwo}%
1272 \errhelp{Only stopped, to give you time to
1273   read the above message.}
1274 \errmessage{}%
1275

```

We reset the macro. Otherwise every user will get a warning on every job.

```
1276 \def\font@submax{0pt}
1277 \fi
```

### 44.1.2 Input encoding

We temporarily define `\reserved@a` to apply `\reserved@c` to all the numbers in the range of its arguments.

```
1278 \def\reserved@a#1#2{%
1279   \@tempcnta#1\relax
1280   \@tempcntb#2\relax
1281   \reserved@b
1282 }
1283 \def\reserved@b{%
1284   \ifnum\@tempcnta>\@tempcntb\else
1285     \reserved@c\@tempcnta
1286     \advance\@tempcnta\@ne
1287     \expandafter\reserved@b
1288   \fi
1289 }
```

Set the special catcodes (although some of these are useless, since an error will have occurred if the catcodes have changed). Note that `^J` has catcode ‘other’ for use in warning messages.

```
1290 \catcode`\_=10
1291 \catcode`\#=6
1292 \catcode`\$=3
1293 \catcode`\%=14
1294 \catcode`\&=4
1295 \catcode`\\=0
1296 \catcode`\^=7
1297 \catcode`\_=8
1298 \catcode`\{=1
1299 \catcode`\}=2
1300 \catcode`\~=13
1301 \catcode`\@=11
1302 \catcode`\^I=10
1303 \catcode`\^J=12
1304 \catcode`\^L=13
1305 \catcode`\^M=5
```

Set the ‘other’ catcodes.

```
1306 \def\reserved@c#1{\catcode#1=12\relax}
1307 \reserved@c{`!`}
1308 \reserved@c{`"}
1309 \reserved@a{`'}`\?`}
1310 \reserved@c{`[`}
1311 \reserved@c{`]`}
1312 \reserved@c{``}
1313 \reserved@c{`|`}
```

Set the ‘letter’ catcodes.

```
1314 \def\reserved@c#1{\catcode#1=11\relax}
1315 \reserved@a{`\A}`\Z}
1316 \reserved@a{`\a}`\z}
```

All the characters in the range 0–31 and 127–255 are illegal, except tab (`^I`), nl (`^J`), ff (`^L`) and cr (`^M`). Now allow 8-bit characters, although their use in this way is strongly discouraged. See `inputenc.dtx` for a supported mechanism for 8-bit input.

```

1317 \def\reserved@c{\catcode#1=15\relax}
1318 \reserved@a{0}{`^\^H}
1319 \reserved@c{`^\^K}
1320 \reserved@a{`^\^N}{31}

```

#### 44.1.3 Lccodes and uccodes

```

1321 \ifnum 0%
1322   \ifx\Umathcode@\undefined\else 1\fi
1323   \ifx\XeTeXmathcode@\undefined\else 1\fi
1324   >\z@
1325 \else
1326 \def\reserved@c{%
1327   \count@=#1\advance\count@ by -"20
1328   \uccode#1=\count@
1329   \lccode#1=#1
1330 }
1331 \reserved@a{`\a}{`\z}
1332 \reserved@a{"A0}{BC}
1333 \reserved@a{"E0}{FF}

```

The upper case characters need their `\uccode` and `\lccode` values set, and their `\sfcode` set to 999.

```

1334 \def\reserved@c{%
1335   \count@=#1\advance\count@ by "20
1336   \uccode#1=#1
1337   \lccode#1=\count@
1338   \sfcode#1=999
1339 }
1340 \reserved@a{`\A}{`\Z}
1341 \reserved@a{"80}{9C}
1342 \reserved@a{"C0}{DF}

```

Well, it would be nice if that were correct, but unfortunately, the Cork encoding contains some odd slots whose uccode or lccode isn't quite what you'd expect.

```

1343 \uccode`\^\^Y=`\I      % dotless i
1344 \lccode`\^\^Y=`\^\^Y  % dotless i
1345 \uccode`\^\^Z=`\J      % dotless j, ae in OT1
1346 \lccode`\^\^Z=`\^\^Z  % dotless j, ae in OT1
1347 \lccode`\^\^9d=`\i    % dotted I
1348 \uccode`\^\^9d=`\^\^9d % dotted I
1349 \lccode`\^\^9e=`\^\^9e % d-bar
1350 \uccode`\^\^9e=`\^\^d0 % d-bar

1351 \lccode`\^\^=[`\^\^[    % oe in OT1
1352 \fi % End of reset block for 8-bit engines

1353 \DeclareRobustCommand{\MakeUppercase}[1]{%
1354   \def\i{I}\def\j{J}%
1355   \def\reserved@a##1##2{\let##1##2\reserved@a}%
1356   \expandafter\reserved@a\@uclclist\reserved@b{\reserved@b\@gobble}%
1357   \protected\edef\reserved@a{\uppercase{\#1}}%
1358   \reserved@a
1359 }

```

```

1360 \DeclareRobustCommand{\MakeLowercase}[1]{{%
1361     \def\reserved@a##1##2{\let##2##1\reserved@a}%
1362     \expandafter\reserved@a\@uclclist\reserved@b{\reserved@b\@gobble}%
1363     \protected@edef\reserved@a{\lowercase{#1}}%
1364     \reserved@a
1365 }
1366 \def@\uclclist{\oe\OE\o\O\ae\AE
1367     \dh\DH\dj\DJ\l\L\ng\NG\ss\SS\th\TH}

1368 \protected@edef\MakeUppercase#1{\MakeUppercase{#1}}
1369 \protected@edef\MakeLowercase#1{\MakeLowercase{#1}}

1370 \% \IfFileExists{ltpatch.ltx}
1371 %   {\typeout{=====
1372 %           Applying patch file ltpatch.ltx^^J%
1373 %           =====}
1374 %   \def\fmtversion@topatch{unknown}
1375 %   \input{ltpatch.ltx}
1376 %   \ifx\fmtversion\fmtversion@topatch
1377 %       \ifx\patch@level\@undefined
1378 %           \typeout{^^J^^J^^J%
1379 %           }
1380 %           !! Patch file `ltpatch.ltx' not suitable for this^^J%
1381 %           !! version of LaTeX.^^J^^J%
1382 %           !! Please check if initex found an old patch !
1383 %           !! --- if so, rename it or delete it, and redo !
1384 %           !! initex run.^^J%
1385 %           }
1386 %           \batchmode \@@end
1387 %   \else

1388 %       \def\fmtversion@topatch{0}%
1389 %       \ifx\fmtversion@topatch\patch@level\else
1390 %           \def\reserved@a\typeout##1##2\reserved@a{%
1391 %               \typeout{##1 patch level \patch@level}##2}
1392 %           \everyjob\expandafter\expandafter\expandafter{%
1393 %               \expandafter\reserved@a\the\everyjob\reserved@a}
1394 %           \let\reserved@a\relax
1395 %           \the\everyjob
1396 %           \fi
1397 %           \fi
1398 %   \else
1399 %       \typeout{^^J^^J^^J%
1400 %           !!! Patch file `ltpatch.ltx' (for version !
1401 %           <\fmtversion@topatch>)^^J%
1402 %           ! is not suitable for version <\fmtversion> of !
1403 %           <LaTeX.^^J^^J%
1404 %           !! Please check if initex found an old patch file:^^J%
1405 %           !! --- if so, rename it or delete it, and redo the^^J%
1406 %           !!     initex run.^^J%

```

```

1406 %      2
1407 %      \batchmode \@@end
1408 %      \fi
1409 %      \let\fmtversion@topatch\relax
1410 %      }{}}

1411 \let\reserved@a@\filelist
1412 \let\reserved@b=\@undefined
1413 \let\reserved@c=\@undefined
1414 \let\reserved@d=\@undefined
1415 \let\reserved@e=\@undefined
1416 \let\reserved@f=\@undefined

1417 \toks0={}
1418 \toks2={}
1419 \toks4={}
1420 \toks6={}
1421 \toks8={}

1422 \errhelp{}
```

#### 44.1.4 Initialise file list

```
\@providesfile
1423 \def\@providesfile#1[#2]{%
1424   \wlog{File: #1 #2}%
1425   \expandafter\xdef\csname ver@#1\endcsname{#2}%
1426 }
```

*(End definition for \@providesfile.)*

```
\@filelist
1427 \let\@filelist\@gobble
1428 \def\@addtofilelist#1{\xdef\@filelist{\@filelist,#1}}%
```

*(End definition for \@filelist.)*

#### 44.1.5 Dumping the format

Finally we make @ into a letter, ensure the format will be in the ‘normal’ error mode, and dump everything into the format file. Call \errorstopmode

```

1429 \makeatother
1430 \errorstopmode
1431 \dump
1432 %</2ekernel>
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 45.1 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  $\text{\LaTeX}\ 2\epsilon$  kernel level plus as a loadable file which can be used with plain TeX and  $\text{\LaTeX}$ .

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  $\text{\LaTeX}\ 2\epsilon$  kernel from 2015 onward these registers are part of the block in the extended area reserved by the kernel (prior to 2015 the  $\text{\LaTeX}\ 2\epsilon$  kernel did not provide any functionality for the extended allocation area).

## 45.2 Core TeX functionality

The commands defined here are defined for possible inclusion in a future  $\text{\LaTeX}$  format, however also extracted to the file `ltluatex.tex` which may be used with older  $\text{\LaTeX}$  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 `lua.name` table to be used in stack traces.

`\catcodetable@init@Predefined` Predefined category code tables with the obvious assignments. Note that the `\catcodetable@string@tex` and `atletter` tables set the full Unicode range to the codes predefined by the kernel.

`\catcodetable@atlett@setattribute{<attribute>}{{value}}`  
`\setattribute \unsetattribute{<attribute>}`

`\unsetattribute` 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.

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

The `ltluatex` 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 `ltluatex` 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 `ltluatex` code but implements a compatibility layer providing the interface of the original package.

## 45.4 Lua functionality

### 45.4.1 Allocators in Lua

`new_attribute` `luatexbase.new_attribute(<attribute>)`  
 Returns an allocation number for the `<attribute>`, indexed from 1. The attribute will be initialised with the marker value `"7FFFFFFF"` ('unset'). The attribute allocation sequence is shared with the T<sub>E</sub>X code but this function does *not* define a token using `\attributedef`. The attribute name is recorded in the `attributes` 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.

`new_whatsit` `luatexbase.new_whatsit(<whatsit>)`  
 Returns an allocation number for the custom `<whatsit>`, indexed from 1.

`new_bytocode` `luatexbase.new_bytocode(<bytocode>)`  
 Returns an allocation number for a bytecode register, indexed from 1. The optional `<name>` argument is just used for logging.

`new_chunkname` `luatexbase.new_chunkname(<chunkname>)`  
 Returns an allocation number for a Lua chunk name for use with `\directlua` and `\latelua`, indexed from 1. The number is returned and also `<name>` argument is added to the `lua.name` array at that index.

`new_luafunction` `luatexbase.new_luafunction(<functionname>)`  
 Returns an allocation number for a lua function for use with `\luafunction`, `\lateluafunction`, and `\luadef`, indexed from 1. The optional `<functionname>` 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 `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`.

#### 45.4.2 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 LuaTeX 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`).

#### 45.4.3 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.

#### 45.4.4 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 LuaTeX 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.

`callback_descriptions` A list of the descriptions of functions registered to the specified callback is returned. `{}` is returned if there are no functions registered.

`create_callback` `\luatexbase.create_callback(<name>, metatype, <default>)` Defines a user defined callback. The last argument is a default function or `false`.

`call_callback` `\luatexbase.call_callback(<name>, ...)` Calls a user defined callback with the supplied arguments.

```

1433 %<*2ekernel|tex|latexrelease>
1434 %<2ekernel|latexrelease>\ifx\directlua@undefined\else
1435 %<latexrelease>\IncludeInRelease{2015/10/01}
1436 %<latexrelease>          {\newluafunction}{LuaTeX}%
1437 \ifnum\luatexversion<60 %
1438   \wlog{*****}
1439   \wlog{* LuaTeX version too old for ltluatex support *}
1440   \wlog{*****}
1441 \expandafter\endinput
1442 \fi
1443 %<*tex>
1444 \directlua{tex.enableprimitives("",tex.extraprimitives("luatex"))}
1445 \ifx\et@alloc@undefined
1446   \ifx\documentclass@undefined
1447     \ifx\loccount@undefined
1448       \input{etex.src}%
1449     \fi
1450     \catcode`\@=11 %
1451     \outer\expandafter\def\csname newfam\endcsname
1452       {\alloc@8\fam\chardef\et@xmaxfam}
1453   \else
1454     \RequirePackage{etex}
1455     \expandafter\def\csname newfam\endcsname
1456       {\alloc@8\fam\chardef\et@xmaxfam}
1457     \expandafter\let\expandafter\new@mathgroup\csname
1458       \newfam\endcsname
1459   \fi
1460 \edef \et@xmaxregs {\ifx\directlua@undefined 32768\else 2
1461   65536\fi}

```

```

1460 \edef \et@xmaxfam {
1461   \ifx\Umathchar@\undefined\sixt@@n\else@cclvi\fi}
1462 \count 270=\et@xmaxregs % locally allocates \count registers
1463 \count 271=\et@xmaxregs % ditto for \dimen registers
1464 \count 272=\et@xmaxregs % ditto for \skip registers
1465 \count 273=\et@xmaxregs % ditto for \muskip registers
1466 \count 274=\et@xmaxregs % ditto for \box registers
1467 \count 275=\et@xmaxregs % ditto for \toks registers
1468 \count 276=\et@xmaxregs % ditto for \marks classes
1469 % \outer\def\newfam{\alloc@8\fam\chardef\et@xmaxfam}
1470 \expandafter\let\csname \newcount\expandafter\expandafter\endcsname
1471           \csname globcount\endcsname
1472 \expandafter\let\csname \newdimen\expandafter\expandafter\endcsname
1473           \csname globdimen\endcsname
1474 \expandafter\let\csname \newskip\expandafter\expandafter\endcsname
1475           \csname globskip\endcsname
1476 \expandafter\let\csname \newbox\expandafter\expandafter\endcsname
1477           \csname globbox\endcsname
1478 \chardef\@alloc@top=65535
1479 \let\@alloc@chardef\chardef
1480 \def\@alloc#1#2#3#4#5#6{%
1481   \global\advance#3\@ne
1482   \e@ch@ck{#3}{#4}{#5}#1%
1483   \allocationnumber#3\relax
1484   \global#2#6\allocationnumber
1485   \wlog{\string#6=\string#1\the\allocationnumber}}%
1486 \gdef\@ch@ck#1#2#3#4{%
1487   \ifnum#1<#2\else
1488     \ifnum#1=#2\relax
1489       #1@cclvi
1490       \ifx\count#4\advance#1 10 \fi
1491     \fi
1492     \ifnum#1<#3\relax
1493     \errmessage{No room for a new \string#4}%
1494   \fi
1495 }%
1496 \long\def@gobble#1{}
1497 \long\def@firstofone#1{#1}
1498 \expandafter\csname newcount\endcsname\@alloc@attribute@count
1499 \expandafter\csname newcount\endcsname\@alloc@ccodetable@count
1500 \expandafter\csname \newcount\endcsname\@alloc@luafunction@count
1501 \expandafter\csname newcount\endcsname\@alloc@whatsit@count
1502 \expandafter\csname newcount\endcsname\@alloc@bytecode@count
1503 \expandafter\csname newcount\endcsname\@alloc@luachunk@count

```

```

1504 \fi
1505 %</tex>
1506 \ifx\@alloc@attribute@count\@undefined
1507   \countdef\@alloc@attribute@count=258
1508 \fi
1509 \def\newattribute#1{%
1510   \e@alloc\attribute\attributedef
1511   \e@alloc@attribute@count\m@ne\@alloc@top#1%
1512 }
1513 \e@alloc@attribute@count=\z@
1514 \def\setattribute#1#2{#1=\numexpr#2\relax}
1515 \def\unsetattribute#1{#1=-"7FFFFFFF\relax}
1516 \ifx\@alloc@ccodetable@count\@undefined
1517   \countdef\@alloc@ccodetable@count=259
1518 \fi
1519 \def\newcatcodetable#1{%
1520   \e@alloc\catcodetable\chardef
1521   \e@alloc@ccodetable@count\m@ne{"8000}#1%
1522   \initcatcodetable\allocationnumber
1523 }
1524 \e@alloc@ccodetable@count=\z@
1525 \newcatcodetable\catcodetable@initex
1526 \newcatcodetable\catcodetable@string
1527 \begingroup
1528   \def\setstrangeccatcode#1#2#3{%
1529     \ifnum#1>#2 %
1530       \expandafter\@gobble
1531     \else
1532       \expandafter\@firstofone
1533     \fi
1534     {%
1535       \catcode#1=#3 %
1536       \expandafter\setstrangeccatcode\expandafter
1537       {\number\numexpr#1 + 1\relax}{#2}{#3}
1538     }%
1539   }
1540   \@firstofone{%
1541     \catcodetable\catcodetable@initex
1542     \catcode0=12 %
1543     \catcode13=12 %
1544     \catcode37=12 %
1545     \setstrangeccatcode{65}{90}{12}%
1546     \setstrangeccatcode{97}{122}{12}%
1547     \catcode92=12 %
1548     \catcode127=12 %
1549     \savecatcodetable\catcodetable@string
1550   }\endgroup
1551 }%
1552 \newcatcodetable\catcodetable@latex
1553 \newcatcodetable\catcodetable@atletter
1554 \begingroup
1555   \def\parseunicodedata#1;#2;#3;#4\relax{%

```

```

1556     \parseunicodedataII#1;#3;#2 First>\relax
1557   }%
1558 \def\parseunicodedataII#1;#2;#3 First>#4\relax{%
1559   \ifx\relax#4\relax
1560     \expandafter\parseunicodedataIII
1561   \else
1562     \expandafter\parseunicodedataIV
1563   \fi
1564   {#1}#2\relax%
1565 }%
1566 \def\parseunicodedataIII#1#2#3\relax{%
1567   \ifnum 0%
1568     \if L#21\fi
1569     \if M#21\fi
1570     >0 %
1571     \catcode"#1=11 %
1572   \fi
1573 }%
1574 \def\parseunicodedataIV#1#2#3\relax{%
1575   \read\unicoderead to \unicodedataline
1576   \if L#2%
1577     \count0="#1 %
1578     \expandafter\parseunicodedataV\unicodedataline\relax
1579   \fi
1580 }%
1581 \def\parseunicodedataV#1;#2\relax{%
1582   \loop
1583     \unless\ifnum\count0>"#1 %
1584       \catcode\count0=11 %
1585       \advance\count0 by 1 %
1586   \repeat
1587 }%
1588 \def\storedpar{\par}%
1589 \chardef\unicoderead=\numexpr\count16 + 1\relax
1590 \openin\unicoderead=UnicodeData.txt %
1591 \loop\unless\ifeof\unicoderead %
1592   \read\unicoderead to \unicodedataline
1593   \unless\ifx\unicodedataline\storedpar
1594     \expandafter\parseunicodedataI\unicodedataline\relax
1595   \fi
1596 \repeat
1597 \closein\unicoderead
1598 \@firstofone{%
1599   \catcode64=12 %
1600   \savecatcodetable\catcodetable@latex
1601   \catcode64=11 %
1602   \savecatcodetable\catcodetable@atletter
1603 }
1604 \endgroup
1605 \ifx\@alloc@luafunction@count@\undefined
1606   \countdef\@alloc@luafunction@count=260
1607 \fi
1608 \def\newluafunction{%
1609   \@alloc\luafunction\@alloc@chardef

```

```

1610     \e@alloc@luafunction@count\m@ne\e@alloc@top
1611 }
1612 \e@alloc@luafunction@count=\z@
1613 \ifx\e@alloc@whatsit@count@undefined
1614   \countdef\e@alloc@whatsit@count=261
1615 \fi
1616 \def\newwhatsit#1{%
1617   \e@alloc\whatsit\e@alloc@chardef
1618   \e@alloc@whatsit@count\m@ne\e@alloc@top#1%
1619 }
1620 \e@alloc@whatsit@count=\z@
1621 \ifx\e@alloc@bytecode@count@undefined
1622   \countdef\e@alloc@bytecode@count=262
1623 \fi
1624 \def\newluabytecode#1{%
1625   \e@alloc\luabytecode\e@alloc@chardef
1626   \e@alloc@bytecode@count\m@ne\e@alloc@top#1%
1627 }
1628 \e@alloc@bytecode@count=\z@
1629 \ifx\e@alloc@luachunk@count@undefined
1630   \countdef\e@alloc@luachunk@count=263
1631 \fi
1632 \def\newluachunkname#1{%
1633   \e@alloc\luachunk\e@alloc@chardef
1634   \e@alloc@luachunk@count\m@ne\e@alloc@top#1%
1635   {\escapechar\m@ne
1636   \directlua{lua.name[\the\allocationnumber] = "\string#1"}%}
1637 }
1638 \e@alloc@luachunk@count=\z@
1639 %<2ekernel>\everyjob\expandafter{%
1640 %<2ekernel> \the\everyjob
1641 \begingroup
1642   \attributedef\attributezero=0 %
1643   \chardef \charzero =0 %
1644   \countdef \CountZero =0 %
1645   \dimendef \dimenzero =0 %
1646   \mathchardef \mathcharzero =0 %
1647   \muskipdef \muskipzero =0 %
1648   \skipdef \skipzero =0 %
1649   \toksdef \tokszero =0 %
1650   \directlua{require("ltluatex")}
1651 \endgroup
1652 %<2ekernel>
1653 %<latexrelease>\EndIncludeInRelease
1654 %<latexrelease>\IncludeInRelease{0000/00/00}
1655 %<latexrelease>           {\newluafunction}{LuaTeX}%
1656 %<latexrelease>\let\e@alloc@attribute@count@undefined
1657 %<latexrelease>\let\newattribute@undefined
1658 %<latexrelease>\let\setattribute@undefined
1659 %<latexrelease>\let\unsetattribute@undefined
1660 %<latexrelease>\let\e@alloc@ccodetable@count@undefined

```

```

1661 %<latexrelease>\let\newcatcodetable@undefined
1662 %<latexrelease>\let\catcodetable@initex@undefined
1663 %<latexrelease>\let\catcodetable@string@undefined
1664 %<latexrelease>\let\catcodetable@latex@undefined
1665 %<latexrelease>\let\catcodetable@atletter@undefined
1666 %<latexrelease>\let\@alloc@luafunction@count@undefined
1667 %<latexrelease>\let\newluafunction@undefined
1668 %<latexrelease>\let\@alloc@luafunction@count@undefined
1669 %<latexrelease>\let\newwhatsit@undefined
1670 %<latexrelease>\let\@alloc@whatsit@count@undefined
1671 %<latexrelease>\let\newluabytecode@undefined
1672 %<latexrelease>\let\@alloc@bytecode@count@undefined
1673 %<latexrelease>\let\newluachunkname@undefined
1674 %<latexrelease>\let\@alloc@luachunk@count@undefined
1675 %<latexrelease>\directlua{luatexbase.uninstall()}
1676 %<latexrelease>\EndIncludeInRelease

1677 %<latexrelease>\IncludeInRelease{2017/01/01}%
1678 %<latexrelease>          {\fontencoding}{TU in }
1679 %<latexrelease>\fontencoding{TU}\let\encodingdefault\f@encoding
1680 %<latexrelease>\ifx\directlua@undefined\else
1681 %<2ekernel>\everyjob\expandafter{%
1682 %<2ekernel> \the\everyjob
1683 %<*2ekernel, latexrelease>
1684   \directlua{%
1685     if xpcall(function ()%
1686       require('luaotfload-main')%
1687       end, texio.write_nl) then %
1688     local _void = luaotfload.main ()%
1689     else %
1690       texio.write_nl('Error in luaotfload: reverting to OT1')%
1691       tex.print('\string\\def\string\\encodingdefault{OT1}')%
1692     end %
1693   }%
1694   \let\f@encoding\encodingdefault
1695   \expandafter\let\csname %
1696     \ver@luaotfload.sty\endcsname\fmtversion
1697 %</2ekernel, latexrelease>
1698 %<2ekernel>\fi
1699 %<2ekernel> }
1700 %<2ekernel>\EndIncludeInRelease
1701 %<2ekernel>          {\fontencoding}{TU in }
1702 %<2ekernel>\fontencoding{OT1}\let\encodingdefault\f@encoding
1703 %<2ekernel>\EndIncludeInRelease

1704 %<2ekernel| latexrelease>\fi
1705 %</2ekernel|tex| latexrelease>

1706 %<*lua>
1707 luatexbase      = luatexbase or { }
1708 local luatexbase = luatexbase
1709 local string.gsub      = string.gsub

```

```

1710 local tex_count          = tex.count
1711 local tex_setattribute   = tex.setattribute
1712 local tex_setcount        = tex.setcount
1713 local texio_write_nl     = texio.write_nl
1714 local luatexbase_warning
1715 local luatexbase_error
1716 local modules = modules or { }
1717 local function luatexbase_log(text)
1718   texio_write_nl("log", text)
1719 end
1720 local function provides_module(info)
1721   if not (info and info.name) then
1722     luatexbase_error("Missing module name for provides_module")
1723   end
1724   local function spaced(text)
1725     return text and (" " .. text) or ""
1726   end
1727   luatexbase_log(
1728     "Lua module: " .. info.name
1729     .. spaced(info.date)
1730     .. spaced(info.version)
1731     .. spaced(info.description)
1732   )
1733   modules[info.name] = info
1734 end
1735 luatexbase.provides_module = provides_module
1736 local function msg_format(mod, msg_type, text)
1737   local leader = ""
1738   local cont
1739   local first_head
1740   if mod == "LaTeX" then
1741     cont = string.gsub(leader, ".", " ")
1742     first_head = leader .. "LaTeX: "
1743   else
1744     first_head = leader .. "Module " .. msg_type
1745     cont = "(" .. mod .. ")"
1746     .. string.gsub(first_head, ".", " ")
1747     first_head = leader .. "Module " .. mod .. " " .. (
1748       msg_type .. ":"
1749     end
1750     if msg_type == "Error" then
1751       first_head = "\n" .. first_head
1752     end
1753     if string.sub(text,-1) ~= "\n" then
1754       text = text .. " "
1755     end
1756     return first_head .. " "
1757     .. string.gsub(
1758       text
1759       .. "on input line "
1760       .. tex.inputlineno, "\n", "\n" .. cont .. " "
1761     )

```

```

1761     .. "\n"
1762 end

1763 local function module_info(mod, text)
1764     texio_write_nl("log", msg_format(mod, "Info", text))
1765 end
1766 luatexbase.module_info = module_info
1767 local function module_warning(mod, text)
1768     texio_write_nl("term and log",msg_format(mod, "Warning", 2
1769     (text)))
1770 end
1771 luatexbase.module_warning = module_warning
1772 local function module_error(mod, text)
1773     error(msg_format(mod, "Error", text))
1774 end
1775 luatexbase.module_error = module_error

1776 function luatexbase_warning(text)
1777     module_warning("luatexbase", text)
1778 end
1779 function luatexbase_error(text)
1780     module_error("luatexbase", text)
1781 end

1782 local luaregisterbasetable = { }
1783 local registermap = {
1784     attributezero = "assign_attr"      ,
1785     charzero      = "char_given"      ,
1786     CountZero     = "assign_int"      ,
1787     dimenzero     = "assign_dimen"    ,
1788     mathcharzero  = "math_given"     ,
1789     muskipzero   = "assign_mu_skip"  ,
1790     skipzero      = "assign_skip"    ,
1791     tokszero     = "assign_toks"     ,
1792 }
1793 local createtoken
1794 if tex.luatexversion > 81 then
1795     createtoken = token.create
1796 elseif tex.luatexversion > 79 then
1797     createtoken = newtoken.create
1798 end
1799 local hashtokens = tex.hashtokens()
1800 local luatexversion = tex.luatexversion
1801 for i,j in pairs (registermap) do
1802     if luatexversion < 80 then
1803         luaregisterbasetable[hashtokens[i][1]] =
1804             hashtokens[i][2]
1805     else
1806         luaregisterbasetable[j] = createtoken(i).mode
1807     end
1808 end

1809 local registernumber
1810 if luatexversion < 80 then
1811     function registernumber(name)
1812         local nt = hashtokens[name]

```

```

1812     if(nt and luaregisterbasetable[nt[1]]) then
1813         return nt[2] - luaregisterbasetable[nt[1]]
1814     else
1815         return false
1816     end
1817   end
1818 else
1819   function registernumber(name)
1820     local nt = createtoken(name)
1821     if(luaregisterbasetable[nt.cmdname]) then
1822       return nt.mode - luaregisterbasetable[nt.cmdname]
1823     else
1824       return false
1825     end
1826   end
1827 end
1828 luatexbase.registernumber = registernumber
1829 local attributes=setmetatable(
1830 {}, {
1831   __index = function(t,key)
1832     return registernumber(key) or nil
1833   end
1834 }
1835 )
1836 luatexbase.attributes = attributes
1837 local attribute_count_name =
1838           attribute_count_name or ^
1839           ("e@alloc@attribute@count")
1840 local function new_attribute(name)
1841   tex_setcount("global", attribute_count_name,
1842               tex_count[attribute_count_name] + 1)
1843   if tex_count[attribute_count_name] > 65534 then
1844     luatexbase_error("No room for a new \\attribute")
1845   end
1846   attributes[name]= tex_count[attribute_count_name]
1847   luatexbase_log("Lua-only attribute " .. name .. " = " ..
1848                 tex_count[attribute_count_name])
1849   return tex_count[attribute_count_name]
1850 end
1851 luatexbase.new_attribute = new_attribute
1852 local whatsit_count_name = whatsit_count_name or ^
1853           ("e@alloc@whatsit@count")
1854 local function new_whatsit(name)
1855   tex_setcount("global", whatsit_count_name,
1856               tex_count[whatsit_count_name] + 1)
1857   if tex_count[whatsit_count_name] > 65534 then
1858     luatexbase_error("No room for a new custom whatsit")
1859   end
1860   luatexbase_log("Custom whatsit " .. (name or "") .. " = " ..
1861                 tex_count[whatsit_count_name])
1862   return tex_count[whatsit_count_name]
1863 end
1864 luatexbase.new_whatsit = new_whatsit

```

```

1863 local bytecode_count_name =
1864     bytecode_count_name or ↪
1865         {"e@alloc@bytecode@count"}
1866 local function new_bytecode(name)
1867     tex_setcount("global", bytecode_count_name,
1868                 tex_count[bytecode_count_name] + 1)
1869     if tex_count[bytecode_count_name] > 65534 then
1870         luatexbase_error("No room for a new bytecode register")
1871     end
1872     luatexbase_log("Lua bytecode " .. (name or "") .. " = " ..
1873                     tex_count[bytecode_count_name])
1874     return tex_count[bytecode_count_name]
1875 end
1876 luatexbase.new_bytecode = new_bytecode

1877 local chunkname_count_name =
1878     chunkname_count_name or ↪
1879         {"e@alloc@luachunk@count"}
1880 local function new_chunkname(name)
1881     tex_setcount("global", chunkname_count_name,
1882                 tex_count[chunkname_count_name] + 1)
1883     local chunkname_count = tex_count[chunkname_count_name]
1884     chunkname_count = chunkname_count + 1
1885     if chunkname_count > 65534 then
1886         luatexbase_error("No room for a new chunkname")
1887     end
1888     lua.name[chunkname_count]=name
1889     luatexbase_log("Lua chunkname " .. (name or "") .. " = " ..
1890                     chunkname_count .. "\n")
1891     return chunkname_count
1892 end
1893 luatexbase.new_chunkname = new_chunkname

1894 local luafunction_count_name =
1895     luafunction_count_name or ↪
1896         {"e@alloc@luafunction@count"}
1897 local function new_luafunction(name)
1898     tex_setcount("global", luafunction_count_name,
1899                 tex_count[luafunction_count_name] + 1)
1900     if tex_count[luafunction_count_name] > 65534 then
1901         luatexbase_error("No room for a new luafunction register")
1902     end
1903     luatexbase_log("Lua function " .. (name or "") .. " = " ..
1904                     tex_count[luafunction_count_name])
1905     return tex_count[luafunction_count_name]
1906 end
1907 luatexbase.new_luafunction = new_luafunction

1908 local callbacklist = callbacklist or { }
1909 local list, data, exclusive, simple = 1, 2, 3, 4
1910 local types = {
1911     list      = list,
1912     data      = data,
1913     exclusive = exclusive,
1914     simple    = simple,

```

```
1912 }
```

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.)

```
1913 local callbacktypes = callbacktypes or {
1914     find_read_file      = exclusive,
1915     find_write_file     = exclusive,
1916     find_font_file      = data,
1917     find_output_file    = data,
1918     find_format_file    = data,
1919     find_vf_file        = data,
1920     find_map_file       = data,
1921     find_enc_file       = data,
1922     find_pk_file        = data,
1923     find_data_file      = data,
1924     find_opentype_file  = data,
1925     find_truetype_file  = data,
1926     find_type1_file     = data,
1927     find_image_file     = data,
1928     open_read_file      = exclusive,
1929     read_font_file      = exclusive,
1930     read_vf_file        = exclusive,
1931     read_map_file       = exclusive,
1932     read_enc_file       = exclusive,
1933     read_pk_file        = exclusive,
1934     read_data_file      = exclusive,
1935     read_truetype_file  = exclusive,
1936     read_type1_file     = exclusive,
1937     read_opentype_file  = exclusive,
```

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

```
1938     find_cidmap_file   = data,
1939     read_cidmap_file    = exclusive,
1940     process_input_buffer = data,
1941     process_output_buffer = data,
1942     process_jobname     = data,
1943     contribute_filter    = simple,
1944     buildpage_filter     = simple,
1945     build_page_insert    = exclusive,
1946     pre_linebreak_filter = list,
```

```

1947   linebreak_filter      = list,
1948   append_to_vlist_filter = exclusive,
1949   post_linebreak_filter = list,
1950   hpack_filter          = list,
1951   vpack_filter          = list,
1952   hpack_quality         = list,
1953   vpack_quality         = list,
1954   pre_output_filter     = list,
1955   process_rule          = list,
1956   hyphenate              = simple,
1957   ligaturing             = simple,
1958   kerning                = simple,
1959   insert_local_par       = simple,
1960   mlist_to_hlist         = list,
1961
1962   pre_dump               = simple,
1963   start_run               = simple,
1964   stop_run                = simple,
1965   start_page_number       = simple,
1966   stop_page_number        = simple,
1967   show_error_hook         = simple,
1968   show_warning_message    = simple,
1969   show_error_message      = simple,
1970   show_lua_error_hook    = simple,
1971   start_file              = simple,
1972   stop_file               = simple,
1973   call_edit               = simple,
1974   finish_synctex_callback = simple,
1975
1976   finish_pdffile = data,
1977   finish_pdfpage = data,
1978
1979 }
1980 luatexbase.callbacktypes=callbacktypes
1981 local callback_register = callback_register or -->
1982   function callback.register()
1983     luatexbase_error("Attempt to use callback.register() > -->
1984   end

```

#### 45.4.5 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.

```

1985 local function data_handler(name)
1986   return function(data, ...)
1987     for _,i in ipairs(callbacklist[name]) do
1988       data = i.func(data,...)
1989     end
1990     return data
1991   end
1992 end

1993 local function exclusive_handler(name)
1994   return function(...)
1995     return callbacklist[name][1].func(...)
1996   end
1997 end

1998 local function list_handler(name)
1999   return function(head, ...)
2000     local ret
2001     local alltrue = true
2002     for _,i in ipairs(callbacklist[name]) do
2003       ret = i.func(head, ...)
2004       if ret == false then
2005         lualatexbase_warning(
2006           "Function `" .. i.description .. "' returned false\n"
2007           .. "in callback `" .. name .. "'")
2008       )
2009       break
2010     end

```

```

2011     if ret ~= true then
2012         alltrue = false
2013         head = ret
2014     end
2015   end
2016   return alltrue and true or head
2017 end
2018 end

2019 local function simple_handler(name)
2020   return function(...)
2021     for _,i in ipairs(callbacklist[name]) do
2022       i.func(...)
2023     end
2024   end
2025 end

      Keep a handlers table for indexed access.

2026 local handlers = {
2027   [data]      = data_handler,
2028   [exclusive] = exclusive_handler,
2029   [list]      = list_handler,
2030   [simple]    = simple_handler,
2031 }

```

#### 45.4.6 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.

```

2032 local user_callbacks_defaults = { }

2033 local function create_callback(name, ctype, default)
2034   if not name or name == ""
2035   or not ctype or ctype == ""
2036   then
2037     luatexbase_error("Unable to create callback:\n" ..
2038                           "valid callback name and type required")
2039   end
2040   if callbacktypes[name] then
2041     luatexbase_error("Unable to create callback `" .. name ..
2042                           "' :\ncallback is already defined")
2043   end
2044   if default ~= false and type (default) ~= "function" then
2045     luatexbase_error("Unable to create callback `" .. name ..
2046                           "' :\ndefault is not a function")
2047   end
2048   user_callbacks_defaults[name] = default
2049   callbacktypes[name] = types[ctype]
2050 end
2051 luatexbase.create_callback = create_callback

call_callback
2052 local function call_callback(name,...)

```

```

2053 if not name or name == "" then
2054   luatexbase_error("Unable to create callback:\n" ..
2055                         "valid callback name required")
2056 end
2057 if user_callbacks_defaults[name] == nil then
2058   luatexbase_error("Unable to call callback `" .. name
2059                         .. "'\nunknown or empty")
2060 end
2061 local l = callbacklist[name]
2062 local f
2063 if not l then
2064   f = user_callbacks_defaults[name]
2065   if l == false then
2066     return nil
2067   end
2068 else
2069   f = handlers[callbacktypes[name]](name)
2070 end
2071 return f...
2072 end
2073 luatexbase.call_callback=call_callback

```

*(End definition for call\_callback.)*

`add_to_callback` Add a function to a callback. First check arguments.

```

2074 local function add_to_callback(name, func, description)
2075   if not name or name == "" then
2076     luatexbase_error("Unable to register callback:\n" ..
2077                           "valid callback name required")
2078   end
2079   if not callbacktypes[name] or
2080     type(func) ~= "function" or
2081     not description or
2082     description == "" then
2083     luatexbase_error(
2084       "Unable to register callback.\n\n"
2085       .. "Correct usage:\n"
2086       .. "add_to_callback(<callback>, <function>, <description>)"
2087     )
2088   end
2089   local l = callbacklist[name]
2090   if l == nil then
2091     l = { }
2092     callbacklist[name] = l
2093     if user_callbacks_defaults[name] == nil then
2094       callback_register(name, )
2095       (handlers[callbacktypes[name]](name))
2096     end
2097   end
2098   local f = {
2099     func      = func,
2100     description = description,

```

```

2100     }
2101     local priority = #l + 1
2102     if callbacktypes[name] == exclusive then
2103       if #l == 1 then
2104         luatexbase_error(
2105           "Cannot add second callback to exclusive >
2106             \function\n` .. "
2107             name .. "'")
2108       end
2109     end
2110     table.insert(l, priority, f)
2111     luatexbase_log(
2112       "Inserting `" .. description .. "' at position "
2113       .. priority .. " in `" .. name .. "'."
2114     )
2115   end
2116 luatexbase.add_to_callback = add_to_callback

```

*(End definition for add\_to\_callback.)*

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

```

2116 local function remove_from_callback(name, description)
2117   if not name or name == "" then
2118     luatexbase_error("Unable to remove function from >
2119                   \callback:\n" ..
2120                   "valid callback name required")
2121   end
2122   if not callbacktypes[name] or
2123     not description or
2124     description == "" then
2125     luatexbase_error(
2126       "Unable to remove function from callback.\n\n"
2127       .. "Correct usage:\n"
2128       .. "remove_from_callback(<callback>, <description>)"
2129     )
2130   end
2131   local l = callbacklist[name]
2132   if not l then
2133     luatexbase_error(
2134       "No callback list for `" .. name .. "'\n")
2135   end
2136   local index = false
2137   for i,j in ipairs(l) do
2138     if j.description == description then
2139       index = i
2140       break
2141     end
2142   end
2143   if not index then
2144     luatexbase_error(
2145       "No callback `" .. description .. "' registered for `" ..
2146       name .. "'\n")
2147   end

```

```

2147 local cb = l[index]
2148 table.remove(l, index)
2149 luatexbase_log(
2150   "Removing `" .. description .. "' from `" .. name .. "'."
2151 )
2152 if #l == 0 then
2153   callbacklist[name] = nil
2154   callback_register(name, nil)
2155 end
2156 return cb.func,cb.description
2157 end
2158 luatexbase.remove_from_callback = remove_from_callback

```

(End definition for `remove_from_callback`.)

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

```

2159 local function in_callback(name, description)
2160   if not name
2161     or name == ""
2162     or not callbacklist[name]
2163     or not callbacktypes[name]
2164     or not description then
2165       return false
2166     end
2167   for _, i in pairs(callbacklist[name]) do
2168     if i.description == description then
2169       return true
2170     end
2171   end
2172   return false
2173 end
2174 luatexbase.in_callback = in_callback

```

(End definition for `in_callback`.)

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

```

2175 local function disable_callback(name)
2176   if(callbacklist[name] == nil) then
2177     callback_register(name, false)
2178   else
2179     luatexbase_error("Callback list for " .. name .. " not "
2180                   .. "empty")
2180   end
2181 end
2182 luatexbase.disable_callback = disable_callback

```

List the descriptions of functions registered for the given callback.

```

callback_descriptions 2183 local function callback_descriptions (name)
2184   local d = {}
2185   if not name
2186     or name == ""
2187     or not callbacklist[name]

```

```

2188     or not callbacktypes[name]
2189     then
2190     return d
2191   else
2192     for k, i in pairs(callbacklist[name]) do
2193       d[k]= i.description
2194     end
2195   end
2196   return d
2197 end
2198 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!

```

2199 local function uninstall()
2200   module_info(
2201     "luatexbase",
2202     "Uninstalling kernel luatexbase code"
2203   )
2204   callback.register = callback_register
2205   luatexbase = nil
2206 end
2207 luatexbase.uninstall = uninstall

2208 %</lua>
2209 %<tex>\catcode`\\@=\etatcatcode\relax

```

Latex Classes

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.



## DISSECTING THE BOOK CLASS

This appendix describes the listing of the book class as defined by L<sup>A</sup>T<sub>E</sub>X. It is described here with extra commentary in order to enable you to understand, how it all works.

  Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada

eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

  Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

  Nulla malesuada porttitor diam. Donec felis erat, congue non, vo-

luptat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna.

Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

## 46.1 General

The book class starts with declaring the version of  $\text{\LaTeX}$ , required and naming the class it provides. The class choices are always checked for backward compatibility with the earlier version of  $\text{\LaTeX}$ . All commands that need to be modified between two column and one column layouts, check the setting and branch accordingly. Another primary choice is if the book is to be printed on both sides or only on one side.

```
2210 \NeedsTeXFormat{LaTeX2e}[1995/12/01]
2211 \ProvidesClass{book}
2212           [2007/10/19 v1.4h
2213 Standard LaTeX document class]
```

### $\text{\@ptsize}$ $\langle\text{dim}\rangle$

This is set to an empty value at start up. The original idea here was by modifying the value one could scale the text later on. I am not aware of any such usage.

```
2214 \newcommand\@ptsize{}
2215 \newif\if@restonecol
2216 \newif\if@titlepage \atitlepagetrue
2217 \newif\if@openright
2218 \newif\if@mainmatter \atmainmattertrue
```

**Paper size.** After checking for compatibility with older versions the code branches to define the different standard paper sizes! The options that are declared are, **a4paper**, **a5paper**, **b5paper**, **letterpaper**, **legalpaper** and **executivepaper**. The class will then later on process the options and set the default to **letterpaper**.<sup>1</sup>

```
2219 \if@compatibility\else
2220 \DeclareOption{a4paper}
2221   {\setlength\paperheight {297mm}%
2222    \setlength\paperwidth {210mm}%
2223 \DeclareOption{a5paper}
2224   {\setlength\paperheight {210mm}%
2225    \setlength\paperwidth {148mm}%
2226 \DeclareOption{b5paper}
```

<sup>1</sup>The package **geometry**, some classes such as the **Octavo** and **KOMA** classes add additional sizes to cater for other standards.

```

2227   {\setlength\paperheight {250mm}%
2228     \setlength\paperwidth {176mm}}
2229 \DeclareOption{letterpaper}
2230   {\setlength\paperheight {11in}%
2231     \setlength\paperwidth {8.5in}}
2232 \DeclareOption{legalpaper}
2233   {\setlength\paperheight {14in}%
2234     \setlength\paperwidth {8.5in}}
2235 \DeclareOption{executivepaper}
2236   {\setlength\paperheight {10.5in}%
2237     \setlength\paperwidth {7.25in}}

```

**Paper orientation.** the paper orientation is set based on the `landscape` option. If it is declared it stores the `\paperheight` into one

of the L<sup>A</sup>T<sub>E</sub>X kernel scratch registers, `\@tempdima` and then reverses the length with the `\paperwidth`.

```

2238 \DeclareOption{landscape}
2239   {\setlength\@tempdima {\paperheight}%
2240     \setlength\paperheight {\paperwidth}%
2241     \setlength\paperwidth {\@tempdima}}
2242 \fi

```

**Font sizing** The class provides for three font sizes `10pt`, `11pt` and `12pt`. It defaults to ten point text. It then sets the `\@ptsize`<sup>P. 595</sup> accordingly. This is used later on to determine what size of font we are using.

```

2243 \if@compatibility
2244   \renewcommand\@ptsize{0}
2245 \else
2246 \DeclareOption{10pt}{\renewcommand\@ptsize{0}}
2247 \fi
2248 \DeclareOption{11pt}{\renewcommand\@ptsize{1}}
2249 \DeclareOption{12pt}{\renewcommand\@ptsize{2}}

```

**Recto and verso pages.** The class provides the `oneside` and `twoside` options for switching between one side printing or two side printing. It sets the booleans `\if@twoside` and `\if@mparswitch` accordingly. These conditionals are used later to setting other variables.

```

2250 \if@compatibility\else
2251   \DeclareOption{oneside}{\@twosidefalse \@mparswitchfalse}
2252 \fi
2253 \DeclareOption{twoside}{\@twosidetrue \@mparswitchtrue}

```

**Draft and final options.** The options draft and final, just set the `\overfullrule` to either `1pt` or `0pt`. The `\overfullrule` is a T<sub>E</sub>X command and simply prints a small vertical line to indicate overfull boxes for the attention of the author.

```

2254 \DeclareOption{draft}{\setlength\overfullrule{5pt}}
2255 \if@compatibility\else
2256   \DeclareOption{final}{\setlength\overfullrule{0pt}}
2257 \fi

```

**Title page option.** If the book class, needed such an option is debatable. The `titlepage` option is normally set as true and results in the title being on

its own page. The **notitlepage** will omit the page break and display the title on the same page with that of the opening text. Highly unlikely for any author to use it for a book. It is useful for the article class.

```
2258 \DeclareOption{titlepage}{\@titlepagetrue}
2259 \if@compatibility\else
2260   \DeclareOption{notitlepage}{\@titlepagefalse}
2261 \fi
```

**Display of chapters.** Chapters can be set to start only on an even page or any page. The class provides the options **openright** and **openany**.

```
2262 \if@compatibility
2263   \@openrighttrue
2264 \else
2265   \DeclareOption{openright}{\@openrighttrue}
2266   \DeclareOption{openany}{\@openrightfalse}
2267 \fi
2268 \if@compatibility\else
2269   \DeclareOption{onecolumn}{\@twocolumnfalse}
2270 \fi
2271 \DeclareOption{twocolumn}{\@twocolumntrue}
2272 \DeclareOption{leqno}{\input{leqno.clo}}
2273 \DeclareOption{fleqn}{\input{fleqn.clo}}
2274 \DeclareOption{openbib}{%
2275   \AtEndOfPackage{%
2276     \renewcommand{\openbib@code}{%
2277       \advance\leftmargin\bibindent
2278       \itemindent -\bibindent
2279       \listparindent \itemindent
2280       \parsep \z@
2281     }%
2282   \renewcommand{\newblock}{\par}%
2283 }}
```

At this point all the options have been declared and we can process them, using **\ExecuteOptions**<sup>→ P. 542</sup> and **\ProcessOptions**<sup>→ P. 540</sup>.

```
2284 \ExecuteOptions{letterpaper,10pt,twoside,onecolumn,final,openright}
2285 \ProcessOptions
```

**The .clo files** The book class now inputs the file **.clo** etc that defines the fontsizes for anything specific to the 10pt. These files hold quite a bit of information and size related commands for the standard sizes provided by L<sup>A</sup>T<sub>E</sub>X. The **.clo** files also set many other parameters for page sizing, lists, paper sectioning, such as margins, marginpars and the like.

```
2286 \input{bk1@ptsize.clo}
2287 \setlength{\lineskip}{1\p@}
2288 \setlength{\normalineskip}{1\p@}
2289 \renewcommand{\baselinestretch}{}
2290 \setlength{\parskip}{0\p@ \oplus \p@}
```

**Penalties.** Next we set some penalties. The definition of ??<sup>→ P. ??</sup>, ??<sup>→ P. ??</sup> and ??<sup>→ P. ??</sup> are in the kernel in the **ltfinal.dtx** file.

```
2291 \lowpenalty 51
2292 \medpenalty 151
2293 \highpenalty 301
```

**Float control parameters.** The allowable number of floats on a page are controlled by a number of parameters. These are set here. Many users overwrite these parameters in order to have more control on the placement of floats.

```

2294 \setcounter{topnumber}{2}
2295 \renewcommand\topfraction{.7}
2296 \setcounter{bottomnumber}{1}
2297 \renewcommand\bottomfraction{.3}
2298 \setcounter{totalnumber}{3}
2299 \renewcommand\textfraction{.2}
2300 \renewcommand\floatpagefraction{.5}
2301 \setcounter{dbltopnumber}{2}
2302 \renewcommand\dbltopfraction{.7}
2303 \renewcommand\dblfloatpagefraction{.5}
```

**Running head and foot.** A page header or simply header in typography is text which is separated from the main body of text and appears at the top of a printed page. Word processing programs usually provide for the creation and maintenance of page headers, which are often the same from page to page, with merely small differences in information, such as page number.

In publishing, the page header (or “pagehead”) is often referred to as the running head. Typical running heads in a book might consist of the book title on the left-hand (verso) page, and the chapter title on the right-hand (recto) page, or chapter title on the verso and subsection title on the recto.

## 46.2 Running Heads

```

2304 \if@twoside
2305   \def\ps@headings{%
2306     \let\@oddfoot\@empty\let\@evenfoot\@empty
2307     \def\@evenhead{\thepage\hfil\slshape\leftmark}%
2308     \def\@oddhead{\slshape\rightmark\hfil\thepage}%
2309     \let\@mkboth\markboth
2310   % chapter
2311   \def\chaptermark##1{%
2312     \markboth {\MakeUppercase{%
2313       \ifnum \c@secnumdepth >\m@ne
2314         \if@mainmatter
2315           \chapapp\ \thechapter. \ %
2316         \fi
2317       \fi
2318     ##1}}{}%
2319   % section
2320   \def\sectionmark##1{%
2321     \markright {\MakeUppercase{%
2322       \ifnum \c@secnumdepth >\z@
2323         \thesection. \ %
2324       \fi
2325     ##1}}}{}%
2326 \else
2327   \def\ps@headings{%
2328     \let\@oddfoot\@empty
2329     \def\@oddhead{\slshape\rightmark\hfil\thepage}%
2330     \let\@mkboth\markboth
```

```

2331 \def\chaptermark##1{%
2332   \markright {\MakeUppercase{%
2333     \ifnum \c@secnumdepth >\m@ne
2334       \if@mainmatter
2335         \chapapp\ \thechapter. \ %
2336       \fi
2337     \fi
2338   ##1}}}
2339 \fi
2340 \def\ps@myheadings{%
2341   \let\@oddfoot\@empty\let\@evenfoot\@empty
2342   \def\@evenhead{\thepage\hfil\slshape\leftmark}%
2343   \def\@oddhead{{\slshape\rightmark}\hfil\thepage}%
2344   \let\@mkboth\@gobbletwo
2345   \let\chaptermark\@gobble
2346   \let\sectionmark\@gobble
2347 }

```

Please note the `\ps@plain`<sup>→ P.437</sup> headings are not defined in the class.  
These are defined in the L<sup>A</sup>T<sub>E</sub>X kernel<sup>2</sup>

```

2348 %\ps@plain The plain page style: No head, centred page
2349 % number in foot.
2350 13 \def\ps@plain{\let\@mkboth\@gobbletwo
2351 14 \let\@oddhead\@empty\def\@oddfoot{\reset@font\hfil\thepage
2352 15 \hfil}\let\@evenhead\@empty\let\@evenfoot\@oddfoot}

```

**Title pages.** Title pages are defined between a conditional, that handle the option `titlepage` and. The commands just take mostly of the typography. If you use the option `notitlepage` in the book class, the title will be similar for all practical purposes to that of an `article` and it will appear on the top of the first page.

The `\maketitle` sets the `\footnotesize`, the `\footnoterule` and the `\footnote`.

### Titlepage

```

2352 \if@titlepage
2353   \newcommand\maketitle{\begin{titlepage}%
2354   \let\footnotesize\small
2355   \let\footnoterule\relax
2356   \let\footnote\thanks
2357   \null\vfil
2358   \vskip 60\p@
2359   \begin{center}%
2360     {\LARGE \atitle \par}%
2361     \vskip 3em%
2362     {\large
2363       \lineskip .75em%
2364       \begin{tabular}[t]{c}%
2365         \author
2366       \end{tabular}\par}%
2367     \vskip 1.5em%
2368     {\large \atdate \par}%
2369   \end{center}%
2370   \thanks

```

<sup>2</sup>See File J: ltpage.dtx ??.

```

2371   \vfil\null
2372   \end{titlepage}%
2373   \setcounter{footnote}{0}%
2374   \global\let\thanks\relax
2375   \global\let\maketitle\relax
2376   \global\let\@thanks\@empty
2377   \global\let\@author\@empty
2378   \global\let\@date\@empty
2379   \global\let\@title\@empty
2380   \global\let\title\relax
2381   \global\let\author\relax
2382   \global\let\date\relax
2383   \global\let\and\relax
2384 }
2385 \else
2386 \newcommand\maketitle{\par
2387   \begingroup
2388     \renewcommand\thefootnote{@fnsymbol\c@footnote}%
2389     \def\@makefnmark{\rlap{@textsuperscript{\normalfont@thefnmark}}}%
2390     \long\def\@makefntext##1{\parindent 1em\noindent
2391       \hb@xt@1.8em{%
2392         \hss@textsuperscript{\normalfont@thefnmark}##1}%
2393       \if@twocolumn
2394         \ifnum \col@number=\@ne
2395           \maketitle
2396         \else
2397           \twocolumn[\maketitle]%
2398         \fi
2399       \else
2400         \newpage
2401         \global\@topnum\z@ % Prevents figures from going at top of page.
2402         \maketitle
2403       \fi
2404       \thispagestyle{plain}\@thanks
2405     \endgroup
2406     \setcounter{footnote}{0}%
2407     \global\let\thanks\relax
2408     \global\let\maketitle\relax
2409     \global\let\@maketitle\relax
2410     \global\let\@thanks\@empty
2411     \global\let\@author\@empty
2412     \global\let\@date\@empty
2413     \global\let\@title\@empty
2414     \global\let\title\relax
2415     \global\let\author\relax
2416     \global\let\date\relax
2417     \global\let\and\relax
2418 }
2419 \def\@maketitle{%
2420   \newpage
2421   \null
2422   \vskip 2em%
2423   \begin{center}%

```

```

2424 \let \footnote \thanks
2425   {\LARGE \@title \par}%
2426   \vskip 1.5em%
2427   {\large
2428     \lineskip .5em%
2429     \begin{tabular}[t]{c}%
2430       \author
2431     \end{tabular}\par}%
2432   \vskip 1em%
2433   {\large \@date}%
2434 \end{center}%
2435 \par
2436 \vskip 1.5em}
2437 \fi

```

**Section counters.** In LaTeX all defaults all document section are numbered by default. These numbers are kept in counters, named after the section name. A series of commands are provided to access these numbers. All the counters are in arabic numerals, with the exception of "part", which is in Roman.

```

2438 \newcommand*\chapertmark[1]{}%
2439 \setcounter{secnumdepth}{2}
2440 \newcounter {part}
2441 \newcounter {chapter}
2442 \newcounter {section}[chapter]
2443 \newcounter {subsection}[section]
2444 \newcounter {subsubsection}[subsection]
2445 \newcounter {paragraph}[subsubsection]
2446 \newcounter { subparagraph}[paragraph]
2447 \renewcommand \thepart {\@Roman\c@part}
2448 \renewcommand \thechapter {\@arabic\c@chapter}
2449 \renewcommand \thesection {\thechapter.\@arabic\c@section}
2450 \renewcommand\thesubsection {
  \thesection.\@arabic\c@subsection}
2451 \renewcommand\thesubsubsection{\thesubsection.\@arabic\c@subsubsection}
2452 \renewcommand\theparagraph {
  \subsubsection.\@arabic\c@paragraph}
2453 \renewcommand\thesubparagraph {
  \subparagraph.\@arabic\c@subparagraph}
2454 \newcommand\@chapapp{\chapertname}

```

**Frontmatter, mainmatter and backmatter.** These are author command to set mostly, the page numbering and the clearing of pages for two page layouts. Front matter has lower roman pages numbering and the main matter has arabic numerals.

### \frontmatter

Front matter sets the page opening and teh numbering in Roman lowercase.

```

2455 \newcommand\frontmatter{%
2456   \cleardoublepage
2457   \@mainmatterfalse
2458   \pagenumbering{roman}}

```

### \mainmatter

The author command to denote the start of the main body of the publication.

```
2459 \newcommand\mainmatter{%
2460   \cleardoublepage
2461   \@mainmattertrue
2462   \pagenumbering{arabic}}
```

### \backmatter

The author command to denote the start of the back matter of the publication. These are still numbered in arabic numerals.

```
2463 \newcommand\backmatter{%
2464   \if@openright
2465     \cleardoublepage
2466   \else
2467     \clearpage
2468   \fi
2469   \@mainmatterfalse}
```

**Part.** The is the definition of part. The Part is displayed with a plain header and the it goes into the secdef. If the section depth is greater or equal -2, the start counter is increased and the part is added to the toc, using \addcontentsline. The partname i.e., default 'Part' gets printer either way except for the star version of the command.

### \part

Starts a new part of a book. The star version of the command does not increment the part number.

```
2470 \newcommand\part{%
2471   \if@openright
2472     \cleardoublepage
2473   \else
2474     \clearpage
2475   \fi
2476   \thispagestyle{plain}%
2477   \if@twocolumn
2478     \onecolumn
2479     \tempswatrue
2480   \else
2481     \tempswafalse
2482   \fi
2483   \null\vfil
2484   \secdef\@part\@spart}
```

The important command to remember here is  $\part^*$ . This is defined in the kernel and not in the classes `ltsect.dtx`. Essentially in the code `\@part` calls the unstar command and the `@spart` calls the starred command. We copy the definition from the kernel for convenience.

```

2485 is \secdef{unstarcmds}{unstarcmds}{starcmds}
2486 When defining a \chapter or \section command without using \-
2487   \startsection,
2488 you can use \secdef as follows:
2489 1. \def\chapter{... \secdef \starcmd \unstarcmd}
2490 2. \def\hstarcmdi[#1]#2{... } % Command to define \-
2491   \chapter[...]{...}
2492 3. \def\unstarcmd#1{... } % Command to define \chapter*{. . .}
2493   \. .
2494 125 \def\secdef#1#2{\ifstar{#2}{\@dblarg{#1}}}
2495   The @part starts now,
2496 \def \@part[#1]#2{%
2497   \ifnum \c@secnumdepth >-2\relax
2498     \refstepcounter{part}%
2499     \addcontentsline{toc}{part}{\thepart\hspace{1em}\#1}%
2500   \else
2501     \addcontentsline{toc}{part}{\#1}%
2502   \fi
2503   \markboth{}{}%
2504   \centering
2505   \interlinepenalty \zM
2506   \normalfont
2507   \ifnum \c@secnumdepth >-2\relax
2508     \huge\bfseries \partname\nobreakspace\thepart
2509     \par
2510     \vskip 20\p@
2511     \fi
2512     \Huge\bfseries #2\par}%
2513   \endpart}

```

The starred version of the command is provided next. The difference the name ‘Part’ is not displayed. However the parameter provided by

the user is displayed. A normal font is provided. Final settings depending on @openright and header styles are set and the code macro is completed.

```

2510 \def \@spart#1{%
2511   \centering
2512   \interlinepenalty \zM
2513   \normalfont
2514   \Huge\bfseries #1\par}%
2515 \endpart}
2516
2517 \def \endpart{\vfil\newpage
2518   \if@twoside
2519     \if@openright
2520       \null
2521       \thispagestyle{empty}%
2522       \newpage
2523     \fi
2524   \fi
2525   \if@tempswa
2526     \twocolumn
2527   \fi}

```

**Chapter**. The chapter definition follows, the same pattern as that of the part definitions. It calls `\secdef` and defines commands for the starred and unstarred versions.

```
2528 \newcommand\chapter{\if@openright\cleardoublepage\else\clearpage\fi
2529             \thispagestyle{plain}%
2530             \global\@topnum\z@
2531             \@afterindentfalse
2532             \secdef\@chapter\@schapter}
```

### Unstarred version

```
2533 \def\@chapter[#1]#2{
2534     \ifnum \c@secnumdepth >\m@ne
2535         \if@mainmatter
2536             \refstepcounter{chapter}%
2537             \typeout{\@chapapp\space \thechapter.}%
2538             \addcontentsline{toc}{chapter}%
2539             {\protect\numberline{\thechapter}#1}%
2540         \else
2541             \addcontentsline{toc}{chapter}{#1}%
2542         \fi
2543     \else
2544         \addcontentsline{toc}{chapter}{#1}%
2545     \fi
2546     \chaptermark{#1}%
2547     \addtocontents{lof}{\protect\addvspace{10\p@}}%
2548     \addtocontents{lot}{\protect\addvspace{10\p@}}%
2549     \if@twocolumn
2550         \atopnewpage[\@makechapterhead{#2}]%
2551     \else
2552         \@makechapterhead{#2}%
2553         \@afterheading
2554     \fi}
```

**Defining the looks of the Chapter heading** Good practice dictates, that when you change the chapterhead layout for the numbered version, you also change it for the star version of the

and. You can do that by using two different macros, although at first glance it might be difficult to see where the difference is.

```
2555 \def\@makechapterhead
2556 \def\@makeschapterhead

2557 \def\@makechapterhead#1{%
2558     \vspace*{50\p@}%
2559     {\parindent \z@ \raggedright \normalfont
2560     \ifnum \c@secnumdepth >\m@ne
2561         \if@mainmatter
2562             \huge\bfseries \@chapapp\space \thechapter
2563             \par\nobreak
2564             \vskip 20\p@
2565         \fi
2566     \fi
2567     \interlinepenalty\@M
2568     \Huge \bfseries #1\par\nobreak}
```

```
2569     \vskip 40\p@
2570 }
```

Finally the starred version of the command is called. This now checks for `twocolumn` or one column via an if statement and executes, the `makeschapterhead`. Another mysterious and wonderful command appears again from the LaTeX source2e.`\@afterheading`. This command is just a hook for custom headings? (Needs to be reviewed again).

```
2571 \def\@schapter#1{\if@twocolumn
2572         \@topnewpage[\@makeschapterhead{#1}]%
2573     \else
2574         \@makeschapterhead{#1}%
2575         \@afterheading
2576     \fi}
```

And finally the `\@makeschapterhead` (remember `s` for star).

```
2577 \def\@makeschapterhead#1{%
2578     \vspace*{50\p@}%
2579     {\parindent \z@ \raggedright
2580      \normalfont
2581      \interlinepenalty\@M
2582      \Huge \bfseries #1\par\nobreak
2583      \vskip 40\p@
2584 }
```

All sorts of variations of the above two commands can be found in different classes, such as `KOMA`, `memoir` and others. The example which follows, typesets the headings as shown in Figure 46.1. The `@makechapterhead` command is modified to produce a centered heading which is displayed between two heavy rules. This style can be found in quite a number of books.

## Full working example

```
2585 \documentclass[oneside]{book}
2586 \usepackage[english]{babel}
2587 \usepackage{lipsum}
2588 \makeatletter
2589 \def\thickhrule{\leavevmode \leaders \hrule height 1ex }
2590             \hfill \kern \z@}
2591 %% Note the difference between the commands the one is
2592 %% make and the other one is makes
2593 \renewcommand{\@makechapterhead}[1]{%
2594     \vspace*{10\p@}%
2595     {\parindent \z@ \centering \reset@font
2596      \Huge \scshape \thechapter }
2597     \par\nobreak
2598     \vspace*{10\p@}%
2599     \interlinepenalty\@M
2600     \thickhrule
2601     \par\nobreak
2602     \vspace*{2\p@}%
2603     {\Huge \bfseries #1\par\nobreak}
2604     \par\nobreak}
```

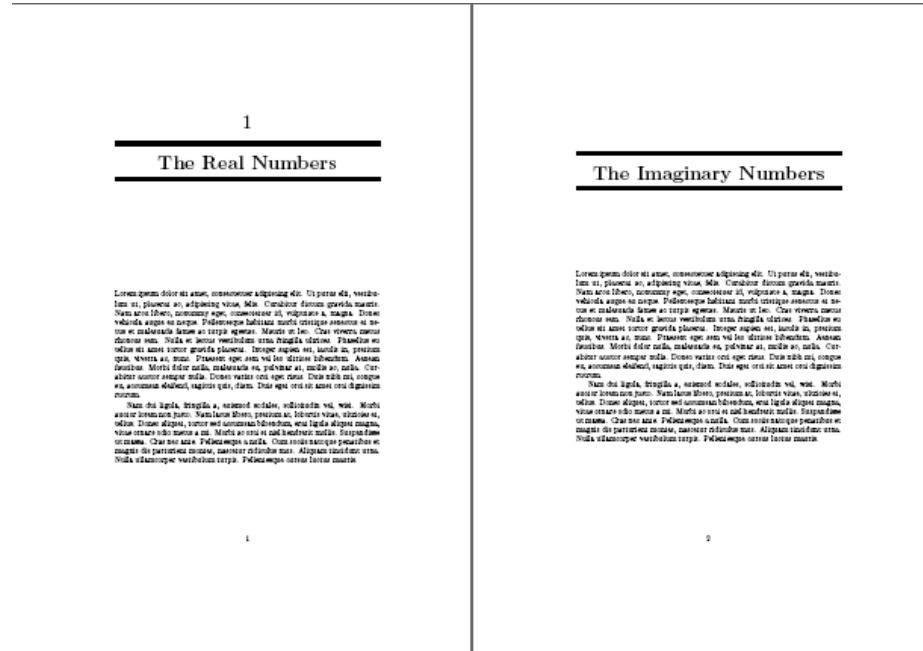


Figure 46.1: Modifying the way the chapterhead looks can be achieved by re-defining the `\@makechapterhead` and `\@makeschapterhead` commands.

```

2605      \vspace*{2\p@}%
2606      \thickhrule
2607      \vskip 40\p@
2608      \vskip 100\p@
2609  }
2610
2611 %% This is makes
2612 \def\@makeschapterhead#1{%
2613   \vspace*{10\p@}%
2614   {\parindent \z@ \centering \reset@font
2615     {\Huge \scshape \vphantom{\thechapter}}}
2616   \par\nobreak
2617   \vspace*{10\p@}%
2618   \interlinepenalty\@M
2619   \thickhrule
2620   \par\nobreak
2621   \vspace*{2\p@}%
2622   {\Huge \bfseries #1\par\nobreak}
2623   \par\nobreak
2624   \vspace*{2\p@}%
2625   \thickhrule
2626   \vskip 100\p@
2627 }
2628 \begin{document}
2629 \chapter{The Real Numbers}
2630 \lipsum[1-2]
2631 \chapter*{The Imaginary Numbers}
```

```
2632 \lipsum[1-2]
2633 \end{document}
```

**The sections.** In this section, all the document elements besides the Chapter and the Part are Defined. They use the mother of all commands from the kernel ltxsection.dtx, named  $\text{\texttt{??}}^{\rightarrow \text{P.??}}$ . This is just a call to the kernel command. No other settings are done here. In order to remember what it does we refer to its definition in the kernel. Of interest is the sixth argument which sets the font style.

The parameter takes eight parameters, some of them optional. We discuss this command in more detail in the kernel chapter.

```
2634 \newcommand\section{@startsection {section}{1}{\z@}%
2635                                     {-3.5ex \oplus -1ex }%
2636                                     {\@minus -.2ex}%
2637                                     {2.3ex \oplus .2ex}%
2638                                     {\normalfont\Large\bfseries}}
2639 \newcommand\subsection{@startsection {subsection}{2}{\z@}%
2640                                     {-3.25ex \oplus -1ex }%
2641                                     {\@minus -.2ex}%
2642                                     {1.5ex \oplus .2ex}%
2643                                     {\normalfont\large\bfseries}}
2644 \newcommand\subsubsection{@startsection {subsubsection}{3}{\z@}%
2645                                     {-3.25ex \oplus -1ex }%
2646                                     {\@minus -.2ex}%
2647                                     {1.5ex \oplus .2ex}%
2648                                     {\normalfont\normalsize\bfseries}}
2649 \newcommand\paragraph{@startsection {paragraph}{4}{\z@}%
2650                                     {3.25ex \oplus 1ex }%
2651                                     {\@minus .2ex}%
2652                                     {-1em}%
2653                                     {\normalfont\normalsize\bfseries}}
2654 \newcommand\ subparagraph{@startsection {subparagraph}{5}{\parindent}%
2655                                     {3.25ex \oplus 1ex }%
2656                                     {\@minus .2ex}%
2657                                     {-1em}%
2658                                     {\normalfont\normalsize\bfseries}}
```

## 46.3 Lists

```
2654 \if@twocolumn
2655   \setlength\leftmargini  {2em}
2656 \else
2657   \setlength\leftmargini  {2.5em}
2658 \fi
2659 \leftmargin \leftmargini
2660 \setlength\leftmarginii {2.2em}
2661 \setlength\leftmarginiii {1.87em}
2662 \setlength\leftmarginiv {1.7em}
2663 \if@twocolumn
2664   \setlength\leftmarginv  {.5em}
2665   \setlength\leftmarginvi {.5em}
2666 \else
2667   \setlength\leftmarginv  {1em}
2668   \setlength\leftmarginvi {1em}
```

```

2669 \fi
2670 \setlength \labelsep {.5em}
2671 \setlength \labelwidth{\leftmargini}
2672 \addtolength\labelwidth{-\labelsep}
2673 \@beginparpenalty -\@lowpenalty
2674 \@endparpenalty -\@lowpenalty
2675 \@itempenalty -\@lowpenalty
2676 \renewcommand\theenumi{@arabic\c@enumi}
2677 \renewcommand\theenumii{@alph\c@enumii}
2678 \renewcommand\theenumiii{@roman\c@enumiii}
2679 \renewcommand\theenumiv{@Alph\c@enumiv}
2680 \newcommand\labelenumi{\theenumi.}
2681 \newcommand\labelenumii{(\theenumii)}
2682 \newcommand\labelenumiii{(\theenumiii.)}
2683 \newcommand\labelenumiv{(\theenumiv.)}
2684 \renewcommand\p@enumii{\theenumi}
2685 \renewcommand\p@enumiii{\theenumi(\theenumii)}
2686 \renewcommand\p@enumiv{\p@enumii\theenumiii}
2687 \newcommand\labelitemi{\textbullet}
2688 \newcommand\labelitemii{\normalfont\bfseries \textendash}
2689 \newcommand\labelitemiii{\textasteriskcentered}
2690 \newcommand\labelitemiv{\textperiodcentered}

```

## 46.4 The description Environment

\descriptionlabel{<<text>>}

```

2691 \newenvironment{description}
2692     {\list{}{\labelwidth\z@ \itemindent-\leftmargin
2693             \let\makelabel\descriptionlabel}}
2694     {\endlist}
2695
2696 \newcommand*\descriptionlabel[1]{\hspace\labelsep
2697                                \normalfont\bfseries #1}

```

## 46.5 Verse Environment

**The verse environment** L<sup>A</sup>T<sub>E</sub>X's **verse** environment, can only serve for the incidental use of a few stanzas. It leaves most of the formatting to the author. It redefines the line break \\ to a \centercr.

```

2698 \newenvironment{verse}
2699     {\let\\@\centercr3
2700     \list{}{\itemsep \z@
2701             \itemindent -1.5em%
2702             \listparindent\itemindent
2703             \rightmargin \leftmargin
2704             \advance\leftmargin 1.5em}%
2705     \item\relax}
2706     {\endlist}
2707 \begin{Verse}
2708 My mobile test\\

```

---

<sup>3</sup>This is defined in ltmiscen.dtx

```

2709     this is other\\
2710     this is last\\
2711 \end{Verse}

```

The environment doesn't really do much, the way I see it but just move the poem a couple of ems inwards to much the definition of lists. Most people will want more from a poem environment.

```

My mobile test
this is other
this is last

```

The simplest thing we can add to this environment if we want to modify it, is a hook. This we can do using the `blkcntrl` package.<sup>4</sup>

```

2712 \renewenvironment{verse}
2713 50 {\let\\@centercr
2714 51 \relax\list{}{\setlength{\itemsep}{\z@}%
2715 52 \setlength{\itemindent}{-1.5em}%
2716 53 \setlength{\listparindent}{\itemindent}%
2717 54 \setlength{\rightmargin}{\leftmargin}%
2718 55 \addtolength{\leftmargin}{1.5em}%
2719 56 \item\relax\PreVerse\relax}
2720 57 {\endlist}

```

Using the command `\PreVerse`, we can add a block at the beginning of the block. For example some code to make a poem title and insert it later on. The setting of the rightmargin to the leftmargin here is curious. It might for example give us problems with `tufte-latex` classes.

## 46.6 Quotation and quote environments

**The quote and quotation environments.** The environments `quote` and `quotation` are defined next. Again they are defined using the general `\listP.319` environment. Again the general `\list`, is used in the definition. The dimension `\listparindentP.315` is set to 1.5 em. (See Kernel file `ltlists.dtx` 25).

```

2721 \newenvironment{quotation}
2722         {\list{}{\listparindent 1.5em%
2723             \itemindent\listparindent
2724             \rightmargin\leftmargin
2725             \parsep\z@ \@plus\p@}%
2726             \item\relax}
2727         {\endlist}

2728 \newenvironment{quote}
2729         {\list{}{\rightmargin\leftmargin}%
2730             \item\relax}
2731         {\endlist}

2732
2733
2734
2735
2736 \section{The \protect\textrtt{titlepage} environment}

```

<sup>4</sup>From the <http://www.ifi.uio.no/it/latex-links/blkcndl.pdf>

```
2737 \if@compatibility
2738 \newenvironment{titlepage}
2739 {%
2740   \cleardoublepage
2741   \if@twocolumn
2742     \restonecoltrue\onecolumn
2743   \else
2744     \restonecolfalse\newpage
2745   \fi
2746   \thispagestyle{empty}%
2747   \setcounter{page}\z@
2748 }%
2749 {\if@restonecol\twocolumn \else \newpage \fi
2750 }
2751 \else
2752 \newenvironment{titlepage}
2753 {%
2754   \cleardoublepage
2755   \if@twocolumn
2756     \restonecoltrue\onecolumn
2757   \else
2758     \restonecolfalse\newpage
2759   \fi
2760   \thispagestyle{empty}%
2761   \setcounter{page}\@ne
2762 }%
2763 {\if@restonecol\twocolumn \else \newpage \fi
2764   \if@twoside\else
2765     \setcounter{page}\@ne
2766   \fi
2767 }
2768 \fi
```

## Appendix B

# Experimental Errors

### B.1 First section

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

#### B.1.1 First subsection

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

5

**The Appendix.** Similarly to the chapter sectioning commands, the Appendix is not defined as a section. It simply sets the chapter and section counters to zero and sets the name of the section. All the relevant counters and uses letters for the numbering of the following chapters etc. If you closely follow the code, it is all based on the chapter command, except that it defaults to Alphanumeric counting.

\appendix

```

2769 \newcommand{\appendix}{\par
2770   \setcounter{chapter}{0}%
2771   \setcounter{section}{0}%
2772   \gdef\@chapapp{\appendixname}5
2773   \gdef\thechapter{@Alph\c@chapter}}

```

An Appendix page has the same looks and feel to that of a Chapter. For all practical purposes, it is a chapter, with different labels and uppercase letters numbering.

**General Settings.** Here, some general settings are set. These include settings for framed boxes, tabbing separators and array column separators.

```

2774 \setlength\arraycolsep{5\p@}
2775 \setlength\tabcolsep{6\p@}
2776 \setlength\arrayrulewidth{.4\p@}
2777 \setlength\doublerulesep{2\p@}
2778 \setlength\tabbingsep{\labelsep}
2779 \skip\@mpfootins = \skip\footins

```

The `\fboxsep`<sup>→ σ 336</sup> and `\fboxrule`<sup>→ σ 336</sup> are then set to `3pt` and `.4pt` respectively. These are used with frame boxes.

```

2780 \setlength\fboxsep{3\p@}
2781 \setlength\fboxrule{.4\p@}

```

**Equation numbering** The equation counter is reset according to the chapter counter, using the L<sup>A</sup>T<sub>E</sub>X kernel command `\@addtoreset`.

```

2782 \@addtoreset {equation}{chapter}
2783 \renewcommand\theequation
2784   {\ifnum \c@chapter>\z@ \thechapter.\fi \arabic\c@equation}

```

## 46.7 FIGURE AND TABLE ENVIRONMENTS

**Figure Environment** The figure environment is defined using commands that have been provided by the kernel. The command `\thefigure` is first redefined to display the combination of the chapter dot figure counter, all in arabic numerals. The extension for the list of figures and finally the floats for single column and double column.

```

2785 \newcounter{figure}[chapter]
2786 \renewcommand \thefigure
2787   {\ifnum \c@chapter>\z@ \thechapter.\fi \arabic\c@figure}
2788 \def\fps@figure{tbp}
2789 \def\ftype@figure{1}
2790 \def\ext@figure{lof}
2791 \def\fnum@figure{\figurename\nobreakspace\thefigure}
2792 \newenvironment{figure}
2793   {\@float{figure}}
2794   {\end@float}
2795 \newenvironment{figure*}
2796   {\@dblfloat{figure}}
2797   {\end@dblfloat}

```

---

<sup>5</sup>The actual literal used for `\appendixname` is defined later on, so that you can customize the language

**Table Environment** Table floats are defined the same way

like the figures with their respective counters and names.

```

2798 \newcounter{table}[chapter]
2799 \renewcommand \thetable
2800   {\ifnum \c@chapter>\z@ \thechapter.\fi \ifarabic\c@table}
2801 \def\fps@table{tbp}
2802 \def\ftype@table{2}
2803 \def\ext@table{lot}
2804 \def\fnum@table{\tablename\nobreakspace\thetable}
2805
2806
2807 \newenvironment{table}
2808   {\@float{table}}
2809   {\end@float}
2810
2811 \newenvironment{table*}
2812   {\@dblfloat{table}}
2813   {\end@dblfloat}
```

**Captions** The captioning macros are rather short but need a bit of explanation. First some lengths are defined. The lengths are for **abovecaptionskip** and

**belowcaptionskip** are set equal to a default of 10pt as for the font-size, but the length **belowcaptionskip** is set to **opt**.

```

2814 \newlength\abovecaptionskip
2815 \newlength\belowcaptionskip
2816 \setlength\abovecaptionskip{10\p@}
2817 \setlength\belowcaptionskip{0\p@}
2818
2819 \long\def\@makecaption#1#2{%
2820   \vskip\abovecaptionskip
2821   \sbox\@tempboxa{#1: #2}
2822   \ifdim \wd\@tempboxa >\hsize
2823     #1: #2\par
2824   \else
2825     \global \minipagetrue
2826     \hb@xt@\hsize{\hfil\box\@tempboxa\hfil}%
2827   \fi
2828   \vskip\belowcaptionskip}
```

The **@makecaption** macro is also interesting. Firstly note in line the use of a colon (:). So if you do not like to have this you know where you need to go and change it. The contents of the caption are first saved into a box. If the box is greater than **hsize**

then they are written like a paragraph otherwise, they are centered. Note that the centering is done using **\hfil\box\@tempboxa\hfil**. The mysterious command **\hb@xt** is defined in the kernel and is equivalent to **\hbox to**.

```

2829 \hb@xt@ The next one is another 100 tokens worth.
2830 16 \def\hb@xt@{\hbox to}
```

It is simply an abbreviation of `\hbox to`. There are many shortcut commands like this, so the com-

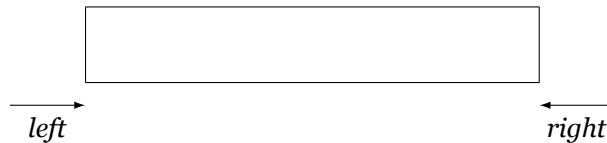
mand just again sets the caption in a horizontal box. There is more to the story later on.

## 46.8 Defining the old style font commands

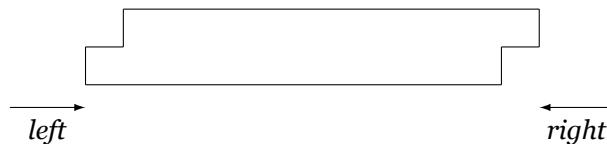
```
2831 \DeclareOldFontCommand{\rm}{\normalfont\rmfamily}{\mathrm}
2832 \DeclareOldFontCommand{\sf}{\normalfont\sffamily}{\mathsf}
2833 \DeclareOldFontCommand{\tt}{\normalfont\ttfamily}{\mathtt}
2834 \DeclareOldFontCommand{\bf}{\normalfont\bfseries}{\mathbf}
2835 \DeclareOldFontCommand{\it}{\normalfont\itshape}{\mathit}
2836 \DeclareOldFontCommand{\sl}{\normalfont\slshape}{\@nomath\sl}
2837 \DeclareOldFontCommand{\sc}{\normalfont\scshape}{\@nomath\sc}
2838 \DeclareRobustCommand*\cal{\@fontswitch\relax\mathcal}
2839 \DeclareRobustCommand*\mit{\@fontswitch\relax\mathnormal}
```

## 46.9 Table of contents

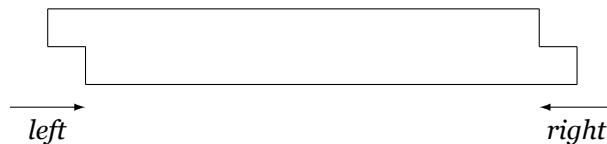
Firstly we define the width of the box that the page number is set. Use ems so that it does not need to be redefined for every change in font size. Toc entries are treated as rectangular areas where the text and probably a filler will be written. Let's draw such an area (of course, the lines themselves are not printed):



The space between the left page margin and the left edge of the area will be named `<left>`; similarly we have `<right>`. You are allowed to modify the beginning of the first line and the ending of the last line. For example by “taking up” both places with `\hspace*{2pc}` the area becomes:



And by “clearing” space in both places with `\hspace*{-2pc}` the area becomes:



If you have seen tocs, the latter should be familiar to you— the label at the very beginning, the page at the very end:

---

### 3.2 This is an example showing that toc entries fits in that scheme . . . 4

---

```
2840 \newcommand{\@pnumwidth{1.55em}}%Width of box in which page is set
  {\number is set.}
```

We then define the margin and the dotsep. We also set the toc counter to whatever is required (don't go too deep especially if you have an index).

```
2841 \newcommand{\@tocrmarg{2.55em}}%Right margin indentation for
  {all but last line of multiple-line entries.
2842 \newcommand{\@dotsep{4.5}}%Separation between dots, in mu
  {units. Should be \def'd to a number like
2843 2 or 1.7}
```

## \tableofcontents

**Defining the contents table.** The author is provided with the author command `\tableofcontents`. All format information is provided at this point.

```
2844 \setcounter{tocdepth}{2}
2845 \newcommand{\tableofcontents}{%
2846   \if@twocolumn
2847     \restonecoltrue\onecolumn
2848   \else
2849     \restonecolfalse
2850   \fi
2851   \chapter*{\contentsname
2852     \@mkboth{%
2853       \MakeUppercase{\contentsname}}{\MakeUppercase{\contentsname}}}
2854   \starttoc{toc}%
2855   \if@restonecol\twocolumn\fi
2856 }

2857 \newcommand*{\l@part[2]}{%
2858   \ifnum \c@tocdepth >-2\relax
2859     \addpenalty{-\highpenalty}%
2860     \addvspace{2.25em \@plus\p@}%
2861     \setlength{\tempdima}{3em}%
2862     \begingroup
2863       \parindent \z@ \rightskip \pnumwidth
2864       \parfillskip -\pnumwidth
2865       \leavevmode
2866       \large \bfseries #1\hfil \hb@xt@\pnumwidth{\hss }%
2867         \#2}\}\par
2868     \nobreak
2869     \global\nobreaktrue
2870   \endgroup
2871 }
```

```

2872 \newcommand*\l@chapter[2]{%
2873   \ifnum \c@tocdepth > \m@ne
2874     \addpenalty{-\@highpenalty}%
2875     \vskip 1.0em \@plus\p@
2876     \setlength{\tempdima}{1.5em}%
2877     \begingroup
2878       \parindent \z@ \rightskip \pnumwidth
2879       \parfillskip -\pnumwidth
2880       \leavevmode \bfseries
2881       \advance\leftskip\tempdima
2882       \hskip -\leftskip
2883       #1\nobreak\hfil \nobreak\hb@xt@\pnumwidth{\hss #2}\par
2884       \penalty\@highpenalty
2885     \endgroup
2886   \fi}

```

The five remaining levels (entry in L<sup>A</sup>T<sub>E</sub>X terminology, are defined next). This is done with the general L<sup>A</sup>T<sub>E</sub>X kernel command

```

2888 \@dottedtocline{<level>}{<indent>}{{<numwidth>}{<title>}{<page>}}: >
  Macro
2889 to produce a table of contents line with the following >
  parameters:

```

The commands for the remaining sections are defined as follows:

```

2890 \newcommand*\l@section{@dottedtocline{1}{1.5em}{2.3em}}
2891 \newcommand*\l@subsection{@dottedtocline{2}{3.8em}{3.2em}}
2892 \newcommand*\l@subsubsection{@dottedtocline{3}{7.0em}{4.1em}}
2893 \newcommand*\l@paragraph{@dottedtocline{4}{10em}{5em}}
2894 \newcommand*\l@subparagraph{@dottedtocline{5}{12em}{6em}}

```

So where are the last two parameters? These are just zeroed here!

I can assure that the **dotted** type of section bothers a lot of people. Most new books will both compact the table of contents as well as remove the dots. You can use the **titlesec** and **titletoc** to do this rather than redefining the kernel commands or the standard classes styles.

### 46.9.1 List of figures, tables etc

```

2895 \newcommand\listoffigures{%
2896   \if@twocolumn
2897     \restonecoltrue\onecolumn
2898   \else
2899     \restonecolfalse
2900   \fi
2901   \chapter*{\listfigurename}%
2902   \mkboth{\MakeUppercase\listfigurename}{%
2903     {\MakeUppercase\listfigurename}%
2904   }%
2905   \starttoc{lof}%
2906   \if@restonecol\twocolumn\fi
2907 }

```

The interesting command here is the **@starttoc{lof}**. This simply does all the housekeeping to open a file. as you can see it is not too difficult to have file extension names other than the standard ones.

The `\@` commands for the Table of Contents are defined as per the rest of the sectioning commands.

```

2907 \newcommand*\l@figure{\@dottedtocline{1}{1.5em}{2.3em}}
2908 \newcommand\listoftables{%
2909   \if@twocolumn
2910     \@restonecoltrue\onecolumn
2911   \else
2912     \@restonecolfalse
2913   \fi
2914   \chapter*{\listtablename}%
2915   \mkboth{%
2916     \MakeUppercase\listtablename}%
2917   { \MakeUppercase\listtablename}%
2918   \starttoc{lot}%
2919   \if@restonecol\twocolumn\fi
2920 }
2921 \let\l@table\l@figure

```

## 46.10 Bibliographies

L<sup>A</sup>T<sub>E</sub>X provides some basic bibliographic commands. Every entry is defined to be displayed in a block. It starts by defining a new length `\bibindent`. Entries are displayed using the `\list`<sup>P.319</sup>. The commands here are mainly to set parameters for macros already provided by the kernel.

```

\begin{thebibliography}{<widest label>}
<environment content>
\end{thebibliography}

2922 \newdimen\bibindent
2923 \setlength\bibindent{1.5em}
2924 \newenvironment{thebibliography}[1]
2925   {\chapter*{\bibname}%
2926    \mkboth{\MakeUppercase\bibname}{\MakeUppercase\bibname}%
2927    \list{@\biblabel{@\arabic{c@enumiv}}}{%
2928      \settowidth\labelwidth{@\biblabel{#1}}%
2929      \leftmargin\labelwidth
2930      \advance\leftmargin\labelsep
2931      \openbib@code
2932      \usecounter{enumiv}%
2933      \let\p@enumiv\empty
2934      \renewcommand\theenumiv{@\arabic{c@enumiv}}%
2935      \sloppy
2936      \clubpenalty4000
2937      \clubpenalty \clubpenalty
2938      \widowpenalty4000%
2939      \sfcode`\.\@m}
2940      \def\noitemerr
2941        {@latex@warning{Empty `thebibliography' environment}}%
2942      \endlist}
2943 \newcommand\newblock{\hskip .11em\@plus.33em\@minus.07em}
2944 \let\openbib@code\empty

```

## 46.11 The Index Environment

This is a short environment definition for styling the Index. It defines in line [2960] the `@idxiditem`, which is then used to define `\subitem` and `\subsubitem` styling.

```

2945 \newenvironment{theindex}
2946   {\if@twocolumn
2947     \@restonecolfalse
2948   \else
2949     \@restonecoltrue
2950   \fi
2951   \twocolumn[\@makeschapterhead{\indexname}]%
2952   \mkboth{\MakeUppercase{\indexname}}%
2953   {\MakeUppercase{\indexname}}%
2954   \thispagestyle{plain}\parindent\z@
2955   \parskip\z@\@plus .3\p@\relax
2956   \columnseprule\z@
2957   \columnsep 35\p@
2958   \let\item\@idxitem}
2959   {\if@restonecol\onecolumn\else\clearpage\fi}
2960 \newcommand\@idxitem{\par\hangindent 40\p@}
2961 \newcommand\subitem{\@idxitem \hspace*{20\p@}}
2962 \newcommand\subsubitem{\@idxitem \hspace*{30\p@}}
2963 \newcommand\indexspace{\par \vskip 10\p@ \@plus5\p@ \relax
2964   \z@\@minus3\p@\relax}
```

## 46.12 Footnotes

### \footnoterule

**Footnote rules.** Footnote rules are defined by renewing the command `\footnoterule`. Counters for footnotes are reset based on the chapter counters. The footnote command `\@makefntext` provides the formatting. It also gives the user the ability to use these to insert footnotes, in difficult places.

```

2964 \renewcommand\footnoterule{%
2965   \kern-3\p@
2966   \hrule\@width.4\columnwidth
2967   \kern2.6\p@}
2968
2969 \addtoreset{footnote}{chapter}
```

### \@makefntext

### \@makefnmark

```

2970 \newcommand\@makefntext[1]{%
2971   \parindent 1em%
2972   \noindent
2973   \hb@xt@1.8em{\hss\@makefnmark}#1}
```

## 46.13 Catering for Other Languages

**Structural element names.** L<sup>A</sup>T<sub>E</sub>X does not provide by itself the means to change the structural element names to a language other than English. However, their names are defined in a series of commands, that make it easier to be overwritten to change them to another language. As they are separate from the macros that use them, it is easy to overwrite them, in order to use another language. This is what the Babel package does. Note the Section, is not defined here.

### \contentsname

Typesets the contents name.

```
2974 \newcommand\contentsname{Contents}
```

### \listfigurename

Typesets “List of Figures”, if it is not redefined.

```
2975 \newcommand\listfigurename{List of Figures}
2976 \newcommand\listtablename{List of Tables}
2977 \newcommand\bibname{Bibliography}
2978 \newcommand\indexname{Index}
2979 \newcommand\figurename{Figure}
2980 \newcommand\tablename{Table}
2981 \newcommand\partname{Part}
2982 \newcommand\chaptername{Chapter}
2983 \newcommand\appendixname{Appendix}
```

**Dates** Not much of a use but the month names are also defined here in an `\ifcase` statement. Again they can be overwritten by Babel.

### \today

```
2984 \def\today{\ifcase\month\or
2985   January\or February\or March\or April\or May\or June\or
2986   July\or August\or September\or October\or November\or
2987   December\fi
2987 \space\number\day, \number\year}
```

**Multicolumn gutter and rule.** Here two lengths are set. The distance between two columns of text and the width of the separating rule.

```
2988 \setlength\columnsep{10\p@}
2989 \setlength\columnseprule{0\p@}
```

## 46.14 Final

```
2990 \pagestyle{headings}
2991 \pagenumbering{arabic}
2992 \if@twoside
2993 \else
2994 \raggedbottom
```

```

2995 \fi
2996 \if@twocolumn
2997   \twocolumn
2998   \sloppy
2999   \flushbottom
3000 \else
3001   \onecolumn
3002 \fi
3003 \endinput
3004 %%
3005 %% End of file `book.cls'.

```

## 46.15 Ending remarks

It is to the credit of Lamport and his associates that he was the first one to produce a system of mark-up that structured documents, using the TeX typographical engine. The class is widely used and many variants exist. One area that can be improved is to provide more ‘hooks’ to enable programmers to redefine classes more easily.

Since the class has been published new packages have established themselves as the ‘de facto’ standards of defining portions of the class. For example the `new` class will attempt to define all the papers as Lamport did, but would rather use the `geometry` package to do so. Top and bottom headings are defined using the `fancyverb`.

It was when the code was written, but is not now (in my opinion). The current LaTeX2e kernel was release in 1992 and carries forward a lot of material from LaTeX2.09. Even with these optimizations and the old ‘autoload’ system, there were a lot of systems that LaTeX was too big for on release. So looked at in the early 1990s this was entirely sensible.

I’d say this is no longer needed as in most LaTeX documents today there are a lot of tokens used by things like pgf which make the modest saving in optimisation pretty meaningless. One of the things we’re doing in LaTeX3 is trying to move to more logical constructs at the expense of efficiency in tokens, at least at a higher level. (Right at the core of expl3 there is still a need to watch the number of expansions, etc., and this is an area where we may yet need some more optimisation.)

You can think of the `LATEX` classes working at three levels.

1. Selecting paper sizes and defining main page elements.
2. They define how the document is sectioned. I have called this sectioning by referring to it as structural commands.
3. It provides the typesetting of these structural elements.

Unfortunately, they are not separated in a way that makes it easy for them to be modified. A plethora of packages assists the author in modifying every type of sectioning and formatting decisions of Lamport. Most authors will focus on the formatting commands. Some will add a bit of structure, perhaps some

special sections for questions and answers. If you have used the titlesec package for modifying the sections, the caption package for modifying the way captions are displayed, the fancyhdr for headers, the titleref for the way table of contents are displayed, one of the bibliography packages what begs to be question is what remains? Very little. You might as well at this point decide on a new class. It will be more efficient and you will have better control. Separation of structure from presentational decisions is important. Some common structural elements that are missing should be integrated in. The KOMA classes and memoir went totally overboard, in that they try to be everything to everybody. A system that is nearer to defining a structural template and then decorate it with a selection of fonts, colors, spacing and the like would have been more appropriate.

## 46.16 The .clo files

```

3007 %%
3008 %% This is file `bk10.clo',
3009
3010 \ProvidesFile{bk10.clo}
3011     [2007/10/19 v1.4h
3012     Standard LaTeX file (size option)]
3013 \normalsize→ P.271 = <commands> Redefined for each font-size option, 10pt,
3014     11pt, 12pt etc.
3015 \renewcommand\normalsize{%
3016     \@setfontsize\normalsize\xpt\@xipt
3017     \abovedisplayskip 10\p@ \oplus2\p@ \minus5\p@
3018     \abovedisplayshortskip \z@ \oplus3\p@
3019     \belowdisplayshortskip 6\p@ \oplus3\p@ \minus3\p@
3020     \belowdisplayskip \abovedisplayskip
3021     \let\@listi\@listI}
3022 \normalsize
3023 \newcommand\small{%
3024     \@setfontsize\small\xpt{11}%
3025     \abovedisplayskip 8.5\p@ \oplus3\p@ \minus4\p@
3026     \abovedisplayshortskip \z@ \oplus2\p@
3027     \belowdisplayshortskip 4\p@ \oplus2\p@ \minus2\p@
3028     \def\@listi{\leftmargin\leftmargini
3029         \topsep 4\p@ \oplus2\p@ \minus2\p@
3030         \parsep 2\p@ \oplus\p@ \minus\p@
3031         \itemsep \parsep}%
3032     \belowdisplayskip \abovedisplayskip
3033 }
3034 \newcommand\footnotesize{%
3035     \@setfontsize\footnotesize\@viiipt{9.5}%
3036     \abovedisplayskip 6\p@ \oplus2\p@ \minus4\p@
3037     \abovedisplayshortskip \z@ \oplus\p@
3038     \belowdisplayshortskip 3\p@ \oplus\p@ \minus2\p@
3039     \def\@listi{\leftmargin\leftmargini
3040         \topsep 3\p@ \oplus\p@ \minus\p@
3041         \parsep 2\p@ \oplus\p@ \minus\p@
3042         \itemsep \parsep}%
3043     \belowdisplayskip \abovedisplayskip
3044 }

```

```

3043 \newcommand\scriptsize{\@setfontsize\scriptsize\@viiipt\@viiipt}
3044 \newcommand\tiny{\@setfontsize\tiny\@vpt\@vpt}
3045 \newcommand\large{\@setfontsize\large\xiip{14}}
3046 \newcommand\Large{\@setfontsize\Large\xivpt{18}}
3047 \newcommand\LARGE{\@setfontsize\LARGE\xviiipt{22}}
3048 \newcommand\huge{\@setfontsize\huge\xxpt{25}}
3049 \newcommand\Huge{\@setfontsize\Huge\xxvpt{30}}

```

**Paragraph indentation.** This parameter is controlled by the TeX command **parindent**. It is set narrower in two column text, to avoid problems with hyphenation that can result in overfull boxes.

```

3050 \if@twocolumn
3051   \setlength\parindent{1em}
3052 \else
3053   \setlength\parindent{15\p@}
3054 \fi
3055
3056 \setlength\smallskipamount{3\p@ \@plus 1\p@ \@minus 1\p@}
3057 \setlength\medskipamount{6\p@ \@plus 2\p@ \@minus 2\p@}
3058 \setlength\bigskipamount{12\p@ \@plus 4\p@ \@minus 4\p@}
3059 \setlength\headheight{12\p@}
3060 \setlength\headsep{.25in}
3061 \setlength\topskip{10\p@}
3062 \setlength\footskip{.35in}
3063 \if@compatibility \setlength\maxdepth{4\p@} \else
3064 \setlength\maxdepth{.5\topskip} \fi
3065 \if@compatibility
3066   \if@twocolumn
3067     \setlength\textwidth{410\p@}
3068   \else
3069     \setlength\textwidth{4.5in}
3070   \fi
3071 \else
3072   \setlength@\tempdima{\paperwidth}
3073   \addtolength@\tempdima{-2in}
3074   \setlength@\tempdimb{345\p@}
3075   \if@twocolumn
3076     \ifdim@\tempdima>2@\tempdimb\relax
3077       \setlength\textwidth{2@\tempdimb}
3078     \else
3079       \setlength\textwidth{\@tempdima}
3080     \fi
3081   \else
3082     \ifdim@\tempdima>@\tempdimb\relax
3083       \setlength\textwidth{\@tempdimb}
3084     \else
3085       \setlength\textwidth{\@tempdima}
3086     \fi
3087   \fi
3088 \fi
3089 \if@compatibility\else
3090   \settowidth
3091 \fi
3092 \if@compatibility

```

```

3093   \setlength{\textheight}{41\baselineskip}
3094 \else
3095   \setlength{\@tempdima}{\paperheight}
3096   \addtolength{\@tempdima}{-2in}
3097   \addtolength{\@tempdima}{-1.5in}
3098   \divide{\@tempdima}{\baselineskip}
3099   \let\tempcpta=\@tempdima
3100   \setlength{\textheight}{\@tempcpta\baselineskip}
3101 \fi
3102 \addtolength{\textheight}{\topskip}
3103 \if@twocolumn
3104   \setlength{\marginparsep}{10\p@}
3105 \else
3106   \setlength{\marginparsep}{7\p@}
3107 \fi
3108 \setlength{\marginparpush}{5\p@}
3109 \if@compatibility
3110   \setlength{\oddsidemargin}{.5in}
3111   \setlength{\evensidemargin}{1.5in}
3112   \setlength{\marginparwidth}{.75in}
3113 \if@twocolumn
3114   \setlength{\oddsidemargin}{30\p@}
3115   \setlength{\evensidemargin}{30\p@}
3116   \setlength{\marginparwidth}{48\p@}
3117 \fi
3118 \else
3119 \if@twoside
3120   \setlength{\@tempdima}{\paperwidth}
3121   \addtolength{\@tempdima}{-\textwidth}
3122   \setlength{\oddsidemargin}{.4\@tempdima}
3123   \addtolength{\oddsidemargin}{-1in}
3124   \setlength{\marginparwidth}{.6\@tempdima}
3125   \addtolength{\marginparwidth}{-\marginparsep}
3126   \addtolength{\marginparwidth}{-0.4in}
3127 \else
3128   \setlength{\@tempdima}{\paperwidth}
3129   \addtolength{\@tempdima}{-\textwidth}
3130   \setlength{\oddsidemargin}{.5\@tempdima}
3131   \addtolength{\oddsidemargin}{-1in}
3132   \setlength{\marginparwidth}{.5\@tempdima}
3133   \addtolength{\marginparwidth}{-\marginparsep}
3134   \addtolength{\marginparwidth}{-0.4in}
3135   \addtolength{\marginparwidth}{-.4in}
3136 \fi
3137 \ifdim \marginparwidth >2in
3138   \setlength{\marginparwidth}{2in}
3139 \fi
3140 \@settopoint{\oddsidemargin}
3141 \@settopoint{\marginparwidth}
3142 \setlength{\evensidemargin}{\paperwidth}
3143 \addtolength{\evensidemargin}{-2in}
3144 \addtolength{\evensidemargin}{-\textwidth}
3145 \addtolength{\evensidemargin}{-\oddsidemargin}
3146 \@settopoint{\evensidemargin}

```

```
3147 \fi
```

**Top margin** Next the top margin is calculated. In earlier versions the  $\text{P}.\text{??}$  was a fixed number. In this class, it is automatically calculated from the `\paperheight` (as the user only inputs the papersize through one of the paper selection options).

```
3148 \if@compatibility
3149   \setlength\topmargin{.75in}
3150 \else
3151   \setlength\topmargin{\paperheight}
3152   \addtolength\topmargin{-2in}
3153   \addtolength\topmargin{-\headheight}
3154   \addtolength\topmargin{-\headsep}
3155   \addtolength\topmargin{-\textheight}
3156   \addtolength\topmargin{-\footskip}    % this might be >
3157   \addtolength\topmargin{-0.35in}
3158   \settowidth\topmargin
3159 \fi
```

The lists settings follow. Similarly all values are hard-coded based on the font size.

```
3160 \setlength\footnotesep{6.65\p@}
3161 \setlength{\skip\footins}{9\p@ \@plus 4\p@ \@minus 2\p@}
3162 \setlength\floatsep{12\p@ \@plus 2\p@ \@minus 2\p@}
3163 \setlength\textfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3164 \setlength\intextsep{12\p@ \@plus 2\p@ \@minus 2\p@}
3165 \setlength\dblfloatsep{12\p@ \@plus 2\p@ \@minus 2\p@}
3166 \setlength\dbltextfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3167 \setlength@\fptop{0\p@ \@plus 1fil}
3168 \setlength@\fpsep{8\p@ \@plus 2fil}
3169 \setlength@\fpbot{0\p@ \@plus 1fil}
3170 \setlength@\dblftop{0\p@ \@plus 1fil}
3171 \setlength@\dblpsep{8\p@ \@plus 2fil}
3172 \setlength@\dblfpbot{0\p@ \@plus 1fil}
```

**\listi**

```
3173 \setlength\partopsep{2\p@ \@plus 1\p@ \@minus 1\p@}
3174 \def@\listi{\leftmargin\leftmargini
3175   \parsep 4\p@ \@plus2\p@ \@minus\p@
3176   \topsep 8\p@ \@plus2\p@ \@minus4\p@
3177   \itemsep4\p@ \@plus2\p@ \@minus\p@}
3178 \let@\listI@\listi
3179 \listi
3180 \def@\listii {\leftmargin\leftmarginii
3181   \labelwidth\leftmarginii
3182   \advance\labelwidth-\labelsep
3183   \topsep 4\p@ \@plus2\p@ \@minus\p@
3184   \parsep 2\p@ \@plus\p@ \@minus\p@
3185   \itemsep \parsep}
3186 \def@\listiii{\leftmargin\leftmarginiii
3187   \labelwidth\leftmarginiii
3188   \advance\labelwidth-\labelsep
3189   \topsep 2\p@ \@plus\p@ \@minus\p@}
```

```
3190          \parsep    \z@  
3191          \partopsep \p@ \@plus\z@ \@minus\p@  
3192          \itemsep   \topsep}  
3193 \def\@listiv {\leftmargin\leftmarginiv  
3194           \labelwidth\leftmarginiv  
3195           \advance\labelwidth-\labelsep}  
3196 \def\@listv { \leftmargin\leftmarginv  
3197           \labelwidth\leftmarginv  
3198           \advance\labelwidth-\labelsep}  
3199 \def\@listvi { \leftmargin\leftmarginvi  
3200           \labelwidth\leftmarginvi  
3201           \advance\labelwidth-\labelsep}  
3202  
3203 %%  
3204 %% End of file `bk10.clo'.
```

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

```

3206 %<article|report|book>\NeedsTeXFormat{LaTeX2e}[1995/12/01]
3207 %<article>\ProvidesClass{article}
3208 %<report>\ProvidesClass{report}
3209 %<book>\ProvidesClass{book}
3210 %<10pt&!bk>\ProvidesFile{size10.clo}
3211 %<11pt&!bk>\ProvidesFile{size11.clo}
3212 %<12pt&!bk>\ProvidesFile{size12.clo}
3213 %<10pt&bk>\ProvidesFile{bk10.clo}
3214 %<11pt&bk>\ProvidesFile{bk11.clo}
3215 %<12pt&bk>\ProvidesFile{bk12.clo}
3216 %%<*driver>
3217 \ProvidesFile{classes.drv}
3218 %%</driver>
3219 [2014/09/29 v1.4h
3220 %<article|report|book> Standard LaTeX document class]
3221 %<10pt|11pt|12pt> Standard LaTeX file (size option)]

```

## 47.1 A driver for this document

The next bit of code contains the documentation driver file for  $\text{\TeX}$ , i.e., the file that will produce the documentation you are currently reading. It will be extracted from this file by the **DOCSTRIP** program.

## 47.2 The **DOCSTRIP** modules

The following modules are used in the implementation to direct **DOCSTRIP** in generating the external files:

|         |                                          |
|---------|------------------------------------------|
| article | produce the <b>documentclass</b> article |
| report  | produce the <b>documentclass</b> report  |
| size10  | produce the class option for 10pt        |
| size11  | produce the class option for 11pt        |
| size12  | produce the class option for 12pt        |
| book    | produce the <b>documentclass</b> book    |
| bk10    | produce the book class option for 10pt   |
| bk11    | produce the book class option for 11pt   |
| bk12    | produce the book class option for 12pt   |
| driver  | produce a documentation driver file      |

## 47.3 Initial Code

In this part we define a few commands that are used later on.

**\@ptsize** This control sequence is used to store the second digit of the pointsize we are typesetting in. So, normally, its value is one of 0, 1 or 2.

```

3222 %%<*article|report|book>
3223 \newcommand\@ptsize{}%
```

(End definition for `disable_callback` and others.)

```
3224 \newif\if@restonecol
```

```

3225 \newif\if@titlepage
3226 %<article>\@titlepagefalse
3227 %%<!article>\@titlepagetrue
3228 %%<!article>\newif\if@openright

```

\if@mainmatter The switch `\if@mainmatter`, only available in the document class book, indicates whether we are processing the main material in the book.

```
3229 %%<book>\newif\if@mainmatter \@mainmattertrue
```

*(End definition for \if@mainmatter.)*

## 47.4 Declaration of Options

### 47.4.1 Setting Paper Sizes

The variables `\paperwidth` and `\paperheight` should reflect the physical paper size after trimming. For desk printer output this is usually the real paper size since there is no post-processing. Classes for real book production will probably add other paper sizes and additionally the production of crop marks for trimming. In compatibility mode, these (and some of the subsequent) options are disabled, as they were not present in L<sup>A</sup>T<sub>E</sub>X2.09.

