

METATYPE1: a METAPOST-based engine for generating Type 1 fonts

Bogusław Jackowski
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GUST, Poland

T_EX AND META:
the Good, the Bad and the Ugly Bits
KERKRADE, 2001

METATYPE¹:

a METAPOST-based engine
for generating Type 1 fonts

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There is a couple of visual tools for
creating POSTSCRIPT and TrueType fonts,
there is METAFONT for T_EXies...

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There is a couple of visual tools for creating POSTSCRIPT and TrueType fonts, there is METAFONT for T_EXies...

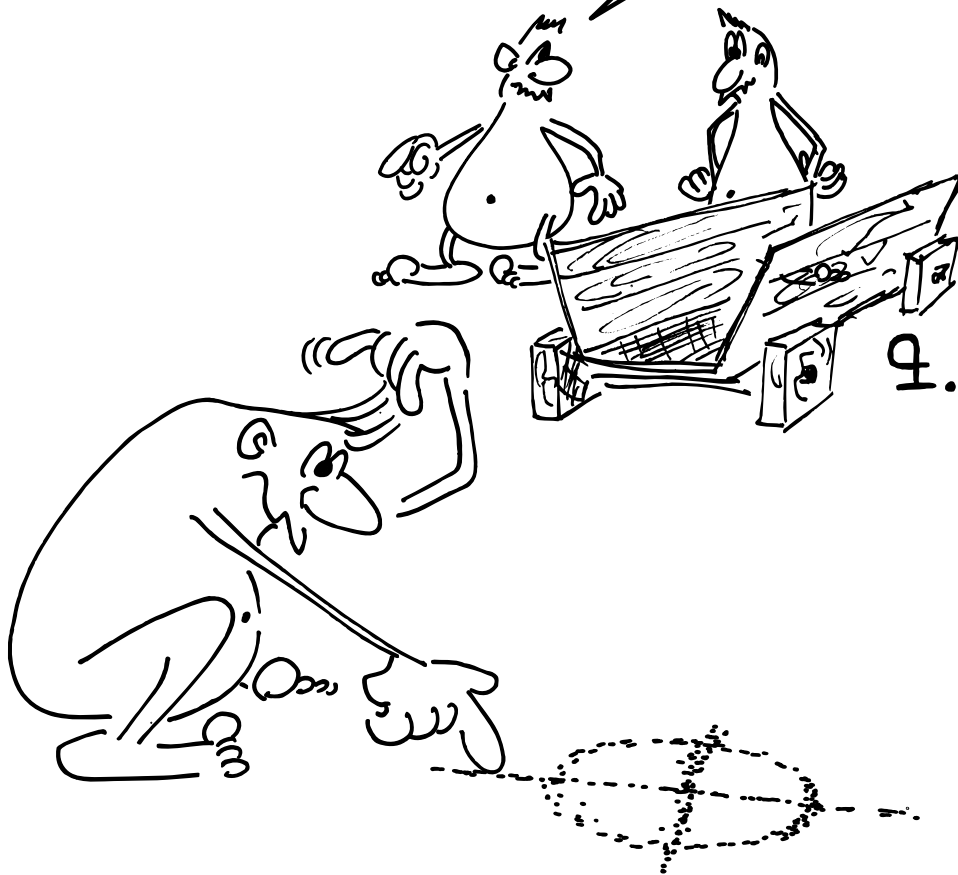
The fundamental question:

WHY TO REINVENT THE WHEEL?

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HE PERSISTENTLY ENDAVOURS
TO REINVENT THE WHEEL...



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THE STATE OF THE ART

- The only freely available tool for generating fonts is bitmap-oriented METAFONT
- METAPOST, a younger sister of METAFONT that is capable of producing outline output, is not equipped with a possibility of generating POSTSCRIPT fonts
- METAFONT and METAPOST are the only fully programmable tools

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THE STATE OF THE ART

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- METAFONT and METAPOST are the only fully programmable tools
- **There are thousands of fonts used all over the world, only a negligible fraction of them being designed using METAFONT, in spite of the hope expressed explicitly in the final exhortation of “The METAFONTbook” (1986):**

Go FORTH now and create masterpieces of digital typography!

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WHAT TO DO?

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WHAT TO DO?

To reinvent the wheel, i.e., to prepare another tool. We decided to employ METAPOST.

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WHAT TO DO?

To reinvent the wheel, i.e., to prepare another tool. We decided to employ METAPOST.

Advantages:

- logical constraints (parameterization)
- powerful constructions and definitions
- precision and full control over details
- availability of sources
- reliability (nearly as good as METAFONT)
- portability
- capability of writing T_EX metric files

Drawbacks:

- lack of visual interface
- generating outline fonts requires postprocessing

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FONT: WHAT IS IT?

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FONT: WHAT IS IT?

- **information about character shapes:**
bitmaps or outlines

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FONT: WHAT IS IT?

- **information about character shapes:**
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- **metric information:** dimensions,
italic correction, kerning, interletter
spacing (tracking), interword spacing,
interline spacing, slant angle,
characteristic dimensions (quad)...

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- **encoding information**

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- **metric information:** dimensions,
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spacing (tracking), interword spacing,
interline spacing, slant angle,
characteristic dimensions (quad)...
- **encoding information**
- **information about groups of characters:**
ligatures, accented characters,
math characters (usually not slanted),
T_EX-specific charlist characters
and extensible characters...

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POSTSCRIPT TYPE 1 FONT: WHAT IS IT?

