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# LaTeX Cheat Sheet

by Charlie Zender
University of California at Irvine

Department of Earth System Science
University of California
Irvine, CA 92697-3100

zender@uci.edu
Voice: (949) 824-2987
Fax: (949) 824-3256



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# 1 Introduction

> Just a box of rain—
> Wind and water—
> Believe it if you need it,
> if you don't just pass it on
>
> —
>
> *Box of Rain*
> Robert Hunter

Someone once said that the best way to learn a language was to speak it. This is my attempt to learn LATEX, one of the most challenging and useful languages ever devised. This section is devoted to introductory material and matters generic to typography. Section 2 describes LATEX installation and maintenance, Section 4 contains hints on using LATEX, Section 5 is devoted to text typography, Section 6 covers formatting mathematics.

`\foo` is undefined Incidentally, the first letter of the preceding paragraph was "dropped" by calling the `\bigdrop` macro defined by the dropcaps.sty package: `\bigdrop0pt3cmr10Someone`.... Another package capable of handling large first letters of paragraphs is the lettrine.sty package. Most of the documentation for lettrine appears to be in French, however.

# 2 LaTeX Installation

This section describes LaTeX installation, maintenance, and upgrades. Thanks to Thomas Esser for producing `tetex`, the TeX distribution that I use.

Many Olympian TeX and LaTeX gurus do not like the RedHat GNU/Linux installation. Apparently RedHat does not change the `tetex` defaults from their European settings. This may cause vertical margins to change in weird ways, e.g., in printouts but not in `ghostview`, or in `acroread` but not in `xdvi`. When this occurs the solution is to reconfigure TeX by running `texconfig` as root:

```
sudo texconfig dvips paper letter
sudo texconfig xdvi us
```

## 2.1 Personal Packages

The `TEXINPUTS` and `BIBINPUTS` environmental variables determine the TeX search path. These should be set in startup files, e.g., .bashrc:

```
export TEXINPUTS=".:${HOME}/tex//:${HOME}/crr//:${DATA}/ps//: \
        ${TEXMFDIR}/pdftex//:${TEXMFDIR}/tex//::"
export BIBINPUTS=".:${HOME}/tex//:${TEXMFDIR}/bibtex//::"
```

If these variables are not set then packages must be in the current directory or the default system search paths. The `::` activates the default system search paths. The `//` indicates that directories beneath the specified directory should be searched recursively. These symbolic links should not be necessary when `TEXINPUTS` contains `${HOME}/tex//`:

```
sudo ln -s ${HOME}/tex/ncarletter.cls ${HOME}/tex/cls/ncarletter.cls
sudo ln -s ${HOME}/tex/zenletter.cls ${HOME}/tex/cls/zenletter.cls
sudo ln -s ${HOME}/tex/bib.bib ${HOME}/tex/cls/bib.bib
sudo ln -s ${HOME}/tex/csz.sty ${HOME}/tex/cls/csz.sty
sudo ln -s ${HOME}/tex/jgr_abb.tex ${HOME}/tex/cls/jgr_abb.tex
sudo ln -s ${HOME}/tex/cls ${TEXMFDIR}/tex/latex/csz
sudo ln -s ${HOME}/tex/bst ${TEXMFDIR}/bibtex/bst/csz
sudo texhash
```

## 2.2 Hyphenation

Check to be sure hyphenation works when documents look poorly hyphenated Ubuntu teTeX upgrades have a habit of breaking hyphenation. The other symptom (besides bad hyphenation) is the header line "Babel ¡v3.8d¿ and hyphenation patterns for loaded". A list of languages should be between "for loaded". Somehow this file gets corrupted: These commands may help:

```
sudo mv /etc/texmf/language.d/00tetex.cnf /etc/texmf/language.d/10tetex.cnf
sudo update-language
sudo fmtutil-sys --all
```

# 3 Output Formats

Using LaTeX to produce PDF files is lots of fun. There is an entire NSF website devoted to this topic.

## 3.1 ps2pdf

The `ps2pdf` program converts complex Postscript files into PDF files. `ps2pdf` is the Ghostscript replacement for Adobe Distiller. A distiller killer, you might say. It is highly configurable; full details are available here.

```
ps2pdf -dMaxSubsetPct=100 -dCompatibilityLevel=1.2 -dSubsetFonts=true \
-dEmbedAllFonts=true -sAutoRotatePages=PageByPage \
-sColorConversionStrategy=LeaveColorUnchanged in.ps out.pdf
```

The `AutoRotatePages` and `ColorConversionStrategy` switches are important when converting slide presentations. The `EmbedAllFonts` option tells `ps2pdf` to embed all fonts in the output file. This makes the output file more portable.

The ghostscript command to convert Postscript into PDF was posted to `comp.text.tex` on 20040825:

```
gs -dSAFER -dNOPAUSE -dBATCH -sDEVICE=pdfwrite -sPAPERSIZE=letter \
-dPDFSETTINGS=/printer -dCompatibilityLevel=1.3 -dMaxSubsetPct=100 \
-dSubsetFonts=true -dEmbedAllFonts=true -sOutputFile=foo.pdf \
foo.ps
```

With `teTeX`, one can tell all `DVI` manipulators (including `pdftex`, `xdvi`, `dvips`) to embed fonts by using one command. The `updmap` command alters the font configuration files of all these programs under `teTeX`:

```
sudo updmap --setoption pdftexDownloadBase14 true
```

## 3.2 a2ps

The `a2ps` program converts text files to Postscript

```
a2ps --no-header fl.txt
a2ps --no-header fl.txt -o fl.ps
a2ps --columns=80 --font-size=12 --lines-per-page=52 --no-header fl.txt -o fl.ps
```

## 3.3 mpage

The `mpage` program combines multiple pages onto one page:

```
mpage -R -8 -Phplj5l ${DATA}/ps/ess_atm_lct_01.ps
mpage -R -8 ${DATA}/ps/ess_atm_lct_03.ps > ${DATA}/tmp/lct.ps
mpage -R -4 ${DATA}/ps/ess_atm_lct_01.ps > ${DATA}/tmp/lct.ps
gv ${DATA}/tmp/lct.ps &
```

## 3.4 ps2epsi

The `ps2epsi` program recomputes the minimal possible bounding box of Postscript and Enscapsulated postscript files.

```
ps2epsi foo.ps foo.eps
```

## 3.5 epsffit

The `epsffit` program permits rescaling bounding boxes Enscapsulated postscript files, as well as rotating them. The following doubles the natural size of an image with original bounding box = $[0, 0, 141, 510]$, and rotates the image by 90° counter-clockwise:

```
% cat foo.eps | epsffit -r 0 0 282 1020 > foo_90.eps
```

epsffit coordinate arguments are: [llx,lly,urx,ury] in Postscript units (points), i.e., [lower-left $x$, lower-left $y$, upper-right $x$, upper-right $y$].

## 3.6 Posters

Creating conference posters using LaTeX is not well documented. The a0poster package is designed to hold conference posters. `epssplit` can break up a poster into letter (or A4) sized pieces, which you can then put back together like a big jigsaw puzzle. First, though, you may need to turn your poster into an `EPS` file using ghostscript, `gs`:

```
gs -q -sDEVICE=epswrite -sOutputFile=${DATA}/ps/pst_ZNT03.eps -r600 -q - < ${DATA}/ps/ps
epssplit -o ${DATA}/ps/pst_ZNT03_mlt.ps -mar 2.5mm ${DATA}/ps/pst_ZNT03.eps
```

Use `psresize` to resize the poster to fit onto a single page. Default units are points, but either `cm` or `in` may be specified for centimeters or inches, respectively.

```
psresize -W1106 -H905 -w2728.575 -h3334.59 ${DATA}/ps/pst_ZNT03.ps ${DATA}/ps/pst_ZNT03_
psresize -Wwdt_in -Hhgt_in -wwdt_out -hhgt_out ${DATA}/ps/pst_ZNT03.ps ${DATA}/ps/pst_ZN
psresize -W60.0in -H40.0in -w11.00in -h8.5in ${DATA}/ps/pst_ZNT03.ps ${DATA}/ps/pst_ZNT0
```

Poster sizes should take advantage of common large format printer sizes. The most common printer widths are 36 and 42 inches. The UCI ImageWorks print shop ((949) 824-6414, Natural Sciences I, Room 2112) charges about $\$10 + \$12$ ft$^{-1}$ for 36 inch-wide posters, and $\$15 + \$15$ ft$^{-1}$ for 42 inch-wide posters.