```

3230 \if@compatibility\else
3231 \DeclareOption{a4paper}
3232   {\setlength\paperheight {297mm}%
3233   \setlength\paperwidth {210mm}%
3234 \DeclareOption{a5paper}
3235   {\setlength\paperheight {210mm}%
3236   \setlength\paperwidth {148mm}%
3237 \DeclareOption{b5paper}
3238   {\setlength\paperheight {250mm}%
3239   \setlength\paperwidth {176mm}%
3240 \DeclareOption{letterpaper}
3241   {\setlength\paperheight {11in}%
3242   \setlength\paperwidth {8.5in}%
3243 \DeclareOption{legalpaper}
3244   {\setlength\paperheight {14in}%
3245   \setlength\paperwidth {8.5in}%
3246 \DeclareOption{executivepaper}
3247   {\setlength\paperheight {10.5in}%
3248   \setlength\paperwidth {7.25in}%
3249 \DeclareOption{landscape}
3250   {\setlength@tempdima {\paperheight}%
3251   \setlength\paperheight {\paperwidth}%
3252   \setlength\paperwidth {\@tempdima}%
3253 \fi
3254 \if@compatibility
3255   \renewcommand\@ptsize{0}
3256 \else
3257 \DeclareOption{10pt}{\renewcommand\@ptsize{0}}
3258 \fi
3259 \DeclareOption{11pt}{\renewcommand\@ptsize{1}}
3260 \DeclareOption{12pt}{\renewcommand\@ptsize{2}}

```

```

3261 \if@compatibility\else
3262 \DeclareOption{oneside}{\@twosidefalse \@mparswitchfalse}
3263 \fi
3264 \DeclareOption{twoside}{\@twosidetrue \@mparswitchtrue}
3265 \DeclareOption{draft}{\setlength\overfullrule{5pt}}
3266 \if@compatibility\else
3267 \DeclareOption{final}{\setlength\overfullrule{0pt}}
3268 \fi
3269 \DeclareOption{titlepage}{\@titlepagetrue}
3270 \if@compatibility
3271   \else
3272   \DeclareOption{notitlepage}{\@titlepagefalse}
3273 \fi
3274 %<!article>\if@compatibility
3275 %<book>\@openrighttrue
3276 %<!article>\else
3277 %<!article>\DeclareOption{openright}{\@openrighttrue}
3278 %<!article>\DeclareOption{openany}{\@openrightfalse}
3279 %<!article>\fi
3280 \if@compatibility\else
3281 \DeclareOption{onecolumn}{\@twocolumnfalse}
3282 \fi
3283 \DeclareOption{twocolumn}{\@twocolumntrue}
3284 \DeclareOption{leqno}{\input{leqno.clo}}
3285 \DeclareOption{fleqn}{\input{fleqn.clo}}

```

#### 47.4.2 Open bibliography

The option `openbib` produces the “open” bibliography style, in which each block starts on a new line, and succeeding lines in a block are indented by `\bibindent`.

```
3286 \DeclareOption{openbib}{%
```

First some hook into the bibliography environment is filled.

```

3287   \AtEndOfPackage{%
3288     \renewcommand{\openbib@code}{%
3289       \advance\leftmargin\bibindent
3290       \itemindent -\bibindent
3291       \listparindent \itemindent
3292       \parsep \z@
3293     }%
3294     \renewcommand{\newblock}{\par}%
3295   }
3296 %<*article>
3297 \ExecuteOptions{letterpaper,10pt,oneside,onecolumn,final}
3298 %</article>
3299 %<*report>
3300 \ExecuteOptions{letterpaper,10pt,oneside,onecolumn,final,openany}
3301 %</report>
```

```

3302 %<*book>
3303 \ExecuteOptions{letterpaper,10pt,twoside,onecolumn,final,openright}
3304 %</book>

```

The **\ProcessOptions** command causes the execution of the code for every option **FOO** which is declared and for which the user typed the **FOO** option in his **\documentclass** command. For every option **BAR** he typed, which is not declared, the option is assumed to be a global option. All options will be passed as document options to any **\usepackage** command in the document preamble.

```

3305 \ProcessOptions

3306 %<!book>\input{size1@ptsize.clo}
3307 %<book>\input{bk1@ptsize.clo}
3308 %</article|report|book>

3309 %<*10pt|11pt|12pt>
3310 \renewcommand\normalsize{%
3311 %<*10pt>
3312   \@setfontsize\normalsize\xpt\@xipt
3313   \abovedisplayskip 10\p@\@plus2\p@\@minus5\p@
3314   \abovedisplayshortskip \z@\@plus3\p@
3315   \belowdisplayshortskip 6\p@\@plus3\p@\@minus3\p@
3316 %</10pt>
3317 %<*11pt>
3318   \@setfontsize\normalsize\xipt{13.6}%
3319   \abovedisplayskip 11\p@\@plus3\p@\@minus6\p@
3320   \abovedisplayshortskip \z@\@plus3\p@
3321   \belowdisplayshortskip 6.5\p@\@plus3.5\p@\@minus3\p@
3322 %</11pt>
3323 %<*12pt>
3324   \@setfontsize\normalsize\xipt{14.5}%
3325   \abovedisplayskip 12\p@\@plus3\p@\@minus7\p@
3326   \abovedisplayshortskip \z@\@plus3\p@
3327   \belowdisplayshortskip 6.5\p@\@plus3.5\p@\@minus3\p@
3328 %</12pt>

3329   \belowdisplayskip \abovedisplayskip
3330   \let\@listi\@listI}

3331 \normalsize

3332 \newcommand\small{%
3333 %<*10pt>
3334   \@setfontsize\small\xpt{11}%
3335   \abovedisplayskip 8.5\p@\@plus3\p@\@minus4\p@
3336   \abovedisplayshortskip \z@\@plus2\p@
3337   \belowdisplayshortskip 4\p@\@plus2\p@\@minus2\p@
3338   \def\@listi{\leftmargin\leftmargini
3339     \topsep 4\p@\@plus2\p@\@minus2\p@
3340     \parsep 2\p@\@plus\p@\@minus\p@
3341     \itemsep \parsep}%
3342 %</10pt>
3343 %<*11pt>
3344   \@setfontsize\small\xipt{13.6}%
3345   \abovedisplayskip 10\p@\@plus2\p@\@minus5\p@
3346   \abovedisplayshortskip \z@\@plus3\p@

```

```

3347      \belowdisplayshortskip 6\p@ \@plus3\p@ \@minus3\p@
3348      \def\@listi{\leftmargin\leftmargini
3349          \topsep 6\p@ \@plus2\p@ \@minus2\p@
3350          \parsep 3\p@ \@plus2\p@ \@minus\p@
3351          \itemsep \parsep}%
3352 %</11pt>
3353 %<*12pt>
3354     \@setfontsize\small\xipt{13.6}%
3355     \abovedisplayskip 11\p@ \@plus3\p@ \@minus6\p@
3356     \abovedisplayshortskip \z@ \@plus3\p@
3357     \belowdisplayshortskip 6.5\p@ \@plus3.5\p@ \@minus3\p@
3358     \def\@listi{\leftmargin\leftmargini
3359         \topsep 9\p@ \@plus3\p@ \@minus5\p@
3360         \parsep 4.5\p@ \@plus2\p@ \@minus\p@
3361         \itemsep \parsep}%
3362 %</12pt>
3363     \belowdisplayskip \abovedisplayskip
3364 }
3365 \newcommand\footnotesize{%
3366 %<*10pt>
3367     \@setfontsize\footnotesize\@viipt{9.5}%
3368     \abovedisplayskip 6\p@ \@plus2\p@ \@minus4\p@
3369     \abovedisplayshortskip \z@ \@plus\p@
3370     \belowdisplayshortskip 3\p@ \@plus\p@ \@minus2\p@
3371     \def\@listi{\leftmargin\leftmargini
3372         \topsep 3\p@ \@plus\p@ \@minus\p@
3373         \parsep 2\p@ \@plus\p@ \@minus\p@
3374         \itemsep \parsep}%
3375 %</10pt>
3376 %<*11pt>
3377     \@setfontsize\footnotesize\@ixpt{11}%
3378     \abovedisplayskip 8\p@ \@plus2\p@ \@minus4\p@
3379     \abovedisplayshortskip \z@ \@plus\p@
3380     \belowdisplayshortskip 4\p@ \@plus2\p@ \@minus2\p@
3381     \def\@listi{\leftmargin\leftmargini
3382         \topsep 4\p@ \@plus2\p@ \@minus2\p@
3383         \parsep 2\p@ \@plus\p@ \@minus\p@
3384         \itemsep \parsep}%
3385 %</11pt>
3386 %<*12pt>
3387     \@setfontsize\footnotesize\@xpt\@xipt
3388     \abovedisplayskip 10\p@ \@plus2\p@ \@minus5\p@
3389     \abovedisplayshortskip \z@ \@plus3\p@
3390     \belowdisplayshortskip 6\p@ \@plus3\p@ \@minus3\p@
3391     \def\@listi{\leftmargin\leftmargini
3392         \topsep 6\p@ \@plus2\p@ \@minus2\p@
3393         \parsep 3\p@ \@plus2\p@ \@minus\p@
3394         \itemsep \parsep}%
3395 %</12pt>
3396     \belowdisplayskip \abovedisplayskip
3397 }
3398 %</10pt|11pt|12pt>

```

**\scriptsize** These are all much simpler than the previous macros, they just select a new

```

\tiny
\large January 26, 2019
\Large
\LARGE
\huge
\Huge

```

phddoc



fontsize, but leave the parameters for displays and lists alone.

```

3399 %<*10pt>
3400 \newcommand\scriptsize{\@setfontsize\scriptsize\@viiipt\@viiipt}
3401 \newcommand\tiny{\@setfontsize\tiny\@vpt\@vpt}
3402 \newcommand\large{\@setfontsize\large\xiipt{14}}
3403 \newcommand\Large{\@setfontsize\Large\xivpt{18}}
3404 \newcommand\LARGE{\@setfontsize\LARGE\xviipt{22}}
3405 \newcommand\huge{\@setfontsize\huge\xxpt{25}}
3406 \newcommand\Huge{\@setfontsize\Huge\xxvpt{30}}
3407 %</10pt>
3408 %<*11pt>
3409 \newcommand\scriptsize{\@setfontsize\scriptsize\@viiipt{9.5}}
3410 \newcommand\tiny{\@setfontsize\tiny\@vpt\@viiipt}
3411 \newcommand\large{\@setfontsize\large\xiipt{14}}
3412 \newcommand\Large{\@setfontsize\Large\xivpt{18}}
3413 \newcommand\LARGE{\@setfontsize\LARGE\xviipt{22}}
3414 \newcommand\huge{\@setfontsize\huge\xxpt{25}}
3415 \newcommand\Huge{\@setfontsize\Huge\xxvpt{30}}
3416 %</11pt>
3417 %<*12pt>
3418 \newcommand\scriptsize{\@setfontsize\scriptsize\@viiipt{9.5}}
3419 \newcommand\tiny{\@setfontsize\tiny\@vpt\@viiipt}
3420 \newcommand\large{\@setfontsize\large\xivpt{18}}
3421 \newcommand\Large{\@setfontsize\Large\xviipt{22}}
3422 \newcommand\LARGE{\@setfontsize\LARGE\xxpt{25}}
3423 \newcommand\huge{\@setfontsize\huge\xxvpt{30}}
3424 \let\Huge=\huge
3425 %</12pt>

(End definition for \scriptsize and others.)

3426 %<*article|report|book>
3427 \setlength\lineskip{1\p@}
3428 \setlength\normallineskip{1\p@}
3429 \renewcommand\baselinestretch{}

3430 \setlength\parskip{0\p@ \@plus .1\p@}
3431 %</article|report|book>
3432 %<*10pt|11pt|12pt>
3433 \if@twocolumn
3434   \setlength\parindent{1em}
3435 \else
3436 %<10pt> \setlength\parindent{15\p@}
3437 %<11pt> \setlength\parindent{17\p@}
3438 %<12pt> \setlength\parindent{1.5em}
3439 \fi
3440 %</10pt|11pt|12pt>
3441 %<*10pt|11pt|12pt>
3442 \setlength\smallskipamount{3\p@ \@plus 1\p@ \@minus 1\p@}
3443 \setlength\medskipamount{6\p@ \@plus 2\p@ \@minus 2\p@}
3444 \setlength\bigskipamount{12\p@ \@plus 4\p@ \@minus 4\p@}
3445 %</10pt|11pt|12pt>

3446 %<*article|report|book>
3447 \lowpenalty 51

```

```

3448 \@medpenalty 151
3449 \@highpenalty 301
3450 % \clubpenalty 150
3451 % \widowpenalty 150
3452 % \displaywidowpenalty 50
3453 % \predisplaypenalty 10000
3454 % \postdisplaypenalty 0
3455 % \interlinepenalty 0
3456 \brokenpenalty 100
3457 %</article|report|book>

```

### 47.4.3 Page Layout

All margin dimensions are measured from a point one inch from the top and lefthand side of the page.

#### 47.4.30 Vertical spacing

\headheight      The \headheight is the height of the box that will contain the running head.  
\headsep          The \headsep is the distance between the bottom of the running head and the  
\topskip         top of the text. The \topskip is the \baselineskip for the first line on a  
page; L<sup>A</sup>T<sub>E</sub>X's output routine will not work properly if it has the value opt, so do  
not do that!

```

3458 %<*10pt|11pt|12pt>
3459 \setlength\headheight{12\p@}
3460 %<!bk>\setlength\headsep {25\p@}
3461 %<10pt&bk>\setlength\headsep {.25in}
3462 %<11pt&bk>\setlength\headsep {.275in}
3463 %<12pt&bk>\setlength\headsep {.275in}
3464 %<10pt>\setlength\topskip {10\p@}
3465 %<11pt>\setlength\topskip {11\p@}
3466 %<12pt>\setlength\topskip {12\p@}

(End definition for \headheight, \headsep, and \topskip.)

3467 %<!bk>\setlength\footskip{30\p@}
3468 %<10pt&bk>\setlength\footskip{.35in}
3469 %<11pt&bk>\setlength\footskip{.38in}
3470 %<12pt&bk>\setlength\footskip{30\p@}

3471 \if@compatibility \setlength\maxdepth{4\p@} \else
3472 \setlength\maxdepth{.5\topskip} \fi

3473 \if@compatibility
3474   \if@twocolumn
3475     \setlength\textwidth{410\p@}
3476   \else
3477     %<10pt&!bk> \setlength\textwidth{345\p@}
3478     %<11pt&!bk> \setlength\textwidth{360\p@}
3479     %<12pt&!bk> \setlength\textwidth{390\p@}
3480     %<10pt&bk> \setlength\textwidth{4.5in}
3481     %<11pt&bk> \setlength\textwidth{5in}

```

```

3482 %<12pt&bk>      \setlength\textwidth{5in}
3483   \fi
3484 \else
3485   \setlength@\tempdima{\paperwidth}
3486   \addtolength@\tempdima{-2in}
3487 %<10pt>  \setlength@\tempdimb{345\p@}
3488 %<11pt>  \setlength@\tempdimb{360\p@}
3489 %<12pt>  \setlength@\tempdimb{390\p@}
3490 \if@twocolumn
3491   \ifdim@\tempdima>2\@tempdimb\relax
3492     \setlength\textwidth{2\@tempdimb}
3493   \else
3494     \setlength\textwidth{\@tempdima}
3495   \fi
3496 \else
3497   \ifdim@\tempdima>\@tempdimb\relax
3498     \setlength\textwidth{\@tempdimb}
3499   \else
3500     \setlength\textwidth{\@tempdima}
3501   \fi
3502 \fi
3503 \fi
3504 \if@compatibility\else
3505   \settowidth\textwidth
3506 \fi
3507 \if@compatibility
3508 %<10pt&!bk>  \setlength\textheight{43\baselineskip}
3509 %<10pt&bk>  \setlength\textheight{41\baselineskip}
3510 %<11pt>  \setlength\textheight{38\baselineskip}
3511 %<12pt>  \setlength\textheight{36\baselineskip}
3512 \else
3513   \setlength@\tempdima{\paperheight}
3514   \addtolength@\tempdima{-2in}
3515   \addtolength@\tempdima{-1.5in}
3516   \divide@\tempdima\baselineskip
3517   \tempcnta=\tempdima
3518   \setlength\textheight{\tempcnta\baselineskip}
3519 \fi
3520 \addtolength\textheight{\topskip}
3521 \if@twocolumn
3522   \setlength\marginparsep {10\p@}
3523 \else
3524 %<10pt&!bk>  \setlength\marginparsep{11\p@}
3525 %<11pt&!bk>  \setlength\marginparsep{10\p@}
3526 %<12pt&!bk>  \setlength\marginparsep{10\p@}
3527 %<bk>    \setlength\marginparsep{7\p@}
3528 \fi
3529 %<10pt|11pt>\setlength\marginparpush{5\p@}
3530 %<12pt>\setlength\marginparpush{7\p@}

```

```

3531 \if@compatibility
3532 %<*bk>
3533 %<10pt> \setlength\oddsidemargin { .5in}
3534 %<11pt> \setlength\oddsidemargin { .25in}
3535 %<12pt> \setlength\oddsidemargin { .25in}
3536 %<10pt> \setlength\evensidemargin { 1.5in}
3537 %<11pt> \setlength\evensidemargin { 1.25in}
3538 %<12pt> \setlength\evensidemargin { 1.25in}
3539 %<10pt> \setlength\marginparwidth { .75in}
3540 %<11pt> \setlength\marginparwidth { 1in}
3541 %<12pt> \setlength\marginparwidth { 1in}
3542 %</bk>
3543 %<!*bk>
3544 \if@twoside
3545 %<10pt> \setlength\oddsidemargin {44\p@}
3546 %<11pt> \setlength\oddsidemargin {36\p@}
3547 %<12pt> \setlength\oddsidemargin {21\p@}
3548 %<10pt> \setlength\evensidemargin {82\p@}
3549 %<11pt> \setlength\evensidemargin {74\p@}
3550 %<12pt> \setlength\evensidemargin {59\p@}
3551 %<10pt> \setlength\marginparwidth {107\p@}
3552 %<11pt> \setlength\marginparwidth {100\p@}
3553 %<12pt> \setlength\marginparwidth {85\p@}
3554 \else
3555 %<10pt> \setlength\oddsidemargin {63\p@}
3556 %<11pt> \setlength\oddsidemargin {54\p@}
3557 %<12pt> \setlength\oddsidemargin {39.5\p@}
3558 %<10pt> \setlength\evensidemargin {63\p@}
3559 %<11pt> \setlength\evensidemargin {54\p@}
3560 %<12pt> \setlength\evensidemargin {39.5\p@}
3561 %<10pt> \setlength\marginparwidth {90\p@}
3562 %<11pt> \setlength\marginparwidth {83\p@}
3563 %<12pt> \setlength\marginparwidth {68\p@}
3564 \fi
3565 %<!/bk>
3566 \if@twocolumn
3567 \setlength\oddsidemargin {30\p@}
3568 \setlength\evensidemargin {30\p@}
3569 \setlength\marginparwidth {48\p@}
3570 \fi
3571 \else
3572 \if@twoside
3573 \setlength\@tempdima {\paperwidth}
3574 \addtolength\@tempdima {-\textwidth}
3575 \setlength\oddsidemargin { .4\@tempdima}
3576 \addtolength\oddsidemargin {-1in}
3577 \setlength\marginparwidth { .6\@tempdima}
3578 \addtolength\marginparwidth {-\marginparsep}
3579 \addtolength\marginparwidth {-0.4in}
3580 \else
3581 \setlength\@tempdima {\paperwidth}
3582 \addtolength\@tempdima {-\textwidth}

```

```

3583   \setlength\oddsidemargin {.5\@tempdima}
3584   \addtolength\oddsidemargin {-1in}
3585   \setlength\marginparwidth {.5\@tempdima}
3586   \addtolength\marginparwidth {-\marginparsep}
3587   \addtolength\marginparwidth {-0.4in}
3588   \addtolength\marginparwidth {-0.4in}
3589 \fi
3590 \ifdim \marginparwidth >2in
3591   \setlength\marginparwidth{2in}
3592 \fi
3593 \@settopoint\oddsidemargin
3594 \@settopoint\marginparwidth
3595 \setlength\evensidemargin {\paperwidth}
3596 \addtolength\evensidemargin{-2in}
3597 \addtolength\evensidemargin{-\textwidth}
3598 \addtolength\evensidemargin{-\oddsidemargin}
3599 \@settopoint\evensidemargin
3600 \fi
3601 \if@compatibility
3602 %<!bk> \setlength\topmargin{27pt}
3603 %<10pt&bk> \setlength\topmargin{.75in}
3604 %<11pt&bk> \setlength\topmargin{.73in}
3605 %<12pt&bk> \setlength\topmargin{.73in}
3606 \else
3607   \setlength\topmargin{\paperheight}
3608   \addtolength\topmargin{-2in}
3609   \addtolength\topmargin{-\headheight}
3610   \addtolength\topmargin{-\headsep}
3611   \addtolength\topmargin{-\textheight}
3612   \addtolength\topmargin{-\footskip} % this might be wrong!
3613   \addtolength\topmargin{-.5\topmargin}
3614   \@settopoint\topmargin
3615 \fi
3616 %<10pt>\setlength\footnotesep{6.65\p@}
3617 %<11pt>\setlength\footnotesep{7.7\p@}
3618 %<12pt>\setlength\footnotesep{8.4\p@}
3619 %<10pt>\setlength{\skip\footins}{9\p@ \@plus 4\p@ \@minus 2\p@}
3620 %<11pt>\setlength{\skip\footins}{10\p@ \@plus 4\p@ \@minus 2\p@}
3621 %<12pt>\setlength{\skip\footins}{10.8\p@ \@plus 4\p@ \@minus 2\p@}
3622 %</10pt|11pt|12pt>
3623 %<*article|report|book>
3624 \setcounter{topnumber}{2}
3625 \renewcommand\topfraction{.7}
3626 \setcounter{bottomnumber}{1}
3627 \renewcommand\bottomfraction{.3}

```

```

3628 \setcounter{totalnumber}{3}
3629 \renewcommand\textfraction{.2}
3630 \renewcommand\floatpagefraction{.5}
3631 \setcounter{dbltopnumber}{2}
3632 \renewcommand\dbltopfraction{.7}
3633 \renewcommand\dblfloatpagefraction{.5}
3634 %</article|report|book>

3635 %<*10pt>
3636 \setlength\floatsep {12\p@ \@plus 2\p@ \@minus 2\p@}
3637 \setlength\textfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3638 \setlength\intextsep {12\p@ \@plus 2\p@ \@minus 2\p@}
3639 %</10pt>
3640 %<*11pt>
3641 \setlength\floatsep {12\p@ \@plus 2\p@ \@minus 2\p@}
3642 \setlength\textfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3643 \setlength\intextsep {12\p@ \@plus 2\p@ \@minus 2\p@}
3644 %</11pt>
3645 %<*12pt>
3646 \setlength\floatsep {12\p@ \@plus 2\p@ \@minus 4\p@}
3647 \setlength\textfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3648 \setlength\intextsep {14\p@ \@plus 4\p@ \@minus 4\p@}
3649 %</12pt>

3650 %<*10pt>
3651 \setlength\dblfloatsep {12\p@ \@plus 2\p@ \@minus 2\p@}
3652 \setlength\dbltextfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3653 %</10pt>
3654 %<*11pt>
3655 \setlength\dblfloatsep {12\p@ \@plus 2\p@ \@minus 2\p@}
3656 \setlength\dbltextfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3657 %</11pt>
3658 %<*12pt>
3659 \setlength\dblfloatsep {14\p@ \@plus 2\p@ \@minus 4\p@}
3660 \setlength\dbltextfloatsep{20\p@ \@plus 2\p@ \@minus 4\p@}
3661 %</12pt>

3662 %<*10pt>
3663 \setlength\@fptop{0\p@ \@plus 1fil}
3664 \setlength\@fpsep{8\p@ \@plus 2fil}
3665 \setlength\@fpbot{0\p@ \@plus 1fil}
3666 %</10pt>
3667 %<*11pt>
3668 \setlength\@fptop{0\p@ \@plus 1fil}
3669 \setlength\@fpsep{8\p@ \@plus 2fil}
3670 \setlength\@fpbot{0\p@ \@plus 1fil}
3671 %</11pt>
3672 %<*12pt>
3673 \setlength\@fptop{0\p@ \@plus 1fil}
3674 \setlength\@fpsep{10\p@ \@plus 2fil}
3675 \setlength\@fpbot{0\p@ \@plus 1fil}
3676 %</12pt>

```

```

3677 %<*10pt>
3678 \setlength{\dblftop{0}{\@plus 1fil}}
3679 \setlength{\dblpsep{8}{\@plus 2fil}}
3680 \setlength{\dblpbot{0}{\@plus 1fil}}
3681 %</10pt>
3682 %<*11pt>
3683 \setlength{\dblftop{0}{\@plus 1fil}}
3684 \setlength{\dblpsep{8}{\@plus 2fil}}
3685 \setlength{\dblpbot{0}{\@plus 1fil}}
3686 %</11pt>
3687 %<*12pt>
3688 \setlength{\dblftop{0}{\@plus 1fil}}
3689 \setlength{\dblpsep{10}{\@plus 2fil}}
3690 \setlength{\dblpbot{0}{\@plus 1fil}}
3691 %</12pt>
3692 %<*article|report|book>

3693 \if@twoside
3694   \def\ps@headings{%
3695     \let\@oddfoot\@empty\let\@evenfoot\@empty
3696     \def\@evenhead{\thepage\hfil\slshape\leftmark}%
3697     \def\@oddhead{\slshape\rightmark}\hfil\thepage}%
3698   \let\@mkboth\markboth
3699 %<*article>
3700   \def\sectionmark##1{%
3701     \markboth {\MakeUppercase{%
3702       \ifnum \c@secnumdepth >\z@
3703         \thesection\quad
3704       \fi
3705     ##1}}{}}
3706   \def\subsectionmark##1{%
3707     \markright {%
3708       \ifnum \c@secnumdepth >\@ne
3709         \thesubsection\quad
3710       \fi
3711     ##1}}
3712 %</article>

3713 %<*report|book>
3714   \def\chaptermark##1{%
3715     \markboth {\MakeUppercase{%
3716       \ifnum \c@secnumdepth >\m@ne
3717 %<book>         \if@mainmatter
3718           \chapapp\ \thechapter. \ %
3719 %<book>         \fi
3720       \fi
3721     ##1}}{}}
3722   \def\sectionmark##1{%
3723     \markright {\MakeUppercase{%
3724       \ifnum \c@secnumdepth >\z@
3725         \thesection. \ %
3726       \fi
3727     ##1}}{}}
3728 %</report|book>

```

```

3729 \else
3730   \def\ps@headings{%
3731     \let@\oddfoot\@empty
3732     \def@\oddhead{{\slshape\rightmark}\hfil\thepage}%
3733     \let@\mkboth\markboth
3734 %<*article>
3735   \def\sectionmark##1{%
3736     \markright {\MakeUppercase{%
3737       \ifnum \c@secnumdepth >\m@ne
3738         \thesection\quad
3739       \fi
3740       ##1}}}%
3741 %</article>
3742 %<*report|book>
3743   \def\chaptermark##1{%
3744     \markright {\MakeUppercase{%
3745       \ifnum \c@secnumdepth >\m@ne
3746         \if@mainmatter
3747           \chapapp\ \thechapter. \ %
3748         \fi
3749       \fi
3750       ##1}}}%
3751 %</report|book>
3752 \fi
3753 \def\ps@myheadings{%
3754   \let@\oddfoot\@empty\let@\evenfoot\@empty
3755   \def@\evenhead{{\thepage\hfil\slshape\leftmark}%
3756   \def@\oddhead{{\slshape\rightmark}\hfil\thepage}%
3757   \let@\mkboth\gobbletwo
3758 %<!article> \let\chaptermark@gobble
3759   \let\sectionmark@gobble
3760 %<article> \let\subsectionmark@gobble
3761 }
3762 % \newcommand*{\title}[1]{\gdef@\title{#1}}
3763 % \newcommand*{\author}[1]{\gdef@\author{#1}}
3764 % \newcommand*{\date}[1]{\gdef@\date{#1}}
3765 % \date{\today}
3766 \if@titlepage
3767   \newcommand\maketitle{\begin{titlepage}%
3768     \let\footnotesize\small
3769     \let\footnoterule\relax
3770     \let \footnote \thanks
3771     \null\vfil
3772     \vskip 60\p@
3773     \begin{center}%
3774       {\LARGE \title \par}%
3775       \vskip 3em%
3776       {\large
3777         \lineskip .75em%
3778         \begin{tabular}[t]{c}%

```

```

3779      \author
3780      \end{tabular}\par}%
3781      \vskip 1.5em%
3782      {\large \date \par}%
3783      % Set date in \large size.
3784      \end{center}\par
3785
3786      \end{titlepage}%
3787
3788      \setcounter{footnote}{0}%
3789      \global\let\thanks\relax
3790      \global\let\maketitle\relax
3791      \global\let\@thanks\empty
3792      \global\let\@author\empty
3793      \global\let\@date\empty
3794      \global\let\@title\empty
3795
3796      \global\let\title\relax
3797      \global\let\author\relax
3798      \global\let\date\relax
3799      \global\let\and\relax
3800
3801 \else
3802 \newcommand\maketitle{\par
3803   \begingroup
3804     \renewcommand\thefootnote{\@fnsymbol\c@footnote}%
3805     \def\@makefnmark{\rlap{@\textsuperscript{\normalfont\@thefnmark}}}%
3806     \long\def\@makefntext##1{\parindent 1em\noindent
3807       \hb@xt@1.8em{%
3808         \hss@\textsuperscript{\normalfont\@thefnmark}##1}%
3809
3810     \if@twocolumn
3811       \ifnum \col@number=\@ne
3812         \maketitle
3813       \else
3814         \twocolumn[\@maketitle]%
3815       \fi
3816     \else
3817       \newpage
3818       \global\@topnum\z@    % Prevents figures from going at top of page.
3819       \maketitle
3820     \fi
3821   \thispagestyle{plain}\@thanks
3822
3823   \endgroup
3824   \setcounter{footnote}{0}%
3825   \global\let\thanks\relax
3826   \global\let\maketitle\relax
3827   \global\let\@thanks\empty
3828   \global\let\@author\empty
3829   \global\let\@date\empty
3830   \global\let\@title\empty

```

```

3828 \global\let\title\relax
3829 \global\let\author\relax
3830 \global\let\date\relax
3831 \global\let\and\relax
3832 }

3833 \def\@maketitle{%
3834 \newpage
3835 \null
3836 \vskip 2em%
3837 \begin{center}%
3838 \let \footnote \thanks
3839 {\LARGE \@title \par}%
3840 \vskip 1.5em%
3841 {\large
3842 \lineskip .5em%
3843 \begin{tabular}[t]{c}%
3844 \author \\
3845 \end{tabular}\par}%
3846 \vskip 1em%
3847 {\large \@date}%
3848 \end{center}%
3849 \par
3850 \vskip 1.5em}
3851 \fi

3852 %<!article>\newcommand*\chaptermark[1]{}
3853 % \newcommand*\sectionmark[1]{}
3854 % \newcommand*\subsectionmark[1]{}
3855 % \newcommand*\subsubsectionmark[1]{}
3856 % \newcommand*\paragraphmark[1]{}
3857 % \newcommand*\subparagraphmark[1]{}

3858 %<article>\setcounter{secnumdepth}{3}
3859 %<!article>\setcounter{secnumdepth}{2}

3860 \newcounter {part}
3861 %<article>\newcounter {section}
3862 %<*report|book>
3863 \newcounter {chapter}
3864 \newcounter {section}[chapter]
3865 %</report|book>
3866 \newcounter {subsection}[section]
3867 \newcounter {subsubsection}[subsection]
3868 \newcounter {paragraph}[subsubsection]
3869 \newcounter { subparagraph}[paragraph]

3870 \renewcommand \thepart {\@Roman\c@part}
3871 %<article>\renewcommand \thesection {\@arabic\c@section}
3872 %<*report|book>
3873 \renewcommand \thechapter {\@arabic\c@chapter}
3874 \renewcommand \thesection {\thechapter.\@arabic\c@section}
3875 %</report|book>
3876 \renewcommand\thesubsection \c{\thesection.\@arabic\c@subsection}

```

```

3877 \renewcommand\thesubsubsection{\thesubsection.\@arabic\c@subsubsection}
3878 \renewcommand\theparagraph    \thesubsubsection.\@arabic\c@paragraph
3879 \renewcommand\thesubparagraph \theparagraph.\@arabic\c@subparagraph
3880 %<report|book>\newcommand{@chapapp{\chaptername}

3881 %<*book>
3882 \newcommand\frontmatter{%
3883 %   \if@openright
3884 %     \cleardoublepage
3885 %   \else
3886 %     \clearpage
3887 %   \fi
3888 %   \@mainmatterfalse
3889 %   \pagenumbering{roman}

3890 \newcommand\mainmatter{%
3891   \if@openright
3892     \cleardoublepage
3893   \else
3894     \clearpage
3895   \fi
3896   \@mainmattertrue
3897   \pagenumbering{arabic}

3898 \newcommand\backmatter{%
3899   \if@openright
3900     \cleardoublepage
3901   \else
3902     \clearpage
3903   \fi
3904   \@mainmatterfalse}
3905 %</book>

3906 %<*article>
3907 \newcommand\part{%
3908   \if@noskipsec \leavevmode \fi
3909   \par
3910   \addvspace{4ex}%
3911   \if@afterindentfalse
3912     \secdef\@part\@spart}
3913 %</article>

3914 %<*report|book>
3915 \newcommand\part{%
3916   \if@openright
3917     \cleardoublepage
3918   \else
3919     \clearpage
3920   \fi
3921   \thispagestyle{plain}%

```

When we are making a two column document, this will be a one column page.  
 We use `@tempswa` to remember to switch back to two columns.

```
3922 \if@twocolumn
```

```

3923     \onecolumn
3924     \@tempswatrue
3925   \else
3926     \@tempswafalse
3927   \fi
3928   \null\vfil
3929   \secdef@part\@spart}
3930 %</report|book>
3931 %<*article>
3932 \def\@part[#1]#2{%
3933   \ifnum \c@secnumdepth >\m@ne
3934     \refstepcounter{part}%
3935     \addcontentsline{toc}{part}{\thepart\hspace{1em}#1}%
3936   \else
3937     \addcontentsline{toc}{part}{#1}%
3938   \fi
3939   {\parindent \z@ \raggedright
3940     \interlinepenalty \zM
3941     \normalfont
3942     \ifnum \c@secnumdepth >\m@ne
3943       \Large\bfseries \partname\nobreakspace\thepart
3944       \par\nobreak
3945     \fi
3946     \huge \bfseries #2%
3947     \markboth{}{}\par}%
3948   \nobreak
3949   \vskip 3ex
3950   \@afterheading}
3951 %</article>
3952 %<*report|book>
3953 \def\@part[#1]#2{%
3954   \ifnum \c@secnumdepth >-2\relax
3955     \refstepcounter{part}%
3956     \addcontentsline{toc}{part}{\thepart\hspace{1em}#1}%
3957   \else
3958     \addcontentsline{toc}{part}{#1}%
3959   \fi
3960   \markboth{}{}%
3961   {\centering
3962     \interlinepenalty \zM
3963     \normalfont
3964     \ifnum \c@secnumdepth >-2\relax
3965       \huge\bfseries \partname\nobreakspace\thepart
3966       \par
3967       \vskip 20\p@
3968   \fi

```

```

3969      \Huge \bfseries #2\par}%
3970      \@endpart}
3971 %%</report|book>

3972 %<*article>
3973 \def\@spart#1{%
3974     {\parindent \z@ \raggedright
3975      \interlinepenalty \zM
3976      \normalfont
3977      \huge \bfseries #1\par}%
3978      \nobreak
3979      \vskip 3ex
3980      \@afterheading}
3981 %%</article>
3982 %%<*report|book>
3983 \def\@spart#1{%
3984     {\centering
3985      \interlinepenalty \zM
3986      \normalfont
3987      \Huge \bfseries #1\par}%
3988      \@endpart}
3989 %%</report|book>

3990 %%<*report|book>
3991 \def\@endpart{\vfil\newpage
3992             \if@twoside
3993                 \if@openright
3994                     \null
3995                     \thispagestyle{empty}%
3996                     \newpage
3997                     \fi
3998                 \fi
3999                 \if@tempswa
4000                     \twocolumn
4001                 \fi}
4002 %%</report|book>

4003 %%<*report|book>
4004 \newcommand\chapter{\if@openright\cleardoublepage\else\clearpage\fi
4005             \thispagestyle{plain}%
4006             \global\@topnum\z@
4007             \@afterindentfalse
4008             \secdef\@chapter\@schapter}

4009 \def\@chapter[#1]#2{\ifnum \c@secnumdepth >\m@ne
4010             \if@mainmatter
4011                 \refstepcounter{chapter}%
4012                 \typeout{@chapapp\space\thechapter.}%
4013                 \addcontentsline{toc}{chapter}{#1}%
4014                 \protect\numberline{\thechapter}#1}%
4015 %%<*book>
4016             \else
4017                 \addcontentsline{toc}{chapter}{#1}%
4018             \fi

```

```

4019 %</book>
4020           \else
4021             \addcontentsline{toc}{chapter}{#1}%
4022           \fi
4023             \chaptermark{#1}%
4024             \addtocontents{lof}{\protect\addvspace{10\p@}}%
4025             \addtocontents{lot}{\protect\addvspace{10\p@}}%
4026             \if@twocolumn
4027               \atopnewpage[\@makechapterhead{#2}]%
4028             \else
4029               \@makechapterhead{#2}%
4030               \@afterheading
4031             \fi}
4032 \def\@makechapterhead#1{%
4033   \vspace*{50\p@}%
4034   {\parindent \z@ \raggedright \normalfont
4035     \ifnum \c@secnumdepth > \m@ne
4036       \if@mainmatter
4037         \huge\bfseries \chapapp\space \thechapter
4038         \par\nobreak
4039         \vskip 20\p@
4040       \fi
4041     \fi
4042     \interlinepenalty\@M
4043     \Huge \bfseries #1\par\nobreak
4044     \vskip 40\p@
4045   } }
4046 \def\@schapter#1{\if@twocolumn
4047   \atopnewpage[\@makeschapterhead{#1}]%
4048   \else
4049     \@makeschapterhead{#1}%
4050     \@afterheading
4051   \fi}
4052 \def\@makeschapterhead#1{%
4053   \vspace*{50\p@}%
4054   {\parindent \z@ \raggedright
4055     \normalfont
4056     \interlinepenalty\@M
4057     \Huge \bfseries #1\par\nobreak
4058     \vskip 40\p@
4059   } }
4060 %</report|book>
4061 \newcommand\section{\startsection {section}{1}{\z@}%
4062   {-3.5ex \oplus -1ex }%
4063   {\ominus -.2ex}%
4064   {2.3ex \oplus .2ex}%
4065   {\normalfont\Large\bfseries}}
4065 \newcommand\subsection{\startsection {subsection}{2}{\z@}%
4066   {-3.25ex \oplus -1ex }%
4067   {\ominus -.2ex}%

```

```

4067           {1.5ex \@plus .2ex}%
4068           {\normalsize\large\bfseries}}
4069 \newcommand{\subsubsection}{\@startsection{subsubsection}{3}{\z@}%
4070           {-3.25ex \@plus -1ex }%
4071           \z\@minus -.2ex}%
4072           {1.5ex \@plus .2ex}%
4073           {\normalsize\normalsize\bfseries}}
4074 \newcommand{\paragraph}{\@startsection{paragraph}{4}{\z@}%
4075           {3.25ex \@plus1ex }%
4076           \z\@minus .2ex}%
4077           {-1em}%
4078           {\normalsize\normalsize\bfseries}}
4079 \newcommand{\ subparagraph}{\@startsection{subparagraph}{5}{\parindent}%
4080           {3.25ex \@plus1ex }%
4081           \z\@minus .2ex}%
4082           {-1em}%
4083           {\normalsize\normalsize\bfseries}}

```

#### 47.4.4 Lists

##### 47.4.40 General List Parameters

The following commands are used to set the default values for the list environment's parameters. See the L<sup>A</sup>T<sub>E</sub>X manual for an explanation of the meanings of the parameters. Defaults for the list environment are set as follows. First, `\rightmargin`, `\listparindent` and `\itemindent` are set to opt. Then, for a Kth level list, the command `\@listK` is called, where 'K' denotes 'i', 'ii', ... , 'vi'. (I.e., `\@listiii` is called for a third-level list.) By convention, `\@listK` should set `\leftmargin` to `\leftmarginK`. When we are in two column mode some of the margins are set somewhat smaller.

```

4081 \if@twocolumn
4082   \setlength\leftmargini  {2em}
4083 \else
4084   \setlength\leftmargini  {2.5em}
4085 \fi
4086 \leftmargin \leftmargini
4087 \setlength\leftmarginii  {2.2em}
4088 \setlength\leftmarginiii {1.87em}
4089 \setlength\leftmarginiv  {1.7em}
4090 \if@twocolumn
4091   \setlength\leftmarginv  {.5em}
4092   \setlength\leftmarginvi {.5em}
4093 \else
4094   \setlength\leftmarginv  {1em}
4095   \setlength\leftmarginvi {1em}
4096 \fi
4097 \setlength \labelsep  {.5em}
4098 \setlength \labelwidth{\leftmargini}
4099 \addtolength\labelwidth{-\labelsep}

```

```

4100 %</article|report|book>
4101 %<10pt>\setlength\partopsep{2\p@ \oplus 1\p@ \minus 1\p@}
4102 %<11pt>\setlength\partopsep{3\p@ \oplus 1\p@ \minus 1\p@}
4103 %<12pt>\setlength\partopsep{3\p@ \oplus 2\p@ \minus 2\p@}

4104 %<*article|report|book>
4105 \@beginparpenalty -\lowpenalty
4106 \@endparpenalty -\lowpenalty
4107 \@itempenalty -\lowpenalty
4108 %</article|report|book>

4109 %<*10pt|11pt|12pt>
4110 \def\@listi{\leftmargin\leftmargini
4111 %<*10pt>
4112     \parsep 4\p@ \oplus2\p@ \minus\p@
4113     \topsep 8\p@ \oplus2\p@ \minus4\p@
4114     \itemsep4\p@ \oplus2\p@ \minus\p@
4115 %</10pt>
4116 %<*11pt>
4117     \parsep 4.5\p@ \oplus2\p@ \minus\p@
4118     \topsep 9\p@ \oplus3\p@ \minus5\p@
4119     \itemsep4.5\p@ \oplus2\p@ \minus\p@
4120 %</11pt>
4121 %<*12pt>
4122     \parsep 5\p@ \oplus2.5\p@ \minus\p@
4123     \topsep 10\p@ \oplus4\p@ \minus6\p@
4124     \itemsep5\p@ \oplus2.5\p@ \minus\p@
4125 %</12pt>
4126 \let\@listI\@listi

4127 \@listi

4128 \def\@listii {\leftmargin\leftmarginii
4129     \labelwidth\leftmarginii
4130     \advance\labelwidth-\labelsep
4131 %<*10pt>
4132     \topsep 4\p@ \oplus2\p@ \minus\p@
4133     \parsep 2\p@ \oplus\p@ \minus\p@
4134 %</10pt>
4135 %<*11pt>
4136     \topsep 4.5\p@ \oplus2\p@ \minus\p@
4137     \parsep 2\p@ \oplus\p@ \minus\p@
4138 %</11pt>
4139 %<*12pt>
4140     \topsep 5\p@ \oplus2.5\p@ \minus\p@
4141     \parsep 2.5\p@ \oplus\p@ \minus\p@
4142 %</12pt>
4143     \itemsep \parsep}
4144 \def\@listiii{\leftmargin\leftmarginiii
4145     \labelwidth\leftmarginiii
4146     \advance\labelwidth-\labelsep
4147 %<10pt>
4148 %<11pt>
4149 %<12pt>
4150     \parsep \z@ \partopsep \p@ \oplus\z@ \minus\p@
4151     \partopsep \p@ \oplus\z@ \minus\p@

```

```

4152           \itemsep   \topsep}
4153 \def\@listiv {\leftmargin\leftmarginiv
4154           \labelwidth\leftmarginiv
4155           \advance\labelwidth-\labelsep}
4156 \def\@listv { \leftmargin\leftmarginv
4157           \labelwidth\leftmarginv
4158           \advance\labelwidth-\labelsep}
4159 \def\@listvi { \leftmargin\leftmarginvi
4160           \labelwidth\leftmarginvi
4161           \advance\labelwidth-\labelsep}
4162 %</10pt|11pt|12pt>
4163 %<*article|report|book>
4164 \renewcommand\theenumi{\@arabic\c@enumi}
4165 \renewcommand\theenumii{\@alph\c@enumii}
4166 \renewcommand\theenumiii{\@roman\c@enumiii}
4167 \renewcommand\theenumiv{\@Alph\c@enumiv}

4168 \newcommand\labelenumi{\theenumi.}
4169 \newcommand\labelenumii{(\theenumi)}
4170 \newcommand\labelenumiii{(\theenumii).}
4171 \newcommand\labelenumiv{(\theenumiv.)}

4172 \renewcommand\p@enumii{\theenumi}
4173 \renewcommand\p@enumiii{(\theenumi(\theenumii))}
4174 \renewcommand\p@enumiv{\p@enumiii(\theenumiii)}

```

#### 47.4.40 Itemize

`\labelitemi` Itemization is controlled by four commands: `\labelitemi`, `\labelitemii`,  
`\labelitemiii`, and `\labelitemiv`, which define the labels of the various  
`\labelitemii` itemization levels: the symbols used are bullet, bold en-dash, centered asterisk  
`\labelitemiv` and centred dot.

```

4175 \newcommand\labelitemi{\textbullet}
4176 \newcommand\labelitemii{\normalfont\bfseries \textendash}
4177 \newcommand\labelitemiii{\textasteriskcentered}
4178 \newcommand\labelitemiv{\textperiodcentered}

```

(End definition for `\labelitemi` and others.)

#### 47.4.40 Description

```

4179 \newenvironment{description}
4180           {\list{}{\labelwidth\z@ \itemindent-\leftmargin
4181             \let\makelabel\descriptionlabel}}
4182           {\endlist}
4183 \newcommand*\descriptionlabel[1]{\hspace\labelsep
4184                           \normalfont\bfseries #1}
4185 % \changes{v1.3m}{1995/10/23}{Added setting of \begin{parpenalty} to
4186 % discourage page break before abstract heading.}
4187 %<*article|report>
4188 \if@titlepage

```

```

4189 \newenvironment{abstract}{%
4190     \titlepage
4191     \null\vfil
4192     \@beginparpenalty\@lowpenalty
4193     \begin{center}%
4194         \bfseries \abstractname
4195         \endparpenalty\@M
4196     \end{center}}%
4197     {\par\vfil\null\endtitlepage}

4198 \else
4199     \newenvironment{abstract}{%
4200         \if@twocolumn
4201             \section*\{\abstractname\}%
4202         \else
4203             \small
4204             \begin{center}%
4205                 \bfseries \abstractname\vspace{-.5em}\vspace{\z@}%
4206             \end{center}%
4207             \quotation
4208         \fi}
4209     {\if@twocolumn\else\endquotation\fi}
4210 \fi
4211 %</article|report>

4212 \newenvironment{verse}
4213     {\let\\@centercr
4214         \list{}{\itemsep      \z@
4215             \itemindent    -1.5em%
4216             \listparindent\itemindent
4217             \rightmargin  \leftmargin
4218             \advance\leftmargin 1.5em}%
4219             \item\relax}
4220         {\endlist}

4221 \newenvironment{quotation}
4222     {\list{}{\listparindent 1.5em%
4223             \itemindent    \listparindent
4224             \rightmargin  \leftmargin
4225             \parsep       \z@ \oplus\p@}%
4226             \item\relax}
4227         {\endlist}

4228 \newenvironment{quote}
4229     {\list{}{\rightmargin\leftmargin}%
4230             \item\relax}
4231         {\endlist}

4232 \if@compatibility
4233     \newenvironment{titlepage}
4234     {%
4235 %<book>      \cleardoublepage
4236     \if@twocolumn
4237         \restonecoltrue\onecolumn
4238     \else
4239         \restonecolfalse\newpage
4240     \fi

```

```

4241     \thispagestyle{empty}%
4242     \setcounter{page}\z@
4243 }
4244 {\if@restonecol\twocolumn \else \newpage \fi
4245 }

4246 \else
4247 \newenvironment{titlepage}
4248 {
4249 %<book>      \cleardoublepage
4250     \if@twocolumn
4251         \atrestonecoltrue\onecolumn
4252     \else
4253         \atrestonecolfalse\newpage
4254     \fi
4255     \thispagestyle{empty}%
4256     \setcounter{page}\@ne
4257 }
4258 {\if@restonecol\twocolumn \else \newpage \fi
4259     \if@twoside\else
4260         \setcounter{page}\@ne
4261     \fi
4262 }
4263 \fi

4264 %<*article>
4265 \newcommand\appendix{\par
4266   \setcounter{section}{0}%
4267   \setcounter{subsection}{0}%
4268   \gdef\thesection{\@Alph\c@section}}
4269 %</article>

4270 %<*report|book>
4271 \newcommand\appendix{\par
4272   \setcounter{chapter}{0}%
4273   \setcounter{section}{0}%
4274   \gdef\@chapapp{\appendixname}%
4275   \gdef\thechapter{\@Alph\c@chapter}}
4276 %</report|book>

4277 \setlength\arraycolsep{5\p@}
4278 \setlength\tabcolsep{6\p@}
4279 \setlength\arrayrulewidth{.4\p@}
4280 \setlength\doublerulesep{2\p@}
4281 \setlength\tabbingsep{\labelsep}
4282 \skip\@mpfootins = \skip\footins
4283 \setlength\fboxsep{3\p@}
4284 \setlength\fboxrule{.4\p@}

4285 %<article>\renewcommand \theequation {\@arabic\c@equation}
4286 %<*report|book>
4287 \@addtoreset {equation}{chapter}
4288 \renewcommand\theequation

```

```

4289   {\ifnum \c@chapter>\z@ \thechapter.\fi \@arabic\c@equation}
4290 %</report|book>
4291 % \setlength{\jot}{3pt}
4292 % \def\@eqnnum{(\theequation)}
4293 %<*article>
4294 \newcounter{figure}
4295 \renewcommand{\thefigure}{\@arabic\c@figure}
4296 %</article>
4297 %<*report|book>
4298 \newcounter{figure}[chapter]
4299 \renewcommand{\thefigure}
4300   {\ifnum \c@chapter>\z@ \thechapter.\fi \@arabic\c@figure}
4301 %</report|book>
4302 \def\fps@figure{tbp}
4303 \def\ftype@figure{1}
4304 \def\ext@figure{lof}
4305 \def\fnum@figure{\figurename\nobreakspace\thefigure}
4306 \newenvironment{figure}
4307   {\@float{figure}}
4308   {\@end@float}
4309 \newenvironment{figure*}
4310   {\@dblfloat{figure}}
4311   {\@end@dblfloat}
4312 %<*article>
4313 \newcounter{table}
4314 \renewcommand{\thetable}{\@arabic\c@table}
4315 %</article>
4316 %<*report|book>
4317 \newcounter{table}[chapter]
4318 \renewcommand{\thetable}
4319   {\ifnum \c@chapter>\z@ \thechapter.\fi \@arabic\c@table}
4320 %</report|book>
4321 \def\fps@table{tbp}
4322 \def\ftype@table{2}
4323 \def\ext@table{lot}
4324 \def\fnum@table{\tablename\nobreakspace\thetable}
4325 \newenvironment{table}
4326   {\@float{table}}
4327   {\@end@float}
4328 \newenvironment{table*}
4329   {\@dblfloat{table}}
4330   {\@end@dblfloat}
4331 \newlength{\abovecaptionskip}
4332 \newlength{\belowcaptionskip}
4333 \setlength{\abovecaptionskip}{10\p@}
4334 \setlength{\belowcaptionskip}{0\p@}
4335 \long\def\@makecaption#1#2{%
4336   \vskip\abovecaptionskip

```

```

4337   \sbox\@tempboxa{\#1: #2}%
4338   \ifdim \wd\@tempboxa >\hsize
4339     #1: #2\par
4340   \else
4341     \global \minipagetrue
4342     \hb@xt@\hsize{\hfil\box\@tempboxa\hfil}%
4343   \fi
4344   \vskip\belowcaptionskip}

4345 \DeclareOldFontCommand{\rm}{\normalfont\rmfamily}{\mathrm}
4346 \DeclareOldFontCommand{\sf}{\normalfont\sfamily}{\mathrm}
4347 \DeclareOldFontCommand{\tt}{\normalfont\ttfamily}{\mathrm}
4348 \DeclareOldFontCommand{\bf}{\normalfont\bfseries}{\mathrm}
4349 \DeclareOldFontCommand{\it}{\normalfont\itshape}{\mathrm}
4350 \DeclareOldFontCommand{\sl}{\normalfont\slshape}{\mathrm}
4351 \DeclareOldFontCommand{\sc}{\normalfont\scshape}{\mathrm}
4352 \DeclareRobustCommand*\cal{@fontswitch\relax\mathcal}
4353 \DeclareRobustCommand*\mit{@fontswitch\relax\mathnormal}

4354 \newcommand\@pnumwidth{1.55em}
4355 \newcommand\@tocrmarg{2.55em}
4356 \newcommand\@dotsep{4.5}
4357 %<article>\setcounter{tocdepth}{3}
4358 %<!article>\setcounter{tocdepth}{2}

4359 \newcommand\tableofcontents{%
4360 %<*report|book>
4361   \if@twocolumn
4362     \@restonecoltrue\onecolumn
4363   \else
4364     \@restonecolfalse
4365   \fi
4366   \chapter*{\contentsname}
4367 %</report|book>
4368 %<article>    \section*{\contentsname}
4369   \mkboth{%
4370     \MakeUppercase\contentsname}{\MakeUppercase\contentsname}%
4371   \starttoc{toc}%
4372 %<!article>    \if@restonecol\twocolumn\fi
4373 }

4374 \newcommand*\l@part[2]{%
4375   \ifnum \c@tocdepth >-2\relax
4376     %<article>    \addpenalty\@secpenalty
4377     %<!article>    \addpenalty{-\@highpenalty}%
4378     \addvspace{2.25em \@plus\p@}%
4379     \setlength\@tempdima{3em}%
4380     \begingroup
4381       \parindent \z@ \rightskip \@pnumwidth
4382       \parfillskip -\@pnumwidth

```

```

4383      {\leavevmode
4384      \large \bfseries #1\hfil \hb@xt@\@pnumwidth{\hss #2}\par
4385      \nobreak
4386 %<article> \if@compatibility
4387     \global\nobreaktrue
4388     \everypar{\global\nobreakfalse\everypar{}}
4389 %<article> \fi
4390   \endgroup
4391 \fi}

4392 %<*report|book>
4393 \newcommand*\l@chapter[2]{%
4394   \ifnum \c@tocdepth >\m@ne
4395     \addpenalty{-\@highpenalty}%
4396     \vskip 1.0em \@plus\p@
4397     \setlength\@tempdima{1.5em}%
4398     \begingroup
4399       \parindent \z@ \rightskip \@pnumwidth
4400       \parfillskip -\@pnumwidth
4401       \leavevmode \bfseries
4402       \advance\leftskip\@tempdima
4403       \hskip -\leftskip
4404       #1\nobreak\hfil \nobreak\hb@xt@\@pnumwidth{\hss #2}\par
4405       \penalty\@highpenalty
4406     \endgroup
4407   \fi}
4408 %</report|book>

4409 %<*article>
4410 \newcommand*\l@section[2]{%
4411   \ifnum \c@tocdepth >\z@
4412     \addpenalty\@secpenalty
4413     \addvspace{1.0em \@plus\p@}%
4414     \setlength\@tempdima{1.5em}%
4415     \begingroup
4416       \parindent \z@ \rightskip \@pnumwidth
4417       \parfillskip -\@pnumwidth
4418       \leavevmode \bfseries
4419       \advance\leftskip\@tempdima
4420       \hskip -\leftskip
4421       #1\nobreak\hfil \nobreak\hb@xt@\@pnumwidth{\hss #2}\par
4422     \endgroup
4423   \fi}
4424 %</article>

4425 %<*report|book>
4426 \newcommand*\l@section{@dottedtocline{1}{1.5em}{2.3em}}
4427 %</report|book>

4428 %<*article>
4429 \newcommand*\l@subsection{@dottedtocline{2}{1.5em}{2.3em}}

```

```

4430 \newcommand*\l@subsubsection{@dottedtocline{3}{3.8em}{3.2em}}
4431 \newcommand*\l@paragraph{@dottedtocline{4}{7.0em}{4.1em}}
4432 \newcommand*\l@subparagraph{@dottedtocline{5}{10em}{5em}}
4433 %</article>
4434 %<*report|book>
4435 \newcommand*\l@subsection{@dottedtocline{2}{3.8em}{3.2em}}
4436 \newcommand*\l@subsubsection{@dottedtocline{3}{7.0em}{4.1em}}
4437 \newcommand*\l@paragraph{@dottedtocline{4}{10em}{5em}}
4438 \newcommand*\l@subparagraph{@dottedtocline{5}{12em}{6em}}
4439 %</report|book>
4440 \newcommand\listoffigures{%
4441 %<*report|book>
4442     \if@twocolumn
4443         \@restonecoltrue\onecolumn
4444     \else
4445         \@restonecolfalse
4446     \fi
4447     \chapter*{\listfigurename}%
4448 %</report|book>
4449 %<article>    \section*{\listfigurename}%
4450     \@mkboth{\MakeUppercase\listfigurename}%
4451     {\MakeUppercase\listfigurename}%
4452     \@starttoc{lof}%
4453 %<report|book>    \if@restonecol\twocolumn\fi
4454 }
4455 \newcommand*\l@figure{@dottedtocline{1}{1.5em}{2.3em}}
4456 \newcommand\listoftables{%
4457 %<*report|book>
4458     \if@twocolumn
4459         \@restonecoltrue\onecolumn
4460     \else
4461         \@restonecolfalse
4462     \fi
4463     \chapter*{\listtablename}%
4464 %</report|book>
4465 %<article>    \section*{\listtablename}%
4466     \@mkboth{%
4467         \MakeUppercase\listtablename}%
4468         {\MakeUppercase\listtablename}%
4469     \@starttoc{lot}%
4470 %<report|book>    \if@restonecol\twocolumn\fi
4471 }
4472 \let\l@table\l@figure
4473 \newdimen\bibindent
4474 \setlength\bibindent{1.5em}
4475 \newenvironment{thebibliography}[1]
4476 %<*article>
4477     {\section*{\refname}%
4478         \@mkboth{\MakeUppercase\refname}{\MakeUppercase\refname}%
4479 %</article>
4480 %<!*article>

```

```

4481      {\chapter*{\bibname}%
4482       \@mkboth{\MakeUppercase\bibname}{\MakeUppercase\bibname}%
4483 %<!/article>
4484     \list{\@biblabel{\@arabic\c@enumiv}}%
4485       {\settowidth\labelwidth{\@biblabel{#1}}%
4486        \leftmargin\labelwidth
4487        \advance\leftmargin\labelsep
4488        \openbib@code
4489        \usecounter{enumiv}%
4490        \let\p@enumiv\empty
4491        \renewcommand\theenumiv{\@arabic\c@enumiv}%
4492      \sloppy
4493      \clubpenalty4000
4494      \@clubpenalty \clubpenalty
4495      \widowpenalty4000%
4496      \sfcodes`.\.\@m}
4497    {\def\noitemerr
4498      {\@latex@warning{Empty `thebibliography' environment}}%
4499    \endlist}
4500 \newcommand\newblock{\hskip .11em\@plus.33em\@minus.07em}
4501 \let\openbib@code\empty
4502 % \renewcommand*{\@biblabel}[1]{[#1]\hfill}
4503 % \renewcommand*{\@cite}[1]{[#1]}
4504 \newenvironment{theindex}
4505   {\if@twocolumn
4506     \restonecolfalse
4507   \else
4508     \restonecoltrue
4509   \fi
4510 %<article>           \twocolumn[\section*{\indexname}]%
4511 %<!/article>         }
4512   {\twocolumn[\makeschapterhead{\indexname}]%
4513    \@mkboth{\MakeUppercase\indexname}%
4514    {\MakeUppercase\indexname}%
4515    \thispagestyle{plain}\parindent\z@
4516    \parskip\z@\@plus .3\p@\relax
4517    \columnseprule \z@
4518    \columnsep 35\p@
4519    \let\item\idxitem
4520    {\if@restonecol\onecolumn\else\clearpage\fi}
4521 \newcommand\@idxitem{\par\hangindent 40\p@}
4522 \newcommand\subitem{\@idxitem \hspace*{20\p@}}
4523 \newcommand\subsubitem{\@idxitem \hspace*{30\p@}}
4524 \newcommand\indexspace{\par \vskip 10\p@ \@plus5\p@ \relax}
4525 \renewcommand\footnoterule{%
4526   \kern-3\p@
4527   \hrule\@width.4\columnwidth
4528   \kern2.6\p@}

```

```
4528 %<!article>\@addtoreset{footnote}{chapter}
4529 \newcommand\@makefntext[1]{%
4530     \parindent 1em%
4531     \noindent
4532     \hb@xt@1.8em{\hss\@makefnmark}\#1}
4533 %\renewcommand\@makefnmark{\hbox{@textsuperscript
4534 %   {\normalfont\@thefnmark}}}
4535 \newcommand\contentsname{Contents}
4536 \newcommand\listfigurename{List of Figures}
4537 \newcommand\listtablename{List of Tables}
4538 %<article>\newcommand\refname{References}
4539 %<report|book>\newcommand\bibname{Bibliography}
4540 \newcommand\indexname{Index}
4541 \newcommand\figurename{Figure}
4542 \newcommand\tablename{Table}
4543 \newcommand\partname{Part}
4544 %<report|book>\newcommand\chaptername{Chapter}
4545 \newcommand\appendixname{Appendix}
4546 %<!book>\newcommand\abstractname{Abstract}
4547 \def\today{\ifcase\month\or
4548     January\or February\or March\or April\or May\or June\or
4549     July\or August\or September\or October\or November\or
4550     December\fi
4551 \space\number\day, \number\year}
4552 \setlength\columnsep{10\p@}
4553 %<!book>\pagestyle{plain}
4554 %<book>\pagestyle{headings}
4555 \pagenumbering{arabic}
4556 \if@twoside
4557 \else
4558     \raggedbottom
4559 \fi
4560 \if@twocolumn
4561     \twocolumn
4562     \sloppy
4563     \flushbottom
4564 \else
4565     \onecolumn
4566 \fi
4567 %</article|report|book>
```

Book Design

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

## 48.1 First Steps

In this chapter we will develop a full book template from scratch. Before we delve into it further, I would like to emphasize that the **phd** system is a bit different from classes. A **phd** style includes all the information necessary for the typesetting of a document. I have called this a style template. It is slightly different from a class system where generic commands might be included that can develop a totally different look. An identical design with perhaps different colors and fonts and other minor changes, is termed a *theme*.

Unlike book designers who would first focus on fonts, we will first give our attention to the structural elements of the book. I will be using as an example the *Linear Algebra*.

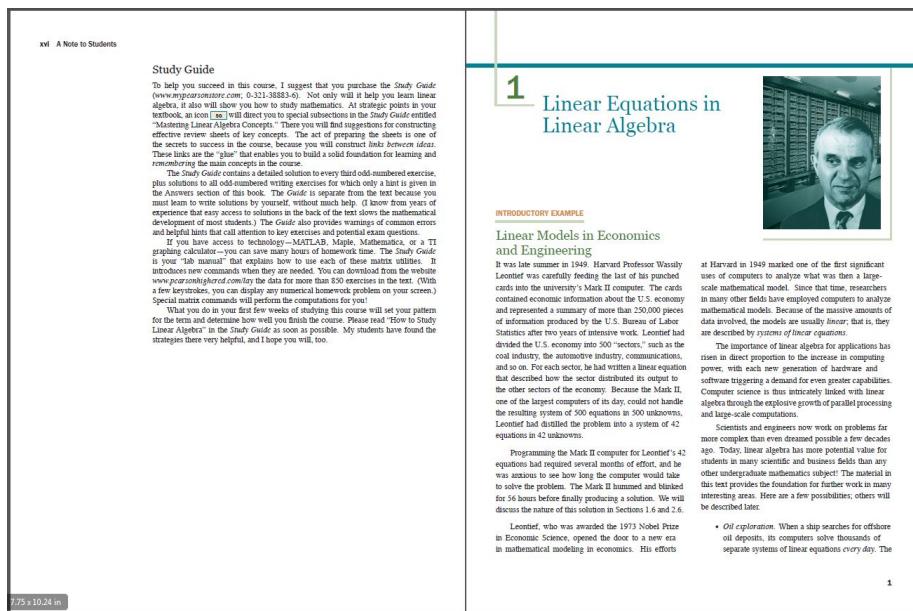


Figure 48.1: The opening chapter can leave a blank page.

Figure 48.1 shows the chapter head design. This is an interesting and challenging design that we will not easily make with the **phd** standard chapter head routines. The chapter starts with a full line and a structural element that is called *Introductory Example*. The heading of this also goes to the Table of Contents. So the chapter opening page starts with a rule and end with a rule. The ending rule in Figure 48.2 can be seen in the next figure.

### 48.1.1 Chapter Opening

One of the first things you will need to take care of, is to design if the style template should cater for opening at right or if it is to open at any place. Another decision you will need to make, is what to do with blank pages. Personally I dislike them and suggest, if you are going to have them to either introduce epigraphs or full page images.

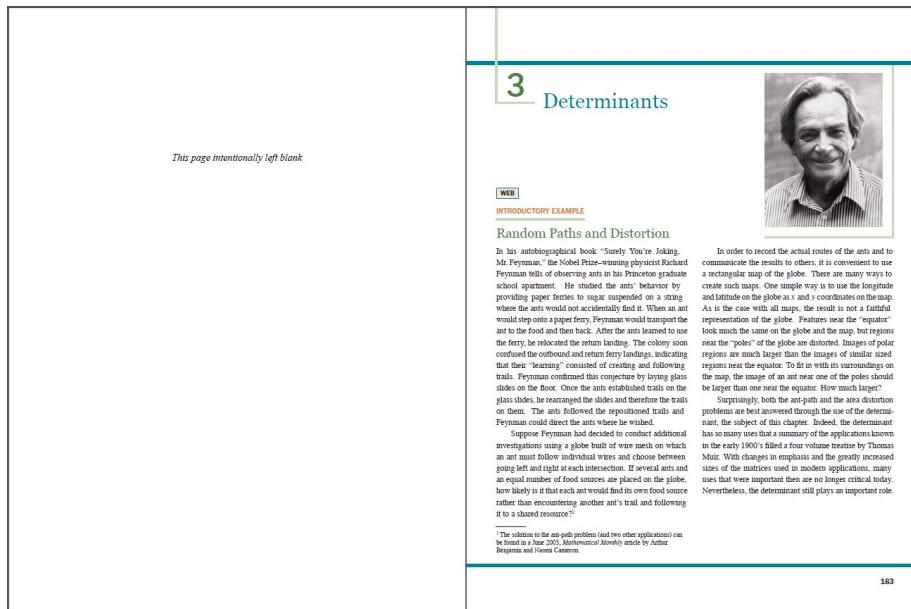


Figure 48.2: The opening chapter can leave a blank page.

### 48.1.2 The User Commands

It is always best to start thinking about the user commands, as we go along in order to provide a user friendly interface, without the introduction of too many keys. We also need to name our template. We will name it *andrea* in honour of the Designer of the book, who was Andrea Nix. Andrea designed many of the Pearson books that were mostly textbooks and has a unique distinctive design style that can make a mathematics book fun to read.

```
\cxset{chapter template = andrea,
       chapter opening = right}
```

Final page layout dimensions and booleans \paperwidth 597.5078pt  
\paperheight 845.04684pt  
\textwidth 345.opt  
\textheight 598.opt  
\oddsidemargin 53.opt  
\evensidemargin 54.opt  
\topmargin 23.opt  
\headheight 12.opt  
\headsep 18.06749pt  
\footskip 25.29494pt  
\marginparwidth 96.opt  
\marginparsep 7.opt  
\columnsep 20.opt  
\columnseprule 0.opt  
\skip\footins 253

```
\hoffset o.opt
\voffset o.opt
\mag 1000
```

```
\@reversemargintrue
```

As we will not be sure our calculations are right or wrong (the rules can disappear at the edge of the page) I have taken 5pt out from the left or right parameters to see that we have done the calculations properly.

We also need to check on oddside pages as well. Remember the switch `\@mparswitchfalse` will set the margin pars to be on the same size. This layout only has them on the right pages. We need to set it to false.

Another decision we need to make is if we going to draw the layout using TeX commands or one of the graphic units. Using TikZ, can be much easier, but we need to ensure we know where we are on the page. Alternatively we can use the remember picture, overlay hack to accomplish it. We will first give it a try with rules and boxes.

Now we have the dimensions of the left margin and right margin width right we can continue with the layout.

The next item we will draw is the corner frame.

## 45.1 Sections

### 48.2 Sections

The sections follow a very similar style to that of the chapter heading with rules and similar colours.

**2 CHAPTER 1 Linear Equations in Linear Algebra**

systems data for the equations are obtained from underground shafts created by explosions from air bombs. The waves break off subsurface rocks and are measured by geophones attached to mile-long cables behind the shaft.

- \* **Linear programming.** Many important management decisions today are made on the basis of linear programming models that utilize hundreds of variables. The airline industry, for instance,

employs linear programs that schedule flight crews, monitor the location of aircraft, or plan the varied schedules of support services such as maintenance and technical operations.

\* **Electrical networks.** Engineers use simulation software to engineer electrical circuits and microchips involving millions of transistors. Such software relies on linear algebra techniques and systems of linear equations.

[WEB]

Systems of linear equations is at the heart of linear algebra, and this chapter uses them to introduce some of the central concepts of linear algebra in a simple and concise setting. Sections 1.1 and 1.2 present a systematic method for solving systems of linear equations. This algorithm will be used for computations throughout the text. Sections 1.3 and 1.4 show how a system of linear equations is equivalent to a vector equation and to a matrix equation. These sections also introduce the basic operations on vectors and the solution of systems of vectors to questions about systems of linear equations. The fundamental concepts of spanning, linear independence, and linear transformations, studied in the second half of the chapter, will play an essential role throughout the text as we explore the beauty and power of linear algebra.

**1.1 SYSTEMS OF LINEAR EQUATIONS**

A **linear equation** in the variables  $x_1, x_2, \dots, x_n$  is an equation that can be written in the form

$$a_1x_1 + a_2x_2 + \dots + a_nx_n = b \quad (1)$$

where  $a_i$  and the **coefficients**  $a_1, a_2, \dots, a_n$  are real numbers, usually known in advance. The subscript  $n$  may be any positive integer. In textbook examples and exercises,  $n$  is normally between 2 and 5. In real-life problems,  $n$  might be 50 or 500, or even larger.

The equations

$$4x_1 - 5x_2 + 2 = x_1 \quad \text{and} \quad x_2 = 2(\sqrt{6} - x_1) + x_1$$

are both linear because they can be rearranged algebraically as in equation (1):

$$3x_1 - 5x_2 = -2 \quad \text{and} \quad 2x_1 + x_2 = 2\sqrt{6}$$

The equations

$$4x_1 - 5x_2 = x_1x_2 \quad \text{and} \quad x_2 = 2\sqrt{6} - x_1$$

are not linear because of the presence of  $x_1x_2$  in the first equation and  $\sqrt{6}$  in the second.

A **system of linear equations** (or a **linear system**) is a collection of one or more linear equations involving the same variables—say,  $x_1, \dots, x_n$ . An example is

$$\begin{aligned} 2x_1 - x_2 + 1.5x_3 &= 8 \\ x_1 &- 4x_3 = -7 \end{aligned} \quad (2)$$

**1.1 Systems of Linear Equations 3**

A **solution** of the system is a list  $(x_1, x_2, \dots, x_n)$  of numbers that makes each equation a statement when the values  $x_1, x_2, \dots, x_n$  are substituted for  $x_1, \dots, x_n$ , respectively. For instance,  $(5, 6.5, 3)$  is a solution of system (2) because, when these values are substituted in (2) for  $x_1, x_2, x_3$ , respectively, the equations simplify to  $8 = 8$  and  $-7 = -7$ .

The set of all possible solutions is called the **solution set** of the linear system. Two lines in the  $x_1$ - $x_2$  plane are shown in Figure 1. The intersection point  $(1, 2)$  is the solution of the first system, because it is a solution of the second system, and each solution of the second system is a solution of the first.

Finding the solution set of a system of two linear equations in two variables is easy because it amounts to finding the intersection of two lines. A typical problem is

$$\begin{aligned} x_1 - 2x_2 &= -1 \\ -x_1 + 2x_2 &= -3 \end{aligned}$$

The graphs of these equations are lines, which we denote by  $\ell_1$  and  $\ell_2$ . A pair of numbers  $(x_1, x_2)$  satisfies both equations in the system if and only if the point  $(x_1, x_2)$  lies on both  $\ell_1$  and  $\ell_2$ . In the system above, the solution is the single point  $(1, 2)$ , as you can easily verify. See Fig. 1.

**FIGURE 1** Exactly one solution.

Of course, two lines need not intersect in a single point—they could be parallel, or they could coincide and hence “intersect” at every point on the line. Figure 2 shows graphs that correspond to the following systems:

(a)  $\begin{aligned} x_1 - 2x_2 &= -1 \\ -x_1 + 2x_2 &= -3 \end{aligned}$

(b)  $\begin{aligned} x_1 - 2x_2 &= -1 \\ -x_1 + 2x_2 &= 1 \end{aligned}$

**FIGURE 2** (a) No solution. (b) Infinitely many solutions.

Figures 1 and 2 illustrate the following general fact about linear systems, to be verified in Section 1.2.

Figure 48.3: The opening chapter can leave a blank page.

The book does not use subsection. As a matter of fact most books don't consider

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that numbering of subsections offers an advantage to the reader.

**THEOREM 3**

If  $A$  is an  $m \times n$  matrix, with columns  $a_1, \dots, a_n$ , and if  $b$  is in  $\mathbb{R}^m$ , the matrix equation

$$Ax = b \quad (4)$$

has the same solution set as the vector equation

$$x_1a_1 + x_2a_2 + \dots + x_na_n = b \quad (5)$$

which, in turn, has the same solution set as the system of linear equations whose augmented matrix is

$$\begin{bmatrix} a_1 & a_2 & \dots & a_n & | & b \end{bmatrix} \quad (6)$$

Theorem 3 provides a powerful tool for gaining insight into problems in linear algebra, because a system of linear equations may now be viewed in three different but equivalent ways: as a matrix equation, as a vector equation, or as a system of linear equations. Whenever you construct a mathematical model of a problem in real life, you are free to choose which way you view the most convenient. Then you may re-examine the formulation of a problem to consider whether it is consistent. In our case, the matrix equation (4), the vector equation (5), and the system of equations are all solved in the same way—by now reducing the augmented matrix (6). Other methods of solution will be discussed later.

**Existence of Solutions**

The definition of  $Ax$  leads directly to the following useful fact.

The equation  $Ax = b$  has a solution if and only if  $b$  is a linear combination of the columns of  $A$ .

Section 1.3 considered the existence question: “Is  $b$  in  $\text{Span}(a_1, \dots, a_n)$ ?” Equivalently, “Is  $Ax = b$  consistent?” A harder existence problem is to determine whether the equation  $Ax = b$  is consistent for all possible  $b$ .

**EXAMPLE 3** Let  $A = \begin{bmatrix} 1 & 3 & 4 & | & b_1 \\ -4 & 2 & -6 & | & b_2 \\ -3 & -2 & -7 & | & b_3 \end{bmatrix}$  and  $b = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$ . Is the equation  $Ax = b$  consistent for all possible  $b_1, b_2, b_3$ ?

**SOLUTION** Row reduce the augmented matrix for  $Ax = b$ :

$$\begin{bmatrix} 1 & 3 & 4 & | & b_1 \\ -4 & 2 & -6 & | & b_2 \\ -3 & -2 & -7 & | & b_3 \end{bmatrix} \sim \begin{bmatrix} 1 & 3 & 4 & | & b_1 \\ 0 & 14 & 10 & | & b_2 + 4b_1 \\ 0 & 0 & 1 & | & b_3 + 3b_1 \end{bmatrix} \sim \begin{bmatrix} 1 & 3 & 4 & | & b_1 \\ 0 & 1 & \frac{5}{7} & | & b_2 + 4b_1 \\ 0 & 0 & 1 & | & b_3 - \frac{4}{7}b_2 + b_1 \end{bmatrix}$$

The third entry in column 4 equals  $b_3 - \frac{4}{7}b_2 + b_1$ . The equation  $Ax = b$  is not consistent for every  $b$  because some choices of  $b$  can make  $b_3 - \frac{4}{7}b_2 + b_1$  nonzero. ■

**FIGURE 1**

The columns of  $A = [a_1 \ a_2 \ \dots \ a_n]$  span a plane through 0.

**FIGURE 1**

The reduced matrix in Example 3 provides a description of all  $b$  for which the equation  $Ax = b$  is consistent. The entries in  $b$  must satisfy

$$b_3 - \frac{4}{7}b_2 + b_1 = 0$$

This is the equation of a plane through the origin in  $\mathbb{R}^3$ . The plane is the set of all linear combinations of the three columns of  $A$ . See Fig. 1.

The equation  $Ax = b$  in Example 3 is consistent for all  $b$  because the reduced matrix has three pivot columns. If there is no pivot in all three rows, we would not care about the calculations in the augmented column because in this case an echelon form of the augmented matrix could not have a row such as  $[0 \ 0 \ 0 \ 1]$ .

In general, a set of vectors  $\{v_1, \dots, v_n\}$  in  $\mathbb{R}^m$  spans (or generates)  $\mathbb{R}^m$  if every vector in  $\mathbb{R}^m$  is a linear combination of the columns of  $A$ . In general, a set of vectors  $\{v_1, \dots, v_n\}$  in  $\mathbb{R}^m$  spans (or generates)  $\mathbb{R}^n$  if every vector in  $\mathbb{R}^n$  is a linear combination of  $\{v_1, \dots, v_n\}$ —that is, if  $\text{Span}\{v_1, \dots, v_n\} = \mathbb{R}^n$ .

**THEOREM 4**

Let  $A$  be an  $m \times n$  matrix. Then the following statements are logically equivalent. That is, for a particular  $A$ , either they are all true statements or they are all false.

- For each  $b$  in  $\mathbb{R}^m$ , the equation  $Ax = b$  has a solution.
- Each  $b$  in  $\mathbb{R}^m$  is a linear combination of the columns of  $A$ .
- The columns of  $A$  span  $\mathbb{R}^m$ .
- $A$  has a pivot position in every row.

**FIGURE 1**

Theorem 4 is one of the most useful theorems in this chapter. Statements (a), (b), and (c) are equivalent because of the definition of  $Ax$  and what it means for a set of vectors to span  $\mathbb{R}^m$ . The discussion after Example 3 suggests why (a) and (d) are equivalent; a proof is given at the end of the section. The exercises will provide exercises to show how (a) implies (b).

**Warning:** Theorem 4 is about a coefficient matrix, not an augmented matrix. If an augmented matrix  $[A \ b]$  has a pivot position in every row, then the equation  $Ax = b$  may or may not be consistent.

**Computation of  $Ax$**

The calculations in Example 1 were based on the definition of the product of a matrix  $A$  and a vector  $x$ . The following simple example will lead to a more efficient method for calculating the entries in  $x$  when working problems by hand.

**EXAMPLE 4** Compute  $Ax$ , where  $A = \begin{bmatrix} 2 & 3 & 4 \\ -1 & 5 & -3 \\ 6 & -2 & 8 \end{bmatrix}$  and  $x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ .

Figure 48.4: The opening chapter can leave a blank page.

## 48.3 Examples and Solutions

The examples are straight forward typesetting and numbering. The specification should be that they be numbered consequently with the example and solution in capital letters to be distinguished by the type size. The colour is to be identical. The example heading is inlined with about a quad of space between it and the text that follow. The solution is on its own line and it is followed normally by a list which is numbered alphabetically. In other cases it is in-lined see the page at the left. We can perhaps handle this with a starred command, one for stand alone heading and another for an inlined. I will come back with some suggestions for this before, we delve into codin.

## 48.4 Exercises

These are modelled after sections and are also numbered. They are numbered in a different counter from that of sections and are reset at every chapter.

## 48.5 Figures and diagrams

The user commands should also be minimized and would follow normal LaTeX conventions, with the exception we will redefine an environment `\begin{marginfigure}`.... The margin figures are both numbered as well as unnumbered, so we will use normal LaTeX conventions to both define them as well as for author commands.

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CHAPTER 1 Supplementary Exercises 89

SOLUTION TO PRACTICE PROBLEM

$$A = \begin{bmatrix} 36 & 51 & 13 \\ 34 & 54 & 13 \\ 0 & 7 & 1.1 \end{bmatrix}, \quad \mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, \quad \mathbf{b} = \begin{bmatrix} 23 \\ 45 \\ 3 \end{bmatrix}$$

CHAPTER 1 SUPPLEMENTARY EXERCISES

1. Mark each statement True or False. Justify each answer. (If true, cite appropriate facts or theorems. If false, explain why it is false and give a simple example that shows why the statement is not true in every case.)

- Every matrix is row equivalent to a unique matrix in reduced echelon form.
- A system of  $n$  linear equations in  $m$  variables has at most  $n$  solutions.
- If a system of linear equations has two different solutions, it must have infinitely many solutions.
- If a system of linear equations has no free variables, then it has a unique solution.
- If an augmented matrix  $[A \mid b]$  is transformed into  $[C \mid d]$  by elementary row operations, then the equation  $Cx = d$  has the same solution set as the equation  $Ax = b$ .
- If a system  $Ax = b$  has more than one solution, then so does the system  $Ax = c$ .
- If  $A$  is an  $m \times n$  matrix and the equation  $Ax = b$  is consistent for some  $b$ , then the columns of  $A$  span  $\mathbb{R}^m$ .
- If an augmented matrix  $[A \mid b]$  is transformed by elementary row operations into reduced echelon form, then the solution set of the system  $Ax = b$  is the same.
- If matrices  $A$  and  $B$  are row equivalent, they have the same reduced echelon form.
- The equation  $Ax = b$  has the trivial solution if and only if the columns of  $A$  span  $\mathbb{R}^m$ .
- If  $A$  is an  $m \times n$  matrix and the equation  $Ax = b$  is consistent for every  $b$  in  $\mathbb{R}^m$ , then the columns of  $A$  span  $\mathbb{R}^m$ .
- If an  $m \times n$  matrix  $A$  has a pivot position, then the reduced echelon form of  $A$  is the  $m \times m$  identity matrix.
- $x + y + z = 0$  and  $A$  and  $B$  both have three pivot positions. Then the equation  $Ax = B$  is a unique solution for each  $x$ .
- If an  $m \times n$  matrix  $A$  has a pivot position, then the reduced echelon form of  $A$  is the  $m \times m$  identity matrix.
- $x + y + z = 0$  and  $A$  and  $B$  both have three pivot positions. Then the equation  $Ax = B$  is a unique solution for each  $x$ .

3. The solution  $(x_1, x_2, x_3)$  of a single linear equation  $ax_1 + bx_2 + cx_3 = d$  is unique if and only if  $a, b$ , and  $c$  are not all zero. Compute solutions of these linear equations whose graphs (3) intersect in a single line, (4) intersect in a single point, and (5) do not have

points in common. Typical graphs are illustrated in the figure.

Three planes intersecting in a line.  
(a)

Three planes intersecting in a point.  
(b)

Three planes with no intersection.  
(c)

Three planes with no intersection.  
(c)

c. Define an appropriate linear transformation  $T$  using the vectors in (4), and restate the problem in terms of  $T$ .

8. Describe the possible echelon forms of the matrix  $A$ . Use the notation of Example 1 in Section 1.2.

a.  $A$  is a  $2 \times 3$  matrix whose column span  $\mathbb{R}^2$ .  
b.  $A$  is a  $3 \times 3$  matrix whose column span  $\mathbb{R}^3$ .

9. Write the vector  $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$  as the sum of two vectors, one on the line  $(t, t, t)$  ( $t = 2t$ ) and one on the line  $(t, -t, 0)$  ( $t = -t/2$ ).

10. Let  $A = \begin{bmatrix} 1 & 2 & 3 \end{bmatrix}$ . Does the equation  $Ax = b$  have a solution? If so, is the solution unique?

$a$  and  $b$  in  $\mathbb{R}^3$

11. Consider  $A = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$ .  $A$  is not an echelon form, such that the columns of  $A$  are linearly dependent.

12. Consider  $A = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$ .  $A$  is not an echelon form, such that the columns of  $A$  are not a plane in  $\mathbb{R}^3$ .

13. Write the reduced echelon form of a  $3 \times 3$  matrix  $A$  such that the first two columns of  $A$  are pivot columns and the third column is a free column.

$$A = \begin{bmatrix} 1 & 2 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

14. Determine the value(s) of  $a$  such that  $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ a \end{bmatrix}$  is linearly independent.

15. In (x) and (y), suppose the vectors are linearly independent. Compute the numbers  $\dots, \dots, \dots$ ? Justify your answers. (Here  $\mathbf{0}$  uses 0's for its components.)

$$x = \begin{bmatrix} 0 & 0 & a \\ b & c & d \\ e & f & g \end{bmatrix}, \quad y = \begin{bmatrix} 0 & 0 & h \\ i & j & k \\ l & m & n \end{bmatrix}$$

16. Use Theorem 1 in Section 1.7 to explain why the columns of the following matrix are linearly independent.

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 2 & 5 & 0 & 0 \\ 3 & 6 & 5 & 0 \\ 4 & 9 & 9 & 10 \end{bmatrix}$$

17. Explain why a set  $\{v_1, v_2, v_3, v_4\}$  in  $\mathbb{R}^3$  must be linearly dependent if  $v_1 + v_2 + v_3$  is linearly independent and  $v_4$  is not in  $\text{span}(v_1, v_2, v_3)$ .

18. Suppose  $y$  is a linearly independent set in  $\mathbb{R}^3$ . Show that  $(v_1 + w_1, v_2 + w_2)$  is also linearly independent.

Figure 48.7: The book will have a lot of examples and their solutions

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8.4 Hyperplanes 463

If  $f$  is a nonzero functional, then  $\text{rank } A = 1$ , and  $\dim \text{Null } A = n - 1$ , by the Rank Theorem.<sup>1</sup> Thus, the subspace  $\{f = 0\}$  has dimension  $n - 1$  and so is a hyperplane. Also, if  $d$  is any number, then

$$\{f : d\} \quad \text{is the same as} \quad \{x \in \mathbb{R}^n : Ax = d\} \quad (2)$$

Recall from Theorem 1 in Section 1.5 that the set of solutions of  $Ax = b$  is obtained by translating the solution set of  $Ax = 0$ , using any particular solution  $p$  of  $Ax = b$ . When  $A$  is the standard matrix of the transformation  $f$ , this theorem says that

$$\{f : d\} = \{f = 0\} + p \quad \text{for any } p \text{ in } \{f = 0\} \quad (3)$$

Thus the sets  $\{f : d\}$  are hyperplanes parallel to  $\{f = 0\}$ . See Fig. 1.

FIGURE 1 Parallel hyperplanes, with  $f(p) = d$ .

When  $A$  is a  $1 \times n$  matrix, the equation  $Ax = d$  may be written with an inner product  $\langle s, x \rangle$ , using  $n$  in  $\mathbb{R}^n$  with the same entries as  $A$ . Thus, from (2),

$$\{f : d\} \quad \text{is the same as} \quad \{x \in \mathbb{R}^n : \langle s, x \rangle = d\} \quad (4)$$

Thus  $\{f = 0\} = \{x \in \mathbb{R}^n : s \cdot x = 0\}$ , which shows that  $\{f = 0\}$  is the orthogonal complement of the subspace spanned by  $s$ . In the terminology of calculus and geometry for  $\mathbb{R}^n$ ,  $\{f = 0\}$  is the "normal vector to  $\{f = 0\}$ ". (A "normal" vector in this sense need not have unit length.) Also, it is not hard to reach each parallel hyperplane  $\{f = d\}$ , even though  $s$  is not zero when  $d \neq 0$ .

Another name for  $\{f : d\}$  is a *level set* of  $f$ , and it is sometimes called the *gradient* of  $f$  when  $f(x) = -n^{-1}s \cdot x$  for each  $x$ .

**EXAMPLE 3** Let  $n = \begin{bmatrix} 0 \\ 4 \end{bmatrix}$  and  $v = \begin{bmatrix} 1 \\ -6 \end{bmatrix}$  and let  $H = \{x : n \cdot x = 12\}$ , so  $H = \{f\}$ , where  $f(x, y) = 3x + 4y$ . Then the line  $3x + 4y = 12$  is a  $1$ -dimensional parallel of the plane hyperplane  $H$ . See Fig. 2.

**SOLUTION** First, find a point  $p$  in  $H$ . To do this, find a point in  $H$  and add  $v$  to it. For instance,  $\begin{bmatrix} 0 \\ 3 \end{bmatrix}$  is in  $H$ , so  $p = \begin{bmatrix} 0 \\ 3 \end{bmatrix} + \begin{bmatrix} 1 \\ -6 \end{bmatrix} = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$  is in  $H$ . Now, compute  $n \cdot p = -9$ . This shows that  $H = \{f = -9\}$ . See Fig. 2, which also shows the subspace  $H_0 = \{x : n \cdot x = 0\}$ . ■

The next three examples show connections between implicit and explicit descriptions of hyperplanes. Example 4 begins with an implicit form.

<sup>1</sup>See Theorem 14 in Section 2.9 or Theorem 14 in Section 4.6.

FIGURE 2

**EXAMPLE 4** In  $\mathbb{R}^2$ , give an explicit description of the line  $x - 4y = 13$  as a parameterized vector equation.

**SOLUTION** This amounts to solving a nonhomogeneous equation  $tx = b$ , where  $t = [1 \ -4]$  and  $b$  is the number 13 in  $\mathbb{R}$ . Write  $x = 13 + ty$ , where  $y$  is a free variable. In parametric form, the solution is

$$x = \begin{bmatrix} 1 \\ y \end{bmatrix} = \begin{bmatrix} 13 + 4y \\ y \end{bmatrix} = \begin{bmatrix} 13 \\ 0 \end{bmatrix} + y \begin{bmatrix} 4 \\ 1 \end{bmatrix} = p + yq, \quad y \in \mathbb{R}$$

Converting an explicit description of a line into implicit form is more involved. The basic idea is to construct  $\{f = 0\}$  and then find  $\{f \neq 0\}$ .

**EXAMPLE 5** Let  $v_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$  and  $v_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ , and let  $L_0$  be the line through  $v_1$  and  $v_2$ . Find a linear function  $f$  and a constant such that  $L_0 = \{f = d\}$ .

**SOLUTION**  $L_0$  is parallel to the translated line  $L_0$  through  $v_2 - v_1$  and the origin. The defining equation for  $L_0$  has the form

$$\langle a \cdot \begin{bmatrix} x \\ y \end{bmatrix}, 0 \rangle = 0 \quad \text{or} \quad a \cdot s = 0, \quad \text{where } a = \begin{bmatrix} a \\ b \end{bmatrix} \quad (5)$$

Since  $a$  is orthogonal to the subspace  $L_0$ , which contains  $v_2 - v_1$ , compute

$$v_2 - v_1 = \begin{bmatrix} 0 \\ 1 \end{bmatrix} - \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \end{bmatrix}$$

and solve

$$\langle a, b \rangle \begin{bmatrix} -1 \\ 0 \end{bmatrix} = 0$$

By inspection, a solution is  $a = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ . Let  $f(x, y) = 2x + 3y$ . From (5),  $L_0 = \{f = 0\}$ , and  $L_0 = \{f = d\}$  for some  $d$ . Since  $L_0$  is on line  $L_0$ ,  $d = (f(v_2) - 2(0) + 3(2)) = 12$ . Thus, the equation for  $L_0$  is  $2x + 3y = 12$ . As a check, note that  $f(v_1) = f(0, 0) = 2(0) + 3(0) = 0$ , so  $v_1$  is on  $L_0$ . ■

**EXAMPLE 6** Let  $v_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ ,  $v_2 = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix}$ , and  $v_3 = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$ . Find an implicit description  $\{f : d\}$  of the plane  $H$  that passes through  $v_1$ ,  $v_2$ , and  $v_3$ .

Figure 48.8: The book will have a lot of examples and their solutions

## 48.6 Geometry

Although we spend a good part of the Chapter on page design, reviewing historical typographical paper sizes, modern book production of text books is not bound with tradition but economics. High speed printing technology uses rolls and pages can be printed up to 64 pages at a time. We will follow the books dimensions which are 7.75x10.25in. The text area occupies approximately 0.67 of the textwidth and is particularly well balanced. Many mathematical text books come out too dense and are difficult to be used by students.

## The Ecosystem

...  
phd package and give a background as to how fonts are used  
in L<sup>A</sup>T<sub>E</sub>X.

# Key Value Interfaces

This chapter discusses primarily TeX's page breaking algorithm and how the output routines can be used to insert additional material on every page, such as inserts, page numbers and similar. Later the chapter discusses the terminology used in the TeXbook and by experts to describe the routines and we will develop some basic output routines.

The last part touches on the main differences between LaTeX output routines and floats as compared to the original approach in PlainTeX.



The key value system greatly simplifies the TeX interface for authors. As **joseph2009** wrote this ease of use was not transferred into setting up key-value systems for authors of pre-packaged TeX code. This Chapter and the one that follows that focus specifically on the **pgfkeys** package provides an overview and describes some of the more difficult areas. The TUGboat article referenced earlier and written by Joseph Wright *et.al* has an excellent introduction to the available packages and some longer examples for comparison. Chapter ?? discusses the **expl3** key-value functions.

## 49.1 keyval

The **keyval** written by David Carlisle is still widely used by package authors to provide the means for users to easily specify numerous optional arguments for macros **keyval**. The main advantages of using keyval are that (1) the number of optional arguments is no longer limited to 9 and that (2) the arguments are named, and hence there is less chance of confusion about the syntax of a macro.

## 49.2 xkeyval

A more recent package, **xkeyval** provides improvements for programming keys and also provides a more advanced interface for the namespaces of keys and families. Before you start experimenting with the xkeyval package, I suggest that you load the package **xkview**. This is part of the **xkeyval**<sup>1</sup> bundle and can help you to view key value parameters in various ways. The **xkeyval** package was developed by Hendri Adriaens and Uwe Kern<sup>2</sup>. This package is an extension of the well-known **keyval** package. The package provides more flexible commands and syntax enhancements as well as newer option processing mechanism.

The main change of the **xkeyval** package is that it provides a means to namespace the keys, which all have the form **\KV@family@keyname**, where the KV is a literal prefix to avoid collisions. They take one argument to handle user input.

The main commands of the package are the same as those of keyval.

### Example 2.1 xkeyval

```

472 \makeatletter
473 \define@key{phd}{pi}{\setlength{\parindent}{#1}}
474 \setkeys{phd}{pi=50pt}
475 \makeatother
476 \lorem\par
477 \setkeys{phd}{pi=0pt}
478 \lorem\par

```

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque  
felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet

<sup>1</sup><http://www.ctan.org/pkg/xkeyval>

<sup>2</sup>**xkeyval**.

mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par  
 Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

Defining a default key, i.e., a key that can be used as `indent` or `indent=30pt` will stretch your memory, as it has an optional parameter as its third argument.

```
\define@key{family}{key}[none]{The input is: #1}
```

#### Example 2.2 xkeyval

```
472 \makeatletter
473
474 \define@key{phd}{pi}[30pt]{\setlength{\parindent}{#1}}
475
476 \setkeys{phd}{pi}
477
478 \lorem
479
480 or \setkeys{phd}{pi=0pt}
481
482 \lorem
483 \makeatother
```

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par  
 or

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

## 49.3 Ordinary Keys

Ordinary keys are keys that have values such as `animal=elephant` and your macro can be called like `animals[animal=elephant]{14}`.

## 49.4 Keys and values in package options

First of all, the package supplies macros to declare class or package options, execute them and process them. The macros are available under the usual L<sup>A</sup>T<sub>E</sub>X names, but all with the suffix **X**, namely

```
\DeclareOptionX
\DeclareOptionX*
\ExecuteOptionsX
```

### \ProcessOptionsX

These commands allow the user to assign a value to an option just like when using `\setkeys`. The first macro is based on `\define@key` and the final two are based on `\setkeys`. Supposing that a package `mypack` is set up with these commands, a user could for instance do

```
\usepackage[textcolor=red, font=times]{mypad}
```

These `xkeyval` macros are fully compatible with the `LATEX` option conventions. They will allow packages to copy global options specified in the `\documentclass` command, to pass options to other classes or packages and to update the list of unused global options that will be displayed by `LATEX` in the log file.

## 49.5 kvoptions

Another package `kvoptions` by Heiko Oberdiek is used extensively in the large suite of packages developed by Heiko<sup>3</sup>. The package originally formed part of the `hyperref` and later branched into an independent package. The package provides a number of additional commands to those found in the `LATEX` kernel and a comparison of the commands is shown in the table below.

It is a good alternative that can be used for single topic package writing. An important feature of the package is its ability to process options both globally as well as locally avoiding conflicts when options are specified both globally as well as locally. Heiko provides an example from his bookmark package<sup>4</sup>, which provides the option `open` that specifies whether the bookmarks are opened or closed initially. Its values are true or false. Since KOMA-Script version 3.00 the KOMA classes also introduces option `open` with values `right` and `any` and a complete different meaning. Such conflicts can be resolved by marking all or part of options as local by `\DeclareLocalOption` or `\DeclareLocalOptions`. Then the packages ignores global occurrences of these options

---

<sup>3</sup>**kvoptions**.

<sup>4</sup>**bookmark**.

# Managing Keys with PGF

This chapter discusses primarily T<sub>E</sub>X's page breaking algorithm and how the output routines can be used to insert additional material on every page, such as inserts, page numbers and similar. Later the chapter discusses the terminology used in the TeXbook and by experts to describe the routines and we will develop some basic output routines.

The last part touches on the main differences between LaTeX output routines and floats as compared to the original approach in PlainTeX.



## 50.1 PGF keys

This chapter describes the package `pgfkeys`. It is loaded automatically by both PGF and TikZ.

This package can be used independently of PGF. Note that no other package of PGF needs to be loaded (so neither the emulation layer nor the system layer is needed). The ConTeXt abbreviation is `pgfkey` if `pgfmod` is not loaded.

### Example 1.1 wavelast

```

472 \bgroup
473 \cxset{paragraph style/uwave/font-weight=\itshape,
474         % paragraph style/uwave/linewidth={15cm},
475         }
476 \begin{center}
477
478 \wavelast{
479 A Dialogue between the Landlady, and Susan the
        Chambermaid, proper to be read by all Innkeepers,
        and their Servants; with the Arrival, and affable
        Behaviour of a beautiful young Lady; which may
        teach Persons of Condition how they may acquire the
        Love of the whole World.}
480
481 \end{center}
482 \egroup

```

*A Dialogue between the Landlady, and Susan the  
Chambermaid, proper to be read by all Innkeepers, and their  
Servants; with the Arrival, and affable Behaviour of a  
beautiful young Lady; which may teach Persons of Condition  
how they may acquire the Love of the whole World.*

```

483 \def\wavelast#1{%
484     \bgroup
485
486     \setbox0=\vbox{\fontstore\noindent #1}%
487     \setbox1=\vbox{%
488         \unvbox0
489         \setbox2=\lastbox
490         \hbox to 2
491             {10cm{\hfill\uwave{\unhbox2}\hfill}}%
492     }%
493     \unvbox1
494 }%

```

Consider the number of variables involved in such a paragraph. How can we abstract the code to make it more general? We can have settings for colors, width, hyphenation, font related commands etc. PGF keys can be used to provide

a dictionary.

**A Dialogue between the Landlady, and Susan the Chambermaid, proper to be read by all Innkeepers, and their Servants; with the Arrival, and affable Behaviour of a beautiful young Lady; which may teach Persons of Condition how they may acquire the Love of the whole World.**

*Alice had never been in a court of justice before, but she had read about them in books, and she was quite pleased to find that she knew the name of nearly everything there. “That’s the judge,” she said to herself, “because of his great wig.”.*

*The judge, by the way, was the King, and as he wore his crown over the wig, (look at the frontispiece if you want to see how he did it,) he did not look at all comfortable, and it was certainly not becoming.*

## 50.2 Introduction

### 50.2.1 Comparison to Other Packages

The `pgfkeys` package defines a key–value management system that is in some sense similar to the more light-weight `keyval` system and the improved `xkeyval` system. However, `pgfkeys` uses a slightly different philosophy than these systems and it will coexist peacefully with both of them. Its power and flexibility are evident in the `pgf` and `tikz` packages and to an extend our own `phd` system.

The main differences between `pgfkeys` and `xkeyval` are the following:

- `pgfkeys` organizes keys in a tree, while `keyval` and `xkeyval` use families. In `pgfkeys` the families correspond to the root entries of the key tree.
- For efficiency reasons, `pgfkeys` does not directly support setting keys drawn from multiple families as `xkeyval` does. This can be emulated if necessary, but it will be slower than `xkeyval`’s native support.
- `pgfkeys` has no save-stack impact (you will have to read the TeXBook very carefully to appreciate this).
- `pgfkeys` is slightly slower than `keyval`, but not much.
- `pgfkeys` supports styles. This means that keys can just stand for other keys (which can stand for other keys in turn or which can also just execute some code). TikZ uses this mechanism heavily.
- `pgfkeys` supports multi-argument key code. This can, however, be emulated in `keyval`.

- **pgfkeys** supports handlers. These are call-backs that are called when a key is not known. They are very flexible, in fact even defining keys in different ways is handled by, well, handlers.

The PGF can be used for complicated and multi-value cases. The fact that it is more capable than the rest does not in itself make it slower.

### 50.3 Technical

The package uses `\csname` to craete the names of macros and token registers to store the values. For example to store a length in a key `/test/length` it does the following:

**Example 3.2 pgfkeyssetvalue**

```

472 \pgfkeyssetvalue{/test/length}{2cm-3cm}
473 \makeatletter
474 \the\pgfkeys@temptoks
475
476 \csname pgfk@/test/length\endcsname
477 \makeatother

2cm-3cm
2cm-3cm

```

Essentially we defined a macro `pgfk@/test/length` with its replacement text being `2cm-3cm`. The definition of `\pgfkeyssetvalue` given by:

```

478 \long\def\pgfkeyssetvalue#1#2{%
479   \pgfkeys@temptoks{#2}
480   \expandafter
481   \edef\csname
482     \pgfk@#1\endcsname{\the\pgfkeys@temptoks}%
483 }

```

The code above just stored a value. If the path ends in `.@cmd` it will set up things so the key .@cmd contains a a macro that takes one parameter and has #2 as its code.

```

483 \long\def\pgfkeysdef#1#2{%
484   \long\def\pgfkeys@temp##1\pgfeov{#2}%
485   \pgfkeyslet{#1/.@cmd}{\pgfkeys@temp}%
486   \pgfkeyssetvalue{#1/.@body}{#2}%
487 }
488
489 \long\def\pgfkeysedef#1#2{%
490   \long\edef\pgfkeys@temp##1\pgfeov{#2}%
491   \pgfkeyslet{#1/.@cmd}{\pgfkeys@temp}%
492   \pgfkeyssetvalue{#1/.@body}{#2}%
493 }

```

**Example 3.3 Defining keys for code**

```

472 \def\city{\expandafter\def\csname#1\endcsname{#1}}
473 \def\city#1{\expandafter\def\csname#1\endcsname{#1}}
474
475 \pgfkeys{/test/cities}{\city{#1}}
476
477 \pgfkeys{/test/cities=Rome}
478 \pgfkeys{/test/cities=Paris}
479
480 \Rome, \Paris

```

Rome, Paris

### 50.3.1 Getting started

The following quick guide to PGF's key mechanism only treats the most commonly used features. For an in-depth discussion of what is going on, please consult the PGF manual.

Keys are organized in a large tree that is similar to the Unix file tree. A typical key might be, say, `/tikz/coordinate system/x` or just `/x`. Again as in Unix, when you specify keys you can provide the complete path of the key, but you usually just provide the name of the key (corresponding to the file name without any path) and the path is added automatically.

Typically (but not necessarily) some code is associated with a key. To execute this code, you use the `\pgfkeys` command. This command takes a list of so-called key–value pairs. Each pair is of the form `<key>=<value>`. For each pair the `\pgfkeys` command will execute the code stored for the `<key>` with its parameter set to `<value>`.

Here is a typical example of how the `\pgfkeys` command is used:

```
\pgfkeys{/my key=hallo,/your keys/main key=something\strange,
         key name without path=something else}
```

Now, to set the code that is stored in a key you do not need to learn a new command. Rather, the `\pgfkeys` command can also be used to set the code of a key. This is done using so-called *handlers*. They look like keys whose names look like “hidden files in Unix” since they start with a dot. The handler for setting the code of a key is appropriately called `.code` and it is used as follows:

```
\pgfkeys{/my key/.code=\value is '#1'.
```

The value is 'hi!'. `\pgfkeys{/my key=hi!}`

As you can see, in the first line we defined the code for the key `/my key`. In the second line we executed this code with the parameter set to `hi!`.

There are numerous handlers for defining a key. For instance, we can also define a key whose value actually consists of more than one parameter.

```
\pgfkeys{/my key/.code 2 args=\values are '#1' and '#2'.
```

The values are 'a1' and 'a2'. `\pgfkeys{/my key={a1}{a2}}`

We often want to have keys where the code is called with some default value

if the user does not provide a value. Not surprisingly, this is also done using a handler, this time called `.default`.

```
(hallo)(hello) \pgfkeys{/my key/.code=(#1)}
\pgfkeys{/my key/.default=hello}
\pgfkeys{/my key=hallo,/my key}
```

The other way round, it is also possible to specify that a value *must* be specified, using a handler called `.value required`. Finally, you can also require that no value *may* be specified using `.value forbidden`.

All keys for a package like, say, TikZ start with the path `/tikz`. We obviously do not like to write this path down every time we use a key (so we do not have to write things like `\draw[/tikz/line width=1cm]`). What we need is to somehow “change the default path to a specific location.” This is done using the handler `.cd` (for “change directory”). Once this handler has been used on a key, all subsequent keys *in the current call of \pgfkeys only* are automatically prefixed with this path, if necessary.

Here is an example:

```
\pgfkeys{/tikz/.cd,line width=1cm,line cap=round}
```

This makes it easy to define commands like `\tikzset`, which could be defined as follows (the actual definition is a bit faster, but the effect is the same):

```
\def\tikzset#1{\pgfkeys{/tikz/.cd,#1}}
```

When a key is handled, instead of executing some code, the key can also cause further keys to be executed. Such keys will be called *styles*. A style is, in essence, just a key list that should be executed whenever the style is executed. Here is an example:

```
(a:foo)(b:bar)(a:wow) \pgfkeys{/a/.code=(a:#1)}
\pgfkeys{/b/.code=(b:#1)}
\pgfkeys{/my style/.style={/a=foo,/b=bar,/a=#1}}
\pgfkeys{/my style=wow}
```

As the above example shows, style can also be parametrized, just like the normal code keys.

Printing a phd key

#### Example 3.4 Printing a Key

```
472 \pgfkeys{/phd/test/.code=(Test),}
473 \pgfkeys{/phd/.style =/phd/.cd,
474     phd, chapter name,
475 }
476 \expandafter\meaning\expandafter\pgfkeysvalueof{/phd/chapter
    font-family}
477 \makeatletter
478 \csname pgfkey@store\endcsname {test}
479 \makeatother
```

macro:#1->\csname pgfk@#1\endcsname /phd/chapter font-family test

As a typical use of styles, suppose we wish to setup the key `/tikz` so that it will change the default path to `/tikz`. This can be achieved as follows:

```
\pgfkeys{/tikz/.style=/tikz/.cd}
\pgfkeys{tikz,line width=1cm,draw=red}
```

Note that when `\pgfkeys` is executed, the default path is set to `/`. This means that the first `tikz` will be completed to `/tikz`. Then `/tikz` is a style and, thus, replaced by `/tikz/.cd`, which changes the default path to `/tikz`. Thus, the `line width` is correctly prefixed with `/tikz`.

### 50.3.2 The Key Tree

The `pgfkeys` package organizes keys in a so-called *key tree*. This tree will be familiar to anyone who has used a Unix operating system: A key is addressed by a path, which consists of different parts separated by slashes. A typical key might be `/tikz/line width` or just `/tikz` or something more complicated like `/tikz/cs/x/.store in`.

Let us fix some further terminology: Given a key like `/a/b/c`, we call the part leading up the last slash (`/a/b`) the *path* of the key. We call everything after the last slash (`c`) the *name* of the key (in a file system this would be the file name). We do not always wish to specify keys completely. Instead, we usually specify only part of a key (typically only the name) and the *default path* is then added to the key at the front. So, when the default path is `/tikz` and you refer to the (partial) key `line width`, the actual key that is used is `/tikz/line width`. There is a simple rule for deciding whether a key is a partial key or a full key: If it starts with a slash, then it is a full key and it is not modified; if it does not start with a slash, then the default path is automatically prefixed.

Note that the default path is not the same as a search path. In particular, the default path is just a single path. When a partial key is given, only this single default path is prefixed; `pgfkeys` does not try to lookup the key in different parts of a search path. It is, however, possible to emulate search paths, but a much more complicated mechanism must be used.

When you set keys (to be explained in a moment), you can freely mix partial and full keys and you can change the default path. This makes it possible to temporarily use keys from another part of the key tree (this turns out to be a very useful feature).

Each key (may) store some *tokens* and there exist commands, described below, for setting, getting, and changing the tokens stored in a key. However, you will only very seldom use these commands directly. Rather, the standard way of using keys is the `\pgfkeys` command or some command that uses it internally like, say, `\tikzset`. So, you may wish to skip the following commands and continue with the next subsection.

`\pgfkeyssetvalue{\langle full key \rangle}{\langle token text \rangle}`

Stores the `\langle token text \rangle` in the `\langle full key \rangle`. The `\langle full key \rangle` may not be a partial key, so no default-path-adding is done. The `\langle token text \rangle` can be arbitrary tokens and may even contain things like # or unbalanced TeX-ifs.