- **Metric file:** AFM (ASCII)
- **Glyph file:** PFB (binary) or PFA (ASCII)

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POSTSCRIPT TYPE 1 FONT: WHAT IS IT?

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glyph names, dimensions, kerns, ligatures
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glyph shapes (outlines, no pens, no overlapping), encoding, hinting, some metric data

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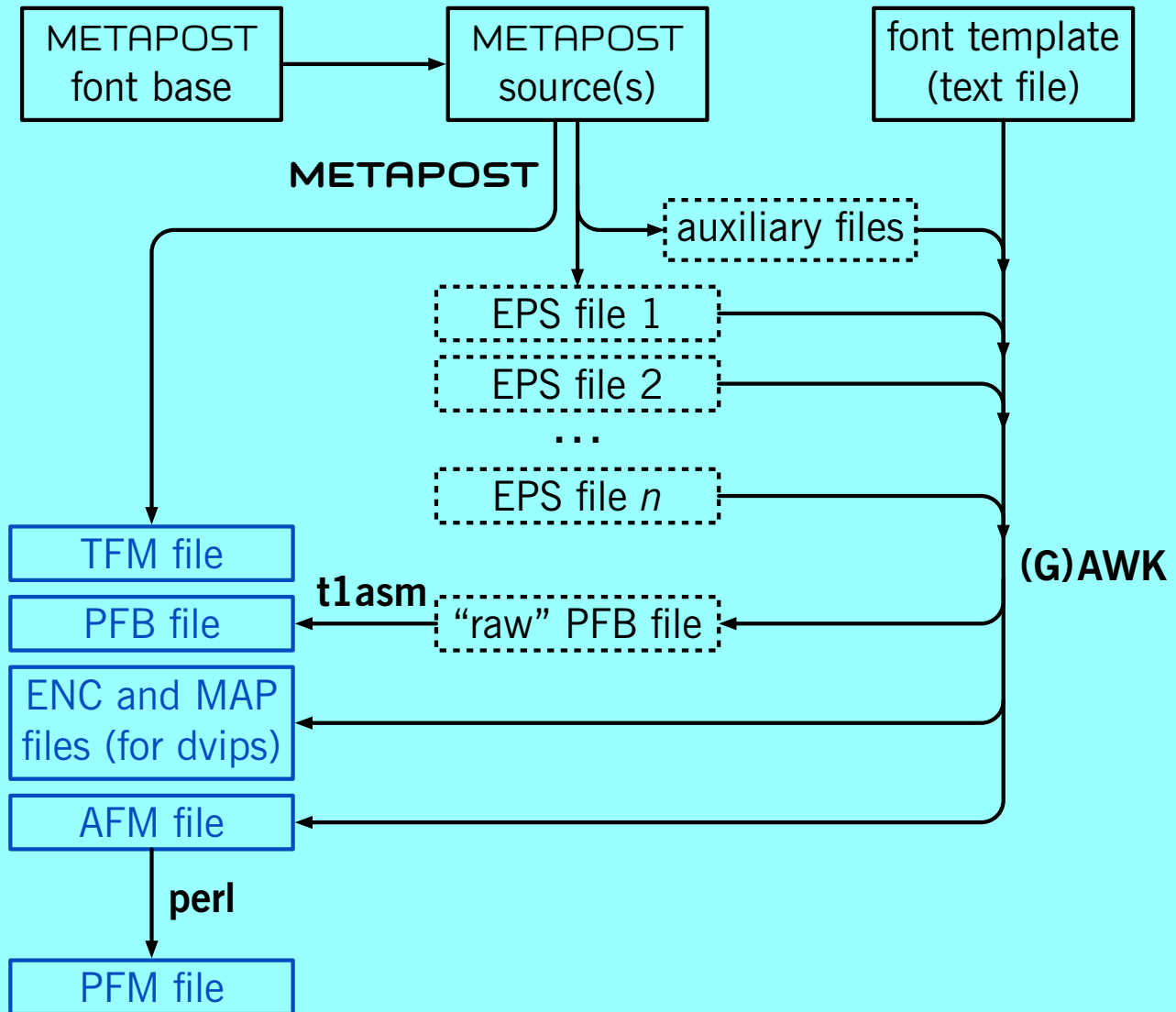
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POSTSCRIPT TYPE 1 FONT: WHAT IS IT?

- **Metric file:** AFM (ASCII)
glyph names, dimensions, kerns, ligatures
- **Glyph file:** PFB (binary) or PFA (ASCII)
glyph shapes (outlines, no pens, no overlapping), encoding, hinting, some metric data
- **Windows (“printer”) metric file:** PFM (binary)
contains nearly the same information as AFM, except glyph names