## 3.7 dvips

The `dvips` program converts DVI files to Postscript files. It also helps generate other formats such as PDF.

```
dvips -o nco.ps nco.dvi # Convert DVI to Postscript
```

One very important feature of `dvips` is that it may be used to generate beautiful PDF files without having to invoke `pdflatex`. This is accomplished by setting the `dvips` output pipe to PDF

```
dvips -Ppdf -G0 -o nco.ps nco.dvi # Convert to Postscript intermediate, then PDF
ps2pdf -Ppdf -G0 nco.ps nco.pdf # Convert Postscript to PDF
```

The resulting PDF file does not preserve the helpful PDF features, such as hyperlinks, but it does appear as intended in PDF readers such as `acroread`. This procedure is very useful when `pdflatex` does not work, e.g., for complicated files, or when the source is in some other format, e.g., TEXInfo.

Unfortunately, the `-Ppdf` switch may typeset ligatures such as "fi" or "ff" incorrectly. The solution is to add the `-G0` switch, or to upgrade to more recent versions of `dvips`. It is also recommend to add `-Pcmz` and `-amz` switches. This is explained in the TEX FAQ.

Another feature of `dvips` is its ability to produce EPS (Encapsulated Postscript) files from all or parts of a document.

```
dvips -Ppdf -G0 -E -i -o rt.ps rt.dvi # Convert to Postscript intermediate, then PDF
```

## 3.8 PDFTEX

PDFTEX, by Hàn Th´ê Thành, is a micro-typographic extensions to the TEX typesetting system. PDFTEX produces PDF output directly, rather than using a PostScript converter such as `ghostscript`. Prof. Dr. Hans Hagen contributed much to the development of PDFTEX. Hagen runs a private company, Pragma Advanced Document Engineering, that supports a macro package for TEX called ConTEXt.

PDFTEX tends to give inscrutable error messages. For more informative diagnostics, invoke with `pdflatex -k 255 foo.tex`.

There are two distinct commands that de-LATEX files, `detex` and `untex`. These converters are really LATEX-strippers—they only do a good job of preserving unformatted text. A good alternative for formatted text is to convert the PDF file (rather than the LATEX file), to text. `pdftotext` accomplishes this.

Foiltex requires the `dvips` option in order to produce landscape mode foils. The `hyperref` package interferes with Foiltex and breaks the rotating capability.

### 3.8.1 Viewing

The three free readers `acroread`, `ghostview`, and `xpdf` all display PDFTEX files. The Adobe-supplied `acroread` was intentiaionally crippled to not refresh documents on the fly. To circumvent this, keep another document open, then use `C-w` to close the document and `C-o` to open the file again. However, `acroread` does have the nice ability to convert PDF to Postscript using, e.g.,

```
acroread -help # Print acroread options
acroread -toPostScript -level2 -size letter -pairs -shrink fl_nm.pdf fl_nm.ps
for fl in `ls *.pdf` ; do
acroread -toPostScript -level2 -size letter -pairs -shrink ${fl} ${fl/pdf/ps}
done
for fl in `ls *.ps` ; do kprinter ${fl}; done
```

### 3.8.2 hyperref

The `hyperref` package provides most of the LaTeX's interface to the Web-aware features of PDF files supported by `pdflatex`. PDF files support links within documents, and between the document and the World Wide Web (WWW). `pdflatex` automatically converts most syntactically useful document entry points to internal links. For example, the first section of an article format document will be linked to the internal name `section.1`. Hence the first section of a document foo.pdf stored at `http://foo.com/doc.pdf` has the global URL `http://foo.com//doc.pdf#section.1`.

LaTeX documents create active links to such URLs with the `\href` command. For example, the following links should actively point to this particular section of this document as an internal link and as an external link, respectively.

```
as an \href{subsubsection.2.5.2}{internal link} and as an
\href{http://dust.ess.uci.edu/doc/ltx/ltx.pdf#subsubsection.2.5.2}{external link},
```

The `\href` macro can access "local" URLs. This local file link accesses the `hyperref`-generated link to Section 5 through the HTTP `file://` protocol:

```
This \href{file:///data/zender/ps/ltx.pdf#section.4}{active link} ...
```

When a local file link points to the file being viewed, the viewer (e.g., `xpdf`) jumps to the link without spawning a new viewer. Local file links are better accomplished with the standard LaTeX `\label` and `\ref` macros. Nonetheless, `hyperref` automatically generates labels at standardized locations in many document types.

The `\href` macro is more useful for accessing remote URLs. This remote URL link should access the `hyperref`-generated link to Section 5 through the HTTP `http://` protocol:

```
\href{http://dust.ess.uci.edu/doc/ltx/ltx.pdf#section.4}{remote URL link}
```

To resolve remote URLs, the current viewer spawns a new viewer process (probably based on the default handler for the mime-type, in this case PDF) to download and display the remote document. Unfortunately, no viewers seem intelligent enough to open the remote document to the specified section. In other words, the viewer downloads the remote document correctly, and then the new viewer opens the document to Page 1, rather than to the specified section (Section 5 in this case).

`hyperref` provides the following macros for fine-grained control:

```
\hyperdef{category}{name}txt % Mark text with category.name
\hyperref{URL}{category}{name}{text} % Link text to URL#category.name
\hyperbaseurl{URL} % Prepend URL to following URLs
\hypertarget{sxn:abb}{} % fxm
```

Samples of these macros for generic situations are

```
\hyperref{sxn}{}{} % fxm
\hyperref{}{sxn}{abb}{fxm} % Link text to URL#category.name
\hypertarget{sxn:abb}{} % fxm
```

Actual targets that work in typical situations are

```
\hyperbaseurl{file:///data/zender/ps/abb.pdf}
\hypertarget{sxn:abb}{}
```

The `\hypertarget` command sets fxm.

### 3.8.3 Manipulating

It is often helpful to manipulate a PDF document using native PDF tools so that no lossy conversions to other formats (e.g., Postscript) need be done. The PDF toolkit pdftk is useful for this. From the `pdftk` homepage:

> If PDF is electronic paper, then pdftk is an electronic staple-remover, hole-punch, binder, secret-decoder-ring, and X-Ray-glasses

PDFtk may be used to merge, split, decrypt, encrypt, burst, uncompress, and repair PDF files. To extract subsets of pages from a PDF document,

```
pdftk A=${DATA}/ps/prp_itr.pdf cat A2 output ~/prp_itr_smr.pdf
```

### 3.8.4 pdfscreen

Another useful package is `pdfscreen`. `pdfscreen` relies heavily on `hyperref` and a number of other packages. I have installed the entirety of `pdfscreen` in `${TEXMFDIR}/tex/latex/pdfscreen`. However, only pdfscreen.sty and a few other files in the directory are strictly required for the installation to work. This should be fixed so the TEX directory does not cruft up. Printing `pdfscreen` presentations is sometimes useful. To do this, set

```
pdfpagemode={FullScreen}, % Starts in full screen mode, hit 'Esc' to escape
pdfmenubar=true % Allow access to reader's menubar
```

in the `\hypersetup` portion of the preamble. This will start the presentation in full screen mode and make the reader (e.g., `acroread`) menubar available once the presentation is "escaped" using, e.g., `Esc`.

### 3.8.5 thumbpdf

PDF files have the capability to show thumbnails, reduced-size images of each page. The various TEX engines do not generate thumbnails automatically (since they are), so that some intervention is required to insert them in the final PDF document. The two freely available methods are the `thumbpdf` package, by Heiko Oberdiek, and `pdfthumb`, a part of the `PPower4` ($P^4$) project. The typical usage of `thumbpdf` is

```
pdflatex ltx.tex;thumbpdf ltx;pdflatex ltx.tex
```

The `thumbpdf` package may also be used in Postscript processing This is accomplished by setting the `dvips` output pipe to PDF

```
dvips -Ppdf -G0 -o ${DATA}/ps/ltx.ps ltx.dvi
thumbpdf --modes=dvips --level2 --useps ${DATA}/ps/ltx.ps
dvips -Ppdf -G0 -o ${DATA}/ps/ltx.ps ltx.dvi
ps2pdf ${DATA}/ps/ltx.ps ${DATA}/ps/ltx.pdf
pdf2ps ${DATA}/ps/ltx.pdf ${DATA}/ps/ltx.ps
```

### 3.8.6 pdfthumb

The P[4] http://www-sp.iti.informatik.tu-darmstadt.de/software/ppower4project created the PDF Presentation Post Processor. Install this package in generic directories then create thumbnail additions to any PDF file.

```
sudo mkdir ${TEXMFDIR}/tex/generic/ppower4
sudo mv *.sty ${TEXMFDIR}/tex/generic/ppower4
sudo mv ppower4 pdfthumb /usr/local/bin
pdfthumb in.pdf out.pdf
pdfthumb nco.pdf nco.pdf2;/bin/mv nco.pdf2 nco.pdf
```

## 3.9 Tables

Tables are perhaps the most difficult-to-master aspect of LaTeX. Use the rotating.sty package to rotate tables.

```
\begin{sidewaystable}

\end{sidewaystable}
```

When large portions of text (many pages) are to be printed sideways, then landscape mode is called for. Footnotes in tables are also tricky.

