The PLtoTF processor

(Version 3.6, January 2014)

The preparation of this report was supported in part by the National Science Foundation under grants IST-8201926 and MCS-8300984, and by the System Development Foundation. ‘TeX’ is a trademark of the American Mathematical Society.
**1. Introduction.** The PLtoTF utility program converts property-list ("PL") files into equivalent T\TeX
type metric ("TFM") files. It also makes a thorough check of the given PL file, so that the TFM file should be
acceptable to T\TeX.

The first PLtoTF program was designed by Leo Guibas in the summer of 1978. Contributions by Frank
Liang, Doug Wyatt, and Lyle Ramshaw also had a significant effect on the evolution of the present code.

Extensions for an enhanced ligature mechanism were added by the author in 1989.

The banner string defined here should be changed whenever PLtoTF gets modified.

```plaintext
define my_name ≡ 'pltotf'
define banner ≡ 'This is PLtoTF, Version 3.6' {printed when the program starts}
```

**2.** This program is written entirely in standard Pascal, except that it has to do some slightly system-
dependent character code conversion on input. Furthermore, lower case letters are used in error messages;
they could be converted to upper case if necessary. The input is read from pl_file, and the output is written
on tfm_file; error messages and other remarks are written on the output file, which the user may choose to
assign to the terminal if the system permits it.

The term print is used instead of write when this program writes on the output file, so that all such output can be easily deflected.

```plaintext
define print(#) ≡ write(stderr, #)
define print_ln(#) ≡ writeLn(stderr, #)
define print_real(#) ≡ fprintf(real(stderr, #)
```

**3.** The following parameters can be changed at compile time to extend or reduce PLtoTF’s capacity.

```plaintext
(buf_size = 3000; {length of lines displayed in error messages}
max_header_bytes = 1000; {four times the maximum number of words allowed in the TFM file header
block, must be 1024 or less}
max_param_words = 254; {the maximum number of fontdimen parameters allowed}
max_lig_steps = 32510; {maximum length of ligature program, must be at most 32767 - 257 = 32510}
max_kerns = 5000; {the maximum number of distinct kern values}
hash_size = 32579;
{preferably a prime number, a bit larger than the number of character pairs in lig/kern steps}
```

This code is used in section 2*. 

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### Note

The code above is extracted from a technical document, likely related to typesetting or font metrics, discussing a utility program named PLtoTF. It details the program’s purpose, history, and some of the technical specifications involved in its operation. The code snippet provided is a Pascal-like pseudocode illustrating how some parameters can be modified at compile time to adjust the utility program’s capacity. The document emphasizes the importance of maintaining certain parameters within specific limits to ensure the program’s functionality. This type of document is typically found in the context of software development or technical writing, where precise control over software behavior is crucial.
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\textbf{5*} (Set initial values 6*) \equiv
\begin{verbatim}
reset(pl_file, pl_name);
if verbose then
  begin print(banner); print ln(version_string);
  end;
\end{verbatim}

See also sections 16*, 20, 22, 24*, 26*, 37, 41, 70, 74, and 119.
This code is used in section 2*.

\textbf{16*} On some systems you may have to do something special to write a packed file of bytes. It’s no problem in C.
\begin{verbatim}
( Set initial values 6* ) +\equiv
\begin{verbatim}
rewritebin(tfm_file, tfm_name);
\end{verbatim}
\end{verbatim}
One of the things PLtoTF has to do is convert characters of strings to ASCII form, since that is the code used for the family name and the coding scheme in a TFM file. An array xord is used to do the conversion from char; the method below should work with little or no change on most Pascal systems.

```pascal
18* define char ≡ 0 .. 255
20* define first_ord = 0  { ordinal number of the smallest element of char }
22* define last_ord = 127 { ordinal number of the largest element of char }
24* xord: array [char] of ASCII code; { conversion table }
```

Just before each CHARACTER property list is evaluated, the character code is printed in octal notation. Up to eight such codes appear on a line; so we have a variable to keep track of how many are currently there.

```pascal
26* chars_on_line: 0 .. 8; { the number of characters printed on the current line }
28* perfect: boolean; { was the file free of errors? }
```

