Using fonts in LaTeX with OzTeX

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This is a short guide explaining how fonts are used in LaTeX and rendered by OzTeX on screen and, using `dvips`, in print. A basic knowledge of Leslie Lamport's LaTeX [2, 3, 4, 5, 8] and Andrew Trevorrow's OzTeX [10] is assumed, but not of Donald E. Knuth's TeX [7]. Please send comments, corrections and suggestions to `Patrick.Cousot@ens.fr`.

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1.1 LaTeX type style and size

At high-level, LaTeX describes a font (or "fount" in british english) by a *type style* (*family*, *series* and *shape*) and a *size*:

family : `\rmfamily`, `\sffamily`, `\ttfamily`;

series : `\mdseries`, `\bfseries`;

shape : `\upshape`, `\itshape`, `\slshape`, `\scshape`;

size : `\tiny` (5pt), `\scriptsize` (7pt), `\footnotesize` (8pt), `\small` (9pt), `\normalsize` (10pt), `\large` (12pt), `\Large` (14.4pt), `\LARGE` (17.28pt), `\huge` (20.74pt), `\Huge` (24.88pt). The normal size (10pt) can be changed by class options (`11pt`, `12pt`).

The `\normalfont` command resets the family, series and shape to default `\rmfamily`, `\mdseries` and `\upshape`. More details are given in `CTAN/macros/latex/base/fntguide.tex` [1] i.e. `:TeX:Inputs:LaTeX:base:fntguide.tex` [2], in particular for math fonts.

1.2 Default fonts

Which fonts are ultimately used is determined by the document style (as described in Sec. 3 below), unless packages are used to modify LaTeX defaults. In LaTeX standard styles (`article`, `report`, `book`), the default fonts are:

- Donald E. Knuth's "cm" (Computer Modern) fonts;
- or, if you say `\usepackage[T1]{fontenc}`, the "ec" (European Computer) fonts.

The "ec" fonts are the "cm" fonts enriched with additional accented letters (see the respective layouts on pages 31 and 32). The default fonts can be easily changed by loading appropriate packages. For example:

```
\usepackage{em}
```

will replace the "ec" fonts by the PostScript "em" fonts of Y&Y.

1.3 Additional fonts

Some packages implicitly make use of specific fonts, such as e.g. the LaTeX `lazy` font when declaring:

```
\usepackage{latexsym}
```

to use the LaTeX symbols (see [8, p. 43] or [2, p. 184]) or the $\mathcal{AMS}$ (American Mathematical Society) fonts [4] when declaring:

```
\usepackage{amssymb}
```

to use the $\mathcal{AMS}$ math symbols (see [2] on p. 221 and the following ones).

[1] `CTAN` (Comprehensive TeX Archive Network) stands for `ftp://ctan.tug.org/tex-archive`, `ftp://ftp.tex.ac.uk/tex-archive`, `ftp://ftp.dante.de/pub/tex` or mirrors given in `ftp://ctan.tug.org/tex-archive/CTAN.sites`

[2] All path names beginning with ":" are relative to the location of the OzTeX application.

1.4 OzTEX input files

OzTEX needs to know where to read the TEX/LATEX input files (such as the `fontenc.sty` and `t1.enc` files used by the `\usepackage[T1]{fontenc}` declaration). OzTEX will scan a list of folders in the following order:

1. the current folder of the TEX/LATEX `.tex` source file;
2. else, the folders indicated by OzTEX's configuration variable `input_folders`.

The default value of this configuration variable `input_folders` is set-up in OzTEX `:TeX:Configs:Default` file:

```
input_folders = :TeX:Inputs:LaTeX:* :TeX:Inputs:Plain: |
                :TeX:Inputs:DVIPS: :TeX:Inputs:AMS-TeX:
```

1.5 Modifying OzTEX configuration variables

The value of `input_folders` and of any other configuration variable can be assigned/modified/updated in several ways (its modification in `:TeX:Configs:Default` is possible but not recommended):

- in the `:Local` file which is read (after `:TeX:Configs:Default`) whenever OzTEX is launched (if present, the `:Local` file is also loaded whenever "Default" is selected from the "Config" menu or, equivalently, "Command-D" is pressed, which is identical to restarting OzTEX);
- in a configuration file which is loaded manually using OzTEX's "Config" menu (the items at the end of the "Config" menu are listed in OzTEX's `config_files` configuration variable and should correspond to standard configuration files stored in the `:TeX:Configs:` folder or to local configuration files);
- in a configuration file named `LaTeX.config` located in the source file folder which is loaded by OzTEX when the `.tex` source file is typeset and its very first line is:

  ```
  %&LaTeX
  ```

  (which forces OzTEX to use the `LaTeX` format);
- recursively, in another configuration file, designated by the value of the configuration variable `load_config` found while OzTEX is reading a configuration file;
- as explained above but through an alias to a configuration file .

The simplest way to modify a configuration variable is to use the former (possibly empty) value `$c` and to append a new folder as in e.g.:

```
current_app = OzTeX
input_folders = :mytex:inputs:* $c
```

so OzTEX will search all subfolders of the subfolder `inputs` of the folder `mytex` located in the folder containing OzTEX. If not found there, OzTEX will go on in their search as indicated by `$c` denoting the former value of `input_folders`. Duplicate strings are automatically removed so the search will be done only once in a given folder. If you make an error while changing the configuration files the only way to reset the configuration variables to their default value is to select "Default → Config" or, equivalently, press "Command-D" which is equivalent to restarting OzTEX. See OzTEX manual [10] for full explanations.

1.6 Hyphenation

The "ec" (European computer) fonts allow for correct hyphenation of words containing accented letters. With standard TEX, this is broken with the "cm" (Computer Modern) fonts since accented letters are composed characters ("`\'{e}`" yields "é" as " ´" over "e"). Hyphenation may be correct only if the input itself is accented, as in éèêë not `\'{e}\`{e}\^{e}\"{e}`. But then the input encoding is no longer the 7 bit ASCII code as originally used by TEX/LATEX.

1.7 Input encoding

But for the standard 7 bit ASCII input encoding, LATEX should be told which input encoding is used. For the 8 bit Macintosh Roman input encoding, the preamble declaration is `\usepackage[applemac]{inputenc}`. The freewares `kb7to8` and `kb8to7` available at:

ftp://ftp.supelec.fr/pub/cs/devMacFB/7-8bit-full-1.3.sea.bin

can also be used to make the input text conversion back and forth automatically.

2 LATEX low-level selection of fonts

2.1 Low-level fonts characteristics

At low-level, LATEX uses the so-called *new font selection scheme* (NFSS2) described in [2, Ch. 7][3] (PSNFSS for PostScript fonts, see [3, Ch. 10], `CTAN/macros/latex/required/psnfss/psnfss2e.tex` or `:TeX:Inputs:LaTeX:psnfss:psnfss2e.tex`).

A font is described by the following attributes:

encoding : `OT1` (Donald E. Knuth), `T1` (Cork), `LY1` (Y&Y), `U` (unknown), `OML` (old math letters), `OMS` (old math symbols), `OMX` (old math extension symbols) . . . ;

family : a 3(/4) letter shortname of the form STT where S represents the supplier of the font (such as `p` (PostScript/Adobe Systems, Inc.) and TT represents the typeface/font family name (such as `hv` (Helvetica));

size : a pair of two numbers (in points) or two numbers with units (`pt` (point), `pc` (pica), `in` (inch), `bp` (big point), `cm` (centimeter), `mm` (millimeter), `dd` (didot point), `cc` (cicero), `sp` (scaled point), as explained in the TEXbook [7, p. 57] or the LATEXbook [8, p. 215]) indicating a *size* and a *baseline*

[3] `CTAN/macros/latex209/contrib/amslatex/fontsel/nfss.tex` is outdated.

skip (also called “leading”, measuring the distance between the baselines of succeeding lines);

series : a *weight* followed by a *width* (with `m` dropped but in `mm` which is `m`):

- ***weight*** : `ul` (ultra light), `el` (extra light), `l` (light), `sl` (semi light), `m` (medium/normal), `sb` (semi bold), `b` (bold), `eb` (extra bold), `ub` (ultra bold);
- ***width*** : `uc` (ultra condensed 50%), `ec` (extra condensed 62.5%), `c` (condensed 75%), `sc` (semi condensed 87.5%), `m` (medium/normal 100%), `sx` (semi expanded 112.5%), `x` (expanded 125%), `ex` (extra expanded 150%), `ux` (ultra expanded 200%);

shape : `n` (upright/normal), `it` (italic), `sl` (slanted), `sc` (small caps), `ui` (upright italic), `ol` (outline);

external font : a font name `ffff`. When using Karl Berry’s filenames for TEX fonts (see `CTAN/info/fontname/fontname.html`) the font name `ffff` has the form “`S TT W [V...] [N] [E] [DD]`” where:

- `S` represents the supplier of the font,
- `TT` represents the typeface/font family name,
- `W` represents the weight: `a` (thin hairline), `b` (bold), `c` (black), `d` (demi), `h` (heavy/heavyface), `j` (extralight), `k` (book), `l` (light), `m` (medium), `p` (poster), `r` (regular/roman), `s` (semibold), `u` (ultra/ultrablack) or `x` (extrabold/extrablack),
- `V...` represents the variant(s), and is omitted if both it and the width are normal. Many fonts have more than one variant,
- `N` represents the encoding, and is omitted if the encoding is nonstandard,
- `E` represents the width ("expansion"), and is omitted if it is normal,
- `DD` represents the design size (in decimal), and is omitted if the font is linearly scaled.

The main variants/encodings are:

`7t` : 7-bit TEX text encoding (as in Computer Modern Roman), LATEX `OT1`, as described by vector `/CMTextEncoding` in the file `CTAN/fonts/utilities/vplutils/encodings/CMtext.enc` (see page 31);

`8t` : 8-bit Cork aka EC, TEX Latin 1, extended TEX text encoding, LATEX `T1`, as described by vector `/ECEncoding` in file `CTAN/fonts/utilities/vplutils/encodings/EC.enc` [4] or by vector `/ExtendedTeXEncoding` in the file `CTAN/fonts/utilities/vplutils/encodings/extex.enc` (see page 32);

`8r` : 8-bit TEX Base 1 encoding (“raw” encoding of the PSNFSS encoding), as described by vector `/TeXBase1Encoding` in files `CTAN/info/fontname/8r.enc`, `CTAN/macros/latex/required/psnfss/8r.enc`, etc (see page 33);

[4] The previous version `/DCEncoding` in `CTAN/fonts/utilities/vplutils/encodings/DC.enc` is similar but for `/.notdef` replaced by `/visiblespace` in position 32.