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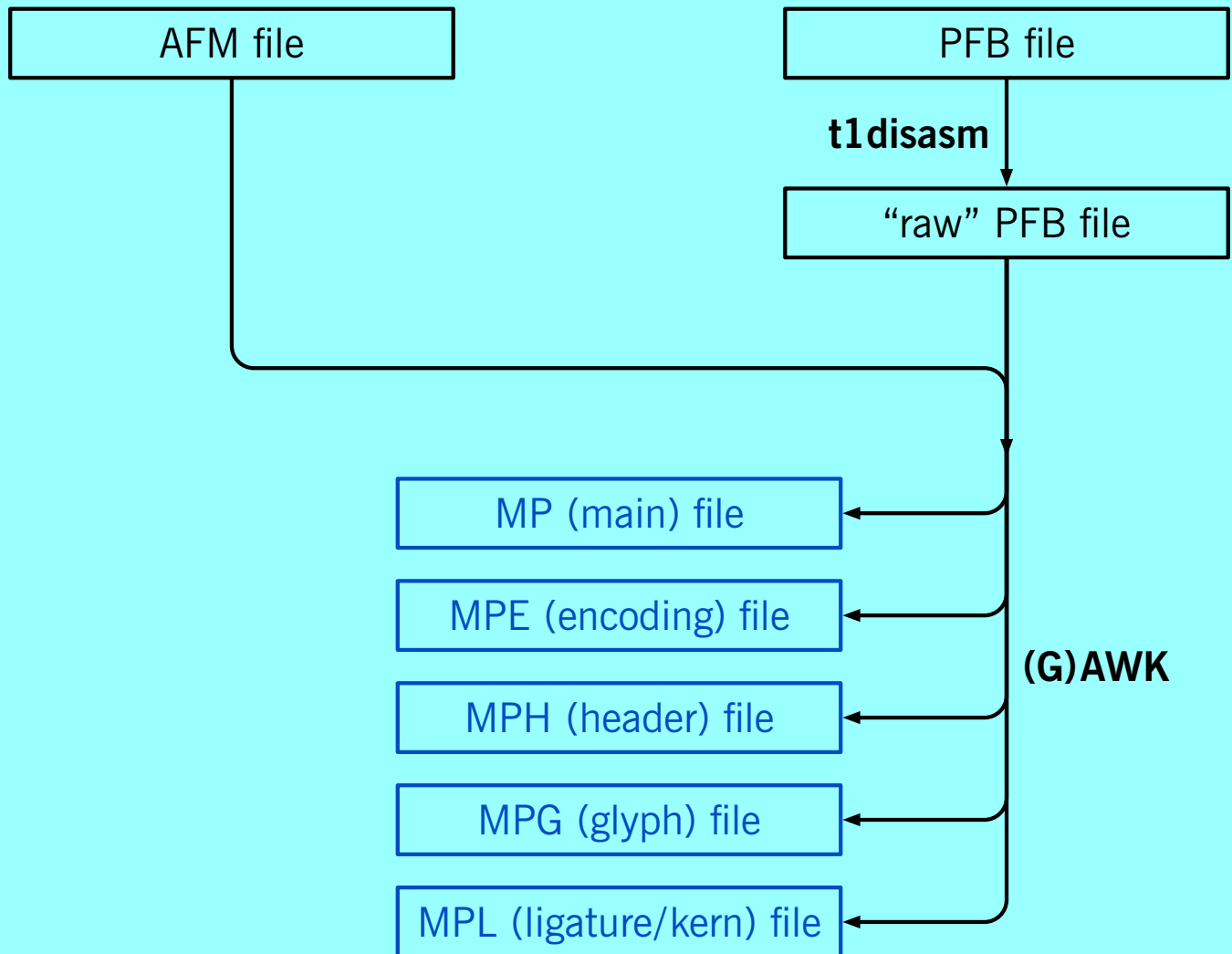
THE SCHEME OF THE ENGINE



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THE SCHEME OF THE “REVERSE” ENGINE



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THE OUTPUT OF THE “REVERSE” ENGINE:

main (driver) encoding header glyph ligature/kern

```
input fontbase;
input logo10.mpe;
beginfont
maybeinput "logo10.mph";
maybeinput "logo10.mpg";
maybeinput "logo10.mpl";
endfont
```

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THE OUTPUT OF THE “REVERSE” ENGINE:

main (driver) encoding header glyph ligature/kern

```
% ENCODING  
encode("space", 32);  
encode("A", 65);  
encode("E", 69);  
encode("F", 70);  
encode("M", 77);  
encode("N", 78);  
encode("O", 79);  
encode("P", 80);  
encode("S", 83);  
encode("T", 84);  
endinput
```

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THE OUTPUT OF THE “REVERSE” ENGINE:

main (driver) encoding header glyph ligature/kern

```
% FONT INFORMATIONS
pf_info_familyname "MFlogo";
pf_info_weight "Normal";
pf_info_fontname "MFlogo10-Regular";
pf_info_version "1.00";
pf_info_author "Author: Donald E. Knuth";
pf_info_encoding "AEFMNOPST_only";
pf_info_italicangle 0;
pf_info_underline -198, 66;
pf_info_fixedpitch false;
pf_info_adl 750, 250, 0;
pf_info_forcebold false;
blue_fuzz := 0;
blue_scale := 0.04546;
blue_shift := 7;
pf_info_overshoots(0, -11.1084), (600.0061, 11.1084);
```

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THE OUTPUT OF THE “REVERSE” ENGINE:

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```
pf_info_designsize 10;
pf_info_space 266.6626, 133.3313, 88.88245;
pf_info_quad 800.00305;
pf_info_pfm "MFlogo10", 0, 0;
pf_info_capheight 600.0061;
pf_info_xheight 0;
pf_info_creationdate;
italic_shift := 0;

% INTRODUCE CHARS
standard_introduce("space");
standard_introduce("A");
standard_introduce("E");
standard_introduce("F");
standard_introduce("M");
standard_introduce("N");
standard_introduce("O");
standard_introduce("P");
```

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THE OUTPUT OF THE “REVERSE” ENGINE:

main (driver) encoding header glyph ligature/kern

```
standard_introduce("S");
standard_introduce("T");
standard_introduce("nbspace");