### 3.9.1 epstopdf

PDFTeX does not recognize *.eps files directly. Instead these must be converted to PDF-format with `epstopdf`. The `epstopdf` package by Heiko Oberdiek is very useful when using PDFLaTeX.

```
for fl in `ls *.eps` ; do
epstopdf ${fl}
done
```

The package epstopdf.sty does this automatically. It converts Postscript (*.ps) and encapsulated Postscript (*.eps) files to PDF files (*.pdf) automatically (using `epstopdf`) if the PDF files do not already exist. However, this capability is intrinsically somewhat insecure since it involves allowing LaTeX to run shell commands. Hence, `epstopdf` is not installed by default and special permissions must be set to activate it. To enable this feature at run-time use, e.g., `pdflatex -shell-escape test.tex`. To permanently enable this feature for the whole distribution set `shell_escape = 1` in configuration file texmf.cnf.

### 3.9.2 Upgrading

Upgrading PDFTEX:

```
cd ${DATA}/tmp;mkdir pdftex;cd pdftex
ftp://ftp.muni.cz/pub/tex/local/cstug/thanh/pdftex/snapshots
gunzip pdftex-20010806-linux.zip
./configure --prefix=/usr --datadir=/usr/share
make
sudo mv /usr/bin/pdfetex /usr/bin/pdftex /usr/bin/ttf2afm /data/zender/bck
sudo mv ${TEXMFDIR}/web2c/pdftex.pool ${TEXMFDIR}/web2c/pdfetex.pool /data/zender/bck
sudo cp pdfetex pdftex ttf2afm pdftosrc /usr/bin
sudo cp pdfetex.pool pdftex.pool ${TEXMFDIR}/web2c
sudo texhash

cd ${DATA}/tmp;mkdir pdftex;cd pdftex
sudo mv pdftex-20010806.tgz ${DATA}/tmp/pdftex
tar xvzf pdftex-20010806.tgz
cd src
./configure --prefix=/usr/share
cd texk/web2c
make pdftexbin
cd ${DATA}/tmp/pdftex/src/texk/web2c
sudo cp pdfetex pdftex ttf2afm pdftosrc /usr/bin
sudo cp pdfetex.pool pdftex.pool ${TEXMFDIR}/web2c
```

Binaries and pool files are located in the directory `${DATA}/tmp/pdftex/src/texk/web2c`. You must regenerate `.fmt` files `pdftex.fmt` and `pdflatex.fmt` after installing a new version of the PDFTEX binary and `pdftex.pool` files.

```
pdftex -ini -fmt=pdftex plain \\dump
pdftex -ini -fmt=pdflatex latex.ltx
```

or

```
sudo fmtutil --byfmt pdftex
sudo fmtutil --byfmt pdflatex
```

Apparently, `texconfig init` may do both in one fell swoop.

Then update the graphics `.def` file to the newest version at http://www.ctan.org/tex-archive/macros/pdftex/graphics/pdftex.def

```
find /usr/share/ -name pdftex.def
cd ${TEXMFDIR}/tex/latex/graphics/
sudo mv pdftex.def pdftex.def.orig
sudo cp ~/pdftex.def .
```

Table 1: **Font Attributes**[a]

| Attribute | Value |
|---|---|
| Encoding | OT1 OT2 T1 OML OMS OMX U |
| Family | cmr cmss cmtt |
| | Computer modern roman, Computer modern sans serif, Computer modern typewriter |
| Series (weight) | ul el l sl m sb b eb ub |
| | Ultralight, Extralight, Light, Semilight, Medium, Semibold, Bold, Extrabold, Ultrabold |
| Series (width) | uc ec c sc m sx x ex ux |
| | Ultracondensed, Extracondensed, Condensed, Semicondensed, Medium, Semiexpanded, |
| Shape | n it sl sc u |
| | Normal, Italic, Slanted, Small caps |
| Size | |

[a] *Sources:* Kopka and Daly (1999, 2004)

# 4 Using LaTeX

## 4.1 NFSS

The font scheme used in LaTeX is known as the *New Font Selection Scheme* (NFSS). NFSS recognizes five distinct font attributes: *encoding*, *family*, *series*, *shape*, and *size* which may be set individually with the commands
`fontencoding`{*encode*},
`fontfamily`{*fam*},
`fontseries`{*wt_wth*},
`fontshape`{*form*}, and
`fontsize`{*line_sp*}. The font *series* consists of two values, weight and width, concatenated sequentially into one argument, *wt_wth* of between one and four characters, e.g., ebsc. The font *size* takes two separate arguments, the point size of the font and the value of `\baselineskip`. Table 1 shows sample values for each font attribute. LaTeX comes with an interactive document which prints font tables on demand.

```
latex ${TEXMFDIR}/tex/latex/base/nfssfont.tex
Name of the font to test = ygoth
\help
\sample
\bye
```

### 4.1.1 fontchart

The preferred method for examining TeX fonts is to use the built-in `fontchart` program. The following examples demonstrates the cmr12 font

Table 2: **Filename Suffixes**[a]

| Suffix | Example | Meaning |
|---|---|---|
| .tfm | pplr.tfm | |

[a] *Sources:* *Kopka and Daly* (1999, 2004)

```
% tex fontchart
> Name of the font to chart = cmr12
kdvi fontchart &
```

### 4.1.2 usefont

Fonts may be swiftly changed with the `\usefont` macro. This macro takes four arguments: `\usefont`.

### 4.1.3 suffixes

Table 2 shows the conventional meaning of some of the filename suffixes in the LaTeX universe. Some characters such as are hard to access. For this purpose, use the `\symbol` command (*Kopka and Daly*, 1999, p. 63). For example, `\symbol{126}` produces ~, the tilde symbol.

## 4.2 Dependencies

Building and maintaining complex LaTeX files is non-trivial and requires effort similar to maintaining a complex model. There are two ways to keep track of the dependencies of a source file. The first is to add the command `\listfiles` somewhere in the document preamble. This causes LaTeX to print the file dependencies to screen during processing. The second is to add the command `\RequirePackage{snapshot}` *before* the `\documentclass` command. This will generate a dependency file (`*.dep`) file.

## 4.3 Citations

Here we try some typical LaTeX bibliographic citations

1. Recommended format for citing URLs is demonstrated by invoking `\cite{Zen01b}`: *Zender* (2001)

## 4.4 Dates and Times

The datetime.sty package provides fine control for printing dates and times. It provides the `\xxivtime` and `\ordinal` commands.

Table 3: **Text Object Types**[a]

| Command | Alternate | Example | Result | Meaning |
|---|---|---|---|---|
| \acronym | \acr | | Acronym | |
| \cite | | | Reference | |
| \code | | | Program code | |
| \command | \cmdprn | | Command name | |
| | \cmdltxprn | | LaTeX Command name | |
| \dfn | \trmdfn | | Definition | |
| \email | | | Electronic mail address | |
| \env | | | Environment variable | |
| \file | \flprn | | File name | |
| \kbd | | | Keyboard input | |
| \key | | | Specifying keys | |
| | \mchprn | | Machine name | |
| | \nmprn | | Proper name | |
| \option | | | Option name | |
| \samp | \smpprn | | Literal character sequence | |
| \url | | | World Wide Web location | |
| \var | | | Metasyntactic variable | |

[a] *Sources:* TeXInfo manual

## 4.5 Indicating Definitions, Commands, Files

It is helpful to indicate what type of object text refers to. For example, the TeXInfo documentation system discriminates between 15 types of text object. Not all those types are relevent here since, e.g., LaTeX has superb citation handling ability already. Table 3 list the types of text objects that appear in this documentation, and the commands necessary to indicate that type of text. For consistency, most object types are defined exactly as in TeXInfo.

## 4.6 TeXInfo

A large suite of tools is available for manipulating LaTeX and TeXInfo documents.

### 4.6.1 Inserting TeX into TeXInfo

```
@tex
% Define TeX macros to roughly correspond to LaTeX style files
\def\dfr{d} % [frc] Math differential
@end tex
```

### 4.6.2 Texi2html

The `texi2html` command converts TeXInfo-format manuals into HTML format. The sources are available from the CVS server

```
cvs -d :pserver:t2h-anon@urmel.mathematik.uni-kl.de:/usr/local/Singular/cvsroot login
cvs -d :pserver:t2h-anon@urmel.mathematik.uni-kl.de:/usr/local/Singular/cvsroot co Texi2
```

with the password `texi2html`.