8y : 8-bit Y&Y TeX 'n ANSI encoding, LaTeX `LY1`, as described by vector `/TeXnANSIEncoding` in file `TEXNANSI.ENC` (distributed by Y&Y) and `:Extras:Y&Y:LY1:encodings:dvips:TEXNANSI.ENC` (see page 35).

The current values of the font attributes are recorded in internal macros which should never be directly modified (`\f@encoding`, `\f@family`, `\f@series`, `\f@shape`, `\f@size` and `\f@baselineskip`).

2.2 Output encodings

Apart from the above font encodings, there are many others. In general the font encodings for LaTeX, the screen and the printer are different so conversions from one encoding to another may be needed for visualizing the typeset text (see Sec. 4.2.8). Apart from TeX math encodings (`OML`, `OMS`, `OMX`), the main other encodings are:

TeX Text Companion Symbols 1 Encoding : 8-bit LaTeX `TS1`, `CTAN/fonts/psfonts/ts1/textcomp.tex` (later merged with `CTAN/macros/latex/unpacked/fontenc.sty`) containing text symbols for use with `T1`-encoded text fonts (see page 34). This encoding is enabled by `\usepackage{textcomp}`;

Macintosh Roman Encoding : 8-bit Apple standard encoding of Macintosh keyboard and screen fonts (see page 36);

Adobe Standard Encoding : 8-bit encoding of PostScript fonts [1] (used in `.afm` files, see Sec. 4.1.7), as described by vector `/StandardEncoding` in the file `CTAN/fonts/utilities/vplutils/encodings/standard.enc` (see page 37);

ISO 8859-1 (Latin-1) encoding : 8-bit encoding (e.g. for Unix) described by vector `/ISOLatin1Encoding` in the file `CTAN/fonts/utilities/vplutils/encodings/isolatin1.enc` (see page 38).

More information about LaTeX encodings can be found by typesetting `CTAN/macros/latex/base/ltoutenc.dtx`.

2.3 Font selection

A font can be used after a declaration in the preamble (before `\begin{document}`):

```
\DeclareFontFamily{T1}{phv}{} % helvetica with T1 encoding
\DeclareFontShape{T1}{phv}{m}{n}{<-> phvr8t}{}
```

followed by selection commands in the document body:

```
{\fontencoding{T1}\fontfamily{phv}\fontsize{10}{12}%
\fontseries{m}\fontshape{n}\selectfont ...}
```

After such a selection command, the text will be in regular Helvetica, 10 points on 12 points (assuming that `phvr8t` refers to the `T1` encoded regular Helvetica font). As shown above, the scope of the font selection command can be limited by brackets.The Helvetica font looks larger than other typefaces at the same size, so it can be scaled down, as in:

```
\DeclareFontFamily{T1}{phv}{} % helvetica with T1 encoding
\DeclareFontShape{T1}{phv}{m}{n}{<-> [0.92] phvr8t}{}
```

Here is an example of 0.92 scaled regular Helvetica font.

2.4 .fd files

The previous method is unusual since the most common font declarations are grouped in .fd font description files [5]. So if a font selection command appears in the .tex source body without corresponding font declaration in the preamble, then LaTeX will take the font encoding FE and family FF and look for a file named FEFF.fd to get the missing declarations.

For example the font selection (where FE = T1 and FF = ppl):

```
\fontencoding{T1}\fontfamily{ppl}\fontsize{3mm}{4mm}%
\fontseries{m}\fontshape{n}\selectfont
```

will load the t1ppl.fd file (as recorded in the .log file). This CTAN/fonts/psfonts/adobe/palatino/tex/t1ppl.fd i.e. :TeX:Inputs:LaTeX:psnfss:t1ppl.fd file is (excerpt):

```
\ProvidesFile{t1ppl.fd}
   [1998/07/06 Fontinst v1.800 font definitions for T1/ppl.]
\DeclareFontFamily{T1}{ppl}{}
\DeclareFontShape{T1}{ppl}{m}{n}{<-> pplr8t}{}
...
\endinput
```

The LaTeX font selection command will utimately translate to TeX font selection command (something like \pplrfont=pplr8t at 10pt\pplrfont).

After this selection command, the text will be in pplr8t font, 3mm on 4mm, provided the corresponding external font (regular Palatino) is properly selected, on screen (see Sec. 4) and in print (see Sec. 5).

2.5 From input to TeX/TFM glyph codes

TeX does not understand its input as characters but as glyph codes/slots, where (when you say \font\fontffff=ffff at 10pt\fontffff) the TeX/TFM glyph's characteristics should be found externally (in file ffff.tfm). Then a device dependent mechanism, whence external to TeX, will determine which actual character/image or *glyph* should be displayed/printed. First we must understand how LaTeX translates the input file into TeX/TFM glyph codes/slots for TeX (and later how the glyphs are displayed or printed).

The \usepackage[applemac]{inputenc} specifies the encoding of the .tex input LaTeX source file. This loads the applemac.def file which defines to which TeX command corresponds each input character. For example CTAN/macros/latex/unpacked/applemac.def i.e. :TeX:Inputs:LaTeX:base:applemac.def contains (excerpt):

```
\DeclareInputText{148}{\^\i}
```

This says that the Macintosh character of code/slot 148 should be translated to "\^\i". This Macintosh character is î (typed as "Option-I" or ˆ followed by i on the french keyboard), as you can see on page 36. Now the \usepackage[T1]{fontenc} will load the t1enc.def file specifying the corresponding TeX/TFM glyph code/slot corresponding to the "\^\i" command, as shown by the following excerpt:

[5] .fd font description files are most often generated from .fdd files using a .ins installation script. Typesetting the .fdd file often provides explanations on the use of the generated .fd files.

```
\DeclareFontEncoding{T1}{}{}
\DeclareTextComposite{\^}{T1}{\i}{238}
```

The code/slot 238 = `"EE` (hexadecimal) corresponds to the î glyph in the `T1` encoding layout as given on page 32. By composition of the two mappings, typing the keyboard character will input the glyph of TEX/TFM character of code/slot “238”.

Formally if we write *applemac* for the map from keyboard to LATEX commands performed by `inputenc.sty` and *t1enc* for the map from LATEX commands to TEX/TFM code/slot performed by `fontenc.sty`, the TEX/TFM glyph code/slot for the input character of Macintosh code/slot c is $t1enc(applemac(c))$.

This input remapping is bypassed by `\symbol{`n`}` which directly enters the TEX/TFM glyph of code/slot “n”.

2.6 `.tfm` files

Whenever the LATEX source `.tex` file instructs TEX to place a character within some font `ffff` (e.g. `phvr8t`) on a page as explained above, TEX needs to know some information on the corresponding glyph/character (such as a bounding box but not its actual design). This information is provided in a `ffff.tfm` file (e.g. `phvr8t.tfm`). For example the file `phvr8t.tfm` is available (in binary) on `CTAN/fonts/psfonts/adobe/helvetic/tfm/phvr8t.tfm` and `:TeX:TFM:PS:phvr8t.tfm`. Notice that glyphs in `.tfm` files are referenced by their code/slot so there are different `.tfm` files for the different font encodings. For example (more information on page 13 of `CTAN/fonts/utilities/fontinst/doc/fontinst.dvi`):

`phvr.tfm`	TEX Base 1 encoding + `dvips` encoding
`phvr7t.tfm`	7-bit TEX text encoding, LATEX `OT1`;
`phvr8c.tfm`	TEX text companion symbols 1, LATEX `TS1`
`phvr8r.tfm`	8-bit TEX Base 1 encoding
`phvr8t.tfm`	8-bit Extended TEX font encoding – latin, LATEX `T1`

It may happen that `.tfm` are distributed under the same name for different encodings. This is the case for Y&Y Lucida Bright where different `lbr.tfm` files are distributed in three folders: “Adobe StandardEncoding”, “TeX ’n ANSI” (LATEX `LY1`) and “Macintosh Standard”. To determine which ones to use, OzTEX first looks in the current folder and then in the list of folders defined by the configuration variable `tfm_folders`. Its default value in `:TeX:Configs:Default` is:

```
tfm_folders = :TeX:TFM:*
```

This `tfm_folders` configuration variable can be modified as explained in Sec. 1.5.

Which encoding is used in a `ffff.tfm` file can be determined by conversion to a `ffff.pl` file by OzMF “Tools → TFtoPL...”. In such a property list file, the encoding is explicit, for example:

```
(CODINGSCHEME ADOBE STANDARDENCODING)
```

2.7 `.dvi` file

The typesetting of the LaTeX `.tex` source yields a TeX `.dvi` file where the position/coordinate of each glyph/character on a page is recorded together with the corresponding external font name and the glyph code/slot within that font. From this information, OzTeX will be able to display the `.dvi` file on the screen and in print (see Sec. 4 and 5).

3 LaTeX translation from high-level to low-level font selection

3.1 Defaults

LaTeX establishes the correspondence between high level font commands (such as `\rmfamily`) and low level ones (such as `\fontfamily`) in terms of defaults. For example, `\rmfamily` and `\normalfont` are (approximately) defined as:

```
\newcommmand{\rmfamily}{...\fontfamily\rmdefault\selectfont}
\newcommmand{\normalfont}{\fontencoding{\encodingdefault}%
      \fontfamily{\familydefault}\fontseries{\seriesdefault}%
      \fontshape{\shapedefault}\selectfont}
```

By default these are:

\encodingdefault	\familydefault	\seriesdefault	\shapedefault
OT1	\rmdefault	m	n

3.2 Changing the defaults

Changing the default value of `\rmdefault` will change the main body font of the document. For example `slides.cls` has:

```
\def\rmdefault{lcmss}        % no roman
```

while `CTAN/macros/latex/required/psnfss/times.sty` is simply:

```
\renewcommand{\rmdefault}{ptm}% Adobe Times
\renewcommand{\sfdefault}{phv}% Adobe Helvetica
\renewcommand{\ttdefault}{pcr}% Adobe Courier
```

The font sizes are set up by the style files (e.g. `size12.clo` for `\documentclass[12pt]{article}`).