% METRICS
wd.space = 267; ht.space = 0; dp.space = 0;
wd.A = 666.67175; ht.A = 611; dp.A = -11;
wd.E = 622.2229; ht.E = 600; dp.E = 0;
wd.F = 622.2229; ht.F = 600; dp.F = -11;
wd.M = 800.00305; ht.M = 611; dp.M = -11;
wd.N = 666.67175; ht.N = 611; dp.N = -11;
wd.O = 666.67175; ht.O = 611; dp.O = -11;
wd.P = 622.2229; ht.P = 600; dp.P = -11;
wd.S = 622.2229; ht.S = 600; dp.S = 0;
wd.T = 577.77405; ht.T = 600; dp.T = -11;
wd.nspace = 267; ht.nspace = 0; dp.nspace = 0;
endinput
```

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THE OUTPUT OF THE “REVERSE” ENGINE:

main (driver) encoding header glyph ligature/kern

```
beginglyph(T);
  save p; path p[];

  z0 0 = (578, 570); z0 0a = (578, 587); z0 1b = (563, 600);
  z0 1 = (545, 600);
  z0 2 = (33, 600); z0 2a = (15, 600); z0 3b = (0, 587);
  z0 3 = (0, 570); z0 3a = (0, 553); z0 4b = (15, 540);
  z0 4 = (33, 540);
  z0 5 = (256, 540);
  z0 6 = (256, 19); z0 6a = (256, 2); z0 7b = (271, -11);
  z0 7 = (289, -11); z0 7a = (307, -11); z0 8b = (322, 2);
  z0 8 = (322, 19);
  z0 9 = (322, 540);
  z0 10 = (545, 540); z0 10a = (563, 540); z0 11b = (578, 553);
  z0 11 = (578, 570);
  p0 = compose_path_z0(11);

  if turningnumber p0 > 0: Fill else: unFill fi p0;
```

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THE OUTPUT OF THE “REVERSE” ENGINE:

main (driver) encoding header glyph ligature/kern

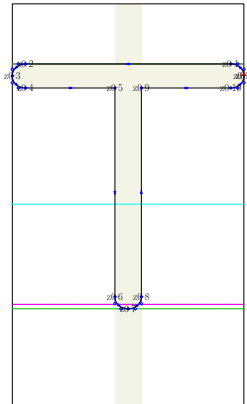
```
fix_hstem(60)(p_0)candidate_list(y)(540, 600);  
fix_vstem(66)(p_0)candidate_list(x)(256, 322);  
standard_exact_hsbw("T");  
endglyph;
```

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THE OUTPUT OF THE “REVERSE” ENGINE: main (driver) encoding header glyph ligature/kern

Construction of the character T: | Konstrukcija znaku T:



```

beginglyph(T);
  save p; path p[];
  z0_0 = (578, 570); z0_0a = (578, 587); z0_1b = (563, 600);
  z0_1 = (545, 600);
  z0_2 = (33, 600); z0_2a = (15, 600); z0_3b = (0, 587);
  z0_3 = (0, 570); z0_3a = (0, 553); z0_4b = (15, 540);
  z0_4 = (33, 540);
  z0_5 = (256, 540);
  z0_6 = (256, 19); z0_6a = (256, 2); z0_7b = (271, -11);
  z0_7 = (289, -11); z0_7a = (307, -11); z0_8b = (322, 2);
  z0_8 = (322, 19);
  z0_9 = (322, 540);
  z0_10 = (545, 540); z0_10a = (563, 540); z0_11b = (578, 553);
  z0_11 = (578, 570);
  p0 = compose_path_z0(11);
  if turningnumber p0 > 0: Fill else: unFill fi p0;
  fix_hstem(60)(p0) candidate_list(y)(540, 600);
  fix_vstem(66)(p0) candidate_list(x)(256, 322);
  standard_exact_hsbw("T");
endglyph;

```

THE OUTPUT OF THE “REVERSE” ENGINE:

main (driver) encoding header glyph ligature/kern

```
% KERN PAIRS
LK("F")
  KP("0", -44.44885)
KL;
LK("P")
  KP("0", 44.44885)
KL;
LK("T")
  KP("A", -22.22443)
KL;
endinput
```

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AN EXAMPLE: the letter “T” from D. E. Knuth’s logo font