The following routine prints an error message and an indication of where the error was detected. The error message should not include any final punctuation, since this procedure supplies its own.

```pascal
27* define err_print(#) ≡
29* begin if chars_on_line > 0 then print_ln(´\n´);
30*               print(#); show_error_context;
31*               end
32* procedure show_error_context; { prints the current scanner location }
33*     var k: 0 .. buf_size; { an index into buffer }
34*     begin print_ln(´\\line\n´);
35*             if ¬left_in then print(´...´);
36*             for k ← 1 to loc do print(buffer[k]); { print the characters already scanned }
37*             print_ln(´\n´);
38*             if ¬left_in then print(´\line\n´);
39*             for k ← 1 to loc do print(´\n´); { space out the second line }
40*             for k ← loc + 1 to limit do print(buffer[k]); { print the characters yet unseen }
41*             if right_in then printLn(´\n´) else printLn(´...´);
42*             chars_on_line ← 0; perfect ← false;
43*             end;
```
When we are nearly ready to output the TFM file, we will set \( index[p] \leftarrow k \) if the dimension in \( memory[p] \) is being rounded to the \( k \)th element of its list.

\[
\text{define } \quad index \equiv index\_var
\]

(Global in the outer block 5) \( +\equiv \)

\[
\begin{align*}
\text{index: array [pointer] of byte; } \\
\text{excess: byte; } \quad \{ \text{number of words to remove, if list is being shortened} \}
\end{align*}
\]
Finally we come to the part of PLtoTF’s input mechanism that is used most, the processing of individual character data.

\[
\text{(Read character info list 103*) \equiv } \\
\quad \begin{array}{l}
\text{begin } c \leftarrow \text{get_byte}; \quad \{ \text{read the character code that is being specified} \} \\
\text{if } \text{verbose then } \{ \text{Print } c \text{ in octal notation 108}\}; \\
\text{while } \text{level} = 1 \text{ do} \\
\quad \begin{array}{l}
\text{begin while } \text{cur_char} = "\_\_" \text{ do get_next;} \\
\text{if } \text{cur_char} = "(" \text{ then } \{ \text{Read a character property 104} \} \\
\text{else if } \text{cur_char} = ")" \text{ then skip_to_end_of_item} \\
\quad \text{else junk_error;}
\end{array} \\
\text{end;} \\
\text{if } \text{char_wd}[c] = 0 \text{ then } \text{char_wd}[c] \leftarrow \text{sort_in}(\text{width}, 0); \quad \{ \text{legimatize } c \} \\
\text{finish_inner_property_list;}
\end{array}
\]

This code is used in section 146.
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115* define round_message(#) ≡
    if delta > 0 then
        begin print(´I had to round some`, #, ´s by´);
            print_real(((delta + 1) div 2)/4000000, 1, 7); print_line(´units´);
        end

(Put the width, height, depth, and italic lists into final form 115*)

delta ← shorten(width, 255); set_indices(width, delta); round_message(´width´);
 delta ← shorten(height, 15); set_indices(height, delta); round_message(´height´);
 delta ← shorten(depth, 15); set_indices(depth, delta); round_message(´depth´);
 delta ← shorten(italic, 63); set_indices(italic, delta); round_message(´italic correction´);

This code is used in section 110.

117* It’s not trivial to check for infinite loops generated by repeated insertion of ligature characters. But fortunately there is a nice algorithm for such testing, copied here from the program TftpPL where it is explained further.

define simple = 0  { f(x, y) = z }
define left_z = 1  { f(x, y) = f(z, y) }
define right_z = 2 { f(x, y) = f(x, z) }
define both_z = 3  { f(x, y) = f(f(x, z), y) }
define pending = 4  { f(x, y) is being evaluated }
define class ≡ class_var  { Avoid problems with AIX <math.h> }

123* (More good stuff from TftpPL.)

ifdef(´notdef´)
    function f(h, x, y : indx): indx;
        begin end;
        { compute f for arguments known to be in hash[h] }
endif(´notdef´)

function eval(x, y : indx): indx;  { compute f(x, y) with hashtable lookup }
    var key: integer;  { value sought in hash table }
    begin key ← 256 * x + y + 1; h ← (1009 * key) mod hash_size;
        while hash[h] > key do
            if h > 0 then decr(h) else h ← hash_size;
        if hash[h] < key then eval ← y  { not in ordered hash table }
            else eval ← f(h, x, y);
        end;
Pascal’s beastly convention for forward declarations prevents us from saying function \( f(h, x, y : \text{indx}) : \text{indx} \) here.