### 4.6.3 Texi2latex

The `texi2latex` command converts TeXInfo-format manuals into LaTeX format. The sources are available from the GNU project server http://www.nongnu.org/texi2latex. `texi2latex` requires an XSLT processor such as Saxon.

```
sudo apt-get install libsaxon-java
cd ${DATA}/tmp/texi2latex-0.9.4
export CXX=g++-3.4
make
sudo make install
texi2latex ~/nco/doc/nco.texi
# First, install saxon version 6.5.3
cd ${DATA}/tmp
mkdir saxon-6.5.3
cp saxon6_5_3.zip saxon-6.5.3
cd saxon-6.5.3
unzip saxon6_5_3.zip
```

### 4.6.4 Tth

The `tth` (TeX-to-HTML) command converts LaTeX-format documents into HTML format.

```
tth -a -Lltx -p${TEXINPUTS}:${BIBINPUTS} < ltx.tex > ltx.html
```

The `-a` switch tells `tth` to *automatically* run commands like `latex`, `bibtex`, etc., to generate any necessary auxiliary files. Tell `tth` the root word for the auxiliary files with the `-L` switch. `tth` searches for files on the path specified by the `-p` switch. Full documentation is available at file:///usr/share/doc/tth/tth_manual.html. According to the manual,

> TTH does not recognize the `\usepackage` command by default because the LaTeX macros that are input by this command almost always contain catcode changes or other usages incompatible with TTH. oTTH requires that personal packages use `\input` instead of `\usepackage`. This usually imposes non-generic, and thus unacceptable, constraints on the source LaTeX document.

### 4.6.5 Tex4ht

`tex4ht` is both a package and a program that converts LaTeX-format documents into HTML. It is best to invoke the `tex4ht` suite of programs using the `htlatex` script.

```
htlatex ltx.tex
```

This produces HTML files of the form ltx.css, ltx[0-9].html, ltx.xref, ltx.lg, ltx.idv, ltx.4ct, ltx.tc,
If interested in displaying pages with `mozilla`, in particular, use the `mzlatex` script:

```
mzlatex ltx.tex
```

This produces XML files of the form ltx[0-9].xml.

## 4.7 HTML/SGML

Hypertext Markup Language (HTML) is used to encode documents displayed by most Web browsers. Table **??** summarizes the most common ways to implement of special characters in HTML, and their LaTeX equivalents.

Table 4: **HTML/SGML Special Characters**[1]

| Mnemonic HTML | Numeric HTML | LaTeX | Result |
|---|---|---|---|
| `<foo@bar>` | `&#60;foo@bar&#62;` | `$<$foo@bar$>$` | <foo@bar> |
| `&egrave;` | `&#232;` | `\‘{e}` | è |
| `&eacute;` | `&#233;` | `\’{e}` | é |
| `&yacute;` | `&#253;` | `\’{y}` | ý |
| ` ` | ` ` | `non-breakable space` | non-breakable space |
| `C. S. Zender` | `C. S. Zender` | `C.~S. Zender` | C. S. Zender |
| `&Alpha;` | `&#913;` | `$\Alpha$` | $\alpha$ (Greek capital letter alpha) |
| `&alpha;` | `&#945;` | `$\alpha$` | $\alpha$ (Greek small letter alpha) |
| `&minus;` | `&#8722;` | `$-$` | $-$ (Minus sign) |
| `&times;` | `&#215;` | `$\times$` | $\times$ (Multiplication sign) |
| `&divide;` | `&#247;` | `$/$` | / (Division sign) |
| `&plusmn;` | `&#177;` | `$\pm$` | $\pm$ (Plus-minus sign) |
| `&part;` | `&#8706;` | `$\partial$` | $\partial$ (Partial differential) |
| `&micro;` | `&#181;` | `$\mu$` | $\mu$ (Micro sign) |
| `&euro;` | `&#8364;` | `\texteuro` | € (euro sign) |
| `&copy;` | `&#169;` | `\copyright` | © |
| ` ` | ` ` | `foo\;bar` | foo bar (em space) |
| ` ` | ` ` | `foo\:bar` | foo bar (en space) |
| ` ` | ` ` | `foo\,bar` | foo bar (thin space) |
| `&mdash;` | `&#8212;` | `---` | — (em dash) |
| `&ndash;` | `&#8211;` | `--` | – (en dash |
| `&lsquo;` | `&#8216;` | `‘foo‘` | ‘foo‘ (left single quotation mark) |
| `&rsquo;` | `&#8217;` | `’foo’` | ’foo’ (right single quotation mark) |
| `&ldquo;` | `&#8220;` | `‘‘foo‘‘` | “foo“ (left double quotation mark) |

Table 4: (continued)

| Mnemonic HTML | Numeric HTML | LaTeX | Result |
|---|---|---|---|
| `&rdquo;` | `&#8221;` | `''foo''` | "foo" (right double quotation mark) |
| `&hellip;` | `&#133;` | `\hellip` | ... (low horizontal ellipsis) |
| `&harr;` | `&#8590;` | `\leftarrow` | ↔ (horizontal left-right arrow) |
| `&larr;` | `&#8592;` | `\leftarrow` | ← (left arrow) |
| `&rarr;` | `&#8594;` | `\rightarrow` | → (right arrow) |

## 4.8 Indexing

Here we show some typical LaTeX indexing and cross-indexing which make use of the `\index` command and derivations thereof.

1. The following instance of the word "quark" is indexed using `\trmdfn{quark}`: *quark*. When processed with the `\usepackage[hyperindex]{hyperref}` package, the index should point back to this instance (as long as `backref=true`).

2. The following instance of the word "quark" is indexed using `\trmidx{quark}`: quark.

   (a) The following index of the author "Homer Simpson" uses `\trmdfn[Simpson, Homer]{Homer Simpson}` so that "Homer Simpson" appears verbatim in the text but is indexed by the optional argument "Simpson, Homer": *Homer Simpson*. Compare this to `\trmidx[Simpson, Homer]{Homer Simpson}`: Homer Simpson and to `\trmidx{Homer Simpson}`: Homer Simpson.

3. Related concepts may be cross-indexed and sub-sorted as well. For example `\index{Frodo|see{Bagg` places 'Frodo, *see* Baggins' in the index. Nesting related item is accomplished by, e.g., `\index{Baggins!Frodo}`, `\index{Baggins!Bilbo}`, `\index{Baggins!Bilbo!adventures}`, `\index{Baggins!Bilbo!rings}`.

4. The index requires some help to determine where to place non-standard symbols. For example, METAFONT should be indexed alphbetically as "Metafont", not as "Metafont", while `\MF` should be indexed alphabetically as "MF". This is accomplished by the command `\index{Metafont@\MF}`. The argument before the `@` is the lexicographical value of the entry used for alphabetization, and the argument after the `@` is the value actually written to the index. By the same token, the command `\index{index@\verb+\index+}` places the word `\index` under the letter "i". Note that this method is tedious and prone to error since it involves typing the word "index" three times. Heiko Oberdiek has provided me with the command, `\cmdltxidx` which prints `\cmdltxidx` in the text and in the index at the correct alphabetical location.

## 4.9 Line Numbering

To number each line in a document, use the package lineno.sty. The `\linenumbers` command turns on line-numbering, and the `\nolinenumbers` turns it off. To demonstrate, the next few sections have line-numbering turned on. The package is very flexible and supports options like `\pagewiselinenumbering`, `\rightlinenumbers`, etc. lineno.sty even supports labeling lines and refering to specific lines with the standard reference commands, e.g., `\ref`. Unfortunately, line-numbering is expensive in terms of processing time and contents of the auxiliary file, so expect LaTeX to slow down when large amounts of material are numbered.

When printing source code, it may be desirable to nicely format certain keywords in the language. The LaTeX command `\cxx` prints "C++" instead of the unformatted "C++".

## 4.10 Vertical Spacing

To change the vertical spacing in a document, use the package setspace.sty.

## 4.11 Horizontal Spacing

Spacing between numbers and dimensions is a complicated issue. The issue is most often ignored by novices, and, for those who care, there are no universal solutions. A related question is the spacing between multiple physical dimensions in a single unit, so-called *interdimensional spacing*. The *J. Fluid. Mech.* convention appears to be a `\;` space between the value and dimension, and then a `\,` space for interdimensional spacing, e.g., `5\;cm\,s$^{-1}$` produces 5 cm s$^{-1}$. AGU journals appear to use `\,` in both positions, e.g., `5\,cm\,s$^{-1}$` produces 5 cm s$^{-1}$.

