This is a list of all substantial corrections made to Computers & Typesetting between the publication of the second “Millennium Edition” at the close of the year 2001 and the beginning of the year 2014. (More precisely, it lists errors corrected in 16th to 19th printings of Volume A, the 7th and 8th printings of Volume B, the 6th and 7th printings of Volume C, the 4th and 5th printings of Volume D, and the 5th and 6th printings of Volume E.) Corrections made to the softcover version of The T\TeX\book, beginning with its 32nd printing, are the same as corrections to Volume A. Corrections to the softcover version of The META\FONT\book, beginning with its 11th printing, are the same as corrections to Volume C. Changes to the mini-indexes and master indexes of Volumes B, D, and E are not shown here unless they are not obviously derivable from what has been shown. All of these errors have supposedly been corrected in more recent printings, unless they were subsequently found to be wrong.

Page A7, line 4 from the bottom (01/15/04)

since control sequences of the second kind always have exactly one symbol after

Page A123, line 7 from the bottom (02/27/08)

that it won’t make the natural height-plus-depth of \box\ n surpass \dim\ n, when it is

Page A124, lines 12 and 13 (02/27/08)

means that T\TeX\ has tried to split an \insert\254 to height 180.2 pt; the natural height-
plus-depth of the best such split is 175.3 pt, and the penalty for breaking there is 100.)

Page A153, line 7 (01/03/14)

of three fonts: one for text size, one for script size, and one for scriptscript size. The

Page A206, lines 12–17 (05/21/07)

or alignment template is also considered to be \outer in this sense; for example, a file
shouldn’t end in the middle of a definition. If you are designing a format for others to
use, you can help them detect errors before too much harm is done, by using \outer
with all control sequences that should appear only at “quiet times” within a document.
For example, Appendix B defines \proclaim to be \outer, since a user shouldn’t be
stating a theorem as part of a definition or argument or preamble.

Page A216, line 3 from the bottom (12/20/07)

\openin\(\text{number}\)=\(\text{file name}\)

Page A290, lines 25–26 (02/24/08)

\begin{itemize}
\item \(\langle \text{leaders}\rangle\langle \text{box or rule}\rangle\langle \text{horizontal skip}\rangle\). Here \langle \text{horizontal skip}\rangle refers to one of the first five glue-appending commands just mentioned; the formal syntax for \langle leaders\rangle
are defined as in the second alternative of a (math field), are recorded in a \texttt{choice}

\def\appendroman#1#2#3{\expandafter\def\expandafter#1\expandafter\{\csname\expandafter\gobble\string#2\romannumeral#3\endcsname\}}

\def\\{\if\space\next\ % assume that \next is unexpandable

\leavevmode\copy0\kern-\wd0\makelightbox

15.13. Yes, in severe circumstances. (1) Previous footnotes might have left no room for any more footnotes on the page. (2) If \texttt{vadjust\{eject\}} occurs on the same line

\def\loggingall{\tracingcommands=2 \tracingstats=2 \tracingpages=1 \tracingoutput=1 \tracinglostchars=1 \tracingmacros=2 \tracingparagraphs=1 \tracingrestores=1 \showboxbreadth=\maxdimen \showboxdepth=\maxdimen} \def\tracingall{\tracingonline=1 \loggingall}

\def\fmtversion{3.141592653} % identifies the current format

And here’s another solution (which may be faster, because token list registers can be expanded more quickly than macros on some implementations, using \texttt{\the}):

\loop \ifnum\m>0 \t=\expandafter{\the\t}\advance\m-1 \repeat
Finally, the reformatting of \texttt{\box\footins} can be achieved easily with an elegant technique suggested by David Kastrup, using the following \TeX code within the \texttt{\output} routine:

\begin{verbatim}
\def\makefootnoteparagraph{\unvbox\footins \baselineskip=\footnotebaselineskip \removehboxes}
\def\removehboxes{\unskip\setbox0=\lastbox \ifhbox0{\removehboxes}\unhbox0 \else\noindent \fi}
\end{verbatim}

The key idea here is \texttt{\removehboxes}, a macro that has the magical ability to take a vertical box such as \texttt{\vbox{\box1\box2\box3\removehboxes}} and transform it into \texttt{\vbox{\noindent\unhbox1\unhbox2\unhbox3}}, if \texttt{\box1}, \texttt{\box2}, and \texttt{\box3} are hboxes. Notice how \texttt{\removehboxes} introduces braces so that \TeX's save stack will hold all of the hboxes before they are unboxed. Each level of recursion in this routine uses one cell of input stack space and three cells of save stack space; thus, it is generally safe to do more than 100 footnotes without exceeding \TeX's capacity.

In our application there is no interline glue within \texttt{\box\footins}, so the \texttt{\unskip} command could be deleted from \texttt{\removehboxes}.