```
Hello, world! \pgfkeyssetvalue{/my family/my key}{Hello, world!}
\pgfkeysvalueof{/my family/my key}
```

The setting of a key is always local to the current TeX group.

```
 Lorem ipsum ... \pgfkeyssetvalue{/phd/chapteris font}{\arial}
                               {\pgfkeysvalueof{/phd/chapteris font}} Lorem ipsum ... }
```

### \pgfkeyslet{\full key}{\macro}

Performs a `\let` statement so the the `\full key` points to the contents of `\macro`.

```
Hello, world! \def\helloworld{Hello, world!}
                               \pgfkeyslet{/my family/my key}{\helloworld}
                               \pgfkeysvalueof{/my family/my key}
```

You should never let a key be equal to `\relax`. Such a key may or may not be indistinguishable from an undefined key.

### \pgfkeysgetvalue{\full key}{\macro}

Retrieves the tokens stored in the `\full key` and lets `\macro` be equal to these tokens. If the key has not been set, the `\macro` will be equal to `\relax`.

```
Hello, world! \pgfkeyssetvalue{/my family/my key}{Hello, world!}
                               \pgfkeysgetvalue{/my family/my key}{\helloworld}
                               \helloworld
```

### \pgfkeysvalueof{\full key}

Inserts the value stored in `\full key` at the current position into the text.

```
Hello, world! \pgfkeyssetvalue{/my family/my key}{Hello, world!}
                               \pgfkeysvalueof{/my family/my key}
```

### \pgfkeyisifdefined{\full key}{\if}{\else}

Checks whether this key was previously set using either `\pgfkeyssetvalue` or `\pgfkeyslet`. If so, the code in `\if` is executed, otherwise the code in `\else`.

This command will use eTeX's `\ifcsname` command, if available, for efficiency. This means, however, that it may behave differently for TeX and for eTeX when you set keys to `\relax`. For this reason you should not do so.

```
yes \pgfkeyssetvalue{/my family/my key}{Hello, world!}
                               \pgfkeyisifdefined{/my family/my key}{yes}{no}
```

### 50.3.3 Setting Keys

Setting keys is done using a powerful command called `\pgfkeys`. This command takes a list of so-called *key–value pairs*. These are pairs of the form `\key=\value`. The principle idea is the following: For each pair in the list, some *action* is taken. This action can be one of the following:

1. A command is executed whose argument(s) are  $\langle value \rangle$ . This command is stored in a special subkey of  $\langle key \rangle$ .
2. The  $\langle value \rangle$  is stored in the  $\langle key \rangle$  itself.
3. If the key's name (the part after the last slash) is a known *handler*, then this handler will take care of the key.
4. If the key is totally unknown, one of several possible *unknown key handlers* is called.

Additionally, if the  $\langle value \rangle$  is missing, a default value may or may not be substituted. Before we plunge into all the details, let us have a quick look at the command itself.

### `\pgfkeys{\langle key list \rangle}`

The  $\langle key list \rangle$  should be a list of key–value pairs, separated by commas. A key–value pair can have the following two forms:  $\langle key \rangle=\langle value \rangle$  or just  $\langle key \rangle$ . Any spaces around the  $\langle key \rangle$  or around the  $\langle value \rangle$  are removed. It is permissible to surround both the  $\langle key \rangle$  or the  $\langle value \rangle$  in curly braces, which are also removed. Especially putting the  $\langle value \rangle$  in curly braces needs to be done quite often, namely whenever the  $\langle value \rangle$  contains an equal-sign or a comma.

The key–value pairs in the list are handled in the order they appear. How this handling is done, exactly, is described in the rest of this section.

If a  $\langle key \rangle$  is a partial key, the current value of the default path is prefixed to the  $\langle key \rangle$  and this “upgraded” key is then used. The default path is just the root path / when the first key is handled, but it may change later on. At the end of the command, the default path is reset to the value it had before this command was executed.

Calls of this command may be nested. Thus, it is permissible to call `\pgfkeys` inside the code that is executed for a key. Since the default path is restored after a call of `\pgfkeys`, the default path will not change when you call `\pgfkeys` while executing code for a key (which is exactly what you want).

### `\pgfqkeys{\langle default path \rangle}{\langle key list \rangle}`

This command has the same effect as `\pgfkeys{\langle default path \rangle/.cd,\langle key list \rangle}`, it is only marginally quicker. This command should not be used in user code, but rather in commands like `\tikzset` or `\pgfset` that get called very often.

### `\pgfkeyalso{\langle key list \rangle}`

This command has exactly the same effect as `\pgfkeys`, only the default path is not modified before or after the keys are being set. This command is mainly intended to be called by the code that is being processed for a key.

### `\pgfqkeyalso{\langle default path \rangle}{\langle key list \rangle}`

This command has the same effect as `\pgfkeyalso{\langle default path \rangle/.cd,\langle key list \rangle}`, it is only quicker. Changing the default path inside a `\pgfkeyalso` is dangerous, so use with care. A rather safe place to call this command is at the beginning of a TeX group.

### 50.3.30 Default Arguments

The arguments of the `\pgfkeys` command can either be of the form `<key>=<value>` or of the form `<key>` with the value-part missing. In the second case, the `\pgfkeys` will try to provide a *default value* for the `<value>`. If such a default value is defined, it will be used as if you had written `<key>=<default value>`.

In the following, the details of how default values are determined is described; however, you should normally use the handlers `.default` and `.value required` as described in Section 50.3.10 and you may wish to skip the following details.

When `\pgfkeys` encounters a `<key>` without an equal-sign, the following happens:

1. The input is replaced by `<key>=\pgfkeysnovalue`. In particular, the commands `\pgfkeys{my key}` and `\pgfkeys{my key=\pgfkeysnovalue}` have exactly the same effect and you can “simulate” a missing value by providing the value `\pgfkeysnovalue`, which is sometimes useful.
2. If the `<value>` is `\pgfkeysnovalue`, then it is checked whether the subkey `<key>/.@def` exists. For instance, if you write `\pgfkeys{/my key}`, then it is checked whether the key `/my key/.@def` exists.
3. If the key `<key>/ .@def` exists, then the tokens stored in this key are used as `<value>`.
4. If the key does not exist, then `\pgfkeysnovalue` is used as the `<value>`.
5. At the end, if the `<value>` is now equal to `\pgfkeysvaluerquired`, then the code (or something fairly equivalent) `\pgfkeys{/errors/value required=<key>{}}` is executed. Thus, by changing this key you can change the error message that is printed or you can handle the missing value in some other way.

### 50.3.4 Keys That Execute Commands

After the transformation process described in the previous subsection, we arrive at a key of the form `<key>=<value>`, where `<key>` is a full key. Different things can now happen, but always the macro `\pgfkeyscurrentkey` will have been setup to expand to the text of the `<key>` that is currently being processed.

The first thing that is tested is whether the key `<key>/ .@cmd` exists. If this is the case, then it is assumed that this key stores the code of a macro and this macro is executed. The argument of this macro is `<value>` directly followed by `\pgfeov`, which stands for “end of value.” The `<value>` is not surrounded by braces. After this code has been executed, `\pgfkeys` continues with the next key in the `<key list>`.

It may seem quite peculiar that the macro stored in the key `<key>/ .@cmd` is not simply executed with the argument `{<value>}`. However, the approach taken in the `pgfkeys` packages allows for more flexibility. For instance, assume that you have a key that expects a `<value>` of the form “`<text>+<more text>`” and

wishes to store `\text` and `\more text` in two different macros. This can be achieved as follows:

**Example 3.5 Storing values in macros**

```

472 { }
473
474 \def\mystore#1#2\pgfeov{\def\@#1\def\@#2}
475 \pgfkeyslet{/my key/.@cmd}{\mystore}
476 \pgfkeys{/my key=hello+world}
477
478 |\@| is \@, |\@| is \@.
```

`\@` is hello, `\@` is world.

Naturally, defining the code to be stored in a key in the above manner is too awkward. A simpler approach is shown in Example 3.6. The following commands simplify things a bit, but the usual manner of setting up code for a key is to use one of the handlers described in Section 50.3.11.

**\pgfkeysdef{<key>} {<code>}**

This command temporarily defines a TeX-macro with the argument list `#1\pgfeov` and then lets `<key>/ .@cmd` be equal to this macro. The net effect of all this is that you have then setup code for the key `<key>` so that when you write `\pgfkeys{<key>=<value>}`, then the `<code>` is executed with all occurrences of `#1` in `<code>` being replaced by `<value>`. (This behaviour is quite similar to the `\define@key` command of `keyval` and `xkeyval`).

**\pgfkeysedef{<key>} {<code>}**

This command works like `\pgfkeysdef`, but it uses `\edef` rather than `\def` when defining the key macro. If you do not know the difference between the two, then you will not need this command; and if you know the difference, then you will know when you need this command.

**\pgfkeysdeargs{<key>}{<argument pattern>}{<code>}**

This command works like `\pgfkeysdef`, but it allows you to provide an arbitrary `<argument pattern>` rather than just the simple single argument of `\pgfkeysdef`.

**Example 3.6 Delineated arguments**

```

472 {}
473 \pgfkeysdeargs{/my key}{#1#2}{\def\@#1\def\@#2}
474 \pgfkeys{/my key=hello+world}
475
476 |\@| is \@, |\@| is \@.
```

```
\a is hello, \b is world.
```

### `\pgfkeysedefargs{<key>}{{<argument pattern>}}{<code>}`

The `\edef` version of `\pgfkeysdefargs`.

#### 50.3.5 Keys That Store Values

Let us continue with what happens when `\pgfkeys` processes the current key and the subkey `<key>/@cmd` is not defined. Then it is checked whether the `<key>` itself exists (has been previously assigned a value using, for instance, `\pgfkeysetvalue`). In this case, the tokens stored in `<key>` are replaced by `<value>` and `\pgfkeys` proceeds with the next key in the `<key list>`.

#### 50.3.6 Keys That Are Handled

If neither the `<key>` itself nor the subkey `<key>/@cmd` are defined, then the `<key>` cannot be processed “all by itself.” Rather, a `<handler>` is needed for this key. Most of the power of `\pgfkeys` comes from the proper use of such handlers. Recall that the `<key>` is always a full key (if it was not originally, it has already been upgraded at this point to a full key). It decomposed into two parts:

1. The `<path>` of `<key>` (everything before the last slash) is stored in the macro `\pgfkeyscurrentpath`.
2. The `<name>` of `<key>` (everything after the last slash) is stored in the macro `\pgfkeyscurrentname`.

It is recommended (but not necessary) that the name of a handler starts with a dot (but not with `.@`), so that they are easy to detect for the reader.

(For efficiency reasons, these two macros are only setup at this point; so when code is executed for a key in the “usual” manner then these macros are not set-up.)

The `\pgfkeys` command now checks whether the key `/handlers/<name>/@cmd` exists. If so, it should store a command and this command is executed exactly in the same manner as described in Section 50.3.4. Thus, this code gets the `<value>` that was originally intended for `<key>` as its argument, followed by `\pgfeov`. It is the job of the handlers to do something useful with the `<value>`.

For an example, let us write a handler that will output the value stored in a key to the log file. We call this handler `.print to log`. The idea is that when someone tries to use the key `/my key/.print to log`, then this key will not be defined and the handler gets executed. The handler will then have access to the path-part of the key, which is `/my key`, via the macro `\pgfkeyscurrentpath`. It can then lookup which value is stored in this key and print it.

```
\pgfkeysdef{/handlers/.print to log}
{%
  \pgfkeysgetvalue{\pgfkeyscurrentpath}{\temp}
  \writetolog{\temp}
}
\pgfkeyssetvalue{/my key}{Hi!}
...
\pgfkeys{/my key/.print to log}

\pgfkeys{/phd/chapter label/.font-size}

font size
```

The above code will print **Hi!** in the log, provided the macro `\writetolog` is setup appropriately.

For a more interesting handler, let us program a handler that will setup a key so that when the key is used some code is executed. This code is given as `<value>`. All the handler must do is to call `\pgfkeysdef` for the path of the key (which misses the handler's name) and assign the parameter value to it.

#### Example 3.7 Defining Handlers

```
472 \pgfkeysdef{/handlers/.my code}
  {\pgfkeysdef{\pgfkeyscurrentpath}{#1}}
473 \pgfkeys{/my key/.my code=(#1)}
474 \pgfkeys{/my key=hallo}

(hallo)
```

### 50.3.7 Keys That Are Unknown

For some keys, neither the key is defined nor its `@cmd` subkey nor is a handler defined for this key. In this case, it is checked whether the key `<current path>/ .unknown / @cmd` exists. Thus, when you try to use the key `/tikz/strange`, then it is checked whether `/tikz/.unknown/.@cmd` exists. If this key exists (which it does), it is executed. This code can then try to make sense of the key. For instance, the handler for TikZ will try to interpret the key's name as a color or as an arrow specification or as a PGF option.

You can setup unknown key handlers for your own keys by simply setting the code of the key `<my path prefix>/ .unknown`. This also allows you to set-up “search paths.” The idea is that you would like keys to be searched not only in a single default path, but in several. Suppose, for instance, that you would like keys to be searched for in `/a`, `/b`, and `/b/c`. We setup a key `/my search path` for this:

```
475 \pgfkeys{/my search path/.unknown/.code=
476   {%
477     \let\searchname=\pgfkeyscurrentname%
478     \pgfkeysalso{%
```

```

479     /a/\searchname/.try=#1,
480     /b/\searchname/.retry=#1,
481     /b/c/\searchname/.retry=#1%
482   }%
483 }%
484 }
485 \pgfkeys{/my search path/.cd,foo,bar}

```

In the above code, `foo` and `bar` will be searched for in the three directories `/a`, `/b`, and `/b/c`.

If the key `<current path>/ .unknown/.@cmd` does not exist, the handler `/handlers/.unknown` is invoked instead, which is always defined and which prints an error message by default.

### 50.3.8 Key Handlers

We now describe which key handlers are defined by default. You can also define new ones as described in Section 50.3.6.

#### 50.3.9 Handlers for Path Management

##### Key handler `<key>/ .cd`

This handler causes the default path to be set to `<key>`. Note that the default path is reset at the beginning of each call to `\pgfkeys` to be equal to `/`.

##### Key handler `<key>/ .is family`

This handler sets up things such that when `<key>` is executed, then the current path is set to `<key>`. A typical use is the following:

```

\pgfkeys{/tikz/.is family}
\pgfkeys{tikz,line width=1cm}

```

The effect of this handler is the same as if you had written `<key>/ .style=<key>/ .cd`, only the code produced by the `.is family` handler is quicker.

This is an importnat handler if you are going to write your own library or package. It will enable you to write code of the form `\mypackageset{}` allowing your users not to have to type every time the full path.

##### Example 3.8 The `.is family` handler

```

472 \def\pkgfamilyname{phd}
473 \pgfkeys{/pkgfamilyname/.is family}
474 %
475 %\newcommand\cxset{\pgfkeys{/pkgfamilyname}}
476
477 \def\cxkeydef#1#2{%
478   \pgfkeyssetvalue{/pkgfamilyname/#1}{#2}%
479 }
480 \def\cxvalueof#1{%

```

```

481 \pgfkeysvalueof{/\\pkgfamilyname/#1}%
482 }
483
484 \pgfkeyssetvalue{/phd/test}{Hello World.}
485 \pgfkeysvalueof{/phd/test} \\
486
487 \cxset{/phd/test=Hello Another world.}
488 \pgfkeysvalueof{/phd/test}
489
490 \cxvalueof{test}
491
492 \let\phdvalueof\cxvalueof
493 \let\phdset\cxset
494
495 \phdset{test=Hello PHD Worlds}
496 \phdvalueof{test}

```

Hello World.  
Hello Another world.  
Hello Another world.  
Hello PHD Worlds

### 50.3.10 Setting Defaults

#### Key handler $\langle key \rangle/.default$

$=\langle value \rangle$  Sets the default value of  $\langle key \rangle$  to  $\langle value \rangle$ . This means that whenever no value is provided in a call to  $\text{\pgfkeys}$ , then this  $\langle value \rangle$  will be used instead. This still means that we need to have the key defined earlier. The key needs to be initialized first.

#### Example 3.9 Using default

```

472 \pgfkeys{myfamily/color/.initial =red, }
473 \pgfkeys{myfamily/color}

```

red

#### Key handler $\langle key \rangle/.value\ required$

This handler causes the error message `key /errors/value required` to be issued whenever the  $\langle key \rangle$  is used without a value.

Example:  $\text{\pgfkeys{/width/.value\ required}}$

#### Key handler $\langle key \rangle/.value\ forbidden$

This handler causes the error message `key /errors/value forbidden` to be issued whenever the  $\langle key \rangle$  is used with a value.

This handler works by adding code to the code of the key. This means that you have to define the key first before you can use this handler.

```
\pgfkeys{/my key/.code=I do not want an argument!}
\pgfkeys{/my key/.value forbidden}

\pgfkeys{/my key}      % Ok
\pgfkeys{/my key=foo} % Error
```

### 50.3.11 Defining Key Codes

A number of handlers exist for defining the code of keys.

#### Key handler `<key>/ .code`

`=<code>`

This handler executes `\pgfkeysdef` with the parameters `<key>` and `<code>`. This means that, afterwards, whenever the `<key>` is used, the `<code>` gets executed. More precisely, when `<key>=<value>` is encountered in a key list, `<code>` is executed with any occurrence of `#1` replaced by `<value>`. As always, if no `<value>` is given, the default value is used, if defined, or the special value `\pgfkeysnovalue`.

It is permissible that `<code>` calls the command `\pgfkeys`. It is also permissible the `<code>` calls the command `\pgfkeysalso`, which is useful for styles, see below.

#### Example 3.10 Some test

```
472 \pgfkeys{/par indent/.code={\parindent=\#1},/par
        indent/.default=2em}
473 \pgfkeys{/par indent=1cm}
474 ...
475 \pgfkeys{/par indent}
```

...

#### Key handler `<key>/ .ecode`

`=<code>` This handler works like `.code`, only the command `\pgfkeysedef` is used.

#### Key handler `<key>/ .code 2 args`

`=<code>` This handler works like `.code`, only two arguments rather than one are expected when the `<code>` is executed. This means that when `<key>=<value>` is encountered in a key list, the `<value>` should consist of two arguments. For instance, `<value>` could be `{first}{second}`. Then `<code>` is executed with any occurrence of `#1` replaced `first` and any occurrence of `#2` replaced by `second`.

Because of the special way the `<value>` is parsed, if you set `<value>` to, for instance, `first` (without any braces), then `#1` will be set to `f` and `#2` will be set to `irst`.

#### Key handler `<key>/ .ecode 2 args`

`=<code>`

This handler works like `.code 2 args`, only an `\edef` is used rather than a `\def` to define the macro.

#### Key handler `<key>/ .code args`

`={<argument pattern>}{<code>}` This handler also works like `.code`, but you can now specify an arbitrary `<argument pattern>`. Such a pattern is a usual TeX macro pattern. For instance, suppose `<argument pattern>` is `(#1/#2)` and `<key>=<value>` is encountered in a key list with `<value>` being `(first/second)`. Then `<code>` is executed with any occurrence of `#1` replaced `first` and any occurrence of `#2` replaced by `second`. So, the actual `<value>` is matched against the `<argument pattern>` in the standard TeX way.

#### Key handler `<key>/ .ecode args={<argument pattern>}{<code>}`

This handler works like `.code args`, only an `\edef` is used rather than a `\def` to define the macro.

There are also handlers for modifying existing keys.

#### Key handler `<key>/ .add code={<prefix code>}&{<append code>}`

This handler adds code to an existing key. The `<prefix code>` is added to the code stored in `<key>/ .@cmd` at the beginning, the `<append code>` is added to this code at the end. Either can be empty. The argument list of `<code>` cannot be changed using this handler. Note that both `<prefix code>` and `<append code>` may contain parameters like `#2`.

```
\pgfkeys{/par indent/.code={\parindent=#1}}
\newdimen\myparindent
\pgfkeys{/par indent/.add code={}{{\myparindent=#1}}}
...
\pgfkeys{/par indent=1cm} % This will set both \parindent and
                           % \myparindent to 1cm
```

#### Key handler `<key>/ .prefix code=<prefix code>`

This handler is a shortcut for `<key>/ .add code={<prefix code>}{}{}`. That is, this handler adds the `<prefix code>` at the beginning of the code stored in `<key>/ .@cmd`.

#### Key handler `<key>/ .append code=<append code>`

This handler is a shortcut for `<key>/ .add code={}{{<append code>}}{}{}`.

### 50.3.12 Defining Styles

The following handlers allow you to define *styles*. A style is a key list that is processed whenever the style is given as a key in a key list. Thus, a style “stands for” a certain key value list. Styles can be parameterized just like normal code.

#### Key handler `<key>/ .style=<key list>`

This handler set things up so that whenever `<key>=<value>` is encountered in a key list, then the `<key list>`, with every occurrence of #1 replaced by `<value>`, is processed instead. As always, if no `<value>` is given, the default value is used, if defined, or the special value `\pgfkeysnovalue`.

You can achieve the same effect by writing `<key>/ .code=\pgfkeysalso{<key list>}`. This means, in particular, that the code of a key could also first execute some normal code and only then process some further keys.

#### Key handler `<key>/ .estyle`

`=<key list>`

This handler works like `.style`, only the `<code>` is set using `\edef` rather than `\def`. Thus, all macros in the `<code>` are expanded prior to saving the style.

For styles the corresponding handlers as for normal code exist:

#### Key handler `<key>/ .style 2 args`

`<key list>` This handler works like `.code 2 args`, only for styles. Thus, the `<key list>` may contain occurrences of both #1 and #2 and when the style is used, two parameters must be given as `<value>`.

##### Example 3.11 example

```
472 \pgfkeys{/paper height/.code={\paperheight=#1},/paper
           width/.code={\paperwidth=#1}}
473 \pgfkeys{/page size/.style 2 args={/paper
           height=#1,/paper width=#2}}
474 \pgfkeys{/page size={30cm}{20cm}}
```

#### Key handler `<key>/ .estyle 2 args`

`=<key list>` This handler works like `.style 2 args`, only an `\edef` is used rather than a `\def` to define the macro.

#### Key handler `<key>/ .style args`

`={{<argument pattern>}}{<key list>}` This handler works like `.code args`, only for styles.

#### Key handler `<key>/ .estyle args`

=⟨argument pattern⟩}{⟨code⟩} This handler works like `.ecode args`, only for styles.

#### Key handler ⟨key⟩/.add style

=⟨prefix key list⟩}{⟨append key list⟩}

This handler works like `.add code`, only for styles. However, it is permissible to add styles to keys that have previously been set using `.code`. (It is also permissible to add normal ⟨code⟩ to a key that has previously been set using `.style`). When you add a style to a key that was previously set using `.code`, the following happens: When ⟨key⟩ is processed, the ⟨prefix key list⟩ will be processed first, then the ⟨code⟩ that was previously stored in ⟨key⟩/.@cmd, and then the keys in ⟨append key list⟩ are processed.

```
\pgfkeys{/par indent/.code={\parindent=#1}}
\pgfkeys{/par indent/.add style={}{/my key=#1}}
...
\pgfkeys{/par indent=1cm} % This will set \parindent and
                           % then execute /my key=#1
```

#### Key handler ⟨key⟩/.prefix style

=⟨prefix key list⟩ Works like `.add style`, but only for the prefix key list.

#### Key handler ⟨key⟩/.append style

=⟨append key list⟩ Works like `.add style`, but only for the append key list.

### 50.3.120 Defining Value-, Macro-, If- and Choice-Keys

For some keys, the code that should be executed for them is rather “specialized.” For instance, it happens often that the code for a key just sets a certain  $\text{\TeX}$ -if to true or false. For these case predefined handlers make it easier to install the necessary code.

However, we start with some handlers that are used to manage the value that is directly stored in a key.

#### Key handler ⟨key⟩/.initial

=⟨value⟩ This handler sets the value of ⟨key⟩ to ⟨value⟩. Note that no subkeys are involved. After this handler has been used, by the rules governing keys, you can subsequently change the value of the ⟨key⟩ by just writing ⟨key⟩=⟨value⟩. Thus, this handler is used to set the initial value of key.

Note that in the after the example, writing `\pgfkeys{/my key}` will not have the effect you might expect (namely that `blue` is inserted into the main text). Rather, `/my key` will be promoted to `/my key=\pgfkeysnovalue` and, thus, `\pgfkeysnovalue` will be stored in `/my key`.

To retrieve the value stored in a key, the handler `.get` is used.

**Example 3.12 The .initial handler**

```

472 \pgfkeys{/my key/.initial=red}
473 % "/my key" now stores the value "red"
474 \pgfkeys{/my key=blue}
475 % "/my key" now stores the value "blue"
476 \pgfkeys{/my key}

```

blue

**Key handler *key*/ .get**

=*macro*) Executes a `\let` command so that *macro*) contains the contents stored in *key*).

**Example 3.13 The handler .get**

```

472 \pgfkeys{/my key/.initial=red}
473 \pgfkeys{/my key=blue}
474 \pgfkeys{/my key/.get=\mymacro}
475 \mymacro

```

blue

**Key handler *key*/ .add**

={{*prefix value*}{{*append value*}} Adds the *prefix value* and the beginning and the *append value* at the end of the value stored in *key*).

The next handler is useful for the common situation where *key*)=*value*) should cause the *value*) to be stored in some macro. Note that, typically, you could just as well store the value in the key itself.

**Key handler *key*/ .store in**

=*macro*) This handler has the following effect: When you write *key*)=*value*), the code `\defmacro{value}` is executed. Thus, the given value is “stored” in the *macro*).

```

Hello Gruffalo! \pgfkeys{/text/.store in=\mytext}
                      \def\@{world}
                      \pgfkeys{/text>Hello \@{}}
                      \def\@{Gruffalo}
                      \mytext

```

**Key handler *key*/ .estore in**

=*macro*) This handler is similar to .store in, only the code `\edefmacro{value}` is used. Thus, the macro-expanded version of *value*) is stored in the *macro*).

```
Hello world! \pgfkeys{/text/.estore in=\mytext}
\def\world{\pgfkeys{/text=Hello \a!}}
\def\Gruffalo{\mytext}
```

The definition of this handler is trivial:

```
476 \pgfkeys{/handlers/.store in/.code=
477   \pgfkeysalso{\pgfkeyscurrentpath/.code=\def#1{##1}}}
```

How about a csname one?

#### Example 3.14 Defining a new handler

```
472 \pgfkeys{/handlers/.csname in/.code=%
473   \pgfkeysalso{\pgfkeyscurrentpath/.code=
474     \expandafter\def\csname#1\endcsname{##1}}}
475 \pgfkeys{/my test/fonts/.csname in=font-store}
476 \pgfkeys{/my test/fonts=\bfseries}
477 \bgroup
478 \csuse{font-store} This is bold text.
479 \egroup
```

**This is bold text.**

If we wanted the user never to have to type a command, but only strings we could do something like this:

#### Example 3.15 Defining a new handler

```
472 \pgfkeys{/handlers/.csstore in/.code=%
473   \pgfkeysalso{\pgfkeyscurrentpath/.code=
474     \expandafter\def\csname#1\endcsname{\csname##1\endcsname}}
475 \pgfkeys{/my test/fonts/.csstore in=font-store}
476 \pgfkeys{/my test/fonts=\bfseries}
477 \bgroup
478 \csuse{font-store} This is bold text.
479 \egroup
```

**This is bold text.**

We can take an idea from another great library `expl3` this time from the  $\text{\LaTeX}^3$  Team. We will modify the above code and create a handler to choose a font-weight from a list of predefined keywords. For example we may want to use css-like font-weights.

**Example 3.16 using Expl3 to Define handlers**

```

472 \ExplSyntaxOn
473 \pgfkeys{/handlers/.fontweights/.code =
474   \pgfkeysalso
475     {\pgfkeyscurrentpath/.code=
476       \tl_set:Nn\l_tmpa_str:N {##1}
477       \str_case_x:nnTF {##1}
478       {
479         { none } { \cs_gset:cpn {#1} {
480           \mdseries } }
481         { bold } { \cs_gset:cpn {#1} {
482           \bfseries } }
483         { normal } { \cs_gset:cpn {#1} {
484           \mdseries } }
485         { bfseries } { \cs_gset:cpn {#1} {
486           \bfseries } }
487         { mdseries } { \cs_gset:cpn {#1} {
488           \mdseries } }
489       }
490       {
491         \cs_gset:cpn {#1} {\mdseries} }
492     }
493   }
494 \ExplSyntaxOff
495 % 1 define where the values will be stored
496 \pgfkeys{/my test/font weight/.fontweights =
497   font-weight-store}
498
499 % 2 store a value
500 \pgfkeys{/my test/font weight = bold}
501
502 % 3 use the store to set the weight
503 \csuse{font-weight-store} This is bold weight text.
504
505 % type an unknown value
506 \pgfkeys{/my test/font weight=very strong}
507
508 % this will just give medium series
509 \csuse{font-weight-store} This is medium weight text.

```

**This is bold weight text.**

This is medium weight text.

We can extend the code to give us an error message, if we use a value that is not acceptable. We could also have written the code using the `.choice` handler. I personally think that using custom defined handlers is a much better option as it can make part of our code portable to other packages (rather than cut-and-paste).

Of course L<sup>A</sup>T<sub>E</sub>X comes with its own set of key generation macros. Personally I made the choice to go this route, for most of the **PHD** package. I made the choice

in order to offer a consistent user interface that consists only of one command to set the keys, that does not require any knowledge of L<sup>A</sup>T<sub>E</sub>X commands to set document parameters.

In another common situation a key is used to set a T<sub>E</sub>X-if to true or false.

### Key handler `<key>/is if`

=`<TEX-if name>` This handler has the following effect: When you write `<key>=<value>`, it is first checked that `<value>` is `true` or `false` (the default is `true` if no `<value>` is given). If this is not the case, the error key `/errors/boolean expected` is executed. Otherwise, the code `\<TEX-if name><value>` is executed, which sets the T<sub>E</sub>X-if accordingly.

```
\newif\iftheworldisflat
Round? \pgfkeys{/flat world/.is if=theworldisflat}
          \pgfkeys{/flat world=false}
          \iftheworldisflat
            Flat
          \else
            Round?
          \fi
```

The next handler deals with the problem when a `<key>=<value>` makes sense only for a small set of possible `<value>`s. For instance, the line cap can only be `rounded` or `rect` or `butt`, but nothing else. For this situation the following handler is useful.

### Key handler `<key>/is choice`

This handler sets things up so that writing `<key>=<value>` will cause the subkey `<key>/<value>` to be executed. So, each of the different possible choices should be given by a subkey of `<key>`.

```
\pgfkeys{/line cap/.is choice}
\pgfkeys{/line cap/round/.style={\pgfsetbuttcap}}
\pgfkeys{/line cap/butt/.style={\pgfsetroundcap}}
\pgfkeys{/line cap/rect/.style={\pgfsetrectcap}}
\pgfkeys{/line cap/rectangle/.style={/line cap=rect}}
...
\draw [/line cap=butt] ...
```

If the subkey `<key>/<value>` does not exist, the error key `/errors/unknown choice value` is executed.  
Behind the scenes PGF uses some mind-boggling code:

```
\pgfkeys{/handlers/.is choice/.code=%
  \pgfkeys{%
    \pgfkeyscurrentpath/.cd,%
    .code=\def\pgfkeys@was@choice{\#1}%
      \expandafter\pgfkeysalso\expandafter{\pgfkeyscurrentkey/\#1},%
    .unknown/.code={%
      \def\pgf@marshal{\pgfkeysvalueof{/errors/unknown choice value/.@cmd}}%
      {\expandafter\expandafter\expandafter\pgf@marshal
        \expandafter\expandafter\expandafter{\expandafter
          \the\expandafter\pgfkeys@pathtoks\expandafter}
        \expandafter{\pgfkeys@was@choice}\pgfeov}%
    }%
  }%
}
```

### 50.3.120 Expanding Values

When you write  $\langle key \rangle = \langle value \rangle$ , you usually wish to use the  $\langle value \rangle$  “as is.” Indeed, great care is taken to ensure that you can even use things like #1 or unbalanced TeX-ifs inside  $\langle value \rangle$ . However, sometimes you want the  $\langle value \rangle$  to be expanded before it is used. For instance,  $\langle value \rangle$  might be a macro name like `\mymacro` and you do not want `\mymacro` to be used as the macro, but rather the *contents* of `\mymacro`. Thus, instead of using  $\langle value \rangle$  you wish to use whatever  $\langle value \rangle$  expands to. Instead of using some fancy `\expandafter` hackery, you can use the following handlers:

#### Key handler $\langle key \rangle / .expand\ once$

$= \langle value \rangle$  This handler expands  $\langle value \rangle$  once (more precisely, it executes an `\expandafter` command on the first token of  $\langle value \rangle$ ) and then process the resulting  $\langle result \rangle$  as if you had written  $\langle key \rangle = \langle result \rangle$ . Note that if  $\langle key \rangle$  contains a handler itself, this handler will be called normally.

#### Example 3.17 Handling expansion

```
472 \def\a{\bottom}
473 \def\b{\a}
474 \def\c{\b}
475
476 \pgfkeys{/phd/key1/.initial=\c}
477 \pgfkeys{/phd/key2/.initial/.expand once=\c}
478 \pgfkeys{/phd/key3/.initial/.expand twice=\c}
479 \pgfkeys{/phd/key4/.initial/.expanded=\c}
480
481 \def\aa{{\ttfamily\string\aa}}
482 \def\bb{{\ttfamily\string\bb}}
483 \def\cc{{\ttfamily\string\cc}}
484
485 \begin{tabular}{ll}
486 Key 1:& \pgfkeys{/phd/key1} \\

```

```

487 Key 2:& \pgfkeys{/phd/key2} \\
488 Key 3:& \pgfkeys{/phd/key3} \\
489 Key 4:& \pgfkeys{/phd/key4}
490 \end{tabular}
```

```

Key 1:  \c
Key 2:  \b
Key 3:  \a
Key 4:  bottom
```

In the example above, you can observe how the key macro definitions can be expanded. When `.expanded` is used the macro is fully expanded (see key4), whereas in the other two expansion is controlled. These are mind-boggling and some patience and skill is required to use them effectively.

#### Key handler `<key>/ .expand twice`

=`<value>` This handler works like saying `<key>/ .expand once/.expand once=<value>`.

#### Key handler `<key>/ .expanded`

=`<value>` This handler will completely expand `<value>` (using `\edef`) before processing `<key>=<result>`.

### 50.3.120 Handlers for Testing Keys

#### Key handler `<key>/ .try`

=`<value>` This handler causes the same things to be done as if `<key>=<value>` had been written instead. However, if neither `<key>/ .@cmd` nor the key itself is defined, no handlers will be called. Instead, the execution of the key just stops. Thus, this handler will “try” to use the key, but no further action is taken when the key is not defined.

The TeX-if `\ifpgfkeyssuccess` will be set according to whether the `<key>` was successfully executed or not.

```
(a:hallo)(b:welt) text \pgfkeys{/a/.code=(a:#1)}
                           \pgfkeys{/b/.code=(b:#1)}
                           \pgfkeys{/x/.try=blue,/a/.try=hallo,/b/.try=welt,/tikz/.try=green}
```

#### Key handler `<key>/ .retry`

=`<value>` This handler works just like `.try`, only it will not do anything if `\ifpgfkeyssuccess` is false. Thus, this handler will only retry to set a key if “the last attempt failed”.

```
(a:hallo) \pgfkeys{/a/.code=(a:#1)}
               \pgfkeys{/b/.code=(b:#1)}
               \pgfkeys{/x/.try=hmm,/a/.retry=hallo,/b/.retry=welt}
```

### 50.3.120 Handlers for Key Inspection

#### Key handler `<key>/ .show value`

This handler executes a `\show` command on the value stored in `<key>`. This is useful mostly for debugging.

*Example:* `\pgfkeys{/my/obscure key/.show value}`

#### Key handler `<key>/ .show code`

This handler executes a `\show` command on the code stored in `<key>/ .@cmd`. This is useful mostly for debugging.

*Example:* `\pgfkeys{/my/obscure key/.show code}`

The following key is not a handler, but it also commonly used for inspecting things:

#### `/utils/exec=<code>`

This key will simply execute the given `<code>`.

*Example:* `\pgfkeys{some key=some value,/utils/exec=\show\hallo,obscure key=obscure value}`

### 50.3.13 Error Keys

In certain situations errors can occur, like using an undefined key. In these situations error keys are executed. They should store a macro that gets two arguments: The first is the offending key (possibly only after macro expansion), the second is the value that was passed as a parameter (also possibly only after macro expansion).

Currently, error keys are simply executed. In the future it might be a good idea to have different subkeys that are executed depending on the language currently set so that users get a localized error message.

#### `/errors/value required={<offending key>} {<value>}`

This key is executed whenever an `<offending key>` is used without a value when a value is actually required.

#### `/errors/value forbidden={<offending key>} {<value>}`

This key is executed whenever a key is used with a value when a value is actually forbidden.

#### `/errors/boolean expected={<offending key>} {<value>}`

This key is executed whenever a key setup using `.is if` gets called with a `<value>` other than `true` or `false`.

#### `/errors/unknown choice value={<offending key>} {<value>}`

This key is executed whenever a choice is used as a `<value>` for a key setup using the `.is choice` handler that is not defined.

#### `/errors/unknown key={<offending key>} {<value>} no default`

This key is executed whenever a key is unknown and no specific `.unknown` handler is found.

expl3

...  
phd package and give a background as to how fonts are used  
in L<sup>A</sup>T<sub>E</sub>X.





# phddoc User Manual

This chapter discusses primarily T<sub>E</sub>X's page breaking algorithm and how the output routines can be used to insert additional material on every page, such as inserts, page numbers and similar. Later the chapter discusses the terminology used in the TeXbook and by experts to describe the routines and we will develop some basic output routines.

The last part touches on the main differences between LaTe<sub>X</sub> output routines and floats as compared to the original approach in PlainT<sub>E</sub>X.



## A.1 Documentation of the L<sup>A</sup>T<sub>E</sub>X sources

This is a class for documenting the **phd** bundle, a collection of packages and classes that enables the typesetting of documents using a flexible user interface. You may however find it generally useful as a class for typesetting the documentation of files produced in ‘doc’ format.

The class is written as a “self-contained” docstrip file: executing **latex phddoc.dtx** generates the **phddoc.cls** file and typesets this documentation; execute **tex l3doc.dtx** to only generate **phddoc.cls**.

Each documented file in the standard distribution comes with extension **dtx**. The appropriate class package or initex file will be extracted from the source by the docstrip system. Each **dtx** file may be directly processed with L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub> , for example

```
% latex2e docclass.dtx
%
```

would produce the documentation of the Class and package interface.

Each file that is used in producing the L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub>  format (ie not including the standard class and packages) will be printed together in one document if you L<sup>A</sup>T<sub>E</sub>X the file **sources2e.tex**. This has the advantage that one can produce a full index of macro usage across all the source files.

If you need to customise the typesetting of any of these files, there are two options:

- You can use **DOCSTRIP** with the module ‘driver’ to extract a small L<sup>A</sup>T<sub>E</sub>X file that you may edit to use whatever class or package options you require, before inputting the source file.
- You can create a file **phddoc.cfg**. This configuration file will be read whenever the **phddoc** class is used, and so can be used to customise the typesetting of all the source files, without having to edit lots of small driver files.

The second option is usually more convenient. Various possibilities are discussed in the next section.

## A.2 Specification

The class builds on the **ltxdoc**<sup>1</sup> class and the **doc**<sup>2</sup> package, but since they were written many authors have come up with different ideas, as to how these documents should be produced.

The L<sup>A</sup>T<sub>E</sub>X3 Team has also more recently developed the **l3doc** class and **l3docstrip** package for documenting the l3 sources. Other Teams such as the developers of **pgf** prefer not to use **docstrip** and document the code and user manuals in a more traditional way, as normal documents in conjunction with external scripts written in python.

My objectives in writing this package, was to integrate the ability of the other packages in this series to document code in a flexible way. For longer books,

<sup>1</sup>Carlisle, David (Mar. 2018). *The file ltxdoc.dtx for use with LaTeX2e.*

<sup>2</sup>Mittelbach (2018).

such as a thesis, where the author might use their own developed macros, it also enables one to use such a method.

This class can be considered as a framework, as it can be used to produce almost any type of document.

The objectives are as follows:

**Flexibility** Provide flexibility to use one of the standard  $\text{\LaTeX}$  2e classes **article**, **book report** or the KOMA classes **scrartcl**, **scrbook**, **scrreprt** as the main class. In addition to classes normally used for documents, the class also can be used for documenting  $\text{\LaTeX}$  or  $\text{\TeX}$  3 packages and classes.

**Style** Enable the use of a fully featured key value interface for documenting the code.

**Tools** Provide a series of tools to create new documents, formatting and scaffolding. Currently LaTeX distributions have a plethora of tools, mostly using perl and lately l3build using Lua. Perl tools have served the community well for many years. One such tool **ctanify** does not work using normal distributions as the Perl bundled in the distributions has some missing modules. Go is a cross-compilation systems language enabling scripts to be bundled for different operating systems easily, hence the choice here.<sup>3</sup> Some of these problems with Perl on Windows can be overcome using **Strawberry Perl**<sup>4</sup>. For any conflicts follow the guidelines in penwatch.<sup>5</sup>

```
phd ctanify myclass.dtx myclass.ins README
```

### A.3 Customisation

The simplest form of customisation is to pass more options to the **article** class which is loaded by **phddoc**. For instance if you wish all the documentation to be formatted for A4 paper, add the following line to **phddoc.cfg**:

```
491 % \PassOptionsToClass{a4paper}{article}
492 %
```

All the source files are in two parts, separated by **\StopEventually**. The first part (should) contain ‘user’ documentation. The second part is a full documented listing of the source code. The **doc** package provides the command **\OnlyDescription** which suppresses the code listings. This may also be used in the configuration file, but as the **doc** package is read later, you must delay the execution of **\OnlyDescription** until after the **doc** package has been read. The simplest way is to use **\AtBeginDocument**. Thus you could put the following in your **phddoc.cfg**.

```
% \AtBeginDocument{\OnlyDescription}
```

---

<sup>3</sup>See for example <https://tex.stackexchange.com/questions/256096/which-perl-to-install-for-xindy-with-miktex-on-windows>

<sup>4</sup>Download at <http://strawberryperl.com/>. This will also enable xindy to work on a MikTeX distribution.

<sup>5</sup>[https://www.penwatch.net/cms/pip\\_conflict/](https://www.penwatch.net/cms/pip_conflict/)

If the full source listing **sources2e.tex** is processed, then an index and change history are produced by default, however indices are not normally produced for individual files.

As an example, consider **ltclass.dtx**, which contains the sources for the new class and package interface commands. With no **cfg** file, a 19 page document is produced. With the above configuration a slightly more readable document (4 pages) is produced.

Conversely, if you really want to read the source listings in detail, you will want to have an index. Again the index commands provided by the doc package may be used, but their execution must be delayed.

```
% \AtBeginDocument{\CodelineIndex\EnableCrossrefs}
% \AtEndDocument{\PrintIndex}
```

The **doc** package writes index files to be sorted using MakeIndex with the **gind** style, so one would then use a command such as

```
% makeindex -s gind.ist ltclass.idx
%
```

and re-run L<sup>A</sup>T<sub>E</sub>X.

Similarly to print a Change history, you would add

```
% \AtBeginDocument{\RecordChanges}
% \AtEndDocument{\PrintChanges}
%
```

to **phddoc.cfg**, and use MakeIndex with a command such as

```
% makeindex -s gglo.ist -o ltclass.gls ltclass.glo
%
```

Finally if you do not want to list all the sections of **source2e.tex**, you can use **\includeonly** in the **cfg** file:

```
% \includeonly{ltvers,ltboxes}
%
```



# Implementation Code

This chapter discusses primarily T<sub>E</sub>X's page breaking algorithm and how the output routines can be used to insert additional material on every page, such as inserts, page numbers and similar. Later the chapter discusses the terminology used in the TeXbook and by experts to describe the routines and we will develop some basic output routines.

The last part touches on the main differences between LaTeX output routines and floats as compared to the original approach in PlainTeX.



## B.1 Options

```

1 *class
2
3 %\RequirePackage{underscore}
4
5 \ExplSyntaxOn
6 \cs_gset:Npn \l_phd_version{1.00}
7 \ExplSyntaxOff

1.00
Boolean to switch off the colorizing of code appearing within a macrocode environment.
Define the prefix of the module
8 @@=phdcl

9 \ExplSyntaxOn
10 \bool_new:N \g__phdcl_macrocode_colorize_bool
11 \bool_new:N \g__phdcl_book_bool
12 \bool_new:N \g__phdcl_article_bool
13 \bool_new:N \g__phdcl_report_bool
14 \bool_new:N \g__phdcl_scrbook_bool
15 \bool_new:N \g__phdcl_scrartcl_bool
16 \bool_new:N \g__phdcl_screprt_bool
17 \bool_new:N \g__phdcl_masterthesis_bool
18 \bool_new:N \g__phdcl_ldoc_bool
19 \bool_new:N \g__phdcl_ldociii_bool
20 \ExplSyntaxOff

21 \ExplSyntaxOn
22 \bool_if:NTF \g__phdcl_macrocode_colorize_bool
23 { \bool_gset_true:N \phdd_code_colorize_bool}
24 { \bool_gset_false:N \phdd_code_colorize_bool}

(End definition for \g@@_macrocode_colorize_bool.)

```

### B.1.1 Geometry parameters

```

25 \DeclareOption{a5paper}{\@latexerr{Option not supported}%
26   {}}
27
28 \DeclareOption { full }
29 {
30   \bool_gset_true:N \g_phdd_typeset_documentation_bool
31   \bool_gset_true:N \g_phdd_typeset_implementation_bool
32 }
33 \DeclareOption { onlydoc }
34 {
35   \bool_gset_true:N \g_phdd_typeset_documentation_bool
36   \bool_gset_false:N \g_phdd_typeset_implementation_bool
37 }
38 \DeclareOption{colorize}
39 { \bool_gset_true:N \phdd_code_colorize_bool}
40 \DeclareOption { check }

```

```

41 { \bool_gset_true:N \g__phdcl_checkfunc_bool }
42 \DeclareOption { nocheck }
43 { \bool_gset_false:N \g__phdcl_checkfunc_bool }
44 \DeclareOption { checktest }
45 { \bool_gset_true:N \g__phdcl_checktest_bool }
46 \DeclareOption { nochecktest }
47 { \bool_gset_false:N \g__phdcl_checktest_bool }
48 \DeclareOption { kernel }
49 { \bool_gset_true:N \g__phdcl_kernel_bool }
50 \DeclareOption { stdmodule }
51 { \bool_gset_false:N \g__phdcl_kernel_bool }
52 \DeclareOption { cm-default }
53 { \bool_gset_false:N \g__phdcl_lmodern_bool }
54 \DeclareOption { lm-default }
55 { \bool_gset_true:N \g__phdcl_lmodern_bool }
56 \DeclareOption { cs-break-off }
57 { \bool_gset_false:N \g__phdcl_cs_break_bool }
58 \DeclareOption { cs-break-nohyphen }
59 { \PassOptionsToPackage{nohyphen}{underscore} }
60 \tl_new:N \g__phdcl_doctype_tl
61 \DeclareOption {book}
62 { \tl_gput_right:Nn \g__phdcl_doctype_tl{book} }
63 \DeclareOption {scrbook}
64 { \tl_gput_right:Nn \g__phdcl_doctype_tl{book} }
65 \DeclareOption* { \PassOptionsToClass { \CurrentOption } { book } }
66 \ExecuteOptions { full, kernel, nocheck, nochecktest, lm-
    default }
67 \PassOptionsToClass { a4paper } { book }
68
69
70
71

```

## B.2 Configuration

Input a local configuration file, if it exists, with a message to the console that this has happened. Since we distribute a `.cfg` file with the class, this should usually always be true. Therefore, check for `\ExplMakeTitle` (defined in “our” `.cfg` file) and only output the informational message if it’s not found.

```

72 \ExplSyntaxOn
73 \msg_new:nnn { phdcl } { input-cfg }
74 { Local~config~file~phdcl.cfg~loaded. }
75 \file_if_exist:nTF {phdcl.cfg}
76 {
77 \file_input:n {phdcl.cfg}
78 }
79 { \msg_info:nn { phdcl } { input-cfg } }
80 {}
81 \ExplSyntaxOff
82
83

```

```

84 \ExplSyntaxOn
85 \str_case_e:nTF { \g__phdcl_doctype_tl }
86 {
87     { book } {
88         \%LoadClass{book}
89         \bool_gset_true:N \g__phdcl_book_bool
90     }
91     { article } {
92         \%LoadClass{article}
93         \bool_gset_true:N \g__phdcl_article_bool
94     }
95     { report } {
96         \%LoadClass{report}
97         \bool_gset_true:N \g__phdcl_report_bool
98     }
99     { scrbook } {
100         \%LoadClass{scrbook}
101         \KOMAoptions{twoside = false}
102         \bool_gset_true:N \g__phdcl_scrbook_bool
103     }
104     { scrartcl } {
105         \%LoadClass{scrartcl}
106         \bool_gset_true:N \g__phdcl_scrartcl_bool
107     }
108     { l3doc } {
109         \%LoadClass{l3doc}
110     }
111     { masterthesis } {
112     }
113     { tufte } {
114     }
115     { ltxdoc } {
116     }
117     { l3doc } {
118     }
119     { memoir } {
120         \%LoadClass{memoir}
121     }
122 }
123 {
124 }
125 \ExplSyntaxOff

```

## B.3 Option Processing

```

122 \ExplSyntaxOn
123 \ProcessOptions
124 \%ProcessKeysPackageOptions
125 \LoadClass{\g__phdcl_doctype_tl}
126 \ExplSyntaxOff
127

```

## B.4 Loading book and doc

The original `ltxdoc` uses the article class. For longer documentation it is preferable to use the book, so for the `phddoc` class I have opted to default it to book.

128 % hypdoc is loaded with the phd-packagemanager so that

```

129 % the right order for packages and patches can be provided
130 \RequirePackage{doc}
131 \RequirePackage{phd}
132 \RequirePackage{phd-pkgmanager}
133 \sethyperref
134 \RequirePackage{phd-documentation} %modifies doc as necessary
135 \RequirePackage{phd-colorpalette}
136 \RequirePackage{phd-runningheads}
137 \RequirePackage{phd-toc}
138

```

Make | be a ‘short verb’ character, but not in the document preamble, where an active character may interfere with packages that are loaded.

```
139 \AtBeginDocument{\MakeShortVerb{\|}}
```

As ‘doc’ documents tend to have a lot of monospaced material, Set up some **tt** substitutions to occur silently. <sup>1 2</sup>

```

140 \% \DeclareFontShape{OT1}{cmtt}{bx}{n}{<-> ssub * cmtt/m/n}{}
141 \% \DeclareFontFamily{OMS}{cmtt}{\skewchar\font 48} % '60
142 \% \DeclareFontShape{OMS}{cmtt}{m}{n}{<-> ssub * cmsy/m/n}{}
143 \% \DeclareFontShape{OMS}{cmtt}{bx}{n}{<-> ssub * cmsy/b/n}{}

```

This substitution is in the standard fd file, but not silent.

```

144 \DeclareFontShape{OT1}{cmss}{m}{it}{<->ssub*cmss/m/sl}{}
145 \CodelineIndex
146 \CodelineNumbered
147 \EnableCrossrefs

```

Increase the text width slightly so that width the standard fonts 72 columns of code may appear in a **macrocode** environment. <sup>3</sup>

```
148 \% \setlength{\textwidth}{375pt}
```

Increase the marginpar width slightly, for long command names. And increase the left margin by a similar amount <sup>4 5</sup>

```

149 \% \addtolength\marginparwidth{40pt}
150 \% \addtolength\oddsidemargin{40pt}
151 \% \addtolength\evensidemargin{40pt}
152 \setcounter{StandardModuleDepth}{1}

```

## B.5 Useful abbreviations

The **phd-documentation** provides numerous commands for typesetting L<sup>A</sup>T<sub>E</sub>X code. It is imported automatically by the **phddoc** class and hence the following macros are described here for convenience.

**\cmd{*foo*}** Prints **\iota*foo*** verbatim. It may be used inside moving arguments. It can *not* be used to record commands that are defined as “**\outer**” nor is it possible to use it on conditionals such as **\iftrue** or defined by **\newif**. **\cs{*foo*}** also prints **\iota*foo***, for those who prefer that syntax. (This second form

---

<sup>1</sup>v2.op,1995/11/02,Add font substitutions.

<sup>2</sup>v2.ot,1999/04/17,Replaced octal number, CAR.

<sup>3</sup>v2.oc,1994/03/15,Set **\textwidth..**

<sup>4</sup>v2.ol,1994/05/25,Increase **\marginparwidth**.

<sup>5</sup>v2.oq,1995/11/28,Increase **\marginparwidth** and page margin..

can be used to record all type of commands so the above restrictions do not apply.

```
\cmd
\cs
153 \def\cmd#1{\cs{\expandafter\cmd@to@cs\string#1}}
154 \def\cmd@to@cs#1#2{\char\number`#2\relax}
155
156 \DeclareRobustCommand\cls{\textcolor{thered}{\texttt{\#1}}}
157 \%newcommand\cs[1]{\color{blue}{\texttt{\char`\#1}}}
158
phddoc

(End definition for \cmd and \cs.)
```

\marg \marg{text} prints {\text}, ‘mandatory argument’.

```
159 \%providecommand\marg[1]{%
160   {\ttfamily\char`\{}\meta{\#1}\ttfamily\char`\%}}
```

(End definition for \marg.)

\oarg \oarg{text} prints [\text], ‘optional argument’.

```
161 \%providecommand\oarg[1]{%
162   {\ttfamily[\}\meta{\#1}\ttfamily]}}
```

(End definition for \oarg.)

\parg \parg{te,xt} prints (\text), ‘picture mode argument’.

```
163 \%providecommand\parg[1]{%
164   {\ttfamily(\}\meta{\#1}\ttfamily)}}
```

(End definition for \parg.)

## B.6 DocInclude

```
165 \%@addtoreset{CodelineNo}{part}
166 \%@addtoreset{CodelineNo}{chapter}

\DocInclude More or less exactly the same as \include, but uses \DocInput on a dtx file,
not \input on a tex file.678
167 \def\partname{File}

(End definition for \DocInclude.)
```

```
168 \def\task#1#2{}
169 \endinput
170
171 \%newcommand*\DocInclude[1]{%
172   \relax
173   \clearpage
174   \docincludeaux
175   \IfFileExists{#1.fdd}{%
```

<sup>6</sup>v2.0b,1994/03/14,Rename from \docinclude.

<sup>7</sup>v2.0f,1994/03/25,Use \part.

<sup>8</sup>v2.0u,1999/08/08,Also works for .fdd (M. Schroeder).

```

176      \def\currentfile{\#1.fdd}{\def\currentfile{\#1.dtx}
177      }%
178      \ifnum@auxout=\@partaux
179          \@latexerr{\string\include\space cannot be nested}\@eha
180      \else \@docininclude#1 \fi}
181 %
182 \def\@docininclude#1 {\clearpage
183     \if@files w \immediate\write\@mainaux{\string\@input{\#1.aux}}\fi
184     \atempswatrue\if@partsw \atempswafalse\edef\@tempb{\#1}\@for
185     \atempa:=\@partlist\do{\ifx\atempa\@tempb\atempb\atempswatrue\fi}\fi
186     \if@tempswa \let\@auxout\@partaux \if@files w
187     \immediate\openout\@partaux \#1.aux
188     \immediate\write\@partaux{\relax}\fi

```

We need to save (and later restore) various index-related commands which might be changed by the included file.

```

189 \let\@phddoc@PrintIndex\PrintIndex
190 \let\PrintIndex\relax
191 \let\@phddoc@PrintChanges\PrintChanges
192 \let\PrintChanges\relax
193 \let\@phddoc@theglossary\theglossary
194 \let\@phddoc@endtheglossary\endtheglossary
195 \part{\currentfile}%
196     {\let\ttfamily\relax
197     \xdef\filekey{\filekey, \the\part={\ttfamily\currentfile}}}%}
198 \DocInput{\currentfile}%
199 \let\PrintIndex@\phddoc@PrintIndex
200 \let\PrintChanges@\phddoc@PrintChanges
201 \let\theglossary@\phddoc@theglossary
202 \let\endtheglossary@\phddoc@endtheglossary
203 \clearpage
204 \atwriteckpt{\#1}\if@files w \immediate\closeout\@partaux \fi
205 \else\@nameuse{cp\#1}\fi\let\@auxout\@mainaux}

```

\codeline@wrindex

```

206 \gdef\codeline@wrindex{\if@files w
207     \immediate\write\@indexfile
208         {\string\indexentry{\#1}%
209         {\filesep\number\c@CodelineNo}}\fi}%

```

(End definition for \codeline@wrindex.)

```
210 \let\filesep\empty
```

\aalph Special form of \alph as currently **source2e.tex** includes more than 26 files<sup>9</sup>.

```

211 \def\aalph#1{\aaalph{\csname c@\#1\endcsname}}
212 \def\aaalph#1{%
213     \ifcase#1\or a\or b\or c\or d\or e\or f\or g\or h\or i\or
214         j\or k\or l\or m\or n\or o\or p\or q\or r\or s\or
215         t\or u\or v\or w\or x\or y\or z\or A\or B\or C\or
216         D\or E\or F\or G\or H\or I\or J\or K\or L\or M\or
217         N\or O\or P\or Q\or R\or S\or T\or U\or V\or W\or
218         X\or Y\or Z\else\@ctrerr\fi}

```

<sup>9</sup>v2.0n, 1994/05/27, Use uppercase letters, for makeindex.

(End definition for `\aalph`.)

```

\docincludeaux 10 11
219 \def\docincludeaux{%
220   \def\thepart{\aalph{part}}\def\filesep{\thepart-}%
221   \let\filekey\@gobble
222 % add to index prologue
223   \g@addto@macro\index@prologue{%
224     \gdef\@oddfoot{\parbox{\textwidth}{\strut\footnotesize
225       \raggedright\bfseries File Key:\ } \filekey}%
226     \let\@evenfoot\@oddfoot}%
227   \global\let\docincludeaux\relax
228 %
229 \gdef\@oddfoot{%
230   \expandafter\ifx\csname ver@\currentfile\endcsname\relax
231     File \thepart: {\ttfamily\currentfile} %
232   \else
233     \GetFileInfo{\currentfile}%
234     File \thepart: {\ttfamily\filena
235     me} %
236     Date: \filedate\ %
237     Version \fileversion
238   \fi
239   \hfill\thepage}%
240 % one sided paper
241 \let\@evenfoot\@oddfoot}%

```

(End definition for `\docincludeaux`.)

```

242 \def\task#1#2{}
243
244 /class

```

---

<sup>10</sup>v2.06,1994/03/31,Use `\footnotesize` in file key..  
<sup>11</sup>v2.0k,1994/05/21,Use `\aalph`.

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```

<sup>12</sup>

---

<sup>12</sup>1.0,2013/01/26,Converted to DTX file.





# phd- documentation Package, Code Implementation Objectives and Strategy

The package provides macros for documenting and indexing primarily L<sup>A</sup>T<sub>E</sub>X or L<sup>A</sup>T<sub>E</sub>X 3 code. It combines the styles originating with `doc` with those found in the pgf series of packages. It removes some of the difficulties of using hyperlinks in the index and elsewhere in the document.



“Lord Campbell [John Campbell, 1st Baron Campbell, 1779-1861] proposed that any author who published a book without an index should be deprived of the benefits of the Copyright Act; and the Hon. Horace Binney, LL.D. [1780-1875], a distinguished American lawyer, held the same views, and would have condemned the culprit to the same punishment.”

---

– H[enry] B[enjamin] Wheatley, How To Make An Index  
(New York: A. C. Armstrong & Son, 1902), 82

This package aims at providing authors with a set of tools and settings that can improve the typesetting of documentation and especially indices.

For the normal author there are both mark-up related macros, as well as a set of settings for indices.

My main motivation for developing this package was to group all the special documentation macros that I have used in developing the **phd** package. I also saw the need to hook up these settings with the concept of color palettes as described in the **phd-colorpalette** package. This enables the integration of full document templates.

## C.1 Requirements Specification

1. To provide a declarative interface to enable users to modify documentation and index entries by setting keys, rather than writing macros. It is suggested that the author has a single style sheet that he loads to decorate a full document such as an article or a book or a document that describes code.
2. Setting of parameters will generally be with one command `\cxset`
3. Provide a consistent ‘look and feel’ for all code displays, irrespective of the package used, i.e., if **minted**, **listings** or **doc** is used the look and feel should be the same, as far as it is possible.
4. Provide a set of environments and commands for documenting symbols and fonts.
5. Seamless integration with doc type classes. As a minimal to support **ltxdoc** and **phddoc**. The latter is provided as part of the **phd** budle.
6. To provide a number of templates that cover most of the typical use case.
7. To provide an easy plug-in architecture for extensions.
8. Provide a detailed user manual.
9. Provide special indexing for doc

**\stok** [*number*] {*char*}

From egreg’s italian latex guide **\stok** takes a **\<char>** argument and prints it with its category code or the number given as optional argument

*Example:* `\stok{a} or \stok{::} a11 or ::12.`

The development of this package predates `tcolorbox` and `minted`. As they are both excellent packages, I have abandoned some of my code and incorporated code from `tcolorbox` extensively.

## C.2 Terminology

**document** Any written item, as a book, article, or letter, especially of a factual or informative nature.

**heading** A division of a document or document series. For a normal book headings are chapters, sections etc. However we allow for specifying a more complex document divided into books, volumes parts etc. For example the Bible has Books, chapters and verses, where a legal document might require divisions such as clauses. In general these divisions are numbered. These document divisions are stored in the comma list `phd_book_divisions_clist`.

**head** A typeset heading, such as chapter head, or section head. This can include a counter, label and title for example, *Chapter 1 Introduction*.

**dom** This is a programming interface that provides a structured representation of the document (a tree) and it defines a way that the structure can be accessed. Although L<sup>A</sup>T<sub>E</sub>X does not offer a standard way to build such a tree (mainly because T<sub>E</sub>X does not require the marking of paragraphs, it is useful to think of the document as a tree structure. We also allow for a semi-automated way to build such a tree (with the exception that paragraphs are not included).

**element** A part of the document tree that can be styled on its own. For example the chapter label, or the section number.

## C.3 Users

We classify users according to the L<sup>A</sup>T<sub>E</sub>X3 terminology as a) programmers b) template designers and c) authors.

### C.3.1 Author

We assume that the author has an existing template which she is using but might want to do some minor modifications, for example use an italic shape for the font of the mark, but an upright font for the page numbers.

We follow the idea of representing the basic elements of documents as elements, each one having a parent in order to specify the element we need to style as accurate as possible. One can think of this approach being congruent with objects in other languages. As a matter fact nothing stops us from defining a key value interface as shown below.

```
\cxset
{
  header.even.mark.font.size = Large,
```

```
    header.even.mark.font.family = serif,
}
```

This would perhaps make it easier for the template designer, but I have rejected the idea as my aim is to make it easy for the author, who can search the template and just enter a couple of new property values.

### C.3.2 Template designer

The template designer in the example above would have selected the format style from a number of predefined formats (templates) or would have created a style called *apa* from an existing template and modified it using declarative key style.

### C.3.3 The programmer

The programmer in the example above could have created the basic format *apa* by using both declarative as well as defining or using existing macros. To the programmer we offer an extension mechanism, where the contents of a `\ps@` command are defined. For example the programmer can define a new style using TikZ, but without having to worry about defining full `\ps@` and their interface.

`\stok[<number>]{<char>}`

From egreg's italian latex guide `\stok` takes a `\<char>` argument and prints it with its category code or the number given as optional argument

*Example:* `\stok[a] a11` or `t12`.

## C.4 Acknowledgements

This package couldn't have been possible if it was not for the documentation section of `tcolorbox`. I have liberally taken ideas and code from Dr. Thomas F. Sturm's package, which in turn draws strongly from the `PGF` manual. I am grateful to both.

## C.5 Preliminaries

We declare that we use `LATEX` and name the package. The code has been moved to the latest version of `LATEX` to take advantage of more allocations. Package works well with `LuaLaTeX`.

7/8/2017

```
1 @@=
2 \wlog{*****}
3 \wlog{ BEGIN PHD-DOCUMENTATION }
4 \wlog{*****}
5 \NeedsTeXFormat{LaTeX2e}[2017/04/15]%
6 \ProvidesPackage{phd-documentation}[2017/04/15 v1.0 less preamble (YL)]%
```

`\MakePrivateLetters`

The **doc** provides the user with a command to define which characters can be treated as letters when scanning the contents of a **macrocode** environment. Since we are using **l3** macros as well we redefine it as:

```

7 \DeclareDocumentCommand\MakePrivateLetters{}%
8   {\catcode`\@11\relax \catcode`_11 \catcode`:11}
9 \ExplSyntaxOn
10 \definecolor{thecodelinecolor}{HTML}{140F15}
11 \% \definecolor{thecodelinecolor}{HTML}{420943}
12 \tl_replace_once:Nnn {\theCodelineNo}
13   { \HDorg@theCodelineNo}
14   {{\color{thecodelinecolor}\ttfamily\scriptsize\arabic{CodelineNo}}}
15 \ExplSyntaxOff

```

We also need the **refcount**.

## C.6 tcolorbox

We load **tcolorbox** with options theorems, skins, documentation etc for internal and external use.

We also provide an interface, between the **tcolorbox** documentation keys and our own.

The indexing keys are still to be sorted out with other sections of the documentation, but they seem to be working for the moment.

## C.7 Verbatim fonts

There are different requirements for verbatim fonts. The module **phd-fontmanager** is our main module for defining fonts. The main mono font is set using the key **/phd/main mono font-face**. This is stored in **\main\_mono\_fontface\_tl**. In this document it is set as: macro:->Source Code Pro

```

16 \newcommand*\{\verb+im+font}{\ttfamily}%
17 \let\displayverbfont\ttfamily
18 % defined in verbatim package
19 \renewcommand*\{\verb+at+font}{\verb+im+font}

```

The **tcolorbox** loads the packages **pgf**, **verbatim**, **environ**, **etoolbox** when the package is loaded. It also loads more when other libraries are loaded.

```

20 % Loaded after in pkg manager
21 % Someone is loading marvosym here and this gives problems
22 \let\oldherm\Hermaphrodite
23 \let\Hermaphrodite\undefined
24
25 \RequirePackage{tcolorbox}[2018/07/26] %version 4.14 latest
26 \tcbuselibrary{documentation,listings,skins,xparse,external,breakable,theorems}
27 \tcbset{index format=doc,
28   index actual={=},
29   index level = {>} ,
30   index quote = {!},
31   index german settings,
32   color hyperlink = thelinkcolor ,

```

```

33         color definition =thelinkcolor,
34         index command= \index,
35     }
36 \tcbset{halostyle/.style={fuzzy halo=2mm with magenta!5}}

```

We use the `docCommand` as `\DescribeMacro` when in doc, hence we better mark it as a `\SpecialMainIndex`.

### phdd\_label\_prefix\_tl

```

37 \ExplSyntaxOn
38 \def\l_phdd_label_prefix_tl {com:}

(End definition for \l_phdd_label_prefix_tl.)

39 \renewenvironment{docCommand}[3][]{\tcbset{#1}%
40   \begin{tcb@manual@entry}%
41   \begin{tcb@doc@head}{doc@head@command}%
42   % Print the command using the current style
43   \tcb@Print@Com{#2}%
44   \%{\verb+verbatimfamily+}\bfseries\textrightslash\color{themacrocolor}\tl_to_str:n{#2}%
45   \SpecialMainIndex{#2}%
46   \protected@edef\@currentlabel{\noexpand\tcb@cs{#2}}\label{com:#2}{\ttfamily #3}%
47   \tcb@doc@do@description%
48   \end{tcb@doc@head}\nobreak\tcbset{before~upper=}\kvtcb@doc@body@command@before\ign
49   {\ifvmode\else\unskip\fi\kvtcb@doc@body@command@aft\end{tcb@manual@entry}%
50
51
52 \% \renewenvironment{docCommand*}{\bgroup\tcb@doc@toindexfalse\begin{docCommand}}{\end
53 \ExplSyntaxOff
54 \% \def\tcb@Print@Com#1{\textcolor{\kvtcb@col@command}{\ttbf\char`\\ }\detokenize{#1}}%
55

```

## C.8 Keys dealing with colors

The actual color definitions should come from a palette, using `phd-colorpalette`. They have names such as `themacrocolor`.

The color names are stored in token lists. The module colorizer, colors code in a macrocode environment and has similar keys.

```

56 \ExplSyntaxOn
57 \cxset{
58   color~command/.store~in      = \phdd_key_color_command_tl,
59   color~environment/.store~in  = \phdd_key_color_environment_tl,
60   color~key/.store~in          = \phdd_key_color_tl,
61   color~value/.store~in        = \phdd_key_color_value_tl,
62   color~color/.store~in        = \phdd_key_color_color_tl,
63   color~definition/.style     = {color~command={#1},
64                                 color~environment={#1},
65                                 color~key={#1},
66                                 color~value={#1},
67                                 color~color={#1}},
68   color~option/.store~in        = \phdkv@col@opt,
69   color~hyperlink/.store~in    = \phdkv@colhyper,
70   color~frame/.store~in        = \phdkv@colhyper,
71   color~meta/.store~in         = \pkdkv@colmeta,
72 %

```

```

73     before~example/.store~in      = \phdkv@beforeexample,
74     after~example/.store~in       = \phdkv@afterexample,
75 }
76 \ExplSyntaxOff
77 /DOCUM
78 *DOCUM|DFLT
79 DOCUM\cxset {
80     color command      = themacrocolor,
81     color environment = theenvironment,
82     color key         = thekey,
83     color value        = thevalue,
84     color color        = black,%leaks to index
85     color option       = theoption,
86     color meta         = themeta,
87     color frame        = theframe,
88 DOCUM }
89 /DOCUM|DFLT
90 *DOCUM

```

### \docAuxCommand{\<command name>}

The `\docAuxCommand` is used to typeset and index an inline command. The star version will just typeset the command. If we are using the `phddoc` or the `ltxdoc` we have to add the `encapchar hyperpage` otherwise the links do not appear in the index.

#### `\phdd_index_typeset_bool`

A boolean to indicate if a variable is to be indexed or not. Used for commands.

```

91 \ExplSyntaxOn
92 \bool_new:N \phdd_index_typeset_bool
93 \bool_gset_true:N \phdd_typeset_bool

(End definition for \phdd_index_typeset_bool.)

94 \cs_new:Npn \phdd_typeset_command #1
95 {
96     \group_begin:
97     \color{\phdd_key_color_command_tl}
98     \cs[no-index]{#1}
99     \group_end:
100 }
101
102 \cs_set:Npn \phdd_typeset_index_command #1
103 {
104     \bool_if:NT \phdd_index_typeset_bool
105     {
106         \kvtcb@index@command
107         {
108             #1\idx@actual{\tcbIndexPrintComC{#1}}
109             \encapchar hyperpage
110         }
111     }
112     \phdd_typeset_command {#1}
113 }
114

```

```

115 \%{\DeclarerDocumentCommand\docAuxCommand { s m }
116 %
117 %   \phdd_typeset_index_command {#2}
118 %   \IfBooleanTF{#1}{}{\tcb@index@Com{#2}}
119 %
120 \%ExplSyntaxOff

```

### \docColor{<color name>}

Typesets a color name and also adds it onto the index. This is identical with tcolorbox, which we overwrite.

*Example:* The `theCS` is the color used for commands.

```

\phdindexprintcolc
  \phdd_print_col
\phdd_doc_color_aux:n
\phdd_doc_color_star:n
121 \ExplSyntaxOn
122 \newrobustcmd{\phdindexprintcolc}[1]
123 {
124   \phd_index_print_c{#1}{\phdd_key_color_color_tl}
125 }
126
127 \cs_set:Npn \phd_print_col #1
128 {
129   \textcolor{\phdd_key_color_color_tl}{\ttfamily\bfseries#1}
130 }
131
132 \cs_set:Npn \@@_doc_color_aux:n #1
133 {
134   \phd_print_col {#1}
135   \phd_index_col {#1}
136 }
137
138 \cs_set:Npn \@@_doc_color_star:n #1
139 {
140   \phd_print_col{#1}
141 }
142
143 \DeclarerDocumentCommand {\docColor} { s m }
144 {
145   \IfBooleanTF {#1}
146   { \@@_doc_color_star:n {#2} }
147   { \@@_doc_color_aux:n {#2} }
148 }
149 \%ExplSyntaxOff

```

(End definition for `\phdindexprintcolc` and others.)

### \docValue{<value>}

Typesets a value `asdf`.

```

phd_index_val
  \docValue@
\docValue@star
150 \ExplSyntaxOn
151 \cs_set:Npn \phd_index_val #1
152 {

```

```

153     \ifphd@doc@toindex
154         \index
155     {
156         #1\idx@actual
157         \phdIndexPrintValCa{#1}
158     }
159     \index
160     {
161         \phdkv@text@values
162         \idx@level #1
163         \idx@actual
164         \phdIndexPrintValC{#1}
165     }
166     \fi
167 }
168
169
170 \cs_set:Npn \docValue@ #1 {\phd@Print@Val{#1}\phd_index_val{#1}}%
171 \cs_set:Npn \docValue@star #1 {\phd@Print@Val{#1}}%
172
173 \DeclareDocumentCommand \docValue { s m }
174 {
175     \IfBooleanTF {#1}
176     { \docValue@star {#2} }
177     { \docValue@ {#2} }
178 }
179 \ExplSyntaxOff

(End definition for \phd_index_val, \docValue@, and \docValue@star.)

180 \cxset {doc command color/.code = \tcbset{color command = #1}}
181 \cxset {doc command color= thecmdcolor}
182 %
183 %
184 \lstdefinelanguage{extras}{morekeywords={%
185     poemtitle, poemtoc, versewidth,
186     vin, poemlines,poemtitlefont,
187     ProvidesClass,IfFileExists,
188     RequirePackage,ifthenelse,chapter,
189     includegraphics, newarray,readarray,of
190 } }
191 \lstloadlanguages{[LaTeX]TeX, [primitive]TeX, extras}

```

Note the `gobble=1` option. We use this to make the colorboxes with code not to show the ‘%’ sign in this documentation. Ideally you should fork the code below and adapt it to your own needs.

Also note that this is the default that is to be used in `tcolorbox` commands.

```

\begin{scriptexample}[<options>]
<text>
\end{scriptexample}

Display box for examples of various languages and scripts.

192 \newtcolorbox{scriptexample}[2][]{colback=thecodebackground,
193   boxrule=0pt,toprule=0pt,colframe=white,#1}

```

```

214 \newtcbox{commands}[2][]{colback=thecodebackground,
215 boxrule=0pt,toprule=0pt,colframe=white}

```

Set the `listings` defaults for TeX and LaTeX. All colours are harmonized with the definitions od the color palette, as set in the **phd-colorpalette**.

```

216 \lstset{language={[LaTeX]TeX},
217   escapeinside={{{(*@}{@*)}}},
218   numbers=left,
219   gobble=0,
220   stepnumber=1,
221   numbersep=5pt,
222   numberstyle={\footnotesize\color{thegray}},
223   breaklines=false,
224   framesep=5pt,
225   basicstyle=\small\ttfamily,
226   showstringspaces=false,
227   stringstyle={\color{orange}\footnotesize},
228   commentstyle=\color{black},
229   rulecolor=\color{theshade},
230   breakatwhitespace=true,
231   showspace=false,
232   xleftmargin=10pt,
233   xrightmargin=0pt,
234   aboveskip=3pt plus1pt minus1pt,
235   belowskip=7pt plus1pt minus1pt,
236   backgroundcolor=\color{theshade},
237 }

```

We predefine some listings styles to use with color palettes. First we define three styles for TeX and LaTeX, as well as three environements.`simple`<sup>1</sup>

```

218 \def\footnotechanges#1#2#3{\footnote{#1#2#3}}
219 \lstdefinestyle{simple}{%
220   escapeinside={{{(*@}{@*)}}},
221   numbers=left,
222   gobble=0,
223   stepnumber=1,
224   numbersep=5pt,
225   firstnumber=last,
226   numberstyle={\ttfamily\scriptsize\color{thecodelinecolor}},
227   breaklines=true,
228   % we do not use frames
229   framesep=0pt,
230   framexleftmargin=0pt,
231   basicstyle=\small\ttfamily,
232   showstringspaces=true,
233   stringstyle={\color{thestringstyle}\footnotesize},
234   commentstyle=\color{thecommentstyle},
235   rulecolor=\color{theshade},
236   breakatwhitespace=true,
237   prebreak={\Righttorque},
238   postbreak={\space\Lefttorque},
239   showspace=false,
240   xleftmargin=1.5pt,

```

<sup>1</sup>v1.01 2019/01/26 Made lines to line up with codeline.

```

241         xrightmargin=0pt,
242         aboveskip=3pt plus1pt minus1pt,
243         belowskip=3pt plus1pt minus1pt,
244         backgroundcolor=\color{white},
245         showlines=false,
246         gobble=0,
247         resetmargins,
248     }
249
250 \lstdefinestyle{singleline}{%
251     escapeinside={{(*@}{@*)}},
252     numbers=left,
253     gobble=0,
254     stepnumber=1,
255     numbersep=5pt,
256     numberstyle={\footnotesize\color{thecodelinecolor}},
257     breaklines=false,
258     framesep=0pt,
259     framexleftmargin=0pt,
260     basicstyle=\small\ttfamily,
261     showstringspaces=false,
262     stringstyle=\color{thestringstyle}\footnotesize,
263     commentstyle=\color{thecommentstyle},
264     rulecolor=\color{theshade},
265     breakatwhitespace=true,
266     prebreak={\Righttorque},
267     postbreak={\space\Lefttorque},
268     showspaces=false,
269     xleftmargin=-10pt,
270     xrightmargin=0pt,
271     aboveskip=3pt plus1pt minus1pt,
272     belowskip=3pt plus1pt minus1pt,
273     backgroundcolor=\color{white},
274     showlines=false,
275     numbers=none,
276     resetmargins,
277 }
278
279
280 % prints the style
281 \def\phd@print@LstStyle#1{%
282     \textcolor{\kvtcb@col@counter}{\tcb@doc@bfseries\tcb@scantokens{#1}}
283 }
284
285 \DeclareDocumentCommand{\docAuxListingsStyle}{s m}{%
286     \phd@print@LstStyle{#2}%
287     \IfBooleanTF{#1}{}{%
288         \%index{\phd@text@lststyles\idx@level#2}
289         \SpecialPackageIndex[\phd@text@lststyles]{#2}
290     }%
291 }

```

An example of `\docAuxListingsStyle simplex`.

The environment `\begin{TeX}..\end{TeX}` provides a listings environment for typesetting, either TeX or LaTeX code. This environment always starts

the number

```
292 \lstnewenvironment{tex}[1][]{%
293   \lstset{language=[LaTeX]TeX}\lstset{%
294     style=simple,#1
295   }%
296 }
```

```
\begin{sverbatim}[(options)]
<environment content>
\end{sverbatim}
```

A listings environment for single line verbatim typesetting. It uses the single line listings style.`singleline`. It typesets with smaller values for `aboveskip` and `belowskip`.

```
297 \lstnewenvironment{sverbatim}[1][]{%
298   \lstset{language=[LaTeX]TeX}\lstset{%
299     style=singleline,#1
300   }%
301 }
```

The `extended` is similar to the rest, except it is numbered continuouly.

```
302 \lstdefinestyle{extended}{%
303   breaklines=true,
304   framesep=5pt,
305   basicstyle=\verb@family@,
306   showstringspaces=false,
307   keywordstyle=\small\verb@family@,
308   stringstyle=\color{thestringstyle},
309   commentstyle=\color{thecommentstyle},
310   rulecolor=\color{gray!10},
311   breakatwhitespace=true,
312   xleftmargin=10pt,
313   xrightmargin=0pt,
314   aboveskip=\medskipamount,
315   belowskip=\medskipamount,
316   backgroundcolor=\color{thecodebackground},
317 }
```

```
\begin{tex}[(listings options)]
<code>
\end{tex}
```

Different listings environment.

```
318 \lstnewenvironment{texXX}[1][]{%
319   \lstset{language=[LaTeX]TeX}\lstset{%
320     style=extended, #1
321   }%
322 }
```

`\continuelinenumber`

Continues code numbers from previous block

```
323 \newcommand\continuelinenumber{\lstset{firstnumber=last}}
```

`startnumberat` The macro `\continueLineNumber`, provides a command to start the next block of code with the code numbers continuing. This requires the `listings` which is already included.

**\startlineat(*line number*)**

Starts a listings display with `(line number)`.

```
324 % Always I forget this so I created some aliases
325 \DeclareDocumentCommand{\startlineat}{ m }{\lstset{firstnumber=#1}}
```

**\numberlineat(*line number*)**

An alias for `\startlineat`.

```
326 \let\numberlineat\startlineat
327 \let\startnumberat\numberlineat
328 \newcommand\emphasis[2][black!80]{%
329   \lstset{%
330     emph={write, writeln,#2},
331     escapeinside={{(*@}{@*)}},
332     emphstyle={\verb+bfseries+
333           \textcolor{#1}%
334         },
335       },
336   }%
337 }
```

**\begin{teXXX}[*<options>*]  
  *environment content*  
\end{teXXX}**

Environment for typesetting long tracks of code with full highlighting of keywords, uses the `highlite` style.

```
338 \lstdefinestyle{highlite}{%
339   alsolanguage=makeindex,
340   alsolanguage=BibTeX,
341   emph={cs, use,new,seq,map,inline,eq,gincr,incr,IfNoValueF,%
342   if,If,exist,protect,nopar,gset,%%
343   set,undefine,define,add,gadd,remove,div,newcounter%%
344   round,truncate,max,min,mod,gzero,int,%
345   zero,newcount,protected,msg,error,\DeclareDocumentCommand{,
346   emphstyle=\ttfamily\color{thered},
347   firstnumber=last,
348   stepnumber=1,
349   escapeinside={{(*@}{@*)}},
350   breaklines=true,
351   framesep=5pt,
352   basicstyle= \ttfamily,
353   showstringspaces=false,
354   keywordstyle=\ttfamily\color{thered},%\color{primary},
355   keywordstyle=[2]\ttfamily\color{black},
356   stringstyle=\color{thecommentscolor},
357   commentstyle=\color{thecommentscolor},
```

```

358     rulecolor=\color{gray!10},
359     breakatwhitespace=true,
360     prebreak={\Righttorque},
361     postbreak={\space\Lefttorque},
362     showspaces=false, % shows spacing symbol
363     upquote=true,
364     xleftmargin=10pt,
365     xrightmargin=0pt,
366     aboveskip=\medskipamount,
367     belowskip=\medskipamount,
368     backgroundcolor=,
369     tabsize=2,%
370     mathescape=true,%
371 }
372
373 \lstnewenvironment{teXXX}[1][]
374   {\lstset{language=[LaTeX]TeX}%
375    \lstset{%
376      style=highlite, #1
377    }%
378  }%
379 \lstnewenvironment{phdverbatim}[1][]
380   {\lstset{language=[LaTeX]TeX}%
381    \lstset{%
382      emph={cs, use, new, seq, map, inline, eq, gincr, incr, IfNoValueF, %
383      if, If, exist, protect, nopar, gset, %
384      set, undefine, define, add, gadd, remove, div, %
385      round, truncate, max, min, mod, gzero, int, %
386      zero, newcount, protected, msg, error, DeclareDocumentCommand}, %
387      emphstyle=\verb+bfseries+\color{black!80}, %
388      numbers=none, %
389      stepnumber=1, %
390      escapeinside={{(*@}{@*)}}, %
391      breaklines=false, %
392      framesep=5pt, %
393      basicstyle= {\small\ttfamily}, %
394      showstringspaces=false, %
395      keywordstyle=\ttfamily\color{thekeywordstyle}, %
396      stringstyle=\color{black!50}, %
397      commentstyle=\color{black!50}, %
398      rulecolor=\color{gray!10}, %
399      breakatwhitespace=true, %
400      showspaces=false, % shows spacing symbol
401      xleftmargin=15pt, %
402      xrightmargin=5pt, %
403      % aboveskip=0pt, % compact the code looks ugly in type
404      % belowskip=0pt, % user responsible to insert any skips
405      aboveskip=\medskipamount, %
406      belowskip=\medskipamount, %
407      backgroundcolor=, %
408      #1
409    }%
410  }%

```

The following have been taken from <https://github.com/cgnieder/cnltx/blob/master/cnltx->

```

listings.sty

411 \lstdefinelanguage{makeindex}{
412   morekeywords = {
413     actual,           % @
414     arg_open,         % {
415     arg_close,        % }
416     encaps,          % |
417     escape,           % \\
418     keyword,          % \indexentry
419     level,            % !
420     page_compositor, % -
421     quote,             % "
422     range_open,        % (
423     range_close,       % )
424     preamble,          % \begin{theindex} \n
425     postamble,         % \n\n \end{theindex} \n
426     setpage_prefix,    % \n \setcounter{page}{%
427     setpage_suffix,    % } \n
428     group_skip,        % \n\n \indexspace \n
429     headings_flag,      % 0
430     heading_prefix,    %
431     heading_suffix,    %
432     symhead_positive, % Symbols
433     symhead_negative, % symbols
434     numhead_positive, % Numbers
435     numhead_negative, % numbers
436     item_0,            % \n \item
437     item_1,            % \n \subitem
438     item_2,            % \n \subsubitem
439     item_01,           % \n \subitem
440     item_x1,           % \n \subitem
441     item_12,           % \n \subsubitem
442     item_x2,           % \n \subsubitem
443     delim_0,           % ,
444     delim_1,           % ,
445     delim_2,           % ,
446     delim_n,           % ,
447     delim_r,           % --
448     delim_t,           % 
449     suffix_2p,          % 
450     suffix_3p,          % 
451     suffix_mp,          % 
452     encaps_prefix,      % \\
453     encaps_infix,        % {
454     encaps_suffix,        % }
455     line_max,            % 72
456     indent_space,         % \t\t
457     indent_length,        % 16
458   },
459   morestring = [b]{"},
460   morecomment = [l]{\%},
461   sensitive = true
462 }
463 % -----

```

```

464 % a listings language BibTeX:
465 \lstdefinelanguage{BibTeX}{
466   % entry types:
467   morekeywords = {
468     % regular types:
469     @article,
470     @book,@mvbook,@inbook,@bookinbook,@suppbook,@booklet,
471     @collection,@mvcollection,@incollection,@suppcollection,
472     @manual,
473     @misc,
474     @online,
475     @patent,
476     @periodical,
477     @suppperiodical,
478     @proceedings,@mvproceedings,@inproceedings,
479     @reference,@mvreference,@inreference,
480     @report,
481     @set,
482     @thesis,
483     @unpublished,
484     @xdata,
485     @customa,@customb,@customc,@customd,@custome,@customf,
486     % type aliases:
487     @conference,
488     @electronic,
489     @mastersthesis,
490     @phdthesis,
491     @techreport,
492     @www,
493     % unsupported types:
494     @artwork,
495     @audiobibnote,
496     @commentary,
497     @image,
498     @jurisdiction,
499     @legislation,
500     @legal,
501     @letter,
502     @movie,
503     @music
504     @performance,
505     @review,
506     @software,
507     @standard,
508     @video,
509     % cnltx types:
510     @bundle,
511     @class,
512     @package,
513   },
514   % entry fields:
515   morekeywords = [2]{
516     % data fields:
517     abstract,

```

```
518     addendum,  
519     afterword,  
520     annotation,  
521     annotator,  
522     author,  
523     authortype,  
524     bookauthor,  
525     bookpagination,  
526     booksubtitle,  
527     booktitle,  
528     booktitleaddon,  
529     chapter,  
530     commentator,  
531     date,  
532     doi,  
533     edition,  
534     editor,editora,editorb,editorc,  
535     editortype,  
536     editoratype,editorbtype,editorctype,  
537     eid,  
538     entrysubtype,  
539     eprint,  
540     eprintclass,  
541     eprinttype,  
542     eventdate,  
543     eventtitle,  
544     eventtitleaddon,  
545     file,  
546     foreword,  
547     hvarer,  
548     howpublished,  
549     indextitle,  
550     institution,  
551     introduction,  
552     isan,  
553     isbn,  
554     ismn,  
555     isrn,  
556     issn,  
557     issue,  
558     issuesubtitle,  
559     issuetitle,  
560     iswc,  
561     journalsubtitle,  
562     journaltitle,  
563     label,  
564     language,  
565     library,  
566     location,  
567     mainsubtitle,  
568     maintitle,  
569     maintitleaddon,  
570     month,  
571     nameaddon,
```

```
572     note,  
573     number,  
574     organization,  
575     origdate,  
576     origlanguage,  
577     origlocation,  
578     origpublisher,  
579     origtitle,  
580     pages,  
581     pagetotal,  
582     pagination,  
583     part,  
584     publisher,  
585     pubstate,  
586     reprinttitle,  
587     series,  
588     shortauthor,  
589     shorteditor,  
590     shorthand,  
591     shorthandintro,  
592     shortjournal,  
593     shortseries,  
594     shorttitle,  
595     subtitle,  
596     title,  
597     titleaddon,  
598     translator,  
599     type,  
600     url,  
601     urldate,  
602     venue,  
603     version,  
604     volume,  
605     volumes,  
606     year,  
607     % special fields:  
608     crossref,  
609     entryset,  
610     execute,  
611     gender,  
612     hyphenation,  
613     ids,  
614     indexsorttitle,  
615     keywords,  
616     options,  
617     presort,  
618     related,  
619     relatedoptions,  
620     relatedtype,  
621     relatedstring,  
622     sortkey,  
623     sortname,  
624     sortshorthand,  
625     sorttitle,
```

```

626     sortyear,
627     xdata,
628     xref,
629     % custom fields:
630     namea, nameb, namec,
631     nameatype, namebtype, namectype,
632     lista, listb, listc, listd, liste, listf,
633     usera, userb, userc, userd, usere, userf,
634     verba, verb, verb,
635     % field aliases:
636     address,
637     annot,
638     archiveprefix,
639     journal,
640     key,
641     pdf,
642     primaryclass,
643     school,
644     % cnlx fields:
645     maintainer
646   } ,
647   morestring = [b]{"} ,
648   morecomment = [l]{\%} ,
649   sensitive = false
650 }
651
652 % listings style for source code from igniter
653 \lstdefinestyle{complex}{
654   basicstyle      = \small\ttfamily,  %{\sourceformat},
655   numbers         = left,
656   numberstyle    = \tiny,
657   xleftmargin    = 1em,
658   numbersep      = .75em,
659   gobble          = \@gobble ,
660   columns         = fullflexible,
661   literate        =
662     {ä}{{\"a}}{1}
663     {ö}{{\"o}}{1}
664     {ü}{{\"u}}{1}
665     {Ä}{{\"A}}{1}
666     {Ö}{{\"O}}{1}
667     {Ü}{{\"U}}{1}
668     {ß}{{\ss}}{1}
669     {'}{{\`{}}}{1}
670     {'}{{\textquotesingle}}{1} ,
671   breaklines      = true,
672   keepspaces      = true,
673   breakindent     = 1em,
674   commentstyle    = \color{thecomment},
675   keywordstyle    = \color{thecls},
676   deletetexcs    =
677   {
678     a,o,u,A,O,U,
679     begin,

```

```

680     center,
681     description,document,
682     end,enumerate,
683     equation,eqnarray,
684     figure,flushleft,flushright,
685     itemize,list,
686     otherlanguage,
687     table,tabu,tabular
688   },
689   deletekeywords  =
690   {
691     a,o,u,A,O,U,
692     begin,
693     center,
694     description,document,
695     end,enumerate,
696     equation,eqnarray,
697     figure,flushleft,flushright,
698     itemize,list,
699     otherlanguage,
700     table,tabu,tabular
701   },
702   % \begin, \end:
703   texcsstyle      = [2]\color{red}, %add color begin end
704   index           = [2][texcs2],
705   indexstyle      = [2]\@gobble,
706   moretexcs       = [2]{begin,end},
707   % control sequences that'll be indexed:
708   texcsstyle      = [3]\color{cs},
709   index           = [3][texcs3],
710   indexstyle      = [3]\indexcs,
711   % control sequences that won't be indexed:
712   texcsstyle      = [4]\color{thecs},
713   index           = [4][texcs4],
714   indexstyle      = [4]\@gobble,
715   % added environments that'll be indexed:
716   texcsstyle      = [5]\color{env},
717   index           = [5][texcs5],
718   indexstyle      = [5]\indexenv,    UNCOMMENT LATER
719   % environments that won't be indexed:
720   texcsstyle      = [6]\color{env},
721   index           = [6][texcs6],
722   indexstyle      = [6]\@gobble,
723   moredelim       = *[s][\color{green}]{${}} %add color the math
724 }

725 \lstnewenvironment{lualisting}[1][]
726 {\lstset{language=[LaTeX]TeX,
727   basicstyle      = \ttfamily,
728   showstringspaces = false,
729   upquote         = true,
730   keywordstyle    = \color{blue},
731   commentstyle   = \color{black!50},
732   stringstyle    = \color{black!80},
733   backgroundcolor = \color{white},

```

```

734   xleftmargin      =15pt,
735   xrightmargin     =5pt,
736   aboveskip        =\medskipamount,
737   belowskip         =\medskipamount,
738   #1}
739 {}
```

### C.8.1 Go language

```

740 \lstdefinelanguage{Go}{
741   % Keywords as defined in the BNF
742   morekeywords=[1]{break,default,func,interface,%
743     case,defer,go,map,struct,chan,else,goto,package,%
744     switch,const,fallthrough,if,range,type,continue,%
745     for,import,return,var,select},
746   % Special identifiers, builtin functions
747   morekeywords=[2]{make,new,nil,len,cap,copy,complex,%
748     real,imag,panic,recover,print,println,iota,close,%
749     closed,_,true,false,append,delete},
750   % Basic types
751   morekeywords=[3]{%
752     string,int,uint,uintptr,double,float,byte,%
753     int8,int16,int32,int64,int128,%
754     uint8,uint16,uint32,uint64,uint128,%
755     float32,float64,complex64,complex128,%
756     rune},
757   % Strings : "toto", 'toto', `toto`
758   morestring=[b]{"},
759   morestring=[b]{'},
760   morestring=[b]{`},
761   % Comments : /* comment */ and // comment
762   comment=[l]{//},
763   morecomment=[s]{/*}{*/},
764   % Options
765   sensitive=true,
766   numbers=left,
767   numberstyle=\footnotesize
768 }

769 \lstnewenvironment{Go}[1][]{%
770   \lstset{language=Go}%
771   \lstset{%
772     style=highlite, #1
773   }%
774 }%
```

```

493
494 package main
495
496 import (
497 → "flag"
498 → "os"
499 → "github.com/involucro/involucro/app" ①
500 → "github.com/involucro/involucro/ilog"
```

```

501  )
502
503 func main() {
504     →err := app.Main(os.Args)
505
506     →switch err {
507         →case flag.ErrHelp:
508             →→os.Exit(0)
509         →case nil:
510             →→os.Exit(0)
511         →default:
512             →→ilog.Error.Logf("Task processing failed: %s", err)
513             →→os.Exit(1)
514     }
515 }
```

See [①](#)

## C.9 LaTeX code demo environments

To demonstrate  $\text{\LaTeX}$  code it is sometimes desirable to have the code be executed. This was pioneered in a number of packages. One of the better packages to do so is **tcolorbox**. We use it to define a special environment.

```
\begin{texexample} {<title>} {<label for referencing>}
  <environment content>
\end{texexample}
```

The environment **texexample** will list the code using the **listings** package, so we can have a nice box and shows the output at the bottom section.

First we define a new counter which resets at every chapter. If **c@chapter** is not defined we reset it based on sections.

#1 Title of the example

#2 label for referencing

```

775   \ifx\c@chapter\@undefined
776       \newcounter{texexp}[section]
777       \@addtoreset{c@texexp}{c@section}
778   \else
779       \newcounter{texexp}[chapter]
780       \@addtoreset{c@texexp}{c@chapter}
781   \fi
782 \%tcbset{listing utf8=latin1}% optional; 'latin1' is the default.
783 \def\dcircle#1{\ding{\numexpr181 + #1\relax}}
784 \def\thetexexp{\@arabic\c@section.\arabic{texexp}}
785 \tcbset{texexp/.style={%
786     fonttitle=\small\ttfamily,
787     fontupper=\small,
788     fontlower=\small,
789     coltitle=black,
790     colback = thecodebackground,% background

```

```

791     colframe=thebackground,
792     % process code={\def\dcircle##1{\ding{\numexpr181 + ##1}}},
793     %colupper=spot!,
794 },
795 listing options = {%
796   gobble=2
797   keywordstyle=\color{thekeywordstyle},
798   belowskip=0pt,
799   escapeinside={(*@}{@*)},%
800   breaklines=true,%  

801   backgroundcolor=\color{thebackground},%
802   %firstnumber=last,%  

803   stepnumber=1,%  

804   upquote=true,%  

805   alsoletter={_,:},%
806   commentstyle=\color{thecommentscolor},%
807   emph={cs,new,seq,map,inline,eq,gincr,incr,IfNoValueF,if,%  

808     If,exist,protect,nopar,gset,%  

809     set,undefine,define,add,gadd,remove,div,%  

810     round,truncate,max,min,mod,gzero,int,exp,put,left,args,%  

811     zero,newcount,protected,msg,error,%  

812     eval,to,arabic,alph,Alph,roman,Roman,dim%  

813     DeclareDocumentCommand,%  

814     NewDocumentCommand,%  

815     RenewDocumentCommand,includegraphics,  

816     function,local,return,break,  

817 },%
818 %
819 % For LaTeX3 we need to add these, note % is important
820 % dn't miss, at the end...
821 moretexcs = {DeclareDocumentCommand,IfBooleanTF,tex_def:D,%  

822 cs_new:Nn,cs_new:Npn,cs_new:cn,cs_set_nopar:Npn,cs_meaning:N,%  

823 %primitives  

824 cs:w,cs_end:,tex_underline,group_begin:, group_end:,%  

825 %coffins  

826 NewCoffin,JoinCoffins,SetHorizontalCoffin,TypesetCoffin,%  

827 %properties  

828 prop_new:N,prop_new:c,prop_put:Nnn,%  

829 %boolean  

830 bool_new:N,bool_set_true:N,bool_set_false:N,%  

831 bool_if:NTF,%  

832 hbox_to_wd:nn,%  

833 IfNoValueTF,%  

834 %token lists  

835 tl_new:N,tl_set:Nn,tl_concat:NNN,%  

836 token_to_meaning:N,%  

837 seq_pop_left:NN,%  

838 %
839 %int  

840 int_if_exist:cT,int_use:c,int_new:c,int_new:N,int_eval:n,%  

841 int_add,int_use,int_to_roman,%  

842 %boxes  

843 box_new:c,hbox_set:cn,box_use:c,vbox_set:cn,box_move_down:nn,%  

844 %string

```

```

845         str_if_eq_x:nnTF,%  

846         tl_tail:n,%  

847         DeclareObjectType,%  

848         DeclareTemplateInterface,%  

849         DeclareTemplateCode,%  

850         DeclareInstance,UseInstance,AssignTemplateKeys%  

851         keys_set,keys_define,%  

852     },%  

853         emphstyle=\verb+at+{\color{theemphasiscolor}},%  

854         %framexleftmargin=-14pt,numbersep=-  

855         7pt,xleftmargin=-28pt,  

856     },%close listings options  

857         % added for better control  

858         arc=0pt,  

859         outer arc=0pt,  

860         example1/.code 2 args={\refstepcounter{texexp}{\ifx#2\empty\else\label{#2}\fi}  

861         \pgfkeysalso{texexp, enhanced, breakable, title={Example \thetexexp\ #1}}%  

862     },  

863  

864 \def\emphasize#1{  

865 \tcbset{texexp/.style={%  

866     fonttitle=\small\ttfamily,  

867     fontupper=\small,  

868     fontlower=\small,  

869     coltitle=black,  

870     colback = thecodebackground,% background  

871     colframe=thecodebackground,  

872     %process code={\def\dcircle##1{\ding{\numexpr181 + ##1}}},  

873     %colupper=spot!,  

874 },  

875 listing options = {  

876     gobble=1,  

877     tabsize=2,  

878     keywordstyle=\color{thekeywordstyle},  

879     belowskip=0pt,  

880     escapeinside={(*@}{@*)},%  

881     breaklines=true,%  

882     backgroundcolor=\color{thecodebackground},%  

883     %firstnumber=last,%  

884     stepnumber=1,%  

885     upquote=true,%  

886     alsoletter={_,:_},%  

887     commentstyle=\color{thecommentstyle},%  

888     emph={cs,new,seq,map,inline,eq,gincr,incr,IfNoValueF,if,%  

889     If,exist,protect,nopar,gset,%  

890     set,undefine,define,add,gadd,remove,div,%  

891     round,truncate,max,min,mod,gzero,int,exp,put,left,args,%  

892     zero,newcount,protected,msg,error,%  

893     eval,to,arabic,alph,Alph,roman,Roman,dim%  

894     DeclareDocumentCommand,%  

895     NewDocumentCommand,%  

896     RenewDocumentCommand,includegraphics,  

897     function,local,return,#1,

```

```

898     },%
899     %
900     % For LaTeX3 we need to add these, note % is important
901     % dn't miss, at the end...
902     moretexcs = {DeclareDocumentCommand,IfBooleanTF,tex_def:D,%
903     cs_new:Nn,cs_new:Npn,cs_new:cn,cs_set_nopar:Npn,token_to_meaning:N,%
904     %primitives
905     cs:w,cs_end:,tex_underline,group_begin:, group_end:,%
906     %coffins
907     NewCoffin,JoinCoffins,SetHorizontalCoffin,TypesetCoffin,%
908     %properties
909     prop_new:N,prop_new:c,prop_put:Nnn,%
910     %boolean
911     bool_new:N,bool_set_true:N,bool_set_false:N,%
912     bool_if:NTF,%
913     hbox_to_wd:nn,%
914     IfNoValueTF,%
915     %token lists
916     tl_new:N,tl_set:Nn,tl_concat:NNN,%
917     token_to_meaning:N,%
918     seq_pop_left:NN,%
919     %
920     %int
921     int_if_exist:cT,int_use:c,int_new:c,int_new:N,int_eval:n,%
922     int_add,int_use,int_to_roman,%
923     %boxes
924     box_new:c,hbox_set:cn,box_use:c,vbox_set:cn,box_move_down:nn,%
925     %string
926     str_if_eq_x:nnTF,%
927     tl_tail:n,%
928     DeclareObjectType,%
929     DeclareTemplateInterface,%
930     DeclareTemplateCode,%
931     DeclareInstance,UseInstance,AssignTemplateKeys,%
932     keys_set,keys_define,%
933     },%
934     emphstyle=\verb+imfont\bfseries\color{theemphasiscolor},%
935     %framexleftmargin=-14pt,numbersep=-7pt,xleftmargin=-
28pt,
936     %
937     },%close listings options
938     % added for better control
939     arc=0pt,
940     outer arc=0pt,
941     }%close style
942 }%close command
943 %
944 \newenvironment{texexp}[1]{\tcblisting[texexp,#1]}{\endtcblisting}
945
946 \newenvironment{example1}[3][]{\tcblisting[example1={#2}{#3},#1]}%
947     {\endtcblisting}
948 %

```

```

\begin{texexample} [<>] {<Title>} <label>
<environment content>
\end{texexample}

949 \newenvironment{texexample}[3][]{\noindent\tcblisting{example1={#2}{#3},#1}}%
950     {\endtcblisting }
951
952 \newenvironment{texcode}[3][listing only]{\noindent\tcblisting{example1={#2}{#3},#1}}%
953     {\endtcblisting }
954 %
955 % Need to fix
956 \let\luaexample\texexample
957 \let\endluaexample\endtexexample
958 \% tcbset{luacode/.style=%
959 %     fonttitle=\small\ttfamily,
960 %     fontupper=\small,
961 %     fontlower=\small,
962 %     coltitle=black,
963 %     colback = thecodebackground,% background
964 %     colframe=thecodebackground,
965 %     %colupper=spot!,
966 % },
967 %     listing options = {
968 %         language={[5.2]Lua},
969 %         belowskip=0pt,
970 %         escapeinside={(*@}{@*)},%
971 %         breaklines=true,%
972 %         backgroundcolor=\color{thecodebackground},%
973 %         firstnumber=last,%
974 %         stepnumber=1,%
975 %         upquote=true,%
976 %         alsoletter={_,:},%
977 %         commentstyle=\bfseries\color{black!90},%
978 %         stringstyle = \color{black!90},
979 %         emphstyle=\verbimfont\bfseries\color{black!80},%
980 %         keywordstyle= \bfseries\color{black!80},%
981 %     },
982 %     % added for better control
983 %     arc=0pt,
984 %     outer arc=0pt,
985 %     luaexp1/.code 2 args={\refstepcounter{texexp}\label{#2}}%Reference
986 %     \pgfkeysalso{luacode, enhanced, breakable, title={Example \thetexexp\ #1}},
987 %}
988 \% \newenvironment{luaexp1}[1]{\tcblisting{luacode,#1}}{\endtcblisting}
989 %
990 \% \newenvironment{luaexample}[3][]{\noindent\tcblisting{luaexp1={#2}{#3},#1}}%
991 %     {\endtcblisting}
992 %%

```

The following demonstrates the usage.

**Example 9.1 atest**

```
472 % \def\demomacro{Hello World!}
473 %
```

*Example:* A TesttestThis is a comment?

## C.10 makeidx

We check that `\printindex` has been defined. If the test is positive then an indexing package has been loaded, otherwise we load the `makeidx`<sup>2</sup>.

```
993 \ExplSyntaxOn
994 \cs_if_exist:cTF {printindex}
995   {
996   }
997   \RequirePackage{makeidx}[2000/03/29]
998 }
999 \ExplSyntaxOff

1000 \ExplSyntaxOn
1001 \cs_set:Npn \cvaref#1{\textcolor{\phdd_key_color_command_tl}{#1}}
1002 \cs_set:Npn \colopt#1{\textcolor{\phdkv@col@opt}{#1}}
1003 \ExplSyntaxOff
1004 \lstddefinestyle{tcbdocumentation}{language={[LaTeX]TeX},
1005   aboveskip={0pt @plus 6pt},
1006   belowskip={0pt @plus 6pt},
1007   columns=fixed,
1008   keepspaces=true,
1009   breaklines=true,
1010   prebreak={\Righttorque},
1011   postbreak={\space\Lefttorque},
1012   breakatwhitespace=true,
1013   basicstyle=\ttfamily\footnotesize,
1014   extendedchars=true,
1015   nolol,
1016   inputencoding = \phdkv@listingencoding}
```

## C.11 Documenting Macros

The following macros are taken from `ltxdoc` and modified accordingly.

```
\begin{docCommand}[\langle options \rangle]{\langle name \rangle}{\langle parameters \rangle}
  \langle command description \rangle
\end{docCommand}

1017 \DeclareRobustCommand\phdcs[1]{\color{thechs}{%
1018   \texttt{\char`\\detokenize{\#1}}}}
```

<sup>2</sup>makeidx.

```
\phddoc_orig_meta
1019 \ExplSyntaxOn
1020 \cs_gset_eq:NN \phd@doc@orig@meta\meta%
1021 \ExplSyntaxOff
(End definition for \phddoc_orig_meta.)
```

### \meta{<argument>}

We modify the standard *<arguments>* to allow for colour settings. The **themeta** is defined in the **phd-colorpalette** package. The braces are not colored as they do not look very good if they are.

Use the original **meta** as defined in **doc** and only colorize and set the font parameters through the **doc** provided macro hook **\meta@font@select**.