```
beginlogochar("T", 13);  
italcorr ht# * slant + .5u#;  
if .5w <> good.x .5w: change_width; fi  
lft  $x_1 = -eps$ ;  $x_2 = w - x_1$ ;  $x_3 = x_4 = .5w$ ;  
 $y_1 = y_2 = y_3$ ; top  $y_1 = h$ ; bot  $y_4 = -o$ ;  
draw  $z_1 -- z_2$ ; draw  $z_3 -- z_4$ ;  
labels(1, 2, 3, 4);  
endchar;
```

METAFONT source

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AN EXAMPLE: the letter “T” from D. E. Knuth’s logo font

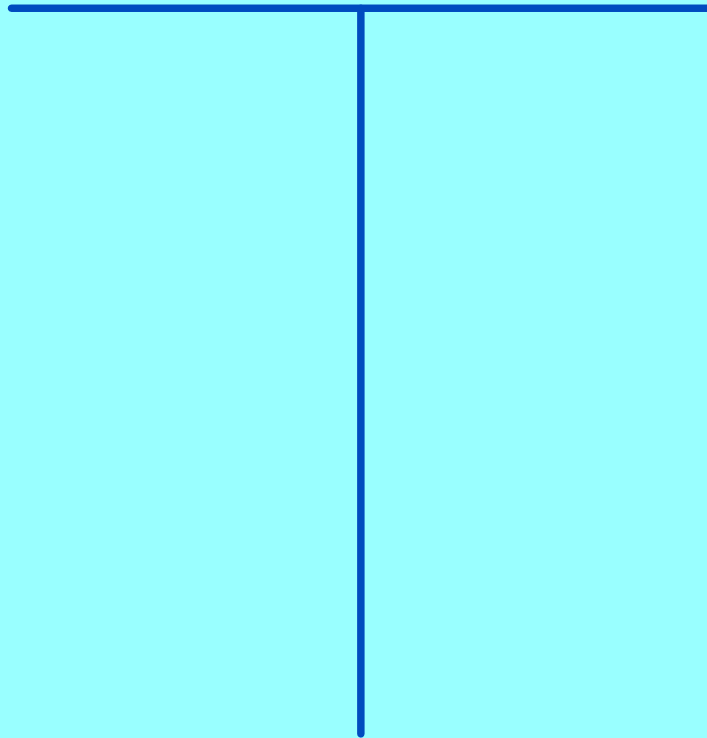
```
beginlogochar("T", 13);  
italcorr ht# * slant + .5u#;  
if .5w <> good.x .5w: change_width; fi  
lft x1 = -eps; x2 = w - x1; x3 = x4 = .5w;  
y1 = y2 = y3; top y1 = h; bot y4 = -o;  
draw z1 -- z2; draw z3 -- z4;  
labels(1, 2, 3, 4);  
endchar;
```

METAFONT source