Incidentally, the \texttt{\unskip} and \texttt{\lastbox} operations have running times of the approximate form \(a + mb\), where \(m\) is the number of items on the list preceding the glue or box that is removed. Hence \texttt{\removehboxes} has a running time of order \(n^2\) when it removes \(n\) boxes. But the constant \(b\) is so small that for practical purposes it's possible to think of \texttt{\unskip} and \texttt{\lastbox} as almost instantaneous.

\begin{verbatim}
\def\leftheadline{\hbox to \pagewidth{\spaceskip=0pt \vbox to 10pt{}% strut to position the baseline \llap{\tenbf\folio\kern1pc}% folio to left of text \tenit\rhead\hfil}} % running head flush left
\def\rightheadline{\hbox to \pagewidth{\spaceskip=0pt\vbox to 10pt{}% strut to position the baseline \llap{\tenbf\folio\kern1pc}% folio to left of text \tenit\rhead\hfil}} % running head flush left
\end{verbatim}

3. If the current item is a style change, set \(C\) to the specified style and move on to the next item.
where subscripts that aren’t shown are zero), and this yields

\[ \text{s}1\text{tic } \text{exp } x_3p \text{ pi}_3a_2 \text{i}_1a \text{i}_2al \text{ ld } 1\text{ci } 2\text{i}o \text{ ou}_2 2\text{us} \]

Page A458, left column (01/11/07)

\backslash, 38, 356, 378, 418.

Page A459, left column (03/17/06)

angle brackets ( ), 59, 146–147, 150, 156, 268, 420, 437; see also \langle, \rangle.

Page A461, left column (02/24/08)

\backslash \text{boxit}, 223, 331.

Page A468, right column (02/26/08)

interline glue, 78–79, 80, 104, 105, 125, 221, 245, 263, 281–282, 335, 352, 399, 409.

Page A469, left column (02/26/08)

Kastrup, David Friedrich, 399.

Page A470, left column (01/21/03)

\text{loggingall}, 364.

Page A477, right column (06/08/07)


Page A479, right column (09/11/07)

\text{undefined}, 350, 384.

Page A483, line 5 from the bottom (11/18/03)

— Hieronymus Hornschuch, Ὀρθοτυπογραφίας (1608)

Page Bv, page number change (12/27/11)

[For consistency with Volumes A, C, and E, the preface now begins on page v instead of page vii. This change was first made in the ninth printing.]

Page Bv (formerly Bvii), bottom two lines (01/06/14)

all of those changes. I now believe that the final bug was discovered on 14 September 2008 and removed in version 3.14159265. The finder's fee has converged to $327.68.
Page Bxiii (formerly Bxv), line −7 (12/27/11)

Format specs have no effect on the corresponding Pascal program, but they do influence

Page B2, line 10 from the bottom (01/02/14)

\texttt{define \textit{banner} \equiv \texttt{``This is TeX, Version 3.14159265\texttt{``}} \{ printed when \TeX \texttt{starts} \}

Page B3, new paragraph to follow line 9 (12/20/02)

Incidentally, Pascal’s standard \texttt{round} function can be problematical, because it disagrees with the IEEE floating-point standard. Many implementors have therefore chosen to substitute their own home-grown rounding procedure.

Page B21, lines 33 and 34 (09/11/07)

\[41 .. 46, 60 .. 71, 136, 141 .. 146, 160 .. 171\] must be printable. Thus, at least 81 printable characters are needed.

Page B109, line 16 (01/06/14)

\texttt{begin print_esc("csname"); print_esc("endcsname"); print_char(" "); end}

Page B114, line 25 (09/11/07)

\texttt{define \textit{save_index}(\#) \equiv \textit{save_stack}[\#].hh.rh \{ eqtb location or token or save_stack location \}}

Page B139, line 20 (12/19/02)

\texttt{begin while (state = token_list) \&\& (loc = null) \&\& (token_type \neq v_template) do}
\texttt{end_token_list; \{ conserve stack space \}}

Page B144, line 14 (09/11/07)

\texttt{cat: 0 .. max_char_code; \{ cat_code(cur_char), usually \}}

Page B153, lines 2 and 3 (09/11/07)

In fact, these three procedures account for almost every use of \texttt{get_next}.

Page B161, line 19 (12/19/02)

\texttt{while (state = token_list) \&\& (loc = null) \&\& (token_type \neq v_template) do}
\texttt{end_token_list; \{ conserve stack space \}}

Page B163, line 29 (12/19/02)