## 4.12 Verbatim

The package listings.sty contains extensive options to nicely format input code. First one must define the current language environment with the `\lstset` command, e.g.,

```
\lstset{% Set up listings.sty environment
language=[LaTeX]TeX, % Language for listings.sty \lstinline
stringstyle=\ttfamily,
keywordstyle=\ttfamily}
```

Once `\lstset` has been initialized, the `\lstinline` command is used to format code inline, and the `lstlisting` environment is available to place longer code fragments in display style.

The `srcltx` package enables `xdvi` to display LaTeX code synchronized with the display: Also consider the fancyvrb.sty package by Timothy van Zandt.

## 4.13 CVS

Using CVS in LaTeX documents is not straightforward. Norman Gray recommended the following on `comp.text.tex`

```
\def\CVS$#1: #2 ${\expandafter\def\csname CVS#1\endcsname{#2}}
\CVS$Revision$
\CVS$Date$
```

and use it like `\date{\CVSDate, version \CVSRevision}`. This recipe only works when CVS versioning is turned on, i.e., when the `-kk` option is not specified. The above definition must appear in the document being tracked, i.e., the `.tex` file, rather than a style file. Otherwise the version information will reflect the evolution of the style file and not the document being tracked. Unfortunately this contributes to preamble bloat.

## 4.14 Watermarks

Printing a message on each page is useful to watermark draft work, so it is a FAQ. To do this in LaTeX, use the `\draftcopy` package by Juergen Vollmer. The word "DRAFT"

Table 5: **TeX Family Symbols**[a]

| Symbol | Command | Package |
|---|---|---|
| TeX | `\TeX` | none |
| TeXInfo | `\TeX{}Info`, `\TeXInfo` | csz |
| LaTeX | `\LaTeX`, `\LATEX` | none, texnames |
| LaTeX 2ε | `\LaTeXe` | none |
| METAFONT | `\MF` | mflogo |
| METAFONT | `\METAFONT` | texnames |
| $\mathcal{AMS}$-TeX | `\AMSTEX`, `\AmSTeX`, `\AMSTeX` | texnames |
| BibTeX | `\BIBTEX`, `\BIBTeX`, `\BibTeX` | texnames |

[a] *Sources:* *Kopka and Daly* (1999, 2004)

(assuming an English document) will be blazed across the specified pages. `ghostview` has troubles showing *DRAFT* watermark in the on-screen window. Ghostscript (`gs`) works fine with watermarks.

Watermarking PDFTeX-generated files requires a more sophisticated package called `eso-pic` which is contained in Martin Schroëder's `ms` bundle. For PDF, try the following:

```
\usepackage[pdftex]{graphics,color} %
\usepackage{eso-pic} % Required for Draft (\AddToShipoutPicture)
\AddToShipoutPicture{\resizebox{0.9\pdfpagewidth}{0.9\pdfpageheight}%
{\rotatebox{60}{\color[gray]{0.8}\hspace*{5mm}\textsc{Sample Paper}}}}
```

## 4.15 Symbols

The variety of symbols LaTeX can produce is astounding. The definitive source of these symbols is the Symbols document by M. Scott Pakin, available from `ftp://cam.ctan.org/tex-archive/info/symbols/comprehensive/`. Some of the more frequently used TeX-related symbols are listed in Table 5. The `\usepackage{texnames}` makes the proper logos available, but, according to Robin Fairbairns, it is an out-of-date, poorly coded package which should be avoided if possible (i.e., use `mflogo` instead for METAFONT). According to the UK TeX FAQ, "For those who don't wish to acquire the 'proper' logos, the canonical thing to do is to say `AMS-\TeX` for AMS-TeX, `Pic\TeX` for PicTeX, `Bib\TeX` for BibTeX, and so on." Extending this advice to More recent packages have their own styles. A few of the more useful are `\textsc{pdf}\TeX` for PDFTeX, and `\textsc{pdf}\LaTeX` for PDFLaTeX.

Often a font is named after its creator, whether a person or a company. Thus learning the names of font creators is a good mnemonic for the package names. The marvosym fonts are named for "Martin Vogel's Symbols".

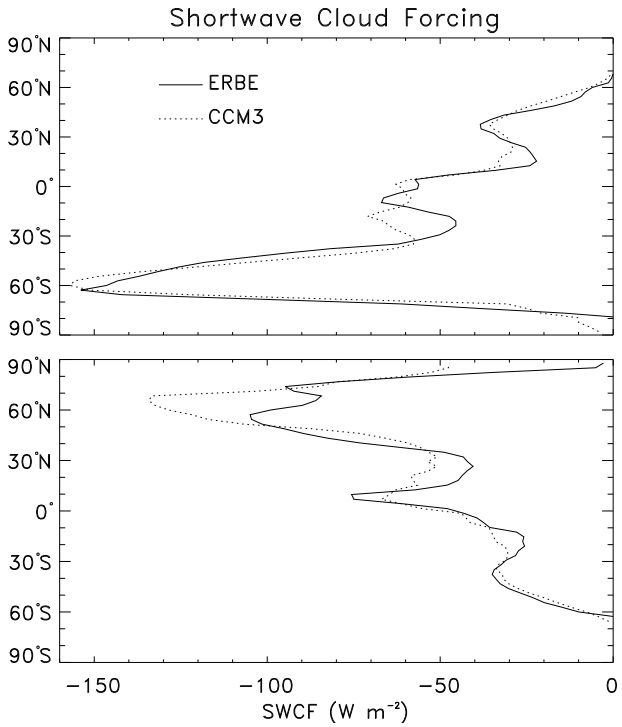


Figure 1: SWCF for (a) January and (b) July.

## 4.16 Graphics

Inclusion of graphics images is controlled by the graphix package. The `\includegraphics` macro imports Postscript (`*.ps`) and encapsulated Postscript (`*.eps`) files automatically.

Normally graphics *float* in documents, i.e., their position varies so as to flow well with the surrounding text. These floats are usually placed within the `figure` environment, so that a caption may be easily added. With sizing and caption, the skeleton code to include a graphical figure looks like

```
\begin{figure*}
\centering
\includegraphics[width=0.5\hsize]{SWCF_x_01}\vfill
\includegraphics[width=0.5\hsize]{SWCF_x_07}%
\caption[Shortwave Cloud Forcing]{SWCF for (a) January and (b) July.
\label{fgr:SWCF_x1}}
\end{figure*}
```

Similar commands produced Figure **??**. The `figure` environment only spans a single text column. The `figure*` environment spans all columns in a multi-column document. The location of the float is an optional argument to the `figure` environment, e.g., `\begin{figure*}[b]` to place the float at the bottom of the current or the next page.

It is not straightforward to import other graphics types. Raster graphics such as GIF and JPEG must first be converted to Postscript. LaTeX will do this automatically if it knows the conversion rules. This may be accomplished with the `\DeclareGraphicsRule` command.

Figure 2: R2D2.

The prerequisite is that a shell-executable exist which can produce Postscript. The command `gif2eps` used to exist and could handle GIF images. Here is how a GIF figure might be indicated

```
\DeclareGraphicsRule{.gif}{eps}{}{`gif2eps #1 -} % Convert GIF files to eps
\begin{figure*}
\centering
\includegraphics[width=0.5in,height=0.5in]{/data/zender/fgr/dmr/r2d2.gif}
\caption[R2D2]{R2D2.\label{fgr:r2d2}}
\end{figure*}
```

These commands produced Figure 2. Note the use of the `width` and `height` options to size the figure. If only one dimension were given, then graphicx would automatically maintain the natural aspect ratio of the figure.

### 4.16.1 Clipping and Rotation

To trim images, use the `trim` and `clip` options to `includegraphics`. Specify the viewport margins in the order Left, Bottom, Right, Top. "Liberty" is a good mnenomonic for the `lbrt` ordering.

```
\includegraphics[width=1.0\hsize,clip=true,trim=0.75in 4.1in 0.1in 4.9in]{/data/zender/f
```

## 4.17 Trademarks

Identifying intellectual property correctly requires some knowledge of copyrights and trademarks. What distinguishes a trademark from a registered trademark or a service mark is not clear. LaTeX automatically makes available the symbols `\copyright`, `\texttrademark`, and `\textregistered` to denote these marks (*Kopka and Daly*, 1999, p. 239). For example, this work is Copyright © 2000–2003 by me. `Linux\textregistered` produces Linux®. `Linux\texttrademark` produces Linux™ (where the superscript is automatic). However, the text companion package textcomp provides nicer versions of `\texttrademark` and `\textregistered` than the defaults, so remember to load it for important documents. textcomp also provides some symbols that are unique, such as `\textservicemark` (e.g., Linux℠), `\textonehalf` (½), `\textonequarter` (¼), and `\textthreequarters` (¾).