4 Which font glyphs OzTeX is going to render on screen?

OzTeX is in charge of previewing the `.dvi` file on screen.

4.1 Default screen font rendering for TeX and METAFONT fonts

4.1.1 OzMF

If you do not say otherwise in OzTeX configuration files, OzTeX will use OzMF (Donald E. Knuth's METAFONT) to generate on demand the bitmaps to be displayed for the glyphs/characters of external font `ffff` on screen. OzMF will look for a file `ffff.mf` where the glyph encoding (`OT1` for “cm”, `T1` for “ec”) is wired and the shape is described. OzMF will produce a temporary `ffff.gf` file used by `MakeTeXPK` to produce a bitmap *packed pixel* file `ffff.`*ddd*`pk` which is used directly by OzTEX to render the glyph/character on screen (and in print). This bitmap represents the glyph as a matrix of white and black pixels for the screen (or printer) resolution.

4.1.2 Which fonts are actually used?

You can check which fonts are actually used in the `.dvi` window by pressing “Command-I” (or selecting OzTEX “View → Page Info” menu, showing the fonts used, and where the `.pk` files are coming from).

4.1.3 Keyboard to screen character mapping

Usually the glyph appearing on screen and in print will be the one typed on the keyboard, but there are surprises. For example, with the `OT1` encoding, typing `$<$` yields $<$ while in text `<` yields ¡, a beginner’s error! However with the `T1` encoding, the text `<` yields $<$, as expected.

The explanation is simple. The Macintosh code for the keyboard key $<$ is 220. The input is reencoded into TEX encoding as $\mathit{ot1enc}(\mathit{applemac}(220)) = 60$. The glyph of decimal code/slot 60 (074 is octal, `"3C` in hexadecimal) in “cm” is ¡ as shown by layout on page 31. The same way $\mathit{t1enc}(\mathit{applemac}(220)) = 60$ but the glyph of code/slot 60 in “ec” is $<$ as shown on page 32.

4.1.4 Resolution

The number *ddd* in the file name file `ffff.`*ddd*`pk` is the font size/resolution as determined by the parameters:

```
viewing_resolution  = 600
viewing_mode        = ljfour
```

of OzTEX configuration files. The default is:

```
viewing_resolution  = 300
viewing_mode        = laserwriter
```

The `viewing_mode` string is passed from OzTEX to METAFONT to make missing `ffff.`*ddd*`pk` fonts.

4.1.5 METAFONT .mf files

The place where OzMF should look for file `ffff.mf` is indicated by line:

```
input_folders  = :MF:Inputs:*
```

of file `:MF:Configs:Default`. This can be adjusted as explained in Sec. 1.5.

The `.mf` files are provided with the OzTEX distribution in `:MF:Inputs:*`. The missing ones are available on `CTAN`. For example you have `:MF:Inputs:EC:ecrm.mf` or `CTAN/fonts/ec/src/ecrm.mf`.

4.1.6 .pk files

.pk files are produced by OzMF on demand of OzTEX and saved to disk for later use. The place where .pk files should go is given by the line:

```
pk_file        = ":New PKs:%m:%f.%dpk"    (used by MakeTeXPK)
```

of file :MF:Configs:Default, where:

> %m is replaced by the mode (e.g. laserwriter);
> %f is replaced by the desired font name (e.g. cmr10);
> %d is replaced by the desired font size (e.g. 360);

(see the **PK files** section of OzTEX manual [10] and the **Files and folders** section in :MF:Configs:Default). Odd Jobs can be used to sort .pk files into the subfolders by sizes. .pk files can always be trashed without damage since they will be regenerated when needed.

4.1.7 Making .tfm files (from .afm files)

The **Creating new TFM files** section of OzTEX user manual [10] explains how to make .tfm files. In particular OzMF integrates the tool "AFM2TFM" for generating the .tfm files from the .afm Adobe Type 1 metric information in ASCII format. The .tfm files found on CTAN are often more accurate and should be preferred if available (to be downloaded in binary mode).

4.2 Screen font rendering for PostScript fonts

4.2.1 PostScript fonts have no .mf file

For non-TEX fonts ffff there is no ffff.mf file. So (if there is also no ffff.vf file, see Sec. 8), OzTEX will call OzMF which will complain because no ffff.mf file, e.g. phvr8t.mf, can be found:

```
This is METAFONT, Version 2.718
**&MakeTeXPK \mode:=ljfour;mag:=magstep(0.0);scrollmode;input phvr8t

! I can't find file "phvr8t".
<*> ...r;mag:=magstep(0.0);scrollmode;input phvr8t

Please type another input file name:
```

(just stop OzMF by pressing "Command-." and "Cancel" the call of OzTEX to OzMF).

This is because phvr8t is a PostScript font which is rendered with a completely different mechanism on screen and in print.

4.2.2 Screen and PostScript fonts

For PostScript fonts you should have the screen fonts (in a font folder (so called *suitcase*) such as ) and the printer fonts (such as , unless the font is preloaded in the printer, which is the case for Helvetica, or .pfa/.pfb files are used, see Sec. 6.1).

4.2.3 Macintosh screen fonts

The Macintosh fonts come in two main formats:

Bitmapped fonts : at a given size (with icons such as ); Bitmapped fonts represent each character as a rectangular grid of pixels at a particular size and resolution. The bitmap for each character indicates precisely what pixels should be on and off;

TrueType fonts : these are scalable/resolution-independent outline fonts (with icons such as ) representing each character mathematically as B-spline curves, and 'hints'.

OzTEX will make the best choice. If only bitmapped fonts are available, `ATM` will render them in a nicer way (i.e.  instead of ).

4.2.4 The Adobe Type Manager (ATM) font rasterizer

These screen fonts are better rendered on screen with `ATM Lite`, and should be in the system font folder/suitcase (the commercial `ATM Deluxe` allows for the placement of fonts outside the system font folder/suitcase with font loading on demand so as to bypass the limitation of the "Fonts" system subfolder to 128 fonts, see [9]).

The general preferences of the `ATM` rasterizer should include "**Preserve** Character shapes" and "Precision Character Positioning" (otherwise some fonts might look dismantled).

Some fonts such as the PostScript "em" fonts of Y&Y require `ATM` to be rendered on screen. The `LWFN` PostScript font files should be in the same folder as the screen font suitcases since otherwise the glyphs will appear as rough bitmaps on screen (which is the case for the $\mathcal{AMS}$ math glyphs if `EUEX10`, ..., `MSBM7` are not in the same folder as the "`AMS/PS screen fonts`" suitcase and idem for the LATEX symbols if `LASY10`, ..., `LINEW10` are not in the same folder as the "`LaTeX Screen Fonts`" suitcase) or even as little black square boxes (which is the case for the "em" glyphs if `EMB10`, ..., `EMVTT10` are not in the same folder as the "`EM Math Screen`" and "`EM Text Screen`" suitcases).

4.2.5 Screen font mapping specification

For PostScript fonts, OzTEX must be told which screen fonts should be used for the preview of the LATEX/TFM fonts `ffff` in the `.dvi` file. This is done in OzTEX configuration files (the printer font is useless here, the style is `b` (bold), `i` (italic), `u` (underline), `o` (outline), `s` (shadow), `c` (condense) and/or `e` (extend)):

```
add_fonts
% TFM     Printer font           Screen font  Encoding   Style
phvr8t    Helvetica              Helvetica    MacT1.enc
phvb8t    Helvetica-Bold         Helvetica    MacT1.enc  b
phvro8t   Helvetica-Oblique      Helvetica    MacT1.enc  i
phvbo8t   Helvetica-BoldOblique  Helvetica    MacT1.enc  bi
...
end_fonts
```

So the TEX font `phvr8t` will use the Macintosh screen Helvetica font.

4.2.6 Default and customized configuration files

The font mapping specification can be placed in any configuration file, as already explained in Sec. 1.5. Here are a few alternatives:

1. If the screen font specification is not given in the `:TeX:Configs:Default` or `:Local` configuration file, then, before typesetting, one may have to select the OzTEX menu "Config → Add ...fonts" (such as "Add CM/PS fonts" which loads the "`:TeX:Configs:Add CM-PS Fonts`" file specifying that PostScript fonts should be used for "cm").

2. This manual configuration file loading can be made automatic before each typesetting by creating an alias `LaTeX.config` of `:TeX:Configs:Add CM/PS Fonts` in the source folder and adding the first line "`%&LaTeX`" to that source.

3. However an alias allows only for one configuration file so a more general solution is to have `LaTeX.config` contains:

   ```
   load_config = ":TeX:Configs:Add CM/PS Fonts"
   ```

4. To keep `:Local` short, the `LaTeX.config` file is also useful to define rarely used font specifications.

4.2.7 Font encodings

Unfortunately the TEX/METAFONT encoding of font `ffff` in the `.dvi` file and the Macintosh Roman encoding of the corresponding screen font (i.e. the rank of the glyphs in the tables of characters of these fonts) are usually quite different. For example the Macintosh encoding on page 36 and the TEX/METAFONT encodings such as the `T1` font encoding on page 32 or the TeX Base 1 encoding on page 33 are definitely different.

4.2.8 Font reencoding, `.enc` files

To cope with the different encodings, OzTEX is to be instructed to map the TEX/TFM `ffff` font in the `.dvi` file to the Macintosh screen font, as specified in the `.enc` encoding file (such as `MacT1.enc` or `Mac8r.enc` or "nil" if the TFM file and screen font use the same encoding).

OzTEX looks for `.enc` files as stated by the configuration variable `enc_folders`. Its initial value in the `:TeX:Configs:Default` file is:

```
enc_folders = :TeX:Encodings:
```

For example, for the `T1` encoding, we have seen in Sec. 4.1 that the Macintosh code/slot for the keyboard key $<$ is 220 and $t1enc(applemac(220)) = 60$. The file `:TeX:Encodings:MacT1.enc` defines no reencoding for code/slot 60 whence the mapping is $MacT1(60) = 60$. It follows that the character displayed on the screen has Macintosh extended ASCII code $MacT1(t1enc(applemac(220))) = 60$ so this character is $<$ (as shown in the layout of page 37).