```
beginlogoglyph("T", 13);  
ic.T# := ht# * slant + .5u#; if ic.T# < 0: ic.T# := 0; fi  
lft x1 = 0; x2 = w - x1; x3 = x4 = .5w;  
y1 = y2 = y3; top y1 = h; bot y4 = -o;  
find_outlines(expand_logo_stroke()(z1 -- z2),  
  expand_logo_stroke(butt_end(0))(z3 -- z4))(glyph);  
Fill glyph1; fix_vstem(px)(glyph1); fix_hstem(py)(glyph1);  
just_labels(1, 2, 3, 4);  
endlogoglyph;
```

METAPOST source

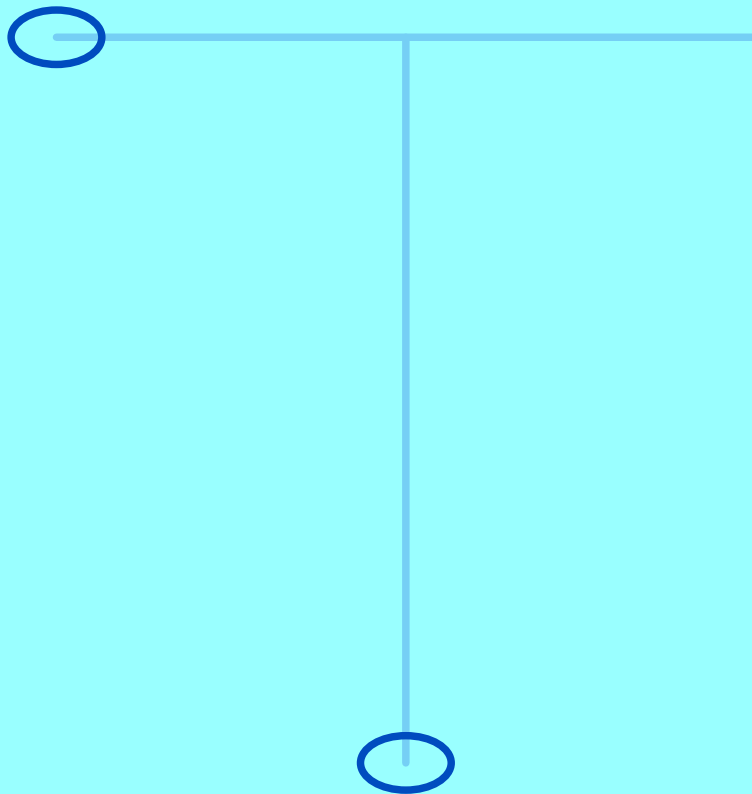
**AN EXAMPLE:
the construction of the letter “T”**



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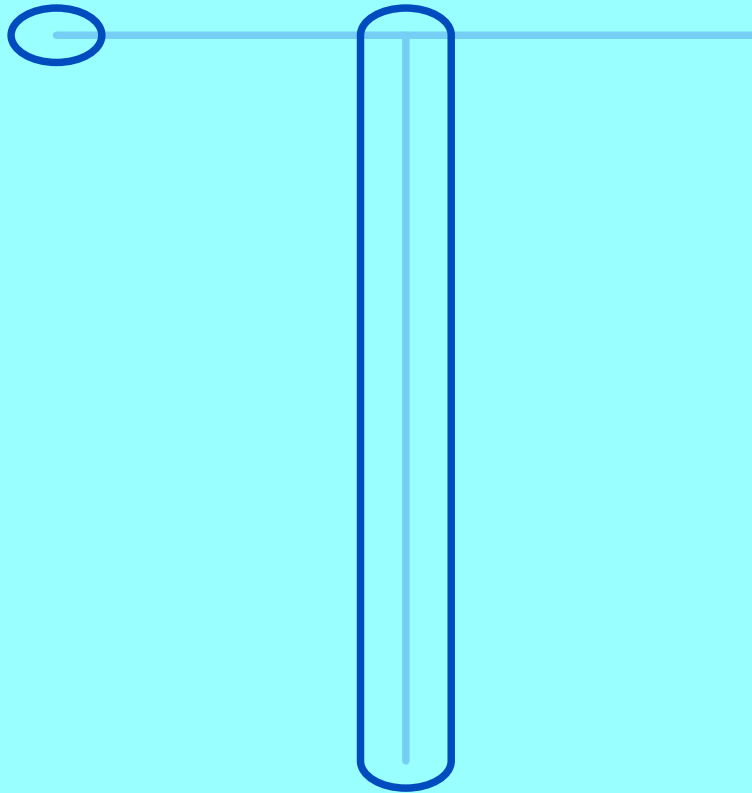
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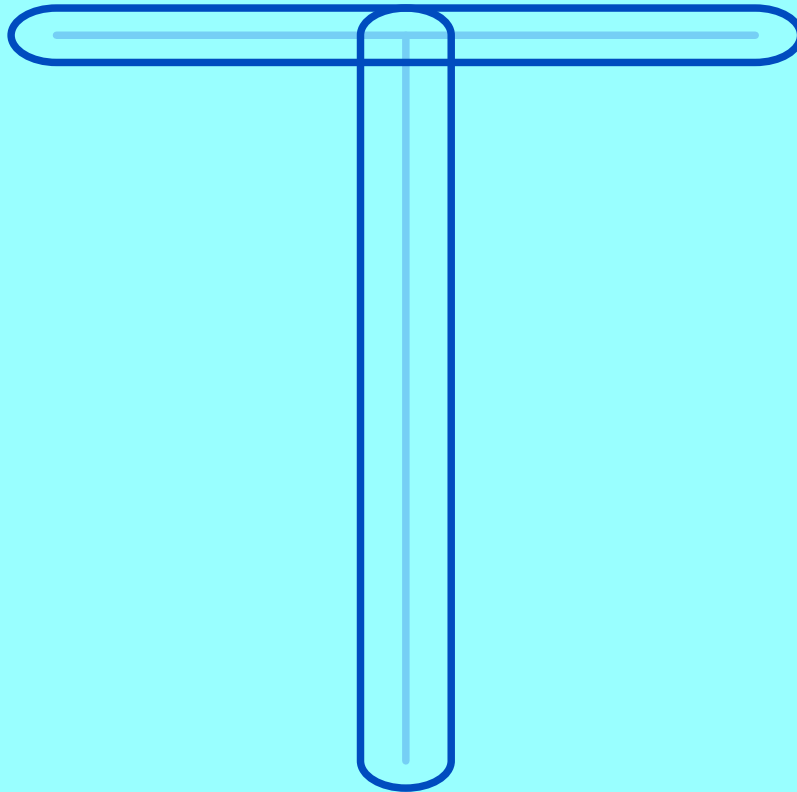