## 4.18 Currencies

The euro, the official currency of the European Union, may be typeset with `\texteuro` (€). Other currency symbols include...

## 4.19 Acronyms and Abbreviation

Abbreviations are contractions of phrases into a sequence of letters each usually representing the first letter of a word. Abbreviations are not intended to be pronounced as a single word. For example, USA is an abbreviation. Acronyms are abbreviations which are pronounceable without spelling the abbreviation letter-by-letter. Thus IBM is not an acronym, but NATO is.

Typographical conventions set acronyms in a "smallcaps" font, i.e., a font where capital letters are smaller than the regular text font. In TeX, smallcaps is one of the font shapes (§4.1). Periodicals which follow this convention include *The Economist*. Thus acronyms may be correctly typeset "on the fly" using the `\textsc` macro. For example, `\textsc{nco}` produces NCO, while `\textsc{Unix}` produces UNIX. There is also a homebrew macro, `\acr`, which is currently just a wrapper for `\textsc`. For example, `\acr{nco}` produces NCO.

After raising the question "When to use smallcaps for acronyms?" on the `comp.text.tex` USENET list, a variety of answers and rationales were proposed. Robin Fairbairns noted that Barbara Beeton specified a not-quite-small caps variant for use in Tugboat. His code for that is

```
\usepackage{relsize}
\def\acro#1{\textsmaller{#1}\@}
\acro{TUG} conferences aren't much like \acro{SOSP}s.
```

Others simply use a small text font

```
\newcommand{\cap}[1]{{\small{#1}}}
\newcommand{\capRB}[1]{\raisebox{1pt}{\small{(}}\small{#1}\raisebox{1pt}{\small{)}}}
\TeX\ User Group \capRB{TUG} conferences aren't much like \cap{SOSP}s.
```

## 4.20 Text Samples

Here we try some typical LaTeX text formatting.

1. Here we use the custom `\dgr` (degree) macro, first in text mode, then in math mode. `\dgr` uses `\ensuremath` so there should be no discernible difference: `10\dgr S--10\dgr N` gives "10°S–10°N". `10$\dgr$S--10$\dgr$N` gives "10°S–10°N".

2. `\includegraphics` will automatically scale a graphic to fit within a given box while maintaining aspect ratio with this argument `width=xxx,height=yyy,keepaspectratio`

Two commands useful for typesetting URLs and e-mail addresses are `\url` and `\href`. Table 6 show the results of various typesetting techniques on URLs, including problematic long URLs.

Table 6: **Typesetting Text**[2]

| LaTeX Command | Result |
|---|---|
| `\url{nco.sourceforge.net}` | nco.sourceforge.net |
| `\href{http://nco.sourceforge.net}{NCO Homepage}` | NCO Homepage |
| `\url{zender@uci.edu}` | zender@uci.edu |
| `\url{http://some/really/long/URL/that/wants/to/wrap}` | http://some/really/long/URL/that/wants/to/wrap |
| `\href{http://some/really/long/URL/that/wants/to/wrap}{Short Name}` | Short Name |

Unfortunately, the `dvips` driver is unable to automatically break URLs across lines. On the other hand, `pdflatex` intelligently breaks URLs whenever necessary. A `comp.text.tex` thread initiated on Oct. 24, 2001 by Olive Moeller discusses the reasons for this. Thus, as demonstrated in Table 6, documents may be formatted differently depending on whether they are produced with `dvips` or `pdflatex`.

# 5 Text Typography

## 5.1 Gothic


othic fonts occupy a special place in the history of typography since they appear in the oldest typeset texts in Western civilization. Yannis Haralambous used METAFONT to design four interesting Old German fonts. The Gothic letter initiating this paragraph if from the "Yannis initial" font called yinit. As mentioned above, the initial letter of paragraphs is "dropped" with the dropcaps package, in this case `\bigdrop{0pt}{3}{yinit}{G}othic`.... Unfortunately, accessing non-default fonts in LaTeX generally involves manipulating a very detailed and complex specification scheme, NFSS (§4.1).

- Yannis Fraktur: `\usefont{U}{yfrak}{m}{n}` Hello, World.
- Yannis Gothic: `\usefont{U}{ygoth}{m}{n}` Hello, World.
- Yannis Schwabacher: `\usefont{U}{yswab}{m}{n}` Hello, World.
- Yannis Initial: `\usefont{U}{yinit}{m}{n}` 

## 5.2 Text Fonts

Table 7 shows different series and styles of the default text font.

Table 7: **Text Series and Styl**

| LaTeX Font | Result |
|---|---|
| \textrm | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \textsf | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \texttt | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \textup | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \textit | *ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789* |
| \textsl | *ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789* |
| \textsc | ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ012 |
| \textmd | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \textbf | **ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz012** |
| \tiny | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \scriptsize | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \footnotesize | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \small | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \normalsize | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| \large | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz |
| \Large | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrst |
| \LARGE | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghij |
| \huge | ABCDEFGHIJKLMNOPQRSTUVWXYZab |
| \Huge | ABCDEFGHIJKLMNOPQRSTUVWXYZab |

Table 8 shows different families of text fonts.

Table 8: **Text Fonts**[4]

| LaTeX Font | Result |
|---|---|
| \textgoth | 𝔄𝔅ℭ𝔇𝔈𝔉𝔊ℌℑ𝔍𝔎𝔏𝔐𝔑𝔒𝔓𝔔ℜ𝔖𝔗𝔘𝔙𝔚𝔛𝔜ℨ𝔞𝔟𝔠𝔡𝔢𝔣𝔤𝔥𝔦𝔧𝔨𝔩𝔪𝔫𝔬𝔭𝔮𝔯𝔰𝔱𝔲𝔳𝔴𝔵𝔶𝔷0123456789 |
| \textfrak | 𝔄𝔅ℭ𝔇𝔈𝔉𝔊ℌℑ𝔍𝔎𝔏𝔐𝔑𝔒𝔓𝔔ℜ𝔖𝔗𝔘𝔙𝔚𝔛𝔜ℨ𝔞𝔟𝔠𝔡𝔢𝔣𝔤𝔥𝔦𝔧𝔨𝔩𝔪𝔫𝔬𝔭𝔮𝔯𝔰𝔱𝔲𝔳𝔴𝔵𝔶𝔷0123456789 |
| \textswab | 𝕬𝕭𝕮𝕯𝕰𝕱𝕲𝕳𝕴𝕵𝕶𝕷𝕸𝕹𝕺𝕻𝕼𝕽𝕾𝕿𝖀𝖁𝖂𝖃𝖄𝖅𝖆𝖇𝖈𝖉𝖊𝖋𝖌𝖍𝖎𝖏𝖐𝖑𝖒𝖓𝖔𝖕𝖖𝖗𝖘𝖙𝖚𝖛𝖜𝖝𝖞𝖟0123456789 |

# 6 Math Typography

## 6.1 Math Conventions

The ISO has established conventions regarding symbols appearing in mathematical documents (*Kopka and Daly*, 1999, p. 142). The most often violated convention, which is also easy avoided with LaTeX, concerns the use of upright fonts for symbols denoting fixed, constant values. So, for example, the base of the natural logarithm should be denoted e rather than simply $e$. This is accomplished by using `$\me$` rather than `$e$`. Likewise the imaginary number is i (`\mi`) rather than $i$ (`$i$`); pi is $\pi$ (`\mpi`) rather than $\pi$ (`\pi`), and the symbol for a differential element is, e.g., d$x$ (`$\dfr x$`), rather than $dx$ (`$dx$`). Uppercase upright Greek symbols may be obtained from the symbols font or from the txfonts package. `\mathbf` is a bold upright mathematical font, and contains only Latin and uppercase Greek letters. The package upgreek.sty supplies upright Greek letters when the normal letter command is prefixed with "up", e.g., `\uppi` produces $\mathbf{\pi}$ whereas `\pi` produces $\pi$. Unfortunately, the letters produced by upgreek.sty appear to be boldface. The package bm.sty boldfaces Greek letters (as does the `\pmb` or "Poor man's bold" from amsbsy.sty). The packages mathptmx.sty and mathpazo.sty create full, bold-italic, alphabets in the Times and Palatino fonts, respectively. Whether this convention applies to Greek numerical prefixes is unclear. For example, a *micron*, $10^{-6}$ m, is often written "$\mu$m" (`$\mu$m`). The $\mu$ in $\mu$m, however, has a fixed value ($10^{-6}$). It is, in essence, a universal constant much like $\pi$. Therefore microns should be written with an upright mu, i.e., $\mathbf{\mu}$m. Most journals, including AGU journals, adhere to this format.