Let us consider another example where $MacT1(c) \neq c$. The file `MacT1.enc` contains:

```
...
29 223 /fl
30 "?" /ffi         no Mac equivalent
...
```

whence *MacT1* (29) = 223 (the case *MacT1* (30) = `"?"` is considered in next Sec. 4.2.9). Observe that the ligature[6,7] "fl" has decimal code/slot 29 in the `T1` TEX encoding and 223 (i.e. `"DF` in hexadecimal) in the Macintosh Roman extended ASCII encoding, as shown by the glyph/character encoding tables on pages 36 and 37. So the character displayed on screen has code *MacT1* (29) = 223 whence is "fl".

4.2.9 Approximation of absent screen glyphs

Sometimes a PostScript glyph has no screen equivalent so that it cannot be conveniently rendered on the screen.

This is the case of the ligature ffi which is rendered as "fi " on screen whereas it should be something like "ffi" (which indeed has to be typed as "`{f}fi`" or even "`\mbox{f}fi`" to bypass the missing TEX ligature "`ffi`" rendered "fi " on screen!).

Observe that on screen, the `MacT1.enc` reencoding file replaces the missing ligature "ffi" (of code/slot 30 in the `T1` encoding) by a question mark "?" while the `Mac8r.enc` reencoding file replaces the missing ligature "ffi" (of code/slot 20 i.e. octal `'024` in the TeX Base 1 encoding) by ligature "fi" with Macintosh keyboard/screen code/slot 222 (i.e. hexadecimal `"DE`). So the two reencoding files provide different screen renderings of the same TEX glyph "ffi".

In that case a PostScript printer will provide the authentic glyph since it exists in the PostScript font.

4.2.10 Checking which screen font specification is used by OzTEX

In case of doubt, the screen font specification which is used by OzTEX can by displayed by the "Config → Show → PostScript Fonts" menu. Again the printer font name is just indicative and does not influence which glyphs OzTEX is going to display on screen or print.

5 Which font glyphs OzTEX is going to print?

5.1 On a non-Postscript printer

Essentially OzTEX will reproduce the screen so none of this section Sec. 5 is needed. The font resolution for `.pk` files as determined by the parameters:

```
printing_resolution = 600          (in dots per inch)
printing_mode       = laserwriter  (used by MakeTeXPK in OzMF)
```

of OzTEX configuration files. In particular the missing glyphs will be approximated as explained in Sec. 4.2.9.

[6] Character *kerning* is the negative space added between a pair of characters that look too far away (such as AV instead of AV).

[7] With most machine-composed lead type, kerning was close to impossible whence the use of *ligatures*, i.e. fixed two- or three letter combinations on a single lead slug.

5.2 On a Postscript printer

OzTEX will ask `dvips` to print on a PostScript printer. It will pass to `dvips` the parameters specified by the value of OzTEX configuration variable `dvips_options` (initially empty `""`). For example the `:Local` configuration file will contain:

```
dvips_options = "-P600dpi"
```

to use a 600 dpi PostScript printer. This can also be typed in the command line when printing or made a default for `dvips` as explained in Sec. 6.4 below. The `printing_resolution` and `printing_mode` configuration variables are not used, see Sec. 6.3.

6 Which font glyphs `dvips` is going to print?

The behavior of `dvips` for printing is similar to that of OzTEX for screen display [3, Ch. 11.2]. Unless otherwise specified, the METAFONT fonts are used. The use of PostScript fonts must be explicitly specified.

6.1 PostScript font formats

The PostScript fonts are mainly in two formats:

Type 1 : resolution-independent outline fonts;

Type 3 : bitmapped fonts.

The Adobe Type 1 PostScript fonts come into three different formats:

LWFN : the Macintosh format, (with icon such as ), which is directly downloadable to PostScript printers;

.pfa : the "Printer Font ASCII" format (PC/Unix) which is directly downloadable to PostScript printers (including on the Macintosh);

.pfb : the "Printer Font Binary" format (PC/Unix) (which `dvips` will map to `.pfa` format before downloading to the PostScript printer).

The PostScript printing may be OK although the `LWFN` file is absent because it is preloaded in printers or `dvips` is instructed to use a `.pfa`/`.pfb` file. On the Macintosh, PostScript fonts are usually distributed with the corresponding screen fonts.

6.2 Creating PostScript `.pfa` font files

To create the `ffff.pfa` file, just use any drawing program to create a simple document that uses at least one character from the font with PostScript name `fontname`, then use any standard LaserWriter driver to print the document to a file called `ffff.pfa`, with all fonts included. Edit the file and delete all lines except those between "`%%BeginFont: fontname`" and the next "`%%EndFont`". However, when creating a PDF file, one can get:

```
%%[ Error: Chicago cannot be embedded due to licensing restrictions.]%%
```

6.3 Default font printing for TeX and METAFONT fonts

By default, `dvips` will use TEX fonts, calling OzMF if necessary, see Sec. 4. The only difference with OzTEX screen rendering is that `dvips` will use information in `:TeX:DVIPS:Inputs:config.ps` for the resolution and mode:

```
D 600
M ljfour
```

(which should be adapted to your printer resolution). The main advantage is that the screen and printer show exactly the same glyphs/characters since `dvips` translate the METAFONT `.pk` bitmap fonts into PostScript `type 3` bitmap fonts.

However if the printing is to a PostScript `.ps` file or to a "Portable Document Format" (`.pdf`) file (obtained by translation through MacGS 5.50 or Acrobat Distiller), the non scalable bitmap fonts look ugly at a different resolution (e.g. when zooming with Acrobat Reader). So PS type 1 fonts should always be preferred when available.

6.4 Specification of which PostScript printer fonts to use

When calling `dvips` for printing, OzTEX is going to pass to `dvips` the specification of which PostScript printer fonts to use. We first explain how OzTEX instructs `dvips` to find the font specification and then the form of this PostScript printer font specification.

6.4.1 Where `dvips` finds the printer font mapping specification?

There are different ways to instruct `dvips` to find the font specification:

1. Include the line:

   ```
   dvips_options = "$c -Pffff"
   ```

   in OzTEX configuration files to tell `dvips` to load `config.ffff`. Here `ffff` stands for the external typeface/font family short name (e.g. `CTAN/fonts/psfonts/adobe/helvetic/dvips/config.phv` for Helvetica[8]) or any other user chosen name (such as e.g. `CMPS` for printing Computer Modern using the $\mathcal{AMS}$ (American Mathematical Society)/BlueSky PostScript fonts). Then `dvips` will look for a file `config.ffff` containing usually one single line:

   ```
   p +psfonts.ffff
   ```

   pointing to the file `psfonts.ffff` finally containing the specification of the font to be printed. On `CTAN`, `config.ffff` has generally the form:

   ```
   p +ffff.map
   ```

   so that `ffff.map` contains the font specification[9]. `dvips` is looking for these `config.ffff` and `psfonts.ffff` (or `ffff.map`) files in the list of folders

[8] If the file is downloaded from `CTAN`, the text editor `Alpha` or the Odd Jobs's Joblet "Mac Text" should be used to convert from a Unix to a Macintosh file format since otherwise `dvips` will only read the first line.

[9] Again, if `ffff.map` is downloaded from `CTAN`, the text editor `Alpha` or the Odd Jobs's Joblet "Mac Text" should be used to convert from a Unix to a Macintosh file format since otherwise `dvips` will only read the first line. Check also that the last line is complete (with a return).

specified by the configuration variable `ps_folders`, which is initially set up in the `:TeX:Configs:Default` file:

```
ps_folders = :TeX:DVIPS:Inputs: :TeX:PS: $f
```

where `$f` denotes the `Font` subfolder of the `System Folder`;

2. Another solution is to type `-Pffff -P600dpi` in the command line each time when printing;

3. One can also add the `p +psfonts.ffff` line in the standard `:TeX:DVIPS:Inputs:config.ps` file loaded by `dvips`;

4. The last solution is to directly include the font specification in the `:TeX:DVIPS:Inputs:psfonts.map` file loaded by `config.ps`.

6.4.2 `dvips` printer font mapping specification

Knowing how OzTEX instructs `.dvi` where to find the printer font specifications, we explain the specification. For our Helvetica example, the printer font mapping specification will be:

```
*TFM     Printer font          Reencoding
 phvr8t  Helvetica             " ECEncoding ReEncodeFont " <EC.enc
 phvb8t  Helvetica-Bold        " ECEncoding ReEncodeFont " <EC.enc
 phvro8t Helvetica-Oblique     " ECEncoding ReEncodeFont " <EC.enc
 phvbo8t Helvetica-BoldOblique " ECEncoding ReEncodeFont " <EC.enc
```

The TEX/TFM font names (`phvr8t`, etc) should be the same as those provided for the screen fonts. The corresponding PostScript font name is given (Helvetica, etc). Moreover, the PostScript interpreter is instructed to reencode the font using a mapping given by an array obtained by loading the file `EC.enc` in the head of the PostScript job [10]. The `EC.enc` file contains:

```
/ECEncoding [
...
/fl  % 29
/ffi % 30
...
] def
```

so that the ligatures "fl" for fl of TEX/TFM code/slot 29 and "ffi" for ffi of TEX/TFM code/slot 30 will be mapped to the corresponding PostScript glyphs of respective symbolic codes `/fl` and `/ffi`.

6.4.3 Including nonresident/nonstandard PostScript fonts

If you produce a PostScript `.ps` file with OzTEX using nonresident/nonstandard PostScript fonts, this file may not be printable on installations where these fonts are not available. The solution is to ask `dvips` to explicitly include the font files in its PostScript output file, as follows:

[10] `dvips` recognizes reencoding files by the `.enc` suffix or using "<[" instead of "<' to tell `dvips` that the following file name is an encoding file.

```
*TFM     Printer font          <Font file   Reencoding
 phvr8t  Helvetica             <Helve       "ECEncoding ReEncodeFont " <EC.enc
 phvb8t  Helvetica-Bold        <HelveBol    "ECEncoding ReEncodeFont " <EC.enc
 phvro8t Helvetica-Oblique     <HelveObl    "ECEncoding ReEncodeFont " <EC.enc
 phvbo8t Helvetica-BoldOblique <HelveBolObl "ECEncoding ReEncodeFont " <EC.enc
```

The PostScript fonts files such as (such as  above) are looked for by `dvips` in the list of folders specified by the configuration variable `ps_folders`. It is initialized according to `:TeX:Configs:Default` file as follows:

```
ps_folders = :TeX:DVIPS:Inputs: :TeX:PS: $f
```

Since `$f` denotes the `Font` subfolder of the `System Folder`, the PostScript font files can be placed there.