```
1022 \ExplSyntaxOn
1023 \cs_set:Npn \meta #1 {
1024   \group_begin:
1025     \def\meta@font@select{\rmfamily\upshape\color{themeta}}
1026     \phd@doc@orig@meta{#1}
1027   \group_end:
1028 }
```

### \marg{<mandatory argument>}

Typesets a mandatory argument as *<argument>*.

```
1029 \cs_set:Npn \marg #1
1030 {
1031   \group_begin:
1032     \ttfamily\char`\{
1033       \def\meta@font@select{\rmfamily\itshape\color{theoarg}}
1034       \phd@doc@orig@meta{#1}
1035     \ttfamily\char`\}
1036   \group_end:
1037 }
```

### \oarg{<argument>}

Typesets an optional argument, as found in L<sup>A</sup>T<sub>E</sub>X commands. The command:

```
\test\oarg{style=two}\marg{mandatory arguments}
```

will typeset:

```
\test[<style=two>]{<mandatory arguments>}
```

```
1038 \cs_set:Npn \oarg #1
1039 {
1040   {\ttfamily[]\meta{#1}\ttfamily[]}
1041 }
1042 \ExplSyntaxOff
```

New: 2015-01-08    \docCounter{<name>}

Documents a counter with given *<name>*. The counter is automatically indexed.

```
472 %The counter \docCounter{foocounter} can be used for computation.
473 %
```

The counter **foocounter** can be used for computation.

New: 2015-01-08 **\docCounter\***{<name>}

Identical to **\docCounter**<sup>→ P. 796</sup>, but without index entry.

Updated: 2017-10-11 **\phdcs** {<macro name>}

We modify the standard **\cs** and save to a new name to be able to use underscores. Maybe there are better ways of doing it as well.

```
1043 \newif\ifphd@doc@toindex
1044 \newif\ifphd@doc@colorize
1045 \newif\ifphd@doc@annotate
```

### C.11.1 Keys for language related texts.

```
1046 %
1047 \ExplSyntaxOn
1048 \cxset{
1049   pageshort/.store~in          = \phdkv@text@pageshort,
1050   doclang/.cd,
1051   color/.store~in             = \phdkv@text@color,
1052   colors/.store~in            = \phdkv@text@colors,
1053   environment~content/.store~in = \phdkv@text@envcontent,
1054   environment/.store~in       = \phdkv@text@env,
1055   environments/.store~in     = \phdkv@text@envs,
1056   key/.store~in               = \phdkv@text@key,
1057   keys/.store~in              = \phdkv@text@keys,
1058   index/.store~in             = \phdkv@text@index,
1059   pageshort/.store~in         = \phdkv@text@pageshort,
1060   value/.store~in              = \phdkv@text@value,
1061   values/.store~in             = \phdkv@text@values,
1062   % List Styles text in english
1063   lst~styles/.store~in         = \phd@text@lststyles,
1064 }
1065 \cxset{doclang/lst~styles      = Listings~Styles}
1066 \ExplSyntaxOff
1067 \cxset
1068 {
1069   documentation listing options/.store in=\phdkv@doclistingoptions,% 
1070   documentation listing style/.style={documentation listing options={style=#1}},%
1071   documentation minted style/.store in=\phdkv@docmintstyle,
1072   documentation minted options/.store in=\phdkv@docmintoptions,
1073 }
```

## C.12 Index settings

We consider indices to be composed of three elements, the index heading i.e., the word Index typeset in a specific language, the entries and the page numbers.

16/08/2017

The following keys relate to settings that must have a one to one relationship with the settings of the `.ist` file. Unfortunately there is no easy way to achieve this. A better strategy is to generate the `.ist` file automatically by writing the parameters to a file.

```
\tex
gobble 474 % Getting codeline and listings number at same distance
475   \cxset{gobble=1} gobbles all
476 % Getting codeline and listings number at same distance
477   \cxset{gobble=1} gobbles all
```

(End definition for `\tex` and `gobble`.)

```
idx@actual
\idx@quote 1074 \cxset{
\idx@level 1075   % indexing
\idx@format 1076   index actual/.store in  = \idx@actual,
\idx@encap 1077   index quote/.store in  = \idx@quote,
1078   index level/.store in   = \idx@level,
1079   index format/.store in  = \idx@format,
1080   index encaps/.store in  = \idx@encap,
1081   index colorize/.is if   = phd@doc@colorize,%
1082   index annotate/.is if   = phd@doc@annotate,%
1083 }
```

(End definition for `idx@actual` and others.)

We provide three default styles. The first style is suitable for documenting normal text without any commands or fancy characters in the index. The second is for the german language. These settings are also suitable for any language that has the `'` messed up by Babel or the `@` has its catcode changed. For better mnemonics we also have one as `doc`. We default to the `//index doc settings`.

```
1084 \cxset{
1085   index default settings/.style = {index actual={@},
1086   index quote={" },
1087   index level={!}},
1088   index german settings/.style = {index actual={=},
1089   index quote={!},
1090   index level={>}},
1091   index doc settings/.style    = {index actual={=},
1092   index quote={!},
1093   index level={>}},
1094 }
1095 /DOCUM
1096 *DOCUM|DFLT
1097 DOCUM \cxset{
1098   % indexing
1099   index actual  = {@},
1100   index quote   = {@},
1101   index level   = {@},
1102   index doc settings,
1103 DOCUM }
1104 /DOCUM|DFLT
1105 *DOCUM
```

### C.12.1 Keys for adjusting design of command displays.

The following keys relate to heading describing commands, keys environments and the like

|                                                                                                                                                                                                                                                                                             |                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| <code>doc left=&lt;length&gt;</code>                                                                                                                                                                                                                                                        | (no default, initially 2em)                                  |
| Sets the lefthand “offset” of the documentation texts for the $\text{\texttt{??}}^{\text{\texttt{P.}}} \text{\texttt{??}}$ , $\text{\texttt{??}}^{\text{\texttt{P.}}} \text{\texttt{??}}$ , $\text{\texttt{??}}^{\text{\texttt{P.}}} \text{\texttt{??}}$ to $\langle\text{length}\rangle$ . |                                                              |
| <code>doc right=&lt;length&gt;</code>                                                                                                                                                                                                                                                       | (no default, initially oem)                                  |
| Sets the righthand “offset” of the documentation texts for the <code>\text{\texttt{docCommand}}</code> , $\text{\texttt{??}}^{\text{\texttt{P.}}} \text{\texttt{??}}$ , <code>\text{\texttt{docKey}}</code> to $\langle\text{length}\rangle$ .                                              |                                                              |
| <code>1106 \cxset{</code>                                                                                                                                                                                                                                                                   |                                                              |
| <code>1107   doc left/.dimstore in</code>                                                                                                                                                                                                                                                   | $= \text{\texttt{phdkv@doc@left}},$                          |
| <code>1108   doc right/.dimstore in</code>                                                                                                                                                                                                                                                  | $= \text{\texttt{phdkv@doc@right}},$                         |
| <code>1109   doc left indent/.dimstore in</code>                                                                                                                                                                                                                                            | $= \text{\texttt{phdkv@doc@indentleft}},$                    |
| <code>1110   doc right indent/.dimstore in</code>                                                                                                                                                                                                                                           | $= \text{\texttt{phdkv@doc@indentright}},$                   |
| <code>1111   doc head command/.style</code>                                                                                                                                                                                                                                                 | $= \{\text{\texttt{doc@head@command/.style}}=\{\#1\}\},$     |
| <code>1112   doc head environment/.style</code>                                                                                                                                                                                                                                             | $= \{\text{\texttt{doc@head@environment/.style}}=\{\#1\}\},$ |
| <code>1113   doc head key/.style</code>                                                                                                                                                                                                                                                     | $= \{\text{\texttt{doc@head@key/.style}}=\{\#1\}\},$         |
| <code>1114   doc head/.style</code>                                                                                                                                                                                                                                                         | $= \{\text{\texttt{doc head command= \{\#1\},}}$             |
| <code>1115</code>                                                                                                                                                                                                                                                                           | $\text{\texttt{doc head environment=\{\#1\},}}$              |
| <code>1116</code>                                                                                                                                                                                                                                                                           | $\text{\texttt{doc head key=\{\#1\},}}$                      |
| <code>1117   doc description/.store in</code>                                                                                                                                                                                                                                               | $= \text{\texttt{phdkv@doc@description,\%}}$                 |
| <code>1118   doc into index/.is if</code>                                                                                                                                                                                                                                                   | $= \text{\texttt{phd@doc@toindex,\%}}$                       |
| <code>1119 }</code>                                                                                                                                                                                                                                                                         |                                                              |
| <code>1120 \cxset{doc description = {some test}}</code>                                                                                                                                                                                                                                     |                                                              |
| <code>1121 % styles</code>                                                                                                                                                                                                                                                                  |                                                              |
| <code>1122 \cxset{</code>                                                                                                                                                                                                                                                                   |                                                              |
| <code>1123 /DOCUM</code>                                                                                                                                                                                                                                                                    |                                                              |
| <code>1124 *DOCUM DFLT</code>                                                                                                                                                                                                                                                               |                                                              |
| <code>1125   doexample/.style={colframe=ExampleFrame,colback=ExampleBack,fontlower=\footnotesize,</code>                                                                                                                                                                                    |                                                              |
| <code>1126   documentation minted style=,</code>                                                                                                                                                                                                                                            |                                                              |
| <code>1127   documentation minted options={tabsize=2,fontsize=\small},</code>                                                                                                                                                                                                               |                                                              |
| <code>1128   english language/.code={\cxset{doclang/.cd,</code>                                                                                                                                                                                                                             |                                                              |
| <code>1129     color=color,colors=Colors,</code>                                                                                                                                                                                                                                            |                                                              |
| <code>1130     environment content=environment content,</code>                                                                                                                                                                                                                              |                                                              |
| <code>1131     environment=environment,environments=Environments,</code>                                                                                                                                                                                                                    |                                                              |
| <code>1132     key=key,keys=Keys,</code>                                                                                                                                                                                                                                                    |                                                              |
| <code>1133     index=Index,</code>                                                                                                                                                                                                                                                          |                                                              |
| <code>1134     pageshort={P.},</code>                                                                                                                                                                                                                                                       |                                                              |
| <code>1135     value=value,values=Values\}},</code>                                                                                                                                                                                                                                         |                                                              |
| <code>1136 }</code>                                                                                                                                                                                                                                                                         |                                                              |
| <code>1137 /DOCUM DFLT</code>                                                                                                                                                                                                                                                               |                                                              |
| <code>1138 *DOCUM</code>                                                                                                                                                                                                                                                                    |                                                              |
| <code>1139 \AtBeginDocument{%</code>                                                                                                                                                                                                                                                        |                                                              |
| <code>1140   \csname phd@doc@index@\idx@format\endcsname%</code>                                                                                                                                                                                                                            |                                                              |
| <code>1141   \hypersetup{</code>                                                                                                                                                                                                                                                            |                                                              |
| <code>1142     citecolor = \text{\texttt{phdkv@colhyper}},</code>                                                                                                                                                                                                                           |                                                              |
| <code>1143     linkcolor = \text{\texttt{phdkv@colhyper}},</code>                                                                                                                                                                                                                           |                                                              |
| <code>1144     urlcolor = \text{\texttt{phdkv@colhyper}},</code>                                                                                                                                                                                                                            |                                                              |
| <code>1145     filecolor = \text{\texttt{phdkv@colhyper}},</code>                                                                                                                                                                                                                           |                                                              |

```

1146     menucolor = \phdkv@colhyper
1147 }

1148 \lstdefinestyle{smalldisplay}{%
1149   numbers=none,
1150   backgroundcolor=\color{thecodebackground},
1151   xleftmargin=0pt
1152
1153 \tcbsset{documentation listing style=smalldisplay}
1154 \tcbsset{
1155   docexample/.style={%
1156   colframe=thecodeframe,
1157   colback=thecodebackground,
1158   before skip=\medskipamount,
1159   after skip=\medskipamount,
1160   fontlower=\footnotesize,
1161   }
1162 }

1163 %
1164 %\newenvironment{dispListing*}[1]{%
1165 %  \phd@layer@pushup\cxset{docexample,#1}\phdwritelntemp%
1166 % }{\end{dispListing}}
1167
1168 % index auxiliary macros

1169 \ExplSyntaxOn
1170 \cs_set:Npn \phdindexprintca #1#2#3 {
1171   \ifphd@doc@colorize
1172     \textcolor{#2}{\texttt{#1}}
1173   { \texttt{#1} }
1174   \else
1175     \texttt{#1}
1176   \fi
1177   \ifphd@doc@annotate\
1178   #3
1179   \fi
1180 }
1181
1182
1183 \cs_set:Npn \phd_index_print_c#1#2{%
1184   \ifphd@doc@colorize
1185     \textcolor{#2}{\texttt{#1}}
1186   \else\texttt{#1}
1187   \fi%
1188
1189 }
1190
1191
1192 \NewDocumentCommand{\phdindexprintcomc}{ m }
1193   {
1194     \phd_index_print_c {\phdcs{#1}}{\phdd_key_color_command_tl}
1195   }
1196 %%
1197

```

```

\phd_print_com {\cs name}
Prints a command.

1198 \cs_new:Npn \phd_print_com #1
1199 {
1200     \textcolor{black}{\ttfamily\bfseries\phdcs{\#1}}%{\phdd_key_color_command_tl
1201 }
1202 }
1203 \ExplSyntaxOff
1204 \ExplSyntaxOn
1205 \newrobustcmd{\phdindexprintenvca}[1]
1206 {
1207     \phdindexprintca{\#1}{\phdd_key_color_environment_tl}{\phdkv{text@env}}
1208 }
1209
1210 \newrobustcmd{\phdindexprintenvc}[1]
1211 {
1212     \phd_index_print_c{\#1}{\phdd_key_color_environment_tl}
1213 }
1214 \ExplSyntaxOff
1215 \ExplSyntaxOn
1216 \cs_set:Npn \phd_print_env#1
1217 {
1218     \textcolor{\phdd_key_color_environment_tl}{\ttfamily\bfseries\#1}
1219 }
1220
1221 \newrobustcmd{\phdindexprintkeyca}[1]
1222 {
1223     \phdindexprintca{\#1}{\phdd_key_color_tl}{\phdkv{text@key}}
1224 }
1225
1226 \newrobustcmd{\phdindexprintkeyc}[1]{\phd_index_print_c{\#1}{\phdd_key_color_tl}}
1227
1228
1229 \newrobustcmd{\phdindexprintvalca}[1]
1230 {
1231     \phdindexprintca{\#1}{\phdd_key_color_value_tl}{\phdkv{text@value}}
1232 }
1233
1234
1235 \newrobustcmd{\phdIndexPrintValC}[1]
1236 {
1237     \phd_index_print_c{\#1}{\phdd_key_color_value_tl}
1238 }
1239
1240 \cs_set:Npn \phd@Print@Val #1
1241 {
1242     \textcolor{\phdd_key_color_value_tl}{\ttfamily\bfseries\#1}
1243 }
1244
1245 \newrobustcmd{\phdindexprintcolca}[1]
1246 {
1247     \phdindexprintca{\#1}{\phdd_key_color_color_tl}{\phdkv{text@color}}

```

```

1248     }
1249
1250
1251
1252
1253
1254 \cs_set:Npn \phdindexcom #1
1255 {
1256     \ifphd@doc@toindex
1257         \index
1258         {
1259             #1
1260             \idx@actual
1261             \phdindexprintcomc{#1}
1262         }
1263     \fi
1264 }
```

### \phd\_index\_env{\<environment name>}

Auxiliary command to add an environment to the index. The environment name need to come from the key settings. This need to be integrated with the i18n package later on.

```

1265 \cs_set:Npn \phd_index_env #1
1266 {
1267     \ifphd@doc@toindex
1268         \index
1269         {#1
1270             \idx@actual
1271             \phdindexprintenvca{#1}
1272         }
1273     \index
1274     {
1275         \phdkv@text@envs
1276         \idx@level#1
1277         \idx@actual
1278         \phdindexprintenvc{#1}
1279     }
1280     \fi
1281 }
```

### \phd\_index\_key{\<key name>}

Indexes a key.

```

1282 \cs_set:Npn \phd_index_key_path #1#2
1283 {
1284     \ifphd@doc@toindex\index{#2\idx@actual
1285         \phdindexprintkeyca{#2}}
1286         \index{\phdkv@text@keys
1287             \idx@level#1
1288             \idx@actual
1289             \phdindexprintkeyc{/#1/}
1290             \idx@level#2}
```

```

1291         \idx@actual
1292         \phdindexprintkeyc{#2}
1293     }
1294     \fi
1295 }

\phd_index_col {\color name}

1296 \cs_set:Npn \phd_index_col #1
1297 {
1298     \ifphd@doc@toindex
1299     \index
1300     {
1301         #1
1302         \idx@actual
1303         {\phdindexprintcolca{#1}}
1304         \encapchar hyperpage
1305     }
1306     \index
1307     {
1308         \phdkv{text@colors \idx@level #1}
1309         \idx@actual{\phdindexprintcolc {#1}\protect\thinspace\protect\docColorBox{#1}
1310         \encapchar hyperpage
1311     }
1312     \fi
1313 }
1314
1315 \ExplSyntaxOff
1316 \ExplSyntaxOn
1317 \cs_set:Npn \phd_brackets #1
1318 {
1319     {\ttfamily\char`{}{\#1{\ttfamily\char`{}}}
1320 }
1321 \ExplSyntaxOff

\begin{phdd_manual_entry}
<environment content>
\end{phdd_manual_entry}

```

A list enclosing manual entries.

```

1322 \ExplSyntaxOn
1323 \newenvironment{phdd_manual_entry}%
1324 {
1325     \begin{list}{}%
1326     \setlength{\leftmargin}{\phdkv{doc@left}}%
1327     \setlength{\itemindent}{0pt}%
1328     \setlength{\itemsep}{0pt}%
1329     \setlength{\parsep}{0pt}%
1330     \setlength{\rightmargin}{\phdkv{doc@right}}%
1331     \item
1332 }
1333 \end{list}

```

```

1335
1336 \cs_set:Npn \phd_manual_top #1
1337 {
1338   \itemsep=0pt
1339   \parskip=0pt
1340   \item\strut{\#1}\par
1341   \topsep=0pt
1342 }
1343
1344 \cs_set:Npn \phd_doc_do_description:
1345 {
1346   \ifx\phdkv@doc@description\empty
1347   \else
1348     \tcblower
1349     \raggedleft(\phdkv@doc@description)
1350   \fi
1351 }
1352 \ExplSyntaxOff

\begin{phd@doc@head} {additional options}
<environment content>
\end{phd@doc@head}

```

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

```

1353 \ExplSyntaxOn
1354 \newtcolorbox{phd@doc@head}[1]
1355 {
1356   blank,
1357   colback=red!10,
1358   colframe=white,
1359   code={\tcbbdimto\tcb@temp@grow@left{-
1360     \phdkv@doc@indentleft}%
1361     \tcbbdimto\tcb@temp@grow@right{-
1362     \phdkv@doc@indentright}},
1363   grow-to-left-by=\tcb@temp@grow@left,%
1364   grow-to-right-by=\tcb@temp@grow@right,
1365   sidebyside,
1366   sidebyside-align=top,
1367   sidebyside-gap=-\tcb@w@upper@real,
1368   phantom=\phantomsection,%
1369   enlarge-bottom-by=-0.2\baselineskip,
1370   #1
1371 }
1372 \ExplSyntaxOff
1373 \ExplSyntaxOn
1374 \newenvironment{docCmd}[3][]{%
1375   \cxset{\#1}%
1376   \begin{phd_manual_entry}%
1377   \begin{phd@doc@head}{doc@head@command}%
1378   \phd_print_com{\#2}

```

```

1377  \phdindexcom{#2}
1378  \protected@edef@\currentlabel{\noexpand\phdcs{#2}}
1379  \label{com:#2}{\ttfamily #3}%
1380  \phd_doc_do_description:%
1381  \end{phd@doc@head}%
1382  {\end{phdd_manual_entry}}
1383 \ExplSyntaxOff
1384 \ExplSyntaxOn
1385 \newenvironment{docCmd*}
1386 {
1387   \begingroup
1388   \phd@doc@toindexfalse
1389   \begin{docCommand}
1390   }
1391   {
1392   \end{docCommand}
1393   \endgroup
1394 }
1395
1396 \newenvironment{docEnv}[3][]{\cxset{#1}%
1397   \begin{phdd_manual_entry}%
1398   \begin{phd@doc@head}{doc@head@environment}%
1399   \strut
1400   \phdcs{begin}
1401   \phd_brackets{\phd_print_env{#2}}
1402   \phd_index_env{#2}
1403   \protected@edef@\currentlabel{#2}\label{env:#2}{\ttfamily #3}\%\par%
1404   \strut~~\meta{\phdkv@text@envcontent}\%\par%
1405   \strut\phdcs{end}
1406   \phd_brackets{\phd_print_env{#2}}%
1407   \phd_doc_do_description:%
1408   \end{phd@doc@head}%
1409   {\end{phdd_manual_entry}}
1410 \ExplSyntaxOff
\begin{docEnv*}<environment content>\end{docEnv*}

1411 \newenvironment{docEnv*}
1412 {
1413   \bgroup
1414   \phd@doc@toindexfalse
1415   \begin{docEnv}
1416   }
1417   { \end{docEnv}\egroup }

```

---

Updated: 2018-12-06

```

\begin{docKey} [<key path>] [<options>] {<name>} {<parameters>} {<description>}
  <key description>
\end{docKey}

```

`/foo/footitle=<text>` (no default, initially empty)  
Creates a heading line with `<text>` as content.

**Example 12.2 Using dockey**

```

472 \%begin{docKey}[foo]{footitle}{ = \meta{text}}{no
    default, initially empty}
473 % Creates a heading line with \meta{text} as content.
474 \%end{docKey}
475 %

```

**/foo/footitle = <text>** (no default, initially empty)

Creates a heading line with <text> as content.

```

1418 \ExplSyntaxOn
1419 \renewenvironment{docKey}[4][\@empty]{
1420     \begin{phdd_manual_entry}%
1421         \cxset{doc~description={#4}}%

```

The contents of the key are placed using `\phd@doc@head`, which is a tcolorbox. `doc@head@key` is a style for the tcolorbox.

```

1422     \begin{phd@doc@head}{doc@head@key}
1423         \ifx#1\@empty%
1424             \phd_print_key:n {#2}
1425             \phd_index_key{#2}
1426             \protected@edef{\currentlabel}{#2}
1427             \label{key:#2}{\ttfamily #3}%
1428         \else
1429             \phd_print_key:n {/#1/#2}
1430             \phd_index_key_path{#1}{#2}
1431             % redefine current label
1432             \protected@edef{\currentlabel}{/#1/#2}
1433             % label
1434             \label{key:/#1/#2}{\ttfamily #3}%
1435         \fi%
1436     \phd_doc_do_description:
1437     \end{phd@doc@head}
1438 \end{phdd_manual_entry}

1439 \renewenvironment{docKey*}
1440     {\bgroup\phd@doc@toindexfalse\begin{docKey}}
1441     {\end{docKey}\egroup}
1442
1443
1444 \cs_set:Npn \phdmakedocSubKey#1#2{%
1445     \newenvironment{#1}[4][\@empty]{%
1446         \ifx##1\@empty
1447             \cs_set:Npn \phd@key@path {#2}
1448         \else
1449             \cs_set:Npn \phd@key@path{#2/#1}
1450         \fi%
1451         \begin{docKey}[\phd@key@path]{##2}{##3}{##4}%
1452     \end{docKey}%
1453     \newenvironment{#1*}{\bgroup\phd@doc@toindexfalse\begin{#1}}{\end{#1}\egroup}%
1454 }
1455 \ExplSyntaxOff

```

```

1456 \ExplSyntaxOn
1457 \cs_set:Npn \@@_doc_aux_env: #1
1458 {
1459     \phd_print_env{#1}
1460     \phd_index_env{#1}
1461 }
1462
1463 \cs_set:Npn \@@_doc_aux_env_star #1
1464 {
1465     \phd_print_env{#1}
1466 }

```

**\docAuxEnv** <star> {<arg1>}

```

1467 \NewDocumentCommand\docAuxEnv { s m }
1468 {
1469     \IfBooleanTF {#1}
1470     {\@@_doc_aux_env_star{#2} }
1471     {\@@_doc_aux_env: {#2} }
1472 }
1473 \ExplSyntaxOff

```

**\docAuxKey** [<path>]{<value>}

Prints in-line the value of a key. For pgf keys the optional argument typesets the family:

*Example:* \docAuxKey[phd]{index doc settings} typesets:  
*/phdd/index doc settings*

\phd\_print\_key:n  
\phd\_index\_key:n  
\phdd\_index\_key:n

Besides the main function we require a function to typeset the key another on to typeset the index and auxiliaries to handle the star and optional argument.

```

1474 \ExplSyntaxOn
1475 \cs_set:Npn \phd_print_key:n #1
1476 {
1477     \textcolor{\phdd_key_color_tl}{\ttfamily\bfseries#1}
1478 }
1479
1480 \cs_set:Npn \phd_index_key #1
1481 {
1482     \ifphd@doc@toindex
1483         \index{#1\idx@actual \phdindexprintkeyc{#1}}
1484         \index
1485         {
1486             \phdkv@text@keys
1487             \idx@level
1488             #1
1489             \idx@actual
1490             \phdindexprintkeyc{#1}
1491         }
1492     \fi
1493 }
1494
1495 \NewDocumentCommand {\@@_doc_aux_key:} {O{\emptyset} m}

```

```

1496      {%
1497          \ifx#1\@empty%
1498              \phd_print_key:n {#2}
1499              \phd_index_key {#2}%
1500          \else%
1501              \phd_print_key:n {/#1/#2}
1502              \phd_index_key_path {#1}{#2}%
1503          \fi
1504      }%
1505
1506      \newcommand{\@@_doc_aux_key_star}[2][\@empty]{%
1507          \ifx#1\@empty%
1508              \phd_print_key {#2}%
1509          \else%
1510              \phd_print_key {/#1/#2}%
1511          \fi}%
1512
1513      \DeclareDocumentCommand {\docAuxKey} { s O{} m }
1514      {
1515          \IfBooleanTF {#1}
1516          { \@@_doc_aux_key_star {#3} }
1517          { \@@_doc_aux_key: [#2]{#3} }
1518      }
1519      \ExplSyntaxOff

```

(End definition for `\phd_print_key:n`, `\phd_index_key:n`, and `\phdd_index_key:n`.)

`\phd_ref_doc {<refname>}`

We use `hyperref`<sup>3</sup> to add links. The `\hyperref[<label>]{<text>}` is used to create the link. We use `\ding{213}` → for the page see `\docColor`<sup>→ σ 776</sup>. This is a great technique pioneered in the PGF and PGFPlots manuals for cross referencing and the code below is an adaptation.

There are two colors involved here and for a good reason. The first color needs to emphasize the command and to be consistent with the description macros. The second is the hyperlink color. For very long manuals, this can get a bit ugly, so one may want to de-emphasize it, like I have done here.

References are not numbers, however they often store numerical data such as section or page numbers. `\ref` or `\pageref` cannot be used for counter assignments and calculations because they are not expandable. The package `refcount`<sup>4</sup> can be used to extract the data from references. The package supports `hyperref`, `nameref`, `titleref`, and `babel` so it is safe to use. We set the default value here. `\docColors`

```

1520  \ExplSyntaxOn
1521  \setrefcountdefault{-1}

```

(End definition for `\setrefcountdefault` and `\getpagerefnumber`.)

```

1522  \cs_set:Npn \phd_ref_doc #1 #2
1523  {

```

<sup>3</sup>`hyperref`.

<sup>4</sup>`refcount`.

```

1524 \IfRefUndefinedExpandable {#2}
1525   {{\bfseries\phdd_typeset_command {#1} }}
1526   {
1527     \hyperref[#2]
1528     {{\color{themacrocolor}\texttt{\{\\ref*{#2}\}}}}%
1529     \ifnum\getpagerefnumber{#2}=\thepage
1530     \else
1531       \textsuperscript
1532       {
1533         \ding{213}\,
1534         \phdkv@text@pageshort\,
1535         \pageref*{#2}
1536       }
1537     \fi
1538   }
1539 }
1540 }
1541
1542 \cs_set:Npn \phd_ref_doc_star#1
1543 {
1544   \hyperref[#1]{\texttt{\{\\ref*{#1}\}}}
1545 }
1546 \ExplSyntaxOff

\refCmd{*} {name}

```

The `\refCmd` references a documented macro, where name is written without a backslash. the page reference is supressed if it links to the same page. The star version does not print a page reference.

#### \ref\_com:

```

1547 \ExplSyntaxOn
1548 \cs_set:Npn \ref_com: #1
1549 {
1550   \phd_ref_doc {#1} {com:#1}
1551 }
1552
1553 \cs_set:Npn \ref_com_star #1
1554 {
1555   \phd_ref_doc_star{com:#1}
1556 }

(End definition for \ref_com::)

1557 \DeclareDocumentCommand {\refCmd} { s m }
1558 {
1559   \IfBooleanTF {#1}
1560   { \ref_com_star {#2} } { \ref_com: {#2} }
1561 }
1562 \ExplSyntaxOff

1563 \ExplSyntaxOn
1564 \cs_set:Npn \refEnv: #1 {\phd_ref_doc{env:#1}}
1565 \cs_set:Npn \refEnv_star#1{\phd_ref_doc_star{env:#1}}
1566

```

```

1567 \DeclareDocumentCommand {\refEnv} { s m }
1568   {
1569     \IfBooleanTF {#1}
1570       { \refEnv_star {#2} }
1571       { \refEnv: {#2} }
1572   }
1573 \ExplSyntaxOff

\refKey*{<ref text>}

1574 \ExplSyntaxOn
1575 \cs_set:Npn \refKey@#1{\phd_ref_doc{key:#1}}
1576 \cs_set:Npn \refKey@star#1{\phd_ref_doc_star{key:#1}}
1577 \DeclareDocumentCommand {\refKey} { s m }
1578   {
1579     \IfBooleanTF { #1 }
1580       { \refKey@star {#2} }
1581       { \refKey@ {#2} }
1582   }
1583 \ExplSyntaxOff

\refAux{<command name>}

1584 \ExplSyntaxOn
1585 \cs_set:Npn \refAux#1{\textcolor{\phdkv@colhyper}{\ttfamily #1}}
1586 \cs_set:Npn \refAuxcs#1{\textcolor{\phdkv@colhyper}{\phdcs{#1}}}
1587 \ExplSyntaxOff

```

## C.13 Indexing

Most of the indexing macros that follow have been adapted from the pgfmanual-en-macros or the tcolorbox documentation code and transliterated to expl3 language.

```

1588 \ExplSyntaxOn
1589 \cs_set:Npn \phd@doc@index@pgf@
1590   {
1591     \c@IndexColumns=2%
1592     \cs_set:Npn \theindex
1593       {
1594         \@restonecoltrue
1595         \columnseprule 0pt
1596         \columnsep 28\p@
1597         \twocolumn[\index@prologue]%
1598         \parindent -30pt%
1599         \columnsep 15pt%
1600         \parskip 0pt plus 1pt%
1601         \leftskip 30pt%
1602         \rightskip 0pt plus 2cm%
1603         \small%
1604         \cs_set:Npn \@idxitem{\par}%
1605         \let\item@\idxitem\ignorespaces
1606     }

```

```

1607     \cs_set:Npn \endtheindex{\onecolumn}%
1608     \cs_set:Npn \noindexing{\let\index=\@gobble}%
1609 }

```

### C.13.1 Index heading and prologue

The index prologue is text that is entered just before the indexing entries start. Most indices do not have any text. We also need to distinguish between using a chapter type heading or a section type heading.

```

1610 \cs_set:Npn \phd@doc@index@pgfsection{%
1611   \cs_set:Npn \index@prologue
1612   {
1613     \section*\{\phdkv@text@index\}
1614     \addcontentsline{toc}{section}{\phdkv@text@index}
1615     \par\noindent%
1616   }
1617   \phd@doc@index@pgf@
1618 }

1619 \cs_set:Npn \phd@doc@index@pgfchapter{%
1620   \cs_set:Npn \index@prologue{\ifdefined\phantomsection\phantomsection\fi
1621   \@makeschapterhead{\phdkv@text@index\}
1622   \addcontentsline{toc}{chapter}{\phdkv@text@index}\%
1623   \phd@doc@index@pgf@%
1624 }
1625 %
1626 \let\phd@doc@index@pgf=\phd@doc@index@pgfsection%
1627 \cs_set:Npn \phd@doc@index@doc
1628 {
1629   \let\phdindexcom = \SpecialMainIndex
1630   \let\phd_index_env = \SpecialMainEnvIndex
1631   \cxset{index german settings}
1632   \EnableCrossrefs
1633   \PageIndex
1634 }
1635
1636 \cs_set:Npn \phd@doc@index@off{}%
1637 \ExplSyntaxOff

1638 \tcbset{%
1639   reset@documentation/.style={%
1640     },
1641   documentation listing style=tcbdocumentation,
1642   doc left=2em,
1643   doc right=0pt,
1644   doc left indent=-2em,
1645   doc right indent=0pt,
1646   doc head=,
1647   before doc body=,
1648   after doc body=,
1649   doc description=,
1650   doc into index=true,
1651   doc marginnote=,
1652   initialize@reset=reset@documentation,

```

```

1653   color option=Option,
1654   color definition=Definition,
1655   color hyperlink=Hyperlink,
1656   index command=\index,%  

1657   index format=pgf,  

1658   index default settings,  

1659   index colorize=false,  

1660   index annotate=true,  

1661   english language,  

1662   keywords bold,  

1663 }
1664 \cxset{%
1665   reset@documentation/.style={%
1666   index format=pgf,  

1667   english language,  

1668   documentation listing style = tcbdocumentation,  

1669   index default settings,  

1670   color option=Option,  

1671   color definition=Definition,  

1672   color hyperlink=Hyperlink,  

1673   before example=\par\smallskip,  

1674   after example=,  

1675   doc left=0em,  

1676   doc right=0pt,  

1677   doc left indent=-2em,  

1678   doc right indent=0pt,  

1679   doc head=,  

1680   doc description=,  

1681   doc into index=true,  

1682   index colorize = true,  

1683   index annotate= false,  

1684 },
1685 % initialize@reset=reset@documentation,  

1686 }
1687 \cxset{reset@documentation}

```

We set the `//index format=pgf` and the rest of the keys to the `german` settings that are suitable for `doc`.

```

1688 \cxset{index format = pgfchapter,  

1689   index actual={=},  

1690   index level = {>},  

1691   index quote = {!},  

1692   index german settings,  

1693   color hyperlink = thelinkcolor, % links with color palette  

1694   color definition =thelinkcolor, % links with color palette  

1695   pageshort      = {$\sigma{}$},  

1696 }

```

`\main` This is defined in `doc` and is the user command for styling the main page in an index.

```
1697 \def\main#1{{\color{red}\underline{#1}}}
```

(End definition for `\main`.)

## C.14 Miscellaneous doc commands

For consistency all commands that typeset their content, as well as index it and perhaps, also reference it have the prefix `doc`.

`\docFile {⟨file name⟩}`

Typesets and index a file.

*Example:* `template_html.tpl`

```

1698 \ExplSyntaxOn
1699 \cs_set:Npn \@@_print_docfile:n #1 {%
1700     \begingroup
1701     \color{thered}
1702     \ttfamily {\tl_to_str:n{#1}}
1703     \endgroup
1704 }
1705
1706 \cs_set:Npn \docFile #1
1707 {
1708     \begingroup
1709     \@@_print_docfile:n {#1}
1710     \endgroup
1711     \index{files:\idx@level\protect\detokenize{#1}\encapchar hyperpage}
1712 }
```

`\docExtension` Extension macro

```

1713 \cs_set:Npn \docExtension #1
1714 {
1715     \texttt{\#1}
1716     \index{file~extensions\idx@level#1\encapchar hyperpage}
1717 }
1718 \let\docextension\docExtension
1719 \ExplSyntaxOff
```

(End definition for `\docExtension`.)

## C.15 Other Indexing functions

`\indexmany [⟨category⟩] {⟨clist⟩}`

This function indexes a comma delimited list of items. It is convenient when you have paragraphs with a lot of terms.

```

1720 \ExplSyntaxOn
1721 \DeclareDocumentCommand\indexmany{o m}{%
1722 {
1723     \clist_gset:Nn \indexmany: {#2}
1724     \IfValueTF{#1}{%
1725         {
1726             \clist_map_inline:Nn\indexmany: {%
1727                 {
1728                     \index{\idx@level##1}\index{##1}
1729                 }
1730             }
1731     }
1732 }
```

```

1731   {
1732     \clist_map_inline:Nn\indexmany:
1733     {
1734       \index{##1}
1735     }
1736   }
1737 }
1738 \ExplSyntaxOff

\idxlanguage{\textit{language name}}
Typesets and index a lanaguage name. Used in the i18n package.
Example: : idxlanguage{cypriote} cypriote
1739 \DeclareRobustCommand{\idxlanguage}[1]{%
1740   \index{\string #1 (script)}
1741   \index[scripts:\idx@level#1\encapchar hyperpage]{%
1742     \texttt{\#1}\xspace}%

```

## C.16 Indexing Symbols

The commands that are defined in this section can be used to produce almost any symbol that is described in the Comprehensive Symbols<sup>5</sup>. They are mostly variants as described by this publication. Some modernized a bit, others using L<sup>A</sup>T<sub>E</sub>X 3 type definitions.

Some of them are just used for typesetting symbols in tables.

\indexboth {\textit{arg1}} {\textit{arg2}}

Indexes both arguments.

Table C.1: **textcomp**  
Currency Symbols

|                    |           |              |                |          |
|--------------------|-----------|--------------|----------------|----------|
| \textbaht          | \$        | \textdollar* | \textguarani   | \textwon |
| \textcent          | \$        | \textdollar  | \textlira      | \textyen |
| \textcent          |           | \textdong    | \textnaira     |          |
| \textcolonmonetary | \texteuro | \texteuro    | \textpeso      |          |
| \textcurrency      | f         | \textflorin  | \textsterling* |          |

```

1743 \newcommand{\idxboth}[2]{\mbox{}\index{#1 #2}\index{#2\idx@level#1}}
1744 \newcommand{\idxbothbegin}[2]{\mbox{}\index{#1 #2|()}\index{#2\idx@level #1|()}}
1745 \newcommand{\idxbothend}[2]{\mbox{}\index{#1 #2|})\index{#2\idx@level #1|})}
1746 \ExplSyntaxOn

```

<sup>5</sup>comprehensive.

```

1747 \cs_gset_eq:NN \indexboth\idxboth
1748 \cs_gset_eq:NN \indexbothbegin \idxbothbegin
1749 \cs_gset_eq:NN \indexbothend\idxbothend
1750 \ExplSyntaxOff

```

We define a related macro for indexing accents. In a previous version of this file, `\indexaccent` additionally included "see also accents" in the index. This became distracting so I made `\indexaccent` a synonym for `\indexcommand` for the time being. Because punctuation marks can be problematic for makeindex, we define an acro that sorts its argument under the comparatively innocuous "`\_`".

```

1751 \def\cmd#1{\texttt{\$string#1}\indexcommand{#1}}
1752 \newcommand{\cmdI}[2][]{%
1753   \def\first@arg{#1}%
1754   \ifx\first@arg\empty
1755     \texttt{\$string#2}\indexcommand[#2]{#2}%
1756   \else
1757     \texttt{\$string#2}\indexcommand[#1]{#2}%
1758   \fi
1759 }
1760 \newcommand{\cmdX}[1]{\cmdI[$string#1${#1}]}
1761 \newcommand{\cmdW}[1]{\cmdI[$string\blackacc{$string#1$}{#1}]}
1762 \newcommand{\cmdIp}[2][]{%
1763   \def\first@arg{#1}%
1764   \ifx\first@arg\empty
1765     \texttt{\$string#2}\indexpunct[#2]{#2}%
1766   \else
1767     \texttt{\$string#2}\indexpunct[#1]{#2}%
1768   \fi
1769 }

```

### `\sanitize{<command>}`

Delimited macro (!!!) that sanitizes macros. Classic TeXBook style. It removes the backslash. Not too sure if the word sanitize is appropriate. Another approach is to gobble the backslash. See ??<sup>P.??</sup>.

```

1770 \begingroup
1771   \catcode`\|=0
1772   \catcode`\\=12
1773   |gdef|sanitize#1#2!!!{%
1774     |ifx#1\%#
1775       #2%
1776     |else
1777       #1#2%
1778     |fi
1779   }
1780 |endgroup

```

### `\indexcommand[<>]{<command>}`

Index a *symbol*, which may or may not begin with a *backslash*. (Is there a better way to do this?) Also, if symbol is given as an optional argument is given, typeset that symbol in the index, as well

```

1781 \ExplSyntaxOn
1782 \NewDocumentCommand \indexcommand { o m }
1783 {
1784   \edef\sanitized{\expandafter\sanitize\string#2!!!}%
1785   \%def\first@arg{#1}%
1786   \IfNoValueTF{#1}
1787   {
1788     \exp_after:wN
1789     \index {
1790       \sanitized
1791       \idx@actual
1792       {\expandafter
1793        \phdIndexPrintCs{\sanitized}}
1794       \encapchar~hyperpage
1795     }%
1796   }
1797   {
1798     \expandafter
1799     \index\expandafter{\sanitized\idx@actual{\string\verb+\string#2+ (#1)}\encap}
1800   }
1801 }
1802 \ExplSyntaxOff
1803

```

### C.16.1 Indexing archaic scripts.

#### \indexcypriot [*arg1*] {*arg2*}

Index helper function for indexing Cypriot script. Only used in the phd documentation.

```

1804 \NewDocumentCommand \indexcypriot { o m }
1805   {
1806     \edef\sanitized{\expandafter\sanitize\string#2!!!}%
1807     \IfNoValueTF{#1}
1808     {
1809       \expandafter\index\expandafter{Cypriot}\idx@level\sanitized=\string\verb+\string
1810     }
1811   {
1812     \expandafter\index\expandafter{Cypriot>}\sanitized=\string\verb+\string#2+ (#1)
1813   }
1814 }

```

#### \indexstaves [*arg1*] {*arg2*}

Index helper function for indexing Icelandic staves. Only used in the phd documentation.

```

1815 \NewDocumentCommand \indexstaves { o m }
1816   {
1817     \edef\sanitized{\expandafter\sanitize\string#2!!!}%
1818     \IfNoValueTF{#1}
1819     {
1820       \expandafter\index\expandafter{Staves>}\sanitized=\string\verb+\string#2+}%
1821     }

```

```

1822     {
1823         \expandafter\index\expandafter{Staves}>\sanitized=\string\verb+\string#2+ (#1)
1824     }
1825 }
```

### \indexlinearb [*<typesetting command(s)>*] {*command*}

Index helper function for indexing the linearb script. Only used in the phd documentation for scripts. In .idx it writes

```

%   \indexentry{Linear B >BPamphora=\phdIndexPrint {BPamphora} (\textlinb
%
\O
1826
1827 \newrobustcmd\phdIndexPrintCs[1]{%
1828   \catcode`\_=12\relax\catcode`\@11\relax\ttfamily\char`\\scantokens{#1}\unskip}%
1829 %
1830 %
1831 \NewDocumentCommand \indexlinearb { o m }
1832   {
1833     \edef\sanitized{\expandafter\sanitize\string#2!!!}%
1834     \IfNoValueTF{#1}
1835     {
1836       \index{Linear B\idx@level\string#1\idx@actual
1837         {\string\verb+\string#2+}\encapchar hyperpage}
1838     }
1839     { % index
1840       \index{Linear B
1841         \idx@level
1842         \string #1
1843         \idx@actual
1844         {\phdIndexPrintCs{\sanitized} (#1)}\encapchar hyperpage}%
1845     % typeset
1846     \string#2 & (#1)
1847   }
1848 }
```

|              |     |            |     |          |     |             |     |
|--------------|-----|------------|-----|----------|-----|-------------|-----|
| \BPamphora   | (Ӧ) | \BPchassis | (Ӯ) | \BPman   | (Ӯ) | \BPwheat    | (Ӯ) |
| \BParrow     | (Ӱ) | \BPcloth   | (Ӯ) | \BPnanny | (Ӯ) | \BPwheel    | (Ӯ) |
| \BPbarley    | (ӷ) | \BPcow     | (Ӯ) | \BPolive | (Ӯ) | \BPwine     | (Ӯ) |
| \BPbilly     | (Ӯ) | \BPcup     | (Ӯ) | \BPOx    | (Ӯ) | \BPwineiih  | (Ӯ) |
| \BPboar      | (Ӱ) | \BPewe     | (Ӯ) | \BPpig   | (Ӯ) | \BPwineiiih | (Ӯ) |
| \BPbronze    | (Ӱ) | \BPfoal    | (Ӯ) | \BPram   | (Ӯ) | \BPwineivh  | (Ӯ) |
| \BPbull      | (Ӯ) | \BPgoat    | (Ӯ) | \BPsheep | (Ӯ) | \BPwoman    | (Ӯ) |
| \BPCauldroni | (Ӯ) | \BPGoblet  | (Ӯ) | \BPsow   | (Ӯ) | \BPwool     | (Ӯ) |
| \BPCauldroni | (Ӯ) | \BPGold    | (Ӯ) | \BPspear | (Ӯ) |             |     |
| \BPchariot   | (Ӯ) | \BPhorse   | (Ӯ) | \BPsword | (Ӯ) |             |     |

### \indexugar [*<arg1>*] {*arg2*}

Index helper function for indexing Ugaritic scripts. Only used in the phd

documentation.

```

1849 \NewDocumentCommand \indexugar { o m }
1850   {
1851     \edef\sanitized{\expandafter\sanitize\string#2!!!}%
1852     \IfNoValueTF{#1}
1853     {
1854       \expandafter\index\expandafter{Ugarite}\sanitized=\string\verb+\string#2+}%
1855     }
1856     {
1857       \expandafter\index\expandafter{Ugarite}\sanitized=\string\verb+\string#2+ (#1
1858     }
1859 }
```

### \indexvarpersian [*arg1*] {*arg2*}

Indexing and doc command for var Persian tables.

```

1860 \NewDocumentCommand \indexvarpersian { o m }
1861   {
1862     \edef\sanitized{\expandafter\sanitize\string#2!!!}%
1863     \IfNoValueTF{#1}
1864     {
1865       \expandafter\index\expandafter{var Persian}\sanitized=\string\verb+\string#2+}%
1866     }
1867     {
1868       \expandafter\index\expandafter{var Persian}\sanitized=\string\verb+\string#2+ (#1
1869     }
1870 }
```

### \indexsoutharabian[⟨⟩]{⟨⟩}

Indexing and doc command for symbols tables.

```

1871 \NewDocumentCommand \indexsoutharabian { o m }
1872   {
1873     \edef\sanitized{\expandafter\sanitize\string#2!!!}%
1874     \IfNoValueTF{#1}
1875     {
1876       \expandafter\index\expandafter{South Arabian}\sanitized=\string\verb+\string#2+}%
1877     }
1878     {
1879       \expandafter\index\expandafter{South Arabian}\sanitized=\string\verb+\string#2+ (#1
1880     }
1881 }
```

## C.16.2 Indexing mathematical symbols

The currently available fonts  
 26-06-2015 The following indexing commands are auxiliary  
 commands to index unicode symbols for maths.

```

1882 \NewDocumentCommand \indexmathcmd { o m }
1883   { \def\cmd@to@cs#1#2{\char\number`#2\relax}
1884     \IfNoValueTF{#1}
1885     {
1886       \index{\string #2\idx@actual{\string\verb+\string#2+
```

```

1887      ($#2$}\encapchar hyperpage}
1888      % put command also
1889      \index{\string#1\idx@actual{\string\verb+\string#2+ ($\string#2$)*}\encapchar
1890    }
1891    {
1892      % with index level
1893      \index{#1\idx@level\protect\detokenize{#2}
1894          \idx@actual{\protect\detokenize{#2}($#2$}\encapchar hyperpage}%
1895      % command alone an symbol in parentheses
1896      \index{\cmd@to@cs#2\idx@actual{\string\verb+\string#2+ ($\string#2$)}\encapcha
1897    }
1898  }

```

### \indexaccent

Syntactic sugar identical to \indexcommand<sup>815</sup>

```

1899 \ExplSyntaxOn
1900 \cs_gset_eq:NN \indexaccent\indexcommand
1901 \cs_new:Npn \CLSLpipe {}|
1902 \ExplSyntaxOff

```

### \indexpunct [<arg1>] {<arg2>}

Indexing punctuation marks for latin scripts.

```

1903 \newcommand{\indexpunct}[2][]{
1904   \def\first@arg{#1}%
1905   \def\second@arg{#2}%
1906   \ifx\first@arg\empty
1907     \ifx\second@arg\CLSLpipe
1908       \index{_=\magicvertname}%
1909     \else
1910       \index{_=\string\verb+\string#2+}%
1911     \fi
1912   \else
1913     \ifx\second@arg\CLSLpipe
1914       \index{_=\magicvertname{} (#1)}%
1915     \else
1916       \index{_=\string\verb+\string#2+ (#1)}%
1917     \fi
1918   \fi
1919 }
1920 \%usepackage{longdiv}
1921 \newcommand\FC{\pkgname{fc}}
1922 \newcommand\VIET{\pkgname{vietnam}}
1923 \%newcommand\ABX{\pkgname{mathabx}}

```

### \incsyms <void>

We define an integer counter **totalsymbols** to keep track of all the symbols we load and list.<sup>6</sup> These are symbols which can be produced using command sequences.

---

<sup>6</sup>Unicode characters are counted separately and are dealt with under the phd-scriptsmanager package.

Define a counter to keep track of how many symbols are listed. Output this counter to the log file at the end of each run. Define `\prevtotalsymbols` to be the total number of symbols from the previous run.

```

1924 \ExplSyntaxOn
1925   \int_new:c {totalsymbols}
1926   \cs_new:Npn \incsyms { \int_gincr:c {totalsymbols} }
1927   \cs_new:Npn \thetotalsymbols {\int_use:c {totalsymbols} }
1928 \ExplSyntaxOff

\graybox {void}

1929 \newcommand*\graybox{\textcolor{thebackground}{\rule[-
  \adp]{\awd}{\aht}}}
1930
1931 % Define |\blackacc| to display an accented box, given an accent command.
1932 % Define |\blackacchack| to display an accented "a" and then black out
1933 % the "a".
1934 \newlength\awd
1935 \newlength\aht
1936 \newlength\adp
1937 \settowidth{\awd}{\normalfont a}
1938 \settoheight{\aht}{\normalfont a}
1939 \settodepth{\adp}{\normalfont a}
1940 \advance\adp by 0.06pt    % In Computer Modern, "a" extends slightly below its bound
1941 \advance\awd by \adp
1942
1943
1944 \gdef\blackacchack{\llap{\graybox}}
1945 \gdef\blackacc{\#1{\graybox}}
1946 \gdef\blackacctwo{\#1{\graybox}\graybox}

Symbol+verbatim for various types of symbols

1947 \def#1{%
1948   \begingroup
1949     \lccode`|=`\\
1950     \def\EStruename{#1T}
1951     \lowercase{\incsyms\index{#1=\string\verb+\string|#1+ (\string|\EStruename)}}
1952   \endgroup
1953   \csname ES#1T\endcsname
1954   & \csname ES#1D\endcsname
1955   &
1956   \ttfamily\expandafter\string\csname#1\endcsname
1957 }

```

These commands are here to be able to index these symbols for the index and to typeset them in the symbols appendix.

`\Kcyp[<text cmd>] {<symbol command>}`

Indexes and prints the Cypriot archaic font symbols.

*Example:* `\Kcyp[\textcyp{\Ca}]\Ca`

```

1958 \def\Kcyp@opt@arg[#1]#2{\incsyms\indexcypriot[\textcyp{\#1}]\#2\#1 & \ttfamily\string#
1959 \def\Kcyp@no@opt@arg#1{\incsyms\indexcypriot[\textcyp{\#1}]\#1\#1 & \ttfamily\string#
1960 \def\Kcyp{\@ifnextchar{\Kcyp@opt@arg}{\Kcyp@no@opt@arg}}

```

**\Kstav** [*<cmd>*] {*<stave cmd>*}

Indexes and prints an Icelandic stave.

```

1961 \ExplSyntaxOn
1962
1963 \cs_set:Npn \Kstav_opt_arg [#1]#2
1964 {
1965     \incsyms\indexstaves[#1]{#2}# 1 &\ttfamily\string#2
1966 }
1967
1968 \cs_set:Npn \Kstav_no_opt_arg #1
1969 {
1970     \incsyms\indexstaves[#1]{#1}#1 &\ttfamily\string#1
1971 }
1972
1973 \NewDocumentCommand\Kstav {o m} {
1974     \IfNoValueTF {#1}
1975     {
1976         \Kstav_no_opt_arg {#2}
1977     }
1978     {
1979         \Kstav_opt_arg [#1] {#2}
1980     }
1981 }
1982 \ExplSyntaxOff

```

**\K** [*<>*] {*<cmd>*}

Adds a symbol cmd to a table and the index.

```

1983 \ExplSyntaxOn
1984 \cs_set:Npn \K@opt@arg#1#2
1985 {
1986     \incsyms
1987     \indexcommand[#1]{#2}#1 &\footnotesize\ttfamily\string#2
1988 }
1989
1990 \cs_set:Npn \K@no@opt@arg#1
1991 {
1992     \incsyms
1993     \indexcommand[#1]{#1}#1 &\footnotesize\ttfamily\string#1
1994 }

```

**\K[*<symbol command>*] {*<symbol command>*}**

Command used to typeset a table of symbols such as textsymbols. The mandatory argument takes a command such as `\texteuro`, typesets the symbol first and then the command. It also adds it to the index. It is the most common command and hence we keep it short. It was originally defined in Comprehensive<sup>7</sup>. It also increases the counter `incsyms`. The optional argument has an alternative symbol.

*Example:* `\K\Square \Square`

---

<sup>7</sup>comprehensive.

```

1995 \NewDocumentCommand {\K} { o m }
1996 {
1997   \IfNoValueTF {#1} { \K@no@opt@arg {#2} } { \K@opt@arg {#1}{#2} }
1998 }
1999 \ExplSyntaxOff

```

Table C.3: L<sup>A</sup>T<sub>E</sub>X Escapable “Special” Characters

|    |     |   |   |   |     |   |    |   |    |   |    |   |      |
|----|-----|---|---|---|-----|---|----|---|----|---|----|---|------|
| \$ | \\$ | % | % | _ | \_* | } | \} | & | \& | # | \# | { | \: { |
|----|-----|---|---|---|-----|---|----|---|----|---|----|---|------|

```

2000 \ExplSyntaxOn
2001 \cs_set:Npn \Kp #1
2002 {
2003   \incsyms
2004   \indexpunct[$#1$]{#1}#1 &\footnotesize\ttfamily\string#1
2005 }
2006 \ExplSyntaxOff
2007 \% \begin{symtable}[EDICE]{\EDICE\ Dice}
2008 \% \index{dice}
2009 \% \idxboth{game-related}{symbols}
2010 \% \label{edice}
2011 \% \begin{tabular}{ll@{\qquad}ll@{\qquad}ll}
2012 \%   \KED[\allepsdice][\epsdice][\epsdice{1}]\epsdice\verb|{1}| &
2013 \%   \KED[\allepsdice][\epsdice][\epsdice{3}]\epsdice\verb|{3}| &
2014 \%   \KED[\allepsdice][\epsdice][\epsdice{5}]\epsdice\verb|{5}| \\
2015 \%   \KED[\allepsdice][\epsdice][\epsdice{2}]\epsdice\verb|{2}| &
2016 \%   \KED[\allepsdice][\epsdice][\epsdice{4}]\epsdice\verb|{4}| &
2017 \%   \KED[\allepsdice][\epsdice][\epsdice{6}]\epsdice\verb|{6}| \\
2018 \% \end{tabular}
2019 \% \end{symtable}
2020 \% \newif\ifEDICE
2021 \% \newcommand\EDICE{\pkgname{epsdice}}
2022 \% \IfFileExists{epsdice.sty}
2023 \% {\EDICEtrue
2024 \%   \usepackage{epsdice}
2025 \%   \let\origepsdice=\epsdice
2026 \%   \DeclareRobustCommand{\epsdice}[1]{\origepsdice##1}
2027 \%   \DeclareRobustCommand{\allepsdice}{%
2028 \%     \epsdice{1}%
2029 \%     \epsdice{2}%
2030 \%     \epsdice{3}%
2031 \%     \epsdice{4}%
2032 \%     \epsdice{5}%
2033 \%     \epsdice{6}%
2034 \%   }
2035 \% }
2036 \% {}

```

The below are faked symbols, based on Scott Pakin’s **fakedozenal.sty**. We include this file with the **phd** bundle distribution. With LuaLaTeX this can be included. This is a rather strange package with probably very few users and

use. It has intrigued me and I include it here.<sup>8</sup>

```

2037 % Load a faked version of a package.
2038 % \newcommand{\fakeusepackage}[1]{%
2039 %   \let\origProvidesPackage=\ProvidesPackage
2040 %   \def\ProvidesPackage##1##2{\origProvidesPackage##1##2}\endinput}
2041 %   \usepackage{#1}
2042 %   \let\ProvidesPackage=\origProvidesPackage
2043 %   \usepackage{fake#1}
2044 %}
2045 %
2046 %\newif\ifDOZ
2047 %\newcommand\DOZ{\pkgname{dozenal}}
2048 %\IfFileExists{dozenal.sty}%
2049 % {\DOZtrue
2050 %   \ifluatex
2051 %     \RequirePackage[nocounters,typeone]{dozenal}
2052 %   \else
2053 %     \fakeusepackage{dozenal}
2054 %   \fi
2055 %   \DeclareRobustCommand{\DOZx}{\doz{X}}
2056 %   \DeclareRobustCommand{\DOZe}{\doz{E}}
2057 %   \DeclareRobustCommand{\alldoztallies}{%
2058 %     \doz{1}%
2059 %     \doz{2}%
2060 %     \doz{3}%
2061 %     \doz{4}%
2062 %     \doz{5}%
2063 %     \doz{6}%
2064 %   }
2065 % }
2066 %{}}

```

### \KED[⟨⟩][⟨2⟩][⟨3⟩][⟨4⟩]

Documentation macros for tables showing dozenal symbols. Rarely used.

```

2067 \def\KED[#1][#2][#3]#4 {%
2068   \incsyms\indexcommand[#1]{#2}#3 &\small\ttfamily\string#4%
2069 }
2070
2071 % feyn provides yet another math font for which we have no room.
2072 % Fortunately, it's relatively easy to define all of its symbols in
2073 % terms of a text font.
2074
2075
2076 \def\Kfeyn#1{\incsyms\indexcommand[\string\feyn{#1}]{\feyn{#1}}\feyn{#1} &\small\ttf
2077 % We have no math alphabets left so we trick svrsymbols.sty into defining
2078 % all of its characters in text mode.
2079 %\newif\ifSVR
2080 %\newcommand\SVR{\pkgname{svrsymbols}}
2081 %\makeatletter

```

---

<sup>8</sup>See the website of the dozenal society to understand what it is all about.  
<http://www.dozenal.org/index.html>

```

2082 \%IfFileExists{svrsymbols.sty}
2083 %   {\SVRtrue
2084 %     \let\origDeclareSymbolFont=\DeclareSymbolFont
2085 %     \let\origDeclareMathSymbol=\DeclareMathSymbol
2086 %     \let\origSetSymbolFont=\SetSymbolFont
2087 %     \renewcommand{\DeclareSymbolFont}[5]{}
2088 %     \renewcommand{\SetSymbolFont}[6]{}
2089 %     \renewcommand{\DeclareMathSymbol}[4]{%
2090 %       \let##1=\relax% \photon and \antiproton are defined repeatedly.
2091 %       \newcommand{##1}{{\usefont{OML}{svr}{m}{it}\char##4}}%
2092 %     }
2093 %     \usepackage{svrsymbols}
2094 %     \let\DeclareSymbolFont=\origDeclareSymbolFont
2095 %     \let\DeclareMathSymbol=\origDeclareMathSymbol
2096 %     \let\SetSymbolFont=\origSetSymbolFont
2097 %   }
2098 % }
2099 %%
2100 %%
2101 % \newenvironment{longsymtable}[2][true]{%
2102 %   \expandafter\global\expandafter\let
2103 %     \expandafter\ifshowsymtable\csname if#1\endcsname
2104 %   \ifshowsymtable
2105 %     \mbox{ }%
2106 %     \Nedspace*{13\baselineskip}%
2107 %     \mbox{ }%
2108 %     \begin{center}%
2109 %     \phantomsection
2110 %     \refstepcounter{table}%
2111 %%
2112 % Inhibit longtable's implicit increment of the table counter.
2113 % \let\refstepcounter=\gobble
2114 % \let\LT@array=\origLT@array
2115 % \let\LT@start=\origLT@start
2116 %%
2117 % \addcontentsline{toc}{subsection}{%
2118 %   \protect\numberline{\tablename~\thetable}{\#2}}%
2119 % \makecaption{\fnum@table}{\#2}%
2120 % \gdef\lt@indexed{}%
2121 % \let\next=\relax
2122 % \else
2123 %   % The following was taken verbatim from verbatim.sty.
2124 %   \let\do\@makeother\dospecials\catcode`^\^^M\active
2125 %   \let\verbatim@startline\relax
2126 %   \let\verbatim@addtoline\gobble
2127 %   \let\verbatim@processline\relax
2128 %   \let\verbatim@finish\relax
2129 %   \let\next=\verbatim@
2130 % \fi
2131 % \next
2132 % }{%
2133 %   \ifshowsymtable
2134 %     \end{center}
2135 %     \let\@elt=\index\lt@indexed % Close our index ranges.

```

```

2136 \% \gdef\lt@indexed{}%
2137 \% \vskip 8ex minus 2ex
2138 \% \fi
2139 \%}

2140 \% \begin{longsymtable}[SVR]{\SVR\ Physics Ideograms}
2141 \% \ltindex{particle-physics symbols}
2142 \% \ltindex{symbols>particle physics}
2143 \% \ltindex{fermions}
2144 \% \ltindex{subatomic particles}
2145 \% \ltindex{photons}
2146 \% \label{svrsymbols}
2147 \% \begin{longtable}{*3{ll}}
2148 \% \multicolumn{6}{l}{\small\textrit{(continued from previous page)}} \\ \[3ex]
2149 \% \endhead
2150 \% \endfirsthead
2151 \% \\\\[3ex]
2152 \% \multicolumn{6}{r}{\small\textrit{(continued on next page)}}
2153 \% \endfoot
2154 \% \endlastfoot
2155 \% \K\adsorbate & \K\experimentalsym & \K\protein & \\
2156 \% \K\adsorbent & \K\externalsym & \K\proton & \\
2157 \% \K\antimuon & \K\fermiDistrib & \K\quadrupole & \\
2158 \% \K\antineutrino & \K\fermion & \K\quark & \\
2159 \% \K\antineutron & \K\Gluon & \K\quarkb & \\
2160 \% \K\antiproton & \K\graphene & \K\quarkc & \\
2161 \% \K\antiquark & \K\graviton & \K\quarkd & \\
2162 \% \K\antiquarkb & \K\hbond & \K\quarks & \\
2163 \% \K\antiquarkc & \K\Higgsboson & \K\quarkt & \\
2164 \% \K\antiquarkd & \K\hole & \K\quarku & \\
2165 \% \K\antiquarks & \K\interaction & \K\reference & \\
2166 \% \K\antiquarkt & \K\internalsym & \K\resistivity & \\
2167 \% \K\antiquarku & \K\ion & \K\rhomesonminus & \\
2168 \% \K\anyon & \K\ionicbond & \K\rhomesonnull & \\
2169 \% \K\assumption & \K\Jpsimeson & \K\rhomesonplus & \\
2170 \% \K\atom & \K\Kaonminus & \K\solid & \\
2171 \% \K\bigassumption & \K\Kaonnull & \K\spin & \\
2172 \% \K\Bigassumption & \K\Kaonplus & \K\spindown & \\
2173 \% \K\biggassumption & \K\magnon & \K\spinup & \\
2174 \% \K\Bmesonminus & \K\maxwellDistrib & \K\surface & \\
2175 \% \K\Bmesonnull & \K\metalbond & \K\svrexample & \\
2176 \% \K\Bmesonplus & \K\method & \K\svrphoton & \\
2177 \% \K\bond & \K\muon & \K\tachyon & \\
2178 \% \K\boseDistrib & \K\neutrino & \K\tauleptonminus & \\
2179 \% \K\boson & \K\neutron & \K\tauleptonplus & \\
2180 \% \K\conductivity & \K\nucleus & \K\Tmesonminus & \\
2181 \% \K\covbond & \K\orbit & \K\Tmesonnull & \\
2182 \% \K\dipole & \K\phimeson & \K\Tmesonplus & \\
2183 \% \K\Dmesonminus & \K\phimesonnull & \K\triplecovbond & \\
2184 \% \K\Dmesonnull & \K\phonon & \K\Upsilonilonmeson & \\
2185 \% \K\Dmesonplus & \K\piomminus & \K\varphoton & \\
2186 \% \K\doublecovbond & \K\pionnnull & \K\water & \\
2187 \% \K\electron & \K\pionplus & \K\Wboson & \\
2188 \% \K\errorsym & \K\plasmon & \K\Wbosonminus & \\
2189 \% \K\etameson & \K\polariton & \K\Wbosonplus &

```

```

2190 \%K\etamesonprime & \K\polaron & \K\Zboson \\ \\
2191 \%K\exciton & \K\positron & \\ \\
2192 \%end{longtable} \\
2193 \%end{longsymtable} \\
2194 \%def\Kpig#1{\incsyms\index{pigpenfont #1=\string\verb+\string\pigpenfont\space#1+} \\
2195 \% \\
2196 \% \\
2197 \% \begin{docCommand} {Ks} { \marg{cmd} } \\
2198 \% \cs{Ks} index and doc command, asterisk for note that is not available in |OT1| \\
2199 \% superscript. \\
2200 \% \end{docCommand} \\
2201 \% \\
2202 \% \subsection{Arrows} \\
2203 \% \\
2204 \% We use a faked version of old-arrows.sty provide by Pakin so as not to waste a mat \\
2205 \% using LuaLaTeX. Under the latest versions of Lua and LaTeX we load it directly. \\
2206 \% \begin{macrocode} \\
2207 \% \newif\ifARR \\
2208 \% \newcommand\ARR{\pkgname{old-arrows}} \\
2209 \% \IfFileExists{old-arrows.sty} \\
2210 \% {\ARRtrue\usepackage[old]{old-arrows}} \\
2211 \% {} \\
2212 \% \\
2213 \% \\
2214 \% \\
2215 \%%\index{arrows} \\
2216 \%%\label{var-arrows} \\
2217 \%%\begin{tabular}{*3{ll}} \\
2218 \% \X\vardownarrow\downarrow & \X\varlongleftrightarrow\longleftrightarrow \\
2219 \% \X\varhookleftarrow\hookleftarrow & \X\varlongmapsfrom\longmapsfrom$^*\$ \\
2220 \% \X\varhookrightarrow\hookrightarrow & \X\varlongmapsto\longmapsto \\
2221 \% \X\varleftarrow\leftarrow & \X\varlongrightarrow\longrightarrow \\
2222 \% \X\varleftrightarrow\leftrightarrow & \X\varmapsfrom\mapsfrom$^*\$ \\
2223 \% \X\varlonghookrightarrow\longhookrightarrow & \X\varmapsto\mapsto \\
2224 \% \X\varlongleftarrow\longleftarrow & \X\varnearrow\nearrow \\
2225 \% \end{tabular} \\
2226 \\
2227 \ExplSyntaxOn \\
2228 \cs_set:Npn \Ks #1 \\
2229 { \\
2230 \incsyms \\
2231 \indexcommand[\string\encone{\string#1}] {#1} \\
2232 { \encone{#1} } & \ttfamily\string#1$^*\$ \\
2233 } \\
2234 \ExplSyntaxOff

```

This macro is also from the comprehensive and takes the symbol command as its only argument. It provides T1 encoding and also adds the command to the index.

```

2235 \ExplSyntaxOn \\
2236 \cs_set:Npn \Kt #1 \\
2237 { \\
2238 \incsyms

```

```

2239     \indexcommand[\string\encone{\string#1}] {#1}
2240     {\encone{#1} & \ttfamily \string #1
2241 }
2242 \ExplSyntaxOff

```

\Kv {⟨cmd⟩}

T5 encoding

```

2243 \def\Kv#1{\incsyms\indexcommand[\string\encfive{\string#1}]{#1}{\encfive{#1}} &\ttfa
2244 \def\Kgr@opt@arg[#1]#2{\incsyms\indexcommand[\string\encgreek{\string#1}]{#2}{\encgr
2245   \def\Kgr@no@opt@arg#1{\incsyms\indexcommand[\string\encgreek{\string#1}]{#1}{\encg
2246
2247 \def\Kgr{@ifnextchar[{\Kgr@opt@arg}{\Kgr@no@opt@arg}}
2248 \def\KN[#1][#2]#3{\incsyms\indexcommand[\string#1]{#3} #1 & #2 & \ttfamily\string#3}
2249 \def\KNbig[#1][#2]#3{\incsyms\indexcommand[\string#2]{#3} #1 & #2 & \ttfamily\string#3
2250
2251 \def\Knoidx#1{\incsyms#1 &\ttfamily\string#1}

```

\N

Big delimiters auxiliary command for doc and index.

```

2252 \ExplSyntaxOn
2253 \cs_set:Npn \N@opt@arg #1 #
2254 {
2255   \incsyms
2256   \indexcommand[$\string#1$]{#2}
2257   $\#1$ & $\Bigl#1$ &\footnotesize\ttfamily\string#2
2258 }
2259
2260 \cs_set:Npn \N@no@opt@arg#1
2261 {
2262   \incsyms\indexcommand[$\string#1$]{#1}
2263   $\#1$ & $\Bigl#1$ &\ttfamily\string#1
2264 }
2265
2266 \NewDocumentCommand {\N} { o m }
2267 {
2268   \IfNoValueTF {#1}
2269   { \N@no@opt@arg {#2} }
2270   { \N@opt@arg {#1}{#2} }
2271 }
2272
2273 \ExplSyntaxOff

```

\Nn[⟨⟩]{⟨⟩}

```

2274   \def\Nn[#1]#2{%
2275     \incsyms\indexcommand[$\string\nathdouble\string#1$]{#2}%
2276     $\nathdouble{#1}$ & $\nathdouble{\Bigr#1}$ &\ttfamily\string#2%
2277   }
2278
2279   \def\Nnt#1[#2]#3{%
2280     \incsyms\indexcommand{\triple}{%

```

```

2281   \$\nathtriple{#2\$} & \$\nathtriple{\Big#2\$} &
2282   \ttfamily\expandafter\string\csname#1\endcsname\string#3}
2283 \def\Np@opt@args[#1]{\ifnextchar[{\Np@two@opt@args[#1]}{\Np@one@opt@arg[#1]}}
2284 \def\Np@two@opt@args[#1][#2]{\inccs{index}{\string#2{} } (\$string#1\$) \$#1\$ & \$#2\$}
2285 \def\Np@one@opt@arg[#1]{\inccs{indexpunct}{\$string#1\$} {\#2\$} \$#1\$ & \$\Big#1\$ & \ttfamily
2286 \def\Np@no@opt@args#1{\inccs{indexpunct}{\$string#1\$} {\#1\$} \$#1\$ & \$\Big#1\$ & \ttfamily
2287 \def\Np{\@ifnextchar[{\Np@opt@args}{\Np@no@opt@args}}
2288 \def\Nbig[#1]{\inccs{indexcommand}{\$string\Big$string#1\$} {\#2\$} \$#1\$ & \$\Big#1\$ & \ttfamily

```

## \Q

Used to typeset accents in a symbols table. Note it adds the (&). First we define auxiliary functions.

\Q@opt@arg

```

2289 \ExplSyntaxOn
2290 \cs_set:Npn \Q@opt@arg#1#2
2291 {
2292   \inccs{indexaccent}{\string\blackacchack{\string#1}} {\#2\$} #1{A}#1{a} &
2293   \ttfamily\string#2\string{A\string}\string#2\string{a\string}
2294 }
2295
2296 \cs_set:Npn \Q@no@opt@arg#1
2297 {
2298   \inccs{indexaccent}{\protect\blackacchack{\string#1}} {\#1\$} #1{A}#1{a} &
2299   \ttfamily\string#1\string{A\string}\string#1\string{a\string}
2300 }
2301
2302 \NewDocumentCommand{\Q}{o m}
2303 {
2304   \IfNoValueTF{#1}
2305   { \Q@no@opt@arg{#2} }
2306   { \Q@opt@arg{#1}{#2} }
2307 }
2308 \ExplSyntaxOff

(End definition for \Q@opt@arg.)

2309 \newif\ifHARM
2310 \newcommand\HARM{\pkgname{harmony}}
2311 \IfFileExists{harmony.sty}
2312 {
2313   \HARMtrue
2314   \let\orignewcommand=\newcommand
2315   \let\newcommand=\DeclareRobustCommand
2316   %\savesymbol{HH}
2317   \usepackage{harmony}
2318   %\restoresymbol{harm}{HH}
2319   \let\newcommand=\orignewcommand
2320 }

```

Table C.4: **harmony**

Musical Accents

|                            |                                  |                              |                                |
|----------------------------|----------------------------------|------------------------------|--------------------------------|
| $\hat{\hat{A}}\hat{a}$     | <code>\Ferli{A}\Ferli{a}*</code> | $\hat{\hat{A}}\hat{a}$       | <code>\Ohne{A}\Ohne{a}*</code> |
| $\hat{\hat{A}}\hat{a}$     | <code>\Fermi{A}\Fermi{a}</code>  | $\widetilde{A}\widetilde{a}$ | <code>\Umd{A}\Umd{a}*</code>   |
| $(\circled{A})\circled{a}$ | <code>\Kr{A}\Kr{a}</code>        |                              |                                |

**\Qc{<accent symbol command>}**

Typesets and indexes accents on two letters (A) and (a), as two tabular cells.  
Increases the **incsyms** counter.

```

2321 \ExplSyntaxOn
2322 \cs_set:Npn \Qc#1
2323 {
2324   \incsyms
2325   \indexaccent[\string\blackacc{\string#1}]{#1} #1 {A} #1{a} &
2326   \ttfamily
2327     \string#1
2328     \token_to_str:N {
2329       A
2330     \token_to_str:N }
2331     \token_to_str:N #1
2332     \token_to_str:N {
2333       a
2334     \token_to_str:N }
2335   }
2336 \ExplSyntaxOff

```

and \=

**\Qe<arg1><arg2><arg3>**

Limited use command to typeset and index **magic symbols**, that is symbols that might confuse MakeIndex and that they are escaped. It is easier to use **text commands**.

*Example:* `\Qe[\magicequal][\magicequalname]\=` produces  
 $\bar{A}\bar{a} \ \bar{=}{A}\bar{=}{a}$

```

2337 \def\Qe[#1][#2]#3{%
2338   \incsyms
2339   \incsyms
2340   \index{_=\string#2{} (\string\blackacchack{\string#1})}%
2341   #3{A}#3{a} &
2342   \ttfamily\string#3\string{A\string}\string#3\string{a\string}%
2343 \def\Qt#1{\incsyms\indexaccent[\string\encone{\string\blackacc{\string#1}}]{#1}{\enc}
2344           \ttfamily\string#1\string{A\string}\string#1\string{a\string}}%
2345 \def\Qpc#1#2{\incsyms\indexcommand{#2}{\raisebox{1pt}{\tiny[#1]}} &
2346           \ttfamily\string#2\string{A\string}\string#2\string{a\string}}%

```

```

2347 \def\Qpfc[#1]{\inccs{indexaccent}[\string\encfour{\string\blackacc{\string#1}}
2348           \ttfamily\string#2\string{A\string}\string#2\string{a\string}]}
2349 \newif\ifFC\FCfalse
2350 \ifFC
2351   \def\Qiv#1#2{\inccs{indexaccent}[\string\encfour{\string\blackacc{\string#1}}
2352           \ttfamily\string#1\string{A\string}\string#1\string{a\string}\string$^{\#2\$}]}
2353
2354   \def\QivBAR#1{\inccs{index}{_=}\string\magicVertname{}}
2355           (\string\encfour{\string\blackacc{\string\FCbar{}}})
2356           \encfour{\FCbar{A}\FCbar{a}} &
2357           \ttfamily\string\|\string{A\string}\string\|\string{a\string}\string$^{\#1\$}}
2358 \else
2359   \def\Qiv#1#2{\Qpc{T4}{#1}\string$^{\#2\$}}
2360   \def\QivBAR#1{\Qpc{T4}{\|}\string$^{\#1\$}}
2361 \fi
2362 \newif\ifVIET\VIETfalse
2363 \ifVIET
2364   \def\Qv#1#2{\inccs{indexaccent}[\string\encfive{\string\blackacc{\string#1}}
2365           \ttfamily\string#1\string{A\string}\string#1\string{a\string}\string$^{\#2\$}]}
2366 \else
2367   \def\Qv#1#2{\Qpc{T5}{#1}\string$^{\#2\$}}\def\Qv#1#2{Err}%TODO
2368 \fi

```

\R [⟨ams cmd⟩] {⟨cmd⟩}

Used for variable size math operators

```

2369 \ExplSyntaxOn
2370 \cs_set:Npn \R@opt@arg#1#2
2371 {
2372   \inccs
2373   \indexcommand[$\string#1\string]{#2}
2374   $\string#1\$ & $\displaystyle\#1\$ & \ttfamily\string#2
2375 }
2376 \cs_set:Npn \R@no@opt@arg#1
2377 {
2378   \inccs
2379   \indexcommand[$\string#1\string]{#1}
2380   $\string#1\$ & $\displaystyle\#1\$ & \ttfamily\string#1
2381 }
2382 \NewDocumentCommand {\R} { o m}
2383 {
2384   \IfNoValueTF {#1}
2385   { \R@no@opt@arg {#2} }
2386   { \R@opt@arg {#1} {#2} }
2387 }
2388 \ExplSyntaxOff
2389 %% T commands

```

Keep tall symbols from touching.

$$\begin{array}{ccccccc} \int & \int & \iint & \int & \iiint & \iint \\ \int & \int & \iint & \int & \iiint & \iint \end{array}$$

### \indexDing {*ding symbol number*}

Auxiliary function to index and print in a table ding symbols. originally from Comprehensive.

```

2390 \ExplSyntaxOn
2391 \newcommand \indexDing [1]
2392 {
2393     \incsyms
2394     \indexcommand{\ding}
2395     \ding{#1} &
2396     \footnotesize\ttfamily\string\ding \string{#1\string}
2397 }
2398 \ExplSyntaxOff
2399 %    \end{macrocode}
2400 %
2401 %    \begin{macrocode}
2402 \def\Tding#1{%
2403     \incsyms\indexcommand[\ding{#1}]{\ding{#1}}\ding{#1}\indexcommand{\ding} &
2404     \ttfamily\string\ding\string{#1\string}%
2405 }
2406
2407 \def\Tm#1{\incsyms\indexcommand{\maya} $\mayadigit{#1}$ &\ttfamily\string\maya\string
2408 \def\Tmoon#1{\incsyms\indexcommand{\MoonPha}\MoonPha{#1} &\ttfamily\string\MoonPha\string

```

### \indexTextcomp[*ltx cmd*] {*symbol arg*}

This command typesets its command argument in a table row of two (used for textcomp symbols).

```

2409 \newcommand{\indexTextcomp}[2][]{%
2410     \incsyms#1 &
2411     \indexcommand[#2]{#2}% necessary to put symbol \text
2412     #2%
2413     &\ttfamily\string#2
2414 }

```

### \Vp

Commands that work both in math and text mode

```

2415 \newcommand{\Vp}[2][]{\incsyms#1 & \indexpunct[$#2$]{#2}#2 &\ttfamily\string#2}
2416 \newcommand{\V}[2][]{\incsyms\indexcommand[#1]{#2}#1 & \indexcommand[#2]{#2}#2 &\ttf
2417 \newcommand{\Vl}[1]{\incsyms\indexcommand[#1]#1 & & \ttfamily\string#1}
2418 \newcommand{\Vpl}[1]{\incsyms\indexpunct[$#1$]{#1}#1 & & \ttfamily\string#1}

2419 \def\W@opt@arg[#1]#2#3{%
2420     \incsyms\indexaccent[$\string\blackacc\string{#1}$$]{#2}%
2421     $#1{#3}$$ &\ttfamily\string#2\string{#3\string}%
2422 }

2423 \def\W@no@opt@arg#1#2{%
2424     \incsyms\indexaccent[$\string\blackacc\string{#1}$$]{#1}%
2425     $#1{#2}$$ &\ttfamily\string#1\string{#2\string}%
2426 }

2427 \def\W{@ifnextchar[{\W@opt@arg}{\W@no@opt@arg}}

```

```

2428 \def\Wf#1#2{\inccs{indexcommand}{#1}{#2} &\ttfamily{string#1}{string#2}}
2429 \def\Ww#1#2#3{\inccs{indexcommand}{#2}{#1}{#3} &\ttfamily{string#2}{string#3}{string}
2430 \def\Wu#1#2#3%
2431   \inccs{indexaccent}{$string\blackacc{two}{string#1}}{#1}%
2432   ${#1}{#2}{#3} &\ttfamily{string#1}{string#2}{string#3}{string}}

```

\X [*command*] {*command*}

Typesets its arguments as commands and also the resulting symbol in math. Used for symbol tables in the documentation.

Table C.6: AMS Commands Defined to Work in Both Math and Text Mode

✓ \checkmark ® \circledR ✕ \maltese

U 25-6-2015

```

2433 \ExplSyntaxOn
2434 \def\X_opt_arg#1#2 {\inccs{indexcommand}{$string#1}{#2}{#1} &\ttfamily{string#2}}
2435 \NewDocumentCommand{\X@no@opt@arg}{m}{\inccs{indexcommand}{$string#1}{#1}{#1} &\ttfamily{string#1}}
2436
2437 \NewDocumentCommand{\X}{o m}
2438 {
2439   \IfNoValueTF{#1}
2440   { \X@no@opt@arg {#2} }
2441   { \X_opt_arg {#1} {#2} }
2442 }
2443 \ExplSyntaxOff
2444 % \def\X@opt@arg[#1]{\inccs{indexcommand}{$string#1}{#2}{#1} &\ttfamily{string#2}}
2445 % \def\X@no@opt@arg#1{\inccs{indexcommand}{$string#1}{#1}{#1} &\ttfamily{string#1}}
2446 % \def\X{\ifnextchar[\X@opt@arg{\X@no@opt@arg}}
```

\Y{*math command*}

```

2447 \def\Y#1{\inccs{indexcommand}{$string\big$string#1}{#1}{\big#1} & $Bigg#1%
2448   &\scriptsize\ttfamily{string#1}}
```

\docZ {*arg1*}

Typesets and index its arguments.

|         |       |      |      |         |         |      |       |
|---------|-------|------|------|---------|---------|------|-------|
| \arccos | \cos  | \csc | \exp | \ker    | \limsup | \min | \sinh |
| \arcsin | \cosh | \deg | \gcd | \lg     | \ln     | \Pr  | \sup  |
| \arctan | \cot  | \det | \hom | \lim    | \log    | \sec | \tan  |
| \arg    | \coth | \dim | \inf | \liminf | \max    | \sin | \tanh |

```

2449 \ExplSyntaxOn
2450 \cs_set:Npn \docZ #1
2451 {
2452   \inccs
2453   \indexcommand{$string#1} {#1}
2454   \footnotesize
```

```

2455     \ttfamily
2456     \string #1
2457   }
2458 \ExplSyntaxOff

\utfviii {void}
Typesets UTF-8.

2459 \NewDocumentCommand{\utfviii}{ }{\mbox{UTF-8}\index{UTF-
8}\xspace}
2460
2461 % Index TeXbook symbols and the CTAN repository. CHECK
2462 \newcommand{\idxTBsyms}{%
2463   \index{symbols>TeXbook=\TeX{}book}%
2464   \index{TeXbook, The=\TeX{}book, The>symbols from}%
2465 }

```

**\pkgname** {*package name*}

Typesets and indexes a L<sup>A</sup>T<sub>E</sub>X package.

### Lazarides

```

2466 \newcommand{\pkgname}[1]{%
2467   \href{http://ctan.org/pkg/#1}{\bfseries{#1}}%
2468   \index{#1=\texttt{#1} (package)}%
2469   \index{packages>#1=\texttt{#1}}%
2470 }
2471 }

The \SpecialPageIndex indexes a package using hypdoc style commands so that it can work both in doc as well as elsewhere.

```

```

2472 \newcommand*\SpecialPageIndex[2][packages:]{%
2473   \@bsphack
2474   \begingroup
2475   \HD@target
2476   \let\HDorg@encapchar\encapchar
2477   \edef\encapchar usage{%
2478     \HDorg@encapchar \hdclindex{\the\c@HD@hypercount}{usage}%
2479   }%
2480   \index{#1\levelchar #2\actualchar
2481     {\protect\ttfamily #2}\encapchar usage}%
2482   \endgroup
2483   \@esphack
2484 }
2485
2486 \newcommand{\pkg}[1]{%
2487   \href{http://ctan.org/pkg/#1}{\bfseries{#1}}%
2488   \SpecialPageIndex[Packages:]{#1}%
2489 }
2490 % Comaptibility
2491 \let\Lpack\pkgname
2492
2493 \newcommand*\opt[1]{\texttt{#1}}
2494

```

```

2495 \newcommand*\feat[1]{\texttt{\#1}}
2496
2497
2498 \newcommand{\optname}[2]{%
2499   \textsf{\#2}%
2500   \index{\#2=\textsf{\#2} (\textsf{\#1} package option)}%
2501   \index{package options\#2=\textsf{\#2} (\textsf{\#1})}%

```

**\docClass{<name of class>}**

Prints and indexes a L<sup>A</sup>T<sub>E</sub>X class.

```

2502 \newcommand{\docClass}[1]{%
2503   \href{http://ctan.org/pkg/\#1}{\bfseries{\#1}}%
2504   \index{\#1=\texttt{\#1} (class)}%
2505   \index{classes\#1=\texttt{\#1}}%
2506
2507 \let\Lpack\pkgnam

```

This macro and all similar macros starting from doc typeset their argument and also add the argument to the index.

**\docfilename {<file name>}**

Typesets and indexes a file name.

```

2508 \newcommand{\docfilename}[1]{%
2509   \texttt{\#1}%
2510   \index{\#1\idx@actual{\phdindexprintcomc{\#1}(file)}\encapchar hyperpage}%
2511
2512 \let\docFilename\docfilename

```

**\docfileextension {<file extension>}**

Typesets and indexes a file extension, such as **\docfileextension{.tex}** (.tex). You type the dot if you want it to appear in the index, which is a good idea.

```

2513 \newcommand{\docfileextension}[1]{%
2514   \texttt{\#1}%
2515   \index{\#1\idx@actual{\texttt{\#1} (file extension)}\encapchar hyperpage}%
2516   \index{file extensions\idx@level \#1\idx@actual{\texttt{\#1}}\encapchar hyperpage}%
2517 }
2518
2519 \let\docFileExtension\docfileextension
2520 \newcommand{\PSfont}[1]{%
2521   \#1%
2522   \index{\#1 (font)}%
2523   \index{fonts\index@level\#1}%
2524 }
2525 \NewDocumentCommand{\person}{ m m } { \#1\index{\#2, \#1} \#2}

```

**\ctan{<package name>}**

Provides a link to the ctan package repository

```

2526 \DeclareRobustCommand{\ctan}[1]{%
2527   \textcolor{green}{%
2528     \href{http://www.ctan.org/pkg/#1}{{\bfseries #1}}%
2529   \footnote{\protect\url{http://www.ctan.org/pkg/#1}}%
2530   \index{Packages>#1}%
2531 }
2532 \newcommand{\idxCTAN}{%
2533   \index{Comprehensive TeX Archive Network=Comprehensive \string\TeX{} Archive Netwo%
2534 % Typeset a string in various encodings.
2535 \newcommand{\encone}[1]{\fontencoding{T1}\selectfont#1}%
2536 \newcommand{\encfour}[1]{\fontencoding{T4}\selectfont#1}%
2537 \newcommand{\encfive}[1]{\fontencoding{T5}\selectfont#1}%
2538 \newcommand{\encgreek}[1]{\fontencoding{LGR}\selectfont#1}%
2539
2540 % Various punctuation marks confuse makeindex when used directly.
2541 \let\magicrbrack=
2542 \let\magicequal=-
2543 \DeclareRobustCommand{\magicequalname}{\texttt{\$string\$}}
2544 \DeclareRobustCommand{\magicvertname}{\texttt{|}}
2545 \DeclareRobustCommand{\magicVertname}{\texttt{\$string\$|}}
2546
2547 % Vertically center a text-mode symbol.
2548 \newsavebox{\tvcbox}
2549 \newcommand*\textvcenter}[1]{%
2550   \savebox{\tvcbox}{#1}%
2551   \raisebox{0.5\dp\tvcbox}{\raisebox{-0.5\ht\tvcbox}{\usebox{\tvcbox}}}%
2552 }
2553 % Many tables have notes beneath them. Define an environment in which to
2554 % display such a note, with an optional, superscripted math symbol
2555 % preceding it.
2556 \newenvironment{tablenote}[1][]{%
2557   \makebox[1em]{\ensuremath{^{\#1}}}}%
2558   \begin{minipage}[t]{0.75\textwidth}%
2559   \setlength{\parskip}{2ex}%
2560 }{%
2561   \end{minipage}%
2562 }
2563
2564 % Define various messages we reuse repeatedly.
2565 \newcommand{\twosymbolmessage}{%
2566   \begin{tablenote}
2567     Where two symbols are present, the left one is the ``faked'' symbol
2568     that \latexe provides by default, and the right one is the ``true''
2569     symbol that \TC makes available.
2570   \end{tablenote}%
2571 }
2572
2573 \newcommand{\notpredefinedmessage}{%
2574   \begin{tablenote}[*]
2575     Not predefined in \latexe. Use one of the packages
2576     \pkgname{latexsym}, \pkgname{amsfonts}, \pkgname{amssymb},
2577     \pkgname{txfonts}, \pkgname{pxfonts}, or \pkgname{wasysym}.
2578   \end{tablenote}%
}

```

```

2579 }
2580
2581 \newcommand{\notpredefinedmessageABX}{%
2582   \begin{tablenote}[*]
2583     Not predefined in \latexe. Use one of the packages
2584     \pkgname{latexsym}, \pkgname{amsfonts}, \pkgname{amssymb},
2585     \pkgname{mathabx}, \pkgname{txfonts}, \pkgname{pxfonts}, or
2586     \pkgname{wasysym}.
2587   \end{tablenote}
2588 }
2589
2590 \newcommand{\usetextmathmessage}[1][]{{%
2591   \begin{tablenote}[#1]
2592     It's generally preferable to use the corresponding symbol from
2593     \vref{math-text} because the symbols in that table work
2594     properly in both text mode and math mode.
2595   \end{tablenote}
2596 }
2597
2598
2599
2600 \newcommand{\usefontcmdmessage}[2]{%
2601   These symbols must appear either within the argument to \cmd{#1} or
2602   following the \cmd{#2} font-selection command within a scope%
2603 }
2604 % Define an environment in which to write a single table of symbols. The
2605 % environment looks a lot like a table, but it doesn't float, and it gets
2606 % an entry in the table of contents as opposed to the list of tables.
2607 %
2608 % The first argument is a conditional. The table will appear only if
2609 % the value of the conditional is true. The second argument is the
2610 % table's caption.
2611
2612 \def\fnum@table{\tablename~\thetable}
2613
2614 \newenvironment{symtable}[2][true]{%
2615   \bgroup
2616   \expandafter\global\expandafter\let%
2617     \expandafter\ifshowsymtable\csname if#1\endcsname
2618   \ifshowsymtable
2619     \noindent%
2620     \begin{minipage}[t]{\linewidth}    % Prevent page breaks
2621       \begin{center}
2622         \refstepcounter{table}%
2623         \phantomsection
2624         \addcontentsline{toc}{subsection}{%
2625           \protect\numberline{\tablename~\thetable:\!\!#2}}%
2626         \makecaption{\fnum@table}{#2}\medskip
2627         \let\next=\relax
2628       \else
2629         % The following was taken verbatim from verbatim.sty.
2630         \let\do\@makeother\dospecials\catcode`\^^M\active
2631         \let\verbatim@startline\relax
2632         \let\verbatim@addtoline\gobble

```

```

2633     \let\verbatim@processline\relax
2634     \let\verbatim@finish\relax
2635     \let\next=\verbatim@
2636   \fi
2637   \next
2638 }{%
2639   \ifshowsymtable
2640     \end{center}
2641     \end{minipage}
2642     \vskip 8ex minus 2ex
2643   \fi
2644   \egroup
2645 }

```

We need a command that can typeset a symbol in the text and index it by its command name and also show the symbol in brackets next to it.

**\docSymbol** [*optional explicit formatting*] {*command*}

```

2646 % Display and index a command, but not its symbol (\cmd). \cmdI shows
2647 % the symbol in the index, with optional explicit formatting. \cmdX is
2648 % the same as \cmdI, but with the optional argument hardwired to the
2649 % command displayed in math mode. \cmdW indexes an accent. \cmdIp is
2650 % also similar to \cmdI but formats its argument with \indexpunct
2651 % instead of \indexcommand.
2652 \ExplSyntaxOn
2653 \newcommand{\docSymbol}[2][]{%
2654   \def\first@arg{\#1}%
2655   \ifx\first@arg\empty
2656     \texttt{\string#2} (#2)%
2657     \indexcommand[#2]{#2}%
2658   \else
2659     \texttt{\string#2} (#2)%
2660     \indexcommand[#1]{#2}%
2661   \fi
2662 }
2663 \ExplSyntaxOff

```

Table C.7: Fontawsome Currency Symbols

|   |        |   |        |   |        |    |            |
|---|--------|---|--------|---|--------|----|------------|
| ฿ | \faBtc | ₪ | \faILs | ₩ | \faKrw | \$ | \faUsd     |
| € | \faEur | ₹ | \faInr | ₱ | \faRub | ₭  | \faViacoin |
| £ | \faGbp | ¥ | \faJpy | ₺ | \faTry |    |            |

Fontawesome defines \faBitcoin(฿) as a synonym for \faBtc(฿); \faCny(¥), \faYen(¥), and \faRmb(¥) as synonyms for \faJpy(faJpy); \faDollar(faDollar) as a synonym for \faUsd(faUsd); \faEuro(faEuro) as a synonym for \faEur(faEur); \faRouble(faRouble) and \faRuble(faRuble) as synonyms for \faRub(faRub); \faRupee(faRupee) as a synonym for \faInr(faInr); \faShekel(faShekel) and \faSheqel(faSheqel) as synonyms for \faILs(faILs); \faTurkishLira(faTurkishLira) as a synonym for \faTry(faTry); and \faWon(W) as a synonym for \faKrw(W).

```

2664 \newenvironment{nonsymtable}[1]{%
2665   \begin{table}[htbp]
2666   \centering
2667   \caption{#1}\medskip
2668 }{%
2669   \end{table}
2670 }
2671
2672
2673
2674 {
2675   \global\let\myempty=\emptyset
2676   \global\let\mygobble=\gobble
2677   \catcode`\@=12
2678   \gdef\getridofats#1@#2\relax{%
2679     \def\getridtest{#2}%
2680     \ifx\getridtest\myempty%
2681       \expandafter\def\expandafter\strippedat\expandafter{\strippedat#1}
2682     \else%
2683       \expandafter\def\expandafter\strippedat\expandafter{\strippedat#1\protect\prin
2684       \getridofats#2\relax%
2685     \fi%
2686   }
2687
2688   \gdef\removeats#1{%
2689     \let\strippedat\myempty%
2690     \edef\strippedtext{\stripcommand#1}%
2691     \expandafter\getridofats\strippedtext @\relax%
2692   }
2693
2694   \gdef\stripcommand#1{\expandafter\mygobble\string#1}
2695 }
2696
2697
2698 \def\printanat{\char`\@}
2699
2700 \def\declare{\afterassignment\pgfmanualdeclare\let\next=}
2701 \def\pgfmanualdeclare{\ifx\next\bgroup\bgroup\color{red!75!black}\else{\color{red!75
2702
2703
2704 \let\texttoken=\command
2705 \let\endtexttoken=\endcommand
2706
2707 \def\myprintocmmand#1{\texttt{\char`\\#1}}

```

**\example{<void>}**

A no parameter macro to typeset a one line example, in code.

*Example:* This is an example for  $\beta$ .

```
2708 \def\example{\par\smallskip\noindent\textit{Example: }}
```

```
2709 \def\themeauthor{\par\smallskip\noindent\textit{Theme author: }}
```

```

2712 \def\indexoption#1{%
2713   \index{#1@\protect\texttt{#1} option}%
2714   \index{Graphic options and styles!#1@\protect\texttt{#1}}%
2715 }
2716
2717 \def\itemcalendaroption#1{\item \declare{\texttt{#1}}{%
2718   \index{#1@\protect\texttt{#1} date test}%
2719   \index{Date tests!#1@\protect\texttt{#1}}%
2720 }
2721
\begin{class}{\class}
  \environment{content}
\end{class}

2722 \def\class#1{%
2723   \list{}{%
2724     {\leftmargin=2em\itemindent-\leftmargin\def\makelabel##1{\hss##1}}%
2725     \extractclass#1@\par\topsep=0pt
2726   }
2727 \def\endclass{\endlist}
2728
2729 \def\extractclass#1#2@{%
2730 \item{{{\ttfamily\char`\\}\documentclass}#2{{\ttfamily\char`\\}\{\declare{#1}\char`\\}}}}%
2731   \index{Classes!#1@\protect\texttt{#1}}%
2732
2733
2734
2735 \def\index@prologue{\section*{Index}\addcontentsline{toc}{section}{My Index}}
2736 This index only contains automatically generated entries. A good
2737 index should also contain carefully selected keywords. This index is
2738 not a good index.
2739 \bigskip
2740 }
2741 \@ifundefined{c@IndexColumns}{\newcount{c@IndexColumns}{}}
2742 \c@IndexColumns=2
2743 \def\theindex{@restonecoltrue
2744   \columnseprule \z@ \columnsep 29\p@
2745   \twocolumn[\index@prologue]%
2746     \parindent -30pt
2747     \columnsep 15pt
2748     \parskip 0pt plus 1pt
2749     \leftskip 30pt
2750     \rightskip 0pt plus 2cm
2751     \small
2752     \def\@idxitem{\par}%
2753     \let\item\@idxitem \ignorespaces}
2754 \def\endtheindex{\onecolumn}
2755 \def\noindexing{\let\index=\@gobble}
2756
2757
2758
2759 \newcommand\symarrow[1]{%
2760   \index{#1\idx@actual\protect\texttt{#1} arrow tip}%

```



```

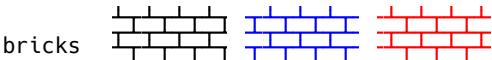
2761 \index{Arrow tips!idx@level#1\idx@actual\protect\texttt{\#1}}%
2762 \texttt{\#1}& yields thick
2763 \begin{tikzpicture}[arrows={\#1-\#1},thick,baseline]
2764   \useasboundingbox (0pt,-0.5ex) rectangle (1cm,2ex);
2765   \draw (0pt,.5ex) -- (1cm,.5ex);
2766 \end{tikzpicture} and thin
2767 \begin{tikzpicture}[arrows={\#1-\#1},thin,baseline]
2768   \useasboundingbox (0pt,-0.5ex) rectangle (1cm,2ex);
2769   \draw (0pt,.5ex) -- (1cm,.5ex);
2770 \end{tikzpicture}
2771 }
2772
2773 \newcommand\sarrow[2]{
2774   \index{\#1@\protect\texttt{\#1} arrow tip}%
2775   \index{Arrow tips!\#1@\protect\texttt{\#1}}%
2776   \index{\#2@\protect\texttt{\#2} arrow tip}%
2777   \index{Arrow tips!\#2@\protect\texttt{\#2}}%
2778   \texttt{\#1-\#2}& yields thick
2779   \begin{tikzpicture}[arrows={\#1-\#2},thick,baseline]
2780     \useasboundingbox (0pt,-0.5ex) rectangle (1cm,2ex);
2781     \draw (0pt,.5ex) -- (1cm,.5ex);
2782   \end{tikzpicture} and thin
2783   \begin{tikzpicture}[arrows={\#1-\#2},thin,baseline]
2784     \useasboundingbox (0pt,-0.5ex) rectangle (1cm,2ex);
2785     \draw (0pt,.5ex) -- (1cm,.5ex);
2786   \end{tikzpicture}
2787 }
2788
2789 \newcommand\carrow[1]{
2790   \index{\#1@\protect\texttt{\#1} arrow tip}%
2791   \index{Arrow tips!\#1@\protect\texttt{\#1}}%
2792   \texttt{\#1}& yields for line width 1ex
2793   \begin{tikzpicture}[arrows={\#1-\#1},line width=1ex,baseline]
2794     \useasboundingbox (0pt,-0.5ex) rectangle (1.5cm,2ex);
2795     \draw (0pt,.5ex) -- (1.5cm,.5ex);
2796   \end{tikzpicture}
2797 }

\patternindex
2798 %% Macros taken fro PGF manual
2799 \newcommand\patternindex[1]{%
2800   \HD@target
2801   \let\HDorg@encapchar\encapchar
2802   \edef\encapchar usage{%
2803     \HDorg@encapchar hdclindex{\the\c@HD@hypercount}{usage}%
2804   }%
2805   \index{\#1\idx@actual{\protect\texttt{\#1} (pattern)}\encapchar usage}%
2806 % \index{\#1\levelchar \#2\actualchar
2807 % {\protect\ttfamily \#2}\encapchar usage}%
2808 \index{Patterns\levelchar\#1\actualchar{\protect\texttt{\#1}}\encapchar usage}%
2809 \texttt{\#1}%
2810 \begin{tikzpicture}[baseline=.5ex]
2811   % Background
2812   \pattern [path fading=west,pattern=checkerboard light gray]

```

```

2813      (0,0) rectangle (5cm,2em);
2814      \pattern [pattern=#1,pattern color=black] (0,0) rectangle +(1.5cm,2em);
2815      \pattern [pattern=#1,pattern color=blue] (1.75,0) rectangle +(1.5cm,2em);
2816      \pattern [pattern=#1,pattern color=red] (3.5,0) rectangle +(1.5cm,2em);
2817  \end{tikzpicture} \\[1ex]
2818 }

bricks 

```

(End definition for `\patternindex`.)

```

2819 \newcommand\patternindexinherentlycolored[1]{%
2820   \HD@target
2821   \let\HDorg@encapchar\encapchar
2822   \edef\encapchar usage{%
2823     \HDorg@encapchar hdclindex{\the\c@HD@hypercount}{usage}%
2824   }%
2825   \index{#1\idx@actual{\protect\textrtt{#1} pattern}\encapchar usage}%
2826   \index{Patterns\idx@level#1\idx@actual{\protect\textrtt{#1}}\encapchar usage}%
2827   \arial #1 &
2828   \begin{tikzpicture}[baseline=.5ex]
2829     % Background
2830     \pattern [path fading=west,pattern=checkerboard light gray]
2831     (0,0) rectangle (5cm,2em);
2832     \pattern [pattern=#1,pattern color=blue] (0,0) rectangle +(5cm,2em);
2833   \end{tikzpicture} \\[1ex]
2834 }
2835
2836
2837 \newcommand\plotmarkentry[1]{%
2838   \index{#1@\protect\textrtt{#1} plot mark}%
2839   \index{Plot marks!#1@\protect\textrtt{#1}}%
2840   \textrtt{\char`\\"pgfuseplotmark\char`{\declare{#1}\char`\\}} &
2841   \tikz\draw[color=black!25] plot[mark=#1,mark options={fill=examplefill,draw=black}]
2842 }
2843 \newcommand\plotmarkentrytikz[1]{%
2844   \index{#1@\protect\textrtt{#1} plot mark}%
2845   \index{Plot marks!#1@\protect\textrtt{#1}}%
2846   \textrtt{\mark=\declare{#1}} & \tikz\draw[color=black!25]
2847   plot[mark=#1,mark options={fill=examplefill,draw=black}]
2848   coordinates {(0,0) (.5,0.2) (1,0) (1.5,0.2)};\\
2849 }
2850
2851
2852
2853 \ifx\scantokens@undefined
2854   \PackageError{phd}{You need to use extended latex
2855   (elatex) or (pdfelatex) to process this document}{}
2856 \fi
2857
2858 \begingroup
2859 \catcode`|=0
2860 \catcode`[= 1
2861 \catcode`]=2
2862 \catcode`{|=12

```

```

2863 \catcode ` \|=12
2864 \catcode`\\|=12 |gdef|find@example#1\end{codeexample}[]|endofcodeexample[#1]|
2865 |endgroup
2866
2867 \begingroup
2868 \catcode`\^=7
2869 \catcode`\^^M=13
2870 \catcode`\ =13%
2871 \gdef\returntospace{\catcode`\ |=13\def {\space}\catcode`\^^M=13\def^^M{}}
2872 \endgroup
2873
2874 \begingroup
2875 \catcode`\%=13
2876 \catcode`\^^M=13
2877 \gdef\commenthandler{\catcode`\%=13\def%{\@gobble@till@return}}
2878 \gdef@\gobble@till@return#1^^M{}
2879 \gdef@\gobble@till@return@ignore#1^^M{\ignorespaces}
2880 \gdef\typesetcomment{\catcode`\%=13\def%{\@typeset@till@return}}
2881 \gdef@\typeset@till@return#1^^M{{\def%{\char`\%}\textsl{\char`\%#1}}\par}
2882 \endgroup
2883
2884 \define@key{codeexample}{width}{\setlength\codeexamplewidth{#1}}
2885 \define@key{codeexample}{graphic}{\colorlet{thecodebackground}{#1}}
2886 \define@key{codeexample}{code}{\colorlet{thecodebackground}{#1}}
2887 \define@key{codeexample}{execute code}{\csname code@execute#1\endcsname}
2888 \define@key{codeexample}{code only}[]{\code@executefalse}
2889 \define@key{codeexample}{pre}{\def\code@pre{#1}}
2890 \define@key{codeexample}{post}{\def\code@post{#1}}
2891 \define@key{codeexample}{vbox}[]{\def\code@pre{\vbox\bgroup\setlength{\hsize}{\linew
6pt}}\def\code@post{\egroup}}
2892 \define@key{codeexample}{ignorespaces}[]{\let@\gobble@till@return=\@gobble@till@return}
2893 \define@key{codeexample}{leave comments}[]{\def\code@catcode@hook{\catcode`\%=12}\le
2894 \def\code@pre{}
2895 \def\code@post{}
2896 \def\code@catcode@hook{}
2897
2898 \newdimen\codeexamplewidth
2899 \newif\ifcode@execute
2900 \newbox\codeexamplebox
2901 \def\codeexample[#1]{%
2902   \begingroup%
2903   \code@executetrue
2904   \setlength\codeexamplewidth{4cm+7pt}
2905   \setkeys{codeexample}{#1}%
2906   \parindent0pt
2907   \begingroup%
2908   \par%
2909   \medskip%
2910   \let\do\@makeother%
2911   \dospecials%
2912   \obeylines%
2913   \vobeyspaces%
2914   \catcode`\%=13%
2915   \catcode`\^^M=13%

```

```

2916   \code@catcode@hook%
2917   \relax%
2918   \find@example}
2919 \def\endofcodeexample#1{%
2920   \endgroup%
2921   \ifcode@execute%
2922     \setbox\codeexamplebox=\hbox{%
2923       {%
2924         {%
2925           \returntospace%
2926           \commenthandler%
2927           \xdef\code@temp{\#1}% removes returns and comments
2928         }%
2929         \colorbox{thecodebackground}{\color{black}\ignorespaces%
2930           \code@pre\expandafter\scantokens\expandafter{\code@temp\ignorespaces}\code%
2931         }%
2932       }%
2933     \ifdim\wd\codeexamplebox>\codeexamplewidth%
2934       \def\code@start{\par}%
2935       \def\code@flushstart{}\def\code@flushend{}%
2936       \def\code@mid{\parskip2pt\par\noindent}%
2937       \def\code@width{\linewidth-6pt}%
2938       \def\code@end{}%
2939     \else%
2940       \def\code@start{%
2941         \linewidth=\textwidth%
2942         \parshape @ne 0pt \linewidth
2943         \leavevmode%
2944         \hbox\bgroup}%
2945       \def\code@flushstart{\hfill}%
2946       \def\code@flushend{\hbox{}}%
2947       \def\code@mid{\hskip6pt}%
2948       \def\code@width{\linewidth-12pt-\codeexamplewidth}%
2949       \def\code@end{\egroup}%
2950     \fi%
2951     \code@start%
2952     \noindent%
2953     \begin{minipage}[t]{\codeexamplewidth}\raggedright
2954       \hrule width0pt%
2955       \small\vskip-1em%
2956       \code@flushstart\box\codeexamplebox\code@flushend%
2957       \vskip-1ex
2958       \leavevmode%
2959     \end{minipage}%
2960   \else%
2961     \def\code@mid{\par}%
2962     \def\code@width{\linewidth-6pt}%
2963     \def\code@end{}%
2964   \fi%
2965   \code@mid%
2966   \colorbox{thecodebackground}{%
2967     \begin{minipage}[t]{\code@width}%
2968       {%
2969         \let\do\@makeother

```

```

2970      \dospecials
2971      \frenchspacing\@vobeyspaces
2972      \normalfont\ttfamily%\footnotesize
2973      \typesetcomment%
2974      \@tempswafalse
2975      \def\par{%
2976          \if@tempswa
2977              \leavevmode \null \@@par\penalty\interlinepenalty
2978          \else
2979              \atempswatrue
2980              \ifhmode\@@par\penalty\interlinepenalty\fi
2981              \fi}%
2982          \obeylines
2983          \everypar \expandafter{\the\everypar \unpenalty}%
2984          #1}
2985      \end{minipage}}%
2986  \code@end%
2987  \par%
2988  \medskip
2989  \end{codeexample}
2990 }
2991
2992 \def\endcodeexample{\endgroup}

```

From pgfplots manual

```

2993 \long\def\codeexamplenl{\noexpand\par}%
2994 \pgfqkeys{/codeexample}{%
2995   every codeexample/.style={%
2996     width=3.9cm,
2997     /pgfplots/every axis/.append style={legend style={fill=thecodebackground}},
2998   },
2999   narrow/.style={width=6.9cm},
3000   %tabsize=4,
3001   %pre={\begin{minipage}{\linewidth}\begingroup},
3002   %post={\endgroup\end{minipage}},
3003   %vbox,
3004   %newline=\codeexamplenl,
3005 }

```

### \keyval{key}{options}{text}

The macro \keyval typesets key value lists and their options.

\keyval{test}{\marg{option1|option2|option2|option4}}{text}

**test** = {{*option1|option2|option2|option4*}} Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

We first measure the width of the option and not use it (want to make it a bit flexible at a later stage). We also ensure that the catcode of | is set properly in case anyone is using short verbatim commands, as we do in this document.