\texttt{long state \leftarrow call; cur_tok \leftarrow par_token; ins_error; goto continue;}
else if \( m = vmode \) then
\[
\text{scanned_result}(\text{preen\_depth})(\text{dimen\_val})
\]
\[
\text{else scanned_result}(\text{space\_factor})(\text{int\_val})
\]
\[
\]
\[
\text{cur\_val} \leftarrow 0; \text{cur\_val\_level} \leftarrow \text{int\_val}; \text{radix} \leftarrow 0; \text{cur\_order} \leftarrow \text{normal};
\]
\[
\]
\[
\text{and denominator sum to 32768 or less. According to the definitions here, } 2660 \text{ dd} \approx 1000.33297 \text{ mm};
\]
\[
\]
\[
\text{used input files like } \text{webmac.tex}.
\]
\[
\]
\[
\text{The following procedures don’t allow spaces to be part of file names; but some users seem to}
\]
\[
\text{like names that are spaced-out. System-dependent changes to allow such things should probably}
\]
\[
\text{be made with reluctance, and only when an entire file name that includes spaces is “quoted”}
\]
\[
\text{somehow.}
\]
\[
\]
\[
\text{if } (nw = 0) \lor (nh = 0) \lor (nd = 0) \lor (ni = 0) \text{ then abort;}
\]
\[
\]
\[
\text{begin}
\]
\[
\text{cur\_glue: real; } \{ \text{glue seen so far}\}
\]
\[
\text{cur\_g: scaled; } \{ \text{rounded equivalent of } \text{cur\_glue} \text{ times the glue ratio}\}
\]
\[
\text{begin}
\]
\[
\text{this\_box} \leftarrow \text{temp_ptr}; \text{g\_order} \leftarrow \text{glue\_order}(\text{this\_box}); \text{g\_sign} \leftarrow \text{glue\_sign}(\text{this\_box});
\]
\[
\text{begin}
\]
\[
\text{g} \leftarrow \text{glue\_ptr}(p); \text{rule\_wd} \leftarrow \text{width}(g) - \text{cur\_g};
\]
\[
\text{begin}
\]
\[
\text{cur\_glue} \leftarrow \text{cur\_glue} + \text{stretch}(g); \text{vet\_glue}(\text{float}(\text{glue\_set}(\text{this\_box})) \times \text{cur\_glue});
\]
\[
\text{cur\_g} \leftarrow \text{round}(\text{glue\_temp});
\]
\[
\text{begin}
\]
\[
\text{cur\_glue} \leftarrow \text{cur\_glue} - \text{shrink}(g); \text{vet\_glue}(\text{float}(\text{glue\_set}(\text{this\_box})) \times \text{cur\_glue});
\]
\[
\text{cur\_g} \leftarrow \text{round}(\text{glue\_temp});
\]
\[
\text{rule\_wd} \leftarrow \text{rule\_wd} + \text{cur\_g};
\]
Page B260, line 21

else begin \( lx \leftarrow br \div (lq + 1); \)

Page B261, line 9

\[
\begin{align*}
\text{cur} \_\text{glue} & \colon \text{real; } \{ \text{glue seen so far} \} \\
\text{cur} \_\text{g} & \colon \text{scaled; } \{ \text{rounded equivalent of cur_glue times the glue ratio} \} \\
\text{begin} & \text{cur} \_\text{g} \leftarrow 0; \text{cur} \_\text{glue} \leftarrow \text{float_constant}(0); \\
\text{this} \_\text{box} & \leftarrow \text{temp} \_\text{ptr}; \text{g_order} \leftarrow \text{glue_order(this_box)}; \text{g_sign} \leftarrow \text{glue_sign(this_box)};
\end{align*}
\]

Page B262, line 10 from the bottom

\[
\begin{align*}
\text{begin} & \text{g} \leftarrow \text{glue_ptr}(p); \text{rule_ht} \leftarrow \text{width}(g) - \text{cur} \_\text{g};
\end{align*}
\]

Page B262, line 6 from the bottom

\[
\begin{align*}
\text{begin} & \text{cur} \_\text{glue} \leftarrow \text{cur} \_\text{glue} + \text{stretch}(g); \text{vet} \_\text{glue} \leftarrow \text{float} \left( \text{glue_set(this_box)} \right) \times \text{cur} \_\text{glue}; \\
\text{cur} \_\text{g} & \leftarrow \text{round} \left( \text{glue_temp} \right);
\end{align*}
\]

Page B262, line 2 from the bottom

\[
\begin{align*}
\text{begin} & \text{cur} \_\text{glue} \leftarrow \text{cur} \_\text{glue} - \text{shrink}(g); \text{vet} \_\text{glue} \leftarrow \text{float} \left( \text{glue_set(this_box)} \right) \times \text{cur} \_\text{glue}; \\
\text{cur} \_\text{g} & \leftarrow \text{round} \left( \text{glue_temp} \right);
\end{align*}
\]

Page B263, new line to precede old line 2

\[
\begin{align*}
\text{rule_ht} & \leftarrow \text{rule_ht} + \text{cur} \_\text{g};
\end{align*}
\]

Page B264, line 10

else begin \( lx \leftarrow br \div (lq + 1); \)

Page B266, line 29

\[
\begin{align*}
\text{total_pages} \geq 65536, \text{the DVI file will lie. And if max_push} \geq 65536, \text{the user deserves whatever chaos might ensue.}
\end{align*}
\]

Page B279, line 19

\[
\begin{align*}
p & \colon \text{pointer; } \{ \text{a new glue node} \}
\end{align*}
\]