6.4.4 Including `.pfa` or `.pfb` files

The `.pfa` or `.pfb` files can be used instead when the `LWFN` format is not available (see Sec. 6.1). For example in `CTAN/fonts/psfonts/adobe/minion/dvips/config.pmn`, one can find:

```
p +pmn.map
```

invoked by the printing command line "`-Ppmn`" and referring to `CTAN/fonts/psfonts/adobe/minion/dvips/pmn.map` which specifies the file to be loaded by the printer for the PostScript fonts:

```
pmnb8r Minion-Bold "TeXBase1Encoding ReEncodeFont" <Mac8r.enc <pmnb8a.pfb
...
```

However the Minion font is not public domain so neither `pmnb8a.pfa` nor `pmnb8a.pfb` is freely available.

7 Font substitution

When a font is absent, it can be replaced by another. This can be done by LaTeX (see e.g. `t1ppl.fd`):

```
\DeclareFontShape{T1}{ppl}{b}{sl}{<-> pplbo8t}{}
\DeclareFontShape{T1}{ppl}{bx}{sl}{<->ssub * ppl/b/sl}{}
```

and/or with the external font:

```
pplbo8r Palatino-Bold " .167 SlantFont TeXBase1Encoding ReEncodeFont "<8r.enc
```

The LaTeX substitutions are traced in the `.log` file.

Font substitution can also be done by the screen font mapping specification of Sec. 4.2.5 and the printer font mapping specification of Sec. 6.4.2. The last and better way is to use TeX virtual fonts.

8 TEX virtual fonts

8.1 .vf files

TEX has also virtual font (`.vf`) files which describe fonts that exists in a logical sense but not a physical sense [6]. `.vpl` files are TEX 'property lists' (human readable) format of a `.vf` file. OzTEX (for screen) and **dvips** (for printing) use the `.vf` files to map the virtual fonts to actual fonts. The actual characters can be shifted and/or magnified and/or combined with other characters from many different fonts. A virtual font can even make use of characters from virtual fonts, including itself.

The `.vf` files are found by OzTEX and **dvips** in the folders specified by the configuration variable `vf_folders`. Its initial value is assigned by **:TeX:Configs: Default** as follows:

```
vf_folders = :TeX:VF:
```

8.2 Which actual fonts are used?

Virtual font files **ffff.vf** come with two corresponding **ffff.tfm** and **rffff.tfm** files. The virtual font **ffff.vf** file allows the virtual font **ffff.tfm** to indirectly reference the actual or "raw" font **rffff.tfm**.

The virtual font is referenced by LATEX in `\fontfamily{ffff}\selectfont` commands so that TEX will use the **ffff.tfm** file (so that OzTEX must have its **tfm_folders** configuration variable properly set, see Sec. 1.5).

OzTEX (for screen) and **dvips** (for printer) are in charge of looking for the actual glyphs to be used for glyphs of font **ffff.tfm** in `.dvi` files. If necessary the **ffff.vf** file will be used to map the virtual glyphs of **ffff.tfm** to the actual/"raw" glyphs of **rffff.tfm**.

The recursive search of the actual glyph to be displayed/printed is as follows:

1. search for an explicit font mapping specification for **ffff.tfm** (as given in Sec. 4.2.5 for screen display and 6.4.2 for printing, in which case the font is said to be *resident*);

2. else, check for the presence of file **ffff.vf** showing that the font **ffff.tfm** is virtual. Then use **ffff.vf** to map **ffff.tfm** glyphs into **rffff.tfm** ones. Then recursively search for the actual glyph in **rffff.tfm** (which may itself be virtual);

3. else, search for a **ffff_.pk** file (so that if OzTEX does not find file **ffff.vf**, OzMF will be automatically launched).

So, if the font **ffff.tfm** is resident it should appear in the OzTEX and **dvips** configuration file's lists of fonts (between **add_fonts** and **end_fonts**) whereas if the font **ffff.tfm** is virtual, it should <u>not</u> (and neither the virtual font files **ffff.vf**); Only the raw font **rffff.tfm** will appear at the termination level of the recursion.

The option `-d70` allows to tracks the files and (virtual) fonts used by **dvips** (`-d70` or `-d-1` should appear first in the list of **dvips** options since otherwise the options appearing before will not be traced).

The main advantages of virtual fonts are that the mapping of **ffff.tfm** is not necessarily to a unique "raw" font, the ability to design the virtual font from existing ones (e.g. define ligatures, compose new glyphs from existing ones) and the possibility of recursion. More details are given in OzMF "Help → Knuth on VFs" (or `CTAN/info/virtual-fonts.knuth`).

8.3 PostScript virtual fonts

There are three ways of using PostScript fonts `ffff` with their own TeX Base 1/`8r` encoding (see page 33) and to let believe to TEX that they have the TEX encoding e.g. `8t`/`T1`:

1. ask the PostScript interpreter to use a reencoding vector;
2. use virtual fonts;
3. combine the previous methods.

8.4 Example of PostScript virtual font

8.4.1 The TEX virtual font

Let us consider an example given in `CTAN/fonts/psfonts/adobe/times/`. The problem is to typeset the left french "guillemet" (that is "«") with the Adobe PostScript Times bold italic font in `T1` encoding. The `.tex` input/source is:

```
{\fontencoding{T1}\fontfamily{ptm}\fontseries{b}\fontshape{it}\selectfont «}
```

Typing « in the source ("Option-7" on french Macintosh keyboards) enters the glyph with hexadecimal code/slot `"C7` = 199 in the `.tex` source. Because of the declaration `\usepackage[applemac]{inputenc}`, this is reencoded as `\guillemotleft`:

```
...
\DeclareInputText{199}{\guillemotleft}
...
```

The `\usepackage[T1]{fontenc}` declaration instructs TEX to reencode `\guillemotleft` as the glyph with TEX/TFM code/slot 19, as stated in `t1.enc` :

```
...
\DeclareTextSymbol{\guillemotleft}{T1}{19}
...
```

The `\fontencoding{T1}\fontfamily{ptm}\selectfont` command instructs TEX to get the necessary information about the font to be used in the `.tfm` file specified by the `CTAN/fonts/psfonts/adobe/times/tex/t1ptm.fd` file (`:TeX:Inputs:LaTeX:psnfss:t1ptm.fd` in OzTEX distribution). This file indicates that the external font to be selected is `ptmbi8t` (`ptmbi7t` for `OT1` encoding):

```
\DeclareFontShape{T1}{ptm}{b}{it}{<-> ptmbi8t}{}
```

So TEX considers that "«" is described as glyph 19 = `'023` = `"13` of `ptmbi8t.tfm`. This information will be recorded in the `.dvi` file for that glyph.

8.4.2 OzTEX screen display

For screen displaying of this `.dvi` file, OzTEX is instructed as follows:

```
% TFM     Printer font       Screen font  Encoding    Style
ptmbi8r   Times-BoldItalic   Times        Mac8r.enc   bi
```

Since `ptmbi8t` is not in this list, the file `ptmbi8t.vf` has to be used. Using OzMF "VFtoVP. . . ", we get the corresponding `ptmbi8t.vp` file where, for glyph 19 (octal `'023`), we can read that:

```
    ...
(MAPFONT D 0
   (FONTNAME ptmbi8r)
   ...
   )
...
(CHARACTER O 23
   (CHARWD R 0.5)
   (CHARHT R 0.406995)
   (CHARDP R -0.031995)
   (MAP
      (SETCHAR O 253)
      )
   )
```

so the glyph of code/slot 19 in `ptmbi8t` is mapped to the glyph of code `'253` = `"AB` = 171 in `ptmbi8r`. OzTEX recursively looks for glyph 171 of the `ptmbi8r` font (so called raw font) which, according to the given instructions:

```
% TFM     Printer font       Screen font  Encoding    Style
ptmbi8r   Times-BoldItalic   Times        Mac8r.enc   bi
```

is directly mapped to the screen font Times in bold italic style. OzTEX is instructed to reencode with file `Mac8r.enc`. The `:TeX:Encodings:Mac8r.enc` file contains:

```
...
\253 $C7     /guillemotleft
...
```

So the glyph of octal code/slot `\253` is mapped to the Times character of Macintosh Roman screen / Apple Standard Encoding hexadecimal code `"C7` = 199, which, as shown by the layout table of page 36, is precisely "«".

Observe that the Macintosh keyboard directly enters the screen code/slot 199 in the `.tex` input/source file but we have gone through the reencodings:

$$
\begin{aligned}
& \mathit{Mac8r.enc}(\mathit{ptmbi8t.vf}(\mathit{t1enc}(\mathit{applemac}(199)))) \\
= \;& \mathit{Mac8r.enc}(\mathit{ptmbi8t.vf}(\mathit{t1enc}(\texttt{\textbackslash guillemotleft}))) \\
= \;& \mathit{Mac8r.enc}(\mathit{ptmbi8t.vf}(19)) \\
= \;& \mathit{Mac8r.enc}(171) \\
= \;& 199
\end{aligned}
$$

to get it on screen. This is the price for TEX to be device independence.

Observe that having the Macintosh character "«" in the TEX input makes it not portable. However, using only ASCII characters we could have written the portable:

```
{\fontencoding{T1}\fontfamily{ptm}\fontseries{b}\fontshape{it}\selectfont
\guillemotleft}
```

which has exactly the same effect "«".

8.4.3 `dvips` PostScript printing

For printing, the file `CTAN/fonts/psfonts/adobe/times/tex/dvips/ptm.map` can be used to instruct `dvips` on where to find the raw font for printing:

```
ptmbi8r Times-BoldItalic "TeXBase1Encoding ReEncodeFont " <8r.enc
```

The same way, `dvips` will use `ptmbi8t.vf` to map the input glyph 19 described by `ptmbi8t.tfm` to glyph `'253` = `"AB` = 171 of `ptmbi8r.tfm`. The glyph is reencoded with `/TeXBase1Encoding` defined in file `CTAN/fonts/psfonts/tools/8r.enc` (OzTEX `:TeX:DVIPS:Inputs:8r.enc`):

```
/TeXBase1Encoding [
...
% 0xA0
 /.notdef % nobreakspace
 /exclamdown /cent /sterling
 /currency /yen /brokenbar /section
 /dieresis /copyright /ordfeminine /guillemotleft
 /logicalnot
 /hyphen % Y&Y (also at 45); Windows' softhyphen
 /registered
 /macron
 ...
] def
```

During printing, the PostScript interpreter will map `"AB` to the PostScript glyph `/guillemotleft` whence print «.