```

3006 \newlength\temp@cx
3007 \def\keyval{%

```

```

3008 \begingroup
3009 \catcode`|=11
3010 \@keyval}
3011 %
3012 % use a list not very good
3013 \def\@keyval#1#2#3{%
3014   \settowidth\temp@cx{\verbatimfont\bfseries{#1\thinspace}}%
3015   \hangindent\temp@cx
3016   \par\leavevmode%
3017 \hspace*{-\temp@cx}{\verbatimfont\color{theoption}\bfseries #1}%
3018           \thinspace=\thinspace#2%
3019 \hspace*{.5em}#3%
3020 \par\addvspace{6.5pt}%
3021 \endgroup
3022 }
3023 %

Typesets a sample of bib

3024 \newenvironment{bibsamp}{%
3025   {\trivlist\samepage
3026     \setlength{\itemsep}{0pt}}
3027   {\endtrivlist}
3028 %% doccommands
3029 \newcommand*{\marglistfont}{\itshape}
3030
3031 \newcommand*{\margoptionfont}{\ttfamily}
3032
3033 \newcommand*{\margnotefont}{}
3034
3035 \newcommand*{\optionlistfont}{\bfseries}
3036
3037 \newcommand*{\ltxsyntaxfont}{\ttfamily}
3038
3039 \newcommand*{\ltxsyntaxlabelfont}{\bfseries}
3040
3041 \newcommand*{\changelogfont}{\normalfont}
3042
3043 \newcommand*{\changeloglabelfont}{\bfseries}
3044
3045
3046
3047 \% \def\cmd#1{\cs{\expandafter\cmd@to\cs{string#1}}}
3048
3049 \% \def\cmd@to\cs#1#2{\char\number`#2\relax}
3050
3051 \newrobustcmd*{\env}[1]{\mbox{\verbatimfont\bfseries\textrm{thegreen}\{#1\}}}
3052
3053 \newrobustcmd*{\len}[1]{\mbox{\verbatimfont\textrm{textbackslash}\#1}}
3054
3055 \newrobustcmd*{\cnt}[1]{\mbox{\verbatimfont\#1}}
3056
3057 \newlength{\marglistsep}
3058
3059 \newlength{\marglistwidth}

```

```

3060
3061 %%% POSSIBLE ERROR
3062 \setlength{\marglistwidth}{\oddsidemargin}%
3063
3064 \def\marglistsep{10pt}
3065 %% This needs thorough checking as to restore previous definitions
3066 %% of parsep we want parsep to be a bit higher than standard enumerated lists.
3067 \global\newlength\varparsep
3068 \newenvironment*{\marglist}
3069   {\setlength\varparsep{\parsep}\list{}{%
3070     \parsep 3.5\p@ \@plus0\p@ \@minus\p@
3071     \setlength{\labelwidth}{\marglistwidth}%
3072     \setlength{\labelsep}{\marglistsep}%
3073     \setlength{\leftmargin}{0pt}%
3074     \renewcommand*{\makelabel}[1]{\hss\marglistfont##1}}}
3075   {\endlist\setlength\parsep{\varparsep}}
3076
3077 %
3078 \newenvironment*{\margoptionslist}
3079   {\setlength\varparsep{\parsep}\list{}{%
3080     \parsep 3.5\p@ \@plus0\p@ \@minus\p@
3081     \setlength{\labelwidth}{\marglistwidth}%
3082     \setlength{\labelsep}{\marglistsep}%
3083     \setlength{\leftmargin}{0pt}%
3084     \renewcommand*{\makelabel}[1]{\hss\margoptionfont\detokenize##1}}}
3085   {\endlist\setlength\parsep{\varparsep}}
3086
3087

\begin{keymarglist} {void}
  (environment content)
\end{keymarglist}

```

Typesets a key options list in the margin.

```

3088 \newenvironment*{\keymarglist}
3089   {\marglist
3090     \setlength{\itemsep}{0pt}%
3091     \raggedright
3092   {\endmarglist}
3093 % color definitions
3094 \def\cvaref#1{\verbatimfont\textrmcolor{themacro}{#1}}
3095 % color for options
3096 \def\col0pt#1{\textrmcolor{theoption}{\verbatimfont\textrm{#1}}}

\option{<option>}

```

Typesets an option. It uses the color `theoption`, which is defined in the package `phd-colorpalette`.

```
3097 \newcommand{\option}[1]{\col0pt{#1}}
```

### C.16.3 Creating a Small Verbatim Environment

This is a modified version from Cambridge classes HAS ERRORS

```

3098 \begingroup \catcode `|=0
3099 \catcode `[= 1
3100 \catcode`]=2
3101 \catcode `\'=12
3102 \catcode `\'\}=12
3103 \catcode`\\=12
3104 |gdef|@xsmallverbatim#1\end{smallverbatim}[]{#1|end[smallverbatim]}
3105 |gdef|@xsmallverbatim#1\end{smallverbatim*}[]{#1|end[smallverbatim*]}
3106 |endgroup
3107 \def@\smallverbatim{\trivlist \item\relax
3108   \if@minipage\else\vskip\parskip\fi
3109   \leftskip\@totalleftmargin\rightskip\z@skip
3110   \parindent\z@ \parfillskip\@flushglue\parskip\z@skip
3111   \@@@par %chaned
3112   \tempswafalse
3113   \def\par{%
3114     \if@tempswa
3115       \leavevmode \null \@@par\penalty\interlinepenalty
3116     \else
3117       \tempswatrue
3118       \ifhmode\@@@par\penalty\interlinepenalty\fi
3119     \fi}%
3120   \let\do\@makeother \dospecials
3121   \obeylines \small \atnoligs%\smallverbatim@font to FIX
3122   \hyphenchar\font\m@ne
3123   \everypar \expandafter{\the\everypar \unpenalty}%
3124 }
3125 \def\smallverbatim{@smallverbatim \frenchspacing\@vobeyspaces \@xsmallverbatim}
3126 \def\endsmallverbatim{\if@newlist \leavevmode\fi\endtrivlist}
3127 \def\smallverbatim@font{\normalfont\smallverbatimsiz\ttfamily}

```

This is a short test. Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

```
% \ifx\bhj
% \else
% \fi
%
```

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

```
\begin{docCommands}
<environment content>
\end{docCommands}
```

```

3128 \let\luacmd\docValue
3129 \newenvironment{docCommands}{%
3130 \bgroup
3131 \par
3132 \parindent=0pt

```

```

3133 \parskip=3.5pt plus0.5pt
3134 \everypar{\hangindent2em}%
3135 \addvspace\belowdisplayskip\relax}%
3136 {\everypar{}%
3137 \par
3138 \vskip\belowdisplayskip\egroup\par}
3139 \long\def\auxm#1(#2);{%
3140 \def\Xtemp{#1}%
3141 \def\Ytemp{#2}%
3142 \parindent=0pt
3143 \addvspace{1.5pt}%
3144 \par\leavevmode
3145 \hangafter=1\relax \hangindent=1em\relax
3146 \bgroup
3147 \bfseries\sffamily\color{red}\Xtemp\,,\color{black}(\textit{\Ytemp})\hskip0.1em
3148 \egroup
3149 }
3150
3151
3152 \newenvironment{docLua}[1]{%
3153 \auxm#1;
3154 }{%
3155 \@@par
3156 \smallskip\parindent=1em }
3157
3158

```

### \docFont{<font name>}

Typeset and indexes a font by name, such as \docFont{Arial} typesetting “Arial”.

```

3159 \DeclareRobustCommand{\phdidxfont}[1]{%
3160 \index{#1 (font)}\index{fonts\idx@level{#1}\encapchar hyperpage}}%
3161 \def\docFont#1{%
3162 \enquote{#1}
3163 \phdidxfont{#1}%
3164 }

```

### Key handler <key>/ .fontweight

A handler to handle fontweights. Chooses between This handler causes the default path to be set to hkeyi. Note that the default path is reset at the beginning of each call to pgfkeys to be equal to ...TODO remove second parameter as it is not needed. Add index command

```

3165 \newenvironment{handler}[2][]{%
3166 \begin{phdd_manual_entry}%
3167 \begingroup
3168 \sffamily\textbf{Key handler} \meta{key}/\bfseries\ttfamily{\color{thered}{#2}}\color{black}%
3169 \endgroup
3170 \end{phdd_manual_entry}%
3171 }
3172 {}
3173 \newcommand\stok[2][]{%
3174 \texttt{\#2}\ensuremath{_}{}%

```

```

3175   \if!#1!
3176     \the\catcode`#2
3177   \else
3178     #1
3179   \fi}}}

```

## C.17 Unicode math index functions

The functions that follow typeset unicode math tables.

**\showsymbolalpha** {*cmd*} {*unicode point*} {*note symbol*}

Indexes and typesets all the alphabetic letters available in math, mostly greek and the dotless j and i.

```

3180 \newcommand\showsymbolalpha[3]
3181 {
3182   \par\noindent\hangindent=3em%
3183   \makebox[2em][l]{\$#1\$} \makebox[3.5em][l]{\texttt{U+\#2}}
3184   \string#1 \$^{#3}$
3185   \indexmathcmd [Math alphabetics] {#1}
3186 }

```

**\showsymbol** {*cmd*} {*unicode point*} {*note symbol*}

```

3187 \newcommand\showsymbol[3]{\par\noindent\hangindent=3em%
3188 \makebox[2em][l]{\$#1\$} \makebox[3.5em][l]{\texttt{U+\#2}}
3189 \string#1 \$^{#3}\$ \indexmathcmd [Math ordinary] {#1}}

```

**\showsymbolbin** {*cmd*} {*unicode point*} {*note symbol*}

```

3190 \newcommand\showsymbolbin[3]{\par\noindent\hangindent=3em%
3191 \makebox[2em][l]{\$#1\$} \makebox[3.5em][l]{\texttt{U+\#2}}
3192 \string#1 \$^{#3}\$ \indexmathcmd [Math bin operators] {#1}}

```

**\showrelsymbol** {*cmd*} {*unicode point*} {*note symbol*}

```

3193 \newcommand\showrelsymbol[3]{\par\noindent\hangindent=3em%
3194 \makebox[2em][l]{\$#1\$} \makebox[3.5em][l]{\texttt{U+\#2}}
3195 \string#1 \$^{#3}\$ \indexmathcmd [Math relations] {#1}}

```

**\integralsymbol** {*cmd*} {*unicode point*} {*note symbol*}

Typesets and inserts into index integral symbols

```

3196 \newcommand\integralsymbol[3]{\par\noindent\hangindent=3em%
3197 \makebox[2em][l]{\$#1\$} \makebox[3.5em][l]{\texttt{U+\#2}}
3198 \string#1 \$^{#3}\$ \indexmathcmd [Math integrals] {#1}}

```

**\showop** {*cmd*} {*unicode point*} {*note symbol*}

Typesets and inserts into index integral symbols

```

3199 \newcommand\showop[3]{\par\noindent\hangindent=6em%
3200   \makebox[5em][l]{\#1\hfill}\displaystyle#1\hfill}
3201   \makebox[3.5em][l]{\small\textrt{U+\#2}} \string#1 $^{#3}$
3202   \indexmathcmd [Math big operators] {#1} }

```

**\showmbrace** {*cmd*} {*unicode point*} {*note symbol*}

Typesets and inserts middle brace symbols

```

3203 \newcommand\showmbrace[3]{\par\noindent\hangindent=6em%
3204   \makebox[5em][l]{\#1\bigm\#1\Bigm\#1\biggm\#1\Biggm\#1\$}
3205   \makebox[3.5em][l]{\small\textrt{U+\#2}} \string#1 $^{#3}$
3206   \indexmathcmd [Math delimiters] {#1}
3207 }

```

**\showlbrace** {*cmd*} {*unicode point*} {*note symbol*}

left braces

```

3208 \newcommand\showlbrace[3]{\par\noindent\hangindent=6em%
3209   \makebox[5em][l]{\Biggl\#1\biggl\#1\Bigl\#1\bigl\#1\$}
3210   \makebox[3.5em][l]{\small\textrt{U+\#2}} \string #1 $^{#3}$
3211   \indexmathcmd [Math delimiters] {#1}
3213 }

```

**\showrbrace** {*cmd*} {*unicode point*} {*note symbol*}

right braces

```

3214 \newcommand\showrbrace[3]{\par\noindent\hangindent=6em%
3215   \makebox[5em][l]{\#1\bigr\#1\Bigr\#1\biggr\#1\Biggr\#1\$}
3216   \makebox[3.5em][l]{\small\textrt{U+\#2}} \string #1 $^{#3}$
3217   \indexmathcmd [Math delimiters] {#1}
3218 }

```

**\wide accents** {*cmd*} {*unicode point*} {*note symbol*}

wide accents

```

3219 \DeclareDocumentCommand \showwideaccent { m m m} {\par\noindent\hangindent=4em%
3220   \makebox[3em][l]{\#1{xxx}}\makebox[3.5em][l]{\small\textrt{U+\#2}} \string #1 $^{#3}$
3221   \indexmathcmd [Math accents] {#1{abc}}
3222 }

```

**\showaccent** {*cmd*} {*unicode point*} {*note symbol*}

right braces

```

3223 \DeclareDocumentCommand\showaccent { m m m} {\par\noindent\hangindent=4em%
3224   \makebox[3em][l]{\#1b\$}\makebox[3.5em][l]{\small\textrt{U+\#2}} \string #1$^{#3}$
3225   \indexmathcmd [Math accents] {#1 b}
3226 }

```

**\showrover** {*cmd*} {*unicode point*} {*note symbol*}

```
3227 \newcommand\showover[3]{\par\noindent\hangindent=6em%
3228   \makebox[5em][l]{\#1{xxxxxx}\$}
3229   \makebox[3.5em][l]{\small\textrm{\#1{xxxxxx}\$}}
3230   \string #1 \$^{\#3}\$}
3231 \index{mathcmd [Math over and under brackets] {\#1{xxxxxx}\$}}
3232 }

3233 \ExplSyntaxOn
3234 \NewDocumentEnvironment{ arguments } {}
3235 {
3236   \begin{enumerate}
3237 }
3238 {
3239   \end{enumerate}
3240 }
3241 \ExplSyntaxOff
```



## l<sub>3</sub> Documentation

The package provides macros for documenting and indexing primarily L<sub>A</sub>T<sub>E</sub>X or L<sub>A</sub>T<sub>E</sub>X 3 code. It combines the styles originating with doc with those found in the pgf series of packages. It removes some of the difficulties of using hyperlinks in the index and elsewhere in the document.



The L<sup>A</sup>T<sub>E</sub>X 3 Team developed the class **l3doc** as a replacement to the **ltxdoc** class. This is currently being used to document the **expl3** and related packages.

This section of the package deals primarily with an adaptation from the class.

The main reason it is easier to integrate with the rest of the **phd** bundle if the code is in a package, as in the original **doc** and **ltxdoc**.

### D.0.1 General text markup

Many of the commands in this section come from **ltxdoc** with some improvements.

---

**\cmd** `\cmd [⟨options⟩] ⟨control sequence⟩`  
**\cs** `\cs [⟨options⟩] {⟨csname⟩}`

These commands are provided to typeset control sequences. `\cmd\foo` produces “`\foo`” and `\cs{foo}` produces the same. In general, `\cs` is more robust since it doesn’t rely on catcodes being “correct” and is therefore recommended.

These commands are aware of the @@ **l3docstrip** syntax and replace such instances correctly in the typeset documentation. This only happens after a `%<@@=<module>` declaration.

Additionally, commands can be used in the argument of `\cs`. For instance, `\cs{\meta{name}}:\meta{signature}}` produces `\langle name\rangle:\langle signature\rangle`.

The `⟨options⟩` are a key–value list which can contain the following keys:

- **index=⟨name⟩**: the `⟨csname⟩` is indexed as if one had written `\cs{⟨name⟩}`.
- **no-index**: the `⟨csname⟩` is not indexed.
- **module=⟨module⟩**: the `⟨csname⟩` is indexed in the list of commands from the `⟨module⟩`; the `⟨module⟩` can in particular be **TeX** for “**TeX** and L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>” commands, or empty for commands which should be placed in the main index. By default, the `⟨module⟩` is deduced automatically from the command name.
- **replace** is a boolean key (true by default) which indicates whether to replace @@ as **l3docstrip** does.

These commands allow hyphenation of control sequences after (most) underscores. By default, a hyphen is used to mark the hyphenation, but this can be changed with the `cs-break-nohyphen` class option. To disable hyphenation of control sequences entirely, use `cs-break-off`.

---

**\tn** `\tn [⟨options⟩] {⟨csname⟩}`

Analogous to `\cs` but intended for “traditional” **TeX** or L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> commands; they are indexed accordingly. This is in fact equivalent to `\cs [module=TeX, replace=false, ⟨options⟩] {⟨csname⟩}`.

---

**\meta** `\meta {<name>}`

`\meta` typesets the `<name>` italicised in `<angle brackets>`. Within a function environment or similar, angle brackets `<...>` are set up to be a shorthand for `\meta{...}`.

This function has additional functionality over its **ltxdoc** versions; underscores can be used to subscript material as in math mode. For example, `\meta{arg_{xy}}` produces “`<argxy>`”.

Function environments take an optional argument to indicate whether the function(s) it describes are expandable or restricted-expandable or defined in conditional forms. Use **EXP**, **rEXP**, **TF**, **pTF**, or **noTF** for this; note that **pTF** implies **EXP** since predicates must always be expandable, and that **noTF** means that the function without **TF** should be documented in addition to **TF**. As an example:

**Example 0.1 Typesetting functions**

```
472 % \begin{function}[pTF]{\cs_if_exist:N}
473 %   \begin{syntax}
474 %     \cs{\cs_if_exist_p:N} \meta{cs}
475 %   \end{syntax}
476 % \end{function}
477 %
```

---

```
\cs_if_exist_p:N ★ \cs_if_exist_p:N <cs>
\cs_if_exist:NTF ★
```

---

This function has additional functionality over its **ltxdoc** versions; underscores can be used to subscript material as in math mode. For example, `\meta{arg_{xy}}` produces “`<argxy>`”.

---

**\Arg** `\Arg {<name>}`  
**\marg** `\marg {<name>}`

Typesets the `<name>` as for `\meta` and wraps it in braces.

**\oarg** The `\marg/\oarg/\parg` versions follow from **ltxdoc** in being used for “mandatory” or “optional” or “picture” brackets as per L<sup>A</sup>T<sub>E</sub>X 2 <sub>$\epsilon$</sub>  syntax.  
**\parg**

---

**\file** `\pkg {<name>}`

**\env** These all take one argument and are intended to be used as semantic commands for representing files, environments, package names, and class names, respectively.  
**\pkg**

---

**\cls**

### D.0.2 Describing functions in the documentation

**function** Two heavily-used environments are defined to describe the syntax of `expl3` functions and variables.

```
% \begin{function}{\function_one:, \function_two:}
%   \begin{syntax}
%     |\foo_bar:| \Arg{meta} \meta{test_1}
%   \end{syntax}
% \meta{description}
% \end{function}
%
```

---



---

```
\function_one: \foo_bar: {<meta>} <test_1>
\function_two: <description>
```

---

Function environments take an optional argument to indicate whether the function(s) it describes are expandable or restricted-expandable or defined in conditional forms. Use `EXP`, `rEXP`, `TF`, `pTF`, or `noTF` for this; note that `pTF` implies `EXP` since predicates must always be expandable, and that `noTF` means that the function without `TF` should be documented in addition to `TF`. As an example:

```
% \begin{function}[pTF]{\cs_if_exist:N}
%   \begin{syntax}
%     \cs{\cs_if_exist_p:N} \meta{cs}
%   \end{syntax}
% \meta{description}
% \end{function}
```

This code will then produce the output, as shown below and place it in the margin.

---

```
\cs_if_exist_p:N ★ \cs_if_exist_p:N <cs>
\cs_if_exist:NTF ★
<description>
```

**variable** If you are documenting a variable instead of a function, use the `variable` environment instead; it behaves identically to the `function` environment above.

**texnote** This environment is used to call out sections within `function` and similar that are only of interest to seasoned TeX developers.

## D.1 Describing functions in the implementation

**macro** The well-used environment from `LATEX 2 $\epsilon$`  for marking up the implementation of

macros/functions remains the `macro` environment. Some changes in `l3doc`: it now accepts comma-separated lists of functions, to avoid a very large number of consecutive `\end{macro}` statements. Spaces and new lines are ignored (the option `[verb]` prevents this).

```
% \begin{macro}{\foo:N, \foo:c}
%   \begin{macrocode}
% ... code for \foo:N and \foo:c ...
%   \end{macrocode}
% \end{macro}
```

If you are documenting an auxiliary macro, it's generally not necessary to highlight it as much and you also don't need to check it for, say, having a test function and having a documentation chunk earlier in a function environment. `l3doc` will pick up these cases from the presence of `_` in the name, or you may force marking as internal by using `\begin{macro}[int]` to mark it as such. The margin call-out is then printed in grey for such cases.

For documenting `expl3`-type conditionals, you may also pass this environment a `TF` option (and omit it from the function name) to denote that the function is provided with `T`, `F`, and `TF` suffixes. A similar `pTF` option prints both `TF` and `_p` predicate forms. An option `notF` prints both the `TF` forms and a form with neither `T` nor `F`, to document functions such as `\prop_get:NN` which also have conditional forms (`\prop_get:NNTF`).

**\TestFiles** `\TestFiles{<list of files>}` is used to indicate which test files are used for the current code; they are printed in the documentation.

**\UnitTested** Within a macro environment, it is a good idea to mark whether a unit test has been created for the commands it defines. This is indicated by writing `\UnitTested` anywhere within `\begin{macro} ... \end{macro}`.

If the class option `checktest` is enabled, then it is an *error* to have a `macro` environment without a call to `Testfiles`. This is intended for large packages such as `expl3` that should have absolutely comprehensive tests suites and whose authors may not always be as sharp at adding new tests with new code as they should be.

**\TestMissing** If a function is missing a test, this may be flagged by writing (as many times as needed) `\TestMissing {<explanation of test required>}`. These missing tests are summarised in the listing printed at the end of the compilation run.

**variable** When documenting variable definitions, use the `variable` environment instead. Here it behaves identically to the `macro` environment, except that if the class option `checktest` is enabled, variables are not required to have a test file.

**arguments** Within a `macro` environment, you may use the `arguments` environment to describe the arguments taken by the function(s). It behaves like a modified enumerate environment.

```
% \begin{macro}{\foo:nn, \foo:VV}
% \begin{arguments}
%   \item Name of froozle to be frazzled
%   \item Name of muble to be jubled
% \end{arguments}
% \begin{macrocode}
% ... code for \foo:nn and \foo:VV ...
```

```
%      \end{macrocode}
% \end{macro}

1 \ExplSyntaxOn
2 \% \RequirePackage{fancybox}
3 \% \newif\iffancyvrb \IfFileExists{fancyvrb.sty}{\fancyvrbtrue}{}%
4 \% \iffancyvrb
5 \% \RequirePackage{fancyvrb}
6 \% \fi
7 \% \fvset{gobble=2,frame=none, framesep=5pt,fillcolor=red!30,numbers=left,
8 \%           numbersep=3pt,fontsize=\small}
```

## D.2 Variables

---

**\g\_docinput\_list** The list of files which have been input through **\DocInput**.

```
9 @@=phdd
10 \clist_new:N \g_docinput_list
11 \seq_new:N \g_doc_functions_seq
12 \seq_new:N \g_doc_macros_seq
```

---

**\l\_\_phdd\_detect\_internals\_bool**

---

**\l\_\_phdd\_detect\_internals\_tl**

If true, **l<sub>3</sub>doc** will check for use of internal commands **\cs[no-index]{\_\_\meta{pkg}\_\ldots{}}** from other packages in the argument of the macro environment, and in the code typeset in macrocode environments, but not in **\cs**. Also a token list to store temporary data for this purpose.

```
13 \bool_new:N \l__phdd_detect_internals_bool
14 \bool_set_true:N \l__phdd_detect_internals_bool
15 \tl_new:N \l__phdd_detect_internals_tl
16 \tl_new:N \l__phdd_detect_internals_cs_tl
```

---

**\l\_\_phdd\_output\_coffin**

The function environment is typeset by combining coffins containing various pieces (function names, description, *etc.*) into this coffin.

```
17 \coffin_new:N \l__phdd_output_coffin
```

---

\l\_\_phdd\_functions\_coffin  
\l\_\_phdd\_descr\_coffin  
\l\_\_phdd\_syntax\_coffin

These coffins contain respectively the list of function names (argument of the function environment), the text between `\begin{function}` and `\end{function}`, and the syntax given in the syntax environment.

18 \coffin\_new:N \l\_\_phdd\_functions\_coffin  
19 \coffin\_new:N \l\_\_phdd\_descr\_coffin  
20 \coffin\_new:N \l\_\_phdd\_syntax\_coffin

---

\g\_\_phdd\_syntax\_box

The contents of the syntax environment are typeset in this box before being transferred to `\l__phdd_syntax_coffin`.

21 \box\_new:N \g\_\_phdd\_syntax\_box

---

\l\_\_phdd\_in\_function\_bool

True when inside a function or variable environment. Used by the syntax environment to determine its behaviour.

22 \bool\_new:N \l\_\_phdd\_in\_function\_bool

---

\l\_\_phdd\_long\_name\_bool

---

\l\_\_phdd\_trial\_width\_dim

The boolean `\l__phdd_long_name_bool` is true if the width `\l__phdd_trial_width_dim` of the coffin `\l__phdd_functions_coffin` (containing the current function names) is bigger than the space available in the margin.

23 \bool\_new:N \l\_\_phdd\_long\_name\_bool  
24 \dim\_new:N \l\_\_phdd\_trial\_width\_dim

---

\l\_\_phdd\_nested\_macro\_int

The nesting of `macro` environments (this is now 0 outside a `macro` environment).

25 \int\_new:N \l\_\_phdd\_nested\_macro\_int

---

\l\_\_phdd\_macro\_tested\_bool  
\g\_\_phdd\_missing\_tests\_prop  
\g\_\_phdd\_not\_tested\_seq  
\g\_\_phdd\_testfiles\_seq

---

A boolean describing whether the current macro has tests, and some global structures which contain information about test files and which tests are missing.

```
26 \bool_new:N \l__phdd_macro_tested_bool
27 \prop_new:N \g__phdd_missing_tests_prop
28 \seq_new:N \g__phdd_not_tested_seq
29 \seq_new:N \g__phdd_testfiles_seq
```

---

\l\_\_phdd\_macro\_internal\_set\_bool  
\l\_\_phdd\_macro\_internal\_bool  
\l\_\_phdd\_macro\_TF\_bool  
\l\_\_phdd\_macro\_pTF\_bool  
\l\_\_phdd\_macro\_noTF\_bool  
\l\_\_phdd\_macro\_EXP\_bool  
\l\_\_phdd\_macro\_rEXP\_bool  
\l\_\_phdd\_macro\_var\_bool  
\l\_\_phdd\_override\_module\_tl  
\l\_\_phdd\_macro\_documented\_tl

---

Contain information about some options of function/macro environments. We initialize \l\_\_phdd\_override\_module\_tl to avoid overriding module names by an empty name (meaning no module).

```
30 \bool_new:N \l__phdd_macro_internal_set_bool
31 \bool_new:N \l__phdd_macro_internal_bool
32 \bool_new:N \l__phdd_macro_TF_bool
33 \bool_new:N \l__phdd_macro_pTF_bool
34 \bool_new:N \l__phdd_macro_noTF_bool
35 \bool_new:N \l__phdd_macro_EXP_bool
36 \bool_new:N \l__phdd_macro_rEXP_bool
37 \bool_new:N \l__phdd_macro_var_bool
38 \tl_new:N \l__phdd_override_module_tl
39 \tl_set:Nn \l__phdd_override_module_tl { \q_no_value }
40 \tl_new:N \l__phdd_macro_documented_tl
```

---

\g\_\_phdd\_lmodern\_bool  
\g\_\_phdd\_checkfunc\_bool  
\g\_\_phdd\_checktest\_bool  
\g\_\_phdd\_cs\_break\_bool  
\g\_\_phdd\_kernel\_bool

---

Information about package options.

```
41 \bool_new:N \g__phdd_lmodern_bool
42 \bool_new:N \g__phdd_checkfunc_bool
43 \bool_new:N \g__phdd_checktest_bool
44 \bool_new:N \g__phdd_kernel_bool
45 \bool_new:N \g__phdd_cs_break_bool
46 \bool_gset_true:N \g__phdd_cs_break_bool
```

---

\l\_\_phdd\_tmpa\_tl Some temporary variables.  
\l\_\_phdd\_tmpb\_tl  
\l\_\_phdd\_tmpa\_int  
\l\_\_phdd\_tmpa\_seq

---

### \l\_\_phdd\_names\_block\_tl

List of local sequence variables (produced through \\_\_phdd\_lseq\_name:n), one for each set of variants in a function or macro environment. More precisely these sequences are named after the base forms, such as \clist\_count:n or \clist\_count:N (which are not variants). Each of these sequences have the base name (without any signature) as their first item, followed by the list of variant's signatures, or \scan\_stop: to denote the absence of signature (no colon).

```
51 \tl_new:N \l__phdd_names_block_tl
```

---

### \g\_\_phdd\_variants\_seq

Stores rather temporarily the list of variants (signatures only) of a function/-macro that is being documented. It is global because we need it to keep its value throughout cells of an alignment.

```
52 \seq_new:N \g__phdd_variants_seq
```

---

### \l\_\_phdd\_names\_verb\_bool

Set to **true** if the main argument of a macro/function environment should be used as is, without removing any comma or space.

```
53 \bool_new:N \l__phdd_names_verb_bool
```

---

**\l\_\_phdd\_names\_seq**

List of functions/environments/... appearing as arguments of a given function or macro environment. These are the names after conversion of \_@@ and @@ to \_\_⟨*module name*⟩ and other sanitizing.

54 \seq\_new:N \l\_\_phdd\_names\_seq

---

**\g\_\_phdd\_nested\_names\_seq**

Collects all macros in nested macro environments, to use them in the “End definition” text.

55 \seq\_new:N \g\_\_phdd\_nested\_names\_seq

---

**\l\_\_phdd\_index\_macro\_tl****\l\_\_phdd\_index\_key\_tl****\l\_\_phdd\_index\_module\_tl****\l\_\_phdd\_index\_internal\_bool**

When analyzing a control sequence found within a macrocode environment, \l\_\_phdd\_index\_macro\_tl holds the control sequence (partially a string), \l\_\_phdd\_index\_key\_tl holds the future sort key in the index, and \l\_\_phdd\_index\_module\_tl is the subindex in which the control sequence should be listed. Finally, \l\_\_phdd\_index\_internal\_bool indicates when the control sequence is internal and should be indexed in a slightly different subindex.

56 \tl\_new:N \l\_\_phdd\_index\_macro\_tl

57 \tl\_new:N \l\_\_phdd\_index\_key\_tl

58 \tl\_new:N \l\_\_phdd\_index\_module\_tl

59 \bool\_new:N \l\_\_phdd\_index\_internal\_bool

---

**\g\_\_phdd\_module\_name\_tl**

The module name, set when reading a line <@@=⟨*module*⟩.

60 \tl\_new:N \g\_\_phdd\_module\_name\_tl

---

**\c\_\_phdd\_iow\_rule\_tl****\c\_\_phdd\_iow\_midrule\_tl**

40 equal signs.

61 \tl\_const:Nn \c\_\_phdd\_iow\_rule\_tl

62 { ===== }

63 \tl\_const:Nn \c\_\_phdd\_iow\_midrule\_tl

64 { ----- }

---

\l\_\_phdd\_macro\_box  
\l\_\_phdd\_macro\_index\_box  
\l\_\_phdd\_macro\_int

A vertical box in which the names given to the macro environment are typeset, a horizontal box in which we store the targets created by indexing commands, and the number of macros so far (including those from surrounding macro environments).

```
65 \box_new:N \l__phdd_macro_box
66 \box_new:N \l__phdd_macro_index_box
67 \int_new:N \l__phdd_macro_int
```

---

\l\_\_phdd\_cmd\_tl  
\l\_\_phdd\_cmd\_index\_tl  
\l\_\_phdd\_cmd\_module\_tl  
\l\_\_phdd\_cmd\_noindex\_bool  
\l\_\_phdd\_cmd\_replace\_bool

Variables used to control the behaviour of \cmd, \cs and \tn.

```
68 \tl_new:N \l__phdd_cmd_tl
69 \tl_new:N \l__phdd_cmd_index_tl
70 \tl_new:N \l__phdd_cmd_module_tl
71 \bool_new:N \l__phdd_cmd_noindex_bool
72 \bool_new:N \l__phdd_cmd_replace_bool
```

---

\l\_\_phdd\_inImplementation\_bool

This boolean is true within the implementation environment, and false anywhere else.

```
73 \bool_new:N \l__phdd_inImplementation_bool
```

---

\g\_\_phdd\_typeset\_documentation\_bool  
\g\_\_phdd\_typeset\_implementation\_bool

These booleans control whether the documentation/implementation should be typeset. By default both should be.

```
74 \bool_new:N \g__phdd_typeset_documentation_bool
75 \bool_new:N \g__phdd_typeset_implementation_bool
76 \bool_set_true:N \g__phdd_typeset_documentation_bool
77 \bool_set_true:N \g__phdd_typeset_implementation_bool
```

\g\_\_phdd\_base\_name\_tl\l\_\_phdd\_variants\_prop

The name of the macro which is being documented (without its signature), and a property list mapping base forms of variants to all variants which have the same base form.

```
78 \tl_new:N \g__phdd_base_name_tl
79 \prop_new:N \l__phdd_variants_prop
```

\l\_\_phdd\_function\_label\_clist\l\_\_phdd\_no\_label\_bool

Option of a function environment which replaces the label that would normally be inserted by labels for the given list of control sequences. This is only useful to avoid duplicate labels when a function's documentation appears multiple times.

```
80 \clist_new:N \l__phdd_function_label_clist
81 \bool_new:N \l__phdd_no_label_bool
```

\l\_\_phdd\_date\_added\_tl\l\_\_phdd\_date\_updated\_tl

Values of some options of the function environment.

```
82 \tl_new:N \l__phdd_date_added_tl
83 \tl_new:N \l__phdd_date_updated_tl
```

\l\_\_phdd\_macro\_argument\_tl

Save the argument of a macro or function environment for use in error messages.

```
84 \tl_new:N \l__phdd_macro_argument_tl
85 % \int_new:N \c@CodelineNo
```

### D.2.1 Variants and helpers

\\_\_phdd\_tmpa:w

Auxiliary macros for temporary use.

```
86 \cs_new_eq:NN \__phdd_tmpa:w ?
87 \cs_new_eq:NN \__phdd_tmpb:w ?
```

(End definition for \\_\_phdd\_tmpa:w and \\_\_phdd\_tmpb:w.)

\seq\_set\_split:Nv

A few missing variants.

```
88 \cs_generate_variant:Nn \seq_set_split:Nnn { Nv }
89 \cs_generate_variant:Nn \seq_gput_right:Nn { Nf }
90 \cs_generate_variant:Nn \str_case:nn { fn }
91 \cs_generate_variant:Nn \tl_count:n { f }
92 \cs_generate_variant:Nn \tl_greplace_all:Nnn { Nx , Nno }
93 \cs_generate_variant:Nn \tl_if_empty:nTF { f }
94 \cs_generate_variant:Nn \tl_if_head_eq_charcode:nNTF { o }
```

\tl\_if\_in:no January 26, 2019

phddoc



```

95 \cs_generate_variant:Nn \tl_if_head_eqCharCode:nNT { o }
96 \cs_generate_variant:Nn \tl_if_head_eqCharCode:nNF { o }
97 \cs_generate_variant:Nn \tl_if_head_eq_meaning:nNF { V }
98 \cs_generate_variant:Nn \tl_if_in:nnTF { no , oo }
99 \cs_generate_variant:Nn \tl_if_in:NnTF { No }
100 \cs_generate_variant:Nn \tl_if_in:NnT { No }
101 \cs_generate_variant:Nn \tl_if_in:NnF { No }
102 \cs_generate_variant:Nn \tl_remove_all:Nn { Nx }
103 \cs_generate_variant:Nn \tl_replace_all:Nnn { Nx , Nnx, No , Nno }
104 \cs_generate_variant:Nn \tl_replace_once:Nnn { Noo }
105 \cs_generate_variant:Nn \tl_to_str:n { f , o }
106 \cs_generate_variant:Nn \prop_get:NnNTF { Nx }
107 \cs_generate_variant:Nn \prop_put:Nnn { Nx }
108 \cs_generate_variant:Nn \prop_gput:Nnn { NVx }

(End definition for \seq_set_split:Nv and others.)

```

dd\_if\_almost\_str:nTF

Used to test if the argument of `\cmd` or other macros to be indexed is almost a string or not: for instance this is false if #1 contains `\meta{...}`. The surprising f-expansion are there to cope with the case of #1 starting with `\c-backslash_str` which should be expanded and considered to be “normal”.

```

109 \prg_new_protected_conditional:Npnn \__phdd_if_almost_str:n #1 { TF , T , F }
110 {
111     \int_compare:nNnTF
112     { \tl_count:n {#1} }
113     < { \tl_count:f { \tl_to_str:f {#1} } }
114     { \prg_return_false: }
115     { \prg_return_true: }
116 }
117 \cs_generate_variant:Nn \__phdd_if_almost_str:nT { V }

(End definition for \__phdd_if_almost_str:nTF.)

```

\_\_phdd\_trim\_right:Nn\_\_phdd\_trim\_right:No

Removes all material after #2 in the token list variable #1. Perhaps combine with `\__phdd_key_trim_module:n`?

```

118 \cs_new_protected:Npn \__phdd_trim_right:Nn #1#2
119 {
120     \cs_set:Npn \__phdd_tmp:w ##1 #2 ##2 \q_stop { \exp_not:n {##1} }
121     \tl_set:Nx #1 { \exp_after:wN \__phdd_tmp:w #1 #2 \q_stop }
122 }
123 \cs_generate_variant:Nn \__phdd_trim_right:Nn { No }

(End definition for \__phdd_trim_right:Nn.)

```

dd\_str\_if\_begin:nnTFdd\_str\_if\_begin:ooTF

True if the first string starts with the second.

```

124 \prg_new_protected_conditional:Npnn \__phdd_str_if_begin:nn #1#2 { TF , T , F }
125 {
126     \tl_if_in:ooTF
127     { \exp_after:wN \scan_stop: \tl_to_str:n {#1} }
128     { \exp_after:wN \scan_stop: \tl_to_str:n {#2} }
129     { \prg_return_true: }
130     { \prg_return_false: }
131 }
132 \prg_generate_conditional_variant:Nnn \__phdd_str_if_begin:nn
133 { oo } { TF , T , F }


```

(End definition for `\__phdd_str_if_begin:nnTF`.)

U 2019-01-07

The goal is to replace `@@` by the current module name. We take advantage of this function to also detect internal macros. If there is no `<module name>`, do nothing. Otherwise, sanitize the catcodes of `@` and `_`, temporarily change `@@@` to `aa` with different catcodes and later to `@@`, and replace `_@@` and `_@@` and `@@` by `_<module name>`. The result contains `_` with category code letter because this is what the `macrocode` environment expects. Other use cases can apply `\tl_to_str:n` if needed. Note that we include spaces between the `@` in the code below, since it is also processed through the same replacement rules. Updated selection to include `!@@`. This must be used with `l3doctripx` otherwise the style file will not be able to do the conversion. This maybe can provide a generic package namespacing possibility.

```

134 \cs_new_protected:Npn \__phdd_replace_at_at:N #1
135   {
136     \tl_if_empty:NF \g__phdd_module_name_tl
137     {
138       \exp_args:NNo \__phdd_replace_at_at_aux:Nn
139         #1 \g__phdd_module_name_tl
140     }
141   }
142 \cs_new_protected:Npx \__phdd_replace_at_at_aux:Nn #1#2
143   {
144 %   \tl_replace_all:Nnn #1 { \token_to_str:N @ } { @ }
145 %   \tl_replace_all:Nnn #1 { \token_to_str:N _ } { _ }
146 %   \tl_replace_all:Nnn #1 { \token_to_str:N ! } { ! }
147 %   \tl_replace_all:Nnn #1 { @ @ @ @ } { \token_to_str:N a a }
148 %   \tl_replace_all:Nnn #1 { -- @ @ } { -- #2 }
149 %   \tl_replace_all:Nnn #1 { - @ @ } { - - #2 }
150 %   \tl_replace_all:Nnn #1 { !@ @ } { #2 }
151 %   \tl_replace_all:Nnn #1 { @ @ } { _ _ #2 }

152 \tl_replace_all:Nnn #1 { \token_to_str:N @ } { @ }
153 \tl_replace_all:Nnn #1 { \token_to_str:N _ } { _ }
154 \tl_replace_all:Nnn #1 { \token_to_str:N ! } { ! }
155 \tl_replace_all:Nnn #1 { @ @ @ @ } { \token_to_str:N a a }
156 \tl_replace_all:Nnn #1 { -- @ @ } { -- #2 }
157 \tl_replace_all:Nnn #1 { - @ @ } { - - #2 }
158 \tl_replace_all:Nnn #1 { !@ @ } { #2 }
159 \tl_replace_all:Nnn #1 { @ @ } { _ _ #2 }

160 \tl_replace_all:Nnn #1 { \token_to_str:N a a } { @ @ }
161
162 \tl_replace_all:Nnn #1 { \token_to_str:N a a } { @ @ }
163 }
```

(End definition for `\__phdd_replace_at_at:N` and `\__phdd_replace_at_at_aux:Nn`.)

`d_detect_internals:N`  
`cetect_internals_aux:N`  
`cetect_internals_ok:NF`

After splitting at each `__` and removing the leading item from the sequence (since it does not follow `__`), remove everything after any space or end-of-line to get a good approximation of the control sequence (for the warning message). Then check if that starts with something allowed: `@@` module name and `:` or `_`, or if the relevant boolean is set `kernel_` (it seems safe to assume we will not define a `\__kernel:... command`). For the message itself remove anything after any `_` or `:` (with either catcode) to get a guess of the module name.

```

164 \cs_new_protected:Npn \__phdd_detect_internals:N #1
165 {
166   \bool_if:NT \l__phdd_detect_internals_bool
167   { \__phdd_detect_internals_aux:N #1 }
168 }
169 \group_begin:
170   \char_set_catcode_active:N \^^M
171   \cs_new_protected:Npn \__phdd_detect_internals_aux:N #1
172   {
173     \tl_set_eq:NN \l__phdd_detect_internals_tl #1
174     \tl_replace_all:Non \l__phdd_detect_internals_tl { \token_to_str:N _ } { _ }
175     \seq_set_split:NnV \l__phdd_tmpa_seq { _ } \l__phdd_detect_internals_tl
176     \seq_pop_left:NN \l__phdd_tmpa_seq \l__phdd_detect_internals_tl
177     \seq_map_variable:NNn \l__phdd_tmpa_seq \l__phdd_detect_internals_tl
178     {
179       \__phdd_trim_right:No \l__phdd_detect_internals_tl
180       \c_catcode_active_space_tl
181       \__phdd_trim_right:Nn \l__phdd_detect_internals_tl ^^M
182       \__phdd_if_detect_internals_ok:NF \l__phdd_detect_internals_tl
183       {
184         \tl_set_eq:NN \l__phdd_detect_internals_cs_tl \l__phdd_detect_internals
185         \__phdd_trim_right:Nn \l__phdd_detect_internals_tl _
186         \__phdd_trim_right:Nn \l__phdd_detect_internals_tl :
187         \__phdd_trim_right:No \l__phdd_detect_internals_tl { \token_to_str:N :
188         \msg_warning:nnxxxx { phdd } { foreign-
internal }
189         { \tl_to_str:N \l__phdd_detect_internals_cs_tl }
190         { \tl_to_str:N \l__phdd_detect_internals_tl }
191         { \tl_to_str:N \g__phdd_module_name_tl }
192       }
193     }
194   }
195 \group_end:
196 \prg_new_protected_conditional:Npnn \__phdd_if_detect_internals_ok:N #1 { F }
197 {
198   \__phdd_str_if_begin:ooTF {#1} { \g__phdd_module_name_tl _ }
199   { \prg_return_true: }
200   {
201     \__phdd_str_if_begin:ooTF {#1} { \g__phdd_module_name_tl : }
202     { \prg_return_true: }
203     {
204       \bool_if:NTF \g__phdd_kernel_bool
205       {
206         \__phdd_str_if_begin:ooTF {#1} { kernel _ }
207         { \prg_return_true: }
208         { \prg_return_false: }
209       }
210     { \prg_return_false: }
211   }
212 }
213 }
```

(End definition for `\__phdd_detect_internals:N`, `\__phdd_detect_internals_aux:N`, and `\__phdd_if_detect_internals_ok:NF`.)

`signature_base_form:n`  
`ture_base_form_aux:n`  
`ture_base_form_aux:w`

Expands to the “base form” of the signature. For instance, given `noxcfV` it would obtain `nnnNnnn`, or given `ow` it would obtain `nw`. The loop stops at the first token that is not recognized; the rest is enclosed in `\exp_not:n`.

```

214 \cs_new:Npn \__phdd_signature_base_form:n #1
215   { \__phdd_signature_base_form_aux:n #1 \q_stop }
216 \cs_new:Npn \__phdd_signature_base_form_aux:w #1
217   {
218     \str_case:nnTF {#1}
219       {
220         { N } { N }
221         { c } { N }
222         { n } { n }
223         { o } { n }
224         { f } { n }
225         { x } { n }
226         { V } { n }
227         { v } { n }
228       }
229     { \__phdd_signature_base_form_aux:n }
230     { \__phdd_signature_base_form_aux:w #1 }
231   }
232 \cs_new:Npn \__phdd_signature_base_form_aux:w #1 \q_stop
233   { \exp_not:n {#1} }
```

(End definition for `\__phdd_signature_base_form:n`, `\__phdd_signature_base_form_aux:n`, and `\__phdd_signature_base_form_aux:w`.)

`predicate_from_base:n`

Get predicate from a function’s base name. The code is not broken by functions with no signature. The `n`-type version can be used for keys and other non-control sequences. The output after `x`-expansion is a string.

```

234 \cs_new:Npn \__phdd_predicate_from_base:n #1
235   {
236     \__phdd_get_function_name:n {#1}
237     \tl_to_str:n { _p: }
238     \__phdd_get_function_signature:n {#1}
239 }
```

(End definition for `\__phdd_predicate_from_base:n`.)

`split_function_do:nn`  
`split_function_do:on`  
`_get_function_name:n`  
`function_signature:n`  
`plit_function_auxi:w`  
`lit_function_auxii:w`

Similar to internal functions defined in [l3basics](#), but here we operate on strings directly rather than control sequences.

```

240 \cs_new:Npn \__phdd_get_function_name:n #1
241   { \__phdd_split_function_do:nn {#1} { \use_i:nnn } }
242 \cs_new:Npn \__phdd_get_function_signature:n #1
243   { \__phdd_split_function_do:nn {#1} { \use_ii:nnn } }
244 \cs_set_protected:Npn \__phdd_tmpa:w #1
245   {
246     \cs_new:Npn \__phdd_split_function_do:nn ##1
247       {
248         \exp_after:wn \__phdd_split_function_auxi:w
249         \tl_to_str:n {##1} \q_mark \c_true_bool
250         #1 \q_mark \c_false_bool
251         \q_stop
252       }
```

```

253   \cs_new:Npn \__phdd_split_function_auxi:w
254     ##1 #1 ##2 \q_mark ##3##4 \q_stop ##5
255     { \__phdd_split_function_auxii:w {##5} ##1 \q_mark \q_stop {##2} ##3 }
256   \cs_new:Npn \__phdd_split_function_auxii:w
257     ##1##2 \q_mark ##3 \q_stop
258     { ##1 {##2} }
259   }
260 \exp_args:No \__phdd_tmpa:w { \token_to_str:N : }
261 \cs_generate_variant:Nn \__phdd_split_function_do:nn { o }

(End definition for \__phdd_split_function_do:nn and others.)

```

**phdd\_key\_get\_base:nN**

Get the base form of a function and store it. As part of getting the base form, change trailing T or F to TF, skipping that change if the function contains no colon to avoid changing for instance some names ending in PDF or similar. The various letters z serve as end-delimiters different from any outcome of \tl\_to\_str:n.

```

262 \cs_new_protected:Npn \__phdd_key_get_base:nN #1#2
263 {
264   \__phdd_if_almost_str:nTF {#1}
265   {
266     \__phdd_key_get_base_TF:nN {#1} \l__phdd_tmpa_tl
267     \tl_set:Nx #2
268     { \__phdd_split_function_do:on \l__phdd_tmpa_tl { \__phdd_base_form_aux:nn
269     }
270     { \tl_set:Nn #2 {#1} }
271   }
272 \cs_new:Npx \__phdd_key_get_base_TF:nN #1#2
273 {
274   \tl_set:Nx #2 { \exp_not:N \tl_to_str:n {#1} }
275   \tl_if_in:Nof #2 { \tl_to_str:n {::} }
276   { \exp_not:N \prg_break: }
277   \tl_if_in:onT { #2 z } { \tl_to_str:n {TF} z }
278   { \exp_not:N \prg_break: }
279   \tl_if_in:onT { #2 z } { \tl_to_str:n {T} z }
280   {
281     \tl_put_right:Nn #2 { \tl_to_str:n {F} }
282     \exp_not:N \prg_break:
283   }
284   \tl_if_in:onT { #2 z } { \tl_to_str:n {F} z }
285   {
286     \tl_put_right:Nn #2 { z }
287     \tl_replace_once:Nnn #2 { \tl_to_str:n {F} z } { \tl_to_str:n {TF} }
288     \exp_not:N \prg_break:
289   }
290   \exp_not:N \prg_break_point:
291 }
292 \cs_new:Npn \__phdd_base_form_aux:nnN #1#2#3
293 {
294   \exp_not:n {#1}
295   \bool_if:NT #3
296   {
297     \token_to_str:N :
298     \str_if_eq:nnTF { #1 ~ } { \exp_args }
```

```

299      { \exp_not:n {#2} }
300      { \__phdd_signature_base_form:n {#2} }
301    }
302  }

```

*(End definition for \\_\_phdd\_key\_get\_base:nN.)*

### form\_signature\_do:nnn

Do #2{#1} if there is no signature, or if #1 contains two colons in a row (this covers the weird function `\::N` and so on). Otherwise apply #3 with the following two arguments: the base form of #1, and the original signature with an extra pair of braces.

```

303 \cs_new_protected:Npn \__phdd_base_form_signature_do:nnn #1#2#3
304 {
305   \__phdd_split_function_do:nn {#1}
306   { \__phdd_base_form_aux:nnnnnN {#1} {#2} {#3} }
307 }
308 \cs_new_protected:Npn \__phdd_base_form_aux:nnnnnN #1#2#3#4#5#6
309 {
310   \bool_if:NTF #6
311   {
312     \tl_if_head_eqCharCode:nNTF {#4} :
313     { #2 {#1} }
314     {
315       \use:x
316       {
317         \exp_not:n {#3}
318         { \__phdd_base_form_aux:nnN {#4} {#5} #6 }
319       }
320       {#4} {#5}
321     }
322   }
323   { #2 {#1} }
324 }

```

*(End definition for \\_\_phdd\_base\_form\_signature\_do:nnn.)*

### d\_date\_compare\_p:nNn

### d\_date\_compare:nNnTF

### \_compare\_aux:nnnNnnn

### d\_date\_compare\_aux:w

Expects #1 and #3 to be dates in the format YYYY-MM-DD (but accepts YYYY or YYYY-MM too). Compares them using #2 (one of <, =, >), filling in zeros for missing data.

```

325 \prg_new_conditional:Npnn \__phdd_date_compare:nNn #1#2#3 { TF , T , F , p }
326 { \__phdd_date_compare_aux:w #1--- \q_mark #2 #3--- \q_stop }
327 \cs_new:Npn \__phdd_date_compare_aux:w
328   #1 - #2 - #3 - #4 \q_mark #5 #6 - #7 - #8 - #9 \q_stop
329 {
330   \__phdd_date_compare_aux:nnnNnnn
331   { \tl_if_empty:nTF {#1} { 0 } {#1} }
332   { \tl_if_empty:nTF {#2} { 0 } {#2} }
333   { \tl_if_empty:nTF {#3} { 0 } {#3} }
334   #5
335   { \tl_if_empty:nTF {#6} { 0 } {#6} }
336   { \tl_if_empty:nTF {#7} { 0 } {#7} }
337   { \tl_if_empty:nTF {#8} { 0 } {#8} }
338 }
339 \cs_new:Npn \__phdd_date_compare_aux:nnnNnnn #1#2#3#4#5#6#7

```

```

340  {
341    \int_compare:nNnTF {#1} = {#5}
342    {
343      \int_compare:nNnTF {#2} = {#6}
344      {
345        \int_compare:nNnTF {#3} #4 {#7}
346        { \prg_return_true: } { \prg_return_false: }
347      }
348      {
349        \int_compare:nNnTF {#2} #4 {#6}
350        { \prg_return_true: } { \prg_return_false: }
351      }
352    }
353    {
354      \int_compare:nNnTF {#1} #4 {#5}
355      { \prg_return_true: } { \prg_return_false: }
356    }
357  \use_none:n
358  \q_stop
359 }
```

(End definition for `\__phdd_date_compare:nNnTF`, `\__phdd_date_compare_aux:nnnNnnn`, and `\__phdd_date_compare_aux:w.`)

`\__phdd_gprop_name:n`  
`\__phdd_lseq_name:n`

We need to keep track of some information about control sequences (and other strings) that are being (or have been) documented. Some is stored into global props and some into local seqs, whose name does not follow conventions: it is `\g__phdd` or `\l__phdd` followed by a space and by the string, which can be arbitrary. We cannot reasonably use a single big `prop` for speed reasons.

```

360 \cs_new:Npn \__phdd_gprop_name:n #1 { g__phdd ~ \tl_to_str:n {#1} }
361 \cs_new:Npn \__phdd_lseq_name:n #1 { l__phdd ~ \tl_to_str:n {#1} }
```

(End definition for `\__phdd_gprop_name:n` and `\__phdd_lseq_name:n.`)

## D.2.2 Messages

```

362 \msg_new:nnn { phdd } { no-signature-TF }
363   { Function/macro~'#1'~cannot~be~turned~into~a~conditional. }
364   {
365     A~function~or~macro~environment~with~option~pTF,~TF~or~noTF~
366     received~the~argument~'#1'.~This~function's~name~has~no~
367     ':'~hence~it~is~not~clear~where~to~add~'_p'~or~'TF'.~
368     Please~follow~expl3~naming~conventions.
369   }
370 \msg_new:nnn { phdd } { deprecated-function }
371   { The~deprecated~function(s)~'#1'~should~have~been~removed~on~#2. }
372
373 \msg_new:nnn { phdd } { date-format }
374   { The~date~'#1'~should~be~given~in~YYYY-MM-DD~format. }
375
376 \msg_new:nnn { phdd } { syntax-nested-function }
377   {
378     The~'syntax'~environment~should~be~used~in~the~
379     innermost~'function'~environment.
```

```

380   }
381 \msg_new:nnn { phdd } { multiple-syntax }
382 {
383   The~'syntax'~environment~should~only~be~used~once~in~
384   a~'function'~environment.
385 }
386 \msg_new:nnn { phdd } { deprecated-option }
387 {
388   The~option~'#1'~has~been~deprecated~for~'#2'.
389 \msg_new:nnn { phdd } { foreign-internal }
390 {
391   A~control~sequence~of~the~form~'..._#1'~was~used.~
392   It~should~only~be~used~in~the~module~'#2'
393   \tl_if_empty:nF {#3} { ,~not~in~'#3' } .
394 }

```

### D.2.3 Configuration and tweaks

#### \MakePrivateLetters

A few more letters are “private” in a L<sup>A</sup>T<sub>E</sub>X3 programming environment.

```

395 \cs_gset:Npn \MakePrivateLetters
396 {
397   \char_set_catcode_letter:N \@_
398   \char_set_catcode_letter:N \_
399   \char_set_catcode_letter:N \:
400 }

```

(End definition for `\MakePrivateLetters`.)

#### CodelineNo

Some configurations which have to do with line numbering. This is now provided through a key value interface.

```

401 \setcounter{StandardModuleDepth}{1}
402 %\addtoreset{CodelineNo}{part}
403 %\tl_replace_once:Nnn \theCodelineNo
404 % { \HDorg@theCodelineNo }
405 % { \textcolor[gray]{0.5} { \sffamily\tiny\arabic{CodelineNo} } }

```

(End definition for `CodelineNo`.)

#### \verbatim \endverbatim

In .dtx documents, the `\verbatim` environment adds extra space because it only removes the first “%” sign, and not the indentation (typically a space). Fix it with `fancyvrb`:

```

406 %
407 % \cs_gset_eq:NN \verbatim \Verbatim
408 % \cs_gset_eq:NN \endverbatim \endVerbatim

```

(End definition for `\verbatim` and `\endverbatim`.)

#### \ifnot@excluded

This function tests whether a macro name stored in `\macro@namepart` was excluded from indexing by `\DoNotIndex`. Rather than trying to fix catcodes that come into here, turn everything to string catcodes. This is somewhat inefficient as we could have ensured that `\index@excludelist` has string catcodes in the first place.

```

409 \cs_set_protected:Npn \ifnot@excluded
410 {

```

```

411   \exp_args:Nxx \expanded@notin
412     { \c_backslash_str \tl_to_str:N \macro@namepart , }
413     { \exp_args:NV \tl_to_str:n \index@excludelist }
414   }

```

(End definition for `\ifnot@excluded`.)

`\pdfstringnewline`  
`\pdfstring_newline:w`

We avoid some hyperref warnings by making `\\" (almost) trivial in bookmarks:` more precisely it might be used with a star and an optional argument, which we thus remove using an `xparse` expandable command. Since there cannot be trailing optional arguments, pick up an extra mandatory one and put it back.

```

415 \cs_new:Npn \pdfstringnewline { : ~ }
416 \DeclareExpandableDocumentCommand
417   { \__phdd_pdfstring_newline:w } { s o m } { \pdfstringnewline #3 }
418 \pdfstringdefDisableCommands
419   { \cs_set_eq:NN \\ \__phdd_pdfstring_newline:w }

```

(End definition for `\pdfstringnewline` and `\__phdd_pdfstring_newline:w`.)

`\cmd`  
`\cs`  
`\tn`

They rely on a common auxiliary `\__phdd_cmd:nn` which receives as arguments the options and some tokens whose string representation starts with a backslash (to support cases such as `\cs{pkg_\ldots}`, we do not turn the whole argument into a string).

```

420 \DeclareDocumentCommand \cmd { O{} m }
421   { \__phdd_cmd:no {#1} { \token_to_str:N #2 } }
422
423 \DeclareDocumentCommand \cs { O{} m }
424   { \__phdd_cmd:no {#1} { \c_backslash_str #2 } }
425
426 \DeclareDocumentCommand \tn { O{} m }
427   {
428     \__phdd_cmd: no
429       { module = TeX , replace = false , #1 }
430       { \c_backslash_str #2 }
431   }

```

(End definition for `\cmd`, `\cs`, and `\tn`.)

`\meta`

A document-level command.

```

432 \DeclareDocumentCommand \meta { m }
433   { \__phdd_meta:n {#1} }

```

(End definition for `\meta`.)

`\phdd_pdfstring_cmd:w`  
`\phdd_pdfstring_cs:w`  
`\phdd_pdfstring_meta:w`

To work within a bookmark, these commands must be expandable.

```

434 \DeclareExpandableDocumentCommand
435   { \__phdd_pdfstring_cmd:w } { o m } { \token_to_str:N #2 }
436 \DeclareExpandableDocumentCommand
437   { \__phdd_pdfstring_cs:w } { o m } { \textbackslash \tl_to_str:n {#2} }
438 \cs_new:Npn \__phdd_pdfstring_meta:w #1
439   { < \tl_to_str:n {#1} > }
440 \pdfstringdefDisableCommands
441   {
442     \cs_set_eq:NN \cmd \__phdd_pdfstring_cmd:w
443     \cs_set_eq:NN \cs \__phdd_pdfstring_cs:w

```

```

444      \cs_set_eq:NN \tn  \__phdd_pdfstring_cs:w
445      \cs_set_eq:NN \meta \__phdd_pdfstring_meta:w
446  }

(End definition for \__phdd_pdfstring_cmd:w, \__phdd_pdfstring_cs:w, and \__phdd_pdf-
string_meta:w.)
```

\Arg  
\marg{text} prints {<text>}, “mandatory argument”.  
\oarg{text} prints [<text>], “optional argument”.  
\parg{te,xt} prints (<te,xt>), “picture mode argument”. Finally, \Arg is the same as \marg.

```

447 \newcommand\Arg[1]
448   { \texttt{\char`{} \{} \meta{#1} \texttt{\char`{} \}} }
449 \providecommand\marg[1]{ \Arg{#1} }
450 \providecommand\oarg[1]{ \texttt{[} \meta{#1} \texttt{]} }
451 \providecommand\parg[1]{ \texttt{(} \meta{#1} \texttt{)} }
```

(End definition for \Arg and others.)

\file  
\env  
\pkg  
\cls

This list may change...this is just my preference for markup.

```

452 \DeclareRobustCommand \file {\nolinkurl}
453 \DeclareRobustCommand \env {\texttt}
454
455 \% \DeclareRobustCommand \pkg {\textsf}
456 \% \DeclareRobustCommand \cls {\textsf}
```

457

(End definition for \file and others.)

\EnableDocumentation  
\EnableImplementation  
\DisableDocumentation  
\DisableImplementation

Control whether to typeset the documentation/implementation or not. These simply set two switches.

```

458 \NewDocumentCommand \EnableDocumentation { }
459   { \bool_gset_true:N \g__phdd_typeset_documentation_bool }
460 \NewDocumentCommand \EnableImplementation { }
461   { \bool_gset_true:N \g__phdd_typeset_implementation_bool }
462 \NewDocumentCommand \DisableDocumentation { }
463   { \bool_gset_false:N \g__phdd_typeset_documentation_bool }
464 \NewDocumentCommand \DisableImplementation { }
465   { \bool_gset_false:N \g__phdd_typeset_implementation_bool }
```

(End definition for \EnableDocumentation and others.)

documentation  
implementation

If the documentation/implementation should be typeset, then simply set the boolean \l\_\_phdd\_in\_implementation\_bool which indicates whether we are within the implementation section. Otherwise use \comment (and a paired \endcomment).

```

466 \NewDocumentEnvironment { documentation } { }
467   {
468     \bool_if:NTF \g__phdd_typeset_documentation_bool
469       { \bool_set_false:N \l__phdd_in_implementation_bool }
470       { \comment }
471   }
472   { \bool_if:NF \g__phdd_typeset_documentation_bool { \endcomment } }
473 \NewDocumentEnvironment { implementation } { }
474   {
```

```

475   \bool_if:NTF \g_phdd_typesetImplementationBool
476     { \bool_set_true:N \l_phdd_inImplementationBool }
477     { \comment }
478   }
479 { \bool_if:NF \g_phdd_typesetImplementationBool { \endcomment } }

```

**variable** The variable environment behaves as a function or macro environment depending on the part of the document.

```

480 \DeclareDocumentEnvironment { variable } { O{} +v }
481   {
482     \bool_if:NTF \l_phdd_inImplementationBool
483       { \__phdd_macro:nw { var , #1 } {#2} }
484       { \__phdd_function:nw {#1} {#2} }
485   }
486   {
487     \bool_if:NTF \l_phdd_inImplementationBool
488       { \__phdd_macro_end: }
489       { \__phdd_function_end: }
490   }

```

**function** Environment for documenting function(s), and environment for documenting  
**macro** the implementation of a macro.

```

491 \DeclareDocumentEnvironment { function } { O{} +v }
492   { \__phdd_function:nw {#1} {#2} }
493   { \__phdd_function_end: }
494 \DeclareDocumentEnvironment { macro } { O{} +v }
495   { \__phdd_macro:nw {#1} {#2} }
496   { \__phdd_macro_end: }

```

**syntax** Syntax block placed next to the list of functions to illustrate their use. TODO: test that the syntax environment is only used inside the function environment, and that it only appears once.

```

497 \NewDocumentEnvironment { syntax } { }
498   { \__phdd_syntax:w }
499   {
500     \__phdd_syntax_end:
501     \ignorespacesafterend
502   }

```

**texnote** Used to describe information destined to TeX experts only.

```

503 \NewDocumentEnvironment { texnote } { }
504   {
505     \endgraf
506     \vspace{3mm}
507     \small\textbf{\TeX-hackers-note:}
508   }
509   {
510     \vspace{3mm}
511   }

```

**\CodedocExplain** Explanation of stars and TF notations, for use in third-party packages.

```

\CodedocExplainEXP
\CodedocExplainREXP
\CodedocExplainTF

```

```

514 \NewDocumentCommand { \CodedocExplainEXP } { }
515   {
516     \raisebox{\baselineskip}[0pt][0pt]{\hypertarget{expstar}{}}
517     \__phdd_typeset_exp:\ indicates~fully~expandable~functions,~which~
518     can~be~used~within~an~\texttt{x}-
519     type~argument~(in~plain~
520     \TeX{}~terms,~inside~an~\cs{edef}),~as~well~as~within~an~
521     \texttt{f}-type~argument.
522   }
523 \NewDocumentCommand { \CodedocExplainREXP } { }
524   {
525     \raisebox{\baselineskip}[0pt][0pt]{\hypertarget{rexpstar}{}}
526     \__phdd_typeset_rexp:\ indicates~
527     restricted~expandable~functions,~which~can~be~used~within~an~
528     \texttt{x}-type~argument~but~cannot~be~fully~expanded~within~an~
529     \texttt{f}-type~argument.
530   }
531 \NewDocumentCommand { \CodedocExplainTF } { }
532   {
533     \raisebox{\baselineskip}[0pt][0pt]{\hypertarget{explTF}{}}
534     \__phdd_typeset_TF:\ indicates~conditional~(\texttt{if})~functions~
535     whose~variants~with~\texttt{T},~\texttt{F}~and~\texttt{TF}~
536     argument~specifiers~expect~different~
537     \enquote{true}/\enquote{false}~branches.
538 }
```

(End definition for `\CodedocExplain` and others.)

#### D.2.4 Implementing text markup

Keys for `\cmd`, `\cs` and `\tn`.

```

538 \keys_define:nn { phdd/cmd }
539   {
540     index      .tl_set:N    = \l__phdd_cmd_index_tl      ,
541     module     .tl_set:N    = \l__phdd_cmd_module_tl     ,
542     no-index   .bool_set:N = \l__phdd_cmd_noindex_bool  ,
543     replace    .bool_set:N = \l__phdd_cmd_replace_bool   ,
544   }
```

`\__phdd_cmd:nn`  
`\__phdd_cmd:no`

Apply the key-value `<options>` #1 after setting some default values. Then (unless `replace=false`) replace @@ in #2, which is a bit tricky: the \_ must be given the catcode expected by `\__phdd_replace_at_at:N`, but should be reverted to their original catcode (normally active, needed for line-breaking) without rescanning the whole argument. Then typeset the command in `\verbatim@font`, after turning it to harmless characters if needed (and keeping the underscore breakable); in any case, spaces must be turned into `\@xobeysp` and we must use `\@` to avoid longer spaces after a control sequence that ends for instance with a colon (empty signature). Finally, produce an index entry. Indexing is suppressed when `\l__phdd_cmd_noindex_bool` is true.

```

545 \cs_new_protected:Npn \__phdd_cmd:nn #1#2
546   {
547     \bool_set_false:N \l__phdd_cmd_noindex_bool
548     \bool_set_true:N \l__phdd_cmd_replace_bool
```

```

549   \tl_set:Nn \l__phdd_cmd_index_tl { \q_no_value }
550   \tl_set:Nn \l__phdd_cmd_module_tl { \q_no_value }
551   \keys_set:nn { phdd/cmd } {#1}
552   \tl_set:Nn \l__phdd_cmd_tl {#2}
553   \bool_if:NT \l__phdd_cmd_replace_bool
554   {
555     \tl_set_rescan:Nnn \l__phdd_tmpb_tl { } { _ }
556     \tl_replace_all:Non \l__phdd_cmd_tl \l__phdd_tmpb_tl { _ }
557     \__phdd_replace_at_at:N \l__phdd_cmd_tl
558     \tl_replace_all:Nno \l__phdd_cmd_tl { _ } \l__phdd_tmpb_tl
559   }

```

**Typesetting** Note the replacement for the underscore is to permit linebreaks. The underscore package adds the linebreak, and the regex results in applying the breakable underscore only to the *last* of a run of underscores, and not if the underscore follows a backslash.

```

560 \def\BreakableUnderscore{\leavevmode\nobreak\hskip\z@skip
561 \%ifx\f@family\ttdefault \string \else
562 \textunderscore
563 \%fi
564 \@dischyph\nobreak\hskip\z@skip}
565 \mode_if_math:T { \mbox }
566 {
567   \verbatim@font
568   \__phdd_if_almost_str:VT \l__phdd_cmd_tl
569   {
570     \tl_set:Nx \l__phdd_cmd_tl { \tl_to_str:N \l__phdd_cmd_tl }
571     \bool_if:NT \g_phdd_cs_break_bool
572     {
573       % underscore is replaced with breakable underscore.
574       \regex_replace_all:nnN
575         {([^\_])_([^\_])}
576         {\1\c{BreakableUnderscore}\2}
577         \l__phdd_cmd_tl
578     }
579   }
580   \tl_replace_all:Nnn \l__phdd_cmd_tl { ~ } { \obeysp }
581   \l__phdd_cmd_tl
582   \o
583 }

```

## Indexing

```

584 \bool_if:NF \l__phdd_cmd_noindex_bool
585 {
586   \quark_if_no_value:NF \l__phdd_cmd_index_tl
587   {
588     \tl_set:Nx \l__phdd_cmd_tl
589     { \c_backslash_str \exp_not:o { \l__phdd_cmd_index_tl } }
590   }
591
592   \exp_args:No \__phdd_key_get:n { \l__phdd_cmd_tl }
593   \quark_if_no_value:NF \l__phdd_cmd_module_tl

```

```

594         {
595             \tl_set:Nx \l__phdd_index_module_tl
596                 { \tl_to_str:N \l__phdd_cmd_module_tl }
597         }
598     \__phdd_special_index_module:ooonN
599         { \l__phdd_index_key_tl }
600         { \l__phdd_index_macro_tl }
601         { \l__phdd_index_module_tl }
602         { usage }
603         \l__phdd_index_internal_bool
604     }
605 }
606 \cs_generate_variant:Nn \__phdd_cmd:nn { no }

(End definition for \__phdd_cmd:nn.)

```

`\__phdd_meta:n`  
`\phdd_ensuremath_sb:n`  
`\phdd_meta_original:n`

Store #1 in `\l__phdd_tmpa_tl` and replaces every underscore, regardless of its category (“math toggle”, “alignment”, “superscript”, “subscript”, “letter”, “other”, or “active”) by `\__phdd_ensuremath_sb:n` (which creates math subscripts), then runs the code used for `\meta` in `doc.sty`.

```

607 \cs_new_protected:Npn \__phdd_meta:n #1
608 {
609     \tl_set:Nn \l__phdd_tmpa_tl {#1}
610     \tl_map_inline:nn
611         { { 3 } { 4 } { 7 } { 8 } { 11 } { 12 } { 13 } }
612         {
613             \tl_set_rescan:Nnn \l__phdd_tmpb_tl
614                 { \char_set_catcode:nn { `_ } {##1} } { _ }
615             \tl_replace_all:Non \l__phdd_tmpa_tl \l__phdd_tmpb_tl
616                 { \__phdd_ensuremath_sb:n }
617         }
618     \exp_args:NV \__phdd_meta_original:n \l__phdd_tmpa_tl
619 }
620
621 \cs_new_protected:Npn \__phdd_ensuremath_sb:n #1
622 {
623     \ensuremath { \sb {#1} }
624
625 % Original meta
626 \cs_new_protected:Npn \__phdd_meta_original:n #1
627 {
628     \ensuremath \langle
629     \mode_if_math:T { \nfss@text }
630     {
631         \meta@font@select
632         \edef \meta@hyphen@restore
633             { \hyphenchar \the \font \the \hyphenchar \font }
634         \hyphenchar \font \m@ne
635         \language \l@nohyphenation
636         \color{themeta}#1 \/
637         \meta@hyphen@restore
638     }
639     \ensuremath \rangle

```

(End definition for `\__phdd_meta:n`, `\__phdd_ensuremath_sb:n`, and `\__phdd_meta_original:n`.)

### D.2.40 Common between macro and function

```
__phdd_typeset_exp:
__phdd_typeset_rexp:
__phdd_typeset_TF:
__phdd_typeset_aux:n

640 %
641 \cs_new_protected:Npn __phdd_typeset_exp: % check
642   { \hyperlink{expstar} {$\star$} }
643
644 \cs_new_protected:Npn __phdd_typeset_rexp:
645   { \hyperlink{rexpstar} {\ding{73}} } % hollow star
646
647 \cs_new_protected:Npn __phdd_typeset_TF:
648   {
649     \hyperlink{explTF}
650     {
651       \color{themacrocolor} % was black
652       \itshape TF
653       \makebox[0pt][r]
654       {
655         \color{red}
656         \underline{ \phantom{\itshape TF} \kern-0.1em }
657       }
658     }
659   }
660 \cs_new_protected:Npn __phdd_typeset_aux:n #1
661   {
662   }
663   \% \color[gray]{0.5}
664   \% YL
665   \color{themacrocolor} #1
666   }
667 }
```

(End definition for `\__phdd_typeset_exp:` and others.)

`get_hyper_target:nN`  
`get_hyper_target:oN`  
`get_hyper_target:xN`

Create a **hyperref** anchor from a macro name #1 and stores it in the token list variable #2. For instance, `\prg_replicate:nn` gives `doc/function//prg/replicate:nn`.

```
668 \cs_new_protected:Npn __phdd_get_hyper_target:nN #1#2
669   {
670     \tl_set:Nx #2 { \tl_to_str:n {#1} }
671     \tl_replace_all:Nnx #2 { \c_underscore_str } { / }
672     \tl_remove_all:Nx #2 { \c_underscore_str }
673     \tl_put_left:Nn #2 { doc/function// }
674   }
675 \cs_generate_variant:Nn __phdd_get_hyper_target:nN { o , x }
```

(End definition for `\__phdd_get_hyper_target:nN`.)

`phdd_names_get_seq:nN`

The argument #1 (argument of a **function** or **macro** environment) has catcodes 10 (space), 12 (other) and 13 (active). Sanitize catcodes. If the **verb** option was used, output a one-item sequence. Otherwise, remove any “%” character at the beginning of a line. Remove tabs and newlines. Finally, convert \_@\_

and @@ to \_\_⟨module name⟩ (if it is non-empty). At this point, \l\_\_phdd\_tma\_tl contains a comma-delimited list of names, where @ and \_ have category code letter. Turn it to a string, parse it as a comma-delimited list (in particular this removes spaces), and output a sequence of function/macro names.

```

676 \cs_new_protected:Npn \__phdd_names_get_seq:nN #1#2
677 {
678     \tl_set:Nx \l__phdd_tma_tl { \tl_to_str:n {#1} }
679     \bool_if:NTF \l__phdd_names_verb_bool
680     {
681         \seq_clear:N #2
682         \seq_put_right:NV #2 \l__phdd_tma_tl
683     }
684     {
685         \tl_remove_all:Nx \l__phdd_tma_tl
686         { \iow_char:N \^M \c_percent_str }
687         \tl_remove_all:Nx \l__phdd_tma_tl { \tl_to_str:n { ^ ^ A } }
688         \tl_remove_all:Nx \l__phdd_tma_tl { \iow_char:N \^I }
689         \tl_remove_all:Nx \l__phdd_tma_tl { \iow_char:N \^M }
690         \__phdd_detect_internals:N \l__phdd_tma_tl
691         \__phdd_replace_at_at:N \l__phdd_tma_tl
692         \exp_args:NNx \seq_set_from_clist:Nn #2
693         { \tl_to_str:N \l__phdd_tma_tl }
694     }
695 }
```

(End definition for \\_\_phdd\_names\_get\_seq:nN.)

\\_\_phdd\_names\_parse:  
dd\_names\_parse\_one:n

The goal is to group variants together. We populate \l\_\_phdd\_names\_block\_tl with local sequence variable named with \\_\_phdd\_lseq\_name:n after the base forms. When encountering a new base form, set the corresponding local sequence to hold the ⟨base name⟩ (stripped of the signature) and add the local sequence to the list \l\_\_phdd\_names\_block\_tl. In all cases append the signature to the local sequence, which thus takes the form ⟨base name⟩, ⟨signature<sub>1</sub>⟩, ⟨signature<sub>2</sub>⟩ and so on. If the original function had no signature (no colon) then use \scan\_stop: as the signature (there can be no variant). We special case commands #1 starting with \:::, namely weird functions named \:::N and the like.

```

696 \cs_new_protected:Npn \__phdd_names_parse:
697 {
698     \tl_clear:N \l__phdd_names_block_tl
699     \seq_map_function:NN
700     \l__phdd_names_seq
701     \__phdd_names_parse_one:n
702 }
703 \cs_new_protected:Npn \__phdd_names_parse_one:n #1
704 {
705     \__phdd_split_function_do:nn {#1}
706     { \__phdd_names_parse_one_aux:nnNn }
707     {#1}
708 }
709 \cs_new_protected:Npn \__phdd_names_parse_one_aux:nnNn #1#2#3#4
710 {
711     \bool_if:NTF #3
```

```

712      {
713        \tl_if_head_eq_charcode:nNTF {#2} :
714          { \__phdd_names_parse_aux:nnn {#4} {#4} { \scan_stop: } }
715        {
716          \exp_args:Nx \__phdd_names_parse_aux:nnn
717            { \__phdd_base_form_aux:nnN {#1} {#2} #3 }
718            {#1} {#2}
719        }
720      }
721      {
722        \bool_if:NT \l__phdd_macro_TF_bool
723          { \msg_error:nnx { l3doc } { no-signature-
TF } {#4} }
724          \__phdd_names_parse_aux:nnn {#4} {#4} { \scan_stop: }
725      }
726    }
727 \cs_new_protected:Npn \__phdd_names_parse_aux:nnn #1
728   { \exp_args:Nc \__phdd_names_parse_aux:Nnn { \__phdd_lseq_name:n {#1} } }
729 \cs_new_protected:Npn \__phdd_names_parse_aux:Nnn #1#2#3
730   {
731     \tl_if_in:NnF \l__phdd_names_block_tl {#1}
732     {
733       \tl_put_right:Nn \l__phdd_names_block_tl {#1}
734       \seq_clear_new:N #1
735       \seq_put_right:Nn #1 {#2}
736     }
737     \seq_put_right:Nn #1 {#3}
738   }

```

(End definition for `\__phdd_names_parse:` and `\__phdd_names_parse_one:n`.)

`.phdd_names_typeset:`  
`names_typeset_auxi:n`

This code is in particular used when typesetting function names in a function environment. The mapping to `\l__phdd_names_block_tl` cannot use `\tl_map_inline:Nn` because the code following `\` would not be expandable, thus breaking `\bottomrule`.

Call `\__phdd_names_typeset_auxi:n` on each local sequence (which holds a set of variants). The first step is to pop the base form and change spaces to category other so that they get displayed eventually. Then store the variants in `\g__phdd_variants_seq`, remove the first, which will be displayed more prominently, and reconstruct the actual name, passing it to `\__phdd_names_typeset_auxi:n`.

```

739 \cs_new_protected:Npn \__phdd_names_typeset:
740   {
741     \tl_map_function:NN \l__phdd_names_block_tl
742     \__phdd_names_typeset_auxi:n
743   }
744 \cs_new_protected:Npn \__phdd_names_typeset_auxi:n #1
745   {
746     \seq_pop:NN #1 \l__phdd_tmpa_tl
747     \tl_gset_eq:NN \g__phdd_base_name_tl \l__phdd_tmpa_tl
748     \tl_greplace_all:Nno \g__phdd_base_name_tl
749       { ~ } { \c_catcode_other_space_tl }
750     \seq_get:NN #1 \l__phdd_tmpa_tl
751     \str_if_eq:VnTF \l__phdd_tmpa_tl { \scan_stop: }

```

```

752     {
753         \seq_gclear:N \g__phdd_variants_seq
754         \__phdd_names_typeset_auxii:x { \g__phdd_base_name_tl }
755     }
756     {
757         \seq_gset_eq:NN \g__phdd_variants_seq #1
758         \seq_gpop:NN \g__phdd_variants_seq \l__phdd_tmpb_tl
759         \__phdd_names_typeset_auxii:x
760             { \g__phdd_base_name_tl : \l__phdd_tmpb_tl }
761     }
762 }
```

(End definition for `\__phdd_names_typeset:` and `\__phdd_names_typeset_auxi:n`.)

`names_typeset_auxii:n`  
`names_typeset_auxii:x`

In case the option `pTF` was given, typeset predicates before the `TF` functions. In case the option `noTF` was given, typeset the non-`TF` function as well. Pass the relevant boolean in both cases to control whether to append `TF`.

```

763 \cs_new_protected:Npn \__phdd_names_typeset_auxii:n #1
764 {
765     \bool_if:NT \l__phdd_macro_pTF_bool
766     {
767         \__phdd_names_typeset_block:xN
768             { \__phdd_predicate_from_base:n {#1} }
769             \c_false_bool
770     }
771     \bool_if:NT \l__phdd_macro_noTF_bool
772         { \__phdd_names_typeset_block:nN {#1} \c_false_bool }
773     \__phdd_names_typeset_block:nN {#1} \l__phdd_macro_TF_bool
774 }
775 \cs_generate_variant:Nn \__phdd_names_typeset_auxii:n { x }
```

(End definition for `\__phdd_names_typeset_auxi:n`.)

`names_typeset_block:nN`  
`names_typeset_block:xN`

Names in function and macro environments are typeset differently. To distinguish the two note that `\l__phdd_nested_macro_int` is at least one when in an `macro` environment (we assume `function` is not nested inside it). A block is a function with all its variants.

```

776 \cs_new_protected:Npn \__phdd_names_typeset_block:nN
777 {
778     \int_compare:nNnTF \l__phdd_nested_macro_int = 0
779         { \__phdd_typeset_function_block:nN }
780         { \__phdd_macro_typeset_block:nN }
781 }
782 \cs_generate_variant:Nn \__phdd_names_typeset_block:nN { x }
```

(End definition for `\__phdd_names_typeset_block:nN`.)

`f_macro_internal_p:n`  
`f_macro_internal:nTF`  
`macro_internal_aux:w`

Determines whether the given macro should be considered internal or public. If an option such as `int` was given then the answer is `\l__phdd_macro_internal_bool`, otherwise check for whether the macro name contains `__`.

```

783 \prg_new_conditional:Npnn \__phdd_if_macro_internal:n #1 { p , T , F , TF }
784 {
785     \bool_if:NTF \l__phdd_macro_internal_set_bool
786         {
```

```

787         \bool_if:NTF \l__phdd_macro_internal_bool
788             { \prg_return_true: } { \prg_return_false: }
789     }
790     {
791         \tl_if_empty:fTF
792         {
793             \exp_after:wN \__phdd_if_macro_internal_aux:w
794             \tl_to_str:n { #1 ~ __ }
795         }
796         { \prg_return_false: } { \prg_return_true: }
797     }
798 }
799 \exp_last_unbraced:NNNNo
800 \cs_new:Npn \__phdd_if_macro_internal_aux:w #1 { \tl_to_str:n { __ } } { }
```

(End definition for `\__phdd_if_macro_internal:nTF` and `\__phdd_if_macro_internal_aux:w`.)

### `mes_block_base_map:N`

The `\l__phdd_names_block_tl` contains sequence variables corresponding to different base functions and their variants. For each such sequence, put the first and second items in `\l__phdd_tmpa_tl` and `\l__phdd_tmpb_tl` and build the base function's name.

```

801 \cs_new_protected:Npn \__phdd_names_block_base_map:N #1
802 {
803     \tl_map_inline:Nn \l__phdd_names_block_tl
804     {
805         \group_begin:
806             \seq_set_eq:NN \l__phdd_tmpa_seq ##1
807             \seq_pop:NN \l__phdd_tmpa_seq \l__phdd_tma_tl
808             \seq_get:NN \l__phdd_tmpa_seq \l__phdd_tmpb_tl
809             \exp_args:NNx
810         \group_end:
811         #1
812         {
813             \l__phdd_tma_tl
814             \str_if_eq:VnF \l__phdd_tmpb_tl { \scan_stop: }
815             { : \l__phdd_tmpb_tl }
816             \bool_if:NT \l__phdd_macro_TF_bool { TF }
817         }
818     }
819 }
```

(End definition for `\__phdd_names_block_base_map:N`.)

## D.2.40 The function environment

```

820 \keys_define:nn { l3doc/function }
821 {
822     TF .value_forbidden:n = true ,
823     TF .code:n =
824     {
825         \bool_set_true:N \l__phdd_macro_TF_bool
826     } ,
827     EXP .value_forbidden:n = true ,
828     EXP .code:n =
```

```

829      {
830          \bool_set_true:N \l_phdd_macro_EXP_bool
831          \bool_set_false:N \l_phdd_macro_rEXP_bool
832      } ,
833      rEXP .value_forbidden:n = true ,
834      rEXP .code:n =
835      {
836          \bool_set_false:N \l_phdd_macro_EXP_bool
837          \bool_set_true:N \l_phdd_macro_rEXP_bool
838      } ,
839      pTF .value_forbidden:n = true ,
840      pTF .code:n =
841      {
842          \bool_set_true:N \l_phdd_macro_pTF_bool
843          \bool_set_true:N \l_phdd_macro_TF_bool
844          \bool_set_true:N \l_phdd_macro_EXP_bool
845          \bool_set_false:N \l_phdd_macro_rEXP_bool
846      } ,
847      noTF .value_forbidden:n = true ,
848      noTF .code:n =
849      {
850          \bool_set_true:N \l_phdd_macro_noTF_bool
851          \bool_set_true:N \l_phdd_macro_TF_bool
852      } ,
853      added .code:n = { \__phdd_date_set:Nn \l_phdd_date_added_tl {#1} },
854      updated .code:n = { \__phdd_date_set:Nn \l_phdd_date_updated_tl {#1} } ,
855      deprecated .code:n = { \__phdd_DEPRECATED_on:n {#1} } ,
856      tested .code:n = { } ,
857      label .code:n =
858      {
859          \clist_set:Nn \l_phdd_function_label_clist {#1}
860          \bool_set_true:N \l_phdd_no_label_bool
861      } ,
862      verb .value_forbidden:n = true ,
863      verb .bool_set:N = \l_phdd_names_verb_bool ,
864      module .tl_set:N = \l_phdd_override_module_tl ,
865  }

```

## \\_\_phdd\_date\_set:Nn

Normalize the date into the format YYYY-MM-DD; more precisely month and day are allowed to be single digits.

```

866 \cs_new_protected:Npn \__phdd_date_set:Nn #1#2
867  {
868      \tl_set:Nn #1 {#2}
869      \regex_replace_once:nnNF
870      { \A(\d\d\d\d)[-](\d\d?)[-](\d\d?)\Z } { \1-\2-
871      \3 } #1
872      {
873          \msg_error:nnn { phdd } { date-format } {#2}
874          \tl_set:Nn #1 { 1970-01-01 }
875      }

```

(End definition for \\_\_phdd\_date\_set:Nn.)

## \phdd\_DEPRECATED\_on:n

The date comparison function expects two dates in the YYYY-MM-DD format

(– is not subtraction here). Complain if a deprecated function should have been removed earlier. In any case, mark it as internal to suppress the text “documented on page ...”.

```

876 \cs_new_protected:Npn \__phdd_DEPRECATED:n #1
877   {
878     \__phdd_DATE_set:Nn \l__phdd_tmpa_tl {#1}
879     \exp_args:No \__phdd_COMPARE:nNnT
880     { \l__phdd_tmpa_tl } < { \tex_YEAR:D - \tex_MONTH:D - \tex_DAY:D }
881     {
882       \msg_error:nnxx { l3doc } { deprecated-function }
883       { \tl_to_str:N \l__phdd_MACRO_ARGUMENT_TL }
884       { \l__phdd_tmpa_tl }
885     }
886     \bool_set_true:N \l__phdd_MACRO_INTERNAL_BOOL
887     \bool_set_true:N \l__phdd_MACRO_INTERNAL_SET_BOOL
888   }

```

*(End definition for \\_\_phdd\_DEPRECATED:n.)*

1. Key–value list.

2. Comma-separated list of functions; input has already been sanitised by catcode changes before reading the argument.

Make sure any paragraph is finished, and similar safe practices at the beginning of an environment which will typeset material. Initialize some variables. Parse the key–value list. Clean up the list of functions, then go through them to extract some data. After this, typeset the function names in the coffin \l\_\_phdd\_FUNCTIONS\_COFFIN and measure it to know if it fits in the margin. Finally, start a vertical coffin for the main part of the environment. This coffin stops when the environment ends, then all the pieces are assembled into a single coffin, which is typeset.

```

889 \cs_new_protected:Npn \__phdd_FUNCTION:nnw #1#2
890   {
891     \__phdd_FUNCTION_TYPESET_START:
892     \__phdd_FUNCTION_INIT:
893     \tl_set:Nn \l__phdd_MACRO_ARGUMENT_TL {#2}
894     \keys_set:nn { l3doc/function } {#1}
895     \__phdd_NAMES_GET_SEQ:nN {#2} \l__phdd_NAMES_SEQ
896     \__phdd_NAMES_PARSE:
897     \__phdd_FUNCTION_TYPESET:
898     \__phdd_FUNCTION_RESET:
899     \__phdd_FUNCTION_DESCR_START:w
900   }
901 \cs_new_protected:Npn \__phdd_FUNCTION_end:
902   {
903     \__phdd_FUNCTION_DESCR_STOP:
904     \__phdd_FUNCTION_ASSEMBLE:
905     \__phdd_FUNCTION_TYPESET_STOP:
906   }

```

*(End definition for \\_\_phdd\_FUNCTION:nnw and \\_\_phdd\_FUNCTION\_end:.)*

`function_typeset_start:`  
`function_typeset_stop:`

At the start of the function environment, before performing any assignment, close the last paragraph, and set up the typesetting scene. Further code typesets a coffin, so we end the paragraph and allow a page break.

```
907 \cs_new_protected:Npn \__phdd_function_typeset_start:
908 {
909     \par \bigskip \noindent
910 }
911 \cs_new_protected:Npn \__phdd_function_typeset_stop:
912 {
913     \par
914     \allowbreak
915 }
```

(End definition for `\__phdd_function_typeset_start:` and `\__phdd_function_typeset_stop:`)

`_phdd_function_init:`

Complain if function environments are nested. Clear various variables.

```
916 \cs_new_protected:Npn \__phdd_function_init:
917 {
918     \box_if_empty:NF \g__phdd_syntax_box
919     { \msg_error:nn { l3doc } { syntax-nested-function } }
920     \coffin_clear:N \l__phdd_descr_coffin
921     \box_gclear:N \g__phdd_syntax_box
922     \coffin_clear:N \l__phdd_syntax_coffin
923     \coffin_clear:N \l__phdd_functions_coffin
924     \bool_set_false:N \l__phdd_macro_TF_bool
925     \bool_set_false:N \l__phdd_macro_pTF_bool
926     \bool_set_false:N \l__phdd_macro_noTF_bool
927     \bool_set_false:N \l__phdd_macro_EXP_bool
928     \bool_set_false:N \l__phdd_macro_rEXP_bool
929     \bool_set_false:N \l__phdd_no_label_bool
930     \bool_set_false:N \l__phdd_names_verb_bool
931     \bool_set_true:N \l__phdd_in_function_bool
932     \clist_clear:N \l__phdd_function_label_clist
933     \tl_set:Nn \l__phdd_override_module_tl { \q_no_value }
934     \char_set_active_eq:NN \< \__phdd_shorthand_meta:
935     \char_set_catcode_active:N \<
936 }
```

(End definition for `\__phdd_function_init:`)

`phdd_shorthand_meta:`  
`ndd_shorthand_meta:w`

Allow `<...>` to be used as markup for `\meta{...}`. As for example `\{<test>\}`

```
937 \cs_new_protected:Npn \__phdd_shorthand_meta:
938     { \mode_if_math:TF { < } { \__phdd_shorthand_meta:w } }
939
940 \cs_new_protected_nopar:Npn \__phdd_shorthand_meta:w #1 > { \meta {#1} }
```

(End definition for `\__phdd_shorthand_meta:` and `\__phdd_shorthand_meta:w`)

`phdd_function_reset:`

Clear some variables.

```
941 \cs_new_protected:Npn \__phdd_function_reset:
942 {
943     \tl_set:Nn \l__phdd_override_module_tl { \q_no_value }
944 }
```

(End definition for `\__phdd_function_reset:`)

**dd\_function\_typeset:**

Typeset in the coffin `\l_phdd_functions_coffin` the functions listed in `\l_phdd_names_block_tl` and the relevant dates, then set `\l_phdd_long_name_bool` to be true if this coffin is larger than the available width in the margin. The function `\_phdd_typeset_functions:` is quite involved hence given later.

```

945 \cs_new_protected:Npn \_phdd_function_typeset:
946   {
947     \dim_zero:N \l_phdd_trial_width_dim
948     \hcoffin_set:Nn \l_phdd_functions_coffin { \_phdd_typeset_functions: }
949     \dim_set:Nn \l_phdd_trial_width_dim
950       { \box_wd:N \l_phdd_functions_coffin }
951     \bool_set:Nn \l_phdd_long_name_bool
952       { \dim_compare_p:nNn \l_phdd_trial_width_dim > \marginparwidth }
953   }

```

*(End definition for `\_phdd_function_typeset:`)*

**unction\_descr\_start:w****function\_descr\_stop:**

The last step in `\_phdd_function:nw` (the beginning of a function environment) is to open a coffin which will capture the description of the function, namely the body of the function environment. This is closed by `\_phdd_function_end:` (the end of a function environment).

```

954 \cs_new_protected:Npn \_phdd_function_descr_start:w
955   {
956     \vcoffin_set:Nnw \l_phdd_descr_coffin { \textwidth }
957     \noindent \ignorespaces
958   }
959 \cs_new_protected:Npn \_phdd_function_descr_stop:
960   { \vcoffin_set_end: }

```

*(End definition for `\_phdd_function_descr_start:w` and `\_phdd_function_descr_stop:`)*

**d\_function\_assemble:**

The box `\g_phdd_syntax_box` contains the contents of the syntax environment if it was used. Now that we have all the pieces, join together the syntax coffin, the names coffin, and the description coffin. The relative positions depend on whether the names coffin fits in the margin. Then typeset the combination.

```

961 \cs_new_protected:Npn \_phdd_function_assemble:
962   {
963     \hcoffin_set:Nn \l_phdd_syntax_coffin
964       { \box_use_drop:N \g_phdd_syntax_box }
965     \bool_if:NTF \l_phdd_long_name_bool
966       {
967         \coffin_join:NnnNnnn
968           \l_phdd_output_coffin {hc} {vc}
969           \l_phdd_syntax_coffin {l} {T}
970           {0pt} {0pt}
971         \coffin_join:NnnNnnn
972           \l_phdd_output_coffin {l} {t}
973           \l_phdd_functions_coffin {r} {t}
974           {-\marginparsep} {0pt}
975         \coffin_join:NnnNnnn
976           \l_phdd_output_coffin {l} {b}
977           \l_phdd_descr_coffin {l} {t}
978           {0.75\marginparwidth + \marginparsep} {-
979             \medskipamount}

```

```

979      \coffin_typeset:Nnnnn \l__phdd_output_coffin
980      {\l__phdd_descr_coffin-l} {\l__phdd_descr_coffin-
t}
981      {0pt} {0pt}
982    }
983    {
984      \coffin_join:NnnNnnnn
985      \l__phdd_output_coffin {hc} {vc}
986      \l__phdd_syntax_coffin {l} {t}
987      {0pt} {0pt}
988      \coffin_join:NnnNnnnn
989      \l__phdd_output_coffin {l} {b}
990      \l__phdd_descr_coffin {l} {t}
991      {0pt} {-\medskipamount}
992      \coffin_join:NnnNnnnn
993      \l__phdd_output_coffin {l} {t}
994      \l__phdd_functions_coffin {r} {t}
995      {-\marginparsep} {0pt}
996      \coffin_typeset:Nnnnn \l__phdd_output_coffin
997      {\l__phdd_syntax_coffin-l} {\l__phdd_syntax_coffin-
T}
998      {0pt} {0pt}
999    }
1000  }

```

(End definition for `\__phdd_function_assemble`.)

### `\__phdd_typeset_functions:`

This function builds the `\l__phdd_functions_coffin` by typesetting the function names (with variants) and the relevant dates in a tabular environment. The use of rules `\toprule`, `\midrule` and `\bottomrule` requires whatever lies between the last `\|` and the rule to be expandable, making our lives a bit complicated.

```

1001 \cs_new_protected:Npn \__phdd_typeset_functions:
1002  {
1003    \small\ttfamily
1004    \HD@savedestfalse
1005    \HD@target
1006    \Hy@MakeCurrentHref { HD. \int_use:N \c@HD@hypercount }
1007    \renewcommand{\arraystretch}{1.6}
1008    \begin{tabular} [b] { @{} l @{} } >{\hspace{\tabcolsep}} r @{} }
1009      \hline
1010      \__phdd_function_extra_labels:
1011      \__phdd_names_typeset:
1012      \__phdd_typeset_dates:
1013      \hline
1014    \end{tabular}
1015    \normalfont\normalsize
1016  }

```

(End definition for `\__phdd_typeset_functions`.)

### `\__phdd_set_function_block:nN`

#1 is a csname, #2 a boolean indicating whether to add `TF` or not.

```

1017 \cs_new_protected:Npn \__phdd_typeset_function_block:nN #1#2
1018  {

```

```

1019     \__phdd_function_index:x
1020     { #1 \bool_if:NT #2 { \tl_to_str:n {TF} } }
1021     \__phdd_function_label:xN {#1} #2
1022     #1
1023     \bool_if:NT #2 { \__phdd_typeset_TF: }
1024     \__phdd_typeset_expandability:
1025     \seq_if_empty:NF \g__phdd_variants_seq
1026     { \__phdd_typeset_variant_list:nN {#1} #2 }
1027     \\
1028   }
1029 \cs_generate_variant:Nn \__phdd_typeset_function_block:nN { x }
1030 \cs_new_protected:Npn \__phdd_function_index:n #1
1031 {
1032   \seq_gput_right:Nn \g_doc_functions_seq {#1}
1033   \__phdd_special_index:nn {#1} { usage }
1034 }
1035 \cs_generate_variant:Nn \__phdd_function_index:n { x }
1036 \cs_new_protected:Npn \__phdd_typeset_expandability:
1037 {
1038   &
1039   \bool_if:NT \l__phdd_macro_EXP_bool { \__phdd_typeset_exp: }
1040   \bool_if:NT \l__phdd_macro_rEXP_bool { \__phdd_typeset_rexp: }
1041 }

#1 is the function, #2 whether to add TF.

1042 \cs_new_protected:Npn \__phdd_typeset_variant_list:nN #1#2
1043 {
1044   \\
1045   \__phdd_typeset_aux:n { \__phdd_get_function_name:n {#1} }
1046   :
1047   \int_compare:nTF { \seq_count:N \g__phdd_variants_seq == 1 }
1048   { \seq_use:Nn \g__phdd_variants_seq { } }
1049   {
1050     \textrm(
1051       \seq_use:Nn \g__phdd_variants_seq { \textrm| }
1052     \textrm)
1053   }
1054   \bool_if:NT #2 { \__phdd_typeset_TF: }
1055   \__phdd_typeset_expandability:
1056 }

#1 is the function name, #2 whether to add TF.

1057 \cs_new_protected:Npn \__phdd_function_extra_labels:
1058 {
1059   \bool_if:NT \l__phdd_no_label_bool
1060   {
1061     \clist_map_inline:Nn \l__phdd_function_label_clist
1062     {
1063       \__phdd_get_hyper_target:oN { \token_to_str:N ##1 }
1064       \l__phdd_tmpa_tl
1065       \exp_args:No \label { \l__phdd_tmpa_tl }
1066     }
1067   }
1068 }
1069 \cs_new_protected:Npn \__phdd_function_label:nN #1#2

```

```

1070  {
1071    \bool_if:NF \l__phdd_no_label_bool
1072    {
1073      \__phdd_get_hyper_target:xN
1074      {
1075        \exp_not:n {#1}
1076        \bool_if:NT #2 { \tl_to_str:n {TF} }
1077      }
1078      \l__phdd_tmpa_tl
1079      \exp_args:No \label { \l__phdd_tmpa_tl }
1080    }
1081  }
1082 \cs_generate_variant:Nn \__phdd_function_label:nN { x }

(End definition for \__phdd_typeset_function_block:nN and \__phdd_function_index:n.)
```

**\_phdd\_typeset\_dates:**

To display metadata for when functions are added/modified. This function must be expandable since it produces rules for use in alignments.

```

1083 \cs_new:Npn \__phdd_typeset_dates:
1084  {
1085    \bool_lazy_and:nnF
1086    { \tl_if_empty_p:N \l__phdd_date_added_tl }
1087    { \tl_if_empty_p:N \l__phdd_date_updated_tl }
1088    { \midrule }
1089    \tl_if_empty:NF \l__phdd_date_added_tl
1090    {
1091      \multicolumn { 2 } { @{} r @{} }
1092      { \scriptsize New: \, , \l__phdd_date_added_tl } \\
1093    }
1094
1095    \tl_if_empty:NF \l__phdd_date_updated_tl
1096    {
1097      \multicolumn { 2 } { @{} r @{} }
1098      { \scriptsize Updated: \, , \l__phdd_date_updated_tl } \\
1099    }
1100  }
```

(End definition for \\_\_phdd\_typeset\_dates:.)

**\\_\_phdd\_syntax:w  
\\_\_phdd\_syntax\_end:**

Implement the syntax environment.

```

1101 \dim_new:N \l__phdd_syntax_dim
1102 \cs_new_protected:Npn \__phdd_syntax:w
1103  {
1104    \box_if_empty:NF \g__phdd_syntax_box
1105    { \msg_error:nn { l3doc } { multiple-syntax } }
1106    \dim_set:Nn \l__phdd_syntax_dim
1107    {
1108      \textwidth
1109      \bool_if:NT \l__phdd_long_name_bool
1110      { + 0.75 \marginparwidth - \l__phdd_trial_width_dim }
1111    }
1112    \hbox_gset:Nw \g__phdd_syntax_box
1113    \small \ttfamily
1114    \arrayrulecolor{white}
1115    \begin{tabular} { @{} l @{} }
```

```

1116      \toprule
1117      \begin{minipage}[t]{\l__phdd_syntax_dim}
1118          \raggedright
1119          \obeyspaces
1120          \obeylines
1121      }
1122 \cs_new_protected:Npn \__phdd_syntax_end:
1123 {
1124     \end{minipage}
1125     \end{tabular}
1126     \arrayrulecolor{black}
1127     \hbox_gset_end:
1128     \bool_if:NF \l__phdd_in_function_bool
1129     {
1130         \begin{quote}
1131             \mode_leave_vertical:
1132             \box_use_drop:N \g__phdd_syntax_box
1133         \end{quote}
1134     }
1135 }
```

(End definition for `\__phdd_syntax:w` and `\__phdd_syntax_end:.`)

#### D.2.40 The macro environment

Keyval for the macro environment. TODO: provide document command for documenting keys.

```

1136 \keys_define:nn { phdd/macro }
1137 {
1138     aux .value_forbidden:n = true ,
1139     aux .code:n =
1140     {
1141         \msg_warning:nnnn { phdd } { deprecated-option }
1142         { aux } { function/macro }
1143     },
1144     internal .value_forbidden:n = true ,
1145     internal .code:n =
1146     {
1147         \bool_set_true:N \l__phdd_macro_internal_bool
1148         \bool_set_true:N \l__phdd_macro_internal_set_bool
1149     },
1150     int .value_forbidden:n = true ,
1151     int .code:n =
1152     {
1153         \bool_set_true:N \l__phdd_macro_internal_bool
1154         \bool_set_true:N \l__phdd_macro_internal_set_bool
1155     },
1156     var .value_forbidden:n = true ,
1157     var .code:n =
1158     { \bool_set_true:N \l__phdd_macro_var_bool } ,
1159     TF .value_forbidden:n = true ,
1160     TF .code:n =
1161     { \bool_set_true:N \l__phdd_macro_TF_bool } ,
1162     pTF .value_forbidden:n = true ,
```

```

1163     pTF .code:n =
1164     {
1165         \bool_set_true:N \l_phdd_macro_TF_bool
1166         \bool_set_true:N \l_phdd_macro_pTF_bool
1167         \bool_set_true:N \l_phdd_macro_EXP_bool
1168         \bool_set_false:N \l_phdd_macro_rEXP_bool
1169     } ,
1170     noTF .value_forbidden:n = true ,
1171     noTF .code:n =
1172     {
1173         \bool_set_true:N \l_phdd_macro_TF_bool
1174         \bool_set_true:N \l_phdd_macro_noTF_bool
1175     } ,
1176     EXP .value_forbidden:n = true ,
1177     EXP .code:n =
1178     {
1179         \bool_set_true:N \l_phdd_macro_EXP_bool
1180         \bool_set_false:N \l_phdd_macro_rEXP_bool
1181     } ,
1182     rEXP .value_forbidden:n = true ,
1183     rEXP .code:n =
1184     {
1185         \bool_set_false:N \l_phdd_macro_EXP_bool
1186         \bool_set_true:N \l_phdd_macro_rEXP_bool
1187     } ,
1188     tested .code:n =
1189     {
1190         \bool_set_true:N \l_phdd_macro_tested_bool
1191     } ,
1192     added .code:n = {} , % TODO
1193     updated .code:n = {} , % TODO
1194     deprecated .code:n = { \__phdd_deprecated_on:n {#1} } ,
1195     verb .bool_set:N = \l_phdd_names_verb_bool ,
1196     module .tl_set:N = \l_phdd_override_module_tl ,
1197     documented-as .tl_set:N = \l_phdd_macro_documented_tl ,
1198 }

```

## \\_\_phdd\_macro:nw

The arguments are a key–value list of *<options>* and a comma-list of *<names>*, read verbatim by **xparse**. First initialize some variables before applying the *<options>*, then parse the *<names>* to get a sequence of macro names, then apply `\__phdd_macro_single:nNN` to each (this step is more subtle than `\seq_map_function:NN` because of TF/pTF/noTF). Finally typeset the macro names in the margin.