Page B288, lines 18–20

\[
\begin{align*}
\text{left_noad} & \colon \text{begin print_esc(”left”); print_delimiter(delimiter(p));} \\
\text{end;} \\
\text{right_noad} & \colon \text{begin print_esc(”right”); print_delimiter(delimiter(p));}
\end{align*}
\]

Page B290, line 12

\[
\begin{align*}
\text{begin} \text{if s = text_size then print_esc(”textfont”);}
\end{align*}
\]
if \( \text{type}(r) = \text{kern\_node} \) then \{ unneeded italic correction \}

is being scanned, or when no alignment preamble is active.

\begin{verbatim}
if \((\text{scanner\_status} = \text{aligning}) \lor (\text{cur\_align} = \text{null})\) then
\end{verbatim}

\( j - i + \text{min\_quarterword} \) in their \textit{link} fields. The values of \( w_{ij} \) were initialized to \textit{null\_flag},

In restricted horizontal mode, the \textit{clang} part of \textit{aux} is undefined; an over-cautious Pascal runtime system may complain about this.

should begin in the sequence of line numbers, in case hanging indentation or \texttt{parshape} is in

\begin{verbatim}
if \( \text{count}(t) = 1000 \) then \( t \leftarrow \text{height}(r) \)
else \( t \leftarrow x\_over\_n(\text{height}(r), 1000) * \text{count}(t) \);
\text{print\_scaled}(t)
\end{verbatim}

\textbf{1035.} If \( \text{link}(\text{cur\_q}) \) is nonnull when \textit{wrapup} is invoked, \textit{cur\_q} points to the list of characters that were consumed while building the ligature character \textit{cur\_l}.

\begin{verbatim}
begin if \( \text{link}(\text{cur\_q}) > \text{null} \) then
if \( \text{character}(\text{tail}) = \text{qi\textunderscore hyphen\textunderscore char}[\text{main\_f}] \) then \( \text{ins\_disc} \leftarrow \text{true} \);
\end{verbatim}

\begin{verbatim}
\text{link}(\text{tail}) \leftarrow \text{lig\_stack}; \text{tail} \leftarrow \text{lig\_stack} \{ \textit{main\_loop\_ lookahead} is next \}
\end{verbatim}

\begin{verbatim}
if \( \text{main\_p} > \text{null} \) then \text{tail\_append}(\text{main\_p}); \{ append a single character \}
\end{verbatim}

\begin{verbatim}
if \( \text{cur\_r} = \text{non\_char} \) then \text{goto} \text{main\_loop\_wrapup} ;
\end{verbatim}
Page B452, line 18 (28/03/11)

`hmode`, where the latter two are used to denote `\vbox` and `\hbox`, respectively.

Page B455, lines 3 and 4 (09/11/07)

```latex
if ((cur_cmd = hskip) ∧ (abs(mode) ≠ vmode)) ∨ ((cur_cmd = vskip) ∧ (abs(mode) = vmode)) then
```

Page B472, new paragraph to follow line 10 (12/20/02)

A devious user might force an `endv` command to occur just about anywhere; we must defeat such hacks.

Page B472, replacement for what used to be line 13 (12/20/02)

```latex
begin base_ptr ← input_ptr; input_stack[base_ptr] ← cur_input;
while (input_stack[base_ptr].index_field ≠ v_template) ∧
   (input_stack[base_ptr].loc_field = null) ∧
   (input_stack[base_ptr].state_field = token_list) do decr(base_ptr);
if (input_stack[base_ptr].index_field ≠ v_template) ∨
   (input_stack[base_ptr].loc_field ≠ null) ∨
   (input_stack[base_ptr].state_field ≠ token_list) then
   fatal_error('interwoven alignment preambles are not allowed');
if cur_group = align_group then

Page B505, line 19 (09/11/07)

("since the result is out of range.");
if p ≥ glue_val then delete_glue_ref(cur_val);
error; return;
```

Page B506, line 1 (10/13/03)

1237. Here we use the fact that the consecutive codes `int_val .. mu_val` and `assign_int ..`

Page B520, line 8 (06/25/04)

says, for example, ‘(preloaded format=plain 1982.11.19)’, showing the year, month, and day

Page B535, new line to follow line 11 (09/11/07)

```latex
if last_glue ≠ max_halfword then delete_glue_ref(last_glue);
```

Page B578, new entry (06/04/06)

Trabb Pardo, Luis Isidoro, 2.

Page Cxi, line 4 (05/20/07)

27 Recovery from Errors 223
the area below the bar to the area above it equal to \((\sqrt{5} + 1)/2 \approx 1.61803\), the

[points 2 and 5 should not be labeled twice]

\[ \text{penpos1(stem,15); penpos2(.9stem,12); penpos3(stem,10); } \]

line 12, where it says ‘x11’, not ‘x11’ or ‘x11’); be sure to distinguish between

suffixed or subscripted. Thus, the syntax rule for (variable) should actually be replaced
by a slightly more complicated pair of rules:

(path subexpression) \rightarrow \text{(path expression not ending with direction specifier)}

point but not after it, the nonempty one is duplicated in a similar way. A basic path
join ‘.. controls u and v ..’ specifies explicit control points that override any direction
specifiers that may immediately surround it.