function \( f(h, x, y : \text{indx}) : \text{indx} \):
    begin case class[h] of
        simple: do nothing;
        left\_z: begin class[h] \leftarrow \text{pending}; lig\_z[h] \leftarrow \text{eval}(lig\_z[h], y); class[h] \leftarrow \text{simple};
            end;
        right\_z: begin class[h] \leftarrow \text{pending}; lig\_z[h] \leftarrow \text{eval}(x, lig\_z[h]); class[h] \leftarrow \text{simple};
            end;
        both\_z: begin class[h] \leftarrow \text{pending}; lig\_z[h] \leftarrow \text{eval}(\text{eval}(x, lig\_z[h]), y); class[h] \leftarrow \text{simple};
            end;
        pending: begin x\_lig\_cycle \leftarrow x; y\_lig\_cycle \leftarrow y; lig\_z[h] \leftarrow 257; class[h] \leftarrow \text{simple};
            end: \{ the value 257 will break all cycles, since it’s not in hash \}
    end: \{ there are no other cases \}
f \leftarrow lig\_z[h];
end:
127* The output phase. Now that we know how to get all of the font data correctly stored in PLoTF's memory, it only remains to write the answers out.

First of all, it is convenient to have an abbreviation for output to the TFM file:

```c
#define out(#) putbyte(#, tfm_file)
```

130* It might turn out that no characters exist at all. But PLoTF keeps going and writes the TFM anyway. In this case ec will be 0 and bc will be 1.

(Compute the twelve subfile sizes 130*)

\[
\text{plh} \leftarrow \text{header} \_ \text{ptr} \text{ div} \ 4;
\]

not\_found \leftarrow \text{true}; bc \leftarrow 0;

while not\_found do

\[
\text{if} \ (\text{char} \_\text{wd}[bc] > 0) \vee (bc = 255) \text{ then} \ not\_found \leftarrow \text{false}
\]

else incr(bc);

not\_found \leftarrow \text{true}; ec \leftarrow 255;

while not\_found do

\[
\text{if} \ (\text{char} \_\text{wd}[ec] > 0) \vee (ec = 0) \text{ then} \ not\_found \leftarrow \text{false}
\]

else decr(ec);

if bc > ec then bc \leftarrow 1;

incr(memory[\text{width}]); incr(memory[\text{height}]); incr(memory[\text{depth}]); incr(memory[\text{italic}]);

(Compute the ligature/kern program offset 139);

\[
\text{if} \ \text{x/} (\text{ec} - \text{bc} + 1) + \text{memory[\text{width}]} + \text{memory[\text{height}]} + \text{memory[\text{depth}]} + \text{memory[\text{italic}]} + \text{nl} + \text{bk}_\text{offset} + \text{nk} + \text{ne} + \text{np};
\]

if \( \text{if} \ < \ 0 \ then \)

begin print\_ln(\"The total number of words in the TFM file too large!\") \ uexit(1);
end

This code is used in section 128.

136* When a scaled quantity is output, we may need to divide it by design\_units. The following subroutine takes care of this, using floating point arithmetic only if design\_units \neq 1.0.

```c
procedure out\_scaled(x: fix\_word); \{ outputs a scaled fix\_word \}
var n: byte; \{ the first byte after the sign \}
  m: 0..65535; \{ the two least significant bytes \}
begin
  if \( \text{fabs(x/design\_units)} \geq 16.0 \) then
    begin print(\"The relative dimension\") \ print_real(x/\'4000000,1,3);
      print\_ln(\"is too large.\") \ print(\"Must be less than 16*designsize\;");
      if design\_units \neq unity then
        begin print(\"\") \ print_real(design\_units/\'200000,1,3); print(\"designunits\") \ end;
        print\_ln(\"\") \ x \leftarrow 0;
      end;
    if design\_units \neq unity then \( x \leftarrow \text{round}((x/design\_units) \times 1048576.0); \)
  if \( x < 0 \) then
    begin out(255); \ x \leftarrow x + \'1000000000 \)
      if \( x \leq 0 \) then \( x \leftarrow 1 \);
    end
  else begin out(0);
    if \( x \geq \'1000000000 \) then \( x \leftarrow \'777777777; \)
    end;
  n \leftarrow x \div \'2000000; m \leftarrow x \mod \'2000000; out(n); out(m \div 256); out(m \mod 256);
end;
```
Here is where PLtoTF begins and ends.