For the PostScript interpreter, the reencoding of the input character « will be:

$$
\begin{aligned}
& \mathit{TeXBase1Encoding}(\mathit{ptmbi8t.vf}(\mathit{t1enc}(\mathit{applemac}(199)))) \\
= \; & \mathit{TeXBase1Encoding}(\mathit{ptmbi8t.vf}(\mathit{t1enc}(\texttt{\textbackslash guillemotleft}))) \\
= \; & \mathit{TeXBase1Encoding}(\mathit{ptmbi8t.vf}(19)) \\
= \; & \mathit{TeXBase1Encoding}(171) \\
= \; & /\texttt{guillemotleft}
\end{aligned}
$$

(where `/guillemotleft` has some code internal to PostScript).

9 Using the Utopia PostScript fonts

This section is a recapitulation using a final example. *Possible errors are given in italic.* More details (in particular for `LY1` encoding) are given at P. Alejandro López-Valencia's site http://sue.ideam.gov.co/alejolo/freefonts/.

9.1 The user view

Let us consider the use of the Utopia PostScript fonts in `T1` encoding with OzTeX. Utopia is an Adobe Originals text face designed by Robert Slimbach in 1989. To use Utopia fonts as the document default fonts we just insert a declaration:

```
\usepackage{utopia}
```

in the preamble. For an occasional use of the Adobe Utopia fonts in the document, we define a LaTeX command `\utopia`:

```
\newcommand{\utopia}{\fontencoding{T1}\fontfamily{put}\selectfont}
```

so that the command `\utopia` will change the current font to the `put` font (`p` (PostScript/Adobe Systems, Inc.), `ut` (Utopia)). The scope of this command can be limited by brackets. Here is an example of text in Utopia font, *including italic,* **bold** and ***bold italic*** with `T1` encoding.

9.2 The LaTeX view

To determine which external font is used, LaTeX loads the `:TeX:Inputs:LaTeX:psnfss:t1put.fd` file. *If this file were absent, a LaTeX message would say:*

```
LaTeX Font Warning: Font shape `T1/put/m/n' undefined
(Font)              using `T1/cmr/m/n' instead on input line 45.
```

The `:TeX:Inputs:LaTeX:psnfss:t1put.fd` file establishes the correspondence between the LaTeX font selection mechanism and the external fonts, for example:

```
\DeclareFontFamily{T1}{put}{}
\DeclareFontShape{T1}{put}{m}{n}{<-> putr8t}{}
```

TeX will use the `putr8t.tfm` file to determine how the glyphs corresponding to input codes (obtained may be after a number of macro-expansions) should be placed on the page in the `.dvi` output file. *If this `:TeX:TFM:PS:putr8t.tfm` file were absent from OzTeX distribution, TeX would complain:*

```
! Font T1/put/m/n/10=putr8t at 10.0pt not loadable: Metric (TFM) file not found
```

If none of these files is absent, the `.tex` source will typeset into a `.dvi` file where glyphs are represented by an external font name and a code/slot. This is completely independent of the external fonts rendering on screen and in print.

9.3 The screen view

For screen previewing OzTeX will use font specifications as given by the OzTeX "Config → Show → PostScript Fonts" menu. Since it contains no specification for `putr8t.tfm`, OzTeX will look for the existence of a file `putr8t.vf` in a folder given by the value of the configuration variable `vf_folders` (by default this is `TeX:VF:PS:`, which can be checked using the OzTeX "Config → Show → Files and Folders" menu). *If OzTeX were unable to find this file (because it is missing or it is in a folder not mentioned in the `vf_folders` list), then OzTeX would ask OzMF for a bitmap and we would get the error:*

```
This is METAFONT, Version 2.7182
**&MakeTeXPK \mode:=laserwriter;mag:=magstep(0.0);scrollmode;input putr8t
```

```
! I can't find file 'putr8t'.
<*> ...r;mag:=magstep(0.0);scrollmode;input putr8t

Please type another input file name:
```

Fortunately, the file `:TeX:VF:PS:putr8t.vf` is in the OzTEX distribution. It instructs OzTEX to map the `putr8t` into `putr8r` (for all glyphs although in general each glyph of `putr8t` could be mapped to a different font and code/slot). So OzTEX restarts the same external font search process for `putr8r`. This time the following font specification is given in the `:TeX:Configs:Default` configuration file:

```
putb8r   Utopia-Bold         Utopia  Mac8r.enc  b
putbi8r  Utopia-BoldItalic   Utopia  Mac8r.enc  bi
putbo8r  Utopia-Bold         Utopia  Mac8r.enc  bi
putr8r   Utopia-Regular      Utopia  Mac8r.enc
putri8r  Utopia-Italic       Utopia  Mac8r.enc  i
putro8r  Utopia-Regular      Utopia  Mac8r.enc  i
```

The information is that the screen font is Utopia and the code/slot of the glyphs must be mapped to a maybe different code/slot as given by file `Mac8r.enc`. This file is available to OzTEX (it is `:TeX:Encodings:Mac8r.enc`). *Otherwise OzTEX would have complained e.g. at start-up when loading the `:TeX:Configs:Default` configuration file. The only thing that can happen is that we have no* Utopia *font on the Macintosh. In that case, OzTEX will open a window claiming that it "`Could not find screen font: Utopia`". The* Utopia *text will appear in red on the screen. At that point we might:*

- *Be happy with that, knowing that everything will go well in print on a PostScript printer;*
- *Load the font on the web e.g. at P. Alejandro López-Valencia's site:*

  http://sue.ideam.gov.co/alejolo/freefonts/utopia-x11.hqx;
- *Replace the* Utopia *font on screen (but not in print) by some other font like* Times*. To do so, we add to the `:Local` configuration file:*

  ```
  add_fonts
  putb8r   Utopia-Bold         Times  Mac8r.enc  b
  putbi8r  Utopia-BoldItalic   Times  Mac8r.enc  bi
  putbo8r  Utopia-Bold         Times  Mac8r.enc  bi
  putr8r   Utopia-Regular      Times  Mac8r.enc
  putri8r  Utopia-Italic       Times  Mac8r.enc  i
  putro8r  Utopia-Regular      Times  Mac8r.enc  i
  end_fonts
  ```

  and load `:TeX:Configs:Default` (by pressing "Command-D" or choosing OzTEX "Config → Default" menu). Since OzTEX always loads `:Local` just after `:TeX:Configs:Default`, the local specification is taken into account while the default specification is always overwritten (so no modification of `:TeX:Configs:Default` is needed).

Pressing "Command-I" in the `.dvi` window will show the virtual font mechanism (*Whether the* Utopia *screen font is used or it is replaced by* Times):

```
Fonts (if used on current page then total chars given):
:TeX:TFM:PS:putb8r.tfm at 10pt        total chars = 4
:TeX:TFM:PS:putbi8r.tfm at 10pt       total chars = 10
:TeX:TFM:PS:putri8r.tfm at 10pt       total chars = 16
:TeX:TFM:PS:putr8r.tfm at 10pt        total chars = 52
...
Fonts used on current page = 9

Virtual fonts:
:TeX:VF:PS:putbi8t.vf at 10pt         used on current page
:TeX:VF:PS:putb8t.vf at 10pt          used on current page
:TeX:VF:PS:putri8t.vf at 10pt         used on current page
:TeX:VF:PS:putr8t.vf at 10pt          used on current page
```

The actual fonts which are used are given by OzTEX "Config → Show → PostScript Fonts" menu.

9.4 The printer view

For a QuickDraw (non-PostScript) printer, the printing process is similar to the screen display process (but, may be, for the use of more precise True Type fonts instead of bitmapped fonts). In particular we may have to pay attention to the possibly missing glyphs *and the possible replacement of the missing* **Utopia** *screen font by* Times *which will also be performed on a QuickDraw printer.*

If we have a PostScript printer, OzTEX will instruct `dvips` to print. *This may fail for several reasons whereas screen fonts were OK. This is because the screen display and printing are two completely different processes. However, from TEX point of view, they are the same, in particular with respect to the virtual font mechanism.*

Since the Utopia font is not resident on most printers, we can check that `dvips` loads the proper fonts to the printer before printing (excerpts):

```
' TeX output 1999.08.10:0041' -> printer
<tex.pro><8r.enc><texps.pro>. <putbi.pfa><putb.pfa><putri.pfa><putr.pfa>[1]
```

These files are available in the OzTEX distribution in folder `:TeX:PS:`. `dvips` uses the same external font search mechanism as for the screen and this can be traced with the `-d70` printing option; `dvips` looks whether `putr8t` is resident, it is not, so `dvips` looks for a `putr8t.vf` file, finds it and remaps to `putr8r` which now is a resident font:

```
This is dvips 5.83 Copyright 1998 Radical Eye Software (www.radicaleye.com)
Input file: Utopia.dvi
Options: -p=1 -l=1 -M0 -T210mm,297mm -P600dpi -d70
...
search: Trying to open psfonts.map
<:TeX:DVIPS:Inputs:psfonts.map(r)> succeeded
...
Defining font () putr8t at 10.0pt
search: Trying to open putr8t.vf
<:TeX:VF:PS:putr8t.vf(r)> succeeded
Loading virtual font putr8t.vf at 10.0pt
Defining font () putr8r at 10.0pt
...
```

```
Font putr8r <Utopia-Regular> is resident.
search: Trying to open :TeX:DVIPS:Inputs:8r.enc
<:TeX:DVIPS:Inputs:8r.enc(r)> succeeded
...
search: Trying to open :TeX:PS:putr.pfa
<:TeX:PS:putr.pfa(r)> succeeded
<putr.pfa>[1]
```

For the Utopia example, `dvips` will find the list of resident fonts which is given in the `:TeX:DVIPS:Inputs:psfonts.map` file as follows:

```
putb8r  Utopia-Bold "TeXBase1Encoding ReEncodeFont" <8r.enc <putb.pfa
putbi8r Utopia-BoldItalic "TeXBase1Encoding ReEncodeFont" <8r.enc <putbi.pfa
putr8r  Utopia-Regular "TeXBase1Encoding ReEncodeFont" <8r.enc <putr.pfa
putri8r Utopia-Italic "TeXBase1Encoding ReEncodeFont" <8r.enc <putri.pfa
putbo8r Utopia-Bold " .167 SlantFont TeXBase1Encoding ReEncodeFont " <8r.enc <putb.pfa
putro8r Utopia-Regular " .167 SlantFont TeXBase1Encoding ReEncodeFont " <8r.enc <putr.pfa
```

One thing that might go wrong is that we tell `dvips` to print on a 300 dpi printer (which is the OzTEX default assumption) whereas we have e.g. a 600 dpi printer. The output comes out enlarged four times. This can be corrected in the `:Local` file as follows:

```
dvips_options = "-P600dpi"
```

`dvips` might also not be able to find the required files (and e.g. call OzMF or claim "`! Couldn't find header file 8r.enc`") in which case the `ps_folders` might have to be adjusted (its value can be checked using OzTEX "Config → Show → Files and Folders" menu).