Let’s conclude this chapter by applying what we’ve learned about paths to a
real-life example. The Journal of Algorithms was published for many years
by Academic Press, and its cover page carried the following logo, which was designed

A \textsc{metafont} program to produce this logo made it possible for the editors of the
journal to use it on letterheads in their correspondence. Here is one way to do that job,

be the values they had upon entry to the group.)
def --- = ..tension infinity.. enddef;
it makes ‘z₁ --- z₂’ become ‘z₁ .. tension infinity .. z₂’. The replacement text
can be any sequence of tokens not including ‘enddef’; or it can include entire
subdefinitions like ‘def ... enddef’, according to certain rules that we shall
explain later.

⟨loop⟩ −→ ⟨loop header⟩:⟨loop text⟩ endfor

next time METAFONT gets to the end of an input line, it will stop reading from the
digits should be a file name that works in essentially the same way on all installations
of METAFONT. Uppercase letters are considered to be distinct from their lowercase
counterparts, on many systems.

When METAFONT is reading the symbolic tokens to be saved by save.

point 3 at the right of the triangle might digitize into a

(path subexpression) −→ ⟨path expression not ending with direction specifier)

following nineteen things will be mentioned:

independent variables (distinct numeric variables)

7.4. False. After ‘newinternal x;’ you can’t say ‘x(tag)’ in a (suffix list).

is performed whenever METAFONT uses the last two alternatives in the definition
19.3. Yes, if and only if \( n - \frac{1}{2} \) is a nonnegative even integer. (Because ambiguous values are rounded upwards.)

Following (boolean primary).)

Problem; it would simply have put \texttt{ENDFOR} into the replacement text of \texttt{asta}, because

\begin{verbatim}
if if pair x: x>(0,0) else: false fi: A else: B fi.
\end{verbatim}

be known by saying ‘if known \( p - q \): \( p = q \) else: \texttt{false fi}’; transforms could be handled

given angle \( \phi \). We can consider the common angle \( \theta \) of \( z_1 - z_4 \) and \( z_0 - z_0 \) to be

‘b’ was shipped out.) The second letter, ‘o’, is placed in a second little box adjacent

— CAROLUS LINNÆUS, \textit{Philosophia Botanica} (1751)

(The proofsheet resolution will be 50 pixels per inch, because \texttt{cheapo} has 200 pixels per

\textit{arccosine, arcsine, arctangent, see angle.}}
Page C352, right column (02/29/08)
Linné, Carl von (= Linnaeus, Carolus), 325.

Page C355, right column (02/29/08)
*save, 155–156, 169, 173, 178, 180, 218, 236, 244, 296, 299.

Page Dv, page number change (12/27/11)
[For consistency with Volumes A, C, and E, the preface now begins on page v instead of page vii. This change was first made in the sixth printing.]

Page Dv (formerly Dvii), bottom two lines (01/06/14)
corporates all of those changes. I now believe that the final bug was discovered on 03 June 2008, and removed in version 2.7182818. The finder’s fee has converged to $327.68.

Page Dxii (formerly Dxv), line −7 (12/27/11)
Format specs have no effect on the corresponding Pascal program, but they do influence

Page D2, line −17 (01/03/14)
define banner = ’This is META FONT, Version 2.7182818’ { printed when META FONT starts }

Page D2, lines 4 and 5 from the bottom (12/23/02)
types; there are no `var' parameters, except in the case of files or in the system-dependent paint_row procedure; there are no tag fields on variant records; there are no real variables; no procedures are declared local to other procedures.)

Page D16, new paragraph to follow line 26 (06/25/04)
The first line is special also because it may be read before META FONT has input a base file. In such cases, normal error messages cannot yet be given. The following code uses concepts that will be explained later. (If the Pascal compiler does not support non-local goto, the statement ‘goto final_end’ should be replaced by something that quietly terminates the program.)

Page D22, line 26 (09/11/07)
ASCII codes [’60 .. ’71, ’136, ’141 .. ’146] must be printable.

Page D31, line 29 (06/25/04)
This is the only nontrivial goto statement in the whole program. It is used when there is no
Notice that if 64-bit integer arithmetic were available, we could simply compute \((2^{29} \times p + q) \text{ div } (2 \times q)\). But when we are restricted to Pascal’s 32-bit arithmetic we must either resort to multiple-precision maneuvering or use a simple but slow iteration. The multiple-precision technique would be about three times faster than the code adopted here, but it would be comparatively long and tricky, involving about sixteen additional multiplications and divisions.