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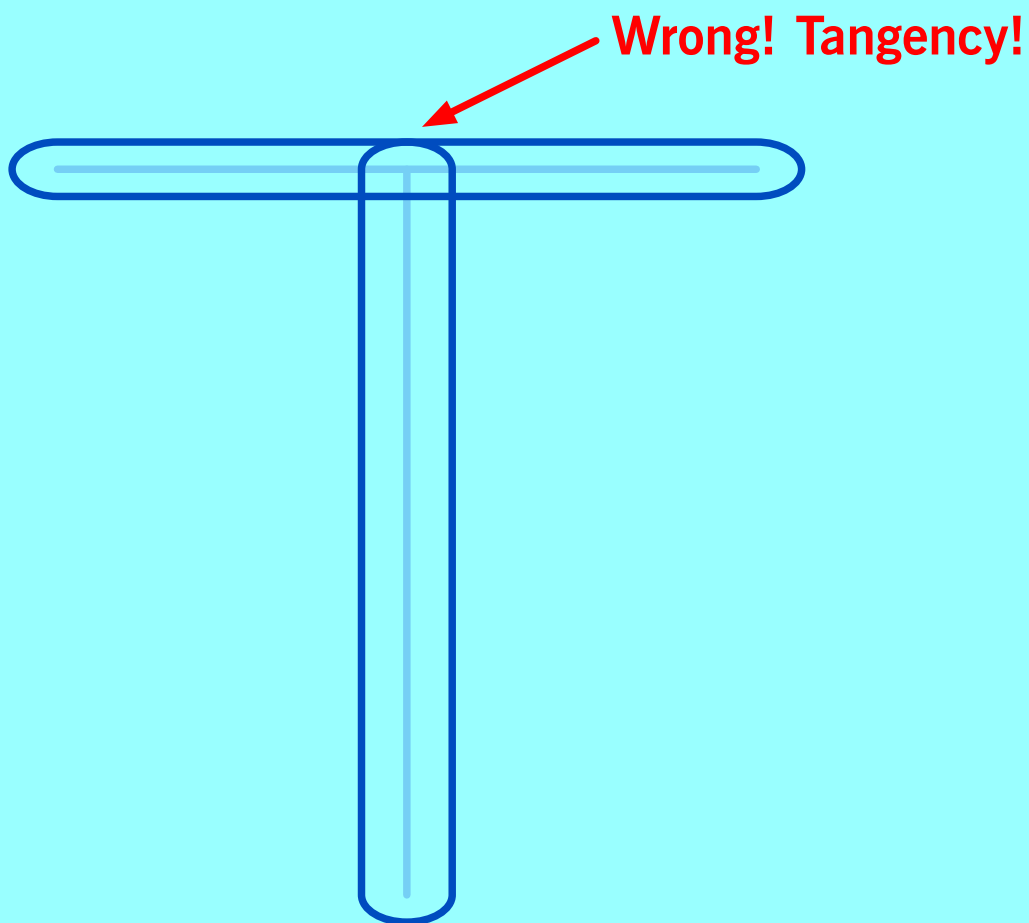
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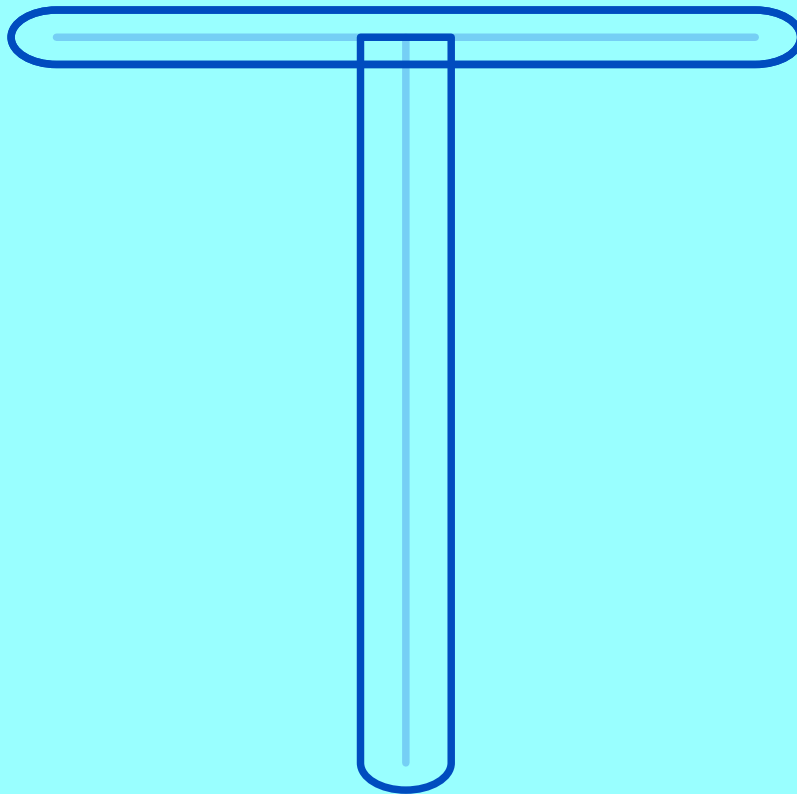
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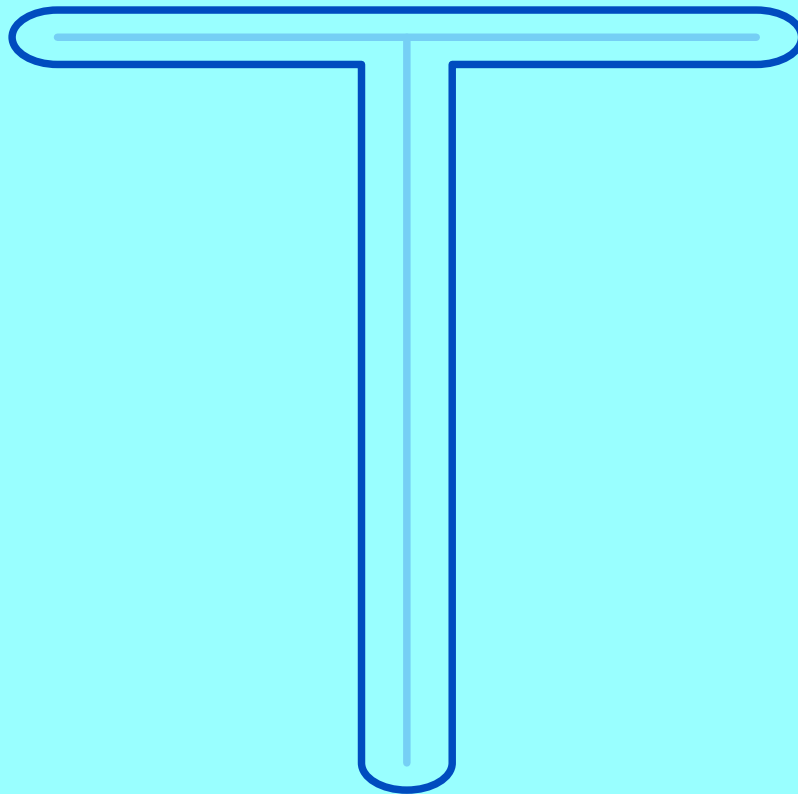
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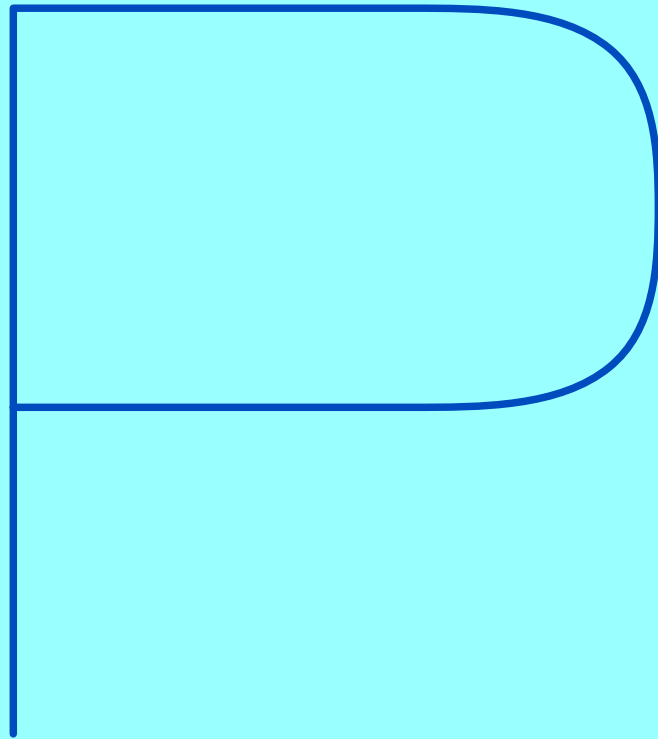
**AN EXAMPLE:
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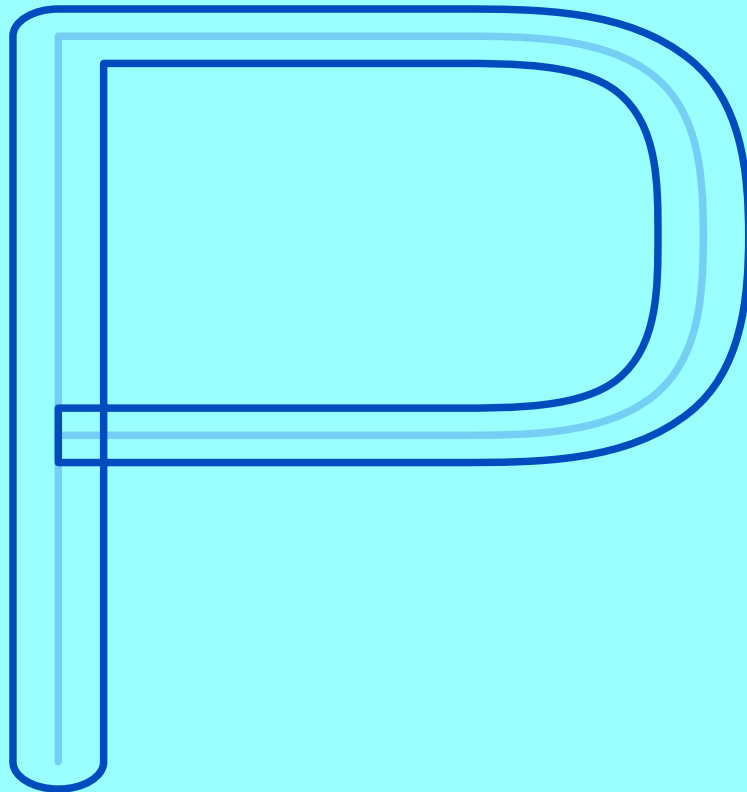
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**AN EXAMPLE:
the construction of the letter “P”**



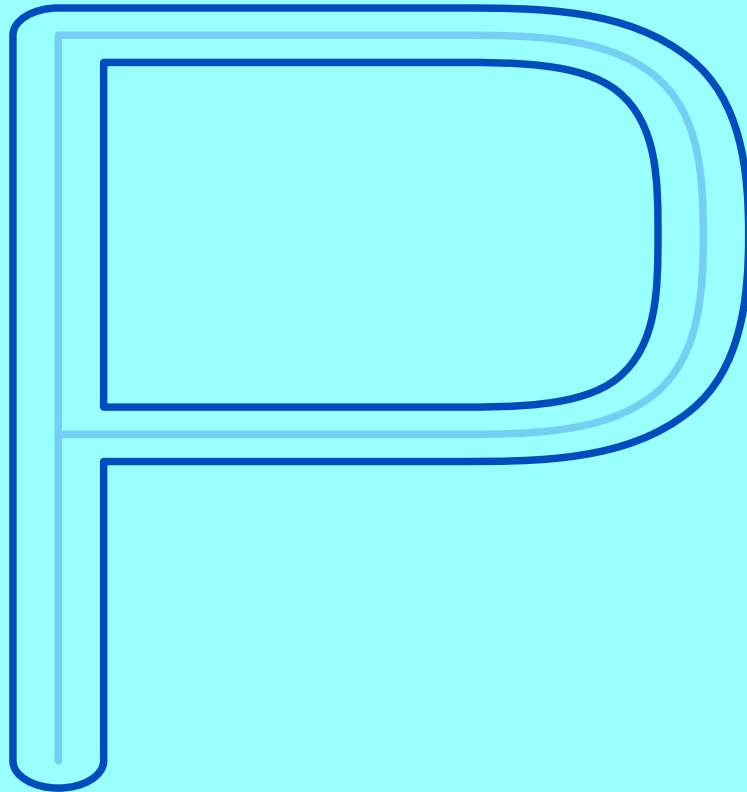
**AN EXAMPLE:
the construction of the letter “P”**



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**AN EXAMPLE:
the construction of the letter “P”**



THE FINAL EXHORTATION

*LET US GO FORTH now and
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typography in Type 1 format!*

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THE FINAL EXHORTATION

*LET US GO FORTH now and
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Fortunately, there are three of us: Janusz, Piotr
and I; and it is known since ancient
times that *tres faciunt collegium*...

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FOR BOLD CHARACTERS:

`ftp://bop.eps.gda.pl/pub/metatype1`