```

1199 \cs_new_protected:Npn \__phdd_macro:nw #1#2
1200 {
1201     \__phdd_macro_init:
1202     \tl_set:Nn \l_phdd_macro_argument_tl {#2}
1203     \keys_set:nn { phdd/macro } {#1}
1204     \__phdd_names_get_seq:nN {#2} \l_phdd_names_seq
1205     \__phdd_names_parse:
1206     \__phdd_macro_save_names:
1207     \__phdd_names_typeset:
1208     \__phdd_macro_dump:
1209     \__phdd_macro_reset:

```

```
1210 }
```

*(End definition for \\_\_phdd\_macro:nnw.)*

**\\_\_phdd\_macro\_init:** The booleans hold various key–value options, \l\_\_phdd\_nested\_macro\_int counts the number of macro environments around the current point (is 0 outside).

```
1211 \cs_new_protected:Npn \__phdd_macro_init:
1212 {
1213   \int_incr:N \l__phdd_nested_macro_int
1214   \bool_set_false:N \l__phdd_macro_internal_bool
1215   \bool_set_false:N \l__phdd_macro_internal_set_bool
1216   \bool_set_false:N \l__phdd_macro_TF_bool
1217   \bool_set_false:N \l__phdd_macro_pTF_bool
1218   \bool_set_false:N \l__phdd_macro_noTF_bool
1219   \bool_set_false:N \l__phdd_macro_EXP_bool
1220   \bool_set_false:N \l__phdd_macro_rEXP_bool
1221   \bool_set_false:N \l__phdd_macro_var_bool
1222   \bool_set_false:N \l__phdd_macro_tested_bool
1223   \bool_set_false:N \l__phdd_names_verb_bool
1224   \tl_set:Nn \l__phdd_override_module_tl { \q_no_value }
1225   \tl_clear:N \l__phdd_macro_documented_tl
1226   \cs_set_eq:NN \testfile \__phdd_print_testfile:n
1227   \box_clear:N \l__phdd_macro_index_box
1228   \vbox_set:Nn \l__phdd_macro_box
1229   {
1230     \hbox:n
1231     {
1232       \strut
1233       \int_compare:nNnT \l__phdd_macro_int = 0
1234         { \HD@target }
1235       }
1236       \vskip \int_eval:n { \l__phdd_macro_int - 1 } \baselineskip
1237     }
1238 }
```

*(End definition for \\_\_phdd\_macro\_init:.)*

**\\_\_phdd\_macro\_reset:** We ensure that \cs commands nested inside a macro whose module is imposed are not affected.

```
1239 \cs_new_protected:Npn \__phdd_macro_reset:
1240 {
1241   \tl_set:Nn \l__phdd_override_module_tl { \q_no_value }
1242 }
```

*(End definition for \\_\_phdd\_macro\_reset:.)*

**\\_\_phdd\_macro\_save\_names:** The list of names defined in a set of macro environments is eventually used to display on which page they are documented. If the **documented-as** key is given, use that, otherwise find names in \l\_\_phdd\_names\_block\_tl.

```
1243 \cs_new_protected:Npn \__phdd_macro_save_names:
1244 {
1245   \tl_if_empty:NTF \l__phdd_macro_documented_tl
1246     { \__phdd_names_block_base_map:N \__phdd_macro_save_names_aux:n }
```

```

1247     {
1248         \seq_gput_right:Nf \g__phdd_nested_names_seq
1249         { \exp_after:wN \token_to_str:N \l__phdd_macro_documented_tl }
1250     }
1251 }
1252 \cs_new_protected:Npn \__phdd_macro_save_names_aux:n #1
1253 { \seq_gput_right:Nn \g__phdd_nested_names_seq {#1} }

(End definition for \__phdd_macro_save_names:.)
```

## \\_\_phdd\_macro\_dump:

This calls \makelabel{}

```

1254 \cs_new_protected:Npn \__phdd_macro_dump:
1255 {
1256     \topsep\MacroTopsep
1257     \trivlist
1258     \cs_set:Npn \makelabel ##1
1259     {
1260         \llap
1261         {
1262             \hbox_unpack_clear:N \l__phdd_macro_index_box
1263             \vtop to \baselineskip
1264             {
1265                 \vbox_unpack_clear:N \l__phdd_macro_box
1266                 \vss
1267             }
1268         }
1269     }
1270     \item []
1271 }
```

(End definition for \\_\_phdd\_macro\_dump:.)

## \\_\_macro\_typeset\_block:nN

Used to typeset a macro and its variants. #1 is the macro name, #2 is a boolean controlling whether to add TF.

```

1272 \cs_new_protected:Npn \__phdd_macro_typeset_block:nN #1#2
1273 {
1274     \__phdd_macro_single:nNN {#1} \c_true_bool #2
1275     \seq_if_empty:NF \g__phdd_variants_seq
1276     {
1277         \__phdd_macro_typeset_variant_list:xN
1278         { \__phdd_get_function_name:n {#1} } #2
1279     }
1280 }
1281 \cs_generate_variant:Nn \__phdd_macro_typeset_block:nN { x }
1282 \cs_new_protected:Npn \__phdd_macro_typeset_variant_list:nN #1#2
1283 {
1284     \seq_map_inline:Nn \g__phdd_variants_seq
1285     { \__phdd_macro_single:nNN { #1 : ##1 } \c_false_bool #2 }
1286 }
1287 \cs_generate_variant:Nn \__phdd_macro_typeset_variant_list:nN { x }

(End definition for \__phdd_macro_typeset_block:nN.)
```

## \\_\_phdd\_macro\_single:nNN

The arguments are #1 a macro name (without TF), #2 a boolean determining whether or not to index, and #3 whether or not to add TF. Let's start to mess

around with `doc`'s macro environment. See `doc.dtx` for a full explanation of the original environment. It's rather *enthusiastically* commented.

1. Macro/function/whatever name; input has already been sanitised.

The assignments to `\saved@macroname` and `\saved@indexname` are used by `doc`'s `\changes` mechanism.

```

1288 \cs_new_protected:Npn __phdd_macro_single:nNN #1#2#3
1289 {
1290   \tl_set:Nn \saved@macroname {#1}
1291   __phdd_macro_typeset_one:nN {#1} #3
1292   \bool_if:NT #3 { \DoNotIndex {#1} }
1293   \exp_args:Nx __phdd_macro_index:nN
1294   { #1 \bool_if:NT #3 { \tl_to_str:n { TF } } }
1295   #2
1296 }
1297 \cs_new_protected:Npn __phdd_macro_index:nN #1#2
1298 {
1299   \DoNotIndex {#1}
1300   \bool_if:NT #2
1301   {
1302     __phdd_if_macro_internal:nF {#1}
1303     { \seq_gput_right:Nn \g_doc_macros_seq {#1} }
1304     \hbox_set:Nw \l_phdd_macro_index_box
1305     \hbox_unpack_clear:N \l_phdd_macro_index_box
1306     \int_gincr:N \c@CodelineNo
1307     __phdd_special_index:nn {#1} { main }
1308     \int_gdecr:N \c@CodelineNo
1309     \exp_args:NNNo \hbox_set_end:
1310     \tl_set:Nn \saved@indexname { \l_phdd_index_key_tl }
1311   }
1312 }
```

(End definition for `__phdd_macro_single:nNN`.)

`macro_typeset_one:nN`

For a long time, `l3doc` collected the macro names as labels in the first items of nested `\trivlist`, but these were not closed properly with `\endtrivlist`. Also, it interacted in surprising ways with `hyperref` targets. Now, we collect typeset macro names by hand in the box `\l_phdd_macro_box`. Note the space `\ . #1` is the macro name, `#2` whether to add `TF`. TODO see if we need to label it here.

```

1313 \cs_new_protected:Npn __phdd_macro_typeset_one:nN #1#2
1314 {
1315   \vbox_set:Nn \l_phdd_macro_box
1316   {
1317     \vbox_unpack_clear:N \l_phdd_macro_box
1318     % YL added 15pt if used in conjunction with listings to avoid overlapping
1319     % still problems lining up with codeline. Need to hack doc or doc-
1320     v3.
1321     \hbox { \llap { __phdd_print_macroname:nN {#1} #2 \space\space\space\space\space
1322     }
1323     \int_incr:N \l_phdd_macro_int
1324 }
```

(End definition for `__phdd_macro_typeset_one:nN`.)

## \\_phdd\\_print\\_macroname:nN

In the name, spaces are replaced by other spaces to ensure they get displayed in case there are any.

```

1324 \cs_new_protected:Npn \__phdd_print_macroname:nN #1#2
1325   {
1326     \strut
1327     \__phdd_get_hyper_target:xN
1328     {
1329       \exp_not:n {#1}
1330       \bool_if:NT #2 { \tl_to_str:n {TF} }
1331     }
1332     \l__phdd_tmpa_tl
1333     \cs_if_exist:cTF { r@ \l__phdd_tmpa_tl }
1334     { \exp_last_unbraced:NNo \hyperref [ \l__phdd_tmpa_tl ] }
1335     { \use:n }
1336     {
1337       \int_compare:nTF { \str_count:n {#1} <= 28 }
1338         { \MacroFont } { \MacroFont } %{ \MacroLongFont }
1339       \tl_set:Nn \l__phdd_tmpa_tl {#1}
1340       \tl_replace_all:Nno \l__phdd_tmpa_tl
1341         { ~ } { \c_catcode_other_space_tl }
1342       \__phdd_macroname_prefix:o \l__phdd_tmpa_tl
1343       \__phdd_macroname_suffix:N #2
1344     }
1345   }
1346 \cs_new_protected:Npn \__phdd_macroname_prefix:n #1
1347   {
1348     \__phdd_if_macro_internal:nTF {#1}
1349     { \__phdd_typeset_aux:n {#1} } {#1}
1350   }
1351 \cs_generate_variant:Nn \__phdd_macroname_prefix:n { o }
1352 \cs_new_protected:Npn \__phdd_macroname_suffix:N #1
1353   { \bool_if:NTF #1 { \__phdd_typeset_TF: } { } }
```

(End definition for \\_\_phdd\_print\_macroname:nN.)

## \MacroLongFont

```

1354 \providecommand \MacroLongFont
1355   {
1356     \fontfamily{lmtt}\fontseries{lc}\small
1357   }
```

(End definition for \MacroLongFont.)

\\_phdd\\_print\\_testfile:n  
\\_print\\_testfile\\_aux:n

Used to show that a macro has a test, somewhere.

```

1358 \cs_new_protected:Npn \__phdd_print_testfile:n #1
1359   {
1360     \bool_set_true:N \l__phdd_macro_tested_bool
1361     \tl_if_eq:nnF {#1} {*}
1362     {
1363       \seq_if_in:NnF \g__phdd_testfiles_seq {#1}
1364     }
1365     \seq_gput_right:Nn \g__phdd_testfiles_seq {#1}
1366     \par
1367     \__phdd_print_testfile_aux:n {#1}
```

```

1368         }
1369     }
1370 }
1371 \cs_new_protected:Npn \__phdd_print_testfile_aux:n #1
1372 {
1373     \footnotesize
1374     (
1375     \textit
1376     {
1377         The~ test~ suite~ for~ this~ command,~
1378         and~ others~ in~ this~ file,~ is~ \textsf{#1}
1379     }.
1380     )\par
1381 }
```

(End definition for `\__phdd_print_testfile:n` and `\__phdd_print_testfile_aux:n`.)

### \TestFiles

```

1382 \DeclareDocumentCommand \TestFiles {m}
1383 {
1384     \par
1385     \textit
1386     {
1387         The~ following~ test~ files~ are~
1388         used~ for~ this~ code:~ \textsf{#1}.
1389     }
1390     \par \ignorespaces
1391 }
```

(End definition for `\TestFiles`.)

### \UnitTested

```
1392 \DeclareDocumentCommand \UnitTested {} { \testfile* }
```

(End definition for `\UnitTested`.)

### \TestMissing

```

1393 \DeclareDocumentCommand \TestMissing { m }
1394 { \__phdd_test_missing:n {#1} }
```

(End definition for `\TestMissing`.)

### \phdd\_test\_missing:n

Keys in `\g__phdd_missing_tests_prop` are lists of macros given as arguments of one macro environment. Values are pairs of a file name and a comment about the missing tests.

```

1395 \cs_new_protected:Npn \__phdd_test_missing:n #1
1396 {
1397     \__phdd_test_missing_aux:Nxn
1398     \g__phdd_missing_tests_prop
1399     { \seq_use:Nn \l__phdd_names_seq { , } }
1400     { { \g_file_curr_name_str \c_space_tl (#1) } }
1401 }
1402 \cs_new_protected:Npn \__phdd_test_missing_aux:Nnn #1#2#3
1403 {
1404     \prop_get:NnNTF #1 {#2} \l__phdd_tmpa_tl
```

```

1405      { \tl_put_right:Nn \l_phdd_tmpa_tl { , #3 } }
1406      { \tl_set:Nn \l_phdd_tmpa_tl {#3} }
1407      \prop_put:Nno #1 {#2} \l_phdd_tmpa_tl
1408  }
1409 \cs_generate_variant:Nn \__phdd_test_missing_aux:Nnn { Nx }

(End definition for \__phdd_test_missing:n.)
```

**\\_\_phdd\_macro\_end:**

It is too late for anyone to declare a test file for this macro, so we can check now whether the macro is tested. If the `macro` environment which is being ended is the outermost one, then wrap each macro in `\texttt` (with the addition of `TF` if relevant) and typeset two informations: that this ends the definition of some macros, and that they are documented on some page.

```

1410 \cs_new_protected:Npn \__phdd_macro_end:
1411  {
1412    \endtrivlist
1413    \__phdd_macro_end_check_tested:
1414    \int_compare:nNnT \l_phdd_nested_macro_int = 1
1415    { \__phdd_macro_end_style:n { \__phdd_print_end_definition: } }
1416  }
```

(End definition for \\_\_phdd\_macro\_end:.)

**\\_\_phdd\_macro\_end\_check\_tested:**

If the `checktest` option was issued and the macro is not an auxiliary nor a variable (and it does not have a test), then add it to the sequence of non-tested macros.

```

1417 \cs_new_protected:Npn \__phdd_macro_end_check_tested:
1418  {
1419    \bool_lazy_all:nT
1420    {
1421      { \g_phdd_checktest_bool }
1422      { ! \l_phdd_macro_var_bool }
1423      { ! \l_phdd_macro_tested_bool }
1424    }
1425    {
1426      \seq_set_filter:NNn \l_phdd_tmpa_seq \l_phdd_names_seq
1427      { ! \__phdd_if_macro_internal_p:n {##1} }
1428      \seq_gput_right:Nx \g_phdd_not_tested_seq
1429      {
1430        \seq_use:Nn \l_phdd_tmpa_seq { , }
1431        \bool_if:NTF \l_phdd_macro_pTF_bool {~(pTF)}
1432        { \bool_if:NT \l_phdd_macro_TF_bool {~(TF)} }
1433      }
1434    }
1435  }
```

(End definition for \\_\_phdd\_macro\_end\_check\_tested:.)

**\\_\_phdd\_macro\_end\_style:n**

Style for the extra information at the end of a top-level `macro` environment.

```

1436 \cs_new_protected:Npn \__phdd_macro_end_style:n #1
1437  {
1438    \nobreak \noindent
1439    { \footnotesize ( \emph{#1} ) \par }
1440  }
```

(End definition for `\__phdd_macro_end_style:n`.)

~~\int\_end\_definition:  
macro\_end\_wrap\_item:n  
dd\_print\_documented:~~

Surround each item by `\texttt{}`, replacing `_` by `\_` as well. Then list the macro names through `\seq_use:Nnnn`, unless there are too many. Finally, if the macro is neither auxiliary nor internal, add a link to where it is documented.

```

1441 \cs_new_protected:Npn \__phdd_macro_end_wrap_item:n #1
1442   {
1443     \tl_set:Nn \l__phdd_tmpa_tl {#1}
1444     \tl_replace_all:Non \l__phdd_tmpa_tl
1445       { \token_to_str:N _ } { \_ }
1446     \texttt{ } { \l__phdd_tmpa_tl }
1447   }
1448 \cs_new_protected:Npn \__phdd_print_end_definition:
1449   {
1450     \seq_set_map:NNn \l__phdd_tmpa_seq
1451       \g__phdd_nested_names_seq
1452       { \exp_not:n { \__phdd_macro_end_wrap_item:n {##1} } }
1453   End~ definition~ for~
1454   \int_compare:nTF { \seq_count:N \l__phdd_tmpa_seq <= 3 }
1455     {
1456       \seq_use:Nnnn \l__phdd_tmpa_seq
1457         { \_,~and~ } { \_,~ } { \_,~,~and~ }
1458     }
1459     { \seq_item:Nn \l__phdd_tmpa_seq {1}\_,~and~others }
1460   \@.
1461   \__phdd_print_documented:
1462 }
1463 \cs_new_protected:Npn \__phdd_print_documented:
1464   {
1465     \seq_gset_filter:NNn \g__phdd_nested_names_seq
1466       \g__phdd_nested_names_seq
1467       { ! \__phdd_if_macro_internal_p:n {##1} }
1468
1469     \seq_if_empty:NF \g__phdd_nested_names_seq
1470     {
1471       \int_set:Nn \l__phdd_tmpa_int
1472         { \seq_count:N \g__phdd_nested_names_seq }
1473       %\int_compare:nNnTF \l__phdd_tmpa_int = 1 {~This~} {~These~}
1474       %\bool_if:NTF \l__phdd_macro_var_bool {variable} {function}
1475       % add switch for this
1476       %       \int_compare:nNnTF \l__phdd_tmpa_int = 1 {~is~} {~are~}
1477       % documented~on~page~
1478       %       \__phdd_get_hyper_target:xN
1479       %         { \seq_item:Nn \g__phdd_nested_names_seq { 1 } }
1480       %         \l__phdd_tmpa_tl
1481       %       \exp_args:Nx \pageref { \l__phdd_tmpa_tl } .
1482
1483     }
1484     \seq_gclear:N \g__phdd_nested_names_seq
1485   }

```

(End definition for `\__phdd_print_end_definition:, \__phdd_macro_end_wrap_item:n, and \__phdd_print_documented:)`)

`\DescribeOption` For describing package options. Due to Joseph Wright. Name/usage might

change soon.

```

1486 \newcommand*\DescribeOption{
1487   {
1488     \leavevmode
1489     \@bsphack
1490     \begingroup
1491       \MakePrivateLetters
1492       \Describe@Option
1493   }
1494 \newcommand*\Describe@Option}[1]
1495 {
1496   \endgroup
1497   \marginpar{
1498     \raggedleft
1499     \PrintDescribeEnv{#1}
1500   }
1501   \SpecialOptionIndex{#1}
1502   \@esphack
1503   \ignorespaces
1504 }
1505 \newcommand*\SpecialOptionIndex}[1]
1506 {
1507   \@bsphack
1508   \begingroup
1509     \HD@target
1510     \let\HDorg@encapchar\encapchar
1511     \edef\encapchar usage
1512     {
1513       \HDorg@encapchar \hdclindex{\the\c@HD@hypercount}{usage}
1514     }
1515   \index
1516   {
1517     #1\actualchar{\protect\ttfamily#1}~(option)
1518     \encapchar usage
1519   }
1520   \index
1521   {
1522     options:\levelchar#\actualchar{\protect\ttfamily#1}
1523     \encapchar usage
1524   }
1525   \endgroup
1526   \@esphack
1527 }
```

(End definition for `\DescribeOption`.)

Here are some definitions for additional markup that helps to structure your documentation.

Provides a danger bend, as known from the TeXbook.

The actual character from the font `manfnt`:

```

1528 \font \manual = manfnt \scan_stop:
1529 \cs_gset:Npn \dbend { {\manual\char127} }
```

Defines the single danger bend. Use it whenever there is a feature in your

package that might be tricky to use. **FIXME:** Has to be fixed when in combination with a macro-definition.

```

1530 \%newenvironment {danger}
1531 %
1532 %   \begin{trivlist}\item[]\noindent
1533 %   \begingroup\hangindent=2pc\hangafter=-2
1534 %   \cs_set:Npn \par{\endgraf\endgroup}
1535 %   \hbox{to0pt{\hskip-\hangindent\hbox{\dbend\hfill}}}\ignorespaces
1536 %
1537 %
1538 %   \par\end{trivlist}
1539 %

1540 \newenvironment{TemplateInterfaceDescription}[1]
1541 {
1542   \subsection{The~object~type~`#1'}
1543   \begingroup
1544   \begin{parpenalty}@M
1545   \description
1546   \def\TemplateArgument##1##2{\item[Arg:~##1]##2\par}
1547   \def\TemplateSemantics
1548   {
1549     \enddescription\endgroup
1550     \subsubsection*{Semantics:}
1551   }
1552 }
1553 {
1554   \par\bigskip
1555 }

1556 \newenvironment{TemplateDescription}[2]
1557 {
1558   \subsection{The~template~`#2'~(object~type~#1)}
1559   \subsubsection*{Attributes:}
1560   \begingroup
1561   \begin{parpenalty}@M
1562   \description
1563   \def\TemplateKey##1##2##3##4
1564   {
1565     \item[##1~(##2)]##3%
1566     \ifx\TemplateKey##4\TemplateKey\else
1567       \hspace{0pt plus 3em}\penalty-500\hspace{0pt plus 1filll Default:~##4%
1568       \hfill\penalty500\hbox{}\hfill Default:~##4%
1569       \nobreak\hspace{-\parfillskip}\hspace{0pt}\relax
1570     \fi
1571     \par
1572   }
1573   \def\TemplateSemantics
1574   {
1575     \enddescription\endgroup
1576     \subsubsection*{Semantics~\&~Comments:}
1577   }
1578 }
1579 { \par\bigskip }

1580 \newenvironment{InstanceDescription}[4][xxxxxxxxxxxxxx]
```

```

1581  {
1582    \subsubsection{The~instance~`#3'~(template~#2/#4)}
1583    \subsubsection*{Attribute~values:}
1584    \begingroup
1585      \begin{parpenalty}@M
1586        \def\InstanceKey##1##2{\>\textbf{##1}\>##2\\}
1587        \def\InstanceSemantics{\endtabbing\endgroup
1588          \vskip-30pt\vskip0pt
1589          \subsubsection*{Layout~description~\&~Comments:}}
1590        \tabbing
1591        xxxx\#=1\=kill
1592      }
1593    { \par \bigskip }

```

### D.2.5 Inheriting doc

Code here is taken from `doc`, stripped of comments and translated into `expl3` syntax. New features are added in various places.

```

\StopEventually
  \Finale
\AlsoImplementation
  \OnlyDescription
  \DeclareDocumentCommand \OnlyDescription { }
  { \bool_gset_false:N \g__phdd_typeset_implementation_bool }

  \DeclareDocumentCommand \AlsoImplementation { }
  { \bool_gset_true:N \g__phdd_typeset_implementation_bool }

\DeclareDocumentCommand \StopEventually { m }
{
  \bool_if:NTF \g__phdd_typeset_implementation_bool
  {
    \bsphack
    \tl_gset:Nn \g__phdd_finale_tl { #1 \check@checksum }
    \init@checksum
    \esphack
  }
  { #1 \endinput }
}

\DeclareDocumentCommand \Finale { }
{ \tl_use:N \g__phdd_finale_tl }

\tl_new:N \g__phdd_finale_tl

(End definition for \StopEventually and others.)

```

`\__phdd_input:n`  
Inputting a file, with some setup: the module name should be empty before the first `<@@=(module)>` line in the file.

```

1615 \cs_new_protected:Npn \__phdd_input:n #1
1616 {
1617   \tl_gclear:N \g__phdd_module_name_tl
1618   \MakePercentIgnore
1619   \input{#1}
1620   \MakePercentComment
1621 }

```

(End definition for `\__phdd_input:n`.)

- `\DocInput` Modified from `doc` to accept comma-list input (who has commas in filenames?).

```
1622 \DeclareDocumentCommand \DocInput { m }
1623   {
1624     \clist_map_inline:nn {#1}
1625     {
1626       \clist_put_right:Nn \g_docinput_list {##1}
1627       \__phdd_input:n {##1}
1628     }
1629   }
```

(End definition for `\DocInput`.)

- `\DocInputAgain` Uses `\g_docinput_list` to re-input whatever's already been `\DocInput`-ed until now. May be used multiple times.

```
1631 \DeclareDocumentCommand \DocInputAgain { }
1632   { \clist_map_function:NN \g_docinput_list \__phdd_input:n }
```

(End definition for `\DocInputAgain`.)

- `\DocInclude` More or less exactly the same as `\include`, but uses `\DocInput` on a `.dtx` file, not `\input` on a `.tex` file.

```
1633 \DeclareDocumentCommand \DocInclude { m }
1634   {
1635     \relax\clearpage
1636     \docincludeaux
1637     \IfFileExists{#1.fdd}
1638       { \cs_set:Npn \currentfile{#1.fdd} }
1639       { \cs_set:Npn \currentfile{#1.dtx} }
1640     \int_compare:nNnTF \@auxout = \partaux
1641       { \@latexerr{\string\include\space cannot~be~nested}\@eha }
1642       { \docinclude #1 }
1643   }
1644 \cs_gset:Npn \docinclude #1
1645   {
1646     \clearpage
1647     \immediate\write\mainaux{\string\@input{#1.aux}}
1648     \tempswattrue
1649     \if@partsw
1650       \tempswafalse
1651       \cs_set:Npx \tempb{#1}
1652       \for\tempa:=\partlist\do
1653         {
1654           \ifx\tempa\tempb\tempswattrue\fi
1655         }
1656     \fi
1657     \if@tempswa
1658       \cs_set_eq:NN \@auxout \partaux
1659       \immediate\openout\partaux #1.aux
1660       \immediate\write\partaux{\relax}
1661       \cs_set_eq:NN \@ltxdoc@PrintIndex \PrintIndex
```

```

1662      \cs_set_eq:NN \PrintIndex           \relax
1663      \cs_set_eq:NN \@ltxdoc@PrintChanges \PrintChanges
1664      \cs_set_eq:NN \PrintChanges        \relax
1665      \cs_set_eq:NN \@ltxdoc@theglossary \theglossary
1666      \cs_set_eq:NN \@ltxdoc@endtheglossary \endtheglossary
1667      \part{\currentfile}
1668      {
1669          \cs_set_eq:NN \ttfamily\relax
1670          \cs_gset:Npx \filekey
1671              { \filekey, \thepart = { \ttfamily \currentfile } }
1672      }
1673      \DocInput{\currentfile}
1674      \cs_set_eq:NN \PrintIndex           \@ltxdoc@PrintIndex
1675      \cs_set_eq:NN \PrintChanges        \@ltxdoc@PrintChanges
1676      \cs_set_eq:NN \theglossary         \@ltxdoc@theglossary
1677      \cs_set_eq:NN \endtheglossary     \@ltxdoc@endtheglossary
1678      \clearpage
1679      \@writeckpt{#1}
1680      \immediate \closeout \@partaux
1681      \else
1682          \nameuse{cp@#1}
1683      \fi
1684      \cs_set_eq:NN \@auxout \mainaux
1685  }
1686 \cs_gset:Npn \codeline@wrindex #1
1687  {
1688      \immediate\write\@indexfile
1689      {
1690          \string\indexentry{#1}
1691          { \filesep \int_use:N \c@CodelineNo }
1692      }
1693  }
1694 \tl_gclear:N \filesep

```

(End definition for `\DocInclude`.)

### `\docincludeaux`

```

1695 \cs_gset:Npn \docincludeaux
1696  {
1697      \tl_set:Nn \thepart { \alphalph { part } }
1698      \tl_set:Nn \filesep { \thepart - }
1699      \cs_set_eq:NN \filekey \use_none:n
1700      \tl_gput_right:Nn \index@prologue
1701      {
1702          \cs_gset:Npn \@oddfoot
1703          {
1704              \parbox { \textwidth }
1705              {
1706                  \strut \footnotesize
1707                  \raggedright { \bfseries File~Key: } ~ \filekey
1708              }
1709          }
1710          \cs_set_eq:NN \@evenfoot \@oddfoot
1711      }

```

```

1712   \cs_gset_eq:NN \docincludeaux \relax
1713   \cs_gset:Npn \@oddfoot
1714   {
1715     \cs_if_exist:cTF { ver @ \currentfile }
1716     { File~\thepart :~{\ttfamily\currentfile}~ }
1717     {
1718       \GetFileInfo{\currentfile}
1719       File~\thepart :~{\ttfamily\filename}~
1720       Date:~\ExplFileVersion\ % space
1721       Version~\ExplFileVersion
1722     }
1723     \hfill \thepage
1724   }
1725   \cs_set_eq:NN \@evenfoot \@oddfoot
1726 }
```

(End definition for `\docincludeaux`.)

## D.2.50 The macrocode environment

`\xmacro@code`  
`\_phdd_xmacro_code:n`  
`\_phdd_xmacro_code:w`

Hook into the `macrocode` environment in a dirty way: `\xmacro@code` is responsible for grabbing (and tokenizing) the body of the environment. Redefine it to pass what it grabs to `\_phdd_xmacro_code:n`. This new macro replaces all `@@` by the appropriate module name. One exceptional case is the `<@@=<module>` lines themselves, where `@@` should not be modified. Actually, we search for such lines, to set the module name automatically. We need to be careful: no `<@@=` should appear as such in the code below since `l3doc` is also typeset using this code.

TODO: right now, in a line containing `<@@=<module>`, the `@@` are replaced (using different values of the `<module>` before and after the assignment). Is this a waste?

```

1727 \RequirePackage{colorize}

(End definition for \xmacro@code, \_phdd_xmacro_code:n, and \_phdd_xmacro_code:w.)

1728 /DOCUM
1729 *colorize
1730 \ExplSyntaxOn
1731 \bgroup
1732 \obeylines
1733 \tl_new:N \l__phdd_store_tl
1734 \egroup
1735
1736 \NewDocumentCommand{\codelinefont}{O{blue} m}
1737   {\begingroup\bfseries
1738     \color{#1}
1739     #2
1740   \endgroup
1741 }
1742
1743 \def\keyvaluestyle#1
1744 {
1745   \begingroup
1746   =\color{orange}
```

```

1747      \%panunicode #1,
1748      \endgroup
1749  }

1750 \regex_const:Nn \c_ifs_regex { ((\\if(x{1}|num|dimen|cat|eof|false|true|mode|mmode|h
1751     |vmode|_meaning_|_mode_|inner|defined|csname|[@a-
zA-Z]*)*|\else|(\fi)) }
1752 \cs_set:Npn \colorizeifs {
1753   \regex_replace_all:NnN
1754     {\c_ifs_regex}
1755   {
1756     \c{codelinefont}[purple500]\cB{\{1\cE\}
1757   }\l_phdd_store_tl
1758 }

1759 % Coffin l33 module. box vbox hbox use same colors
1760 % captures hbox:n hbox:_... etc
1761 \clist_gset:Nn\coffinkeywords_clist
1762 { {((coffin|box|hbox|vbox)_*[a-zA-Z_]+[^:])},
1763 }
1764 \def\coffinkeywordsregex#1{
1765   \regex_replace_all:nnN
1766     {#1}
1767   {
1768     \c{codelinefont}[oprah]\cB{\{1\cE\}
1769   }\l_phdd_store_tl
1770 }
1771
1772 % Key handlers such as |.code| common with \pkg{pgf}.
1773 % reserved words starting with a dot and any number of letters terminating
1774 % with a colon which is not colorized .code
1775 % For pgf keys we can look for the equal sign to terminate the capture.
1776 \regex_const:Nn \c_handlers_regex { ( ( [.]code|\value|\bool|\meta|.choice|\tl )[
z\_]*[ :] ) }
1777 \cs_set:Npn \colorizehandlers {
1778   \regex_replace_all:NnN
1779     {\c_handlers_regex}
1780   {
1781     \c{codelinefont}[thered]\cB{\{1\cE\}
1782   }\l_phdd_store_tl
1783 }

```

**colorizemodulekeywords**

To colorize modules such as `tex_`, `tl_` etc, we use a factory function. These are called via a `clist`, which stores the regexes. Best later to choose the colors from a color stack. `#1` is the prefix and `#2` is the style to be used. The style is to be changed to use a key value interface down the line. This can also be captured in a generic fashion.

```

1784 \cs_generate_variant:Nn \clist_map_function:NN {cc}
1785 \cs_generate_variant:Nn \regex_replace_all:NnN {cnN}

```

A list to hold simple regular expressions.

```
1786 \clist_new:N \l_phdd_regexes_clist
```

Enables the addition of more keywords, so we can expose it at the programmer interface. The `\u` in the regular expression namely, `\u{htl var namei}`

matches the exact contents of the token list `htl vari`. Within a `\c{...}` control sequence matching, the `\u` escape sequence only expands its argument once, in effect performing `\tl_to_str:v`. Quantifiers are not supported directly: use a group.

```
\cs_new_protected:Npn \regex_const:Nn #1#2
{
    \__regex_compile:n {#2}
    \tl_const:Nx #1 { \exp_not:o \l__regex_internal_regex }
}
```

The constant regex in `l3regex` is defined using `tl_const:Nx`, hence we build a new one from its definition to allow us to hook into the keywords list. We first handle modules. Our life is easier as all modules in `l3` have prefixes with an underscore and can be captured fairly easily.

Token lists holding regex prefixes.

```
phd_more_keywords_tl
1787 \cs_set:Npn \phd_more_keywords_tl {|phd}

1788 \def\AAA#1{
1789     % \regex_const:Nn \c_cs_regex
1790     \__regex_compile:n{\(\cs|regex|seq|tl|clist|dim|char|int|%
1791     group|bool|prg|iow|prop|exp|msg|quark|str|token|keys|q|c|%
1792     coffin|box|hbox|vbox|tex|sys#1)_\[a-zA-Z\]+\^:]\)}
1793     \tl_set:Nx \c_cs_regex { \exp_not:o \l__regex_internal_regex }
1794 }

adds more module prefixes to \c_cs_regex
1795 \cs_new:Npn \add_module_prefix:n #1 {
1796     \tl_put_right:Nn \phd_more_keywords_tl{#1}
1797     \expandafter\AAA\expandafter{\phd_more_keywords_tl }
1798
1799 }
1800 \cs_generate_variant:Nn \add_module_prefix:n {x,f}
1801 \NewDocumentCommand\AddPrefix{m}
1802 {
1803     \add_module_prefix:n {#1}
1804 }
1805
1806 \add_module_prefix:x {|phdd}
1807
1808
1809 \tl_new:N \g__phdd_design_colors_tl
1810 \tl_put_right:Nn \g__phdd_design_colors_tl
1811 {
1812     \cs_set:Npn \cscolor{\color{blue}}
1813     \cs_set:Npn \regexcolor{\color{theblue}}
1814     \cs_set:Npn \seqcolor{\color{purple500}}
1815     \cs_set:Npn \tlcolor{\color{blue900}}
1816     \cs_set:Npn \clistcolor{\color{purple800}}
1817     \cs_set:Npn \dimcolor{\color{unorange}}
1818     \cs_set:Npn \charcolor{\color{red}}
1819     \cs_set:Npn \intcolor{\color{red}}
1820     \cs_set:Npn \groupcolor{\color{red800}}
```

```

1821   \cs_set:Npn \boolcolor{\color{purple800}}
1822   \cs_set:Npn \prgcolor{\color{purple800}}
1823   \cs_set:Npn \iowcolor{\color{purple500}}
1824   \cs_set:Npn \propcolor{\color{red400}}
1825   \cs_set:Npn \expcolor{\color{redA100}}
1826   \cs_set:Npn \msgcolor{\color{green900}}
1827   \cs_set:Npn \quarkcolor{\color{red800}}
1828   \cs_set:Npn \strcolor{\color{orange700}}
1829   \cs_set:Npn \tokencolor{\color{orange700}}
1830   \cs_set:Npn \qcolor{\color{orange500}}
1831   \cs_set:Npn \ccolor{\color{unorange}}
1832   \cs_set:Npn \keyscolor{\color{deeperange700}}
1833   \cs_set:Npn \coffincolor{\color{deeperange700}}
1834   \cs_set:Npn \boxcolor{\color{deeperange600}}
1835   \cs_set:Npn \hboxcolor{\color{deeperange500}}
1836   \cs_set:Npn \vboxcolor{\color{deeperange500}}
1837   \cs_set:Npn \phdcolor{\color{deeperange900}}
1838   \cs_set:Npn \phddcolor{\color{deeperange900}}
1839   \cs_set:Npn \texcolor{\color{red800}}
1840   \cs_set:Npn \cctabcolor{\color{red800}}
1841   \cs_set:Npn \intarraycolor{\color{green500}}
1842   \cs_set:Npn \syscolor{\color{purple500}}
1843 }
1844
1845 \tl_use:N \g__phdd_design_colors_tl
1846
1847 \regex_const:Nn \c_tl_regex {(\(\tl_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\tl)) }
1848 \regex_const:Nn \c_seq_regex {(\(\seq_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\seq)) }
1849 \regex_const:Nn \c_clist_regex { (\(\clist_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\clist)) }
1850 \regex_const:Nn \c_tex_regex { (\tex_[a-zA-Z_]+[^:]) }
1851 \regex_const:Nn \c_exp_regex { (\exp_[a-zA-Z_]+[^:]) }
1852 \regex_const:Nn \c_dim_regex { (\(\bool_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\dim)) }
1853 \regex_const:Nn \c_str_regex { (\(\str_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\str)) }
1854 \regex_const:Nn \c_bool_regex { (\(\bool_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\bool)) }
1855 \regex_const:Nn \c_char_regex { (\(\char_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\char)) }
1856 \regex_const:Nn \c_int_regex { (\(\int_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\int)) }
1857 \regex_const:Nn \c_iow_regex { (\iow_[a-zA-Z_]+[^:]) }
1858 \regex_const:Nn \c_group_regex { (\group_[a-zA-Z_]+[^:]) }
1859 \regex_const:Nn \c_box_regex { (\box_[a-zA-Z_]+[^:]) }
1860 \regex_const:Nn \c_skip_regex { (\skip_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\skip)) }
1861 \regex_const:Nn \c_token_regex { (\token_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\token)) }
1862 \regex_const:Nn \c_regex_regex { (\regex_[a-zA-Z_]+[^:]\)|(\c_[^_][a-zA-Z_]+\regex)) }
1863

```

```

1864 \cs_new:Npn \colorizemodulekeywords #1 #2
1865 {
1866   \cs_set:cpn {currentcolors} {\color{#2}}
1867
1868   \cs_gset:cpn {#1keywordsregex} ##1
1869   {
1870     \regex_replace_all:nnN
1871     { ##1}
1872     {
1873       \c{codelinefont}[#2]\cB{\color{#2}\cE}
1874     }\l_phdd_store_tl
1875   }
1876
1877   \cs_gset:Npn \keywordsregex_aux:n ##1 ##2
1878   {
1879     \regex_replace_all:cnN
1880     {c_cs_regex}
1881   {
1882     \cB{
1883       \c{\color{#2}}\cE
1884     }\cE
1885   }\l_phdd_store_tl
1886 }
```

In order to speed up the regular expression processing we predefine common module regular expressions

```

1887 \cs_if_free:cTF {c_cs_regex} {
1888 %   \clist_gset:cn {#1keywords_clist}
1889 %   { % c if it has a constant c_underscore_str, i.e it has no :
1890 %     {(\!(#1)_[a-zA-Z]+[^:]\!)},
1891 %     % capture c_something_tl but not c__something_tl
1892 %     {\!\!c_[^_][a-zA-Z]+\!}
1893 %   }
1894 %   \clist_map_function:cc {#1keywords_clist} {#1keywordsregex}
1895 }
1896 { \keywordsregex_aux:n {#1} {#2} }
1897
1898 }
```

(End definition for `\colorizemodulekeywords`, `\l_phdd_regexes_clist`, and `\phd_more_keywords_tl`.)

`keywordsregex` *{<regex expression for keywords>}*

```

1899 \%def\keywordsregex#1{
1900 %   \regex_replace_all:nnN
1901 %   {#1}
1902 %   {
1903 %     \c{codelinefont}[blue]\cB{\color{blue}\cE}
1904 %   }\l_phdd_store_tl
1905 %}
```

(End definition for `keywordsregex`.)

`\colorizebrackets`  
`\orizesquarebrackets` 1906 `\regex_const:Nn \c_braces_regex { (\{|}\})+ }`

```

1907 \regex_const:Nn \c_square_brackets_regex { [\[\]]+ }
1908 \regex_const:Nn \c_brackets_regex { [\\()]+ }
1909
1910 \def\bracescolor#1{\normalcolor\textcolor{thebracescolor}{#1}\normalcolor}
1911
1912 \def\squarebracketscolor#1{\textcolor{thesquarebracketscolor}{#1}}
1913
1914 \def\bracketscolor#1{\bgroup\bfseries\color{thered}#1\egroup}
1915 \cs_set:Npn \colorizebraces #1
1916 {
1917   \regex_replace_all:NnN
1918   {
1919     \c_braces_regex
1920   }
1921   {
1922     \c{bracescolor}\cB{\{\0\cE\}}
1923   }\l_phdd_store_tl
1924 }
1925
1926 \cs_set:Npn \colorizesquarebrackets #1
1927 {
1928   \regex_replace_all:NnN
1929   {
1930     \c_square_brackets_regex
1931   }
1932   {
1933     \c{squarebracketscolor}\cB{\{\0\cE\}}
1934   }\l_phdd_store_tl
1935 }
1936 \cs_set:Npn \colorizebrackets #1
1937 {
1938   \regex_replace_all:NnN
1939   {
1940     \c_brackets_regex
1941   }
1942   {
1943     \c{bracketscolor}\0
1944   }\l_phdd_store_tl
1945 }
1946
1947 % Highlight math operators
1948 % First we do the math operator signs$
1949 \regex_const:Nn \c_math_operator_regex { [\$]+ }
1950
1951 \def\mathoperatorcolor#1
1952 {
1953   \bgroup
1954   \bfseries\color{thered}#1
1955   \egroup
1956 }
1957
1958 \cs_set:Npn \colorizemathoperator #1
1959 {
1960   \regex_replace_all:NnN

```

```

1961      {
1962          \c_math_operator_regex
1963      }
1964      {
1965          \c{mathoperatorcolor}\cB{\l0 \cE}
1966      }\l_phdd_store_tl
1967  }

(End definition for \colorizebrackets and colorizesquarebrackets.)

1968 \cs_new:Npn \colorizexparseddeclarations{
1969     \regex_replace_all:nnN
1970     {
1971         \\(DeclareDocumentCommand|DeclareOption|NewDocumentCommand%
1972             |DeclareRobustCommand|NewDocumentEnvironment|r*e*newcommand|newenvironment|%
1973             )
1974     {
1975         \c{codelinefont}[blue]\cB{\l1\cE}
1976     }\l_phdd_store_tl
1977 }

```

The command colorizes the output in macro code. It uses the `l3regex` package, which is inherently slow. It is only called when the key `/phdd/codecolorize` is set to true.

`d_code_colorize_bool`

```

1978 \%bool_new:N \phdd_code_colorize_bool
1979 \%bool_gset_false:N \phdd_code_colorize_bool

```

(End definition for `\phdd_code_colorize_bool`.)

`colorizecomments`

```

1980 % Attempt to capture comment strings
1981 % for TeX these are the (%). Note the (\v) in the
1982 % regex is any character for vertical space ^M.
1983 % Also captures \foo_underscore:N.
1984 % Captures also escape characters # & * - and others.
1985 % Parameter parameter_test
1986 %%
1987 % % %
1988 % Capture all characters up to vertical command. Has issues
1989 % as it is not protected and other commands can colorize it.
1990 %
1991 %
1992 % \* Any number of starting spaces
1993 %
1994 % [^<]* Do not colorize guards i.e., %<*guard>, use star as
1995 % we may have only a %.
1996 % Strategy: capture anything except end of lines. These are
1997 % modified by \obeylines and \doc uses everypar that makes
1998 % it hard to capture.
1999 \regex_const:Nn \c_comments_regex
2000  {
2001      (%\*%*[ a-zA-Z\ \\\*\_:\;.\!\"`\\#\&\-
2002      \^(\()\\d+=+\, @{}\{[\]\\/% ]*)
2003  }

```

```

2003
2004 \cs_gset:Npn \colorizecomments
2005 {
2006     \regex_replace_all:NnN \c_comments_regex
2007     {
2008         \c{color}\cB{green800\cE}\1\c{normalcolor}
2009     }\l_phdd_store_tl
2010 }
2011

(End definition for colorizecomments.)

2012
2013 \cs_gset:Npn \listings_code
2014 {
2015 %\colorizebraces{orangeA700}
2016 % \colorizesquarebrackets{orange500}
2017 %\colorizebrackets{thered}
2018 % \colorizemathoperator{thered}
2019 %%
2020 % \colorizehandlers
2021 % \colorizemodekeywords{tex}{red500}
2022 % \colorizemodekeywords{regex}{red400}
2023 % \colorizemodekeywords{exp}{red500}
2024 % \colorizemodekeywords{dim}{teal500}
2025 % \colorizemodekeywords{mode}{teal500}
2026 % \colorizemodekeywords{clist}{teal600}
2027 % \colorizemodekeywords{str}{unorange}
2028 % \colorizemodekeywords{bool}{blue800}
2029 % \colorizemodekeywords{tl}{blue600}
2030 %
2031 % \colorizemodekeywords{token}{orange700}
2032 %
2033 \colorizemodekeywords{cs}{-thecsmodulecolor}
2034 % \colorizemodekeywords{xcol}{thecsmodulecolor}
2035 % \colorizemodekeywords{char}{orange900}
2036 % \colorizemodekeywords{seq}{blue900}
2037 % \colorizemodekeywords{iow}{blueprint}
2038 % \colorizemodekeywords{int}{purple500}
2039 % \colorizemodekeywords{dim}{purple500}
2040 % \colorizemodekeywords{tex}{unorange}
2041 % \colorizemodekeywords{skip}{purple700}
2042 % \colorizemodekeywords{hbox}{purple500}
2043 % \colorizemodekeywords{box}{purple500}
2044 % \colorizemodekeywords{group}{purple500}
2045 % \colorizeifs{}
2046 %\colorizecomments
2047 %\commentshack
2048 % \show\l_phdd_store_tl
2049
2050 }
2051 \ExplSyntaxOff
2052 /colorize
2053 *DOCUM

```

```

2054 \ExplSyntaxOn
2055 \group_begin:
2056   \char_set_catcode_other:N \^A
2057   \char_set_catcode_active:N \^S
2058   \char_set_catcode_active:N \^B
2059   \char_set_catcode_other:N \^L
2060   \char_set_catcode_other:N \^R
2061   \char_set_lccode:nn { `^A } { `%
2062   \char_set_lccode:nn { `^S } { `\
2063   \char_set_lccode:nn { `^B } { `\\ }
2064   \char_set_lccode:nn { `^L } { `{
2065   \char_set_lccode:nn { `^R } { `} }
2066 \tex_lowercase:D
2067 {
2068   \group_end:
2069   \cs_set_protected:Npn \xmacro@code #1 ^A ^S^S^S^S^S ^Bend ^Lmacrocode^R
2070     {\__phdd_xmacro_code:n {#1} \end{macrocode} }
2071 }
2072
2073
2074 \group_begin:
2075   \bool_set_false:N \phdd_code_colorize_bool
2076   \char_set_catcode_active:N \
2077   \char_set_catcode_active:N \

```

We check for guards as well as <nocolor> directive

```

2078 \cs_new_protected:Npn \__phdd_xmacro_code:n #1
2079 {
2080   \tl_if_in:nnTF {#1} { < @ @ = }
2081     { \__phdd_xmacro_code:w #1 \q_stop }
2082   {
2083     \tl_if_in:nnTF {#1} { < nocolor }
2084     {
2085       \bool_set_false:N \phdd_code_colorize_bool
2086       \tl_gset:Nn \l__phdd_store_tl {#1}
2087       \__phdd_detect_internals:N \l__phdd_store_tl
2088       \__phdd_replace_at_at:N \l__phdd_store_tl
2089       % Call the pretty printer or skip
2090
2091       \bool_if:NTF \phdd_code_colorize_bool
2092         {
2093           \listings_code
2094           \tl_use:N \l__phdd_store_tl
2095         }
2096     {#1}
2097   }
2098 {
2099
2100   \tl_gset:Nn \l__phdd_store_tl {#1}
2101   \__phdd_detect_internals:N \l__phdd_store_tl
2102   \__phdd_replace_at_at:N \l__phdd_store_tl
2103   % Call the pretty printer or skip
2104
2105   \bool_if:NTF \phdd_code_colorize_bool

```

```

2106      {
2107          \listings_code
2108          \tl_use:N \l__phdd_store_tl
2109      }
2110      {
2111          \tl_use:N \l__phdd_store_tl
2112
2113
2114          % #1
2115      }
2116  }
2117 }
2118
2119 % \tl_if_in:nnTF {#1} { < nocolor }
2120 % { \__phdd_xmacro_code:w #1 \q_stop }
2121 %
2122 % { \tl_gset:Nn \l__phdd_store_tl {#1}
2123 % \__phdd_detect_internals:N \l__phdd_store_tl
2124 % \__phdd_replace_at_at:N \l__phdd_store_tl
2125 % % Call the pretty printer or skip
2126 % \bool_set_true:N \phdd_code_colorize_bool
2127 % \bool_if:NTF \phdd_code_colorize_bool
2128 %
2129 % {
2130 %     \listings_code
2131 %     \tl_use:N \l__phdd_store_tl
2132 %
2133 % {#1}
2134 }
2135
2136
2137
2138
2139
2140 \cs_new_protected:Npn \__phdd_xmacro_code:w #1 < @ @ = #2 > #3 \q_stop
2141 {
2142     \tl_set:Nn \l__phdd_tmpa_tl {#1}
2143     \__phdd_detect_internals:N \l__phdd_tmpa_tl
2144     \__phdd_replace_at_at:N \l__phdd_tmpa_tl
2145
2146 % We have found the name hence store it
2147     \tl_gset:Nn \g__phdd_module_name_tl {#2}
2148     \tl_put_right:Nn \l__phdd_tmpa_tl { < @ @ = #2 > }
2149
2150 % three represents the full code outside the guards
2151     \tl_set:Nn \l__phdd_tmpb_tl {#3}
2152 % detect interna;
2153     \__phdd_detect_internals:N \l__phdd_tmpb_tl
2154 % replace ats
2155     \__phdd_replace_at_at:N \l__phdd_tmpb_tl
2156 %
2157     \tl_put_right:No \l__phdd_tmpa_tl { \l__phdd_tmpb_tl }
2158     \tl_use:N \l__phdd_tmpa_tl
2159 }

```

```

2160
2161
2162 \group_end:
```

### D.2.6 At end document

Print all defined and documented macros/functions.

```

2163 \iow_new:N \g__phdd_func_iow
2164 \tl_new:N \l__phdd_doc_def_tl
2165 \tl_new:N \l__phdd_doc_undef_tl
2166 \tl_new:N \l__phdd_undoc_def_tl
2167 \cs_new_protected:Npn \__phdd_show_functions_defined:
2168 {
2169   \bool_lazy_and:nnT
2170     { \g__phdd_typesetImplementation_bool } { \g__phdd_checkfunc_bool }
2171   {
2172     \iow_term:x { \c__phdd_iow_separator_tl \iow_newline: }
2173     \iow_open:Nn \g__phdd_func_iow { \c_sys_jobname_str .cmds }
2174
2175     \tl_clear:N \l__phdd_doc_def_tl
2176     \tl_clear:N \l__phdd_doc_undef_tl
2177     \tl_clear:N \l__phdd_undoc_def_tl
2178     \seq_map_inline:Nn \g_doc_functions_seq
2179     {
2180       \seq_if_in:NnTF \g_doc_macros_seq {##1}
2181       {
2182         \tl_put_right:Nx \l__phdd_doc_def_tl
2183         { ##1 \iow_newline: }
2184         \iow_now:Nn \g__phdd_func_iow { > ~ ##1 }
2185       }
2186       {
2187         \tl_put_right:Nx \l__phdd_doc_undef_tl
2188         { ##1 \iow_newline: }
2189         \iow_now:Nn \g__phdd_func_iow { ! ~ ##1 }
2190       }
2191     }
2192     \seq_map_inline:Nn \g_doc_macros_seq
2193     {
2194       \seq_if_in:NnF \g_doc_functions_seq {##1}
2195       {
2196         \tl_put_right:Nx \l__phdd_undoc_def_tl
2197         { ##1 \iow_newline: }
2198         \iow_now:Nn \g__phdd_func_iow { ? ~ ##1 }
2199       }
2200     }
2201   \__phdd_functions_typeout:nN
2202   {
2203     Functions~both~documented~and~defined: \iow_newline:
2204     (In~order~of~being~documented)
2205   }
2206   \l__phdd_doc_def_tl
2207   \__phdd_functions_typeout:nN
```

```

2208         { Functions~documented~but~not~defined: }
2209         \l__phdd_doc_undef_tl
2210     \__phdd_functions_typeout:nN
2211         { Functions~defined~but~not~documented: }
2212         \l__phdd_undoc_def_tl
2213
2214         \iow_close:N \g__phdd_func_iow
2215         \iow_term:x { \c__phdd_iow_separator_tl }
2216     }
2217 }
2218 \AtEndDocument { \__phdd_show_functions_defined: }

TODO: use \iow_term:x.

2219 \cs_new_protected:Npn \__phdd_functions_typeout:nN #1#2
2220 {
2221     \tl_if_empty:NF #2
2222     {
2223         \typeout
2224         {
2225             \c__phdd_iow_midrule_tl \iow_newline:
2226             #1 \iow_newline:
2227             \c__phdd_iow_midrule_tl \iow_newline:
2228             #2
2229         }
2230         \tl_clear:N #2
2231     }
2232 }
2233 \cs_new_protected:Npn \__phdd_show_not_tested:
2234 {
2235     \bool_if:NT \g__phdd_checktest_bool
2236     {
2237         \tl_clear:N \l__phdd_tmpa_tl
2238         \prop_if_empty:NF \g__phdd_missing_tests_prop
2239         {
2240             \cs_set:Npn \__phdd_tmpa:w ##1##2
2241             {
2242                 \iow_newline:
2243                 \space\space\space\space \exp_not:n {##1}
2244                 \clist_map_function:nN {##2} \__phdd_tmpb:w
2245             }
2246             \cs_set:Npn \__phdd_tmpb:w ##1
2247             {
2248                 \iow_newline:
2249                 \space\space\space\space\space\space * ~ ##1
2250             }
2251         \tl_put_right:Nx \l__phdd_tmpa_tl
2252         {
2253             \iow_newline: \iow_newline:
2254             The~ following~ macro(s)~ have~ incomplete~ tests:
2255             \iow_newline:
2256             \prop_map_function:NN
2257                 \g__phdd_missing_tests_prop \__phdd_tmpa:w
2258         }
2259     }

```

```

2260     \seq_if_empty:NF \g_phdd_not_tested_seq
2261     {
2262         \cs_set:Npn \__phdd_tmpa:w ##1
2263             { \clist_map_function:nN {##1} \__phdd_tmpb:w }
2264         \cs_set:Npn \__phdd_tmpb:w ##1
2265             {
2266                 \iow_newline:
2267                 \space\space\space\space ##1
2268             }
2269         \tl_put_right:Nx \l_phdd_tmpa_tl
2270             {
2271                 \iow_newline:
2272                 \iow_newline:
2273                     The~ following~ macro(s)~ do~ not~ have~ any~ tests:
2274                 \iow_newline:
2275                 \seq_map_function:NN
2276                     \g_phdd_not_tested_seq \__phdd_tmpa:w
2277                 }
2278             }
2279         \tl_if_empty:NF \l_phdd_tmpa_tl
2280             {
2281                 \int_set:Nn \l_phdd_tmpa_int { \tex_interactionmode:D }
2282                 \errorstopmode
2283                 \ClassError { l3doc } { \l_phdd_tmpa_tl } { }
2284                 \int_set:Nn \tex_interactionmode:D { \l_phdd_tmpa_int }
2285             }
2286         }
2287     }
2288 \AtEndDocument { \__phdd_show_not_tested: }
```

## D.2.7 Indexing

### D.2.70 Userspace commands

Fix index (for now):

```

2289 \g@addto@macro \theindex { \MakePrivateLetters }
2290 \cs_gset:Npn \verbatimchar {&}
2291 \setcounter { IndexColumns } { 2 }
```

Set up the Index to use `\part`

```

2292 \IndexPrologue
2293 {
2294     \part*[Index]
2295     \markboth{Index}{Index}
2296     \addcontentsline{toc}{part}{Index}
2297     The~italic~numbers~denote~the~pages~where~the~
2298     corresponding~entry~is~described,~
2299     numbers~underlined~point~to~the~definition,~
2300     all~others~indicate~the~places~where~it~is~used.
2301 }
```

`\SpecialIndex` An attempt at affecting how commands which appear within the `macrocode` environment are treated in the index.

```

2302 \cs_gset_protected:Npn \SpecialIndex #1
2303 {
2304     \@bsphack
2305     \__phdd_special_index:nn {#1} { }
2306     \@esphack
2307 }

(End definition for \SpecialIndex.)
```

```

2308 \msg_new:nnn { l3doc } { print-index-howto }
2309 {
2310     Generate~the~index~by~executing\\
2311     \iow_indent:n
2312     { makeindex~-s~gind.ist~-o~\c_sys_jobname_str.ind~\c_sys_jobname_str.idx }
2313 }
2314 \tl_gput_right:Nn \PrintIndex
2315 { \AtEndDocument { \msg_info:nn { l3doc } { print-index-
howto } } }
```

### D.2.70 Internal index commands

\it@is@a The index of one-character commands within the macrocode environment is produced using \it@is@a *char*. Alter that command.

```

2316 \cs_gset_protected:Npn \it@is@a #1
2317 {
2318     \use:x
2319     {
2320         \__phdd_special_index_module:nnnnN
2321         {#1}
2322         { \bslash #1 }
2323         { }
2324         { }
2325         \c_false_bool
2326     }
2327 }
```

(End definition for \it@is@a.)

#### ndd\_special\_index:nn

```

2328 \cs_new_protected:Npn \__phdd_special_index:nn #1#2
2329 {
2330     \__phdd_key_get:n {#1}
2331     \quark_if_no_value:NF \l__phdd_override_module_tl
2332     { \tl_set_eq:NN \l__phdd_index_module_tl \l__phdd_override_module_tl }
2333     \__phdd_special_index_module:ooonN
2334     { \l__phdd_index_key_tl }
2335     { \l__phdd_index_macro_tl }
2336     { \l__phdd_index_module_tl }
2337     {#2}
2338     \l__phdd_index_internal_bool
2339 }
2340 \cs_generate_variant:Nn \__phdd_special_index:nn { o }
```

(End definition for \\_\_phdd\_special\_index:nn.)

~~\_index\_module:nnnnN  
 \_index\_module:ooonN  
 al\_index\_aux:nnnnnn  
 special\_index\_set:Nn~~

Remotely based on Heiko's replacement to play nicely with `hypdoc`. We use `\verb` or a `\verb@font` construction depending on whether the number of tokens in #2 is equal to its number of characters: if it is not then that suggests that there is a construct such as `\meta{...}`.

```

2341 \tl_new:N \l__phdd_index_escaped_macro_tl
2342 \tl_new:N \l__phdd_index_escaped_key_tl
2343 \cs_new_protected:Npn \__phdd_special_index_module:nnnnN #1#2#3#4#5
    #1 = key
    #2 = macro
    #3 = module
    #4 = index 'type' (main/usage/etc.)
    #5 = boolean whether internal command
2344 {
2345   \use:x
2346   {
2347     \exp_not:n { \__phdd_special_index_aux:nnnnnn {#1} {#2} }
2348     \tl_if_empty:nTF {#3}
2349     { { } { } { } }
2350     {
2351       \str_if_eq:nnTF {#3} { TeX }
2352       {
2353         { TeX~and~LaTeX2e }
2354         { \string\TeX{}~and~\string\LaTeX{}{} }
2355       }
2356     {
2357       {#3}
2358       { \% \string\pkg our \pkg is a ref use something else
2359         \bgroup\string\color{red}
2360         \string\texttt{#3}\egroup }
2361     }
2362     { \bool_if:NT #5 { ~internal } ~commands: }
2363   }
2364 }
2365 {#4}
2366 }

2367 \cs_generate_variant:Nn \__phdd_special_index_module:nnnnN { ooo }
2368 \cs_new_protected:Npn \__phdd_special_index_aux:nnnnnn #1#2#3#4#5#6
    #1 = key
    #2 = macro
    #3 = index subheading string
    #4 = index subheading text
    #5 = index subheading suffix (appended to both arg 3 and 4)
    #6 = index 'type' (main/usage/etc.)
2369 {
2370   \tl_set:Nn \l__phdd_index_escaped_key_tl {#1}
2371   \__phdd_quote_special_char:N \l__phdd_index_escaped_key_tl
2372   \__phdd_special_index_set:Nn \l__phdd_index_escaped_macro_tl {#2}
2373   \str_if_eq:onTF { \currenvir } { macrocode }
2374   { \codeline@wrindex }
2375 }
```

```

2376      \str_case:nnF {#6}
2377      {
2378          { main } { \codeline@wrindex }
2379          { usage } { \index }
2380      }
2381      { \HD@target \index }
2382  }
2383  {
2384      \tl_if_empty:nF { #3 #4 #5 }
2385      { #3 #5 \actualchar #4 #5 \levelchar }
2386      \l__phdd_index_escaped_key_tl
2387      \actualchar
2388      {
2389          \token_to_str:N \verbatim@font \c_space_tl
2390          \l__phdd_index_escaped_macro_tl
2391      }
2392      \encapchar
2393      \hdclindex{\the\c@HD@hypercount}{#6}
2394  }
2395 }

2396 \cs_new_protected:Npn \__phdd_special_index_set:Nn #1#2
2397 {
2398     \tl_set:Nx #1 { \tl_to_str:n {#2} }
2399     \__phdd_if_almost_str:nTF {#2}
2400     {
2401         \tl_replace_all:Non #1 { \tl_to_str:n { __ } }
2402         {
2403             \verbatimchar
2404             \token_to_str:N \_ \token_to_str:N \_
2405             \token_to_str:N \verb * \verbatimchar
2406         }
2407         \exp_args:Nx \tl_map_inline:nn
2408         { \tl_to_str:N \verbatimchar \token_to_str:N _ }
2409         {
2410             \tl_replace_all:Nnn #1 {##1}
2411             {
2412                 \verbatimchar \c_backslash_str ##1
2413                 \token_to_str:N \verb * \verbatimchar
2414             }
2415         }
2416         \tl_set:Nx #1
2417         {
2418             \token_to_str:N \verb * \verbatimchar
2419             #1 \verbatimchar
2420         }
2421     }
2422     {
2423         \tl_set:Nn #1 {#2}
2424         \tl_replace_all:Non #1
2425         { \c_backslash_str }
2426         { \token_to_str:N \bslash \c_space_tl }
2427     }
2428     \__phdd_quote_special_char:N #1
2429 }

```

(End definition for `\__phdd_special_index_module:nnnnN`, `\__phdd_special_index_aux:nnnnnn`,  
and `\__phdd_special_index_set:Nn`.)

`quote_special_char:N`

Quote some special characters.

```

2430 \cs_new_protected:Npn \__phdd_quote_special_char:N #1
2431 {
2432   \tl_map_inline:nn { \quotearchar \actualchar \encapchar \levelchar }
2433   {
2434     \tl_replace_all:Nnx #1
2435     { \tl_to_str:N ##1 } { \quotearchar \tl_to_str:N ##1 }
2436   }
2437 }
```

(End definition for `\__phdd_quote_special_char:N`.)

## D.2.70 Finding sort-key and module

`\__phdd_key_get:n`

Sets `\l__phdd_index_macro_tl`, `\l__phdd_index_key_tl`, and `\l__phdd_index_module_tl` from #1. The base function is stored by `\__phdd_key_get_base:nN` in `\l__phdd_index_macro_tl`, falling back to #1 if it contains markup or has no signature.

The starting point for the `<key>` is `\l__phdd_index_key_tl` as a string. If it the first character is a backslash, remove it. Then recognize `expl` functions and variables by the presence of `:` or `_` and `\TeX/\LaTeX2\epsilon` commands by the presence of `@`. For `expl` names, we call `\__phdd_key_func:` or `\__phdd_key_var:`, which are responsible for removing some characters and finding the module name, while for `\TeX/\LaTeX2\epsilon` commands the module name is `\TeX`, and others have an empty module name.

```

2438 \cs_new_protected:Npn \__phdd_key_get:n #1
2439 {
2440   \__phdd_key_get_base:nN {#1} \l__phdd_index_macro_tl
2441   \tl_set:Nx \l__phdd_index_key_tl
2442   { \tl_to_str:N \l__phdd_index_macro_tl }
2443   \tl_clear:N \l__phdd_index_module_tl
2444   \tl_if_in:NoTF \l__phdd_index_key_tl { \tl_to_str:n { __ } }
2445   { \bool_set_true:N \l__phdd_index_internal_bool }
2446   { \bool_set_false:N \l__phdd_index_internal_bool }
2447   \exp_last_unbraced:NNo
2448   \tl_if_head_eqCharCode:oNT
2449   { \l__phdd_index_key_tl } \c_backslash_str
2450   { \__phdd_key_pop: }
2451   \tl_if_in:NoTF \l__phdd_index_key_tl { \token_to_str:N : }
2452   { \__phdd_key_func: }
2453   {
2454     \tl_if_in:NoTF \l__phdd_index_key_tl { \token_to_str:N _ }
2455     { \__phdd_key_var: }
2456     {
2457       \tl_if_in:NoT \l__phdd_index_key_tl { \token_to_str:N @ }
2458       { \tl_set:Nn \l__phdd_index_module_tl { \TeX } }
2459     }
2460   }
2461 }
2462 \cs_new_protected:Npn \__phdd_key_pop:
```

```

2463  {
2464    \tl_set:Nx \l__phdd_index_key_tl
2465    { \tl_tail:N \l__phdd_index_key_tl }
2466  }

```

(End definition for `\__phdd_key_get:n`.)

### `\__phdd_key_trim_module:n` `\__phdd_key_drop_underscores:`

Helper that removes from `\l__phdd_index_module_tl` everything after the first occurrence of #1. Helper that removes any leading underscore from `\l__phdd_index_key_tl`.

```

2467 \cs_new_protected:Npn \__phdd_key_trim_module:n #1
2468  {
2469    \cs_set:Npn \__phdd_tma:w ##1 #1 ##2 \q_stop
2470    { \exp_not:n {##1} }
2471    \tl_set:Nx \l__phdd_index_module_tl
2472    { \exp_after:wN \__phdd_tma:w \l__phdd_index_module_tl #1 \q_stop }
2473  }
2474 \cs_new_protected:Npn \__phdd_key_drop_underscores:
2475  {
2476    \tl_if_head_eqCharCode:oNT { \l__phdd_index_key_tl } -
2477    { \__phdd_key_pop: \__phdd_key_drop_underscores: }
2478  }

```

(End definition for `\__phdd_key_trim_module:n` and `\__phdd_key_drop_underscores:`.)

### `\__phdd_key_func:`

The function `\__phdd_key_func:` is used if there is a colon, so either for usual `expl3` functions or for keys from `lgkeys`. After removing from the key a leading dot (for the latter case), and any leading underscore, the module name is the part before any colon or underscore.

```

2479 \cs_new_protected:Npn \__phdd_key_func:
2480  {
2481    \tl_if_head_eqCharCode:oNT { \l__phdd_index_key_tl } .
2482    { \__phdd_key_pop: }
2483    \__phdd_key_drop_underscores:
2484    \tl_set_eq:NN \l__phdd_index_module_tl \l__phdd_index_key_tl
2485    \exp_args:No \__phdd_key_trim_module:n { \token_to_str:N : }
2486    \exp_args:No \__phdd_key_trim_module:n { \token_to_str:N _ }
2487  }

```

(End definition for `\__phdd_key_func:`.)

### `\__phdd_key_var:` `\__phdd_key_get_module:`

The function `\__phdd_key_var:` covers cases with no : but with \_, typically variables but occasionally non-`expl3` functions such as Lua function with underscores. First test the second character: if that is \_ then assume we have a proper variable, otherwise use the part before any underscore as the module name. For variables, distinguish quarks and scan marks (starting with q and s), then drop the first letter (local/global/constant marker) and underscores. If there is no underscore left we had something like `\c_zero` which we assume is an integer constant. If there is one underscore we assume it is a variable like `\c_empty_tl` whose module name is the last part. Otherwise the module name is the part before any underscore.

```

2488 \cs_new_protected:Npn \__phdd_key_var:
2489  {
2490    \exp_args:Nx \tl_if_head_eqCharCode:nNTF

```

```

2491 { \exp_args:No \str_tail:n \l__phdd_index_key_tl } _ 
2492 {
2493   \str_case:fn { \str_head:N \l__phdd_index_key_tl }
2494   {
2495     { q } { \tl_set:Nn \l__phdd_index_module_tl { quark } }
2496     { s } { \tl_set:Nn \l__phdd_index_module_tl { quark } }
2497   }
2498   \__phdd_key_pop:
2499   \__phdd_key_pop:
2500   \__phdd_key_drop_underscores:
2501   \tl_if_empty:NT \l__phdd_index_module_tl
2502   {
2503     \seq_set_split:NoV \l__phdd_tmpa_seq
2504     { \token_to_str:N _ } \l__phdd_index_key_tl
2505     \tl_set:Nx \l__phdd_index_module_tl
2506     {
2507       \int_case:nnF { \seq_count:N \l__phdd_tmpa_seq }
2508       {
2509         { 0 } { }
2510         { 1 } { int }
2511         { 2 } { \seq_item:Nn \l__phdd_tmpa_seq { 2 } }
2512       }
2513       { \seq_item:Nn \l__phdd_tmpa_seq { 1 } }
2514     }
2515   }
2516 }
2517 {
2518   \tl_set_eq:NN \l__phdd_index_module_tl \l__phdd_index_key_tl
2519   \exp_args:No \__phdd_key_trim_module:n { \token_to_str:N _ }
2520 }
2521 }

```

(End definition for `\__phdd_key_var:` and `\__phdd_key_get_module::`)

### D.2.8 Change history

Set the change history to use `\part`. Allow control names to be hyphenated in here...

```

2522 \GlossaryPrologue
2523 {
2524   \part*{Change~History}
2525   {\GlossaryParms\ttfamily\hyphenchar\font=\-}
2526   \markboth{Change~History}{Change~History}
2527   \addcontentsline{toc}{part}{Change~History}
2528 }
2529 \msg_new:nnn { phdd } { print-changes-howto }
2530 {
2531   Generate~the~change~list~by~executing\\
2532   \iow_indent:n
2533   { makeindex~-s~gglo.ist~-o~\c_sys_jobname_str.gls~
2534     \c_sys_jobname_str.glo }
2535 }
2536 \tl_gput_right:Nn \PrintChanges

```

```

2537   { \AtEndDocument { \msg_info:nn { phdd } { print-changes-
  howto } } }
2538
2539 %

```

Allocate a counter and use L<sup>A</sup>T<sub>E</sub>X \list to implement this environment. For example:

```

#1 = first argument
#2 = second argument
#3 = third argument Fusce adipiscing justo nec ante. Nullam in enim. Pel-
lentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc
non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin
justo sed quam et quadd.par

```

#### labelargcount

```

2540 \newcounter{phddargcount}
2541 \cs_new:Npn \labelargcount
2542 {
2543     \texttt{\#\arabic{phddargcount}\hskip\labelsep$=$}
2544 }

```

(End definition for *labelargcount*.)

#### \macroarguments

#### \endmacroarguments

```

2545 \cs_new:Npn \macroarguments
2546   {\list\labelargcount
2547     {\usecounter{phddargcount}
2548       \leftmargin=2\leftmargin
2549       \parsep \z@ \oplus \z@ \ominus \z@
2550       \topsep 4\p@ \oplus \p@ \ominus 2\p@
2551       \itemsep \z@ \oplus \z@ \ominus \z@
2552       \def\makelabel##1{\hss\llap{##1}}}
2553   }
2554
2555 \cs_new:Npn \endmacroarguments {\endlist}

```

(End definition for *\macroarguments* and *\endmacroarguments*.)

#### \AltMacroFont

Set doc's font for modules to up, otherwise \* cannot be printed in unicode fonts  
(we have issues...) <sup>1</sup> TODO change to lmtt

```

2556 \def\Module{
2557   \color{green800}
2558 }
2559 \def\AltMacroFont{
2560   \fontfamily{lmtt}\fontseries{lc}
2561 }

```

(End definition for *\AltMacroFont*.)

```

2562 \wlog{*****}
2563 \wlog{ END PHD-DOCUMENTATION }
2564 \wlog{*****}
2565

```

---

<sup>1</sup>1.01 2018/01/18 Added settings.

2566 /DOCUM

<sup>2</sup>

---

<sup>2</sup>1.0,2013/01/26,Converted to DTX file.





# Code Implementation and Objectives

The package provides macros for documenting and indexing primarily L<sup>A</sup>T<sub>E</sub>X or L<sup>A</sup>T<sub>E</sub>X 3 code. It combines the styles originating with `doc` with those found in the `pgf` series of packages. It removes some of the difficulties of using hyperlinks in the index and elsewhere in the document.



Having provided for individual control for virtually all document elements, we need some form of organizing all the color keys. This package defines different color palettes, that make it easier to change all the colors of a document with a single key setting (provided of course we have a predefined palette).

We start by outlining what we are trying to achieve with the **phd-colorpalette** package.

1. To provide a declarative interface to enable users to modify colors specifications in logical groups rather than individual elements..
2. To provide a number of predefined color themes.
3. To provide a plug-in architecture for user extensions.

## E.1 Terminology

**document** Any written item, as a book, article, or letter, especially of a factual or informative nature.

**heading** A division of a document or document series. For a normal book headings are chapters, sections etc. However we allow for specifying a more complex document divided into books, volumes parts etc. For example the Bible has Books, chapters and verses, where a legal document might require divisions such as clauses. In general these divisions are numbered. These document divisions are stored in the comma list

**head** A typeset heading, such as chapter head, or section head. This can include a counter, label and title for example, *Chapter 1 Introduction*.

**dom** This is a programming interface that provides a structured representation of the document (a tree) and it defines a way that the structure can be accessed. Although L<sup>A</sup>T<sub>E</sub>X does not offer a standard way to build such a tree (mainly because T<sub>E</sub>X does not require the marking of paragraphs, it is useful to think of the document as a tree structure. We also allow for a semi-automated way to build such a tree (with the exception that paragraphs are not included).

**element** A part of the document tree that can be styled on its own. For example the chapter label, or the section number.

## E.2 Users

We classify users according to the L<sup>A</sup>T<sub>E</sub>X3 terminology as a) programmers b) template designers and c) authors.

### E.2.1 Author

We assume that the author has an existing template which she is using but might want to do some minor modifications, for example use an italic shape for the font of the mark, but an upright font for the page numbers.

We follow the idea of representing the basic elements of documents as elements, each one having a parent in order to specify the element we need to

style as accurate as possible. One can think of this approach being congruent with objects in other languages. As a matter fact nothing stops us from defining a key value interface as shown below.

### E.2.2 Template designer

The template designer in the example above would have selected the format style from a number of predefined formats (templates) or would have created a style called *apa* from an existing template and modified it using declarative key style.

### E.2.3 The Programmer

The programmer in the example above could have created the basic format *apa* by using both declarative as well as defining or using existing macros. To the programmer we offer an extension mechanism, where the contents of a `\ps@` command are defined. For example the programmer can define a new style using TikZ, but without having to worry about defining full `\ps@` and their interface.

## E.3 Color Palettes

Although documents would normally have only a small number of colors, the number of variables that need a color setting is quite large. In this package we introduce the option of a *color palette*, where all color settings can be in one place.

## E.4 Companion Go packages

The Companion Go `colornames.go` package can be used to generate Material Design color palettes inspired by Google's [material design](#). Color in Material Design uses bold hues juxtaposed with muted environments, deep shadows, and bright highlights.

Palettes provided with the package have memorable names.

478 `\cxset{palette bbc}`

Once a palette is set a number of colornames are available and are used by the rest of the phd packages to set colors.

`\cxset {<palette name>}` For example setting the palette to *unorange*<sup>1</sup> will change *thesubsectioncolor* to an orange color defined with the *unorange* palette.

This renders as follows:

#### Example 4.1 Setting palette colors

```
472 % \bgroup
473 % \cxset{palette unorange}
474 % \subsection{Subsection heading example}
475 % \subsubsection{Subsubsection example}
```

<sup>1</sup>unbelievable orange

```

476 % \lorem
477 % \egroup
478 %

```

### E.4.1 Subsection heading example

### E.4.10 Subsubsection example

Fusce adipiscing justo nec ante. Nullam in enim. Pellentesque felis orci, sagittis ac, malesuada et, facilisis in, ligula. Nunc non magna sit amet mi aliquam dictum. In mi. Curabitur sollicitudin justo sed quam et quadd.par

## E.5 Preliminaries

Standard file identification. We first announce the package and require that it be used with LATEX2e. need to upgrade

```

1 \NeedsTeXFormat{LaTeX2e}[2017/04/15]%
2 \ProvidesPackage{phd-colorpalette}[2018/1/13 v1.0 color palettes (YL)]%
3 \RequirePackage{phd-materialdesign}

Ensure we have the xcolor
4 \@ifpackageloaded{xcolor}{}%
5 {\PassOptionsToPackage{\xcolorkeys@cx}{xcolor}}
6 \RequirePackage{xcolor}
7 \ExplSyntaxOn
8 \cs_set_eq:NN \xcol_define_color:n { \definecolor }
9 \cs_set_eq:NN \xcol_let:nn { \colorlet }
10 \xcol_define_color:n { themacrocolor } { rgb } { 0.784, 0.06, 0.176 }
11 \ExplSyntaxOff

```

`\docColorBox{<color name>}`

*Example:* A demo box for the `\docColor{thegreen}`  
`\docColorBox{thegreen}`.  
A demo box for the `thegreen` ■.

```

12 \long\def\docColorBox#1{%
13 \tcbox[on line,arc=0pt,outer arc=0pt,colback=#1,colframe=white,
14   boxsep=0pt,left=0pt,right=0pt,top=1pt,bottom=1pt,
15   boxrule=0pt,bottomrule=1pt,toprule=1pt]{\Zi}%
16 }

```

## E.6 Palette and Color Naming Conventions

One of the conventions used in the **phd** series of packages is that mostly names are lower cased. Another convention to avoid conflicts with other packages is to define standard colors with a “the” prefix, as for example the color `blue` ■ is defined as `the<blue>`. A similar convention is used for document elements. For example, the colors `thechaptercolor` ■, `thesectioncolor` ■ and similar color definitions are used to color the title of a heading command.

### E.6.1 Material Design

The naming conventions for these follow the names provided by the authors of the scheme, colors are graded by numbers such as █, █, █.

```

17 \def\palettename{palette}
■ Define the glyphbox color.
18 \definecolor{glyphbox}{rgb}{0.86,0.86,0.8}
19 %\definecolor{codebackground}{rgb}{0.8,0.8,1}
20 \definecolor{theblue} {rgb}{0.02,0.04,0.48}
21 \definecolor{thered} {rgb}{0.65,0.04,0.07}
22 \definecolor{thegreen}{rgb}{0.06,0.44,0.08}
23 \definecolor{thelightgreen}{rgb}{0.06,0.44,0.06}
24 \definecolor{thegrey} {gray}{0.5}
25 \definecolor{thegray} {gray}{0.5}
26 \definecolor{thedarkgray} {gray}{0.95}
27 \definecolor{thelightgray}{gray}{0.6}
28
29
30 \colorlet{thefontname}{black}%font examples
■ Define the thehighlight color. This is used in conjunction with the \hlmacro.
31 \colorlet{thehighlight}{yellow}%soul highlight
■ Define the thecancel color.
32 \colorlet{thecancel}{thered}%for cancel commands
■ Define the shadecolor color.
33 \definecolor{shadecolor}{gray}{0.6}
34 \definecolor{thelightgray}{gray}{0.6}
35 \definecolor{theshade}{gray}{0.94}
36 \definecolor{theframe}{gray}{0.75}
37 \definecolor{thecream}{rgb}{1,0.95,0.4}
38 \definecolor{spot}{rgb}{0,0.2,0.6}%some shades of blue
39 \definecolor{sweet}{rgb}{0,.68,.93}%shades of blue
40 %\colorlet{codebackground}{spot!5!white}
41 \definecolor{boxframe}{gray}{0.8}
42 \definecolor{boxfill}{rgb}{0.95,0.95,0.99}
43 \definecolor{theoption}{gray}{0.6}
44 \definecolor{ExampleFrame}{rgb}{0.628,0.705,0.942}
45 \definecolor{ExampleBack}{rgb}{0.963,0.971,0.994}
46 \colorlet{preciscolor}{sweet}
47 \definecolor{creamy}{HTML}{FDEBD7}
48 \definecolor{tofu}{HTML}{e7e3d8}
49 \colorlet{thetodo}{thegreen}
50 \newcommand{\TODO}{\textcolor{thetodo}{\bf TODO!}}\xspace

```

Once the colors are defined we are ready to create keys for the most common defined colors. **TODO!** (Fix me!)

```

51 \cxset{shadecolor/.code = \colorlet{shadecolor}{#1},
52         thetodo/.code   = \colorlet{thetodo}{#1}}
53 \cxset{shadecolor = thecream,
54         thetodo   = thetodo,}

```

■ Define the **shadecolor** color. ■ Define the **thetodo** color.

## E.7 Creating new palettes

`\createpalette{<name of color palette>}{<color space>} {<hex color code>} {<optional extra code>}`

Creates a palette, given a hex code and a name.

Following the design pattern in other sections we try to generalize the command. Given a color applicable to heading titles, I have set the color commands as best as I could. For some color combinations this is not satisfactory and modifications are necessary. This can be done by the `\addtocolorpalette` function.

```

55 \ExplSyntaxOn
56 \cs_gset:Npn \createpalette #1#2#3#4
57   { \tl_gset:cn {auxpalette#1_tl} {}
58     \addtotl {#1}{#2}{#3}{#4}
59 %
60     \cxset{palette~#1/.code = \cs:w auxpalette#1_tl \cs_end:
61             \edef\currentpalette{#1},
62%
63   }
64 % the below are useless
65 %\definecolor{palettemain}{#2}{#3}
66 %\definecolor{#1}{#2}{#3}
67 % store the name of the palette
68 \cs_gset:cpn {palette#1} {#1 }
69 }
70 %
71 \cs_set:Npn \addtotl #1 #2 #3 #4
72 {
73   \tl_put_left:cn {auxpalette#1_tl}
74   {
75     \xcol_define_color:nnn {bgsexy}{#2}{#3}
76%
77     \xcol_define_color:nnn {thechaptercolor} {#2}{#3}
78     \xcol_let:nn {thechaptercolor}{bgsexy}
79     \xcol_let:nn {thechapternumbercolor}{bgsexy}
80     \xcol_let:nn {thesectioncolor}{bgsexy}
81     \xcol_let:nn {thesectiontitlecolor}{bgsexy}
82     \xcol_let:nn {thesubsectioncolor}{bgsexy}
83     \xcol_let:nn {thesubsectiontitlecolor}{bgsexy}
84     \xcol_let:nn {thesubsubsectioncolor}{bgsexy}
85     \xcol_let:nn {theparagraphcolor}{bgsexy}
86     \xcol_let:nn {thesubparagraphcolor}{bgsexy}
87     \xcol_let:nn {thesectionnumbercolor}{bgsexy}
88     \xcol_let:nn {thesubsectionnumbercolor}{bgsexy}
89     \xcol_let:nn {thesubsubsectionnumbercolor}{bgsexy}
90     \xcol_let:nn {thelinkcolor}{bgsexy}
91     \xcol_let:nn {thecommentstyle}{thegreen}
92     \xcol_let:nn {thestringstyle}{thegreen}
93     \xcol_let:nn {thekeywordstyle}{spot!90}
94     \xcol_let:nn {theoperatorstyle}{thered}
95     % code
96     \xcol_let:nn {thecodebackground}{bgsexy!10}

```

```

97      \xcol_let:nn{thecodeframe}{bgsexy!20}
98      \xcol_let:nn{theoption}{black}
```

The following deal with color schemes for code highlighting in listings and documentation commands.

```

99      \xcol_let:nn{theprimarycolor}{bgsexy}
100     \xcol_let:nn{thecs}{bgsexy}
101     \xcol_let:nn{theoption}{bgsexy}
102     \xcol_let:nn{themodule}{bgsexy}
103     \% \xcol_let:nn{thecomment}{bgsexy}
104     \xcol_let:nn{thebeginend}{bgsexy}
105     \xcol_let:nn{theenv}{bgsexy}
106     \xcol_let:nn{theenvironment}{bgsexy}
107     \xcol_let:nn{theValue}{bgsexy}
108     \xcol_let:nn{thedoccommandcolor}{bgsexy}
109     \xcol_let:nn{thekey}{bgsexy}
110     \xcol_let:nn{theargument}{bgsexy}
111     \xcol_let:nn{theoarg}{bgsexy}
112     \% maybe duplicate of the MANT consider removing.
113     \xcol_let:nn{themetab}{thegreen}
114     \xcol_let:nn{versionnote}{black!75}
115     \xcol_let:nn{bibentry}{thegreen}
116     \xcol_let:nn{bibentryfield}{black}
117     \xcol_let:nn{theidx}{thegreen}
118     \% headers
119     \xcol_let:nn{theplainoddheaderbgcolor}{white}
120     \xcol_let:nn{theplainevenheaderbgcolor}{white}
121     \xcol_let:nn{theplainoddfooterbgcolor}{white}
122     \xcol_let:nn{theplainevenfooterbgcolor}{white}
123     %
124     \xcol_let:nn{theoddheaderbgcolor}{white}
125     \xcol_let:nn{theevenheaderbgcolor}{white}
126     \xcol_let:nn{theoddfooterbgcolor}{white}
127     \xcol_let:nn{theevenfooterbgcolor}{white}
128     %
129     \xcol_let:nn{theheadingsoddheaderbgcolor}{white}
130     \xcol_let:nn{theheadingsevenheaderbgcolor}{white}
131     \xcol_let:nn{theheadingsoddfooterbgcolor}{white}
132     \xcol_let:nn{theheadingsevenfooterbgcolor}{white}
133     #4
134     \% rules
135     \xcol_let:nn{theplainoddheaderframerule}{bgsexy}
136     \xcol_let:nn{theplainoddfooterframerule}{bgsexy}
137     \xcol_let:nn{theplainevenheaderframerule}{bgsexy}
138     \xcol_let:nn{theplainevenfooterframerule}{bgsexy}
139     %
140     \xcol_let:nn{theoddheaderframerule}{bgsexy}
141     \xcol_let:nn{theoddfooterframerule}{bgsexy}
142     \xcol_let:nn{theevenheaderframerule}{bgsexy}
143     \xcol_let:nn{theevenfooterframerule}{bgsexy}
144     %
145     \xcol_let:nn{theheadingsoddheaderframerule}{bgsexy}
146     \xcol_let:nn{theheadingsoddfooterframerule}{bgsexy}
147     \xcol_let:nn{theheadingsevenheaderframerule}{bgsexy}
```

```

148      \xcol_let:nn{theheadingsevenfooterrule}{bgsexy}
149 % toc name color, i.e., Table of Contents
150 % this is normally best to be black.
151      \xcol_let:nn{thetocname}{bgsexy}
152      \xcol_let:nn{thelofname}{bgsexy}
153      \xcol_let:nn{thelotname}{bgsexy}
154      \xcol_let:nn{thetocpart}{bgsexy}
155      \xcol_let:nn{thetocchapter}{bgsexy}
156      \xcol_let:nn{thetocsection}{black}
157      \xcol_let:nn{thetocsubsection}{black}
158 %
159 % list bullets
160      \xcol_let:nn{theitemicolor}{bgsexy}
161      \xcol_let:nn{theitemiicolor}{bgsexy}
162      \xcol_let:nn{theitemiiicolor}{bgsexy}
163      \xcol_let:nn{theitemivcolor}{bgsexy}
164      \xcol_let:nn{theitemvcolor}{bgsexy}
165      \xcol_let:nn{theitemvicolor}{bgsexy}
166 % phd doc specific
167      \xcol_let:nn{theunicodesymbolcolor}{bgsexy}
168      \xcol_let:nn{thecmdcolor}{bgsexy}
169 % epigraph rule
170      \xcol_let:nn{theepigraphrulecolor}{bgsexy}
171 %tabulars
172      \xcol_let:nn{thetablevrulecolor}{bgsexy}
173      \xcol_let:nn{thetableheadbgcolor}{bgsexy}
174
175 %l3colors
176      \xcol_let:nn { thebracescolor } { theblue }
177      \xcol_let:nn { thesquarebracketscolor } { oprah }
178      \xcol_let:nn { thecommentscolor } { green500 } %thepalettecolor does not look good
179      \xcol_let:nn { thecommentsstyle } { thepalettecolor }
180      \xcol_let:nn { thecsmodulecolor } { unorange }
181    }
182  }

```

We now create a number of color palettes for convenience. These are given various names, mostly from magazines or the web that have inspired the color schemes.

■ Define the **esquire** color.

```
183 \createpalette {esquire}      {HTML}  {D11C23} {} % red shade
```

■ Define the **fortune** color.

```
184 \createpalette {fortune}      {HTML}  {EA8A4E} {} % brick color
```

■ Define the **oprah** color.

```
185 \createpalette {oprah}        {HTML}  {F060A8} {} % nice pinkish modern
```

■ Define the **vogue** color.

```
186 \createpalette {vogue}        {HTML}  {F21C93} {} % nice pinkish modern
```

■ Define the **bbc** color.

```
187 \createpalette {bbc}          {HTML}  {991B1e} {} % dark red
```

```
188 \tl_put_right:cN {auxpalettebbc_tl}
```

```
189  {
```

```
190      \colorlet{thecodebackground}{thelightgray!20}
```

```

191    }
■ Define the architectural color.
192 \createpalette {architectural} {HTML} {0168FD} {} % blue shade
■ Define the instyle
193 \createpalette {instyle}      {HTML} {227CE8} {} % blue shade
194
■ Define the smithsonian
195 \createpalette {smithsonian} {HTML} {60A8C0} {} % milky blue
■ Define the blueprint color
196 \createpalette {blueprint}    {HTML} {486090} {} % dark milky blue
■ Define the knoll color

```

### E.7.1 Green Palettes

```

■ Define the oprahgreen color.
197 \createpalette {oprah~green}      {HTML} {6EC715} {}
198 \createpalette {oprahgreen}      {HTML} {6EC715} {}
199 \createpalette {knoll}          {HTML} {88A65E} {} % nice sweet green
■ Define the living color
200 \createpalette {living}         {HTML} {678756} {} % green shade
■ Define the spring onion
201 \createpalette {spring~onion}   {HTML} {90D228} {} % bright green shade
202 \createpalette {springonion}   {HTML} {90D228} {} % bright green shade
■ Define the olive color
203 \createpalette {olive}          {HTML} {EED38D} {} % washed out not nice
■ Define the zealous color
204 \createpalette {zealous}        {HTML} {075D6B} {} %
205 % orangey
206 \createpalette {orange~sakura} {HTML}{E6781E} {} % nice modern serious book
207 \createpalette {orange}         {HTML}{FF6927} {} % bright orange
208 \createpalette{unorange}       {HTML}{FE6B08} {} %unbelievable orange
209 \createpalette{african~sun}    {HTML}{F76E2A} {} %african sun http://www.colourlo...
210 % brown
211 \createpalette {brown}          {HTML}{AF0C39} {} % red brown
212 \createpalette {brown~red}      {HTML}{8D2420} {} % brown red, serious luxury
213 % purples
214 \createpalette {black~tulip}    {HTML}{420943} {} % darkish purple
215 \createpalette {helvetica}      {HTML}{404547} {} % darkish purple
216 \createpalette {budapest}      {HTML}{BD7898} {} % serious purple
217 %
218 \createpalette {cerulean}       {HTML}{9bb7d6} {} % pantone light milky bluish
219 \createpalette {sealife }       {HTML}{7c7d89} {} % sea life from https://www.benjam...
us/color-overview/color-collections/color-trends-2017
220 % reds
■ Define the rouge color.
221 \createpalette {rouge}          {HTML}{D2476F} {} %rouge like in hot lips
222 \createpalette {sugar~hearts}   {HTML} {FE4365} {} % red rose http://www.colourlo...

```

```

223 \createpalette{Purple500}      {HTML} {7B1FA2} {}
224 %
225 %
226 \tl_put_right:cn {auxpalettelerulean_tl}
227 {
228   \colorlet{thebackground}{tofu}
229 }
230 %
231 \tl_put_right:cn {auxpaletteblueprint_tl}
232 {
233   \colorlet{theunicodesymbolcolor}{bgsexy}
234   \colorlet{thebackground}{thelightgray!20}
235 }
236 \ExplSyntaxOff
237 \cxset{
238 /PLT
239 *PLT|DFLT
240   % default palette
241   palette orange sakura,
242 /PLT|DFLT
243 *PLT
244 }%

```

## E.8 Hyperlinks

These colors are used for hyperlinking. We normally provide a uniform color for all hyperlinks

```

245 \colorlet{thelinkcolor}{bgsexy}    %linkcolor (also used in toc)
246 \colorlet{theanchorcolor}{bgsexy}  %anchorcolor
247 \colorlet{thecitecolor}{bgsexy}   %citecolor
248 \colorlet{thefilecolor}{bgsexy}  %filecolor
249 \colorlet{themenucolor}{bgsexy}  %menucolor
250 \colorlet{theruncolor}{bgsexy}   %runcolor
251 \colorlet{theurlcolor}{bgsexy}    %urlcolor
252 \colorlet{Hyperlink}{bgsexy}     %{rgb}{0.281,0.275,0.485}

```

## E.9 Code listings and documentation macros

For publications that require listings or self running examples we need to define a number of colors. We also need to cater for control sequences in the text and the like.

```

253 \definecolor{lstbgcolor}{rgb}{0.9,0.9,0.9}
254 \colorlet{examplefill}{yellow!80!black}
255 %
256 \% \definecolor{thebackground}{HTML}{F2F2EA}
257 \% \definecolor{thebackground}{HTML}{DED4B9}
258 \% \definecolor{thebackground}{HTML}{F3EFE3} % light
259 \definecolor{thekeywordstyle}{HTML}{000000}
260 \% \definecolor{thecommentstyle}{HTML}{DF8743}
261 \definecolor{thestringcolor}{HTML}{DF8743}
262 \definecolor{theemphasiscolor}{HTML}{DF8743}

```

```

263 \definecolor{theframerulecolor}{HTML}{FF6927}
264 \definecolor{theframefillcolor}{HTML}{000000}
265 \definecolor{theidentifiercolor}{HTML}{000000}
```

### E.9.1 Specific code coloring for I3

The idea behind these colors is to provide a set of colors to colorize L<sup>A</sup>T<sub>E</sub>X 3 code, like in the implementation part of this document. L<sup>A</sup>T<sub>E</sub>X modules have distinct prefixes and sometimes suffixes, so it is unnecessary to group them in long lists of keywords as listings does. My preference is to use softer colors and to colorize them in groups. Contrasting colors should be provided for braces, square brackets to ease reading.

Matching colors to the document palette main colors is not easy, especially if the code is typeset on a background.

```

266 % Color for braces, square brackets and comments.
267 % If you use the same color as headings, since the size and thickness
268 % are different your brain will interpret them as different colors!
```

■

```

269 \def\done{\cellcolor{teal}done}
270 \def\partialdone{\cellcolor{yellow}done}
271 \def\hcyan#1{{\color{teal} #1}}
```

## E.10 User Commands

### \SaveCurrentPalette

Saves the current palette into \previouspalette

```

272 \edef\SaveCurrentPalette{%
273   \noexpand\edef\noexpand\previouspalette{\noexpand\currentpalette}}
```

The current default palette is the palette spring onion

<sup>2</sup>

---

<sup>2</sup>1.0,2013/01/26,Converted to DTX file.





# Handlers Package Code Implementation Objectives and Strategy

The package provides macros for documenting and indexing primarily L<sup>A</sup>T<sub>E</sub>X or L<sup>A</sup>T<sub>E</sub>X 3 code. It combines the styles originating with `doc` with those found in the `pgf` series of packages. It removes some of the difficulties of using hyperlinks in the index and elsewhere in the document.



---

I was reflecting on the convoluted Java frameworks widely adopted at work. Those hefty frameworks brought coding structures and conventions to large engineering teams; meanwhile, they also sucked the fun of programming like a Pastafarian monster slurping all the tomato sauce on a plate of spaghetti.

Zhen Wang

We start by outlining what we are trying to achieve with this package:

1. To provide a declarative interface to enable users to modify headings by setting keys, rather than writing macros.
2. The interface must be able to manipulate properties of headings down to the last detail.
3. To provide a compatibility mode, where documents wishing to test the package can have an easy switch to switch in and out. This is also important for the testing of the package.
4. To provide a number of templates that cover most of the typical use case.
5. To provide means for a plug-in architecture for extensions.

## F.1 Terminology

**document** Any written item, as a book, article, or letter, especially of a factual or informative nature.

**heading** A division of a document or document series. For a normal book headings are chapters, sections etc. However we allow for specifying a more complex document divided into books, volumes parts etc. For example the Bible has Books, chapters and verses, where a legal document might require divisions such as clauses. In general these divisions are numbered. These document divisions are stored in the comma list `\phd_book_divisions_clist`<sup>P.960</sup>.

**head** A typeset heading, such as chapter head, or section head. This can include a counter, label and title for example, *Chapter 1 Introduction*.

**dom** This is a programming interface that provides a structured representation of the document (a tree) and it defines a way that the structure can be accessed. Although L<sup>A</sup>T<sub>E</sub>X does not offer a standard way to build such a tree (mainly because T<sub>E</sub>X does not require the marking of paragraphs, it is useful to think of the document as a tree structure. We also allow for a semi-automated way to build such a tree (with the exception that paragraphs are not included).

**element** A part of the document tree that can be styled on its own. For example the chapter label, or the section number.

## F.2 Users

We classify users according to the L<sup>A</sup>T<sub>E</sub>X3 terminology as a) programmers b) template designers and c) authors.

### F.2.1 Author

We assume that the author has an existing template which she is using but might want to do some minor modifications, for example use an italic shape for the font of the mark, but an upright font for the page numbers.

```
\cxset
{
    chapter number color format      = apa,
    section title font-size font-size = Large,
}
```

We follow the idea of representing the basic elements of documents as elements, each one having a parent in order to specify the element we need to style as accurate as possible. One can think of this approach being congruent with objects in other languages. As a matter fact nothing stops us from defining a key value interface as shown below.

```
\cxset
{
    header.even.mark.font.size = Large,
    header.even.mark.font.family = serif,
}
```

This would perhaps make it easier for the template designer, but I have rejected the idea as my aim is to make it easy for the author, who can search the template and just enter a couple of new property values.

### F.2.2 Template designer

The template designer in the example above would have selected the format style from a number of predefined formats (templates) or would have created a style called *apa* from an existing template and modified it using declarative key style.

### F.2.3 The programmer

The programmer in the example above could have created the basic format *apa* by using both declarative as well as defining or using existing macros. To the programmer we offer an extension mechanism, where the contents of a **ps@** command are defined. For example the programmer can define a new style using TikZ, but without having to worry about defining full **ps@** and their interface.

## F.3 Preliminaries

Standard file identification. We first announce the package and require that it be used with L<sup>A</sup>T<sub>E</sub>X2e.

```

1 \NeedsTeXFormat{LaTeX2e}[2018/04/15]%
2 \ProvidesPackage{phd-handlers}[2015/1/13 v1.0 less preamble (YL)]%
3 \g@addto@macro \theindex { \MakePrivateLetters }

```

## F.4 Source2e Interface

I am not very fond of mixing expl3 control sequences with source2e commands. Here we provide an interface for all these commands we might use. This section can be revisited once expl3 code becomes available.

```

4 \ExplSyntaxOn
5 \let\ltxtoday\today
6 \let\phd_hang_from:nn \hangfrom
7 \newif\if@ltxcompat \ltxcompatfalse
8 \ExplSyntaxOff

```

## F.5 PGF Key Handlers

One of the greatest ideas in key management was pgf's handlers. New handlers can be added in quite easily and they are very versatile in this respect.

### F.5.1 Font family handler

This handler first checks if the font-family has been supplied as a list. In this case it will call check font and pick the first available font.

```

9 \ExplSyntaxOn
10 \pgfkeys{%
11     /handlers/.alias/.code=
12         \pgfkeysedef\pgfkeyscurrentpath{%
13             \noexpand\pgfkeysalso{\pgfkeysdefaultpath#1={##1}}},%
14             /handlers/.alias/.value required,% 
15             /handlers/.blank/.code=\pgfkeyssetvalue{\pgfkeyscurrentpath/.@blank}{#1},%
16             /handlers/.blank/.default=\pgfkeysnovalue,% 
17 }
18
19 \clist_new:N \allowed_font_family_options
20 \clist_gset:Nn \allowed_font_family_options
21 {
22     sffamily,rmfamily,ttfamily, normal,italic,oblique,
23     itshape,slshape,upshape,sans-serif,serif,monospace,
24     inherit,auto,normalfont
25 }
26 % create aliases for some of the names to match those commonly
27 % used in css NEEDS TESTING
28 \cs_gset_eq:cc {bold} {bfseries}
29
30 \pgfkeys{/handlers/.font-family~in/.code =
31     \pgfkeysalso
32         {\pgfkeyscurrentpath/.code=
33             \clist_if_in:NnTF \allowed_font_family_options {##1 }%
34             {%
35                 \gdef #1 {##1}

```

```

36      }
37      {
38          \gdef #1 {\sffamily}
39      }
40  }
41 }
42 \pgfkeys{/handlers/.fontfamily/.code =
43 \pgfkeysalso
44     {\pgfkeyscurrentpath/.code=
45         \tl_set:Nn\l_tmpa_str:N {##1}
46         \str_case_x:nnTF {##1}
47         {
48             { none } { \cs_gset:cpn {##1} { \normalfont } }
49             { rmfamily } { \cs_gset:cpn {##1} { \rmfamily } }
50             { serif } { \cs_gset:cpn {##1} { \rmfamily } }
51             { sans-serif } { \cs_gset:cpn {##1} { \sffamily } }
52             { sffamily } { \cs_gset:cpn {##1} { \sffamily } }
53             { ttfamily } { \cs_gset:cpn {##1} { \ttfamily } }
54         }
55         {
56             { \cs_gset:cpn {##1} { \cs:w ##1 \cs_end:} }
57         }
58     }
59 }
60 \ExplSyntaxOff

```

### F.5.2 Font face handler

The handler `.font-face` in creates a command for activating a font face and also activates if it was not ?

`\title_font_face <font name>`

This peculiar handler is a store in that can be used for all elements. We defined them as `<element>_font_face`. This took a bit long to figure out. The `allowed_font_face_options` will eventually be linked with the font loading mechanism.

```

61 \ExplSyntaxOn
62 \clist_new:N \allowed_font_face_options
63 \clist_gset:Nn \allowed_font_face_options
64 {
65     sffamily,rmfamily,ttfamily, normal,italic,oblique,
66     itshape,slshape,upshape,sans-serif,serif,monospace,
67     inherit,auto,tiresias,arial,pan
68 }
69 % creat aliases for some of the names to match those commonly
70 % used in css.
71
72 \pgfkeys{/handlers/.font-face~in/.code =
73 \pgfkeysalso
74     {\pgfkeyscurrentpath/.code=
75         \IfNoValueTF {##1} {\@empty}
76         {

```

```

77      \cs_if_exist:NTF { #1 }
78      { \gdef#1 {##1} }
79      { \gdef#1 {\rmfamily} } %add error trapping as well
80    }
81  }
82 }
83 }
84
85 \ExplSyntaxOff

```

### F.5.3 Font face handler

```

86 \ExplSyntaxOn
87 \pgfkeys{/handlers/.set~font-face/.code=\pgfkeysalso {
88   \pgfkeyscurrentpath/.code=
89     \def\tempa{##1}
90     \def\tempb{normal}
91     \def#1{##1}
92     \ifx\tempa\tempb
93       \def#1{\normalfont}
94     \fi
95   }
96 }
97 \ExplSyntaxOff

```

### F.5.4 Fonts style handler

This controls the input for font-shape or font-style, which they are equivalent.

```

98 \ExplSyntaxOn
99 \clist_new:N \allowed_font_style_options
100 \clist_gset:Nn \allowed_font_style_options {normal,upshape,itshape,oblique,slshape,}
101 % create some aliases also for these options.
102 \cs_gset_eq:cc {normal}{upshape}
103 \cs_gset_eq:cc {italic}{itshape}
104 \cs_gset_eq:cc {oblique}{slshape}
105
106 \pgfkeys{/handlers/.font-style~in/.code =
107
108   \pgfkeysalso
109   {\pgfkeyscurrentpath/.code=
110     \clist_if_in:NnTF \allowed_font_style_options {##1 }
111     {
112       \gdef #1 {##1}
113     }
114     {
115       \gdef#1 {upshape} %Plus error message
116     }
117   }
118 }
119 \pgfkeys{/handlers/.fontstyle/.code =
120   \pgfkeysalso
121   {\pgfkeyscurrentpath/.code=
122     \tl_set:Nn\l_tmpa_str:N {##1}
123     \str_case_x:nnTF {##1}

```

```

124      {
125          { normal } { \cs_gset:cpn {#1} { \upshape } }
126          { upshape } { \cs_gset:cpn {#1} { \upshape } }
127          { itshape } { \cs_gset:cpn {#1} { \itshape } }
128          { italic } { \cs_gset:cpn {#1} { \itshape } }
129          { oblique } { \cs_gset:cpn {#1} { \slshape } }
130          { slshape } { \cs_gset:cpn {#1} { \slshape } }
131          { scshape } { \cs_gset:cpn (#1) { \scshape } }
132      }
133      {
134          { \cs_gset:cpn {#1} {##1} }
135      }
136  }
137
138 \pgfkeys{/handlers/.listformat/.code =
139     \pgfkeysalso
140         {\pgfkeyscurrentpath/.code=
141             \tl_set:Nn\l_tmpa_str:N {##1}
142             \str_case_x:nnTF {##1}
143             {
144                 { normal } { \cs_gset:cpn {#1} { \upshape } }
145                 { upshape } { \cs_gset:cpn {#1} { \upshape } }
146                 { itshape } { \cs_gset:cpn {#1} { \itshape } }
147                 { italic } { \cs_gset:cpn {#1} { \itshape } }
148                 { oblique } { \cs_gset:cpn {#1} { \slshape } }
149                 { slshape } { \cs_gset:cpn {#1} { \slshape } }
150                 { scshape } { \cs_gset:cpn (#1) { \scshape } }
151             }
152             {
153                 { \cs_gset:cpn {#1} {##1} }
154             }
155         }
156 \ExplSyntaxOff

```

### \title\_font\_weight *font weight name*

Handler for defining the font-weight of an element.

These are all very repetitive and could have been replaced by one handler at the cost of obfuscating the code.

```

157 \ExplSyntaxOn
158 \clist_new:N \allowed_font_weight_options
159 \clist_gset:Nn \allowed_font_weight_options
160 {
161     normal,bold,bfseries,mdseries,none
162 }
163 \pgfkeys{/handlers/.font-weight~in/.code =
164     \pgfkeysalso
165         {\pgfkeyscurrentpath/.code=
166             \tl_set:Nn\l_tmpa_str:N {##1}
167             \str_case_x:nnTF {##1}
168             {
169                 { none } { \cs_gset:Npn #1 { empty } }
170                 { bold } { \cs_gset:Npn #1 { bfseries } }
171                 { normal } { \cs_gset:Npn #1 { normalfont } }

```

```

172           { bfseries } { \cs_gset:Npn #1 { bfseries } }
173           { mdseries } { \cs_gset:Npn #1 { mdseries } }
174       }
175     }
176   { \cs_gset:Npn #1 {empty} }
177 }
178 }
```

The `.fontweight` handler is used to define keys for `font-weight`.

```

179   \pgfkeys{/handlers/.fontweight/.code =
180   \pgfkeysalso
181   {\pgfkeyscurrentpath/.code=
182     \tl_set:Nn\l_tmpa_str:N {##1}
183     \str_case_x:nnTF {##1}
184     {
185       { none } { \cs_gset:cpn {#1} { } }
186       { bold } { \cs_gset:cpn {#1} { \bfseries } }
187       { normal } { \cs_gset:cpn {#1} { } }
188       { bfseries } { \cs_gset:cpn {#1} { \bfseries } }
189       { mdseries } { \cs_gset:cpn {#1} { \mdseries } }
190     }
191     {
192       { \cs_gset:cpn {#1} { } }
193     }
194   }
195 \ExplSyntaxOff
```

The `font-size` in handler is defined next. This can be set both as a command or a name.

`\allowed_keys_font_size<list of allowed keys>`  
list with all allowed keys in the `phd system`

Coding this through `expl3` is such a pleasure and cut the previous code in half! The mavericks of the LaTeX3 Team pulled it off! It also enables better error trapping and the allowed words can be configurable, one day! For example if `38/52` is typed one can automatically set it to a specific size? Could also allow say `1opt` check in list if we have them and set it. The keys `auto`, `inherit`, `autoscale` need development.

`auto` should scale one step down from parent element. `inherit` takes the same value as the parent element `autoscale` will fit the contents in the width of its container box. (All three for next version)

```

196 \ExplSyntaxOn
197
198 \clist_new:N \allowed_keys_font_size
199 \clist_gset:Nn \allowed_keys_font_size
200 {
201   normal,tiny,footnotesize,small,
202   scriptsize,
203   large,Large,LARGE,
204   huge,Huge,HUGE,HHUGE,
205   HHHUGE,auto,inherit,
206   autoscale,
207 }
```

```

208 \pgfkeys{/handlers/.font-size~in/.code =
209   \pgfkeysalso
210     {\pgfkeyscurrentpath/.code=
211       \clist_if_in:NnTF \allowed_keys_font_size {##1 }
212       {
213         \cs_gset:Npn #1 {##1}
214       } {normalsize}
215     }
216   }
217 }
```

When the storing key is provided as a name we use the `.fontsize` handler.