begin initialize;
name_enter;
read_input;
if verbose then print ln (" ");
corr_and_check;
(Do the output 128);
if ¬perfect then uexit(1);
end.
System-dependent changes. Parse a Unix-style command line.

```plaintext
define argument_is(#) ≡ (strcmp(long_options[option_index].name, #) = 0)

(Define parse_arguments 148*) ≡
procedure parse_arguments;
  const n_options = 3; { Pascal won’t count array lengths for us. }
  var long_options: array [0..n_options] of getopt_struct;
  getopt_return_val: integer; option_index: c_int_type; current_option: 0..n_options;
begin {Initialize the option variables 153*};
  (Define the option table 149*);
repeat getopt_return_val ← getopt_long_only(argv, argv, "", long_options, address_of (option_index));
  if getopt_return_val = -1 then
    begin do nothing; { End of arguments; we exit the loop below. }
      end
  else if getopt_return_val = "?" then
    begin usage(my_name);
      end
  else if argument_is("help") then
    begin usage_help(PLTOTF_HELP, nil);
      end
  else if argument_is("version") then
    begin print_version_and_exit(banner, nil, "D.E. Knuth", nil);
      end; { Else it was a flag; getopt has already done the assignment. }
until getopt_return_val = -1; { Now optind is the index of first non-option on the command line. We must have one or two remaining arguments. }
if (optind + 1 ≠ argc) ∧ (optind + 2 ≠ argc) then
  begin write ln(stderr, my_name, ":\Need_one_or\two_file\arguments."); usage(my_name);
    end;
  pl_name ← extend_filename(cmdline(optind), "pl");
  { If an explicit output filename isn’t given, construct it from pl_name. }
if optind + 2 = argc then
  begin tfm_name ← extend_filename(cmdline(optind + 1), "tfm");
    end
else begin tfm_name ← basename_change_suffix(pl_name, ".pl", ".tfm");
    end;
end;
```

This code is used in section 2*.  

Here are the options we allow. The first is one of the standard GNU options.

```plaintext
(Define the option table 149* ) ≡
  current_option ← 0; long_options[current_option].name ← "help";
  long_options[current_option].has_arg ← 0; long_options[current_option].flag ← 0;
  long_options[current_option].val ← 0; incr(current_option);
```

See also sections 150*, 151*, and 154*. This code is used in section 148*.

Another of the standard options.

```plaintext
(Define the option table 149* ) +≡
  long_options[current_option].name ← "version"; long_options[current_option].has_arg ← 0;
  long_options[current_option].flag ← 0; long_options[current_option].val ← 0; incr(current_option);
```
Print progress information?

\[(\text{Define the option table } \text{§149}) \equiv\]
\[
\begin{align*}
\text{long_options}[[\text{current_option}}].\text{name} & \leftarrow \text{“verbose”}; \\
\text{long_options}[[\text{current_option}}].\text{has_arg} & \leftarrow 0; \\
\text{long_options}[[\text{current_option}}].\text{flag} & \leftarrow \text{address_of(\text{verbose})}; \\
\text{long_options}[[\text{current_option}}].\text{val} & \leftarrow 1; \\
\text{incr(\text{current_option})};
\end{align*}
\]

\[(\text{Globals in the outer block } \text{§5}) \equiv\]
\[
\text{verbose: } \text{c_int_type};
\]

\[(\text{Initialize the option variables } \text{§153}) \equiv\]
\[
\text{verbose} \leftarrow \text{false};
\]

This code is used in section 148*.

An element with all zeros always ends the list.

\[(\text{Define the option table } \text{§149}) \equiv\]
\[
\begin{align*}
\text{long_options}[[\text{current_option}}].\text{name} & \leftarrow 0; \\
\text{long_options}[[\text{current_option}}].\text{has_arg} & \leftarrow 0; \\
\text{long_options}[[\text{current_option}}].\text{flag} & \leftarrow 0; \\
\text{long_options}[[\text{current_option}}].\text{val} & \leftarrow 0;
\end{align*}
\]

Global filenames.

\[(\text{Globals in the outer block } \text{§5}) \equiv\]
\[
\text{tfm_name, pl_name: const_c_string};
\]
156* Index. Pointers to error messages appear here together with the section numbers where each identifier is used.

The following sections were changed by the change file: 1, 2, 3, 6, 14, 16, 18, 25, 26, 27, 79, 103, 115, 117, 123, 124, 127, 130, 136, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156.

- help: 149*
- version: 150*
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