10 Installing a nonstandard PostScript font

In order to illustrate the installation of a nonstandard PostScript font we will use Utopia again but assuming nothing is given with OzTEX distribution. We also require not to modify the default and local configuration files and to place all necessary files in a local `:myTex:Fonts:utopia` folder (but for the screen fonts going to the `Fonts` subfolder of the `System Folder` when neither `ATM Deluxe` nor any equivalent screen rasterizer is available).

First we download the `CTAN/fonts/psfonts/adobe/utopia/` folder into `:myTex:Fonts:utopia`. It contains four subfolders `dvips`, `tex`, `tfm` and `vf` to which we add two new `PS` and `Configs` folders. Then the fonts can be downloaded at P. Alejandro López-Valencia's site:

http://sue.ideam.gov.co/alejolo/freefonts/utopia-x11.hqx.

Unpacking yields a folder `Utopia PS1 & TT v2.1 ƒ`. The True Type `Utopia (TT).fam` and screen bitmap `Utopia (PS1).fam` font folders/suitcases are moved to the `Fonts` subfolder of the `System Folder` (or are made accessible to ATM Deluxe). The PostScript fonts `UtopiBol`, `UtopiBolIta`, `UtopiIta` and `UtopiReg` are moved to `:myTex:Fonts:utopia:PS:` (or to the `Fonts` subfolder of the `System Folder`). Then `Utopia PS1 & TT v2.1 ƒ` can be trashed. One can also download:

http://sue.ideam.gov.co/alejolo/freefonts/utopia-metrics.hqx.

This file unpacks into `utopia metrics`. It contains improved `.tfm` files so we replace the content of `:myTex:Fonts:utopia:tfm:` by that of `utopia metrics:puttf:`. Now `utopia metrics` can be trashed.

For OzTEX screen fonts, one creates a new file `:myTex:Fonts:utopia:Configs:Add Utopia Fonts`, including the location of files, the screen font specification and instructions for `dvips`, as follows:

```
current_app = OzTeX
input_folders = :myTex:Fonts:utopia:tex: $c
tfm_folders   = :myTex:Fonts:utopia:tfm: $c
vf_folders    = :myTex:Fonts:utopia:vf: $c
dvips_options = "$c -Pput"
ps_folders    = :myTex:Fonts:utopia:dvips: |
                :myTex:Fonts:utopia:PS: $c
add_fonts
putb8r   Utopia-Bold        Utopia  Mac8r.enc  b
putbi8r  Utopia-BoldItalic  Utopia  Mac8r.enc  bi
putbo8r  Utopia-Bold        Utopia  Mac8r.enc  bi
putr8r   Utopia-Regular     Utopia  Mac8r.enc
putri8r  Utopia-Italic      Utopia  Mac8r.enc  i
putro8r  Utopia-Regular     Utopia  Mac8r.enc  i
end_fonts
```

For a casual use of the Utopia fonts, the `Add Utopia Fonts` configuration file can be loaded manually using the OzTEX "Config → Load Config..." menu. The loading of the `Add Utopia Fonts` configuration file can also be automatized by including in the `.tex` source folder the following `LaTeX.config` file:

```
load_config = ":myTeX:Fonts:utopia:Configs:Add Utopia Fonts"
```

as well as a first line:

%&`LaTeX`

in the `.tex` source file.

For the printer fonts, the `-Pput` option of `dvips_options` loads `config.put` (changed with the text editor `Alpha` from a Unix to a Macintosh text file [11]) which in turn loads `:myTeX:Fonts:charter:dvips:put.map`. Since `put.map` uses the `.pfb` file format, it can be changed as follows for the Macintosh `LWFN` format [12]:

```
putb8r  Utopia-Bold <UtopiBol "TeXBase1Encoding ReEncodeFont" <8r.enc
putbi8r Utopia-BoldItalic <UtopiBolIta "TeXBase1Encoding ReEncodeFont" <8r.enc
putr8r  Utopia-Regular <UtopiReg "TeXBase1Encoding ReEncodeFont" <8r.enc
putri8r Utopia-Italic <UtopiIta "TeXBase1Encoding ReEncodeFont" <8r.enc
putbo8r Utopia-Bold <UtopiBol " .167 SlantFont TeXBase1Encoding ReEncodeFont " <8r.enc
putro8r Utopia-Regular <UtopiReg " .167 SlantFont TeXBase1Encoding ReEncodeFont " <8r.enc
```

To have this specification be taken into account by `dvips`, it is necessary to comment all lines relative to `putb8r`, ..., `putro8r` in `:TeX:DVIPS:Inputs:psfonts.map` which is loaded *after* `config.put` whence `put.map`.

(The above solution for installing fonts has the advantage of grouping all files relative to a font family (including the screen fonts when using ATM Deluxe)

[11] Otherwise `dvips` will only read the first line.

[12] The same way, the text editor `Alpha` must be used to change from a Unix to a Macintosh text file since otherwise `dvips` will only read the first line.

in a single folder. A more classical implementation consists in storing the `.tfm` files in a common `:myTex:tfm:` folder, the `.vf` files in `:myTex:vf:`, etc. The advantage of such an organization mimicking that of the OzTEX distribution, is that moving the various files in the appropriate folders avoids the need for adjusting the configuration files, which is needed anyway for screen fonts.)

11 Font encoding layouts

11.1 METAFONT “cm” layout at 12 pt in OT1 encoding

(The TEX text encoding is defined by vector `/CMTextEncoding` in the file `CTAN/fonts/utilities/vplutils/encodings/CMtext.enc` and `:TeX:Encodings:CMtext.enc`, see also the TEXbook [7], page 427.)

	´0	´1	´2	´3	´4	´5	´6	´7	
´00x	Γ	Δ	Θ	Λ	Ξ	Π	Σ	Υ	″0x
´01x	Φ	Ψ	Ω	ﬀ	ﬁ	ﬂ	ﬃ	ﬄ	
´02x	ı	ȷ	`	´	ˇ	˘	¯	˚	″1x
´03x	¸	ß	æ	œ	ø	Æ	Œ	Ø	
´04x	-	!	”	#	$	%	&	’	″2x
´05x	(	)	*	+	,	-	.	/	
´06x	0	1	2	3	4	5	6	7	″3x
´07x	8	9	:	;	¡	=	¿	?	
´10x	@	A	B	C	D	E	F	G	″4x
´11x	H	I	J	K	L	M	N	O	
´12x	P	Q	R	S	T	U	V	W	″5x
´13x	X	Y	Z	[	“	]	ˆ	˙	
´14x	‘	a	b	c	d	e	f	g	″6x
´15x	h	i	j	k	l	m	n	o	
´16x	p	q	r	s	t	u	v	w	″7x
´17x	x	y	z	–	—	˝	˜	¨	
	″8	″9	″A	″B	″C	″D	″E	″F	

11.2 METAFONT "ec" layout at 9 pt in T1 encoding

(The `T1`/EC/Cork encoding is defined by vector `/ECEncoding` in files `CTAN/fonts/utilities/vplutils/encodings/EC.enc` and `:TeX:DVIPS:Inputs:EC.enc`. See also `http://www.YandY.com/art/tex256.gif` on the Web)

	´0	´1	´2	´3	´4	´5	´6	´7	
´00x	`	´	ˆ	˜	¨	˝	˚	ˇ	˝0x
´01x	˘	¯	˙	¸	˛	‚	‹	›	
´02x	“	”	„	«	»	–	—		˝1x
´03x	₀	ı	ȷ	ff	fi	fl	ffi	ffl	
´04x	␣	!	"	#	$	%	&	’	˝2x
´05x	(	)	*	+	,	-	.	/	
´06x	0	1	2	3	4	5	6	7	˝3x
´07x	8	9	:	;	<	=	>	?	
´10x	@	A	B	C	D	E	F	G	˝4x
´11x	H	I	J	K	L	M	N	O	
´12x	P	Q	R	S	T	U	V	W	˝5x
´13x	X	Y	Z	[	\	]	ˆ	_	
´14x	‘	a	b	c	d	e	f	g	˝6x
´15x	h	i	j	k	l	m	n	o	
´16x	p	q	r	s	t	u	v	w	˝7x
´17x	x	y	z	{	|	}	˜	-	
´20x	Ă	Ą	Ć	Č	Ď	Ě	Ę	Ğ	˝8x
´21x	Ĺ	Ľ	Ł	Ń	Ň	Ŋ	Ő	Ŕ	
´22x	Ř	Ś	Š	Ş	Ť	Ţ	Ű	Ů	˝9x
´23x	Ÿ	Ź	Ž	Ż	Ĳ	İ	đ	§	
´24x	ă	ą	ć	č	ď	ě	ę	ğ	˝Ax
´25x	ĺ	ľ	ł	ń	ň	ŋ	ő	ŕ	
´26x	ř	ś	š	ş	ť	ţ	ű	ů	˝Bx
´27x	ÿ	ź	ž	ż	ĳ	¡	¿	£	
´30x	À	Á	Â	Ã	Ä	Å	Æ	Ç	˝Cx
´31x	È	É	Ê	Ë	Ì	Í	Î	Ï	
´32x	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	Œ	˝Dx
´33x	Ø	Ù	Ú	Û	Ü	Ý	Þ	SS	
´34x	à	á	â	ã	ä	å	æ	ç	˝Ex
´35x	è	é	ê	ë	ì	í	î	ï	
´36x	ð	ñ	ò	ó	ô	õ	ö	œ	˝Fx
´37x	ø	ù	ú	û	ü	ý	þ	ß	
	˝8	˝9	˝A	˝B	˝C	˝D	˝E	˝F	

11.3 TeX Base 1 Encoding

(The TeX Base 1 Encoding is defined in `CTAN/fonts/utilities/vplutils/encodings/8r.enc`, `CTAN/info/fontname/8r.enc`, `CTAN/fonts/psfonts/tools/8r.enc`, `CTAN/macros/latex/required/psnfss/8r.enc` and `:TeX:DVIPS:Inputs:8r.enc`. On the web, see also http://www.yandy.com/art/8r.gif.)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0		˙	ﬁ	ﬂ	⁄	˝	Ł	ł	˛	˚		˘	−		Ž	ž
1	ˇ	ı	ȷ	ﬀ	ﬃ	ﬄ									`	‘
2	␣	!	"	#	$	%	&	’	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	ˆ	_
6	‘	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	˜	
8			‚	ƒ	„	…	†	‡	ˆ	‰	Š	‹	Œ			
9		‘	’	“	”	•	–	—	˜	™	š	›	œ			Ÿ
A		¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬	-	®	¯
B	°	±	²	³	´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿
C	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
D	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
E	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
F	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ù	ú	û	ü	ý	þ	ÿ

11.4 TS1 encoding

(The TS1 encoding is described in CTAN/fonts/eco/src/TS1.etx. It is enabled by \usepackage{textcomp}.)