```

218 \pgfkeys{/handlers/.fontsize/.code =
219   \pgfkeysalso
220     {\pgfkeyscurrentpath/.code=
221       \tl_set:Nn\l_tmpa_str:N {##1}
222         \str_case_x:nnTF {##1}
223       {
224         { normal } { \cs_gset:cpn {#1} { \normalsize } }
225         { tiny } { \cs_gset:cpn {#1} { \tiny } }
226         { small } { \cs_gset:cpn {#1} { \small } }
227         { scriptsize } { \cs_gset:cpn {#1} { \scriptsize } }
228         { large } { \cs_gset:cpn {#1} { \large } }
229         { Large } { \cs_gset:cpn {#1} { \Large } }
230         { LARGE } { \cs_gset:cpn {#1} { \LARGE } }
231         { huge } { \cs_gset:cpn {#1} { \huge } }
232         { Huge } { \cs_gset:cpn {#1} { \huge } }
233         { HUGE } { \cs_gset:cpn {#1} { \HUGE } }
234         { HHUGE } { \cs_gset:cpn {#1} { \HHUGE } }
235         { HHHUGE } { \cs_gset:cpn {#1} { \HHHHUGE } }
236       }
237       {
238         { \cs_gset:cpn {#1} {##1} }
239       }
240     }
241 }
```

### F.5.5 Capitalization handler

This handler is for making text upper or lower case. Took a few tests to get it right! Will have to go to `expl3` when these work ok. **Fire**

```

242 \ExplSyntaxOn
243   \clist_new:N \allowed_options_case
244   \clist_gset:Nn \allowed_options_case
245   {
246     lower,upper,none
247   }
248
249 \pgfkeys{/handlers/.case~in/.code =
250   \pgfkeysalso
251     {\pgfkeyscurrentpath/.code=
252       \tl_set:Nn\l_tmpa_str:N {##1}
253         \str_case_x:nnTF {##1}
```

```

254      {
255        { none } { \cs_gset:Npn #1 { empty } }
256        { lower } { \cs_gset:Npn #1 { MakeTextLowercase } }
257        { lowercase } { \cs_gset:Npn #1 { MakeTextLowercase } }
258        { upper } { \cs_gset:Npn #1 { MakeTextUppercase } }
259        { uppercase } { \cs_gset:Npn #1 { MakeTextUppercase } }
260        { upper case } { \cs_gset:Npn #1 { MakeTextUppercase } }
261      }
262      {
263        { \cs_gset:Npn #1 {empty} } }
264    }
265  }
266
267 \pgfkeys
268 {/handlers/.case/.code =
269   \pgfkeysalso
270     {\pgfkeyscurrentpath/.code=
271       \str_case_x:nnTF {##1}
272       {
273         { none } { \cs_gset:cpn {#1} { \empty } }
274         { lower } { \cs_gset:cpn {#1} { \MakeTextLowercase } }
275         { lowercase } { \cs_gset:cpn {#1} { \MakeTextLowercase } }
276         { upper } { \cs_gset:cpn {#1} { \MakeTextUppercase } }
277         { uppercase } { \cs_gset:cpn {#1} { \MakeTextUppercase } }
278         { upper~case } { \cs_gset:cpn {#1} { \MakeTextUppercase } }
279       }
280       {
281         { \cs_gset:cpn #1 { \MakeTextLowercase } } }
282     }
283   }
284
285 \pgfkeys
286 {/handlers/.store/.code =
287   \pgfkeysalso
288     {\pgfkeyscurrentpath/.code=
289       \cs_gset:cpn {#1} {##1}
290     }
291   }
292 \ExplSyntaxOff

```

### F.5.6 Alignment handler

This handler is for aligning text. We cater for all variations.

```

293 \ExplSyntaxOn
294   \pgfkeys{/handlers/.textalign/.code =
295     \pgfkeysalso
296       {\pgfkeyscurrentpath/.code=
297         \tl_set:Nn\l_tmpa_str:N {##1}
298         \str_case_x:nnTF {##1}
299         {
300           { none } { \cs_gset:cpn {#1} {} } }
301           { left } { \cs_gset:cpn {#1} { \RaggedRight } } }
302           { RaggedLeft } { \cs_gset:cpn {#1} { \RaggedLeft } } }

```

```

303         { raggedleft } { \cs_gset:cpn {#1} { \raggedleft } }
304         { right } { \cs_gset:cpn {#1} { \RaggedLeft } }
305         { RaggedRight } { \cs_gset:cpn {#1} { \RaggedRight } }
306         { raggedright } { \cs_gset:cpn {#1} { \raggedright } }
307         { center } { \cs_gset:cpn {#1} { \Centering } }
308         { centre } { \cs_gset:cpn {#1} { \Centering } }
309         { centering } { \cs_gset:cpn {#1} { \centering } }
310         { Centering } { \cs_gset:cpn {#1} { \Centering } }
311         { flushleft } { \cs_gset:cpn {#1} { \flushleft } }
312         { flushright } { \cs_gset:cpn {#1} { \flushright } }
313     }
314     {
315     { \cs_gset:cpn #1 {\empty} }
316   }
317 }
318 \ExplSyntaxOff

```

### F.5.7 On off general handlers

This handler is for programmatically setting on off variables.

```

319 \ExplSyntaxOn
320   \pgfkeys{/handlers/.onoff/.code =
321     \pgfkeysalso
322       {\pgfkeyscurrentpath/.code=
323         \tl_set:Nn\l_tmpa_str:N {##1}
324         \str_case_x:nnTF {##1}
325         {
326           { on } { \% \cs_gset:cpn {#1} {##1}
327             \bool_if_exist:cTF {#1} { \bool_gset_true:c {#1} }
328             { \bool_new:c {#1}
329               \bool_gset_true:c {#1}
330             }
331         }
332
333           { off } {
334             \bool_if_exist:cTF {#1} { \bool_gset_false:c {#1} }
335             { \bool_new:c {#1}
336               \bool_gset_false:c {#1}
337             }
338         }
339
340           { true } { \% \cs_gset:cpn {#1} {##1}
341             \bool_if_exist:cTF {#1} { \bool_gset_true:c {#1} }
342             { \bool_new:c {#1}
343               \bool_gset_true:c {#1}
344             }
345         }
346
347           { false } {
348             \bool_if_exist:cTF {#1} { \bool_gset_false:c {#1} }
349             { \bool_new:c {#1}
350               \bool_gset_false:c {#1}
351             }

```

```

352 }
353 }
354 }
355     }
356     {
357     { }%{\cs_gset:cpn {\#1} {empty} }
358   }
359 }
360 \ExplSyntaxOff

```

### F.5.8 Shadow handlers

Many components can be rendered with shadows. This can be done through the tcolorbox shadowing commands or directly through TikZ. The way parameters are specified in both cases results in multi-argument keys, which is generally against the philosophy of the mark-up semantics of the **phd** package. Most of these keys required color specification and or size specification.

Since colors are linked to palettes, I decided that the color part would belong to the palette settings rather than the shadow keys. Also any sizing of shadows has been delegated to default macros. This simplifies the user interface tremendously. Should a template designer wish to provide a more complicated shadow, this can be achieved through the style property of the element.

Shadows are only available when the box rendering engine depend on tcolorbox.

```

361
362 \ExplSyntaxOn
363 \pgfkeys
364 {/handlers/.shadow/.code =
365   \pgfkeysalso
366     {\pgfkeyscurrentpath/.code=
367       \str_case_x:nnTF {\##1}
368       {
369         { none } { \cs_gset:cpn {\#1} { {no~shadow} } }
370         { off } { \cs_gset:cpn {\#1} { {no~shadow} } }
371         { on } { \cs_gset:cpn {\#1} { {drop~shadow} } }
372         { drop~shadow } { \cs_gset:cpn {\#1} { drop~shadow } }
373         { drop~lifted~shadow } { \cs_gset:cpn {\#1} { {##1} } }
374         { fuzzy~halo } { \cs_gset:cpn {\#1} { halostyle } }
375       }
376       {
377         { \cs_gset:cpn {\#1} {##1} }
378       }
379     }
380 \ExplSyntaxOff

```

31/07/2017 Nasty bug fix, did  
not brace one argument of  
cpn, resulted redefining the l

### F.5.9 Sectioning format handler

This handler manages sectioning type formats. Not all of them are currently defined.

```
381 \ExplSyntaxOn
```

```

382 \msg_new:nnnn {phd-handlers} {undefined-format}
383   {'#1'~is~not~a~defined~format}
384   {You~have~to~define~and~register~the~format~`#1'~before~you~can~use~it.}
385
386 \clist_new:N \allowed_options_format
387 \clist_gset:Nn \allowed_options_format
388 {
389   plain, block, display, runin, leftmargin,
390   rightmargin, drop, wrap, frame, custom, inline, inmargin,
391   hanginmargin, paperback,fashion,traditional,hang,stewart,
392 }
393 \pgfkeys{/handlers/.format~in/.code =
394   \pgfkeysalso
395     {\pgfkeyscurrentpath/.code=
396       \clist_if_in:NnTF \allowed_options_format {##1 }
397       {
398         \cs_gset:cpn {#1} {##1} %true code
399       }
400       {
401         \cs_if_exist:cTF{##1}{ \cs_gset:cpn {#1} {##1}}
402       }
403       \msg_error:nnx { phd-handlers } { undefined-
404         format } {##1}
405         % define it in any case until we have a stable API
406         \cs_gset:cpn {#1} {##1}
407         } %false code
408       } % to add that this is custom message and check if defined
409     }
410 \ExplSyntaxOff
411
412 \ExplSyntaxOn
413 \msg_new:nnnn {phd-handlers} {undefined-color}
414   {'#1'~is~not~a~defined~color}
415   {You~have~to~define~the~color~`#1'~before~you~can~use~it.~I~am~using~the~current
416 \clist_new:N \allowed_color_options
417 \clist_gset:Nn \allowed_color_options
418 {
419   auto, palette,
420 }
421 \pgfkeys{/handlers/.colorin/.code =
422   \pgfkeysalso
423     {\pgfkeyscurrentpath/.code=
424       \clist_if_in:NnTF \allowed_color_options {##1 }
425       {
426         %check to see if palette is defined
427         \cs_if_exist:cTF{palettename}{\cs_gset:cpn{#1} {\color{the#1color}} }{
428           \cs_gset:cpn {#1} {\color{##1}}
429         }
430       }
431     }
432     {
433       {
434         % We check that the color is defined

```

```

435      @ifundefined{\string\color@##1}{
436          \msg_error:nnx { phd-
  handlers } { undefined-color } {##1}
437          \colorlet{##1}{black}
438      }
439      {
440          \cs_gset:cpn {#1} {\color{##1}}
441      }
442      } %FIRE MUST CATER FOR SPECIALS
443      } % to add that this is custom message and check if defined
444  }
445 }
446 \ExplSyntaxOff

```

### F.5.10 Number format handler

This ~~handler handles the~~ definition of `\the<section>` type commands. As the first argument of the key handler is a command we need to remove the `\the` part in order to define the counter correctly. One day we will remove all L<sup>A</sup>T<sub>E</sub>X's counters and use our own, then this would be unnecessary. as we need to gobble four tokens we need to define a `\use_v:nnnnn`, as `expl3` does not have one.

```
\use_v:nnnnn {{arg1}} {{arg2}} {{arg3}} {{arg4}} {{arg5}}
Gobbles five arguments.
```

```

447 \ExplSyntaxOn
448   \cs_set:Npn \use_v:nnnnn #1#2#3#4#5 {#5}
449   \cs_new:Npn \remove_the:#1
450   {
451     \exp_after:wN \use_v:nnnnn \token_to_str:N #1
452   }

```

next we provide a function to remake the `the<name>` based on the key handler input.

```

453   \cs_gset:Npn \make_the_cmd: #1#2
454   {
455     \cs_gset:Npn \countername { \remove_the:{#1} }
456     \cs_gset:Npn #1
457     {
458       \exp_after:wN \exp_after:wN \exp_after:wN #2
459       \exp_after:wN \cs:w c@\countername\cs_end:
460     }
461   }

```

In comparison to the mind twister above the key-handler is easily defined next and cuts quite a bit of code later.

```

462   \pgfkeys{/handlers/.numbering~in/.code =
463
464   \pgfkeysalso
465   {
466     \pgfkeyscurrentpath/.code=
467     \tl_set:Nn\l_tmpa_str:N {##1}

```

```

468     \str_case_x:nnTF {##1}
469     {
470         { none } { \cs_gset:Npn #1 {} }
471         { arabic } { \make_the_cmd: {#1} { \@arabic } }
472         { Alpha } { \make_the_cmd: {#1} { \@Alph } }
473         { alph } { \make_the_cmd: {#1} { \@alph } }
474         { Roman } { \make_the_cmd: {#1} { \@Roman } }
475         { roman } { \make_the_cmd: {#1} { \@roman } }
476         { WORDS } { \make_the_cmd: {#1} { \WORDS@cx } }
477         { Words } { \make_the_cmd: {#1} { \Words@cx } }
478         { words } { \make_the_cmd: {#1} { \words@cx } }
479         { ordinals } { \make_the_cmd: {#1} { \ordinals@cx } }
480         { Ordinals } { \make_the_cmd: {#1} { \ordinals@cx } }
481         { ORDINALS } { \make_the_cmd: {#1} { \ORDINALS@cx } }
482         % add padzeroes later
483     }
484     {
485         { \cs_gset:Npn #1 {##1} }
486     }
487 }
488 \ExplSyntaxOff
</HANDLER>
1

```

<sup>1</sup>1.0,2013/01/26,Converted to DTX file.



## IMPLEMENTATION AND FRIENDS

phd package and give a background as to how fonts are used in L<sup>A</sup>T<sub>E</sub>X.

G

# phd-sect Code Implementation Objectives and Strategy

This chapter provides the objectives of the package, provides the methodology to attack the problem and discusses the difficulties encountered in trying to provide a full declarative interface.



---

I was reflecting on the convoluted Java frameworks widely adopted at work. Those hefty frameworks brought coding structures and conventions to large engineering teams; meanwhile, they also sucked the fun of programming like a Pastafarian monster slurping all the tomato sauce on a plate of spaghetti.

---

Zhen Wang

We start by outlining what we are trying to achieve with this package:

1. To provide a declarative interface to enable users to modify headings by setting keys, rather than writing macros.
2. The interface must be able to manipulate properties of headings down to the last detail.
3. To provide a compatibility mode, where documents wishing to test the package can have an easy switch to switch in and out. This is also important for the testing of the package.
4. To provide a number of templates that cover most of the typical use case.
5. To provide means for a plug-in architecture for extensions.

## G.1 Terminology

**document** Any written item, as a book, article, or letter, especially of a factual or informative nature.

**heading** A division of a document or document series. For a normal book headings are chapters, sections etc. However we allow for specifying a more complex document divided into books, volumes parts etc. For example the Bible has Books, chapters and verses, where a legal document might require divisions such as clauses. In general these divisions are numbered. These document divisions are stored in the comma list `phd_book_divisions_clist`.

**head** A typeset heading, such as chapter head, or section head. This can include a counter, label and title for example, *Chapter 1 Introduction*.

**dom** This is a programming interface that provides a structured representation of the document (a tree) and it defines a way that the structure can be accessed. Although LATEX does not offer a standard way to build such a tree (mainly because TeX does not require the marking of paragraphs, it is useful to think of the document as a tree structure. We also allow for a semi-automated way to build such a tree (with the exception that paragraphs are not included).

**element** A part of the document tree that can be styled on its own. For example the chapter label, or the section number.

## G.2 Users

We classify users according to the L<sup>A</sup>T<sub>E</sub>X3 terminology as a) programmers b) template designers and c) authors.

### G.2.1 Author

We assume that the author has an existing template which she is using but might want to do some minor modifications, for example use an italic shape for the font of the mark, but an upright font for the page numbers.

```
\cxset
{
    chapter number color format      = apa,
    section title font-size font-size = Large,
}
```

We follow the idea of representing the basic elements of documents as elements, each one having a parent in order to specify the element we need to style as accurate as possible. One can think of this approach being congruent with objects in other languages. As a matter fact nothing stops us from defining a key value interface as shown below.

```
\cxset
{
    header.even.mark.font.size = Large,
    header.even.mark.font.family = serif,
}
```

This would perhaps make it easier for the template designer, but I have rejected the idea as my aim is to make it easy for the author, who can search the template and just enter a couple of new property values.

### G.2.2 Template designer

The template designer in the example above would have selected the format style from a number of predefined formats (templates) or would have created a style called *apa* from an existing template and modified it using declarative key style.

### G.2.3 The programmer

The programmer in the example above could have created the basic format *apa* by using both declarative as well as defining or using existing macros. To the programmer we offer an extension mechanism, where the contents of a **ps@** command are defined. For example the programmer can define a new style using TikZ, but without having to worry about defining full **ps@** and their interface.

## G.3 Preliminaries

Standard file identification. We first announce the package and require that it be used with L<sup>A</sup>T<sub>E</sub>X2e.

```

1  @@=phd
2  \NeedsTeXFormat{LaTeX2e}[2017/04/15]%
3  \ProvidesFile{phd-lowersections}[2017/04/15 v1.0 Better headings (YL)]%

```

## G.4 Source2e Interface

I am not very fond of mixing expl3 control sequences with source2e commands. Here we provide an interface for all these commands we might use. This section can be revisited once expl3 code becomes available.

```

4  \ExplSyntaxOn
5  \let\ltxtoday\today
6  \let\phd_hang_from:nn \hangfrom
7  \newif\if@ltxcompat \ltxcompatfalse
8  \ExplSyntaxOff

9
10 \%newcommand\tikzi[1][]{}
11
12 \newif\if@DEBUG
13 \if@DEBUGfalse
14
15
16
17 \def\DEBUGON{
18 \if@DEBUGtrue
19 \if@DEBUG
20 \def\tikzi[##1]{%
21     \begin{tikzpicture}[remember picture,overlay]
22         \draw[<->] (0,0)--(0,.2)--+(-
23         .5,0) node[left,fill=blue!15,text=black]{%
24             \parbox{2cm}{%
25                 \sffamily
26                 \footnotesize ##1 }%
27             };
28     \end{tikzpicture}%
29 }
30 \end{tikzpicture}%
31 }
32 \else
33 \def\tikzi[##1]{}
34 \fi
35
36
37 \def\DEBUGOFF{
38 \if@DEBUGfalse
39 \if@DEBUG
40 \def\tikzi[##1]{%
41     \begin{tikzpicture}[remember picture,overlay]
42         \draw[<->] (0,0)--(0,.2)--+(-
43         .5,0) node[left,fill=blue!5,text=black]{%
44             \parbox{2cm}{%

```

```

45          {
46            {\sffamily
47             \footnotesize ##1 }
48           }
49         };
50   \end{tikzpicture}%
51 }
52 \else
53 \def\tikzi[##1]{}
54 \fi
55 }
56
57 \DEBUGON
58

```

## G.5 Key Management

This part of the code is a bit verbose. We care to provide keys for all parameters in order to allow flexibility and easy extensions.

```

59 \ExplSyntaxOn
60 \def\lphdsubsectionnumberprefixtl {}
61 \def\lphdsubsectionnumbersuffixtl {}
62 \def\lphdsubsubsectionnumberprefixtl{}
63 \def\lphdsubsubsectionnumbersuffixtl{}
64 \def\lphdparagraphnumberprefixtl{}
65 \def\lphdparagraphnumbersuffixtl{}
66 \def\lphdsubparagraphnumberprefixtl{}
67 \def\lphdsubparagraphnumbersuffixtl{}

```

### \phd\_document\_type\_tl{\textit{type of document}}

A macro holding the literal type name of the document, i.e, article, proceedings, book, letter etc. This will be used to enable user commands to be created for maximum flexibility.

### \@@\_document\_types\_clist{\textit{list of types provided}}

An associated clist that holds all the document types available by the class.

```
68 \clist_new:N \__phd_document_types_clist {}
```

The build-in default document types are those provided by the standard classes, book, article etc.

```

69 \tl_new:N \__phd_document_type_tl {}
70 \cs_new_nopar:Npn \__phd_set_document_type:n #1
71 {
72   \tl_gset:Nn \__phd_document_type_tl {#1}
73   %create secondary list as well here
74   \clist_gput_right:Nn \__phd_document_types_clist {#1}
75   \clist_new:c {__phd_#1_divisions_clist}
76 }
```

We set the default document type as *book*.

```
77 \__phd_set_document_type:n {book}
```

**\phd\_book\_divisions\_clist {<clist>}**

This clist contains all the book divisions, we later also provide an interface for the user to add new content to it. For example this document is of type book.

```

78 \cs_new:Npn \__phd_set_document_divisions #1 #2 {
79   \clist_gset:cn {__phd_#1_divisions_clist} {#2}
80 }
81
82 \__phd_set_document_divisions {book}
83 {
84   part,chapter,section,subsection,subsubsection,
85   paragraph,subparagraph
86 }
87
88 \__phd_set_document_divisions {article}
89 {
90   section,subsection,subsubsection,
91   paragraph,subparagraph
92 }
93
94 \__phd_set_document_divisions {proc}
95 {
96   section,subsection,subsubsection,
97   paragraph,subparagraph
98 }
99
100 \__phd_set_document_divisions {journal}
101 {
102   volume,article,section,subsection,subsubsection,
103   paragraph,subparagraph
104 }
105 %

```

Somehow controversial, we divide a bible-like book into testament, book, chapter and verse. As we can create new ones to one's liking, we leave other religious main body subdivisions for another time.

```

106 \__phd_set_document_divisions {bible}
107 {
108   testament,book,chapter,verse
109 }

```

The structural elements of the main body of a publication, have been dealt with the code described so far. For dealing with the visual parts for such elements we have to define, subdivisions to cater for each one of them.

**\phd\_secondary\_clist{<clist>}**

Holds a list of all secondary elements for a book. Each main element has an associated number of secondary elements, which are used in typesetting the element. Most sections will have a title, others will have an associated counter with them.

```

110 \cs_new:Npn \element_delimiter{.}
111 \clist_new:N \thirddlist

```

```

112 \cs_new:Npn \z_make_names #1 {
113     % append to third list
114     \clist_map_inline:Nn \__phd_book_divisions_clist {
115         \clist_put_right:Nn \thirdlist{##1\element_delimiter#1}
116     }
117 }
118
119 \clist_new:N \__phd_secondary_clist_names_clist
120 \clist_gset:Nn \__phd_secondary_clist_names_clist
121 {
122     label,label_before,number,title, title_before,number_before
123 }
124 % map the two lists and create a third
125 \clist_map_inline:Nn \__phd_secondary_clist_names_clist
126 {
127     \z_make_names {#1}
128 }

```

Testing everything so far, we get a mind-boggling list of sub-elements that we can provide keys and settings for them. Each one of them will have numerous properties associated with them.

|                             |                              |
|-----------------------------|------------------------------|
| part.label,                 | part.title,                  |
| chapter.label,              | chapter.title,               |
| section.label,              | section.title,               |
| subsection.label,           | subsection.title,            |
| subsubsection.label,        | subsubsection.title,         |
| paragraph.label,            | paragraph.title,             |
| subparagraph.label,         | subparagraph.title,          |
| part.label_before,          | part.title_before,           |
| chapter.label_before,       | chapter.title_before,        |
| section.label_before,       | section.title_before,        |
| subsection.label_before,    | subsection.title_before,     |
| subsubsection.label_before, | subsubsection.title_before,  |
| paragraph.label_before,     | paragraph.title_before,      |
| subparagraph.label_before,  | subparagraph.title_before,   |
| part.number,                | part.number_before,          |
| chapter.number,             | chapter.number_before,       |
| section.number,             | section.number_before,       |
| subsection.number,          | subsection.number_before,    |
| subsubsection.number,       | subsubsection.number_before, |
| paragraph.number,           | paragraph.number_before,     |
| subparagraph.number,        | subparagraph.number_before,  |

```

129 \clist_new:N \__phd_secondary_clist
130 \clist_gset:Nn \__phd_secondary_clist
131 {
132     part_label,
133     part_label_before,
134     part_number,
135     part_title,
136     part_title_before
137     part_number_before,

```

```

138
139     chapter_title,
140     section_title,
141     subsection_title,
142     subsubsection_title,
143     paragraph_title,
144     subparagraph_title,
145     chapter_title_before,
146 %
147     chapter_label,
148     section_label,
149     subsection_label,
150     subsubsection_label,
151     paragraph_label,
152     subparagraph_label,
153     chapter_label_before,
154 %
155     chapter_number,section_number,
156     subsection_number,subsubsection_number,
157     paragraph_number,subparagraph_number,
158
159     chapter_number_before,
160
161 }

```

### \phd\_create\_new\_element:nn {<label>}

Creates new dims for primary elements. The label is one of chapter, section etc.

```

162 \cs_new:Npn \__phd_create_new_element:nn #1
163 {
164     \dim_gzero_new:c {l__phd_#1_margin_top_width_dim} %margin
165     \dim_gzero_new:c {l__phd_#1_margin_right_width_dim}
166     \dim_gzero_new:c {l__phd_#1_margin_bottom_width_dim}
167     \dim_gzero_new:c {l__phd_#1_margin_left_width_dim}
168
169     \dim_gzero_new:c {l__phd_#1_padding_top_width_dim} %margin
170     \dim_gzero_new:c {l__phd_#1_padding_right_width_dim}
171     \dim_gzero_new:c {l__phd_#1_padding_bottom_width_dim}
172     \dim_gzero_new:c {l__phd_#1_padding_left_width_dim}
173
174     \dim_gzero_new:c {l__phd_#1_border_top_width_dim} %margin
175     \dim_gzero_new:c {l__phd_#1_border_right_width_dim}
176     \dim_gzero_new:c {l__phd_#1_border_bottom_width_dim}
177     \dim_gzero_new:c {l__phd_#1_border_left_width_dim}
178 }

```

Next we create the secondary elements.

```

179 \clist_map_inline:Nn \__phd_book_divisions_clist
180 {
181     \__phd_create_new_element:nn {#1}
182 }
183
184

```

```

185
186 \clist_map_inline:Nn \__phd_secondary_clist
187 {
188   \__phd_create_new_element:nn {#1}
189 }
190
191
192 \cs_new:Npn \printproperties
193 {
194   \input{debug-dims}
195 }
196 \ExplSyntaxOff

```

**\l\_@@\_make\_new\_heading\_keys:n <element name>**

Creates a new set of keys for an element for example, chapter, section or chapter title. Not all keys are applicable to all elements (for example numbering), hence the code is split into primary and secondary elements. A primary element is an element whose parent is **document**.

```

197 \ExplSyntaxOn
198 \cs_new:Npn \l__phd_make_new_heading_keys:n #1 #2
199 {
200   \cxset
201   {

```

The first key we define is to set the element name. This is compatible with all classes, e.g. **\chaptername()** for the name of the chapter, **\sectionname** (Section) etc. The handler **.store** is similar to PGF's **.store in**, except it accepts a **csname**.

```
202   #1~name/.store          = #1name,
```

At this point we should think as to how we can internationalize our code. We create a path **/phd/locale/en/chaptername** to store the various names. This will be extended later to cater for other aspects of internationalization.

```
203   locale/en/#1~name/.store      = #1name,
```

We avoid having to load packages to set the indentation of the first paragraph after a heading on or off. The handler **.onoff** is defined in the phd-handlers package and can take a value of on, off, true, false. As we use **expl3** we get a value of **\char"0** for false or off.

```

204   #1~afterindent/.onoff        = #1_afterindent,
205 % Main text alignment
206   #1~align/.textalign          = l__phd_#2_align_tl,
207 % spacing
208   #1~bforeskip/.store         = l__phd_#2_bforeskip_tl,
209   #1~afterskip/.store         = l__phd_#2_afterskip_tl,
210   #1~indent/.store            = l__phd_#2_indent_tl,

```

The font keys, following the pattern defined in CSS models.

```

211   #1~font-size/.fontsize       = l__phd_#2_fontsize_tl,
212   #1~font-weight/.fontweight  = l__phd_#2_fontweight_tl,
213   #1~font-shape/.fontshape    = l__phd_#2_fontshape_tl,
214   #1~font-style/.fontstyle    = l__phd_#2_fontshape_tl,
215   #1~font-family/.fontfamily  = l__phd_#2_fontfamily_tl,
216   #1~font-face/.fontface      = l__phd_#2_fontface_tl,

```

The `<element>case` can be used to determine the text case, as lower or upper. This will have to be extended one day for languages that have difficult folding cases.

```
217      #1~case/.case          = l__phd_#2_case_tl,
```

The `<element>format` is the workhorse of the layout engine. It is similar to templates in other languages. We use a special handler that checks if the format is either in a list or is defined. If it has been registered it can have any value, otherwise it needs to follow the convention, `\format_<name>:nn`. This API is still not very stable and I might change it down the line.

```
218      #1~format/.format~in    = l__phd_#2_format_tl,
```

The following keys deal with colors. Color names are stored in macros, with `.store`. The `colorin` macro uses `color<value>`. The handler checks that the color exists. If it does not exist it issues an error and maps to the color black. The values `palette` or `auto`, have a special meaning. If a palette is defined the color will map to `the<element>color` or to the element parent color. The inheritance still needs to be defined better.

```
219      #1~background-color/.store      = l__phd_#2_background_color_tl,  
220      #1~frame-color/.store        = l__phd_#2_frame_color_tl,  
221      #1~color/.colorin          = l__phd_#2_color_tl,  
222      #1~shadow/.shadow          = l__phd_#2_shadow_tl,
```

Add missing  
colornames in  
color\_palette

The following keys deal with setting values for heading elements that use the ‘box’ model. They are normally defined in a similar way to those defined by `tcol-orbox`.

```
223      #1~width/.store           = l__phd_#2_width,  
224      #1~arc/.store           = l__phd_#2_arc_tl,  
225      #1~grow~left/.store     = l__phd_#2_grow_left_dim,  
226      #1~grow~right/.store    = l__phd_#2_grow_right_dim,  
227      #1~rounded~corners/.store= l__phd_#2_rounded_corners_tl,  
228 % Borderlines  
229      #1~borderline~top/.store = l__phd_#2_borderline_top_tl,  
230      #1~borderline~right/.store= l__phd_#2_borderline_right_tl,  
231      #1~borderline~bottom/.store= l__phd_#2_borderline_bottom_tl,  
232      #1~borderline~left/.store = l__phd_#2_borderline_left_tl,
```

Borderlines can be colored individually. They can use the palette, auto, cascade values, as previously discussed.

```
233      #1~borderline~top~color/.store = l__phd_#2_borderline_top_color_tl,  
234      #1~borderline~right~color/.store= l__phd_#2_borderline_right_color_tl,  
235      #1~borderline~bottom~color/.store= l__phd_#2_borderline_bottom_color_tl,  
236      #1~borderline~left~color/.store = l__phd_#2_borderline_left_color_tl,
```

The `<element>border-top-width` and other similar elements store the dimension of borders, padding and margins.

```
237 % Box borders  
238      #1~border-top-width/.store   = l__phd_#2_border_top_width_dim,  
239      #1~border-right-width/.store = l__phd_#2_border_right_width_dim,  
240      #1~border-bottom-width/.store= l__phd_#2_border_bottom_width_dim,  
241      #1~border-left-width/.store  = l__phd_#2_border_left_width_dim,  
242 % Box padding  
243      #1~padding-top-width/.store  = l__phd_#2_padding_top_width_dim,  
244      #1~padding-right-width/.store= l__phd_#2_padding_right_width_dim,  
245      #1~padding-bottom-width/.store= l__phd_#2_padding_bottom_width_dim,
```

```

246      #1~padding-left-width/.store          = l__phd_#2_padding_left_width_dim,
247 % Box margin
248      #1~margin-top-width/.store           = l__phd_#2_margin_top_width_dim,
249      #1~margin-right-width/.store        = l__phd_#2_margin_right_width_dim,
250      #1~margin-bottom-width/.store       = l__phd_#2_margin_bottom_width_dim,
251      #1~margin-left-width/.store        = l__phd_#2_margin_left_width_dim,
252    }
253  }
254
255
256
257 \ExplSyntaxOff

```

Chapter, Part and sometimes Sections might need to be typeset on new pages, we create booleans for these,

```

258 \ExplSyntaxOn
259 \cs_gset:Npn \make_new_bool:n #1
260 {
261   \bool_new:c {#1_open_left_bool}
262   \bool_gset_false:c {#1_open_left_bool}
263   \bool_new:c {#1_open_any_bool}
264   \bool_gset_false:c {#1_open_any_bool}
265   \bool_new:c {#1part_open_anywhere_bool}
266   \bool_gset_false:c {#1_open_anywhere_bool}
267   \bool_new:c {#1_open_right_bool}
268   \bool_gset_false:c {#1_open_right_bool}
269 }
270
271 \make_new_bool:n {part}
272 \make_new_bool:n {chapter}
273 \make_new_bool:n {section}
274 \ExplSyntaxOff

```

We create keys for the booleans by defining a function and the calling it for the document elements we allow,

```

275 \ExplSyntaxOn
276 \cs_gset:Npn \make_new_opening_keys:n #1
277 {
278   \cxset{
279     #1~opening/.is~choice,
280     #1~opening/right/.code      = \bool_gset_true:c {#1_open_right_bool},
281     #1~opening/left/.code     = \bool_gset_true:c {#1_open_left_bool},
282     #1~opening/any/.code      = \bool_gset_true:c {#1_open_any_bool},
283     #1~opening/none/.code     = \bool_gset_true:c {#1_open_anywhere_bool},
284     #1~opening/anywhere/.code = \bool_gset_true:c {#1_open_anywhere_bool},
285     #1~opening/ifafter/.code= {},
286   }
287 }
288 \make_new_opening_keys:n {part}
289 \make_new_opening_keys:n {chapter}
290 \make_new_opening_keys:n {section}
291 \ExplSyntaxOff

```

Set the default values for part, chapter and sections.

```
292 \cxset{part opening = anywhere,
```

```

293         chapter opening = anywhere,
294         section opening = none}

\l_@@_make_new_numbering_keys:n {{element name}}

```

Not all heading elements need to access a counter and associated fields, so we provide a function to specifically target these keys.

```

295 \ExplSyntaxOn
296 \cs_new:Npn \l__phd_make_new_numbering_keys:n #1
297 {
298 % Numbering Wow!
299 \cxset{
300     #1~number~prefix/.store      = lphd#1numberprefixtl,
301     #1~number~suffix/.store      = lphd#1numbersuffixtl,
302
303     #1~number~after/.store       = \l__phd_#1_number_after_tl,
304     #1~numbering/.is~choice,
305     #1~numbering/roman/.code    =
306     \cs_gset:cpn {the#1}
307     {
308         \cs:w lphd#1numberprefixtl \cs_end:
309         \@roman\cs:w c@#1\cs_end:\relax
310         \cs:w lphd#1numbersuffixtl \cs_end:
311     },
312     #1~numbering/Roman/.code      =
313     \cs_gset:cpn {the#1}
314     {
315         \cs:w lphd#1numberprefixtl \cs_end:
316         \expandafter\@Roman{\cs:w c@#1\cs_end:\relax}
317         \cs:w lphd#1numbersuffixtl \cs_end:
318     },
319     #1~numbering/(roman)/.code    =
320     \cs_gset:cpn {the#1}
321     {
322         \cs:w lphd#1numberprefixtl \cs_end:
323         (\@roman\cs:w c@#1\cs_end:\relax)
324         \cs:w lphd#1numbersuffixtl \cs_end:
325     },
326     #1~numbering/(Roman)/.code    =
327     \cs_gset:cpn {the#1}
328     {
329         \cs:w lphd#1numberprefixtl \cs_end:
330         (\@Roman \cs:w c@#1\cs_end:\relax)
331         \cs:w lphd#1numbersuffixtl \cs_end:
332     },
333     #1~numbering/arabic/.code      =
334     \cs_gset:cpn {the#1}
335     {
336         \cs:w lphd#1numberprefixtl \cs_end:
337         \@arabic\cs:w c@#1\cs_end:\relax
338         \cs:w lphd#1numbersuffixtl \cs_end:
339     },
340     #1~numbering/numeric/.code      =
341     \cs_gset:cpn {the#1}

```

```

342      {
343          \cs:w lphd#1numberprefixtl \cs_end:
344          \@arabic\cs:w c@#1\cs_end:\relax
345          \cs:w lphd#1numbersuffixtl \cs_end:
346      },
347      #1~numbering/none/.code           =
348      \cs_gset:cpn {the#1} {},
349
350      #1~numbering/alpha/.code         =
351      \cs_gset:cpn {the#1}
352      {
353          \cs:w lphd#1numberprefixtl \cs_end:
354          \exp_after:wN \alphanum {\cs:w c@#1\cs_end:\relax}
355          \cs:w lphd#1numbersuffixtl \cs_end:
356      },
357      #1~numbering/Alpha/.code        =
358      \cs_gset:cpn {the#1}
359      {
360          \cs:w lphd#1numberprefixtl \cs_end:
361          \exp_after:wN \AlphAlph{\cs:w c@#1\cs_end:\relax}
362          \cs:w lphd#1numbersuffixtl \cs_end:
363      },
364      #1~numbering/words/.code        =
365      \cs_gset:cpn {the#1}
366      {
367          \cs:w lphd#1numberprefixtl \cs_end:
368          \words@cx{\@arabic\cs:w c@#1\cs_end:\relax}
369          \cs:w lphd#1numbersuffixtl \cs_end:
370      },
371      #1~numbering/Words/.code        =
372      \cs_gset:cpn {the#1}
373      {
374          \cs:w lphd#1numberprefixtl \cs_end:
375          \Words@cx{\@arabic\cs:w c@#1\cs_end:\relax }
376          \cs:w lphd#1numbersuffixtl \cs_end:
377      },
378      #1~numbering/WORDS/.code        =
379      \cs_gset:cpn {the#1}
380      {
381          \cs:w lphd#1numberprefixtl \cs_end:
382          \WORDS@cx{\@arabic\cs:w c@#1\cs_end:\relax}
383          \cs:w lphd#1numbersuffixtl \cs_end:
384      },
385      #1~numbering/ordinals/.code     =
386      \cs_gset:cpn {the#1}
387      {
388          \cs:w lphd#1numberprefixtl \cs_end:
389          \ordinals@cx{\@arabic\cs:w c@#1\cs_end:\relax}
390          \cs:w lphd#1numbersuffixtl \cs_end:
391      },
392      #1~numbering/ORDINALS/.code    =
393      \cs_gset:cpn {the#1}
394      {
395          \cs:w lphd#1numberprefixtl \cs_end:

```

```

396      \ORDINALS@cx{@arabic\cs:w c@#1\cs_end:\relax}
397      \cs:w lphd#1numbersuffixtl \cs_end:
398      },
399      #1~numbering~custom/.code           =
400      \cs_gset:cpn {the#1} {##1},
401      }
402  }
403 \ExplSyntaxOff
404 \ExplSyntaxOn
405 \cs_gset:Npn\phd_setparent:nn #1#2 {%
406   \cs_gset:cpn {#1parent} {#2}
407 }

```

### G.5.1 Inheritance, auto and cascade

This can be a list pointing up. also need to think about secondary elements For example `\chapterparent` will point to `document` and where keys are set to inherit will be inherited. Other key values set to cascade can go up to top level. This is probably and ideal way to use clists.

```

408 \phd_setparent:nn {document}{root}
409 \phd_setparent:nn {part}{document}
410 \phd_setparent:nn {chapter}{document}
411 \phd_setparent:nn {section}{chapter}
412 \phd_setparent:nn {subsection}{section}
413 \phd_setparent:nn {subsubsection}{subsection}
414 \phd_setparent:nn {paragraph}{subsubsection}

```

### G.5.2 Creating the Keys

We are now ready to start creating the keys for the headings. The headings names are stored in `phd_book_divisions_clist`. We iterate through all the elements to create the keys, first for the major elements and second for the secondary elements. Reminder a major element can be defined with one word and a secondary element with two or more.

```

415 \clist_map_inline:Nn \__phd_book_divisions_clist
416 {
417   \l__phd_make_new_heading_keys:n{#1}{#1}
418   \l__phd_make_new_numbering_keys:n{#1}
419 }

```

Map through the list again for the secondary elements.

```

420 \clist_map_inline:Nn \__phd_book_divisions_clist
421 {
422   \iow_log:n {#1, }
423   \l__phd_make_new_heading_keys:n {#1~title}{#1_title}
424   \l__phd_make_new_heading_keys:n {#1~title~before}{#1_title_before}
425   \l__phd_make_new_heading_keys:n {#1~number}{#1_number}
426   \l__phd_make_new_heading_keys:n {#1~number~before}{#1_number_before}
427   \l__phd_make_new_heading_keys:n {#1~label}{#1_label}
428   \l__phd_make_new_heading_keys:n {#1~label~before}{#1_label_before}
429   \l__phd_make_new_heading_keys:n {#1~before}{#1_before}
430   \l__phd_make_new_heading_keys:n {#1~after}{#1_after}

```

```

431     }
432
433 \ExplSyntaxOff

```

## G.6 Programmatically create key defaults

With such a large list of properties, we create default values programmatically. Then these are overwritten later to more appropriate values. This ensures that all keys are created and that no errors occur.

`\l_@@_set_headings_key_defaults:n {{element name}}`

This function takes one argument and initializes all the keys.

```

434 \ExplSyntaxOn
435 \cs_new:Npn \l__phd_set_headings_key_defaults:n #1
436 {
437     \cxset
438     {
439 % name
440         % #1~name                      = Chapter,
441 % numbering
442         % #1~numbering                  = arabic,
443         #1~align                       = Centering,
444 % renderer format
445         #1~format                      = block,
446 % fonts
447         #1~font-size                   = HUGE,
448         #1~font-weight                 = bold,
449         #1~font-family                 = sffamily,
450         #1~font-shape                  = upshape,
451         #1~font-style                  = upshape,
452         #1~case                        = upper,
453 % colors
454         #1~color                        = black,
455         #1~background-color            = bgsexy,
456         #1~frame-color                 = bgsexy,
457 % spacing
458         #1~indent                       = 0pt,
459         #1~beforeskip                  = 10pt,
460         #1~afterskip                   = -3ex,
461         #1~afterindent/.onoff          = #1_afterindent,
462 % box and effects
463         #1~arc                          = 0pt,
464
465         #1~grow~left                    = 0mm,
466         #1~grow~right                  = 0mm,
467         #1~rounded~corners              = northeast,
468         #1~shadow                       = drop~shadow,
469 % borderlines
470         #1~borderline~top               = 1pt,
471         #1~borderline~right              = 1pt,
472         #1~borderline~bottom              = 1pt,
473         #1~borderline~left               = 1pt,

```

```

474 % borderlines color
475     #1~borderline~top-color    = black,
476     #1~borderline~right-color = black,
477     #1~borderline~bottom-color = black,
478     #1~borderline~left-color  = black,
479 %
480     #1~border-left-width      = 1pt,
481     #1~border-right-width    = 1pt,
482     #1~border-top-width      = 1pt,
483     #1~border-bottom-width   = 1pt,
484
485     #1~padding-left-width    = 1pt,
486     #1~padding-right-width   = 1pt,
487     #1~padding-top-width     = 1pt,
488     #1~padding-bottom-width  = 1pt,
489 %
490 }
491 }
```

Next we map all the keys to defaults.

### `book_divisions_clist`

```

492 \clist_map_inline:Nn \__phd_book_divisions_clist
493 { \wlog{set defaults ... #1 ...}
494     \l__phd_set_headings_key_defaults:n {#1}
495     \l__phd_set_headings_key_defaults:n {#1~title}
496     \l__phd_set_headings_key_defaults:n {#1~title~before}
497     \l__phd_set_headings_key_defaults:n {#1~label}
498     \l__phd_set_headings_key_defaults:n {#1~label~before}
499     \l__phd_set_headings_key_defaults:n {#1~number}
500     \l__phd_set_headings_key_defaults:n {#1~number~before}
501     \l__phd_set_headings_key_defaults:n {#1~before}
502     \l__phd_set_headings_key_defaults:n {#1~after}
503 }
504 \ExplSyntaxOff

(End definition for \__phd_book_divisions_clist.)

505
506 \ExplSyntaxOn
507 \cxset
508 {
509     section~spaceout/.is~choice,
510     section~spaceout/soul/.code           = \@sectionspaceouttrue,
511     section~spaceout/none/.code          = \@sectionspaceoutfalse,
512 }
513 \ExplSyntaxOff
```

As described earlier boxed headings have numerous elements, each of which can be styled on its own.



# Formatters and Associated Functions

This chapter provides the objectives of the package, provides the methodology to attack the problem and discusses the difficulties encountered in trying to provide a full declarative interface.



Formatters are functions that produce a layout and apply the properties to a number of elements. There are is a formatter for each format available as a property to a heading. The most comprehensive is the css block formatter that can size individual boxes and also float them as required. Special formatters can be added to the package as extensions.

## H.1 Helper functions

The helper functions transfer properties from keys to tikz or tcolorbox boxes or to plain macros for simpler formatters. They are just convenient functions to keep the code for the formatters, shorter.

**\set\_font\_aux:n {*element name*}**

This helper function sets the font properties.

```

1 \ExplSyntaxOn
2 \cs_gset:Npn \set_font_aux:n #1
3 {
4     \%cs_if_exist_use:c { #1_fontface_tl}
5     \%cs_if_exist_use:c { #1_fontfamily_tl }
6     \%cs_if_exist_use:c { #1_fontweight_tl }
7     \%cs_if_exist_use:c { #1_fontshape_tl }
8     \%cs_if_exist_use:c { #1_fontsize_tl   }
9
10 }
11 \cs_new:Npn \set_borders_aux:nn #1 #2
12 {
13     \dim_if_exist:cTF{l__phd_#1_border_#2_width_dim } {8pt}{2pt}
14 }
```

**\set\_color\_aux:nn {*element name*} {⟨⟩}**

```

15 \cs_new:Npn \set_color_aux:nn #1 #2
16 {
17     \cs:w l__phd_#1_#2_color_tl \cs_end:
18 }
19 \ExplSyntaxOff
```

**\set\_borderline\_aux:nn {⟨⟩} {⟨⟩}**

Sets the borders of a tcolorbox or other box. For tcolorbox, there is an important difference between borderlines and rules. Borderlines are a bit problematic in a declarative interface. Firstly they take four arguments. Following the shadows interface we offer predetermined, styles as well as allow maximum flexibility through styles for the user.

To draw them they require offset, thickness, color and line type. The offset determines if they drawn away or inwards the original path.

```

20 \ExplSyntaxOn
21 \cs_new:Npn \set_borderline_aux:nn #1 #2
22 {
23     \tcbset{borderline~style/.style =
```

```

24      {
25        borderline~west = {\cs:w l__phd_#1_borderline_left_tl \cs_end:}
26          {-\set_borders_aux:nn {#1} {left}-
27          Opt }
28          {
29            \cs:w l__phd_#1_borderline_left_color_tl \cs_end: ,
30            solid,
31          },
32        borderline~east = {\cs:w l__phd_#1_borderline_right_tl \cs_end:}
33          {-\set_borders_aux:nn {#1} {right}-
34          Opt }
35          {
36            \cs:w l__phd_#1_borderline_right_color_tl \cs_end: ,
37            solid
38          },
39        borderline~north = {\cs:w l__phd_#1_borderline_top_tl \cs_end:}
40          {-\set_borders_aux:nn {#1} {top}-
41          Opt }
42          {
43            \cs:w l__phd_#1_borderline_top_color_tl \cs_end: ,
44            dashed},
45        borderline~south = {\cs:w l__phd_#1_borderline_bottom_tl \cs_end:}
46          {-\set_borders_aux:nn {#1} {bottom}-
47          Opt }
48          {
49            \cs:w l__phd_#1_borderline_bottom_color_tl \cs_end: ,
50            dashed
51          },
52      }
53 \ExplSyntaxOff

```

### \format\_inmargin

This is a simple formatter that places the heading in the margin. Useful for old style books.

```

51 \ExplSyntaxOn
52 \cs_set:Npn \format_inmargin:nnn #1#2#3
53 {
54   \tcbdocmarginnote
55   {
56     \hbox{Section~\@svsec}
57     #3
58   }
59 }
60 \ExplSyntaxOff

```

## H.2 Hanged formats

Most books will have sections as hanged paragraphs. They can be indented or outdented into the margins and can consist of a single line or more. We provide a generic formatter based on the one in L<sup>A</sup>T<sub>E</sub>X first.

**\format\_hang:nn** {*element name*} {*unused*} {*title text*}

This formatter renders the classic L<sup>A</sup>T<sub>E</sub>X hanged paragraph. As all the properties are available in the keys, we do not really need to concern ourselves with passing values from the main function to here.

```

62 \ExplSyntaxOn
63 \cs_set:Npn \format_hang:nn #1#2#3
64   {\par\leavevmode
65     \phd_hang_from:nn
66     {
67       \set_font_aux:n {l_phd_#1}
68       \cs_if_exist_use:c {the_#1_title_fontface_tl}
69       \cs:w
70         l_phd_#1_number_color_tl
71       \cs_end:
72       {\hskip 0pt %indent
73         \cs:w the#1 \cs_end:
74         \hskip1em
75       }
76     }
77     {
78       \set_font_aux:n {l_phd_#1}
79       \cs_if_exist_use:c {the_section_title_fontface_tl}
80       \cs:w
81         l_phd_#1_color_tl
82       \cs_end:
83       #3
84     }
85   }
86   { \interlinepenalty\@M
87     \par } %Check par here

```

In classic L<sup>A</sup>T<sub>E</sub>X end of section action depends on the sign of the afterskip. A negative sign is used to indicate an inline paragraph and a positive a hanged section. All the post action being handled by `\@xsect`.

As this is not very intuitive, we move the xsect code below for the hang paragraphs, with the intention to simplify the inline code in the inline renderer later.

```

88   \par \nobreak
89   \%skip_vertical:c {l_phd_#1_afterskip_tl}
90   \vskip10pt
91   \phd_after_heading:
92   \tex_ignorespaces:D
93 }
94 \ExplSyntaxOff

```

**\format\_hang\_inmargin** {*element name*} {*text*}

This is a variation to the hanged format, where the heading number is in the margin.

```

95 \ExplSyntaxOn
96 \cs_set:Npn \format_hang_inmargin:nn #1#2
97   {
98     \bgroup

```

```

99      \parindent0pt
100     \setbox\@tempboxb\hbox
101     {
102       \set_font_aux:n {l_phd_#1}
103       \expandafter\@arabic\cs:w c@#1 \cs_end:
104     }
105     \makebox[0pt]{
106       \makebox[-\wd\@tempboxb][r]{%
107         \set_font_aux:n {l_phd_#1}
108         {
109           \tcbox[nobeforeafter,box-align=center,
110                 colback=bgsexy]
111           {
112             \cs:w the#1 \cs_end:
113           }
114         }
115       }
116     }
117     \begin{tcolorbox}[enhanced,
118                   %title empty,
119                   size=minimal,
120                   nobeforeafter,box-align=center,
121                   title,title code={%
122                     \path[draw=yellow,solid,decorate,line width=2mm,
123                     decoration={coil,aspect=0,segment length=10.1mm}]
124                     ([xshift=1mm]title.west) -- ([xshift=-1mm]title.east);%
125                   ]
126                     \set_font_aux:n {l_phd_#1}
127                     \cs:w
128                     l_phd_#1_color_tl
129                     \cs_end:
130                     #2
131                   \end{tcolorbox}
132                   \egroup
133                   \interlinepenalty\@M
134                   \tex_par:D
135                   \par \nobreak
136                   \skip_vertical:c {l_phd_#1_afterskip_tl}
137                   \phd_after_heading:
138     }
139 \ExplSyntaxOff

```

### H.3 Format block

\format\_block:nnnn <element name> <> {<>} {<>}

This function is the main function for block and fancy headings. It uses the package **tcolorbox** in order to provide as much flexibility as possible.

We create a boolean that determines if the element label and its number are to be typeset inline or not.

```

140 \ExplSyntaxOn
141 \bool_new:N \combo_if_bool \bool_gset_true:N \combo_if_bool

```

We are now ready to define the function.

```

142 \cs_set:Npn \label_number_box #1 {
143   \bool_if:NTF \combo_if_bool
144   {
145     \fboxsep=2pt
146     \fboxrule=1pt
147     \%phd_float_box:nnn {chapter_number} {}{
148       \tcbox[size=minimal,
149         nobeforeafter,
150         before = \vskip1sp,
151         colback=white]
152       {
153         \%cs:w l__phd_#1_fontsize_tl\cs_end:
154         \tcbox[size=minimal,
155           nobeforeafter,
156           colback= \cs:w l__phd_chapter_label_background_color_tl \c
157           valign=top,
158         ]{
159         \bgroup
160         \cs_if_exist_use:c { the_#1_fontface_tl}
161         \cs_if_exist_use:c {l__phd_#1_label_fontfamily_tl}
162         \cs_if_exist_use:c {l__phd_#1_label_fontweight_tl}
163         \cs_if_exist_use:c {l__phd_#1_label_fontshape_tl}
164         \cs_if_exist_use:c {l__phd_#1_label_fontsize_tl}
165
166         \%l__phd_chapter_label_fontfamily_tl
167         \%l__phd_chapter_label_fontshape_tl\space
168         \cs:w l__phd_#1_label_color_tl\cs_end:
169
170         \cs:w #1name\cs_end:\space
171
172         \egroup}
173
174         \tcbox[size=minimal,
175           nobeforeafter, top=0pt, valign=top,
176           colback=\cs:w
177             l__phd_chapter_number_background_color_tl
178             \cs_end:, ]
179         ]{
180         \bgroup
181
182         \cs_if_exist_use:c { the_#1_number_fontface_tl }
183         \cs_if_exist_use:c {l__phd_#1_number_fontfamily_tl }
184         \cs_if_exist_use:c {l__phd_#1_number_fontweight_tl }
185         \cs_if_exist_use:c {l__phd_#1_number_fontshape_tl }
186         \cs_if_exist_use:c {l__phd_#1_number_fontsize_tl }
187         \cs:w l__phd_#1_number_color_tl\cs_end:

```

We have to introduce a phantom here to have a proper strut. Introduce after the font sizing and use the chapter name?

```

188           \vphantom{\chaptername}
189           \cs:w the#1\cs_end:\scan_stop:
190           \egroup
191         }

```

```

192         }
193     %}
194   }
195   {
196     \phd_float_box:nnn {#1}{}
197     {
198       \tcbbox{\@svsec}
199     }
200   }
201 }
202 }
203
204
205
206 \cs_set:Npn \format_block:nnnn #1#2#3#4
207   {
208     \bgroup
209     %\leftskip-1.25in
210     \set borderline_aux:nn {#1}{}
211     \noindent\begin{tcolorbox}[size=minimal,
212       width      = \textwidth-4pt, %\pdfpagewidth-4cm,
213       arc        = 10mm,
214       auto~outer~arc,
215       \cs_if_exist_use:cTF {l_phd_#1_shadow_tl}{}{},
216       colback    = white, %bgsexy!5,%\set_color_aux:nn {#1}{background},FII
217       colframe   = white, %\set_color_aux:nn {#1}{frame},
218       toprule    = \set borders_aux:nn {#1} {top},
219       rightrule  = \set borders_aux:nn {#1} {right},
220       bottomrule = \set borders_aux:nn {#1} {bottom},
221       lefrule    = 0pt,%\set borders_aux:nn {#1} {left},
222       left~skip = 0pt,
223       left=0pt,
224       boxsep=0pt,
225       % borderline      = {5pt}{5pt}{blue,double,dashed,line~join=bevel},
226       % borderline~north = {2pt}{-3pt}{dotted},
227       % borderline~south = {2pt}{-3pt}{dotted},
228       % borderline~east  = {2pt}{-3pt}{dotted},
229       % borderline~west  = {2pt}{-3pt}{dotted},
230       % borderline~style,
231       % no~borderline,
232       % show~bounding~box,
233       align = left,
234       valign = top,
235       %rounded~corners=all,
236       %drop~lifted~shadow=black,
237     ]
238
239     \label_number_box {#1}
240 %
241 % above title box {empty}
242   \phd_float_box:nnn {#1_title_before}{}{}
243 % title float box
244
245   \phd_float_box:nnn {#1_title}{}{#4}

```

```

246     \par
247     \vskip10pt %TODO
248     \end{tcolorbox}
249     \vskip10pt
250 \egroup
251 \par\nobreak\nointerlineskip
252 }

\phd_float_box:nnn {⟨identifier⟩} {⟨⟩} {⟨⟩}

#1 The section label
#2 The secondary identifier i.e, title
#3 The text of the box

```

This box contains an outer and an inner box, permitting the second box to float freely into the first box. The widths are constrained based on user inputs or automatic calculations.

```

253 \cs_set:Npn \phd_float_box:nnn #1 #2 #3
254 {\set_borderline_aux:nn {#1}{}
255
256 \begin{tcolorbox}
257 [
258     size=minimal,
259     width = \ linewidth,
260     no~shadow,
261     colback = \cs:w l__phd_#1_background_color_tl \cs_end:,
262     colframe = \cs:w l__phd_#1_frame_color_tl \cs_end:,
263     toprule = 0pt,
264     borderline~style,
265     boxsep=0pt,
266     left~skip=0pt,
267     left=0pt,
268     right=0pt,
269     right~skip=0pt,
270 ]
271
272 \set_font_aux:n {l__phd_#1}
273 \cs:w l__phd_#1_align_tl \cs_end:
274 %in between box or title or author block
275 \begin{tcolorbox}
276 [
277     %%#1~outer,
278     size=minimal,
279     no~shadow,
280     colback = white,%\cs:w l__phd_#1_background_color_tl \cs_end:,
281     colframe= white,%\cs:w l__phd_#1_frame_color_tl \cs_end:,
282     boxsep=0pt,
283     top=0pt,
284     bottom=0pt,
285     left=0pt,
286     right=2pt,
287     %drop~shadow,
288     %width=\ linewidth,

```

```

289         borderline-style,
290         % halign = ,
291     ]
292     { \language-1\relax
293     %\RaggedRight
294     \set_font_aux:n {l__phd_#1_tl}
295     \cs:w l__phd_#1_color_tl \cs_end:
296     \cs:w l__phd_#1_align_tl \cs_end:
297     {\textsl{\textls{#3}}}\relax %
298     \vskip10pt
299   }
300 \end{tcolorbox}
301 \par
302 \end{tcolorbox}
303 }
304
305 \ExplSyntaxOff

```

### H.3.1 Display format

The display format typesets a heading in a similar fashion to traditional chapters.

```

\format_display:nn{<section name>}
{<skip after number>} {}{} Displays a section similar to Chapters

#1 Section name
#2 indent
#3 format para
#4 Title text
svsec number

306 \ExplSyntaxOn
307 \cs_set:Npn \format_display:nnnn #1 #2 #3 #4
308 {
309   \%cxset{#1~title~margin-top-width=30pt}
310   \format_block:nnnn {#1}{#2}{#3}{#4}
311 }
312 \ExplSyntaxOff
      #1 name #2 indent #3 title

313 \ExplSyntaxOn
314 \cs_set:Npn \format_inline:nnn #1 #2 #3
315 {
316   {\bfseries\normalfont
317     \theparagraph #3}
318 }
319 \ExplSyntaxOff

320 \ExplSyntaxOn
321 \cs_new:Npn \format_part_traditional:nn #1 #2 #3
322   {\par\leavevmode
323     \group_begin:
324       \centering

```

```

325     \interlinepenalty \@M
326     \set_font_aux:n {l__phd_#1}
327     \cs:w l__phd_#1_number_tl\cs_end:
328     \set_font_aux:n {l__phd_#1_number}
329     \ifnum \c@secnumdepth >-2\relax
330         \csname #1name\endcsname\nobreakspace\csname the#1\endcsname
331         \par
332         \vskip 20\p@
333     \fi
334     \group_begin:
335         \%set_color:nn {#1}{color}
336         \set_font_aux:n {l__phd_#1 }
337             #3
338     \group_end:
339     \tex_par:D
340     \vskip20pt
341     \group_end:
342
343 }
344 \ExplSyntaxOff
345 \ExplSyntaxOn
346 \cs_new:Npn \format_traditional:nn #1 #2 #3
347 { \par\leavevmode
348     \group_begin:
349         \centering
350         \interlinepenalty \@M
351         \set_font_aux:n {l__phd_#1}
352         \cs:w l__phd_#1_number_tl\cs_end:
353
354         \ifnum \c@secnumdepth >-2\relax
355             \set_font_aux:n {l__phd_#1_number}
356
357             \csname #1name\endcsname\nobreakspace\csname the#1\endcsname
358             {
359                 \cxset{chapter~label~font-family=\ovidius}
360                 \begin{tikzpicture}
361                     \node (a) at (0,0) {\expandafter\csname#1name\endcsname};
362                     \node (b) at (0,15pt) {\tiny \set_font_aux:n{l__phd_chapter_label} test};
363                 \end{tikzpicture}
364             }
365             \par
366             \vskip 20\p@
367         \fi
368         \group_begin:
369             \%set_color:nn {#1}{color}
370             \set_font_aux:n {l__phd_#1 }
371                 #3
372         \group_end:
373         \par
374         \vskip20pt
375         \group_end:
376
377 }
378 \ExplSyntaxOff

```

# I

## Layout Engine Code

This chapter provides the objectives of the package, provides the methodology to attack the problem and discusses the difficulties encountered in trying to provide a full declarative interface.



The Layout Engine renders a heading, made out of elements. It uses some of the techniques of L<sup>A</sup>T<sub>E</sub>X, primarily for me to understand the methodology used in the old kernel.

The function is declared using `xparse` to simplify the switching between the various options of the headings commands.

### `\start_section:nnnnnnnnn {<nine parameters>}`

The command takes up nine parameters

- #1 name e.g., subsection
- #2 level: a number, denoting depth of a section - e.g., chapter=0, section=1, etc.
- #3 indent: Indentation of heading from left margin.
- #4 beforeskip: Absolute value = skip to leave above the heading. If negative, then paragraph indent of the text following the heading is suppressed.
- #5 afterskip:
- #6 styling command
- #7 star or absent
- #8 optional argument
- #9 section title

```

1 \ExplSyntaxOn
2 \DeclareDocumentCommand \start_section:nnnnnnnnn {m m m m m s o m}
3   {
4     \if@noskipsec \leavevmode \fi
5     \par

```

The old L<sup>A</sup>T<sub>E</sub>X code used to check if the skip was negative (i.e., for inline Paragraph headings to decide if it will indent or not afterwards. We have a boolean for every heading, allowing us for example for subsubsections to indent, so this code is modified slightly.

```

6 %    check for before skip
7     \l_tmpa_skip #4\relax
8     \@afterindenttrue
9     \if_dim:w \l_tmpa_skip <\z@
10 % make it positive
11     \skip_gset:Nn\l_tmpa_skip {-\l_tmpa_skip}
12     \@afterindentfalse
13
14 \fi:
15
16 \bool_if:cTF {#1_afterindent}{
17   \@afterindentfalse
18 }{\@afterindenttrue}
19 %
20 \if@nobreak
21   \everypar{\tikz{[start]\sect] \bool_if:cTF {#1_afterindent}{\tikz{[TRUE]}{\tikz{}}}}
22 \else
23   \addpenalty \secpenalty
24   \addvspace\l_tmpa_skip
25 \fi
26 %

```

```

27 % redirect depending on star or option
28 %
29   \IfBooleanTF {#7}
30   % send to star section
31   {
32     % This is only for LaTeX Compatibility
33     % name is not send which is problematic as we cannot
34     % pick-up the properties
35     %
36     \gdef\currentsectionname{#1}
37     \@sect {#3} {#4} {#5} {#6} {#9}
38
39   }
40   {
41     \IfValueTF {#8} {@sect: {#1} {#2} {#3} {#4} {#5} {#6} [{#8}] {#9} }
42                 {@sect: {#1} {#2} {#3} {#4} {#5} {#6} [{#8}] {#9} }
43   }
44 }
```

If we are running in compatibility mode we totally ignore the function and revert back to normal L<sup>A</sup>T<sub>E</sub>X.

```

45 \@ltxcompatfalse
46 \if@ltxcompat
47   \else
48   \cs_gset_eq:NN \@startsection \start_section:nnnnnnnn
49 \fi
50
51 \ExplSyntaxOff
```

**\@sect: {<8 args>}**

The auxiliary function to start the rendering process.

The function takes now eight parameters, as we do not care about the star option of the command. #2 level number 2 section

#3 indent  
#4 beforeskip  
#5 afterskip  
#6 styling command  
#8 Is the optional argument, was no.7 on the previous one.

```

52 \ExplSyntaxOn
53 \cs_set:Npn \@sect: #1 #2 #3 #4 #5 #6 [#7] #8
54 {
```

We check if the section number depth allows for the heading to be added to the toc, if not we let it to empty.

```

55   \int_compare:nTF {#2}>\c@secnumdepth}
56   {
57     \let\@svsec\@empty
58   }
59   {
60     \refstepcounter{#1}
61 % Since |\@seccnformat| might end with an improper |\hskip| which is scanning
62 % forward for plus or minus we end the definition with a relax.
```

```

63         \protected@edef\@svsec
64         {
65             \@seccntformat{\#1}\relax
66         }
67         % add short title or long title
68         \IfValueTF{\#7}
69         {
70             \cs:w #1\mark\cs_end: {\#7}
71         % put curly brackets around \#7 to enable capturing the title
72             \addcontentsline{toc}{\#1}%
73                 \protect\numberline{\csname the\#1\endcsname{\#7}}
74         }
75         {
76             \cs:w #1\mark\cs_end: {\#8}
77             \addcontentsline{toc}{\#1}%
78                 \protect\numberline{\csname the\#1\endcsname{\#8}}
79         }
80     }

```

The next part is basically a router that redirects rendering to the right formatter. This allows for new formatters to be added by the user or in future releases of this package.

```

81     \@tempskipa #5\relax
82 % save the title.
83     \gdef\g__phd_saved_heading_tl{\#8}
84
85     \phd_format_router:nn {\#1}{\#8}
86 }
87 \ExplSyntaxOff

```

### \phd\_format\_router:nnn {<text>}

The format router selects the format to be used to render the heading. It takes the text as its parameter. The rendering properties are picked up by the template.

```

88 \ExplSyntaxOn
89 \cs_set:Npn \phd_format_router:nn #1 #2
90 {
91     \str_case_x:nnTF {\cs:w l__phd_\#1_format_tl \cs_end:}
92     {
93         { display } {\format_display:nnnn {\#1} {} {} {} {\#2} }
94         { block } {\format_block:nnnn {\#1} {} {} {} {\#2} }
95         { plain } {\format_hang:nn {\#1} {} {\#2} }
96         { hang } {\format_hang:nn {\#1} {} {} {\#2} }
97         { hanginmargin } {\format_hang_inmargin:nn {\#1} {\#2} }
98         { leftmargin } {\format_hang_inmargin:nn {\#1} {\#2} }
99         { inline } {\xsect:n {-} }
100
101     }
102     { \format_hang:nn {\#1} {} {\#2} }
103     { \format_hang_inmargin:nn {\#1} {\#2} }
104     { \format_hang_inmargin:nn {\#1} {\#2} }
105     { \xsect:n {-} }
106 }

```

```

106      { inmargin } {\format_inmargin:nnn {#1} {} {#2} }
107      { traditional } {\format_part_traditional:nn {#1}{}{#2}
108                      \xsect:n {5pt}{section} }
109      { paperback } {\format_traditional:nn {#1}{}{#2}
110                      \xsect:n {5pt}{section} }
111      }
112      {

```

We test for formatters provided as extensions. If they have been defined by the user, they can either exist in a file or have been entered in the preamble. We first test for the preamble. If they exist we load them.

```

113
114      {
115          \cs_if_exist:cTF { l__phd_#1_format_tl }
116          {
117              \expandafter\cs:w
118                  \cs:w l__phd_#1_format_tl
119                  \cs_end:
120                  \cs_end:
121                  \%stewart
122                  { #1 } { #2 }
123          }
124          { FALSE }
125      }
126  }
127
128 \ExplSyntaxOff

```

### \@ssect <indent> <beforeskip> <afterskip> <styling commands> <arg1>

This is the star version of the command. What it means is that we want a heading with no numbers and not in the toc. Also it does not add it as a mark! This is very limiting as originally programmed in the kernel; probably the thinking was to use it to create same style headings, that one would use for purposes other than sectioning. In reality many books have unnumbered sections and one might want them to go on the headings. We modify it to be able to do both based on a settings command. So to summarize star section means unnumbered. Will use choices as to what must be done with it.

#1 indent  
#2 beforeskip  
#3 afterskip  
#4 styling command  
#5 arg1 follows

```

129 \ExplSyntaxOn
130 %
131 \cs_set:Npn \@ssect #1 #2 #3 #4 #5 {
132     \@tempskipa #3\relax
133     \ifdim \@tempskipa>\z@
134     \begingroup
135         #4

```

```

136      {
137          \phd_hang_from:nn{\hskip #1}%
138          \interlinepenalty \zM
139
140          % do color
141          \newfontfamily\aegean{aegean}
142          \cxset{section~title~color=thesectiontitlecolor,
143          section~title~font-shape=itshape,
144          section~title~font-family=sfamily}
145
146          \cs:w l__phd_\currentsectionname _title_color_tl\cs_end:
147          \% \pgfkeysvalueof{/phd/section~title~color}
148          \set_font_aux:n{l__phd_\currentsectionname _title}
149          \% \pgfkeysvalueof{/phd/section~title~font-family}
150          \% \MakeUppercase{#5}
151          #5
152          \@@par
153      }%
154      \endgroup
155      \else
156
157      \def\@svsechd{#4{\hskip #1\relax #5}}%
158      \fi
159      % |\xsect:n{afterskip}| then sets the afterskipping as well as the afterindent.
160      \cxset{section~afterindent = true,
161             subsection~afterindent = true,
162             subsubsection~afterindent = true}
163      \xsect:n{#3}{#1} %ONLY NEEDED FOR HANG PARA
164  }
165  %
166
167
168
169 \ExplSyntaxOff
170

```

### \@xsect:n{<afterskip>}

This command sets handles indentation after a sectioning command. It also handles the printing of the title for inline sections (it is saved as `\@svsechd` earlier. It is common for both the star and unstarred versions of `\section`.

Note that `\@noskipsec` is a switch set true by a sectioning command when it is creating an in-text heading with `\everypar`. #2 is experimental will fail with people that have redefined the routines

```

171 \ExplSyntaxOn
172 \cs_set:Npn \xsect:n #1 #2
173 {
174     \l_tmpa_skip #1\relax
175     \if_dim:w \l_tmpa_skip>-1pt %WATCH better boolean
176         \par \nobreak
177         \vskip\l_tmpa_skip
178         \phd_after_heading:

```

```

179
180 % negative dimension
181 \else:
182   \nobreakfalse
183   \global\@noskipsectrue
184 \tex_everypar:D
185   {\if@noskipsec
186     \global\@noskipsecfalse%resets switch
187     {\setbox\z@\lastbox}
188     \tex_clubpenalty:D\@M
189     \group_begin:
190       \parindent0pt
191         \tcbbox[size=minimal,
192           nobeforeafter,
193           colback=white,
194           box-align=base]{\bfseries \g__phd_saved_heading_tl }%
195     \group_end:
196     \tex_unkip:D
197     \l_tmpa_skip #1\relax
198     \hskip -\l_tmpa_skip
199   \else
200     \tex_clubpenalty:D \clubpenalty
201     \tex_everypar:D {\tikz[every\bool_if:cTF {#2_afterindent}{#2~TRUE}{#2~FALSE}]{\fi
202   \fi
203 }
204 \fi:
205 \tex_ignorespaces:D
206 }
207
208 \cs_set:Npn \after_block:n #1
209 {
210   \par \nobreak
211   \vskip\l_tmpa_skip
212   \phd_after_heading:
213 }
214 \ExplSyntaxOff

\tex_phd_after_heading: <void>

```

This is an explorified version of the L<sup>A</sup>T<sub>E</sub>X \afterheading control sequence. It has an interesting purpose. It is called after block headings to remove the indentation from the first line of the next paragraph.

The `\nobreak` hackery is used to ensure that there is no page break after a heading (it will look very odd). We add some hooks for visual debugging. Note that `\nobreak`, `\break` and `\allowbreak` are just macros holding penalty values.

Also note the definitions of the kernel.

```
479 % \def@\nobreakfalse{\global\let\if@nobreak\iffalse}\\\n480 % \def@\nobreaktrue {\global\let\if@nobreak\iftrue}\\\n481 % \nobreakfalse\\n\n482 %
```

```

215 \ExplSyntaxOn
216 \cs_gset:Npn \phd_after_heading:
217 {
218     \nobreaktrue
219     \tex_everypar:D
220     {
221         \if@nobreak
222             \nobreakfalse
223             \clubpenalty \zM %1000 no orphans from this point onwards
224             \if@afterindent
225             \else

```

If afterindent is true, the indentation is removed. this will have to be changed per heading level.

```

226         {\setbox\z@\lastbox}%
227         \tikz[afterheading]{
228             \clubpenalty\%
229             = \the\clubpenalty}
230         \fi
231     \else
232         \clubpenalty \Z@clubpenalty %150
233         \tex_everypar:D
234         {
235             \tikz[everypar in after heading cleared]{
236                 \clubpenalty\% \the\clubpenalty
237             }
238         }
239     \fi
240 }
241 }
242 \ExplSyntaxOff

```

When LaTeX is typesetting the section number it calls `\@secCntFormat` to use it when typesetting a section heading number. This is common for all the subsectioning commands. We modify it based on code from `sectsty` in order to generalize it.

We first check if `\section@cntFormat` is defined and then we redirect to specific section level command.

`\@secCntFormat{\<section name>}`

This is a `LATEX` kernel factory command that produces `\thesection` etc. In the kernel it only takes a generic value, where we have `\sectionNumberAfterTl`. We modify to enable adjustable values for all sectioning commands.

```

243 \ExplSyntaxOn
244 \cs_gset:Npn \@secCntFormat #1
245 {
246     \ifundefined{#1@cntFormat}%
247     {\csname the#1\endcsname\sectionNumberAfterTl}%
248     {\csname #1_cntFormat\endcsname}%
249 }

```

---

**\section\_number\_after\_tl <void>**

This function and its siblings are auxiliary functions.

```

250 \tl_set:Nn  \section_number_after_tl{\quad}%default value only space
251 \tl_set:Nn  \subsection_number_after_tl{\quad}%default value only space
252 \tl_set:Nn  \subsubsection_number_after_tl{\quad}%default value only space
253 \tl_set:Nn  \l__phd_paragraph_number_after_tl{\quad}%default value only space
254 \tl_set:Nn  \subparagraph_number_after_tl{\quad}%default value only space
255 %
256 \cs_set:Npn \section_cntformat{\thesection\section_number_after_tl}
257 \cs_set:Npn \subsection_cntformat{\thesubsection\subsection_number_after_tl}
258 \cs_set:Npn \subsubsection_cntformat{\thesubsubsection\subsubsection_number_after_tl}
259 \cs_set:Npn \paragraph_cntformat {\theparagraph\l__phd_paragraph_number_after_tl }
260 \cs_set:Npn \subparagraph_cntformat {\thesubparagraph\subparagraph_number_after_tl }
261 \ExplSyntaxOff

```

**\part <\*> [<arg1>] {<arg2>}**

The standard L<sup>A</sup>T<sub>E</sub>X part is renewed next. We avoid all the complications of the kernel with different longish sections for chapters and parts.

```

262 \ExplSyntaxOn
263 \cs_gset:Npn \emptypagecontents{This~is~an~empty~page.}
264 \ExplSyntaxOff
265
266
267 \NewDocumentCommand\EmptyPageContents{ m }{
268 \global\long\def\emptypagecontents {#1}
269 }
270
271 \EmptyPageContents{%
272   \vspace*\{\fill\}%
273   \begin{center}
274     \LARGE \lorem
275   \end{center}
276   \vspace{\fill}%
277   \thispagestyle{empty}
278 }
279
280 \long\def\cleardoublepage{\clearpage\if@twoside\ifodd\c@page\else
281   \hbox{}%
282   \emptypagecontents\tikz[In Clear Double Page, empty page]
283   \newpage
284   \if@twocolumn\hbox{}\newpage\fi\fi\fi}

```

**\part**

```

285 \ExplSyntaxOn
286 \renewcommand\part {%
287   \newpage\null
288   \thispagestyle{empty}
289   \start_section:nnnnnnnn{part}%
290   {-1} %level check this conflicts with source2e
291   {\l__phd_part_indent_tl} %indent#2
292

```

```

293     {\l__phd_part_beforeskip_tl}%before skip#3
294
295     {\l__phd_part_afterskip_tl}% after skip#4
296
297     {
298     % \setfont@cx
299     % {\l__phd_chapter_fontweight_tl}%
300     % {\l__phd_chapter_fontfamily_tl}
301     % {\l__phd_chapter_fontsize_tl}
302     % {\l__phd_chapter_fontshape_tl}%
303     %\expandafter\setfontparam@cx\l__phd_chapter_align_tl;%
304     %\l__phd_part_color_tl %5
305     }
306   }
307 \ExplSyntaxOff

(End definition for \part.)

308 \ExplSyntaxOn
309 \cs_gset:Npn \phd_set_opening #1 {
310   \bool_if:cT {chapter_open_left_bool} {
311     \cleartoevenpage\null
312     \global\@topnum\z@\~
313     \tikzi[open~left]
314     \bool_gset_false:c {\#1_open_right_bool}
315     \bool_gset_false:c {\#1_open_any_bool}
316     \bool_gset_false:c {\#1_open_anywhere_bool}
317   }
318   \bool_if:cT {\#1_open_right_bool}
319   {
320     \cleardoublepage\null
321     \global\@topnum\z@\~
322     \tikzi[open~right]
323     \bool_gset_false:c {\#1_open_left_bool}
324     \bool_gset_false:c {\#1_open_any_bool}
325     \bool_gset_false:c {\#1_open_anywhere_bool}
326   }
327   \bool_if:cT {\#1_open_any_bool}
328   {
329     \clearpage\null
330     \global\@topnum\z@\~
331     \tikzi[open~any]
332     \bool_gset_false:c {\#1_open_left_bool}
333     \bool_gset_false:c {\#1_open_right_bool}
334     \bool_gset_false:c {\#1_open_anywhere_bool}
335   }
336   \bool_if:cT {\#1_open_anywhere_bool}
337   {
338     \global\@topnum\z@\~
339     \tikzi[open~anywhere ]
340     \bool_gset_false:c {\#1_open_left_bool}
341     \bool_gset_false:c {\#1_open_right_bool}
342     \bool_gset_false:c {\#1_open_any_bool}
343   }
344 }

```

```
345 \ExplSyntaxOff
```

```
\chapter {*} [{arg1}] [{arg2}]
```

The standard L<sup>A</sup>T<sub>E</sub>X chapter is renewed next. We avoid all the complications of the kernel with different longish sections for chapters and parts. However some more coding is required here.

```
346 \ExplSyntaxOn
347 \renewcommand\chapter {%
348   \phd_set_opening{chapter}
349   \% \bool_if:NT \chapter_open_left_bool {
350     \% \cleartoevenpage
351     \% \global\@topnum\z@~
352     \% \noindent\ldots open~left\par \tikz[open~left]
353     \% \bool_gset_false:N \chapter_open_right_bool
354     \% \bool_gset_false:N \chapter_open_any_bool
355     \% \bool_gset_false:N \chapter_open_anywhere_bool
356   }
357   \% \bool_if:NT \chapter_open_right_bool {
358     \% \cleardoublepage
359     \% \global\@topnum\z@~
360     \% \noindent\ldots open~right\par \tikz[open~right]
361     \% \bool_gset_false:N \chapter_open_left_bool
362     \% \bool_gset_false:N \chapter_open_any_bool
363     \% \bool_gset_false:N \chapter_open_anywhere_bool
364   }
365   \% \bool_if:NT \chapter_open_any_bool {
366     \% \clearpage
367     \% \global\@topnum\z@~
368     \% \noindent\ldots open~any\par \tikz[open~any]
369     \% \bool_gset_false:N \chapter_open_left_bool
370     \% \bool_gset_false:N \chapter_open_right_bool
371     \% \bool_gset_false:N \chapter_open_anywhere_bool
372   }
373   \% \bool_if:NT \chapter_open_anywhere_bool {
374     \% \global\@topnum\z@~
375     \% \noindent\ldots open~anywhere\par \tikz[open~anywhere ]
376     \% \bool_gset_false:N \chapter_open_left_bool
377     \% \bool_gset_false:N \chapter_open_right_bool
378     \% \bool_gset_false:N \chapter_open_any_bool
379   }
380   \% \thispagestyle{empty}
381   \% \newpage
382   \% \bool_show:c \chapter_open_right_bool
383   \% \start_section:nnnnnnnn{chapter}%
384     {0} % level check this conflicts with source2e
385   \% \l_phd_chapter_indent_tl} % indent#2
386
387
388
389
390
391
```

```

392     {\l_phd_chapter_beforeskip_tl}%
393     {\l_phd_chapter_afterskip_tl}%
394     % after skip#4
395
396     \setfont@cx
397     {\l_phd_chapter_fontweight_tl}%
398     {\l_phd_chapter_fontfamily_tl}
399     {\l_phd_chapter_fontsize_tl}
400     {\l_phd_chapter_fontshape_tl}%
401     %\expandafter\setfontparam@cx{\l_phd_chapter_align_tl;}%
402     %\color{\l_phd_chapter_color_tl}%
403     {}
404     {}
405
406     }%
407

```

**\section** *(\* [arg1] {arg2})*

The standard L<sup>A</sup>T<sub>E</sub>X subsection is renewed next.

```

408
409 \if@ltxcompat
410 \else
411   \renewcommand\section{%
412     \@startsection{section}{%
413       {1}%level check this conflicts with source2
414
415       {\l_phd_section_indent_tl}%
416       {\l_phd_section_beforeskip_tl}%
417       {\l_phd_section_afterskip_tl}%
418       % after skip#4
419       {
420         \set_font_aux:n {\l_phd_section}
421         {\l_phd_section_fontweight_tl}%
422         {\l_phd_section_fontfamily_tl}
423         {\l_phd_section_fontsize_tl}
424         {\l_phd_section_fontshape_tl}%
425         %\expandafter\setfontparam@cx{\l_phd_section_align_tl;}%
426         \l_phd_section_color_tl %
427         5
428       }
429     }%
430   }%
431 }
432 \fi
433 \ExplSyntaxOff

```

**\subsection** *(\* [arg1] {arg2})*

The standard L<sup>A</sup>T<sub>E</sub>X subsection is renewed next.

```

434 \ExplSyntaxOn
435 \if@ltxcompat
436 \else
437 %

```

```

438 \renewcommand{\subsection}
439 {
440     \@startsection{subsection}
441     {1}
442     {\l__phd_subsection_indent_tl}%
443     {\l__phd_subsection_beforeskip_tl}%
444     {\l__phd_subsection_afterskip_tl}%
445
446     {
447         \set_font_aux:n {\l__phd_subsection}
448         % \expandafter\setfontparam@cx\l__phd_subsection_align_tl;%
449         \l__phd_subsection_color_tl %5
450     }
451 }
452 \fi
453 \ExplSyntaxOff
454 \% \renewcommand{\subsection}{\@startsection{subsection}{2}{\z@}%
455 %   {-3.25ex plus -%
456 %   1.5ex plus .2ex}%
457 %   {\normalfont\large\bfseries\raggedright}}
458 \% \fi
459 %

```

**\subsubsection** *(\* [arg1] {arg2})*

The standard L<sup>A</sup>T<sub>E</sub>X subsection is renewed next.

```

460 \ExplSyntaxOn
461 \if@ltxcompat
462 \else
463 \renewcommand{\subsubsection}
464 {
465     \@startsection{subsubsection}%
466     {3}%
467     {\l__phd_subsubsection_indent_tl}%
468     {\l__phd_subsubsection_beforeskip_tl}%
469     {\l__phd_subsubsection_afterskip_tl}%
470     {
471         \set_font_aux:n {\l__phd_subsubsection}
472         % \l__phd_subsubsection_fontweight_tl %
473         % \l__phd_subsubsection_fontfamily_tl %
474         % \l__phd_subsubsection_fontsize_tl %
475         % \l__phd_subsubsection_fontshape_tl %
476         % \expandafter\setfontparam@cx
477         % \l__phd_subsubsection_align_tl;
478         \l__phd_subsubsection_color_tl
479     }
480 }
481 \fi
482 \ExplSyntaxOff

```

### I.0.1 Paragraphs

We now deal with paragraphs and subparagraphs, normally termed ‘runin’ heads, as they produce headings that are inlined with the text that follows. We add hooks, so that later the key mechanism can be used to pick-up values. Although they are termed runins, there is no issue to display them as block.

**\paragraph** *<\*>* [*<arg1>*] {*<arg2>*}

There is a feature in the standard L<sup>A</sup>T<sub>E</sub>X classes that a subparagraph is indented by the value of **\parindent**. This also features in memoir but is absent in the KOMA classes. In our defaults we follow the European norm.

Next we provide our definition for paragraphs.

```

483 \ExplSyntaxOn
484 %\if@ltxcompat
485 %\renewcommand\paragraph{\@startsection{paragraph}{4}{\z@}%
486 %                                {3.25ex plus1ex minus.2ex}%
487 %                                {-1em}%
488 %                                {\normalfont\normalsize\bfseries}}
489 %\else
490 %\if@ltxcompat
491 %\else
492   \renewcommand\paragraph{
493     \@startsection{paragraph}
494     {4}%
495     {\l__phd_paragraph_indent_tl}%
496     {\l__phd_paragraph_beforeskip_tl}%
497     {\l__phd_paragraph_afterskip_tl}%
498     {
499       \set_font_aux:n {\l__phd_paragraph}
500       {\l__phd_paragraph_fontweight_tl}%
501       {\l__phd_paragraph_fontfamily_tl}%
502       {\l__phd_paragraph_fontsizetl}%
503       {\l__phd_paragraph_fontshape_tl}%
504       \expandafter\setfontparam@cx\l__phd_paragraph_align_tl;%
505       \l__phd_paragraph_color_tl
506     }%
507   }
508 %\fi
509 \ExplSyntaxOff

```

### I.0.2 Subparagraph

**\subparagraph** *<\*>* [*<arg1>*] {*<arg2>*}

There is a feature in the standard L<sup>A</sup>T<sub>E</sub>X classes that a subparagraph is indented by the value of **\parindent**. This also features in memoir but is absent in the KOMA classes. In our defaults we follow the European norm.

```

510 \ExplSyntaxOn
511 \if@ltxcompat
512   \renewcommand\subparagraph{\@startsection{subparagraph}{5}{0pt}%
513                                {2ex}%

```

```
514                                     {-1em}%
515                                     {\normalfont\normalsize\bfseries}}
516 \else
517 \renewcommand\subparagraph
518 {
519     \@startsection{subparagraph}
520     {5}%
521     {\l_phd_subparagraph_indent_tl}%
522     {\l_phd_subparagraph_beforeskip_tl}
523     {\l_phd_subparagraph_afterskip_tl}
524     {
525         \set_font_aux:n {\l_phd_subparagraph}
526         \expandafter\setfontparam@cx
527             \l_phd_subparagraph_align_tl;
528             \l_phd_subparagraph_color_tl
529     }
530 }
531
532 \fi
533 \ExplSyntaxOff
```



# Default Settings

This chapter provides the objectives of the package, provides the methodology to attack the problem and discusses the difficulties encountered in trying to provide a full declarative interface.



## Setting default values

```

1 \cxset{%
2 /LSECT
3 *LSECT|DFLT
4   part format           = traditional,
5   chapter title margin-top-width = 0cm,
6   chapter title margin-right-width = 1cm,
7   chapter title margin-bottom-width = 10pt,
8   chapter title margin-left-width = 0pt,
9   chapter align          = left,
10  chapter title align    = left, %checked
11  chapter name           = chapter,
12  chapter format         = fashion,
13  chapter font-size      = Huge,
14  chapter font-weight     = bold,
15  chapter font-family     = sffamily,
16  chapter font-shape      = upshape,
17  chapter color           = black,
18  chapter number prefix   = ,
19  chapter number suffix   = ,
20  chapter numbering        = arabic,
21  chapter indent          = 0pt,
22  chapter beforeskip      = -3cm,
23  chapter afterskip       = 30pt,
24  chapter afterindent     = off,
25  chapter number after    = ,
26  chapter arc              = 0mm,
27  chapter background-color = white,
28  chapter afterindent     = off,
29  chapter grow left        = 0mm,
30  chapter grow right       = 0mm,
31  chapter rounded corners = northeast,
32  chapter shadow          = fuzzy halo,
33  chapter border-left-width = 0pt,
34  chapter border-right-width = 0pt,
35  chapter border-top-width = 0pt,
36  chapter border-bottom-width = 0pt,
37  chapter padding-left-width = 0pt,
38  chapter padding-right-width = 10pt,
39  chapter padding-top-width = 10pt,
40  chapter padding-bottom-width = 10pt,
41  chapter number color     = white,
42  chapter label color      = black,
43 %
44  chapter number font-size = huge,
45  chapter number font-weight = bfseries,
46  chapter number font-family = sffamily,
47  chapter number font-shape = upshape,
48  chapter number align      = Centering,
49 %
50  chapter title font-size = Huge,
51  chapter title font-weight = bold,
52  chapter title font-family = sffamily,
53  chapter title font-shape = upshape,

```

```

54     chapter title color      = black,
55 /LSECT|DFLT
56 *LSECT
57 }

58 /LSECT
59 *LSECT|DFLT
60 LSECT\cxset {
61     section name            = Section,
62     section format          = traditional,
63     section align            = Centering,
64     section title align      = Centering, %checked
65 %
66     section font-size        = Large,
67     section font-weight       = bfseries,
68     section font-family       = serif,
69     section font-shape        = upshape,
70 %
71     section number font-size = Large,
72     section number font-weight = bfseries,
73     section number font-family = serif,
74     section number font-shape = upshape,
75 %
76     section title font-size   = Large,
77     section title font-weight  = bfseries,
78     section title font-family = serif,
79     section title font-shape   = upshape,
80 %
81     section color             = black,
82     section number prefix     = \thechapter.,
83     section number suffix      = ,
84     section numbering          = arabic,
85     section indent             = 0pt,
86     section beforeskip         = 3ex,
87     section afterskip          = 1.5ex plus .1ex,
88     section afterindent        = on,
89     section number after       = \quad,
90 %
91     section arc                  = 3pt,
92     section background-color    = white,
93     section afterindent          = on,
94     section grow left           = 0mm,
95     section grow right          = 0mm,
96     section rounded corners      = northeast,
97 %
98     section border-left-width   = 0pt,
99     section border-right-width  = 0pt,
100    section border-top-width    = 2pt,
101    section border-bottom-width = 2pt,
102 %
103   section padding-left-width  = 0pt,
104   section padding-right-width = 10pt,
105   section padding-top-width   = 2pt,
106   section padding-bottom-width = 2pt,

```

```

107 %
108   section title margin-top-width = 2pt,
109   section title color           = thesectiontitlecolor,
110   section shadow              = no shadow,
111 LSECT}
112 /LSECT|DFLT
113 *LSECT

114 \cxset
115 {
116 /LSECT
117 *LSECT|DFLT
118 %% sybsection
119   subsection name             = Subsection,
120   subsection format           = hang,
121 %
122   subsection font-size        = large,
123   subsection font-weight      = bfseries,
124   subsection font-family      = rmfamily,
125   subsection font-shape       = upshape,
126 %
127   subsection number font-size = large,
128   subsection number font-weight = bfseries,
129   subsection number font-family = rmfamily,
130   subsection number font-shape = upshape,
131 %
132   subsection title font-size  = Large,
133   subsection title font-weight = bfseries,
134   subsection title font-family = sffamily,
135   subsection title font-shape = upshape,
136   subsection title color      = bgsexy,
137 %
138   subsection color            = bgsexy,
139   subsection numbering        = arabic,
140   subsection align            = Centering, %checked
141   subsection title align      = Centering, %checked
142   subsection beforeskip       = -3.25explus -
143   subsection minus -.2ex,
144   subsection afterskip        = 1.5ex plus .2ex,
145   subsection number prefix    = \thesection.,
146   subsection indent           = 0pt,
147   subsection number after     = 0pt,
148 %
149   subsection background-color = white,
150 %
151   subsection border-left-width = 0pt,
152   subsection border-right-width = 0pt,
153 %
154   subsection border-top-width = 5pt,
155   subsection border-bottom-width = 5pt,
156 %
157   subsection padding-left-width = 0pt,
158   subsection padding-right-width = 0pt,
159   subsection padding-top-width = 20pt,
160   subsection padding-bottom-width = 20pt,
161   subsection shadow           = drop shadow,

```

```

159 /LSECT|DFLT
160 *LSECT
161 }

162 \cxset
163 {
164 /LSECT
165 *LSECT|DFLT
166     subsubsection name          = Subsubsection,
167     subsubsection format        = hang,
168     subsubsection background-color = white, %checked
169     subsubsection afterindent    = off,
170 %
171     subsubsection font-family   = rmfamily,
172     subsubsection font-size    = large,
173     subsubsection font-weight   = bfseries,
174     subsubsection font-family   = tiresias,
175     subsubsection font-shape    = upshape,
176 %
177     subsubsection font-family   = sffamily,
178     subsubsection font-size    = large,
179     subsubsection font-weight   = bfseries,
180     subsubsection font-family   = tiresias,
181     subsubsection font-shape    = upshape,
182 %
183     subsubsection color         = black,
184     subsubsection number prefix = \thesubsection,
185     subsubsection number suffix = ,
186     subsubsection numbering     = arabic,
187     subsubsection indent        = 0pt,
188     subsubsection beforeskip    = -3.25explus -
189     subsubsection afterskip     = 1.5ex plus .2ex,
190     subsubsection align         = center,
191     subsubsection title align   = center,
192     subsubsection number after  = ,
193 %
194     subsubsection border-left-width = 0pt,
195     subsubsection border-right-width = 0pt,
196     subsubsection border-top-width  = 2pt,
197     subsubsection border-bottom-width = 0pt,
198 %
199     subsubsection padding-left-width = 0pt,
200     subsubsection padding-right-width = 0pt,
201     subsubsection padding-top-width  = 20pt,
202     subsubsection padding-bottom-width = 20pt,
203     subsubsection shadow         = no shadow,
204 %
205     subsubsection title font-size = large,
206     subsubsection title font-weight = bfseries,
207     subsubsection title font-family = serif,
208     subsubsection title font-shape = itshape,
209     subsubsection title color    = thesubsectiontitlecolor,
210 /LSECT|DFLT

```

```

211 *LSECT
212 }

213 % paragraph
214 \cxset
215 {
216 /LSECT
217 *LSECT|DFLT
218   paragraph name          = paragraph,
219   paragraph format        = inline,
220   paragraph name          = paragraph,
221   paragraph font-size     = large,
222   paragraph font-weight    = bfseries,
223   paragraph font-family   = rmfamily,
224   paragraph font-shape    = upshape,
225   paragraph numbering      = alpha,
226   paragraph number prefix = \thesubsubsection,
227   paragraph align         = flushleft,
228   paragraph beforeskip    = 3.25ex plus1ex minus.2ex,
229   paragraph afterskip     = -1em,
230   paragraph indent        = 0pt,
231   paragraph number after  = \quad,
232   paragraph color         = bgsexy,
233   paragraph background-color = white,
234   paragraph shadow        = no shadow,
235   paragraph afterindent   = off
236 /LSECT|DFLT
237 *LSECT
238 }

239 \cxset
240 {
241 /LSECT
242 *LSECT|DFLT
243   subparagraph name        = subparagraph,
244   subparagraph format      = inline,
245   subparagraph name        = subparagraph,
246   subparagraph font-size   = large,
247   subparagraph font-weight  = bfseries,
248   subparagraph font-family = rmfamily,
249   subparagraph font-shape   = upshape,
250   subparagraph color       = bgsexy,
251   subparagraph background-color = bgsexy,
252   subparagraph numbering   = none,
253   subparagraph align       = flushleft,
254   subparagraph beforeskip  = 3.25ex plus1ex minus .2ex,
255   subparagraph afterskip   = -1em,
256   subparagraph indent      = 0pt,
257   subparagraph number after = ,
258   %subparagraph shadow     = off,
259 /LSECT|DFLT
260 *LSECT
261 }

```

## J.1 Styles

```
262 \cxset{chapter title style/.style= {
263     chapter title align = left,}
264 }
265 \cxset{section title style/.style= {
266     section title align = Centering,}
267 }
268 \cxset{section title style/.style= {
269     section title align = Centering,}
270 }
271 \cxset{subsection title style/.style= {
272     subsection title align = Centering,}
273 }
274 \cxset{subsubsection title style/.style=
275 {
276     subsubsection align      = #1,
277     subsubsection title align = #1,
278 }
279 }
280 %
281 \cxset{%
282     subsubsection title style= raggedright
283 }
```



# Tests

This chapter provides the objectives of the package, provides the methodology to attack the problem and discusses the difficulties encountered in trying to provide a full declarative interface.



We prepare a number of tests to verify that all settings work as advertised.

### \testsections<void>

In honor of Barbara Beeton all testing commands are in lowercase, but we also provide them in mixed case for the rest of the crowd.

```
1 % predefined unnumbered headings for compatibility with Springer classes
2 \newcommand{\preface}[1][\prefacename]{\chapter*{\#1}\markboth{\#1}{\#1}}
3 \newcommand{\foreword}[1][\forewordname]{\chapter*{\#1}\markboth{\#1}{\#1}}
4
5 % TODO
6 \newcommand{\extrachap}[1]{\chapter*{\#1}\markboth{\#1}{\#1}}
7 \ExplSyntaxOn
8 \cs_set:Npn \testsections
9  {
10   \section{Sections}
11   \lorem\par
12   \subsection{Subsections}
13   \lorem\par
14   \subsubsection{Subsubsections}
15   \lorem\par
16   \paragraph {Paragraph}
17 }
18 \cs_set_eq:NN \TestSections\testsections
19 \ExplSyntaxOff
```

1

## **Abstract**

This is the Ukrainian language module for the `datetime2` package. If you want to use the settings in this module you must install it in addition to installing `datetime2`. If you use `babel` or `polyglossia`, you will need this module to prevent them from redefining `\today`. The `datetime2` `useregional` setting must be set to "text" or "numeric" for the language styles to be set. Alternatively, you can set the style in the document using `\DTMsetstyle`, but this may be changed by `\dateukrainian` depending on the value of the `useregional` setting.

L

# The phd-i18n Package

This chapter provides the objectives of the package, provides the methodology to attack the problem and discusses the difficulties encountered in trying to provide a full declarative interface.



One of the primary aims of the package was to simplify the user interface. At the author level, if one has the appropriate stylesheet, nothing needs to be done.

# Section L.1

---

## *Usage*

---

To set the main language of the document use:

```
% \cxset{locale german}  
%
```

This is best done early in the preamble.

To use any secondary language in the text, there is no need with LuaLaTeX to do anything in the preamble. Just use the appropriate `\text` command.

```
\textgerman{your text here}
```

For longer texts you can use the environment type commands:

```
\begin{ngerman}  
\end{ngerman}
```

All locale names can be inputted in multiple ways: a) Using the lowercase name of the language as found in polyglossia or Babel. Using a title case of the language name i.e., `Greek` or `greek`. You can also use the ISO two code or BCF47 codes for greek it would be `el`. If there are dialects you can use `UKenglish`, as in Babel. Remember you only input the main language. If you do not and the package is included it will default to `UKenglish`.

<\*package>



# Implementation

This chapter provides the objectives of the package, provides the methodology to attack the problem and discusses the difficulties encountered in trying to provide a full declarative interface.



# Section A.1

---

## *Specification*

---

1. Provide translation strings for all languages listed in the Babel and polyglossia packages and extend this to all the unicode languages.
2. Handle date time.
3. Provide useful macros.
4. Set quotation marks for the language.
5. Provide lua code where appropriate.
6. Handle specific numerals, for languages that have their own numerals.
7. Handle text directionality without having to load the bidi package.
8. Handle Asian languages.
9. Rationalize methodology and algorithms as far as possible.
10. Enable traditional typesetting rules for the language. I am not too sure if this belongs here, as at least for sectioning commands this is provided by the sectioning keys, however it makes no harm to re-introduce it here.
  - (a) Different enumerate environments (e.g. for French).
  - (b) Indentation of paragraphs after sections (e.g. French, basque, Ukrainian).
  - (c) French spacing after punctuation.
  - (d) Spacing before colons.
11. No active quotes will be provided by default, as we expect the author to enter commands using unicode. However these will be provided as options and be compatible with Babel.
12. Version 1.0 should work with Lua $\text{\LaTeX}$  only. Higher versions will be adapted to work with  $\text{\LaTeX}$  and  $\text{\XeTeX}$ , as far as this is feasible..
13. Provide a Go or Lua pre-processor utility to reduce the user mark-up for quotations and other similar cases such as spacing before and after \ldots.

## Section A.2

---

### *Data*

---

1. The CLDR data currently at version 33.1 will be used as the data source for translations available in the CLDR specification. A Go program will be developed to download the data and transform it to LATEX macros.
2. The CLDR does not provide translations for sectioning and other common strings currently required. These will be manually entered.
3. Number formatting will use the CLDR data.
4. Date formatting will use both the CLDR data as well as current conventional data formatting as used in polyglossia and babel.

## Section A.3

---

### *Preliminaries*

---

Standard file identification. We first announce the package and require that it be used with LATEX2e.

```
1 \NeedsTeXFormat{LaTeX2e}[2017/04/15]%
2 \ProvidesPackage{phd-i18n}[2018/1/13 v1.0 i18N utilities (YL)]%
```

## Section A.4

---

### *Keys*

---

The keys are defined using the PGF keys package. I diverted from the normal pattern used in other phd packages, using a higher number of paths than normal. I did this, as it can give more flexibility to user extensions and also to have almost a one to one relationship with the nesting found in CLDR language files.

We first define a generic command to generate keys for a language tag.

```

3 \ExplSyntaxOn
4 \def\setcaptions#1{
5 \cxset
6 {
7   locale/#1/captions/refname/.code           =
8     \cs_set:cpn {refname} {##1}
9     \cs_set:cpn {greekrefname} {##1},
10  locale/#1/captions/abstractname/.code        =
11    \def\abstractname{##1},
12  locale/#1/captions/bibname/.code             =
13    \def\bibname{##1},
14  locale/#1/captions/prefacename/.code          =
15    \def\prefacename{##1},
16  locale/#1/captions/chaptername/.code          =
17    \def\chaptername{\panunicode ##1},
18  locale/#1/captions/appendixname/.code         = \cs_set:cpn {appendixname} {##1},
19  locale/#1/captions/contentsname/.code          = \cs_set:cpn {contentsname} {##1},
20  locale/#1/captions/listfigurename/.code        = \cs_set:cpn {listfigurename} {##1},
21  locale/#1/captions/listtablename/.code         = \cs_set:cpn {listtablename} {##1},
22  locale/#1/captions/indexname/.code            = \cs_set:cpn {indexname} {##1},
23  locale/#1/captions/figurename/.code           = \cs_set:cpn {figurename} {##1},
24  locale/#1/captions/tablename/.code            = \cs_set:cpn {tablename} {##1},
25  locale/#1/captions/partname/.code             = \cs_set:cpn {partname} {##1},
26  locale/#1/captions/pagename/.code             = \cs_set:cpn {pagename} {##1},
27  locale/#1/captions/seename/.code              = \cs_set:cpn {seename} {##1},
28  locale/#1/captions/also name/.code            = \cs_set:cpn {also name} {##1},
29  locale/#1/captions/enclname/.code             = \cs_set:cpn {enclname} {##1},
30  locale/#1/captions/ccname/.code               = \cs_set:cpn {ccname} {##1},
31  locale/#1/captions/headtoname/.code           = \cs_set:cpn {headtoname} {##1},
32  locale/#1/captions/proofname/.code            = \cs_set:cpn {proofname} {##1},
33  locale/#1/captions/glossaryname/.code         = \cs_set:cpn {glossaryname} {##1},

```

For dates we have a slightly different approach than Babel and Polyglossia, we just redefine `\today`. So far I don't see the need to define `\date(language)`. If the language is set as main language it will work ok and for others it will work in a group. It will save +- 100 tokens. We can always add it, afterwards just for documentation if necessary.

```

34  locale/#1/date/.code  = \cs_set:cpn {today} {##1}
35  \cs_set:cpn {date#1}{##1},

```

## Subsection A.4.1

### Numbers

For numbers we define one to one keys to match the numbers.json of the CLDR specification for the language.