According to *Kopka and Daly* (1999), p. 142:

1. Simple variables are represented by italic letters, $abcxyz$.
2. Vectors are written in bold face italic, as $\boldsymbol{Bv\omega}$.
3. Tensors of 2nd order and matrices may appear in a sans serif font, as MDI
4. The special numbers e, i, $\mathbf{\pi}$, as well as the differential operator d, are to be *written in an upright font* to emphasize that they are not variables.
5. A measurement consisting of a number plus a dimension is an indivisible unit, with a smaller than normal space between them, as 5.3 km and 62 $\mathbf{\mu}$m. The dimension is set in an upright font.

*Kopka and Daly* (1999) recommend using fxm.

## 6.2 Math Equations

Lengthy derivations may require breaking the derivation across a page boundary. It is generally considered smarter to diallow page breaks between equation lines by default, and to require the author to specifically enable them where necessary. Thus normal display environments, e.g., the `eqnarray` environment, do not, by default, allow breaking across pages. The `\displaybreak` command causes a break in a particular equation on a particular page. The optimal position for the `\displaybreak` is just before the `\\` where it should take effect. `\displaybreak` takes an optional integer argument valued 0 to 4 to indicate the

degree of penalty associated with breaking a display environment, with 0 merely allowing a break to take place, and 4 requiring that the page break, e.g., `\displaybreak[4]`.

$\mathcal{AMS}$-TEX also supplies the `\allowdisplaybreaks` macro which changes the default to permit displayed equations to flow smoothly from one page to the next. This macro should be placed in the document preamble. `\allowdisplaybreaks` takes an optional integer argument valued 1 to 4 to indicate the degree of penalty associated with breaking a display environment, with 4 being the most permissive, e.g., `\allowdisplaybreaks[4]`.

## 6.3 Math Fonts

Table 9 shows the different mathematical fonts. The `\mathscr` command is defined by multiple packages. When `\usepackage[mathscr]{eucal}` is employed, `\mathscr` prints a vertical script font, but when `\usepackage{mathrsfs}` is in effect `\mathscr` prints an ornate and very curvy script font reminiscent of wedding invitations.

Table 9: **Math Fonts**[5]

| LaTeX Command | Result |
|---|---|
| Greek | $\Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Upsilon\Phi\Psi\Omega\alpha\beta\gamma\delta\epsilon\varepsilon\zeta\eta\theta\vartheta\iota\kappa\lambda\mu\nu\xi o\pi\varpi\rho\varrho\sigma\varsigma\tau\upsilon\phi\varphi\chi\psi\omega$ |
| `\bm` | $\boldsymbol{\Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Upsilon\Phi\Psi\Omega\alpha\beta\gamma\delta\epsilon\varepsilon\zeta\eta\theta\vartheta\iota\kappa\lambda\mu\nu\xi o\pi\varpi\rho\varrho\sigma\varsigma\tau\upsilon\phi\varphi\chi\psi\omega}$ |
| upgreek.sty | $\Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Upsilon\Phi\Psi\Omega\alpha\beta\gamma\delta\epsilon\varepsilon\zeta\eta\theta\vartheta\iota\kappa\lambda\mu\nu\xi o\pi\varpi\rho\varrho\sigma\varsigma\tau\upsilon\phi\varphi\chi\psi\omega$ |
| `\mathnormal` | $ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz012345$ |
| `\mathrm` | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| `\mathsf` | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| `\mathtt` | ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789 |
| `\mathit` | $ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789$ |
| `\mathbf` | $\mathbf{ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz01}$ |
| `\mathcal` | $\mathcal{ABCDEFGHIJKLMNOPQRSTUVWXYZ}\dashv\lfloor\rfloor\lceil\rceil\{\}\langle\rangle\vert\Vert\updownarrow\Updownarrow\backslash\surd\amalg\nabla\int\sqcup\sqcap\sqsubseteq\sqsupseteq\S\dagger\ddagger\prime\infty\in$ |
| `\mathbb` | $\mathbb{ABCDEFGHIJKLMNOPQRSTUVWXYZ}\eth\Finv\beth\gimel\daleth\leqslant\geqslant\ltimes\rtimes\barwedge\veebar\sim\approx\cong\gtrsim\lesssim\curvearrowleft\curvearrowright\digamma\Game\Bbbk\nexists\Bbbk$ |
| `\mathscr` | $\mathscr{A\,B\,C\,D\,E\,F\,G\,H\,I\,J\,K\,L\,M\,N\,O\,P\,Q\,R\,S\,T\,U\,V\,W\,X\,Y\,Z}$ |
| `\mathfrak` | $\mathfrak{ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789}$ |
| `\pmb` | $\boldsymbol{ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz012345}$ |
| | fxm 20030224, 20050827: Produces "Too many math alphabets used in "version norm |

## 6.4 Math Samples

LaTeX contains many useful, but hard-to-remember, commands and symbols for formatting mathematics. It is easy to forget when to use uncommon symbols like `\lesssim`, `\gtrapprox`, and `\,`. Table 10 shows results of different mathematical typesetting techniques.

Table 10: **Typesetting Math**[6]

| LaTeX Command | Result |
|---|---|
| `\frac{\partial \prs}{\partial \tpt}\|_{\vlm}` | $\frac{\partial p}{\partial T}\|_V$ |
| `\frac{\partial \prs}{\partial \tpt}\big\|_{\vlm}` | $\frac{\partial p}{\partial T}\big\|_V$ |
| `\frac{\partial \prs}{\partial \tpt}\Big\|_{\vlm}` | $\frac{\partial p}{\partial T}\Big\|_V$ |
| `\frac{\partial \prs}{\partial \tpt}\bigg\|_{\vlm}` | $\frac{\partial p}{\partial T}\bigg\|_V$ |
| `\frac{\partial \prs}{\partial \tpt}\Bigg\|_{\vlm}` | $\frac{\partial p}{\partial T}\Bigg\|_V$ |
| `10\dgr \times 10\dgr` | $10^\circ \times 10^\circ$ |
| `\tilde{\dmt}_{\nbrsbs}` | $\tilde{D}_\mathrm{n}$ |
| `\tilde{\dmt_{\nbrsbs}}` | $\tilde{D_\mathrm{n}}$ |
| `\tilde{\dmt}_{\nbrsbs}^{2}` | $\tilde{D}^2_\mathrm{n}$ |
| `\tilde{\dmt_{\nbrsbs}^{2}}` | $\tilde{D^2_\mathrm{n}}$ |
| `\bar{\dmt}_{\nbrsbs}` | $\bar{D}_\mathrm{n}$ |
| `\bar{\dmt_{\nbrsbs}}` | $\bar{D_\mathrm{n}}$ |
| `\bar{\dmt}_{\nbrsbs}^{2}` | $\bar{D}^2_\mathrm{n}$ |
| `\bar{\dmt_{\nbrsbs}^{2}}` | $\bar{D^2_\mathrm{n}}$ |
| `\hat{\dmt}_{\nbrsbs}` | $\hat{D}_\mathrm{n}$ |
| `\hat{\dmt_{\nbrsbs}}` | $\hat{D_\mathrm{n}}$ |
| `\hat{\dmt}_{\nbrsbs}^{2}` | $\hat{D}^2_\mathrm{n}$ |
| `\hat{\dmt_{\nbrsbs}^{2}}` | $\hat{D^2_\mathrm{n}}$ |
| `\overline{\dmt}_{\nbrsbs}` | $\overline{D}_\mathrm{n}$ |
| `\overline{\dmt_{\nbrsbs}}` | $\overline{D_\mathrm{n}}$ |
| `\overline{\dmt}_{\nbrsbs}^{2}` | $\overline{D}^2_\mathrm{n}$ |
| `\overline{\dmt_{\nbrsbs}^{2}}` | $\overline{D^2_\mathrm{n}}$ |
| `\underline{\dmt}_{\nbrsbs}` | $\underline{D}_\mathrm{n}$ |
| `\underline{\dmt_{\nbrsbs}}` | $\underline{D_\mathrm{n}}$ |
| `\underline{\dmt}_{\nbrsbs}^{2}` | $\underline{D}^2_\mathrm{n}$ |
| `\underline{\dmt_{\nbrsbs}^{2}}` | $\underline{D^2_\mathrm{n}}$ |
| `\dot{\dmt}_{\nbrsbs}` | $\dot{D}_\mathrm{n}$ |
| `\dot{\dmt_{\nbrsbs}}` | $\dot{D_\mathrm{n}}$ |
| `\dot{\dmt}_{\nbrsbs}^{2}` | $\dot{D}^2_\mathrm{n}$ |