\capitalcedilla	¸	\capitalogonek	˛
\capitalgrave	`	\capitalacute	´
\capitalcircumflex	ˆ	\capitaltilde	˜
\capitaldieresis	¨	\capitalhungarumlaut	˝
\capitalring	˚	\capitalcaron	ˇ
\capitalbreve	˘	\capitalmacron	¯
\capitaldotaccent	˙	\t	⁀
\capitaltie	⁀	\newtie	⁀
\capitalnewtie	⁀	\textcapitalcompwordmark	
\textascendercompwordmark		\textquotestraightbase	'
\textquotestraightdblbase	"	\texttwelveudash	—
\textthreequartersemdash	—	\textleftarrow	←
\textrightarrow	→	\textblank	␢
\textdollar	$	\textquotesingle	'
\textasteriskcentered	∗	\textdblhyphen	⹀
\textfractionsolidus	⁄	\textzerooldstyle	0
\textoneoldstyle	1	\texttwooldstyle	2
\textthreeoldstyle	3	\textfouroldstyle	4
\textfiveoldstyle	5	\textsixoldstyle	6
\textsevenoldstyle	7	\texteightoldstyle	8
\textnineoldstyle	9	\textlangle	〈
\textminus	−	\textrangle	〉
\textmho	℧	\textbigcircle	◯
\textcircled	◯	\textohm	Ω
\textlbrackdbl	⟦	\textrbrackdbl	⟧
\textuparrow	↑	\textdownarrow	↓
\textasciigrave	`	\textborn	⋆
\textdivorced	⚮	\textdied	†
\textleaf	🍃	\textmarried	⚭
\textmusicalnote	♪	\texttildelow	˷
\textdblhyphenchar	⹀	\textasciibreve	˘
\textasciicaron	ˇ	\textacutedbl	˝
\textgravedbl	˵	\textdagger	†
\textdaggerdbl	‡	\textbardbl	‖
\textperthousand	‰	\textbullet	•
\textcelsius	℃	\textdollaroldstyle	$
\textcentoldstyle	¢	\textflorin	ƒ
\textcolonmonetary	₡	\textwon	₩
\textnaira	₦	\textguarani	₲
\textpeso	₱	\textlira	₤
\textrecipe	℞	\textinterrobang	‽
\textinterrobangdown	⸘	\textdong	₫
\texttrademark	™	\textpertenthousand	‱
\textpilcrow	¶	\textbaht	฿
\textnumero	№	\textdiscount	⁒
\textestimated	℮	\textopenbullet	◦
\textservicemark	℠	\textlquill	⁅
\textrquill	⁆	\textcent	¢
\textsterling	£	\textcurrency	¤
\textyen	¥	\textbrokenbar	¦
\textsection	§	\textasciidieresis	¨
\textcopyright	©	\textordfeminine	ª
\textcopyleft	🄯	\textlnot	¬
\textcircledP	℗	\textregistered	®
\textasciimacron	¯	\textdegree	°
\textpm	±	\texttwosuperior	^{2}
\textthreesuperior	^{3}	\textasciiacute	´
\textmu	µ	\textparagraph	¶
\textperiodcentered	·	\textreferencemark	※
\textonesuperior	^{1}	\textordmasculine	º
\textsurd	√	\textonequarter	¼
\textonehalf	½	\textthreequarters	¾
\texteuro	€	\texttimes	×
\textdiv	÷		

11.5 TeX'n ANSI Encoding

(The TeX'n ANSI encoding is defined by the array `/TeXnANSIEncoding` of file `TEXNANSI.ENC` (distributed by Y&Y) and `:Extras:Y&Y:LY1:encodings:dvips:TEXNANSI.ENC`. See also `http://www.yandy.com/art/texnansi.gif` on the web.)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0					/	˙	˝	˛	ﬂ			ﬀ	ﬁ	ﬂ	ﬃ	ﬄ
1	ı	ȷ	`	´	ˇ	˘	¯	˚	¸	ß	æ	œ	ø	Æ	Œ	Ø
2	␣	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	ˆ	_
6	‘	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	˜	¨
8	Ł	‘	‚	ƒ	„	…	†	‡	ˆ	0	Š	‹	Œ	Ž	ˆ	–
9	ł	‘	’	“	”	•	–	—	˜	™	š	›	œ	ž	˜	Ÿ
A	␣	¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬		®	¯
B	°	±	^{2}	^{3}	´	μ	¶	·	¸	^{1}	º	»	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	¿
C	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
D	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
E	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
F	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ù	ú	û	ü	ý	þ	ÿ

11.6 Macintosh Roman Encoding

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0																
1																
2	␣	!	"	#	$	%	&	‘	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	ˆ	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	˜	
8	Ä	Å	Ç	É	Ñ	Ö	Ü	á	à	â	ä	ã	å	ç	é	è
9	ê	ë	í	ì	î	ï	ñ	ó	ò	ô	ö	õ	ú	ù	û	ü
A	†	°	¢	£	§	•	¶	ß	®	©	™	´	¨	≠	Æ	Ø
B	∞	±	≤	≥	¥	µ	∂	∑	∏	π	∫	ª	º	Ω	æ	ø
C	¿	¡	¬	√	ƒ	≈	∆	«	»	…	␣	À	Ã	Õ	Œ	œ
D	–	—	“	”	‘	’	÷	◊	ÿ	Ÿ	⁄	¤	‹	›	ﬁ	ﬂ
E	‡	·	‚	„	0	Â	Ê	Á	Ë	È	Í	Î	Ï	Ì	Ó	Ô
F		Ò	Ú	Û	Ù	ı	ˆ	˜	¯	˘	˙	˚	¸	˝	˛	ˇ

The freeware `PopChar Lite 2.7.2` can be used to get the Macintosh code/slot of all screen glyphs. `PopChar Lite 2.7.2` can also be used to enter the glyphs directly in the `.tex` source if you do not know which are the corresponding keyboard keys, see http://infosoft.soft.uni-linz.ac.at/Info/MacSoftware.html.

11.7 PostScript “Avant Garde” layout at 9 pt in Adobe Standard Encoding

(The Adobe Standard Encoding[13] is defined in file `CTAN/info/fontname/8a.enc`.)

	´0	´1	´2	´3	´4	´5	´6	´7	
´00x		˙	ﬁ	ﬂ	⁄	˝	Ł	ł	˝0x
´01x	˛	˚		˘	−		Ž	ž	
´02x	ˇ	ı							˝1x
´03x							`	'	
´04x		!	"	#	$	%	&	’	˝2x
´05x	(	)	*	+	,	-	.	/	
´06x	0	1	2	3	4	5	6	7	˝3x
´07x	8	9	:	;	<	=	>	?	
´10x	@	A	B	C	D	E	F	G	˝4x
´11x	H	I	J	K	L	M	N	O	
´12x	P	Q	R	S	T	U	V	W	˝5x
´13x	X	Y	Z	[	\	]	^	_	
´14x	‘	a	b	c	d	e	f	g	˝6x
´15x	h	i	j	k	l	m	n	o	
´16x	p	q	r	s	t	u	v	w	˝7x
´17x	x	y	z	{	|	}	~		
´20x			‚	ƒ	„	…	†	‡	˝8x
´21x	ˆ	‰	Š	‹	Œ				
´22x				“	”	•	–	—	˝9x
´23x	˜	™	š	›	œ			Ÿ	
´24x		¡	¢	£	¤	¥	¦	§	˝Ax
´25x	¨	©	ª	«	¬	-	®	¯	
´26x	°	±	²	³	´	µ	¶	·	˝Bx
´27x	¸	¹	º	»	¼	½	¾	¿	
´30x	À	Á	Â	Ã	Ä	Å	Æ	Ç	˝Cx
´31x	È	É	Ê	Ë	Ì	Í	Î	Ï	
´32x	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	˝Dx
´33x	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß	
´34x	à	á	â	ã	ä	å	æ	ç	˝Ex
´35x	è	é	ê	ë	ì	í	î	ï	
´36x	ð	ñ	ò	ó	ô	õ	ö	÷	˝Fx
´37x	ø	ù	ú	û	ü	ý	þ	ÿ	
	˝8	˝9	˝A	˝B	˝C	˝D	˝E	˝F	

[13] `/Lslash` and `/lslash` are approximated on screen

11.8 ISO Latin 1 Encoding

(The ISO Latin 1 Encoding is defined by vector `/ISOLatin1Encoding` in the file `CTAN/fonts/utilities/vplutils/encodings/isolatin1.enc`.)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0																
1																
2	␣	!	"	#	$	%	&	’	(	)	*	+	,	−	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	ˆ	_
6	‘	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	˜	
8																
9	ı	`	´	ˆ	˜	¯	˘	˙	¨		˚	¸		˝	˛	ˇ
A	␣	¡	¢	£	¨	¥	¦	§	¨	©	ª	«	¬	-	®	¯
B	°	±	²	³	´	μ	¶	·	¸	¹	º	»	¼	½	¾	¿
C	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
D	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
E	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
F	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ù	ú	û	ü	ý	þ	ÿ

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