```

36   locale/#1/numbers/defaultnumberingsystem/.code      =
37     \def\defaultnumberingsystem{##1},                  =
38   locale/#1/numbers/othenumberingsystems/.code        =
39     \def\othernumberingsystems{##1},                  =
40   locale/#1/numbers/minimumgroupdigits/.code         =
41     \def\minimumgroupdigits{##1},                  =
42   locale/#1/numbers/symbols/decimal/.code            =
43     \def\symbolsdecimal{##1},                  =
44   locale/#1/numbers/symbols/group/.code              =
45     \def\symbolsgroup{##1},                  =
46   locale/#1/numbers/symbols/list/.code               =
47     \def\symbolslist{##1},                  =
48   locale/#1/numbers/symbols/centsign/.code          =
49     \def\symbolspermille{##1},                  =
50   locale/#1/numbers/symbols/plussign/.code          =
51     \def\symbolsplussign{##1},                  =
52   locale/#1/numbers/symbols/minussign/.code         =
53     \def\symbolsminussign{##1},                  =
54   locale/#1/numbers/symbols/exponential/.code       =
55     \def\symbolsexponential{##1},                  =
56   locale/#1/numbers/symbols/superscriptingexponent/.code =
57     \def\symbolssuperscriptingexponent{##1},      =
58   locale/#1/numbers/symbols/permille/.code          =
59     \def\symbolsnan{##1},                  =
60   locale/#1/numbers/symbols/infinity/.code          =
61     \def\symbolsinfinity{##1},                  =
62   locale/#1/numbers/symbols/nan/.code               =
63     \def\symbolsnan{##1},                  =
64   locale/#1/numbers/symbols/timeseparator/.code    =
65     \def\symbolstimeseparator{##1},                  =
66 %
67 }
68 }
69
70 \setcaptions{asturian}
71 \setcaptions{amharic}
72 \setcaptions{greek}
73 \setcaptions{german}
74 \setcaptions{french}
75 \setcaptions{italian}
76 \setcaptions{albanian}
77 \setcaptions{malayalam}
78 \setcaptions{basque}
79 \setcaptions{brazil}
80 \setcaptions{breton}
81 \setcaptions{bulgarian}
82 \setcaptions{catalan}
83 \setcaptions{croatian}
84 \setcaptions{czech}
85 \setcaptions{danish}
86 \setcaptions{dutch} %TODO

```

```

87 \setcaptions{estonian}
88 \setcaptions{finnish}
89 \setcaptions{friulan}
90 \setcaptions{galician}
91 \setcaptions{icelandic}
92 \setcaptions{irish}
93 \setcaptions{latin}
94 \setcaptions{latvian}
95 \setcaptions{lithuanian}
96 \setcaptions{lsorbian}
97 \setcaptions{magyar}
98 \setcaptions{marathi}
99 \setcaptions{nko}
100 \setcaptions{norsk}
101 \setcaptions{occitan}
102 \setcaptions{piedmontese}
103 \setcaptions{polish}
104 \setcaptions{portuges}
105 \setcaptions{romanian}
106 \setcaptions{romansh}
107 \setcaptions{samin}
108 \setcaptions{serbian}
109 \setcaptions{serbian~cyrillic}
110 \setcaptions{slovak}
111 \setcaptions{slovenian}
112 \setcaptions{swedish}
113 \setcaptions{tamil}
114 \setcaptions{telugu}
115 \setcaptions{turkish}
116 \setcaptions{turkmen}
117 \setcaptions{ukrainian}
118 \setcaptions{usorbian}
119 \setcaptions{hangul}
120 \setcaptions{welsh}
121 \setcaptions{russian}

```

## Section A.5

### *Retrieving the translation strings*

```

\gettext[<language>]caption name
122      \NewDocumentCommand{\gettext}{o m m}{%
123          \cxset{locale~#2}
124          \csname #3name\endcsname}

```

Retrieve the text for chapter in Danish danishchapter

danhappendix  
Get appendix in Greek greekappendix

## Section A.6

### *Functions generated via scripts*

A number of L<sup>A</sup>T<sub>E</sub>X 3 functions are generated automatically via a Go program. The Go script obtains data for a particular language tag via the CLDR database and transforms the data into suitable TeX commands. As TeX commands are stored in memory this is faster for execution.

`\l_phd_months_wide_language<month>`

Used to print the wide format month for a *(language)*.

`\l_phd_months_abbreviated_language<month>`

Used to print the wide format month for a *(language)*.

`\l_phd_months_narrow_language<month>`

Used to print the wide format month for a *(language)*.

## Section A.7

### *Asturian*

Astur-Leonese is the historical language of Asturias, portions of the Spanish provinces of León and Zamora and the area surrounding Miranda do Douro in northeastern Portugal.[8] Like the other Romance languages of the Iberian peninsula, it evolved from Vulgar Latin during the early Middle Ages. Asturian was closely linked with the Kingdom of Asturias (718–910) and the ensuing Leonese kingdom. The language had contributions from pre-Roman languages spoken by the Astures, an Iberian Celtic tribe, and the post-Roman Germanic languages of the Visigoths and Suevi. CLDR language code = ast

```
125 \cxset{locale~asturian/.style = {
126   locale/asturian/captions/refname      = Referencies,
127   locale/asturian/captions/abstractname  = Sumariu,
```

```

128  locale/asturian/captions/bibname      = Bibliografía,
129  locale/asturian/captions/prefacename   = Entamu,
130  locale/asturian/captions/chaptername   = Capítulu,
131  locale/asturian/captions/appendixname  = Apéndiz,
132  locale/asturian/captions/contentsname  = Conteniu,
133  locale/asturian/captions/listfigurename = Llista~de~figures,
134  locale/asturian/captions/listtablename  = Llista~de~tables,
135  locale/asturian/captions/indexname    = Índiz,
136  locale/asturian/captions/figurename   = Figura,
137  locale/asturian/captions/tablename    = Tabla,
138  locale/asturian/captions/partname     = Parte,
139  locale/asturian/captions/pagename    = Páxina,
140  locale/asturian/captions/seename     = ver,
141  locale/asturian/captions/alsoiname   = ver~tamién,
142  locale/asturian/captions/enclname   = incl.,
143  locale/asturian/captions/ccname     = cc,
144  locale/asturian/captions/headtoname  = Pa,
145  locale/asturian/captions/proofname   = Demostración,
146  locale/asturian/captions/glossaryname = Glosariu,
147  locale/asturian/date=\number\day~\ifcase\month\or
148    de~xineru\or de~febreru\or de~marzu\or d'abril\or de~mayu\or de~xunu\or
149    de~xunetu\or d'agostu\or de~setiembre\or d'ochobre\or de~payares\or
150    d'avientu\fi\space de~\number\year,
151  }
152 \cxset{locale~Asturian/.alias = locale~asturian}

```

Asturian

## Section A.8

### *Amharic*

CLDR is am

```

153 \cxset{locale~amharic/.style = {
154   locale/amharic/captions/refname      = ~~, 
155   locale/amharic/captions/abstractname = ~, 
156   locale/amharic/captions/bibname     = ~, 
157   locale/amharic/captions/prefacename = , 
158   locale/amharic/captions/chaptername = , 
159   locale/amharic/captions/appendixname = , 
160   locale/amharic/captions/contentsname = , 
161   locale/amharic/captions/listfigurename = ~, 
162   locale/amharic/captions/listtablename = ~, 
163   locale/amharic/captions/indexname   = ~, 
164   locale/amharic/captions/figurename  = , 
165   locale/amharic/captions/tablename   = , 
166   locale/amharic/captions/partname   = ,

```

```

167   locale/amharic/captions/pagename      = ,
168   locale/amharic/captions/seename       = ,
169   locale/amharic/captions/alsoname      = ~,
170   locale/amharic/captions/enclname     = ,
171   locale/amharic/captions/ccname       = ,
172   locale/amharic/captions/headtoname   = ,
173   locale/amharic/captions/proofname    = ,
174   locale/amharic/captions/glossaryname = ~,
175   locale/amharic/date=\number\day\space\ifcase\month\or
176     de~xineru\or de~febreru\or de~marzu\or d'abril\or de~mayu\or de~xunu\or
177     de~xunetu\or d'agostu\or de~setiembre\or d'ochobre\or de~payares\or
178     d'avientu\fi\space de~\number\year,
179 }
180
181 \cxset{locale~Amharic/.alias = locale~amharic}
Amharic

```

## Section A.9

### *Greek*

```

182 \cs_set:Npn \l_phd_months_wide_greek #1 {
183   \if_case:w #1
184     \or:
185     \or:
186     \or:
187     \or: π
188     \or:
189     \or:
190     \or:
191     \or:
192     \or: π
193     \or:
194     \or:
195     \or:
196   \fi:
197 }
198 \cxset{locale~greek/.style = {
199   locale/greek/captions/refname      = ,
200   locale/greek/captions/abstractname = ,
201   locale/greek/captions/bibname     = ,
202   locale/greek/captions/prefacename = ,
203   locale/greek/captions/chaptername = ,
204   locale/greek/captions/appendixname = ,
205   locale/greek/captions/contentsname = ,
206   locale/greek/captions/listfigurename = ~,
207   locale/greek/captions/listtablename = ~π,

```

```

208  locale/greek/captions/indexname      = ,
209  locale/greek/captions/figurename     = ,
210  locale/greek/captions/tablename      = ,
211  locale/greek/captions/partname       = ,
212  locale/greek/captions/pagename       = ,
213  locale/greek/captions/seename        = π,
214  locale/greek/captions/alsoname       = π~π,
215  locale/greek/captions/enclname       = ,
216  locale/greek/captions/ccname         = π,
217  locale/greek/captions/headtoname     = ,
218  locale/greek/captions/proofname      = π,
219  locale/greek/captions/glossaryname   = ,
220  locale/greek/date = {\number\day\space%
221    \l_phd_months_wide_greek {\month}
222    \space\number\year},
223 }
224 \cxset{locale~Greek/.alias = locale~Greek}

```

Greek

## Section A.10

### *German*

```

225 \cs_set:Npn \l_phd_months_wide_german #1 {
226   \if_case:w #1
227     \or: Januar
228     \or: Februar
229     \or: März
230     \or: April
231     \or: Mai
232     \or: Juni
233     \or: Juli
234     \or: August
235     \or: September
236     \or: Oktober
237     \or: November
238     \or: Dezember
239   \fi:
240 }
241 \cxset{locale~german/.style = {
242   locale/german/captions/refname      = Literatur,
243   locale/german/captions/abstractname  = Zusammenfassung,
244   locale/german/captions/bibname       = Literaturverzeichnis,
245   locale/german/captions/prefacename   = Vorwort,
246   locale/german/captions/chaptername  = Kapitel,
247   locale/german/captions/appendixname  = Anhang,
248   locale/german/captions/contentsname  = Inhaltsverzeichnis,
249   locale/german/captions/listfigurename = Abbildungsverzeichnis,

```

```

250  locale/german/captions/listtablename   = Tabellenverzeichnis,
251  locale/german/captions/indexname      = Index,
252  locale/german/captions/figurename     = Abbildung,
253  locale/german/captions/tablename      = Tabelle,
254  locale/german/captions/partname       = Teil,
255  locale/german/captions/pagename       = Seite,
256  locale/german/captions/seename        = siehe,
257  locale/german/captions/alsoname       = siehe~auch,
258  locale/german/captions/enclname       = Anlage(n),
259  locale/german/captions/ccname         = Verteiler,
260  locale/german/captions/headtoname     = An,
261  locale/german/captions/proofname      = Beweis,
262  locale/german/captions/glossaryname   = Glossar,
263  locale/german/date = {\number\day.\%
264    \space
265    \l_phd_months_wide_german{\month}
266    \space \number\year},
267  }
268 \cxset{locale~German/.alias=locale~german}

```

German

## Section A.11

### French

## Subsection A.11.1

### French months

Months for French are defined as per CLDR.

```

269 \cs_set:Npn \l_phd_months_wide_french #1 {
270   \if_case:w #1
271     \or: janvier
272     \or: février
273     \or: mars
274     \or: avril
275     \or: mai
276     \or: juin
277     \or: juillet
278     \or: août
279     \or: septembre

```

```

280      \or: octobre
281      \or: novembre
282      \or: décembre
283  \fi:
284 }
285 %
286 \cs_set:Npn \l_phd_months_wide_abbreviated #1 {
287   \if_case:w #1
288     \or: janv.,
289     \or: févr.,
290     \or: mars,
291     \or: avr.,
292     \or: mai,
293     \or: juin,
294     \or: juil.,
295     \or: août,
296     \or: sept.,
297     \or: oct.,
298     \or: nov.,
299     \or: déc.,
300   \fi:
301 }
302 %
303 \cxset{locale~french/.style = {
304   locale/french/captions/refname      = Références,
305   locale/french/captions/abstractname = Résumé,
306   locale/french/captions/bibname     = Bibliographie,
307   locale/french/captions/prefacename = Préface,
308   locale/french/captions/chaptername = Chapitre,
309   locale/french/captions/appendixname = Annexe,
310   locale/french/captions/contentsname = Table~des~matières,
311   locale/french/captions/listfigurename = Table~des~figures,
312   locale/french/captions/listtablename = Liste~des~tableaux,
313   locale/french/captions/indexname   = Index ,
314   locale/french/captions/figurename  = \textsc{Fig.},
315   locale/french/captions/tablename   = \textsc{Tab.} ,
316   locale/french/captions/partname    = ,
317   locale/french/captions/pagename    = page,
318   locale/french/captions/seename     = \emph{voir},
319   locale/french/captions/alsoiname   = \emph{voir~aussi} ,
320   locale/french/captions/enclname   = P.~J.,
321   locale/french/captions/ccname     = Copie~à ,
322   locale/french/captions/headtoname = {},
323   locale/french/captions/proofname   = Démonstration,
324   locale/french/captions/glossaryname = ,
325   locale/french/date =
326   {
327     \ifx\ier\undefined\def\ier{er}\fi
328     \ifnum\day=1\relax~\!\ier%
329     \else \number\day\fi
330     \space
331     \l_phd_months_wide_french {\month}
332     \space
333     \number\year

```

```

334     },
335 }
336
337 \cxset{locale~French/.alias = locale~french}
French

```

## Section A.12

### *Italian*

```

338 \cs_set:Npn \l_phd_months_wide_italian #1 {
339   \if_case:w #1
340     \or: gennaio
341     \or: febbraio
342     \or: marzo
343     \or: aprile
344     \or: maggio
345     \or: giugno
346     \or: luglio
347     \or: agosto
348     \or: settembre
349     \or: ottobre
350     \or: novembre
351     \or: dicembre
352   \fi:
353 }
354 \cxset{locale~italian/.style = {
355   locale/italian/captions/refname      = Riferimenti bibliografici,
356   locale/italian/captions/abstractname = Sommario ,
357   locale/italian/captions/bibname       = Bibliografia ,
358   locale/italian/captions/prefacename  = Prefazione ,
359   locale/italian/captions/chaptername  = Capitolo,
360   locale/italian/captions/appendixname = Appendice ,
361   locale/italian/captions/contentsname = Indice ,
362   locale/italian/captions/listfigurename= Elenco~delle~figure,
363   locale/italian/captions/listtablename = Elenco~delle~tabelle,
364   locale/italian/captions/indexname    = Indice~analitico,
365   locale/italian/captions/figurename   = Figura,
366   locale/italian/captions/tablename    = Tabella,
367   locale/italian/captions/partname    = Parte ,
368   locale/italian/captions/pagename    = Pag. , %in Italian abbreviation is prefer
369   locale/italian/captions/seename     = vedi ,
370   locale/italian/captions/alsoiname   = vedi~anche,
371   locale/italian/captions/enclname   = Allegati,
372   locale/italian/captions/ccname     = e~p.~c. ,
373   locale/italian/captions/headtoname = Per,
374   locale/italian/captions/proofname   = Dimostrazione,

```

```

375   locale/italian/captions/glossaryname = Glossario,
376   locale/italian/date = {\number\day\space
377     \l_phd_months_wide_italian {\month}
378     \space\number\year},
379 }
380 \cxset{locale~Italian/.alias = locale~italian}

```

Italian

## Section A.13

### *Albanian*

```

381 \cs_set:Npn \l_phd_months_wide_albanian #1 {
382   \if_case:w #1
383     \or: Janar
384     \or: Shkurt
385     \or: Mars
386     \or: Prill
387     \or: Maj
388     \or: Qershori
389     \or: Korrik
390     \or: Gusht
391     \or: Shtator
392     \or: Tetor
393     \or: Nëntor
394     \or: Dhjetor
395   \fi:
396 }
397 \cxset{locale~albanian/.style = {
398   locale/albanian/captions/refname      = Referencat,
399   locale/albanian/captions/abstractname = Përbledhja ,
400   locale/albanian/captions/bibname      = Bibliografia ,
401   locale/albanian/captions/prefacename = Parathenia,
402   locale/albanian/captions/chaptername = Kapitulli,
403   locale/albanian/captions/appendixname = Shtesa,
404   locale/albanian/captions/contentsname = Përbajta,
405   locale/albanian/captions/listfigurename = Figurat,
406   locale/albanian/captions/listtablename = Tabelat,
407   locale/albanian/captions/indexname   = Indeksi,
408   locale/albanian/captions/figurename  = Figura,
409   locale/albanian/captions/tablename   = Tabela,
410   locale/albanian/captions/partname   = Pjesa,
411   locale/albanian/captions/pagename   = Faqe,
412   locale/albanian/captions/seename    = shiko,
413   locale/albanian/captions/also name = shiko~dhe,
414   locale/albanian/captions/enclname  = ,
415   locale/albanian/captions/ccname    = ,
416   locale/albanian/captions/headtoname = ,

```

```

417   locale/albanian/captions/proofname      = V rtetim,
418   locale/albanian/captions/glossaryname   = P rhasja~e~Fjal ve ,
419   locale/albanian/date=\number\day\space
420   \l_phd_months_wide_albanian {\month}
421     \space \number\year,
422 }

```

## Section A.14

### *Malayalam*

```

423 \cxset{locale~malayalam/.style = {
424   locale/malayalam/captions/refname = ,
425   locale/malayalam/captions/abstractname = ,
426   locale/malayalam/captions/bibname = ,
427   locale/malayalam/captions/prefacename = ,
428   locale/malayalam/captions/chaptername = \panunicode ,
429   locale/malayalam/captions/appendixname = ,
430   locale/malayalam/captions/contentsname = \panunicode ,
431   locale/malayalam/captions/listfigurename = ,
432   locale/malayalam/captions/listtablename = ~,
433   locale/malayalam/captions/indexname = ,
434   locale/malayalam/captions/figurename = ,
435   locale/malayalam/captions/tablename = ,
436   locale/malayalam/captions/partname = ,
437   locale/malayalam/captions/pagename = ,
438   locale/malayalam/captions/seename = ,
439   locale/malayalam/captions/alsoiname = ~,
440   locale/malayalam/captions/enclname = ,
441   locale/malayalam/captions/ccname = ,
442   locale/malayalam/captions/headtoname = ,
443   locale/malayalam/captions/proofname = ,
444   locale/malayalam/captions/glossaryname = ,
445   locale/malayalam/date = {
446     \panunicode\number\year\space\ifcase\month\or
447       \or
448       \or
449       \or
450       \or
451       \or
452       \or
453       \or
454       \or
455       \or
456       \or
457       \or
458       \fi
459     \space\number\day},

```

```
460  } }
malayalam
```

## Section A.15

### Russian

```
461 \cs_set:Npn \l_phd_months_wide_russian #1 {
462   \if_case:w #1
463     \or:
464     \or:
465     \or:
466     \or:
467     \or:
468     \or:
469     \or:
470     \or:
471     \or:
472     \or:
473     \or:
474     \or:
475   \fi:
476 }
477 \cxset{locale~russian/.style = {
478   locale/russian/captions/refname      = ~,
479   locale/russian/captions/abstractname = ,
480   locale/russian/captions/bibname      = ,
481   locale/russian/captions/prefacename = ,
482   locale/russian/captions/chaptername = ,
483   locale/russian/captions/appendixname
484
485   = ,
486   locale/russian/captions/contentsname = ,
487   locale/russian/captions/listfigurename= ~,
488   locale/russian/captions/listtablename = ~,
489   locale/russian/captions/indexname   = ~,
490   locale/russian/captions/figurename  = ..,
491   locale/russian/captions/tablename   = ,
492   locale/russian/captions/partname   = ,
493   locale/russian/captions/pagename   = ..,
494   locale/russian/captions/seename    = ..,
495   locale/russian/captions/also name = .~,
496   locale/russian/captions/enclname  = ..,
497   locale/russian/captions/ccname    = ..,
498   locale/russian/captions/headtoname= ..,
499   locale/russian/captions/proofname = ,
500   locale/russian/captions/glossaryname = ,
501   locale/russian/date =
```

```

502     {\number\day%
503      \space
504      \l_phd_months_wide_russian {\month}
505      \space \number\year\space .},
506    }
507 }

russian

```

## Section A.16

### *Basque*

The Basque language definitions are in line with those of Babel and Polyglossia. Sadly we do not have any miller's numbers yet. See Languages Monograph for more details.

```

508 \cs_set:Npn \l_phd_months_wide_basque #1 {
509   \if_case:w #1
510   \or: urtarrilaren
511   \or: otsailaren
512   \or: martxoaren
513   \or: apirilaren
514   \or: maiatzaren
515   \or: ekainaren
516   \or: uztailaren
517   \or: abuztuaren
518   \or: irailaren
519   \or: urriaren
520   \or: azaroaren
521   \or: abenduaren
522   \fi:
523 }
524 \cxset{locale~basque/.style = {
525   locale/basque/captions/refname      = Erreferentziak,
526   locale/basque/captions/abstractname = Laburpena,
527   locale/basque/captions/bibname      = Bibliografia,
528   locale/basque/captions/prefacename  = Hitzaurrea,
529   locale/basque/captions/chaptername = Kapitulua,
530   locale/basque/captions/appendixname = Eranskina,
531   locale/basque/captions/contentsname = Gaien~Aurkibidea,
532   locale/basque/captions/listfigurename = Irudien~Zerrenda,
533   locale/basque/captions/listtablename = Taulen Zerrenda,
534   locale/basque/captions/indexname   = Kontzeptuen Aurkibidea,
535   locale/basque/captions/figurename  = Irudia,
536   locale/basque/captions/tablename   = Taula,
537   locale/basque/captions/partname   = Atala,
538   locale/basque/captions/pagename   = Orria ,
539   locale/basque/captions/seename   = Ikusi,

```

```

540   locale/basque/captions/alsoname      = {Ikusi,~halaber}, % has a comma!
541   locale/basque/captions/enclname      = Erantsia,
542   locale/basque/captions/ccname        = Kopia,
543   locale/basque/captions/headtoname    = Nori,
544   locale/basque/captions/proofname     = Frogapena,
545   locale/basque/captions/glossaryname  = Glosarioa,
546   locale/basque/date = {\number\year.eko\space
547   \l_phd_months_wide_basque{\month}
548   \space\number\day},
549 }
basque

```

## Section A.17

### *Brazil*

```

550 \cs_set:Npn \l_phd_months_wide_brazil #1
551 {
552   \if_case:w #1
553     \or: janeiro
554     \or: fevereiro
555     \or: março
556     \or: abril
557     \or: maio
558     \or: junho
559     \or: julho
560     \or: agosto
561     \or: setembro
562     \or: outubro
563     \or: novembro
564     \or: dezembro
565   \fi:
566 }
567 \cxset{locale~brazil/.style = {
568   locale/brazil/captions/refname      = Referências,
569   locale/brazil/captions/abstractname  = Resumo,
570   locale/brazil/captions/bibname       = Referências~Bibliográficas,
571   locale/brazil/captions/prefacename   = Prefácio,
572   locale/brazil/captions/chaptername   = Capítulo,
573   locale/brazil/captions/appendixname  = Apêndice,
574   locale/brazil/captions/contentsname   = Sumário,
575   locale/brazil/captions/listfigurename = Lista~de~Figuras,
576   locale/brazil/captions/listtablename  = Lista~de~Tabelas,
577   locale/brazil/captions/indexname     = Índice~Remissivo,
578   locale/brazil/captions/figurename    = Figura,
579   locale/brazil/captions/tablename     = Tabela,
580   locale/brazil/captions/partname     = Parte,

```

```

581   locale/brazil/captions/pagename      = Página,
582   locale/brazil/captions/seename       = veja,
583   locale/brazil/captions/alsoname     = veja~também,
584   locale/brazil/captions/enclname     = Anexo,
585   locale/brazil/captions/ccname       = Cópia~para,
586   locale/brazil/captions/headtoname   = Para,
587   locale/brazil/captions/proofname    = Demonstração,
588   locale/brazil/captions/glossaryname = Glossário,
589   locale/brazil/date = {\number\day\space de\space\ifcase\month\or
590     janeiro\or fevereiro\or março\or abril\or maio\or junho\or
591     julho\or agosto\or setembro\or outubro\or novembro\or dezembro%
592     \fi\space de\space\number\year},
593 }
brazil

```

## Section A.18

### Breton

```

594 \cs_set:Npn \l_phd_months_wide_breton #1
595 {
596   \if_case:w #1
597     \or: Gêver
598     \or: C'hwevrer
599     \or: Meurzh
600     \or: Ebrel
601     \or: Mae
602     \or: Mezheven
603     \or: Gouere
604     \or: Eost
605     \or: Gwengolo
606     \or: Here
607     \or: Du
608     \or: Kerzu
609   \fi:
610 }
611 \cxset{locale~breton/.style = {
612   locale/breton/captions/refname      = Daveennoù,
613   locale/breton/captions/abstractname  = Dvierrañ,
614   locale/breton/captions/bibname       = Lennadurezh,
615   locale/breton/captions/prefacename   = Rakskrid,
616   locale/breton/captions/chaptername  = Pennad,
617   locale/breton/captions/appendixname  = Stagadenn,
618   locale/breton/captions/contentsname  = Taolenn,
619   locale/breton/captions/listfigurename = Listenn~ar~Figurennoù,
620   locale/breton/captions/listtablename  = Listenn~an~taolennoù,
621   locale/breton/captions/indexname     = Meneger,
622   locale/breton/captions/figurename    = Figurenn,

```

```

623   locale/breton/captions/tablename      = Taolenn,
624   locale/breton/captions/partname       = Lodenn,
625   locale/breton/captions/pagename       = Pajenn,
626   locale/breton/captions/seename        = Gwelout,
627   locale/breton/captions/alsoname       = Gwelout~ivez,
628   locale/breton/captions/enclname       = Dielloù~kevret,
629   locale/breton/captions/ccname         = Eilstkrid~da,
630   locale/breton/captions/headtoname    = evit,
631   locale/breton/captions/proofname      = Proof,
632   locale/breton/captions/glossaryname   = Glossary,
633   locale/breton/date =
634     {ifnum\day=1\relax 1/\textsuperscript{añ}\else
635       \number\day\fi \space a\space viz\space
636       \l_phd_months_wide_breton {\month}
637       \space\number\year},
638   }
639 }
```

## Section A.19

### Bulgarian

```

640 \cs_set:Npn \l_phd_months_wide_bulgarian #1
641 {
642   \if_case:w #1
643     \or:
644     \or:
645     \or:
646     \or:
647     \or:
648     \or:
649     \or:
650     \or:
651     \or:
652     \or:
653     \or:
654     \or:
655   \fi:
656 }
657 \cxset{locale~bulgarian/.style = {
658   locale/bulgarian/captions/refname      = ,
659   locale/bulgarian/captions/abstractname  = ,
660   locale/bulgarian/captions/bibname       = ,
661   locale/bulgarian/captions/prefacename   = ,
662   locale/bulgarian/captions/chaptername   = ,
663   locale/bulgarian/captions/appendixname  = ,
664   locale/bulgarian/captions/contentsname   = ,
665   locale/bulgarian/captions/listfigurename = ~~,
```

```

666   locale/bulgarian/captions/listtablename = ~~,
667   locale/bulgarian/captions/indexname   = ~,
668   locale/bulgarian/captions/figurename  = ,
669   locale/bulgarian/captions tablename   = ,
670   locale/bulgarian/captions/partname    = ,
671   locale/bulgarian/captions/pagename   = ..,
672   locale/bulgarian/captions/seename    = ..,
673   locale/bulgarian/captions/alsoname   = .\~~,
674   locale/bulgarian/captions/enclname   = ,
675   locale/bulgarian/captions/ccname    = ,
676   locale/bulgarian/captions/headtoname = {},
677   locale/bulgarian/captions/proofname  = Proof,
678   locale/bulgarian/captions/glossaryname = Glossary,
679   locale/bulgarian/date = {\number\day\space
680     \l_phd_months_wide_bulgarian {\month}
681     \space\number\year\space .},
682 }
bulgarian

```

## Section A.20

### Catalan

```

683 \cs_set:Npn \l_phd_months_wide_catalan #1
684 {
685   \if_case:w #1
686     \or: de~gener
687     \or: de~febrer
688     \or: de~març
689     \or: d'abril
690     \or: de~maig
691     \or: de~juny
692     \or: de~juliol
693     \or: d'agost
694     \or: de setembre
695     \or: d'octubre
696     \or: de~novembre
697     \or: de~desembre
698   \fi:
699 }
700 \cxset{locale~catalan/.style = {
701   locale/catalan/captions/refname      = Referències,
702   locale/catalan/captions/abstractname = Resum,
703   locale/catalan/captions/bibname     = Bibliografia,
704   locale/catalan/captions/prefacename = Pròleg,
705   locale/catalan/captions/chaptername = Capítol,
706   locale/catalan/captions/appendixname = Apèndix,
707   locale/catalan/captions/contentsname = Índex,

```

```

708   locale/catalan/captions/listfigurename = Índex~de~figures,
709   locale/catalan/captions/listtablename = Índex~de~taules,
710   locale/catalan/captions/indexname = Índex~alfabètic,
711   locale/catalan/captions/figurename = Figura,
712   locale/catalan/captions tablename = Taula,
713   locale/catalan/captions/partname = Part,
714   locale/catalan/captions/pagename = Pàgina ,
715   locale/catalan/captions/seename = Vegeu,
716   locale/catalan/captions/alsoname = Vegeu~també ,
717   locale/catalan/captions/enclname = Adjunt,
718   locale/catalan/captions/ccname = Còpies~a,
719   locale/catalan/captions/headtoname = A,
720   locale/catalan/captions/proofname = Demostració,
721   locale/catalan/captions/glossaryname = Glossari,
722   locale/catalan/date ={\number\day\space
723     \l_phd_months_wide_catalan {\month}
724     \space de~\number\year} ,
725 }
726 \cxset{locale~Catalan/.alias = locale~catalan}
```

Catalan

## Section A.21

### *Croatian*

```

727 \cs_set:Npn \l_phd_months_wide_croatian #1
728 {
729   \if_case:w #1
730   \or: siječnja
731   \or: veljače
732   \or: ožujka
733   \or travnja
734   \or svibnja
735   \or lipnja
736   \or srpnja
737   \or kolovoza
738   \or rujna
739   \or listopada
740   \or studenoga
741   \or prosinca
742   \fi:
743 }
744 \cxset{locale~croatian/.style = {
745   locale/croatian/captions/refname      = Literatura,
746   locale/croatian/captions/abstractname = Sažetak,
747   locale/croatian/captions/bibname      = Bibliografija,
748   locale/croatian/captions/prefacename = Predgovor,
749   locale/croatian/captions/chaptername = Poglavlje,
```

```

750   locale/croatian/captions/appendixname    = Dodatak,
751   locale/croatian/captions/contentsname     = Sadržaj,
752   locale/croatian/captions/listfigurename   = Popis~slika,
753   locale/croatian/captions/listtablename    = Popis~tablica,
754   locale/croatian/captions/indexname       = Kazalo,
755   locale/croatian/captions/figurename      = Slika,
756   locale/croatian/captions/tablename       = Tablica,
757   locale/croatian/captions/partname        = Dio,
758   locale/croatian/captions/pagename        = Stranica,
759   locale/croatian/captions/seename         = Vidjeti,
760   locale/croatian/captions/also name       = Također~vidjeti,
761   locale/croatian/captions/enclname        = Prilozi,
762   locale/croatian/captions/ccname          = Kopija,
763   locale/croatian/captions/headtoname     = Prima,
764   locale/croatian/captions/proofname       = Dokaz,
765   locale/croatian/captions/glossaryname   = Pojmovnik,
766   locale/croatian/date ={\number\day.\space
767   \l_phd_months_wide_croatian {\month}
768   \space \number\year.},
769 }

```

## Section A.22

### Czech

```

770 \cs_set:Npn \l_phd_months_wide_czech #1{
771   \if_case:w #1
772     \or: ledna
773     \or: února
774     \or: března
775     \or: dubna
776     \or: května
777     \or: června
778     \or: července
779     \or: srpna
780     \or: září
781     \or: října
782     \or: listopadu
783     \or: prosince
784   \fi:
785 }
786 \cxset{locale~czech/.style = {
787   locale/czech/captions/refname      = Referències,
788   locale/czech/captions/abstractname = Resum,
789   locale/czech/captions/bibname     = Bibliografia,
790   locale/czech/captions/prefacename = Pròleg,
791   locale/czech/captions/chaptername = Kapitola,
792   locale/czech/captions/appendixname = Apèndix,

```

```

793   locale/czech/captions/contentsname = Obsah,
794   locale/czech/captions/listfigurename = Índex~de~figures,
795   locale/czech/captions/listtablename = Índex~de~taules,
796   locale/czech/captions/indexname = Índex~alfabètic,
797   locale/czech/captions/figurename = Figura,
798   locale/czech/captions/tablename = Taula,
799   locale/czech/captions/partname = Part,
800   locale/czech/captions/pagename = Pàgina,
801   locale/czech/captions/seename = Vegeu,
802   locale/czech/captions/alsofname = Vegeu~també,
803   locale/czech/captions/enclname = Adjunt,
804   locale/czech/captions/ccname = Còpies~a,
805   locale/czech/captions/headtoname = A,
806   locale/czech/captions/proofname = Demostració,
807   locale/czech/captions/glossaryname = Glossari,
808   locale/czech/date =
809     {\number\day.\space
810       \l_phd_months_wide_czech {\month}
811       \space \number\year},
812     }
813 }
```

## Section A.23

### Danish

```

814 \cs_set:Npn \l_phd_months_wide_danish #1{
815   \if_case:w #1
816     \or: januar
817     \or: februar
818     \or: marts
819     \or: april
820     \or: maj
821     \or: juni
822     \or: juli
823     \or: august
824     \or: september
825     \or: oktober
826     \or: november
827     \or: december
828   \fi:
829 }
830 \cxset{locale~danish/.style = {
831   locale/danish/captions/refname = Litteratur,
832   locale/danish/captions/abstractname = Resumé,
833   locale/danish/captions/bibname = Litteratur,
834   locale/danish/captions/prefacename = Forord,
835   locale/danish/captions/chaptername = Kapitel,
```

```

836   locale/danish/captions/appendixname = Bilag,
837   locale/danish/captions/contentsname = Indhold,
838   locale/danish/captions/listfigurename = Figurer,
839   locale/danish/captions/listtablename = Tabeller,
840   locale/danish/captions/indexname = Indeks,
841   locale/danish/captions/figurename = Figur,
842   locale/danish/captions/tablename = Tabel,
843   locale/danish/captions/partname = Del,
844   locale/danish/captions/pagename = Side,
845   locale/danish/captions/seename = Se,
846   locale/danish/captions/also name = Se~også,
847   locale/danish/captions/enclname = Vedlagt,
848   locale/danish/captions/ccname = Kopi~til,
849   locale/danish/captions/headtoname = Til,
850   locale/danish/captions/proofname = Bevis,
851   locale/danish/captions/glossaryname = Gloseliste ,
852   locale/danish/date ={\number\day.\space
853     \l_phd_months_wide_danish {\month}
854     \space\number\year},
855 }

```

## Section A.24

### *Estonian*

See [estonian](#) local page for standards.

```

856 \cs_set:Npn \l_phd_months_wide_estonian #1{
857   \if_case:w #1
858     \or: jaanuar
859     \or: veebruar
860     \or: märt
861     \or: aprill
862     \or: mai
863     \or: juuni
864     \or: juuli
865     \or: august
866     \or: september
867     \or: oktoober
868     \or: november
869     \or: detsember
870   \fi:
871 }
872 \cxset{locale~estonian/.style = {
873   locale/estonian/captions/refname = Viited,
874   locale/estonian/captions/abstractname = Kokkuvõte,
875   locale/estonian/captions/bibname = Kirjandus,
876   locale/estonian/captions/prefacename = Sissejuhatus,
877   locale/estonian/captions/chaptername = Peatükk,

```

```

878 locale/estonian/captions/appendixname = Lisa,
879 locale/estonian/captions/contentsname = Sisukord,
880 locale/estonian/captions/listfigurename = Joonised,
881 locale/estonian/captions/listtablename = Tabelid,
882 locale/estonian/captions/indexname = Indeks,
883 locale/estonian/captions/figurename = Joonis ,
884 locale/estonian/captions tablename = Tabel,
885 locale/estonian/captions/partname = Osa,
886 locale/estonian/captions/pagename = Lk.,
887 locale/estonian/captions/seename = vt.,
888 locale/estonian/captions/also name = vt.^ka,
889 locale/estonian/captions/enclname = Lisa(d),
890 locale/estonian/captions/ccname = Koopia(d),
891 locale/estonian/captions/headtoname = ,
892 locale/estonian/captions/proofname = Korrektuur,
893 locale/estonian/captions/glossaryname = , %unknown
894 locale/estonian/date =
895 {\number\day.\space
896     \l_phd_months_wide_estonian{\month}
897     \space\number\year.\space a.
898 },
899 }
900 \cxset{locale~esti/.alias=locale~estonian,
901         esti/.alias=locale~estonian,
902         locale~Greek/.alias=locale~greek}
903

```

## Section A.25

### *Finnish*

The data for Finnish has been collected from Polyglossia, Babel, Translator, CLDR files and IBM. It is missing at this stage.

```

904 \cs_set:Npn \l_phd_months_abbreviated_finnish#1{
905     \if_case:w #1
906         \or: tammi
907         \or: helmi
908         \or: maaliskuu
909         \or: huhtikuu
910         \or: toukokuu
911         \or: kesäkuu
912         \or: heinäkuu
913         \or: eloakuu
914         \or: syyskuu
915         \or: lokakuu
916         \or: marraskuu
917         \or: joulu

```

```
918   \fi:  
919 }
```

I am not too sure if the below are correct. They have been copied from the relevant CLDR file, but as we can see these abbreviations will result in ambiguous date strings. The example at IBM <sup>1</sup> uses two character abbreviations, but does not list all of them.

```
920 \cs_set:Npn \l_phd_months_narrow_finnish#1{  
921   \if_case:w #1  
922     \or: T  
923     \or: H  
924     \or: M  
925     \or: H  
926     \or: T  
927     \or: K  
928     \or: H  
929     \or: E  
930     \or: S  
931     \or: L  
932     \or: M  
933     \or: J  
934   \fi:  
935 }
```

The wide months are used as the default.

```
936 \cs_set:Npn \l_phd_months_wide_finnish#1{  
937   \if_case:w #1  
938     \or: tammikuuta  
939     \or: helmikuuta  
940     \or: maaliskuuta  
941     \or: huhtikuuta  
942     \or: toukokuuta  
943     \or: kesäkuuta  
944     \or: heinäkuuta  
945     \or: elokuuta  
946     \or: syyskuuta  
947     \or: lokakuuta  
948     \or: marraskuuta  
949     \or: joulukuuta  
950   \fi:  
951 }
```

## Subsection A.25.1

---

### *Lists*

---



---

<sup>1</sup>See [IBM Knowledge Center](#)

The Finnish alphabet has three extra letters Å, Ä and Ö. The “Swedish o” is redundant in Finnish, but is used for writing Finland-Swedish proper names.

```

952 \cs_new:Npn \int_to_Alph_finnish:n #1
953 {
954 \int_to_symbols:nnn {#1} { 29 }
955 {
956 { 1 } { A }
957 { 2 } { B }
958 { 3 } { C }
959 { 4 } { D }
960 { 5 } { E }
961 { 6 } { F }
962 { 7 } { G }
963 { 8 } { H }
964 { 9 } { I }
965 { 10 } { J }
966 { 11 } { K }
967 { 12 } { L }
968 { 13 } { M }
969 { 14 } { N }
970 { 15 } { O }
971 { 16 } { P }
972 { 17 } { Q }
973 { 18 } { R }
974 { 19 } { S }
975 { 20 } { T }
976 { 21 } { U }
977 { 22 } { V }
978 { 23 } { W }
979 { 24 } { X }
980 { 25 } { Y }
981 { 26 } { Z }
982 { 27 } { Å }
983 { 28 } { Ä }
984 { 29 } { Ö }
985 }
986 }
987 \cs_new:Npn \int_to_alpha_finnish:n #1
988 {
989 \int_to_symbols:nnn {#1} { 29 }
990 {
991 { 1 } { a }
992 { 2 } { b }
993 { 3 } { c }
994 { 4 } { d }
995 { 5 } { e }
996 { 6 } { f }
997 { 7 } { g }
998 { 8 } { h }
999 { 9 } { i }
1000 { 10 } { j }
1001 { 11 } { k }
1002 { 12 } { l }
1003 { 13 } { m }

```

```

1004 { 14 } { n }
1005 { 15 } { o }
1006 { 16 } { p }
1007 { 17 } { q }
1008 { 18 } { r }
1009 { 19 } { s }
1010 { 20 } { t }
1011 { 21 } { u }
1012 { 22 } { v }
1013 { 23 } { w }
1014 { 24 } { x }
1015 { 25 } { y }
1016 { 26 } { z }
1017 { 27 } { å }
1018 { 28 } { ä }
1019 { 29 } { ö }
1020 }
1021 }
```

We will avoid getting into collations orders and leave this for external sorting libraries.

```

1022
1023 \cxset{locale~finnish/.style = {
1024   locale/finnish/captions/refname      = Viitteet,
1025   locale/finnish/captions/abstractname = Tiivistelmä,
1026   locale/finnish/captions/bibname     = Kirjallisuutta,
1027   locale/finnish/captions/prefacename = Esipuhe,
1028   locale/finnish/captions/chaptername = Luku,
1029   locale/finnish/captions/appendixname = Liite,
1030   locale/finnish/captions/contentsname = Sisältö,
1031   locale/finnish/captions/listfigurename = Kuvat,
1032   locale/finnish/captions/listtablename = Taulukot,
1033   locale/finnish/captions/indexname    = Hakemisto,
1034   locale/finnish/captions/figurename   = Kuva,
1035   locale/finnish/captions/tablename   = Taulukko,
1036   locale/finnish/captions/partname    = Osa,
1037   locale/finnish/captions/pagename    = Sivu,
1038   locale/finnish/captions/seename     = katso,
1039   locale/finnish/captions/also name   = katso~myös,
1040   locale/finnish/captions/enclname   = Liitteet,
1041   locale/finnish/captions/ccname     = Jakelu,
1042   locale/finnish/captions/headtoname = Vastaanottaja,
1043   locale/finnish/captions/proofname  = Todistus,
1044   locale/finnish/captions/glossaryname = Sanasto,
1045   locale/finnish/date ={             =
1046     \number\day.\space
1047     \l_phd_months_wide_finnish{\month}
1048     \space\number\year},
1049   }
1050 \cxset{locale~Finnish/.alias = locale~finnish}
```

finnish

# Section A.26

## *Friulan*

See [Friulian Journal of Science](#).

```

1051 \cs_set:Npn \l_phd_months_wide_friulian#1 {
1052   \if_case:w #1
1053   \or: Genâr
1054   \or: Fevrâr
1055   \or: Març
1056   \or: Avril
1057   \or: Mai
1058   \or: Jugn
1059   \or: Lui
1060   \or: Avost
1061   \or: Setembar
1062   \or: Otober
1063   \or: Novembar
1064   \or: Dicembar
1065 \fi:
1066 }
1067 \cxset{locale~friulian/.style = {
1068   locale/friulian/captions/refname = ,
1069   locale/friulian/captions/abstractname = Somari,
1070   locale/friulian/captions/bibname = Bibliografie,
1071   locale/friulian/captions/prefacename = Prefazion,
1072   locale/friulian/captions/chaptername = Cjapitul,
1073   locale/friulian/captions/appendixname = Zonte,
1074   locale/friulian/captions/contentsname = Tabele~gjenerâl,
1075   locale/friulian/captions/listfigurename = Liste~des~figuris,
1076   locale/friulian/captions/listtablename = Liste~des~tabelis,
1077   locale/friulian/captions/indexname = Tabele~analitiche,
1078   locale/friulian/captions/figurename = Figure,
1079   locale/friulian/captions tablename = Tabele,
1080   locale/friulian/captions/partname = Part,
1081   locale/friulian/captions/pagename = Paggine,
1082   locale/friulian/captions/seename = cjale,
1083   locale/friulian/captions/also name = cjale~ancje,
1084   locale/friulian/captions/enclname = Zonte(is),
1085   locale/friulian/captions/ccname = Cun~copie~a,
1086   locale/friulian/captions/headtoname = Par,
1087   locale/friulian/captions/proofname = Dimostrazion,
1088   locale/friulian/captions/glossaryname = Glossari,
1089   locale/friulian/date ={\number\day\space di\space
1090 \l_phd_months_wide_friulian {\month}
1091 \space dal\space\number\year},
1092 }}}
```

## Section A.27

### *Galician*

```

1093 \cs_set:Npn \l_phd_months_wide_galician #1 {
1094   \if_case:w #1
1095     \or: Genár
1096     \or: Fevrâr
1097     \or: Març
1098     \or: Avril
1099     \or: Mai
1100     \or: Jugn
1101     \or: Lui
1102     \or: Avost
1103     \or: Setembrar
1104     \or: Otoobar
1105     \or: Novembar
1106     \or: Dicembar
1107   \fi:
1108 }
```

## Section A.28

### *Galician*

```

1109 \cxset{locale~galician/.style = {
1110   locale/galician/captions/refname      = Referencias ,
1111   locale/galician/captions/abstractname = Resumo,
1112   locale/galician/captions/bibname       = Bibliografía,
1113   locale/galician/captions/prefacename   = Prefacio,
1114   locale/galician/captions/chaptername  = Capítulo,
1115   locale/galician/captions/appendixname = Apéndice,
1116   locale/galician/captions/contentsname = Índice~Xeral,
1117   locale/galician/captions/listfigurename= Índice~de~Figuras,
1118   locale/galician/captions/listtablename = Índice~de~Táboas,
1119   locale/galician/captions/indexname    = Índice~de~Materias,
1120   locale/galician/captions/figurename   = Figura,
1121   locale/galician/captions/tablename    = Táboa,
1122   locale/galician/captions/partname    = Parte,
1123   locale/galician/captions/pagename    = Páxina,
1124   locale/galician/captions/seename     = véxase,
```

```

1125   locale/galician/captions/alsoname      = véxase~tamén,
1126   locale/galician/captions/enclname     = Adxunto,
1127   locale/galician/captions/ccname       = Copia~a,
1128   locale/galician/captions/headtoname   = A,
1129   locale/galician/captions/proofname    = Demostración,
1130   locale/galician/captions/glossaryname = Glosario,
1131   locale/galician/date ={\number\day~de\space\ifcase\month\or
1132     xaneiro\or febreiro\or marzo\or abril\or maio\or xuño\or
1133     xullo\or agosto\or setembro\or outubro\or novembro\or decembro\fi
1134     \space de~\number\year},
1135 }
1136 galician

```

## Section A.29

### Icelandic

```

1136 \cxset{locale~icelandic/.style = {
1137   locale/icelandic/captions/refname      = Heimildir,
1138   locale/icelandic/captions/abstractname  = Útdráttur,
1139   locale/icelandic/captions/bibname       = Heimildir,
1140   locale/icelandic/captions/prefacename   = Formáli,
1141   locale/icelandic/captions/chaptername  = Kafli,
1142   locale/icelandic/captions/appendixname = Viðauki,
1143   locale/icelandic/captions/contentsname = Efnisyfirlit ,
1144   locale/icelandic/captions/listfigurename= Myndaskrá,
1145   locale/icelandic/captions/listtablename = Töfluskrá,
1146   locale/icelandic/captions/indexname    = Atriðisorðaskrá,
1147   locale/icelandic/captions/figurename   = Mynd,
1148   locale/icelandic/captions/tablename    = Tafla,
1149   locale/icelandic/captions/partname    = Hluti,
1150   locale/icelandic/captions/pagename    = Blaðsíða,
1151   locale/icelandic/captions/seename     = Sjá,
1152   locale/icelandic/captions/alsoname    = Sjá einnig,
1153   locale/icelandic/captions/enclname   = Hjálagt,
1154   locale/icelandic/captions/ccname     = Samrit,
1155   locale/icelandic/captions/headtoname = Til:,
1156   locale/icelandic/captions/proofname  = Sönnun,
1157   locale/icelandic/captions/glossaryname= Orðalisti,
1158   locale/icelandic/date ={\number\day.\space\ifcase\month\or
1159     janúar\or febrúar\or mars\or apríl\or maí\or
1160     júní\or júlí\or ágúst\or september\or
1161     október\or nóvember\or desember\fi
1162     \space\number\year},
1163 }

```

icelandic

## Section A.30

### *Irish*

```

1164 \cxset{locale~irish/.style = {
1165   locale/irish/captions/refname      = Tagairtí,
1166   locale/irish/captions/abstractname = Achoimre,
1167   locale/irish/captions/bibname     = Leabharliosta,
1168   locale/irish/captions/prefacename = Réamhrá,
1169   locale/irish/captions/chaptername = Tagairtí,
1170   locale/irish/captions/appendixname = Aguisín ,
1171   locale/irish/captions/contentsname = Clár~Ábhair,
1172   locale/irish/captions/listfigurename = Léaráidí ,
1173   locale/irish/captions/listtablename = Táblaí ,
1174   locale/irish/captions/indexname   = Innéacs,
1175   locale/irish/captions/figurename  = Léaráid,
1176   locale/irish/captions tablename   = Tábla,
1177   locale/irish/captions/partname   = Cuid,
1178   locale/irish/captions/pagename   = Leathanach,
1179   locale/irish/captions/seename    = féach,
1180   locale/irish/captions/alsoiname   = féach~freisin,
1181   locale/irish/captions/enclname   = faoi~iamh,
1182   locale/irish/captions/ccname    = cc,
1183   locale/irish/captions/headtoname = Go,
1184   locale/irish/captions/proofname  = Cruthúnas,
1185   locale/irish/captions/glossaryname = Glossary,
1186   locale/irish/date ={\number\day\space \ifcase\month\or
1187     Eanáir\or Feabhra\or Márt\or Aibreán\or
1188     Bealtaine\or Meitheamh\or Iúil\or Lúnasa\or
1189     Meán Fómhair\or Deireadh Fómhair\or
1190     Mí na Samhna\or Mí na Nollag\fi
1191     \space \number\year},
1192 }
1193 }
```

irish

## Section A.31

### *Latin*

```
1193 \cxset{locale~latin/.style = {
```

```

1194  locale/latin/captions/refname = Conspectus librorum,
1195  locale/latin/captions/abstractname = Summarium,
1196  locale/latin/captions/bibname      = Conspectus librorum,
1197  locale/latin/captions/prefacename = Praefatio, % change for medieval
1198  locale/latin/captions/chaptername = Caput,
1199  locale/latin/captions/appendixname = Additamentum,
1200  locale/latin/captions/contentsname = Index,
1201  locale/latin/captions/listfigurename = Conspectus~descriptionum,
1202  locale/latin/captions/listtablename = Conspectus~tabularum,
1203  locale/latin/captions/indexname = Index~rerum~notabilium,
1204  locale/latin/captions/figurename = Descriptio,
1205  locale/latin/captions tablename = Tabula,
1206  locale/latin/captions/partname = Pars,
1207  locale/latin/captions/pagename = charta,
1208  locale/latin/captions/seename = cfr.,
1209  locale/latin/captions/alsofname = cfr.,
1210  locale/latin/captions/enclname = Additur,
1211  locale/latin/captions/ccname = Exemplar,
1212  locale/latin/captions/headtoname = ,
1213  locale/latin/captions/proofname = Demonstratio,
1214  locale/latin/captions/glossaryname = Glossarium,
1215  locale/latin/date ={\uppercase\expandafter{\romannumeral\day}}%
1216          \space \ifcase\month%
1217          \or Januarii\or Februarii\or Martii\or Aprilis\or Maii\or
1218          Junii\or Julii\or Augusti\or Septembris\or Octobris\or
1219          Novembris
1220          \or Decembris\fi%
1221          \space \uppercase\expandafter{\romannumeral\year}},
1222  }

```

## Section A.32

### *Latvian*

```

1223 \cxset{locale~latvian/.style = {
1224   locale/latvian/captions/refname      = Literatūras~saraksts,
1225   locale/latvian/captions/abstractname = Anotācija,
1226   locale/latvian/captions/bibname     = Literatūra,
1227   locale/latvian/captions/prefacename = Priekšvārds,
1228   locale/latvian/captions/chaptername = Nodaļa,
1229   locale/latvian/captions/appendixname = Pielikums,
1230   locale/latvian/captions/contentsname = Saturs,
1231   locale/latvian/captions/listfigurename = Attēlu~saraksts,
1232   locale/latvian/captions/listtablename = Tabulu~saraksts,
1233   locale/latvian/captions/indexname = Index,
1234   locale/latvian/captions/figurename = Att.,
1235   locale/latvian/captions tablename = Tabula,
1236   locale/latvian/captions/partname = Daļa,

```

```

1237  locale/latvian/captions/pagename      = lpp.,
1238  locale/latvian/captions/seename       = sk.,
1239  locale/latvian/captions/alsoname      = sk. arī,
1240  locale/latvian/captions/enclname      = encl,
1241  locale/latvian/captions/ccname        = cc,
1242  locale/latvian/captions/headtoname    = To,
1243  locale/latvian/captions/proofname     = Pierādījums,
1244  locale/latvian/captions/glossaryname   = ,
1245  locale/latvian/date ={\number\year.\thinspace gada%
1246    \space\number\day.\thinspace%
1247    \ifcase\month\or%
1248      janvārī\or februārī\or martā\or%
1249      aprīlī\or maijā\or jūnijā\or%
1250      jūlijā\or augustā\or septembrī\or%
1251      oktobrī\or novembrī\or decembri\fi},
1252  }{}
```

## Section A.33

### *Lithuanian*

```

1253 \cxset{locale~lithuanian/.style = {
1254   locale/lithuanian/captions/refname      = Literatūra,
1255   locale/lithuanian/captions/abstractname   = Santrauka,
1256   locale/lithuanian/captions/bibname        = Literatūra,
1257   locale/lithuanian/captions/prefacename    = Pratarmė,
1258   locale/lithuanian/captions/chaptername    = Skyrius,
1259   locale/lithuanian/captions/appendixname   = Priedas,
1260   locale/lithuanian/captions/contentsname    = Turinys,
1261   locale/lithuanian/captions/listfigurename  = Iliustracijų~sarašas,
1262   locale/lithuanian/captions/listtablename    = Lentelių~sarašas,
1263   locale/lithuanian/captions/indexname      = Rodyklė,
1264   locale/lithuanian/captions/figurename      = pav.,
1265   locale/lithuanian/captions tablename       = lentelė,
1266   locale/lithuanian/captions/partname       = Dalis,
1267   locale/lithuanian/captions/pagename       = puslapis,
1268   locale/lithuanian/captions/seename        = žiūrėk,
1269   locale/lithuanian/captions/alsoname       = taip~pat,
1270   locale/lithuanian/captions/enclname       = Idėta,
1271   locale/lithuanian/captions/ccname        = Kopijos,
1272   locale/lithuanian/captions/headtoname     = Kam,
1273   locale/lithuanian/captions/proofname      = Įrodymas,
1274   locale/lithuanian/captions/glossaryname   = Terminų~žodynas,
1275   locale/lithuanian/date ={\number\year\space m.\space\ifcase\month\or
1276     sausio\or
1277     vasario\or
1278     kovo\or
1279     balandžio\or}
```

```

1280      gegužés\or
1281      birželio\or
1282      liepos\or
1283      rugpjūčio\or
1284      rugsėjo\or
1285      spalio\or
1286      lapkričio\or
1287      gruodžio\fi
1288      \space\number\day\space d.
1289      },
1290  }},

```

## Section A.34

### *Lsorbian*

See also usorbian for Upper Sorbian.

```

1291 \cxset{locale~lsorbian/.style = {
1292   locale/lsorbian/captions/refname      = Reference,
1293   locale/lsorbian/captions/abstractname = Abstrakt,
1294   locale/lsorbian/captions/bibname     = Literatura,
1295   locale/lsorbian/captions/prefacename = Zawod,
1296   locale/lsorbian/captions/chaptername = Kapitl,
1297   locale/lsorbian/captions/appendixname = Dodawki,
1298   locale/lsorbian/captions/contentsname = Wopśimješe,
1299   locale/lsorbian/captions/listfigurename = Zapis~wobrazow,
1300   locale/lsorbian/captions/listtablename = Zapis~tabulkow,
1301   locale/lsorbian/captions/indexname   = Indeks,
1302   locale/lsorbian/captions/figurename  = Wobraz,
1303   locale/lsorbian/captions/tablename   = Tabulka,
1304   locale/lsorbian/captions/partname    = Žél,
1305   locale/lsorbian/captions/pagename   = Strona ,
1306   locale/lsorbian/captions/seename    = gl.,
1307   locale/lsorbian/captions/alsoiname   = gl.^teke,
1308   locale/lsorbian/captions/enclname   = Pšíłoga,
1309   locale/lsorbian/captions/ccname    = CC,
1310   locale/lsorbian/captions/headtoname = Komu,
1311   locale/lsorbian/captions/proofname  = Proof,
1312   locale/lsorbian/captions/glossaryname = Glossary,
1313   locale/lsorbian/date ={%
1314     \number\day.\~\ifcase\month\or
1315       januara\or februara\or měrca\or apryla\or maj\or
1316       junija\or julija\or awgusta\or septembra\or oktobra\or
1317       nowembra\or decembra\fi
1318       \space \number\year},
1319  }},

```

## Section A.35

### *Magyar (Hungarian)*

```

1320 \cxset{locale~magyar/.style = {
1321   locale/magyar/captions/refname      = Hivatkozások ,
1322   locale/magyar/captions/abstractname = Kivonat,
1323   locale/magyar/captions/bibname     = Irodalomjegyzék,
1324   locale/magyar/captions/prefacename = Előszó,
1325   locale/magyar/captions/chaptername = fejezet,
1326   locale/magyar/captions/appendixname = Függelék,
1327   locale/magyar/captions/contentsname = Tartalomjegyzék,
1328   locale/magyar/captions/listfigurename = Ábrák~jegyzéke,
1329   locale/magyar/captions/listtablename = Táblázatok~jegyzéke,
1330   locale/magyar/captions/indexname   = Tárgymutató,
1331   locale/magyar/captions/figurename  = ábra,
1332   locale/magyar/captions/tablename   = táblázat,
1333   locale/magyar/captions/partname   = rész,
1334   locale/magyar/captions/pagename   = oldal,
1335   locale/magyar/captions/seename    = lásd,
1336   locale/magyar/captions/alsoiname  = lásd~még,
1337   locale/magyar/captions/enclname   = Melléklet,
1338   locale/magyar/captions/ccname    = Körlevél-címzettek,
1339   locale/magyar/captions/headtoname = Címzett,
1340   locale/magyar/captions/proofname  = Bizonyítás,
1341   locale/magyar/captions/glossaryname = Szójegyzék,
1342   locale/magyar/date =
1343   {
1344     \number\year.\nobreakspace\ifcase\month\or
1345       január\or február\or március\or
1346       április\or május\or június\or
1347       július\or augusztus\or szeptember\or
1348       október\or november\or december\fi
1349     \space\number\day
1350   },
1351 }
1352 \cxset{locale~Magyar/.alias = locale~magyar,
1353           locale~Hungarian/.alias = locale~magyar}

```

## Section A.36

### *Marathi*

```

1354 \cxset{locale~marathi/.style = {
1355   locale/marathi/captions/refname      = ,
1356   locale/marathi/captions/abstractname = ,
1357   locale/marathi/captions/bibname     = ~~, 
1358   locale/marathi/captions/prefacename = ,
1359   locale/marathi/captions/chaptername = ,
1360   locale/marathi/captions/appendixname = ,
1361   locale/marathi/captions/contentsname = ,
1362   locale/marathi/captions/listfigurename = ~ ,
1363   locale/marathi/captions/listtablename = ~,
1364   locale/marathi/captions/indexname   = ,
1365   locale/marathi/captions/figurename  = ,
1366   locale/marathi/captions tablename   = ,
1367   locale/marathi/captions/partname   = ,
1368   locale/marathi/captions/pagename   = ,
1369   locale/marathi/captions/seename   = ,
1370   locale/marathi/captions/also name = ~~ ,
1371   locale/marathi/captions/enclname  = ,
1372   locale/marathi/captions/ccname    = ...,
1373   locale/marathi/captions/headtoname= ,
1374   locale/marathi/captions/proofname = ,
1375   locale/marathi/captions/glossaryname= ~,
1376   locale/marathi/date ={{\panunicode
1377     \number\day\space
1378     \ifcase\month\or
1379       \or
1380       \or
1381       \or
1382       \or
1383       \or
1384       \or
1385       \or
1386       \or
1387       \or
1388       \or
1389       \or
1390       \fi
1391     \space\number\year
1392   },
1393 }
1394 \cxset{locale~Marathi/.alias=locale~marathi}

```

Marathi

## Section A.37

---

*Nko*

---

The script is RTL, it needs to be fixed for LuaLaTeX

```

1395 \RequirePackage{nkonumbers}
1396 \cxset{locale~nko/.style = {
1397   locale/nko/captions/refname      = ,
1398   locale/nko/captions/abstractname = ,
1399   locale/nko/captions/bibname     = ~~,
1400   locale/nko/captions/prefacename = ,
1401   locale/nko/captions/chaptername = {{\textdir TRT }},
1402   locale/nko/captions/appendixname = ,
1403   locale/nko/captions/contentsname = {{ \textdir TRT }},
1404   locale/nko/captions/listfigurename = ~,
1405   locale/nko/captions/listtablename = ~,
1406   locale/nko/captions/indexname    = ,
1407   locale/nko/captions/figurename   = ,
1408   locale/nko/captions tablename   = ,
1409   locale/nko/captions/partname    = ,
1410   locale/nko/captions/pagename    = ,
1411   locale/nko/captions/seename    = ,
1412   locale/nko/captions/also name  = ~~,
1413   locale/nko/captions/enclname   = ,
1414   locale/nko/captions/ccname    = ...,
1415   locale/nko/captions/headtoname = ,
1416   locale/nko/captions/proofname  = ,
1417   locale/nko/captions/glossaryname = ~,
1418   locale/nko/date ={{\panunicode\textdir TRT
1419 %FIX FOR NKO NUMBERS
1420   \nkonumber{\year}\space
1421   \ifcase\month
1422     \or %
1423     \or %
1424     \or %
1425     \or %
1426     \or %
1427     \or %
1428     \or %
1429     \or %
1430     \or %
1431     \or %
1432     \or %
1433     \or \fi
1434     \space
1435     \space\nkonumber{\day}
1436   },
1437 }

```

## Section A.38

### *Norwegian (Norsk)*

```

1438 \cxset{locale~norsk/.style = {
1439   locale/norsk/captions/refname      = Referanser,
1440   locale/norsk/captions/abstractname = Sammendrag,
1441   locale/norsk/captions/bibname     = Bibliografi,
1442   locale/norsk/captions/prefacename = Forord,
1443   locale/norsk/captions/chaptername = Kapittel,
1444   locale/norsk/captions/appendixname = Tillegg,
1445   locale/norsk/captions/contentsname = Innhold,
1446   locale/norsk/captions/listfigurename = Figurer,
1447   locale/norsk/captions/listtablename = Tabeller,
1448   locale/norsk/captions/indexname   = Register,
1449   locale/norsk/captions/figurename  = Figur,
1450   locale/norsk/captions/tablename   = Tabell,
1451   locale/norsk/captions/partname   = Del,
1452   locale/norsk/captions/pagename   = Side,
1453   locale/norsk/captions/seename    = Se,
1454   locale/norsk/captions/alsofname  = Se~også,
1455   locale/norsk/captions/enclname  = Vedlegg,
1456   locale/norsk/captions/ccname    = Kopi~sendt,
1457   locale/norsk/captions/headtoname = Til,
1458   locale/norsk/captions/proofname  = Bevis,
1459   locale/norsk/captions/glossaryname = Ordliste,
1460   locale/norsk/date               =
1461   {
1462     \number\day.~
1463     \ifcase\month
1464       \or januar
1465       \or februar
1466       \or mars
1467       \or april
1468       \or mai
1469       \or juni
1470       \or juli
1471       \or august
1472       \or september
1473       \or oktober
1474       \or november
1475       \or desember
1476     \fi
1477     \space\number\year
1478   },
1479 }
1480 \cxset{locale~Norsk/.alias = locale~norsk,
1481         locale~Norwegian/.alias = locale~norsk}

```

Norsk

## Section A.39

### Piedmontese

```

1482 \cxset{locale~piedmontese/.style = {
1483   locale/piedmontese/captions/refname      = Riferiment,
1484   locale/piedmontese/captions/abstractname  = Somari,
1485   locale/piedmontese/captions/bibname       = Bibliografia,
1486   locale/piedmontese/captions/prefacename   = Prefassion,
1487   locale/piedmontese/captions/chaptername   = Kapittel,
1488   locale/piedmontese/captions/appendixname  = Gionta,
1489   locale/piedmontese/captions/contentsname  = Innhalde,
1490   locale/piedmontese/captions/listfigurename = Lista~dile~figure ,
1491   locale/piedmontese/captions/listtablename  = Lista~dile~tabele,
1492   locale/piedmontese/captions/indexname     = Taula~analitica,
1493   locale/piedmontese/captions/figurename    = Figura,
1494   locale/piedmontese/captions/tablename     = Tabela,
1495   locale/piedmontese/captions/partname     = Part,
1496   locale/piedmontese/captions/pagename     = Pàgina,
1497   locale/piedmontese/captions/seename      = vèd,
1498   locale/piedmontese/captions/also name    = vèd~anche,
1499   locale/piedmontese/captions/enclname    = Gionta/e,
1500   locale/piedmontese/captions/ccname      = Con~còpia~a,
1501   locale/piedmontese/captions/headtoname  = Pér,
1502   locale/piedmontese/captions/proofname   = Dimostrassion,
1503   locale/piedmontese/captions/glossaryname = Glossari,
1504   locale/piedmontese/date ={%
1505     \number\day\space\ifcase\month\or
1506       èd~gené\or èd~fevré\or èd~mars\or d'avril\or èd~maj\or èd~giugn\or
1507       èd~luj\or d'agost\or dë~stèmber\or d'otóber\or èd~novèmber\or dë~dzèmber%
1508       \fi\space dal\space\year
1509   },
1510 }

```

piedmontese

## Section A.40

### *Occitan*

```

1511 \cxset{locale~occitan/.style = {
1512   locale/occitan/captions/refname      = Referéncias,
1513   locale/occitan/captions/abstractname  = Resumit,
1514   locale/occitan/captions/bibname       = Bibliografia,
1515   locale/occitan/captions/prefacename   = Prefaci,
1516   locale/occitan/captions/chaptername   = Capítol,
1517   locale/occitan/captions/appendixname  = Annèx,
1518   locale/occitan/captions/contentsname  = Ensenhador,
1519   locale/occitan/captions/listfigurename = Taula~de~las~figuras,
1520   locale/occitan/captions/listtablename  = Taula~dels~tablèus,
1521   locale/occitan/captions/indexname     = Indèx,
1522   locale/occitan/captions/figurename    = Figura,
1523   locale/occitan/captions/tablename     = Tableù,

```

```

1524   locale/occitan/captions/partname      = Partida,
1525   locale/occitan/captions/pagename       = Pagina,
1526   locale/occitan/captions/seename        = vejatz,
1527   locale/occitan/captions/alsoname       = vejatz~tanben,
1528   locale/occitan/captions/enclname       = Pèça~junta,
1529   locale/occitan/captions/ccname         = còpia~a,
1530   locale/occitan/captions/headtoname     = A,
1531   locale/occitan/captions/proofname      = Demostracion,
1532   locale/occitan/captions/glossaryname   = Glossari,
1533   locale/occitan/date ={
1534     {\def\occitanmonth{\ifcase\month\or
1535       de~genièr\or
1536       de~febrièr\or
1537       de~març\or
1538       d'abril\or
1539       de~mai\or
1540       de~junh\or
1541       de~julhet\or
1542       d'agost\or
1543       de~setembre\or
1544       d'octobre\or
1545       de~novembre\or
1546       de~decembre\fi
1547     }
1548     \def\occitanday{\ifcase\day\or
1549       1èr\else% primièr
1550       \number\day\fi% all other numbers
1551     }
1552     \occitanday\space \occitanmonth\space de~\number\year
1553   },
1554 }
1555 \cxset{locale~Occitan/.alias = locale~occitan}

```

Occitan

## Section A.41

### *Polish*

```

1556 \cxset{locale~polish/.style = {
1557   locale/polish/captions/refname = Literatura,
1558   locale/polish/captions/abstractname =Streszczenie ,
1559   locale/polish/captions/bibname    = Bibliografia,
1560   locale/polish/captions/prefacename = Przedmowa,
1561   locale/polish/captions/chaptername = Rozdział,
1562   locale/polish/captions/appendixname = Dodatek,
1563   locale/polish/captions/contentsname = Spis treści,
1564   locale/polish/captions/listfigurename = Spis rysunków,
1565   locale/polish/captions/listtablename = Spis tabel,

```

```

1566   locale/polish/captions/indexname      = Indeks,
1567   locale/polish/captions/figurename     = Rysunek,
1568   locale/polish/captions/tablename      = Tabela,
1569   locale/polish/captions/partname       = Część,
1570   locale/polish/captions/pagename       = Strona,
1571   locale/polish/captions/seename        = Zobacz,
1572   locale/polish/captions/alsofilename    = Zobacz też,
1573   locale/polish/captions/enclname       = Załącznik,
1574   locale/polish/captions/ccname         = Kopie:,,
1575   locale/polish/captions/headtoname     = Do,
1576   locale/polish/captions/proofname       = Dowód ,
1577   locale/polish/captions/glossaryname    = Glossary, % no translation
1578   locale/polish/date ={\number\day\space\ifcase\month\or
1579     stycznia\or lutego\or marca\or kwietnia\or maja\or czerwca\or
1580     lipca\or sierpnia\or września\or października\or
1581     listopada\or grudnia\fi\space
1582     \number\year},
1583 }

```

## Section A.42

### *Portuguese*

```

1584 \cxset{locale~portuges/.style = {
1585   locale/portuges/captions/refname      = Referências,
1586   locale/portuges/captions/abstractname   = Resumo,
1587   locale/portuges/captions/bibname        = Bibliografia,
1588   locale/portuges/captions/prefacename    = Prefácio,
1589   locale/portuges/captions/chaptername    = Capítulo,
1590   locale/portuges/captions/appendixname   = Apêndice,
1591   locale/portuges/captions/contentsname   = Conteúdo,
1592   locale/portuges/captions/listfigurename = Lista~de~Figuras,
1593   locale/portuges/captions/listtablename   = Lista~de~Tabelas,
1594   locale/portuges/captions/indexname      = Índice,
1595   locale/portuges/captions/figurename     = Figura,
1596   locale/portuges/captions/tablename      = Tabela,
1597   locale/portuges/captions/partname       = Parte,
1598   locale/portuges/captions/pagename       = Página,
1599   locale/portuges/captions/seename        = ver,
1600   locale/portuges/captions/alsofilename    = ver~também,
1601   locale/portuges/captions/enclname       = Anexo,
1602   locale/portuges/captions/ccname         = Com~cópia~a,
1603   locale/portuges/captions/headtoname     = Para,
1604   locale/portuges/captions/proofname       = Dowód,
1605   locale/portuges/captions/glossaryname   = Glossário,
1606   locale/portuges/date =
1607   {
1608     \number\day\space de\space\ifcase\month\or

```

```

1609     Janeiro\or Fevereiro\or Março\or Abril\or Maio\or Junho\or
1610     Julho\or Agosto\or Setembro\or Outubro\or Novembro\or Dezembro\fi
1611     \space de\space\number\year
1612 },
1613 }
1614 }
```

## Section A.43

### *Romanian*

```

1615 \cxset{locale~romanian/.style = {
1616   locale/romanian/captions/refname      = Bibliografie,
1617   locale/romanian/captions/abstractname   = Rezumat,
1618   locale/romanian/captions/bibname       = Bibliografie,
1619   locale/romanian/captions/prefacename    = Prefață,
1620   locale/romanian/captions/chaptername   = Capitolul,
1621   locale/romanian/captions/appendixname   = Anexa,
1622   locale/romanian/captions/contentsname   = Cuprins,
1623   locale/romanian/captions/listfigurename = Listă~de~figuri,
1624   locale/romanian/captions/listtablename   = Listă~de~tabele,
1625   locale/romanian/captions/indexname     = Glosar,
1626   locale/romanian/captions/figurename    = Figura,
1627   locale/romanian/captions/tablename     = Tabela,
1628   locale/romanian/captions/partname     = Partea,
1629   locale/romanian/captions/pagename     = Pagina,
1630   locale/romanian/captions/seename      = Vezi,
1631   locale/romanian/captions/also name    = Vezi~de~asemenea,
1632   locale/romanian/captions/enclname     = Anexă,
1633   locale/romanian/captions/ccname       = Copie,
1634   locale/romanian/captions/headtoname   = Pentru,
1635   locale/romanian/captions/proofname    = Demonstrație ,
1636   locale/romanian/captions/glossaryname = Glosar,
1637   locale/romanian/date ={\number\day\space\ifcase\month\or
1638     ianuarie\or februarie\or martie\or aprilie\or mai\or
1639     iunie\or iulie\or august\or septembrie\or octombrie\or
1640     noiembrie\or decembrie\fi
1641     \space \number\year},
1642 }}
```

## Section A.44

### *Romansh*

```

1643 \cxset{locale~romansh/.style = {
1644   locale/romansh/captions/refname      = Bibliografia,
1645   locale/romansh/captions/abstractname  = Recapitulaziun,
1646   locale/romansh/captions/bibname       = Index~bibliografic,
1647   locale/romansh/captions/prefacename   = Prefaziun,
1648   locale/romansh/captions/chaptername  = Chapitel,
1649   locale/romansh/captions/appendixname = Appendix,
1650   locale/romansh/captions/contentsname = Tavla~dal~cuntegn,
1651   locale/romansh/captions/listfigurename= Tavla~da~las~figuras,
1652   locale/romansh/captions/listtablename = Tavla~da~las~tabellas,
1653   locale/romansh/captions/indexname    = Register~da~materias,
1654   locale/romansh/captions/figurename   = Figura,
1655   locale/romansh/captions tablename    = Tabella,
1656   locale/romansh/captions/partname    = Part,
1657   locale/romansh/captions/pagename    = pagina,
1658   locale/romansh/captions/seename     = vesair,
1659   locale/romansh/captions/also name   = vesair~era,
1660   locale/romansh/captions/enclname   = Agiunta(s),
1661   locale/romansh/captions/ccname     = Copia~a,
1662   locale/romansh/captions/headtoname = A,
1663   locale/romansh/captions/proofname  = Demonstraziun,
1664   locale/romansh/captions/glossaryname=Glossari,
1665   locale/romansh/date ={{\ifcase\day\or1.\else ils\space\number\day\fi\space da\space
1666   \ifcase\month\or
1667   schaner\or favrer\or mars\or avrigl\or matg\or zercladur\or
1668   fanadur\or avust\or settember\or october\or november\or
1669   december\fi\space \number\year}},,
1670 }

```

## Section A.45

### *Sami Languages*

Sami languages (/smi/[5]) is a group of Uralic languages spoken by the Sami people in Northern Europe (in parts of northern Finland, Norway, Sweden and extreme northwestern Russia). There are, depending on the nature and terms of division, ten or more Sami languages. Several names are used for the Sami languages: Saami, Sámi, Saame, Samic, Saamic, as well as the exonyms Lappish and Lappic. The last two, along with the term Lapp, are now often considered pejorative

```

1671 \cxset{locale~samin/.style = {
1672   locale/samin/captions/refname      = Čujuhusat,
1673   locale/samin/captions/abstractname  = Čoahkkáigeassu,
1674   locale/samin/captions/bibname       = Girjjálašvuhta,
1675   locale/samin/captions/prefacename   = Ovdasátni,
1676   locale/samin/captions/chaptername  = Kapihttal,
1677   locale/samin/captions/appendixname = Čuovus,

```

```

1678 locale/samin/captions/contentsname = Sisdoallu,
1679 locale/samin/captions/listfigurename = Govvosat,
1680 locale/samin/captions/listtablename = Tabeallat ,
1681 locale/samin/captions/indexname = Registtar,
1682 locale/samin/captions/figurename = Govus,
1683 locale/samin/captions tablename = Tabealla,
1684 locale/samin/captions/partname = Oassi,
1685 locale/samin/captions/pagename = Sidu,
1686 locale/samin/captions/seename = geahča,
1687 locale/samin/captions/also name = geahčageahča~maiddái ,
1688 locale/samin/captions/enclname = Mielddus,
1689 locale/samin/captions/ccname = Kopia sáddejuvpon,
1690 locale/samin/captions/headtoname = Vuostáiváldi,
1691 locale/samin/captions/proofname = Dowód ,
1692 locale/samin/captions/glossaryname = Sátnelistu,
1693 locale/samin/date ={\ifcase\month\or
1694     oðdajagemánu\or
1695     guovvamánu\or
1696     njukčamánu\or
1697     cuoománu\or
1698     miessemánu\or
1699     geassemánu\or
1700     suoidnemánu\or
1701     borgemánu\or
1702     čakčamánu\or
1703     golggotmánu\or
1704     skábmamánu\or
1705     juovlamánu\fi
1706     \space\number\day.\space b.\space\number\year},
1707 }

```

## Section A.46

### *Scottish*

```

1708 \cxset{locale~scottish/.style = {
1709   locale/scottish/captions/refname = Iomraidi,
1710   locale/scottish/captions/abstractname = Brìgh ,
1711   locale/scottish/captions/bibname = Leabhrachean,
1712   locale/scottish/captions/prefacename = Preface, % needs translation
1713   locale/scottish/captions/chaptername = Caibideil,
1714   locale/scottish/captions/appendixname = Ath-sgr`íobhadh,
1715   locale/scottish/captions/contentsname = Clàr-obrach,
1716   locale/scottish/captions/listfigurename = Liosta~Dhealbh,
1717   locale/scottish/captions/listtablename = Liosta~Chlàr,
1718   locale/scottish/captions/indexname = Clàr-innse,
1719   locale/scottish/captions/figurename = Dealbh ,

```

```

1720   locale/scottish/captions tablename      = Clàr ,
1721   locale/scottish/captions partname       = Cuid,
1722   locale/scottish/captions pagename       = t.d.,
1723   locale/scottish/captions seename        = see, % needs translation
1724   locale/scottish/captions alsoname       = ,
1725   locale/scottish/captions enclname       = a-staigh,
1726   locale/scottish/captions ccname         = lethbhreac~gu,
1727   locale/scottish/captions headtoname     = gu,
1728   locale/scottish/captions proofname      = Proof,
1729   locale/scottish/captions glossaryname    = Glossary,
1730   locale/scottish/date ={\number\day\space \ifcase\month\or
1731     am~Faoilteach\or an~Gearran\or am~Màrt\or an~Giblean\or
1732     an~Cèitean\or an~t~Òg mhios\or an~t~Iuchar\or
1733     Lùnasdal\or an~Sultuine\or an~Dàmhar\or
1734     an~t~Samhainn\or an~Dubhlachd\fi
1735     \space \number\year},
1736   }

```

## Section A.47

### Serbian

Standard Serbian language uses both Cyrillic (Ћирилица, ћирилица) and Latin script (latinica, латиница). Serbian is a rare example of synchronic digraphia, a situation where all literate members of a society have two interchangeable writing systems available to them. Media and publishers typically select one alphabet or another. The default is for latin script.

```

1737 \cxset{locale~serbian/.style = {
1738   locale/serbian/captions/refname      = Bibliografija,
1739   locale/serbian/captions/abstractname  = Sažetak,
1740   locale/serbian/captions/bibname       = Literatura,
1741   locale/serbian/captions/prefacename   = Predgovor,
1742   locale/serbian/captions/chaptername   = Glava,
1743   locale/serbian/captions/appendixname  = Dodatak,
1744   locale/serbian/captions/contentsname  = Sadržaj,
1745   locale/serbian/captions/listfigurename = Spisak slika,
1746   locale/serbian/captions/listtablename  = Spisak tabela,
1747   locale/serbian/captions/indexname     = Registar,
1748   locale/serbian/captions/figurename    = Slika,
1749   locale/serbian/captions tablename     = Tabela ,
1750   locale/serbian/captions partname      = Deo,
1751   locale/serbian/captions pagename      = Strana ,
1752   locale/serbian/captions seename       = Vidi,
1753   locale/serbian/captions alsoname      = Vidi takođe ,
1754   locale/serbian/captions enclname      = Prilozi,
1755   locale/serbian/captions ccname        = Kopije,
1756   locale/serbian/captions headtoname    = Prima,

```

```

1757  locale/serbian/captions/proofname      = Dokaz,
1758  locale/serbian/captions/glossaryname   = Rečnik~nepoznatih~reči,
1759  locale/serbian/date ={\number\day .\space\ifcase\month\or
1760    januar\or februar\or mart\or april\or maj\or
1761    jun\or jul\or avgust\or septembar\or oktobar\or novembar\or
1762    decembar\fi \space \number\year.},
1763  }
1764 \cxset{locale~serbian~cyrillic/.style = {
1765   locale/serbian~cyrillic/captions/refname      = ,
1766   locale/serbian~cyrillic/captions/abstractname   = ,
1767   locale/serbian~cyrillic/captions/bibname        = ,
1768   locale/serbian~cyrillic/captions/prefacename    = ,
1769   locale/serbian~cyrillic/captions/chaptername    = ,
1770   locale/serbian~cyrillic/captions/appendixname   = ,
1771   locale/serbian~cyrillic/captions/contentsname   = ,
1772   locale/serbian~cyrillic/captions/listfigurename = ~,
1773   locale/serbian~cyrillic/captions/listtablename   = ,
1774   locale/serbian~cyrillic/captions/indexname      = ,
1775   locale/serbian~cyrillic/captions/figurename     = ,
1776   locale/serbian~cyrillic/captions tablename       = ,
1777   locale/serbian~cyrillic/captions/partname       = ,
1778   locale/serbian~cyrillic/captions/pagename       = ,
1779   locale/serbian~cyrillic/captions/seename        = ,
1780   locale/serbian~cyrillic/captions/aloname        = ,
1781   locale/serbian~cyrillic/captions/enclname       = ,
1782   locale/serbian~cyrillic/captions/ccname         = ,
1783   locale/serbian~cyrillic/captions/headtoname     = ,
1784   locale/serbian~cyrillic/captions/proofname      = ,
1785   locale/serbian~cyrillic/captions/glossaryname   = ,
1786   locale/serbian~cyrillic/date ={\number\day .\space\ifcase\month\or
1787     \or \or \or \or \or
1788     \or \or \or \or \or \or
1789     \fi \space \number\year.},
1790  }

```

## Section A.48

### *Slovak*

```

1791 \cxset{locale~slovak/.style = {
1792   locale/slovak/captions/refname      = Referencie,
1793   locale/slovak/captions/abstractname = Abstrakt,
1794   locale/slovak/captions/bibname     = Literatúra,
1795   locale/slovak/captions/prefacename = Úvod,
1796   locale/slovak/captions/chaptername = Kapitola,
1797   locale/slovak/captions/appendixname = Dodatok,
1798   locale/slovak/captions/contentsname = Obsah,

```

```

1799  locale/slovak/captions/listfigurename = Zoznam~obrázkov ,
1800  locale/slovak/captions/listtablename   = Zoznam~tabuliek,
1801  locale/slovak/captions/indexname     = Index,
1802  locale/slovak/captions/figurename    = Obrázok,
1803  locale/slovak/captions tablename      = Tabuľka,
1804  locale/slovak/captions/partname      = Časť,
1805  locale/slovak/captions/pagename      = Strana,
1806  locale/slovak/captions/seename       = vid',
1807  locale/slovak/captions/alsoname      = vid~tiež,
1808  locale/slovak/captions/enclname      = Prílohy,
1809  locale/slovak/captions/ccname        = cc.,
1810  locale/slovak/captions/headtoname    = Pre,
1811  locale/slovak/captions/proofname     = Dôkaz,
1812  locale/slovak/captions/glossaryname = Slovník,
1813  locale/slovak/date ={\number\day.\~\ifcase\month\or
1814    janára\or februára\or marca\or apríla\or mája\or
1815    júna\or júla\or augusta\or septembra\or októbra\or
1816    novembra\or decembra\fi
1817    \space \number\year},
1818  }{}
```

## Section A.49

### *Slovenian*

```

1819 \cxset{locale~slovenian/.style = {
1820   locale/slovenian/captions/refname      = Literatura,
1821   locale/slovenian/captions/abstractname  = Povzetek,
1822   locale/slovenian/captions/bibname       = Literatura,
1823   locale/slovenian/captions/prefacename   = Predgovor,
1824   locale/slovenian/captions/chaptername   = Poglavlje,
1825   locale/slovenian/captions/appendixname  = Dodatek,
1826   locale/slovenian/captions/contentsname  = Kazalo,
1827   locale/slovenian/captions/listfigurename = Slike,
1828   locale/slovenian/captions/listtablename  = Tabele,
1829   locale/slovenian/captions/indexname     = Stvarno~kazalo,
1830   locale/slovenian/captions/figurename    = Slika,
1831   locale/slovenian/captions tablename     = Tabela,
1832   locale/slovenian/captions/partname      = Del,
1833   locale/slovenian/captions/pagename      = Stran,
1834   locale/slovenian/captions/seename       = glej,
1835   locale/slovenian/captions/alsoname      = glej~tudi,
1836   locale/slovenian/captions/enclname      = Priloge,
1837   locale/slovenian/captions/ccname        = Kopije,
1838   locale/slovenian/captions/headtoname    = Prejme,
1839   locale/slovenian/captions/proofname     = Dokaz,
1840   locale/slovenian/captions/glossaryname = Slovar,
1841   locale/slovenian/date ={\number\day.\~\ifcase\month\or
```

```

1842     januar\or februar\or marec\or april\or maj\or junij\or
1843     julij\or avgust\or september\or oktober\or november\or december\fi
1844     \space \number\year},
1845 }
1846 % Alphabet consists of 25 lower and 25 upper letters
1847 \cs_new:Npn \int_to_Alph_slovenian:n #1
1848 {
1849     \int_to_symbols:nnn {#1} { 25 }
1850 {
1851     { 1 } { A }
1852     { 2 } { B }
1853     { 3 } { C }
1854     { 4 } { Č }
1855     { 5 } { D }
1856     { 6 } { E }
1857     { 7 } { F }
1858     { 8 } { G }
1859     { 9 } { H }
1860     { 10 } { I }
1861     { 11 } { J }
1862     { 12 } { K }
1863     { 13 } { L }
1864     { 14 } { M }
1865     { 15 } { N }
1866     { 16 } { O }
1867     { 17 } { P }
1868     { 18 } { R }
1869     { 19 } { S }
1870     { 20 } { Š }
1871     { 21 } { T }
1872     { 22 } { U }
1873     { 23 } { V }
1874     { 24 } { Z }
1875     { 25 } { Ž }
1876 }
1877 }
1878
1879 \cs_new:Npn \int_to_alpha_slovenian:n #1
1880 {
1881     \int_to_symbols:nnn {#1} { 25 }
1882 {
1883     { 1 } { a }
1884     { 2 } { b }
1885     { 3 } { c }
1886     { 4 } { č }
1887     { 5 } { d }
1888     { 6 } { e }
1889     { 7 } { f }
1890     { 8 } { g }
1891     { 9 } { h }
1892     { 10 } { i }
1893     { 11 } { j }
1894     { 12 } { k }
1895     { 13 } { l }

```

```

1896 { 14 } { m }
1897 { 15 } { n }
1898 { 16 } { o }
1899 { 17 } { p }
1900 { 18 } { r }
1901 { 19 } { s }
1902 { 20 } { š }
1903 { 21 } { t }
1904 { 22 } { u }
1905 { 23 } { v }
1906 { 24 } { z }
1907 { 25 } { ž }
1908 }
1909 }
```

## Section A.50

### *Spanish*

```

1910 \cxset{locale~spanish/.style = {
1911   locale/spanish/captions/refname      = Referencias,
1912   locale/spanish/captions/abstractname = Resumen,
1913   locale/spanish/captions/bibname     = Bibliografía,
1914   locale/spanish/captions/prefacename = Prefacio,
1915   locale/spanish/captions/chaptername = Capítulo,
1916   locale/spanish/captions/appendixname = Apéndice,
1917   locale/spanish/captions/contentsname = Índice~general,
1918   locale/spanish/captions/listfigurename = Índice~de~figuras,
1919   locale/spanish/captions/listtablename = Índice~de~cuadros,
1920   locale/spanish/captions/indexname    = Índice~alfabético,
1921   locale/spanish/captions/figurename   = Figura,
1922   locale/spanish/captions/tablename   = Cuadro,
1923   locale/spanish/captions/partname    = Parte,
1924   locale/spanish/captions/pagename    = Página,
1925   locale/spanish/captions/seename     = véase,
1926   locale/spanish/captions/alsoname    = véase~también,
1927   locale/spanish/captions/enclname   = Adjunto(s),
1928   locale/spanish/captions/ccnname    = Copia~a,
1929   locale/spanish/captions/headtoname = A,
1930   locale/spanish/captions/proofname   = Prueba,
1931   locale/spanish/captions/glossaryname = Glosario,
1932   locale/spanish/date ={\number\day~de~\ifcase\month\or
1933     enero\or febrero\or marzo\or abril\or mayo\or junio\or
1934     julio\or agosto\or septiembre\or octubre\or noviembre\or
1935     diciembre\fi\space de~\number\year},
1936 }}
```

## Section A.51

### *Swedish*

```

1937 \cxset{locale~swedish/.style = {
1938   locale/swedish/captions/refname      = Referenser,
1939   locale/swedish/captions/abstractname  = Sammanfattning,
1940   locale/swedish/captions/bibname       = Litteraturförteckning,
1941   locale/swedish/captions/prefacename   = Förord,
1942   locale/swedish/captions/chaptername  = Kapitel,
1943   locale/swedish/captions/appendixname  = Bilaga,
1944   locale/swedish/captions/contentsname  = Innehåll,
1945   locale/swedish/captions/listfigurename= Figurer,
1946   locale/swedish/captions/listtablename = Tabeller,
1947   locale/swedish/captions/indexname    = Sakregister,
1948   locale/swedish/captions/figurename   = Figur,
1949   locale/swedish/captions/tablename    = Tabell,
1950   locale/swedish/captions/partname    = Del,
1951   locale/swedish/captions/pagename    = Sida,
1952   locale/swedish/captions/seename     = se,
1953   locale/swedish/captions/alsoiname   = se~även,
1954   locale/swedish/captions/enclname   = Bil.,
1955   locale/swedish/captions/ccname     = Kopia~för~kändedom,
1956   locale/swedish/captions/headtoname = Till,
1957   locale/swedish/captions/proofname   = Bevis,
1958   locale/swedish/captions/glossaryname= Ordlista,
1959   locale/swedish/date ={\number\day\space\ifcase\month\or
1960     januari\or februari\or mars\or april\or maj\or juni\or
1961     juli\or augusti\or september\or oktober\or november\or
1962     december\fi
1963     \space\number\year},
1964 }}
```

swedish

## Section A.52

### *Tamil*

```

1965 \cxset{locale~tamil/.style = {
1966   locale/tamil/captions/refname = ,
1967   locale/tamil/captions/abstractname = ,
```

```

1968   locale/tamil/captions/bibname      = ,
1969   locale/tamil/captions/prefacename  = ,
1970   locale/tamil/captions/chaptername = ,
1971   locale/tamil/captions/appendixname = ,
1972   locale/tamil/captions/contentsname = ,
1973   locale/tamil/captions/listfigurename = ~,
1974   locale/tamil/captions/listtablename = ~,
1975   locale/tamil/captions/indexname = ,
1976   locale/tamil/captions/figurename = ,
1977   locale/tamil/captions tablename = ,
1978   locale/tamil/captions/partname = ,
1979   locale/tamil/captions/pagename = ,
1980   locale/tamil/captions/seename = ,
1981   locale/tamil/captions/also name = ,
1982   locale/tamil/captions/enclname = {},
1983   locale/tamil/captions/ccname = {},
1984   locale/tamil/captions/headtoname ={} ,
1985   locale/tamil/captions/proofname = ,
1986   locale/tamil/captions/glossaryname = ,
1987   locale/tamil/date ={\number\year\space\ifcase\month\or
1988     \or
1989     \or
1990     \or
1991     \or
1992     \or
1993     \or
1994     \or
1995     \or
1996     \or
1997     \or
1998     \or
1999     \fi
2000     \space\number\day},
2001   }
tamil

```

## Section A.53

### Telugu

```

2002 \cxset{locale~telugu/.style = {
2003   locale/telugu/captions/refname = ,
2004   locale/telugu/captions/abstractname = ,
2005   locale/telugu/captions/bibname      = ,
2006   locale/telugu/captions/prefacename = ,
2007   locale/telugu/captions/chaptername = ,
2008   locale/telugu/captions/appendixname = ,
2009   locale/telugu/captions/contentsname = ,

```

```

2010  locale/telugu/captions/listfigurename = ,
2011  locale/telugu/captions/listtablename = ,
2012  locale/telugu/captions/indexname = ,
2013  locale/telugu/captions/figurename = ,
2014  locale/telugu/captions tablename = ,
2015  locale/telugu/captions/partname = ,
2016  locale/telugu/captions/pagename = ,
2017  locale/telugu/captions/seename = ,
2018  locale/telugu/captions/also name = ,
2019  locale/telugu/captions/enclname = *,
2020  locale/telugu/captions/ccname = ,
2021  locale/telugu/captions/headtoname = ,
2022  locale/telugu/captions/proofname = ,
2023  locale/telugu/captions/glossaryname = ,
2024  locale/telugu/date ={\panunicode
2025  \def\telugu@month{
2026    \ifcase\month\or
2027      \or
2028      \or
2029      \or
2030      \or
2031      \or
2032      \or
2033      \or
2034      \or
2035      \or
2036      \or
2037      \or
2038      \fi}
2039  \telugu@month\space\number\day,\space\number\year}} ,
2040  }
telugu

```

## Section A.54

### *Turkish*

```

2041 \cxset{locale~turkish/.style = {
2042   locale/turkish/captions/refname      = Kaynaklar,
2043   locale/turkish/captions/abstractname = Özeti,
2044   locale/turkish/captions/bibname      = Kaynakça,
2045   locale/turkish/captions/prefacename = Önsöz,
2046   locale/turkish/captions/chaptername = Bölüm,
2047   locale/turkish/captions/appendixname = Ek,
2048   locale/turkish/captions/contentsname = İçindekiler,
2049   locale/turkish/captions/listfigurename = Şekil Listesi,
2050   locale/turkish/captions/listtablename = Tablo Listesi,
2051   locale/turkish/captions/indexname   = Dizin,

```

```

2052 locale/turkish/captions/figurename      = Şekil,
2053 locale/turkish/captions tablename        = Tablo,
2054 locale/turkish/captions/partname        = Kısım,
2055 locale/turkish/captions/pagename        = Sayfa,
2056 locale/turkish/captions/seename         = bkz.,
2057 locale/turkish/captions/also name       = ayrıca~bkz.,
2058 locale/turkish/captions/enclname        = İlişik,
2059 locale/turkish/captions/ccname          = Diğer~Alicilar,
2060 locale/turkish/captions/headtoname      = Alıcı,
2061 locale/turkish/captions/proofname        = Kanıt,
2062 locale/turkish/captions/glossaryname    = Lügatçe,
2063 locale/turkish/date = {\number\day\space\ifcase\month\or
2064 Ocak\or Şubat\or Mart\or Nisan\or Mayıs\or Haziran\or
2065 Temmuz\or Ağustos\or Eylül\or Ekim\or Kasım\or
2066 Aralı̄k\fi
2067 \space\number\year},
2068 }

```

## Section A.55

### Turkmen

```

2069 \cxset{locale~turkmen.style = {
2070   locale/turkmen/captions/refname      = Çeşmeler,
2071   locale/turkmen/captions/abstractname  = Gysgaça~manisy,
2072   locale/turkmen/captions/bibname       = Çeşmeler,
2073   locale/turkmen/captions/prefacename   = Sözbaşı,
2074   locale/turkmen/captions/chaptername  = Bap,
2075   locale/turkmen/captions/appendixname  = Goşmaça,
2076   locale/turkmen/captions/contentsname  = Mazmuny,
2077   locale/turkmen/captions/listfigurename = Suratlaryň~sanawy,
2078   locale/turkmen/captions/listtablename  = Tablisalaryň~sanawy,
2079   locale/turkmen/captions/indexname     = Indeks,
2080   locale/turkmen/captions/figurename    = Surat,
2081   locale/turkmen/captions tablename     = Tablisa,
2082   locale/turkmen/captions/partname     = Bölüm,
2083   locale/turkmen/captions/pagename     = Sahypa,
2084   locale/turkmen/captions/seename      = ser.,
2085   locale/turkmen/captions/also name    = şuňa-da~ser.,
2086   locale/turkmen/captions/enclname    = Goşmaça,
2087   locale/turkmen/captions/ccname       = Iberilenler,
2088   locale/turkmen/captions/headtoname  = Kime,
2089   locale/turkmen/captions/proofname    = Delil,
2090   locale/turkmen/captions/glossaryname = Sözlük,
2091   locale/turkmen/date = {\number\day\space\ifcase\month\or
2092 Yanwar\or Fewral\or Mart\or Aprel\or Mayý\or Iýun\or
2093 Iýul\or Awgust\or Sentýabr\or Oktýabr\or Noýabré\or
2094 Dekabr\fi

```

```
2095     \space\number\year},  
2096 } }
```

turkmen

## Section A.56

### *Ukrainian*

Ukrainian uk uk 1058 422 1251

```
2097 \cxset{locale~ukrainian/.style = {  
2098   locale/ukrainian/captions/refname      = ,  
2099   locale/ukrainian/captions/abstractname  = ,  
2100   locale/ukrainian/captions/bibname       = ,  
2101   locale/ukrainian/captions/prefacename   = ,  
2102   locale/ukrainian/captions/chaptername  = ,  
2103   locale/ukrainian/captions/appendixname = ,  
2104   locale/ukrainian/captions/contentsname = ,  
2105   locale/ukrainian/captions/listfigurename = ~,  
2106   locale/ukrainian/captions/listtablename  = ~,  
2107   locale/ukrainian/captions/indexname    = ,  
2108   locale/ukrainian/captions/figurename   = .,  
2109   locale/ukrainian/captions tablename     = .,  
2110   locale/ukrainian/captions/partname    = ,  
2111   locale/ukrainian/captions/pagename    = .,  
2112   locale/ukrainian/captions/seename     = .,  
2113   locale/ukrainian/captions/also name   = .\ ~,  
2114   locale/ukrainian/captions/enclname    = ,  
2115   locale/ukrainian/captions/ccname     = ,  
2116   locale/ukrainian/captions/headtoname = ,  
2117   locale/ukrainian/captions/proofname   = ,  
2118   locale/ukrainian/captions/glossaryname= ~,  
2119   locale/ukrainian/date ={\number\day\space\ifcase\month\or  
2120     \or  
2121     \or  
2122     \or  
2123     \or  
2124     \or  
2125     \or  
2126     \or  
2127     \or  
2128     \or  
2129     \or  
2130     \or  
2131     \fi  
2132     \space\number\year\space .},  
2133 } }
```

# Section A.57

## *Usorbian*

The Sorbian languages (Upper Sorbian: Serbska rěč, Lower Sorbian: Serbska rěc) are two closely related, but only partially mutually intelligible, West Slavic languages spoken by the Sorbs, a West Slavic minority in the Lusatia region of eastern Germany. They are classified under the West Slavic branch of the Indo-European languages and are therefore closely related to the other two West Slavic subgroups: Lechitic and Czech–Slovak.<sup>2</sup> Historically the languages have also been known as Wendish (named after the Wends, earliest Slavic people in modern Poland and Germany) or Lusatian. Their collective ISO 639-2 code is **wen**.

There are two literary languages: Upper Sorbian (hornjoserbsce), spoken by about 40,000 people in Saxony, and Lower Sorbian (dolnoserbski) spoken by about 10,000 people in Brandenburg. The area where the two languages are spoken is known as Lusatia (Łužica in Upper Sorbian, Łužyc in Lower Sorbian, or Lausitz in German).

```

2134 \cxset{locale~usorbian/.style = {
2135   locale/usorbian/captions/refname      = Referency ,
2136   locale/usorbian/captions/abstractname  = Abstrakt,
2137   locale/usorbian/captions/bibname       = Literatura ,
2138   locale/usorbian/captions/prefacename   = Zawod,
2139   locale/usorbian/captions/chaptername  = Kapitl,
2140   locale/usorbian/captions/appendixname = Dodawki,
2141   locale/usorbian/captions/contentsname = Wobsah,
2142   locale/usorbian/captions/listfigurename= Zapis~wobrazow,
2143   locale/usorbian/captions/listtablename = Zapis~tabulkow,
2144   locale/usorbian/captions/indexname    = Indeks,
2145   locale/usorbian/captions/figurename   = Wobraz,
2146   locale/usorbian/captions/tablename    = Tabulka,
2147   locale/usorbian/captions/partname    = Dźel,
2148   locale/usorbian/captions/pagename    = Strona,
2149   locale/usorbian/captions/seename     = hl.,
2150   locale/usorbian/captions/alsoiname   = hl.~tež,
2151   locale/usorbian/captions/enclname   = Přloha,
2152   locale/usorbian/captions/ccname     = CC,
2153   locale/usorbian/captions/headtoname = Komu ,
2154   locale/usorbian/captions/proofname   = Proof,
2155   locale/usorbian/captions/glossaryname=Glossary,
2156   locale/usorbian/date                =
2157   {
2158     \number\day.\space
2159     \ifcase\month

```

<sup>2</sup>Online article by Hermut Feska in: [About Sorbian Language](#).

```

2160      \or januara
2161      \or februara
2162      \or m  rc  
2163      \or apryla
2164      \or meje
2165      \or junija
2166      \or julija
2167      \or awgusta
2168      \or septembra
2169      \or oktobra
2170      \or nowembra
2171      \or decembra
2172      \fi
2173      \space\number\year
2174 },
2175 }
2176 \cxset{locale~Usorbian/.alias = locale~usorbian}
    Usorbian

```

## Section A.58

### *hangul*

```

2177
2178 \cxset{locale~hangul/.style = {
2179   locale/hangul/captions/refname      = Tài~liệu,
2180   locale/hangul/captions/abstractname = Tóm~t  t~n  i~dung,
2181   locale/hangul/captions/bibname     = Tài~liệu~th  m~kh  o  ,
2182   locale/hangul/captions/prefacename = L  r  i~n  o  i~  d    u  ,
2183   locale/hangul/captions/chaptername = Chương,
2184   locale/hangul/captions/appendixname = Phụ~l  c,
2185   locale/hangul/captions/contentsname = M  c~l  c,
2186   locale/hangul/captions/listfigurename = Danh~s  ch~h  nh~v   ,
2187   locale/hangul/captions/listtablename = Danh~s  ch~b  ng,
2188   locale/hangul/captions/indexname   = Chỉ~m  c,
2189   locale/hangul/captions/figurename  = H  nh,
2190   locale/hangul/captions tablename   = B  ng,
2191   locale/hangul/captions/partname   = Ph  n ,
2192   locale/hangul/captions/pagename   = Trang,
2193   locale/hangul/captions/seename    = Xem ,
2194   locale/hangul/captions/also name = Xem~th  m,
2195   locale/hangul/captions/enclname  = K  m~theo,
2196   locale/hangul/captions/ccname    = C  ng~g  i  ,
2197   locale/hangul/captions/headtoname = G  i  ,
2198   locale/hangul/captions/proofname = Ch  ng~minh,
2199   locale/hangul/captions/glossaryname = T  ~di  n~ch  ~gi  i,
2200   locale/hangul/date = {Ng  y\space\number\day\space

```

```

2201     thng\space\number\month\space
2202     nm\space\number\year},
2203 }
2204 \cxset{locale~hangul/.alias = locale~hangul}
    hangul

```

## Section A.59

### *Welsh*

for dates and times see [swansea](#)

```

2205 \newif\ifwelsh@first
2206
2207 \def\welsh@article#1{
2208   \welsh@firsttrue
2209   y
2210   \expandafter\welsh@article@do#1
2211 }
2212
2213 \def\welsh@article@do#1{
2214   \ifwelsh@first\welsh@isvowel#1
2215   \ifwelsh@vowel
2216     r\space
2217     \welsh@vowelfalse
2218   \else
2219     \space
2220     \fi#1
2221   \welsh@firstfalse
2222   \fi
2223 }
2224
2225 \newif\ifwelsh@vowel
2226 \def\welsh@isvowel#1{
2227   \ifx#1a\welsh@voweltrue
2228   \else
2229   \ifx#1u
2230     \welsh@voweltrue
2231   \else
2232     \ifx#1w\welsh@voweltrue
2233     \fi\fi\fi}%
               % FIXME Add the other vowels, just for good measure
2234
2235 \def\welsh@ordinal@long#1{%
2236   \if_case:w #1
2237     \or: cyntaf
2238     \or: ail
2239     \or: trydydd
2240     \or: pedwerydd

```

```

2241     \or: pumed
2242     \or: chweched
2243     \or: seithfed
2244     \or: wythfed
2245     \or: nawfed
2246     \or: degfed
2247     \or: unfed~ar~ddeg
2248     \or: deuddegfed
2249     \or: trydydd~ar~ddeg
2250     \or: pedwerydd~ar~ddeg
2251     \or: pymthegfed
2252     \or: unfed~ar~bymtheg
2253     \or: ail~ar~bymtheg
2254     \or: deunawfed
2255     \or: pedwerydd~ar~bymtheg
2256     \or: ugeinfed
2257     \else:
2258     \exp_after:wN \welsh@ordinalplusxx@long#1
2259     \fi:
2260 }
2261
2262 \def\welsh@ordinalplusxx@long#1{%
2263   \let\dday=#1\advance\dday~-by~-20\relax\welsh@ordinal@long\dday\space ar~hugain%
2264 }
2265
2266 \cxset{welsh~date~format/.is~choice,
2267   welsh~date~format/standard/.code =
2268   \def\today{\expandafter\welsh@article\welsh@ordinal@long\day\space o\space
2269   \if_case:w \month
2270   \or: Ionawr
2271   \or: Chwefror
2272   \or: Fawrth
2273   \or: Ebrill
2274   \or: Fai
2275   \or: Fehefin
2276   \or: Orffenaf
2277   \or: Awst
2278   \or: Fedi
2279   \or: Hydref
2280   \or: Dachwedd
2281   \or: Ragfyr
2282   \fi:
2283   \space\number\year},
2284   welsh~date~format/formal/.code = \def\today{\ifcase\day\or 1af\or 2ail\or 3y
2285   \or 7fed\or 8fed\or 9fed\or 10fed\or 11eg\or 12fed\or 13eg\or
2286   14eg\or 15fed\or 16eg\or 17eg\or 18fed\or 19eg\or
2287   20fed\else\number\day ain\fi\space\ifcase\month\or
2288   Ionawr\or Chwefror\or Mawrth\or Ebrill\or
2289   Mai\or Mehefin\or Gorffennaf\or Awst\or
2290   Medi\or Hydref\or Tachwedd\or Rhagfyr\fi%
2291   \space\number\year},
2292   welsh~date~format=formal,
2293 }
2294 \cxset{locale~welsh/.style = {

```

```

2295  locale/welsh/captions/refname      = Cyfeiriadau,
2296  locale/welsh/captions/abstractname = Crynodeb,
2297  locale/welsh/captions/bibname     = Llyfryddiaeth,
2298  locale/welsh/captions/prefacename = Rhagair,
2299  locale/welsh/captions/chaptername = Pennod,
2300  locale/welsh/captions/appendixname = Atodiad,
2301  locale/welsh/captions/contentsname = Cynnwys,
2302  locale/welsh/captions/listfigurename = Rhestr~Ddarluniau,
2303  locale/welsh/captions/listtablename = Rhestr~Dablau,
2304  locale/welsh/captions/indexname   = Mynegai,
2305  locale/welsh/captions/figurename  = Darlun,
2306  locale/welsh/captions tablename   = Taflen,
2307  locale/welsh/captions/partname   = Rhan,
2308  locale/welsh/captions/pagename   = tudalen,
2309  locale/welsh/captions/seename    = gweler,
2310  locale/welsh/captions/also name  = gweler~hefyd,
2311  locale/welsh/captions/enclname   = amgaeëdig,
2312  locale/welsh/captions/ccname    = copïau,
2313  locale/welsh/captions/headtoname = At,
2314  locale/welsh/captions/proofname  = Prawf,
2315  locale/welsh/captions/glossaryname = Rhestr~termau,
2316  welsh~date~format=standard,
2317  }
2318 \cxset{locale~Welsh/.alias=locale~welsh}

```

## Section A.60

### *Hangul*

```

2319 \cxset{locale~hangul/.style = {
2320   locale/hangul/captions/refname      = ,
2321   locale/hangul/captions/abstractname = ,
2322   locale/hangul/captions/bibname     = ,
2323   locale/hangul/captions/prefacename = ,
2324   locale/hangul/captions/chaptername = ,
2325   locale/hangul/captions/appendixname = ,
2326   locale/hangul/captions/contentsname = ~,
2327   locale/hangul/captions/listfigurename = ~,
2328   locale/hangul/captions/listtablename = ~,
2329   locale/hangul/captions/indexname   = ,
2330   locale/hangul/captions/figurename  = ,
2331   locale/hangul/captions tablename   = ,
2332   locale/hangul/captions/partname   = ,
2333   locale/hangul/captions/pagename   = ,
2334   locale/hangul/captions/seename    = ,
2335   locale/hangul/captions/also name  = ,
2336   locale/hangul/captions/enclname   = ,

```

```

2337  locale/hangul/captions/ccname      = ,
2338  locale/hangul/captions/headtoname = ,
2339  locale/hangul/captions/proofname  = ,
2340  locale/hangul/captions/glossaryname = ,
2341  locale/hangul/date ={Ngày\space\number\day\space
2342    tháng\space\number\month\space
2343    năm\space\number\year},
2344  }}

hangul
Welsh The Captions List is helpful for presenting the captions in various languages. Inspired from MonTeX!!!
2345 \newcommand{\CaptionsList}[1]{%
2346   \bgroup
2347   \cxset{locale~#1}
2348   %\ttfamily
2349   \panunicode%
2350 \begin{longtable}[]{}lll}
2351 \caption{Captions~in~#1\label{#1captions}}\\
2352 \toprule
2353   Command          & English          & #1 \\
2354 \midrule
2355 \cs{prefacename}    & Preface          & \prefacename\\
2356 \cs{refname}        & References       & \refname\\
2357 \cs{abstractname}   & Abstract          & \abstractname\\
2358 \cs{bibname}         & Bibliography     & \bibname\\
2359 \cs{chaptername}    & Chapter           & \chaptername\\
2360 \cs{appendixname}   & Appendix          & \appendixname\\
2361 \cs{contentsname}   & Contents          & \contentsname\\
2362 \cs{listfigurename} & List~of~Figures  & \listfigurename\\
2363 \cs{listtablename}  & List~of~Tables   & \listtablename\\
2364 \cs{indexname}       & Index             & \indexname\\
2365 \cs{figurename}     & Figure            & \figurename\\
2366 \cs{tablename}       & Table             & \tablename\\
2367 \cs{partname}        & Part              & \partname\\
2368 \cs{enclname}        & encl              & \enclname\\
2369 \cs{ccname}          & cc                & \ccname\\
2370 \cs{headtoname}      & To                & \headtoname\\
2371 \cs{pagename}        & Page              & \pagename\\
2372 \cs{seename}         & see               & \seename\\
2373   \cs{also name}     & see~also          & \also name\\
2374 \cs{glossaryname}    & Glossary          & \glossaryname\\
2375 \cs{today}           & & \today \\
2376 \% \cs{dateitalian} & & \dateitalian\\
2377 \bottomrule
2378 \end{longtable}
2379 \% \captionenglish
2380 \egroup
2381 }
2382
2383 \clist_set:cn {en_clist} {, January, February, March, April, May,
2384   June, July, August, September, October, November, December}
2385
2386 \ExplSyntaxOff

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