Once again it is a good idea to use 64-bit arithmetic if possible; otherwise \texttt{take\_scaled} will use more than 2\% of the running time when the Computer Modern fonts are being generated.

\begin{verbatim}
if j\_random = 0 then new\_randoms else decr\(j\_random\)
\end{verbatim}

Locations of \texttt{mem} between \texttt{mem\_min} and \texttt{mem\_top} may be dumped as part of preloaded base

\begin{verbatim}
define fi\_or\_else = 2 \{ delimiters for conditionals (elseif, else, fi) \}
\end{verbatim}

\begin{verbatim}
define type\_name = 30 \{ declare a type (numeric, pair, etc.) \}
\end{verbatim}

\begin{verbatim}
define lig\_kern\_token = 76 \{ the operators ‘kern’ and ‘=:’ and ‘=:|’, etc. \}
\end{verbatim}

They consist of zero or more parameter tokens followed by a code for the type of macro.

\begin{verbatim}
METAFONT user assigns a type to a variable like \texttt{x20a\_b} by saying, for example, ‘\texttt{boolean x[]a\_b}’.\end{verbatim}
variable that is relevant when no attributes are attached to the parent. The \textit{attr\_head} node has the fields of either a value node, a subscript node, or an attribute node, depending on what the parent would be if it were not structured; but the subscript and attribute fields are ignored, so it effectively contains only the data of a value node. The \textit{link} field in this special node points to an attribute node whose \textit{attr\_loc} field is zero; the latter node represents a collective subscript \textit{\{\}} attached to the parent, and its \textit{link} field points to the first non-special attribute node (or to \textit{end\_attr} if there are none).

\begin{verbatim}
subser\_head(q1) = qq1; qq is a three-word “attribute-as-value” node with 
type(qq) = numeric (assuming that x5 is numeric, because qq represents ‘x\{\}’ with no further 
attributes), name\_type(qq) = structured\_root, attr\_loc(qq) = 0, parent(qq) = p.
\end{verbatim}
Page D177, line 18  
\(\text{cur}_x, \text{cur}_y: \text{scaled}; \{\text{outputs of skew, unskew, and a few other routines}\}\)

Page D182, lines 27–29  
399. If the segment numbers on the cycle are \(t_1, t_2, \ldots, t_m\), and if \(m \leq \max\_\text{quarterword}\), we have \(t_{k-1} \leq t_k\) except for at most one value of \(k\). If there are no exceptions, \(f\) will point to \(t_1\); otherwise it will point to the exceptional \(t_k\).

Page D184, line 18  
\(\text{chopped}: \text{integer}; \{\text{positive if data truncated, negative if data dangerously large}\}\)

Page D184, line 25  
if \((\text{internal}[\text{autorounding}] > 0) \land (\text{chopped} = 0)\) then \(xy\_\text{round};\)

Page D184, line 27  
if \((\text{internal}[\text{autorounding}] > \text{unity}) \land (\text{chopped} = 0)\) then \(\text{diag}\_\text{round};\)

Page D184, line 32  
if \((\text{internal}[\text{autorounding}] \leq 0) \lor (\text{chopped} \neq 0)\) then \text{print_spec}(\ast, \_\text{after}\_\text{subdivision})\)

Page D185, lines 15–19  
define \text{procrustes}(\#) \equiv \text{if abs(\#)} \geq \text{dmax} \text{ then}
  \text{if abs(\#)} > \text{max\_allowed} \text{ then}
    \text{begin chopped} \leftarrow 1;
    \text{if \#} > 0 \text{ then \#} \leftarrow \text{max\_allowed} \text{ else \#} \leftarrow -\text{max\_allowed};
  \text{end}
  \text{else if chopped} = 0 \text{ then chopped} \leftarrow -1

Page D185, old line 22  
\(p \leftarrow \text{cur\_spec}; k \leftarrow 1; \text{chopped} \leftarrow 0; \text{dmax} \leftarrow \text{half(\text{max\_allowed})};\)

Page D185, old line 28  
if \text{chopped} > 0 \text{ then}

Page D196, lines 3–8  
The first job is to fix things so that \(x(t)\) plus the horizontal pen offset is an integer multiple of the current “granularity” when the derivative \(x'(t)\) crosses through zero. The given cyclic path contains regions where \(x'(t) \geq 0\) and regions where \(x'(t) \leq 0\). The \text{quadrant}\_\text{subdivide} routine is called into action before any of the path coordinates have been skewed, but some of them may have been negated. In regions where \(x'(t) \geq 0\) we have \text{right\_type} = \text{first\_octant} or \text{right\_type} = \text{eighth\_octant}; in regions where \(x'(t) \leq 0\), we have \text{right\_type} = \text{fifth\_octant} or \text{right\_type} = \text{fourth\_octant}.\)
current pen might be unsymmetric in such a way that \( x \) coordinates should round differently in different parts of the curve. These considerations imply that \( \text{round}(x_0) \)

and that there are similar ways to address other important offsets.