Table 10: (continued)

| LaTeX Command | Result |
|---|---|
| `\dot{\dmt_{\nbrsbs}^{2}}` | $\dot{D}^2_{\mathrm{n}}$ |
| `\ddot{\dmt}_{\nbrsbs}` | $\ddot{D}_{\mathrm{n}}$ |
| `\ddot{\dmt_{\nbrsbs}}` | $\ddot{D}_{\mathrm{n}}$ |
| `\ddot{\dmt}_{\nbrsbs}^{2}` | $\ddot{D}^2_{\mathrm{n}}$ |
| `\ddot{\dmt_{\nbrsbs}^{2}}` | $\ddot{D}^2_{\mathrm{n}}$ |
| `\vec{\dmt}_{\nbrsbs}` | $\vec{D}_{\mathrm{n}}$ |
| `\vec{\dmt_{\nbrsbs}}` | $\vec{D}_{\mathrm{n}}$ |
| `\vec{\dmt}_{\nbrsbs}^{2}` | $\vec{D}^2_{\mathrm{n}}$ |
| `\vec{\dmt_{\nbrsbs}^{2}}` | $\vec{D}^2_{\mathrm{n}}$ |
| `\imath` | $\imath$ |
| `\vec{\imath}` | $\vec{\imath}$ |
| `\hat{\imath}` | $\hat{\imath}$ |
| `\mathbf{\vec{\iii}}` | $\mathbf{\vec{\imath}}$ |
| `\mathbf{\iii}` | $\mathbf{\imath}$ |
| `\mathbf{\hat{i}}` | $\mathbf{\hat{\imath}}$ |
| `\mbox{\boldmath$\hat{\imath}$}` | $\boldsymbol{\hat{\imath}}$ |
| `\mbox{\boldmath$\hat{\iii}$}` | $\boldsymbol{\hat{\imath}}$ |
| `\jmath` | $\jmath$ |
| `\vec{\jmath}` | $\vec{\jmath}$ |
| `\hat{\jmath}` | $\hat{\jmath}$ |
| `\mathbf{\hat{j}}` | $\mathbf{\hat{\jmath}}$ |
| `\mbox{\boldmath$\hat{\jmath}$}` | $\boldsymbol{\hat{\jmath}}$ |
| `\vec{k}` | $\vec{k}$ |
| `\hat{k}` | $\hat{k}$ |
| `\mathbf{\hat{k}}` | $\mathbf{\hat{k}}$ |
| `\mbox{\boldmath$\hat{k}$}` | $\boldsymbol{\hat{k}}$ |
| `\int_{0}^{\infty} \dstnbrrds \; \dfr\rds` | $\int_0^\infty n^r_{\mathrm{n}}\,\mathrm{d}r$ |
| `\int_{0}^{\infty} \dstnbrrds \: \dfr\rds` | $\int_0^\infty n^r_{\mathrm{n}}\,\mathrm{d}r$ |
| `\int_{0}^{\infty} \dstnbrrds \, \dfr\rds` | $\int_0^\infty n^r_{\mathrm{n}}\,\mathrm{d}r$ |
| `\int_{0}^{\infty} \dstnbrrds \dfr\rds` | $\int_0^\infty n^r_{\mathrm{n}}\mathrm{d}r$ |
| `\int_{0}^{\infty} \dstnbrrds \! \dfr\rds` | $\int_0^\infty n^r_{\mathrm{n}}\mathrm{d}r$ |
| `\dstfnc_{\nbrsbs}(\dmt)` | $n_{\mathrm{n}}(D)$ |
| `\dstfnc^{\mathrm{o}}_{\nbrsbs}(\dmt)` | $n^{\mathrm{o}}_{\mathrm{n}}(D)$ |

Table 10: (continued)

| LaTeX Command | Result |
|---|---|
| `\dstfnc^{o}_{\nbrsbs}(\dmt)` | $n^{o}_{\mathrm{n}}(D)$ |
| `\dstfnc^{\mathrm{e}}_{\nbrsbs}(\dmt)` | $n^{e}_{\mathrm{n}}(D)$ |
| `\dstfnc^{e}_{\nbrsbs}(\dmt)` | $n^{e}_{\mathrm{n}}(D)$ |
| `\tilde{\gsd}^{2}` | $\tilde{\sigma_{\mathrm{g}}}^{2}$ |
| `\tilde{\gsd}^{\!\!2}` | $\tilde{\sigma_{\mathrm{g}}^{2}}$ |
| `\tilde{\gsd^{2}}` | $\tilde{\sigma_{\mathrm{g}}^{2}}$ |
| `\tilde{\gsd^{\!\!2}}` | $\tilde{\sigma_{\mathrm{g}}^{2}}$ |
| `\widetilde{\gsd}^{\!\!2}` | $\widetilde{\sigma_{\mathrm{g}}^{2}}$ |
| `\dmtnaa` | $\bar{D}_{\mathrm{n}}$ |
| `\dmtnar` | $\bar{D}_{\mathrm{n}}$ |
| `\dmtnma` | $\tilde{D}_{\mathrm{n}}$ |
| `\dmtnmr` | $\tilde{D}_{\mathrm{n}}$ |
| `\dmtnwa` | $D_{\mathrm{n}}$ |
| `\dmtnwr` | $D_{\mathrm{n}}$ |
| `\mbox{\textonehalf}, \mbox{\textonequarter}` | $\frac{1}{2}\frac{1}{4}$ |
| `\frac{1}{2} \frac{2}{3}` | $\frac{1}{2}\frac{2}{3}$ |
| `\dfrac{1}{2} \dfrac{2}{3}` | $\dfrac{1}{2}\dfrac{2}{3}$ |
| `\tfrac{1}{2} \tfrac{2}{3}` | $\tfrac{1}{2}\tfrac{2}{3}$ |
| `\sfrac{1}{2} \sfrac{2}{3}` | $\sfrac{1}{2}\sfrac{2}{3}$ |
| `1 / 2 \ 2 / 3` | 1/2 2/3 |
| `1 / 2 \ 2 / 3` | 1/2 2/3 |
| `x^{1/2}` | $x^{1/2}$ |
| `x^{1\!/2}` | $x^{1/2}$ |
| `x^{1\negthinspace/2}` | $x^{1/2}$ |
| `x^{1\!/\!2}` | $x^{1/2}$ |
| `x^{1\!/\mspace{-2mu}2}` | $x^{1/2}$ |
| `x^{\frac{1}{2}}` | $x^{\frac{1}{2}}$ |
| `x^{\sfrac{1}{2}}` | $x^{\sfrac{1}{2}}$ |
| `x^{\tfrac{1}{2}}` | $x^{\frac{1}{2}}$ |
| `a \lesssim b` | $a \lesssim b$ |
| `a \lessapprox b` | $a \lessapprox b$ |
| `a \cong b` | $a \cong b$ |
| `a \approxeq b` | $a \approxeq b$ |

Table 10: (continued)

| LaTeX Command | Result |
|---|---|
| `a \gtrsim b` | $a \gtrsim b$ |
| `a \gtrapprox b` | $a \gtrapprox b$ |
| `\pi \Pi \prod` | $\pi \Pi \prod$ |
| `\sigma \Sigma \sum` | $\sigma \Sigma \sum$ |
| `\mpi` | $\boldsymbol{\pi}$ |
| `\mathbf{\pi \Pi}` | $\pi \mathbf{\Pi}$ |
| `\bm{\pi \Pi}` | $\boldsymbol{\pi \Pi}$ |
| `\hm{\pi \Pi}` | $\boldsymbol{\pi \Pi}$ |
| `\uppi` | $\boldsymbol{\pi}$ |
| `\mbox{\boldmath$\pi \uppi \Pi$}` | $\boldsymbol{\pi \pi \Pi}$ |
| `\pmb{\pi}` | $\boldsymbol{\pi}$ |
| `\partial` | $\partial$ |
| `\nabla \times \cccbld` | $\nabla \times \mathbf{c}$ |
| `\nabla \cross \cccbld` | $\nabla \times \mathbf{c}$ |
| `\nabla_{\iii\iii}` | $\nabla_{ii}$ |
| `\nabla_{\!\iii\iii}` | $\nabla_{ii}$ |

# Bibliography

Kopka, H., and P. W. Daly (1995), *A Guide to LaTeX2e*, second ed., Addison-Wesley, Reading, MA.

Kopka, H., and P. W. Daly (1999), *A Guide to LaTeX2e*, third ed., Addison-Wesley, Reading, MA. *a*, *a*, 4.1.3, *a*, 4.17, 6.1, 6.1

Kopka, H., and P. W. Daly (2004), *A Guide to LaTeX2e*, Tools and Techniques for Computer Typesetting, fourth ed., Addison-Wesley, Boston, MA. *a*, *a*, *a*

Zender, C. S. (2001), Radiative transfer in the Earth system, "http://dust.ess.uci.edu/facts/rt/rt.pdf". 1

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