[Also delete the definitions of north,south,edge, etc., on lines 11–15; those definitions are never used.]

at \((x_0, y_0)\) and ends at \((x_1, y_1)\), it’s possible to prove (by induction on the length of the truncated

we list it twice (with coordinates interchanged, so as to make the second octant look like

as the list of transformed and skewed offsets to use when curves that travel in the second octant. Similarly, we will have

\[
\begin{align*}
w_2 w_2 w_2 & \mapsto (-5, 6) (-5, 6) (-5, 6) \\
(7, -6) & (7, -6) (7, -6)
\end{align*}
\]

\[
\begin{align*}
w_2 w_2 w_3 w_3 & \mapsto (-7, 1) (-7, 1) (-3, 2) (-3, 2) \\
(3, -2) & (3, -2) (3, -2)
\end{align*}
\]

\[
\begin{align*}
w_3 w_3 w_0 w_0 & \mapsto (-3, 1) (-3, 1) (1, 0) (1, 0) \\
(1, 0) & (1, 0) (1, 0)
\end{align*}
\]

\[
\begin{align*}
w_0 w_0 w_0 & \mapsto (-1, 1) (-1, 1) (-1, 1) \\
(1, 0) & (1, 0) (1, 0)
\end{align*}
\]

\[
\begin{align*}
w_0 w_0 w_0 & \mapsto (-1, 1) (-1, 1) (-1, 1) \\
(-1, 1) & (-1, 1) (-1, 1)
\end{align*}
\]

count followed by pointers to the eight offset lists, followed by an indication of the pen’s range of values.

The \textit{link} field of a pen header node should be \textit{null} if and only if the pen is a single point.

\textit{endpoint}. The cubics all have monotone-nondecreasing \( x(t) \) and \( y(t) \).
In odd-numbered octants, the numerator and denominator of this fraction will be nonnegative; in even-numbered octants they will both be nonpositive. Furthermore we always have $0 = s_0 \leq s_1 \leq \cdots \leq s_n = \infty$. The goal of offset\_prep is to find an offset index $k$ to associate with each cubic, such that the slope $s(t)$ of the cubic satisfies

$$0 \leq s_1 \leq \cdots \leq s_n = \infty.$$ 

Page D231, line 7 (06/25/04)

if $\text{abs}(du) \geq \text{abs}(dv)$ then \{ $s_{k-1} \leq 1$ or $s_k \leq 1$ \}

Page D231, line 16 (06/25/04)

and return towards $s_{k-1}$ or $s_k$, respectively, yielding another solution of (*).

dinate fields. Hence, for example, the point $(x_{\text{coord}}(p) - \text{left}v(q), y_{\text{coord}}(p) + \text{right}u(p))$ also

Page D248, lines 14 and 15 (01/06/14)

the $x$-axis at the point $(a^2 - b^2) \sin \theta \cos \theta / \rho + i\rho$, where $\rho = \sqrt{(a \sin \theta)^2 + (b \cos \theta)^2}$. It reaches furthest to the right of the $y$-axis at the point $\sigma + (a^2 - b^2) \sin \theta \cos \theta / \sigma$, where $\sigma = \sqrt{(a \sin \theta)^2 + (b \cos \theta)^2}$. It

Page D248, line 24 (06/25/04)

else begin beta ← minor\_axis; gamma ← major\_axis; theta ← 0;

Page D251, line 1 (01/06/14)

536. Only the coordinates need to be copied, not the class numbers and other stuff. At this point either link(p) or link(link(p)) is null.

done1: if (link(p) ≠ null) then free\_node(link(p), knot\_node\_size);

Page D251, line 10 (01/06/14)

link(p) ← s; beta ← -$y_{\text{coord}}(h)$;

Page D256, line 2 from the bottom (06/25/04)

we have $2^i u_{\text{min}} = 2^i u_0 + U_{\text{min}}$, etc.; the condition for overlap reduces to

Page D261, line 5 (06/25/04)

$tol$: integer; \{ bound on the uncertainty in the overlap test \}

Page D262, lines 26 and 27 (06/25/04)

$uv ← uv + \text{int}_\text{packets}$; \{ switch from $l\text{_packets}$ to $r\text{_packets}$ \}

$\text{decr}(\text{cur}_\text{tt})$; $xy ← xy - \text{int}_\text{packets}$; \{ switch from $r\text{_packets}$ to $l\text{_packets}$ \}
xy ← xy + int_packets;  { switch from l_packets to r_packets }

begin if serial_no > el_gordo - s_scale then
overflow(“independent_variables”, serial_no div s_scale);
type(#) ← independent; serial_no ← serial_no + s_scale; value(#) ← serial_no;

670. We go to restart instead of to switch, because we might enter token_state after the error

728. A suffix or text parameter will have been scanned as a token list pointed to by cur_exp,

cur_type = unknown_boolean means that cur_exp points to a capsule node that is in a ring of equivalent booleans whose value has not yet been defined.

cur_type = unknown_string means that cur_exp points to a capsule node that is in a ring of equivalent strings whose value has not yet been defined.

cur_type = unknown_pen means that cur_exp points to a capsule node that is in a ring of equivalent pens whose value has not yet been defined.

cur_type = unknown_path means that cur_exp points to a capsule node that is in a ring of equivalent paths whose value has not yet been defined.

cur_type = unknown_picture means that cur_exp points to a capsule node that is in a ring of equivalent pictures whose value has not yet been defined.

cur_type = token_list means that cur_exp points to a linked list of tokens.
nodes have \texttt{name_type} = \texttt{capsule}, and their \texttt{type} field is one of the possibilities for \texttt{cur_type} listed above. Also \texttt{link} \leq \texttt{void} in capsules that aren’t part of a token list.

\begin{verbatim}
my_var_flag: 0 .. max_command_code;  \{ initial value of \texttt{var_flag} \}
\end{verbatim}

Page D380, line 12 (06/25/04)

\begin{verbatim}
begin type(r) ← known; value(r) ← 0; free_node(p, dep_node_size);
\end{verbatim}

Page D390, lines 2 and 3 (06/25/04)

by a previous operation. We must maintain the value of \texttt{right_type(q)} in cases such as 
\texttt{..{curl2}z{0,0}..}. 

Page D437, line 1 (06/25/04)

996. And \texttt{do_assignment} is similar to \texttt{do_equation}:

Page D439, line 10 becomes two lines (06/25/04)

\begin{verbatim}
begin nonlinear_eq(v, cur_exp, false); cur_type ← t; goto done;
\end{verbatim}

Page D443, line 11 (06/25/04)

\begin{verbatim}
done: if eq_type(x) \mod outer_tag \neq tag_token then clear_symbol(x, false);
\end{verbatim}

Page D452, line 9 (06/25/04)

though they don’t necessarily correspond to primitive tokens.

Page D476, line 12 from the bottom (06/25/04)

\begin{verbatim}
if \texttt{nl − skip_table}[c] > 128 then
max_tfm_dimen ← 16 + internal[design_size] − 1 − internal[design_size] \div ‘10000000;
\end{verbatim}

Page D483, lines 15–17 (06/25/04)

\begin{verbatim}
if \texttt{x > 0} then \texttt{x ← max_tfm_dimen} else \texttt{x ← −max_tfm_dimen};
end;
x ← make_scaled(x \ast 16, internal[design_size]);
\end{verbatim}
a pointer to an edge structure. Its mission is to describe the positive pixels in GF form,

\[ \text{selector} \leftarrow \text{old\_setting}; \text{gf\_out}(\text{cur\_length}); \text{gf\_string}(0, \text{make\_string}); \text{decr}(\text{str\_ptr}); \]

METAFONT it says, for example, `(preloaded base=plain 1984.2.29)`, showing the year, month, and day that the base file was created. We have `base\_ident = 0` before METAFONT’s tables are loaded.

\text{CMMF}, should also be provided for commonly used bases such as \text{cmbase}.

Zillions of alphabets can be generated by the programs in this book. All

- `square\_dots` tells whether dots should be square, not rounded;
- `hefty` tells whether weight-reducing strategies should be used;
- `monospace` tells whether the characters should all be forced to have the same width;

\text{hair, vair, stem, curve, ess, flare, dot\_size, bar, slab,}

- `crisp`, `tiny`, `fine`;

and \text{thin\_join} should not be less than `fine`.

\text{cap\_notch\_cut} 46/36 31/36 25/36 24/36 22/36 25/36

\text{extra\_endchar} \leftarrow \text{extra\_endchar} \& "\text{charcode:=charcode+code\_offset;}";

\text{numeric mid\_thickness}; \text{mid\_thickness} = \text{Vround} \frac{1}{3}[\text{vair, stem}];
top $y_1 = top y_6 = h$; $z_2 = .5[z_3, z_1] + bend;

\textbf{draw} z_1 - \text{flourish}_\text{change} \{\text{up}\} + (0, .15\text{asc}_\text{height})\{\text{up}\}
\ldots \{\text{right}\}(z_1 + (2u, 0)) \ldots \{\text{down}\} z_7; \quad \% \text{upper bar}

[The labels on the new illustrations of beta, omega, and spadesuit are too large, and the resolution of the shapes is too small.]

cycle;

% This lowercase italic alphabet was prepared by D. E. Knuth in December, 1979,
Page E379, bottom line of the program  

\texttt{math}\_fit(0, x\# - 2.5a\#); \texttt{penlabels}(0, 1, 2, 3, 4, 5, 6, 7); \texttt{endchar};

Page E489, bottom line  

\texttt{labels}(1, 2, 3, 4, 5, 6); \texttt{endchar};

[Labels ‘5’ and ‘6’ should also be added to the lower illustration on page E488.]

Page E545, line 11 from the bottom  

The most important general routine in \texttt{cmbase} is probably the \texttt{pos}

Page E551, line 3 from the bottom  

quantities needed in the \texttt{callu} programs are also established at this time.

Page E577, right column  

$p_\ast$, 305, 377.

\texttt{padded}, 103–111, 117–121, 549.

Page E578, left column  

\texttt{postcontrol}, 347, 377.

\texttt{precontrol}, 347, 377.