TEXing

An Introductionto LATEX

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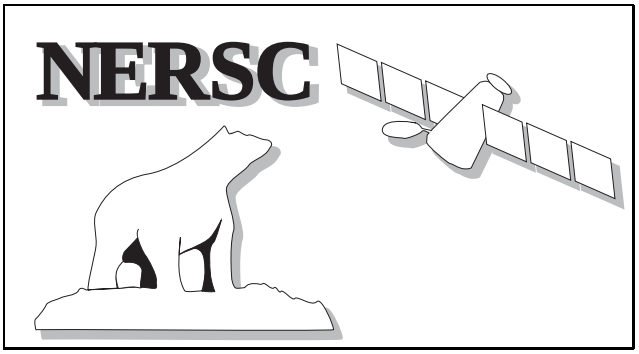

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Contents

1 Snapshots From the World of LaTeX

A near complete description of the LaTeX system is found in the text book

> Leslie Lamport (1986). LaTeX: *A Document Preparation System.* Addison-Wesley Publishing Company. Reading, Massachusetts.

This paper is, of course, an example of a LaTeX document, and the intention with this paper is to give the reader an introduction to LaTeX. In order to distinguish between ordinary bla-bla text in this paper and the actual text typed in your LaTeX file, the latter is typed in `typewriter type style, like this`.

1.1 Basic

Every LaTeX file has to end with .tex, for instance text.tex. A typical syntax for your text.tex file is as follows:

```
\documentstyle[12pt,a4wide]{article}
\begin{document}
    .
    .
    .
\end{document}
```

Here `12pt` indicates that the basic document font size is twelve point, and `article` specifies the document style, or page-setup and -rules. Since LaTeX is developed in the US for the standard US paper, the file `a4wide` redefines the textheigth and -width to fit the A4 paper commonly used in the countries located somewhat nearer the Greenwich meridian. The `12pt`, `a4wide` and `article` files are all examples of style or .sty files. There is a couple of hundred style files on the directory

Fritjof:/usr/local/lib/tex/inputs .

The `documentstyle` example illustrates how LaTeX is organized: The default document rules are defined by `article.sty` (with default ten point font size, this paper is set with 11pt), the style-files between the square brackets `[` and `]` modify *and* extend the default rules. From the quite large number of different style-files one can easily imagine how powerful the LaTeX system is. Examples of some very useful style-files will be given later on.

Now some worlds about the dots in the above example; the text we would like to write. First of all, there are ten special characters in LaTeX namely

\# \$ \% \& ~ _ ^ { } \

In order to turn off the special meaning of the characters, a *backslash* \ is placed in front of the special symbol;

% and & is typed like this.	`\% and \& is typed like this.`

In this example, the left part shows the actual output of your LaTeX document, the right part shows how the text as it is typed in the LaTeX file. This convention will be followed, as far as practical, throughout the paper.

OBS: The backslash symbol \ has a super-super-special meaning in LaTeX and

Backslash \ may be typed like this.

```
Backslash $\backslash$ may be typed like this.
```

Most LaTeX commands begin with a \ character, as illustrated by the above `documentstyle` example.

Furthermore, LaTeX ignores the number of spaces between words, and two subsequent paragraphs are separated by a blank line.

The number of spaces between subsequent words are ignored by LaTeX.

A new paragraph is produced by one (or several) blank line(s).

```
The    number  of        spaces
between subsequent     words   are
ignored by \LaTeX.

A new paragraph is produced    by
one (or several) blank line(s).
```

The character % has two functions: Any text to the right of the character is ignored by LaTeX, and if % is placed at the end of a line, no end-of-line mark is produced.

1.2 National Symbols

œ	`{\oe}`	å	`{\aa}`	ł	`{\l}`
Œ	`{\OE}`	Å	`{\AA}`	Ł	`{\L}`
æ	`{\ae}`	ø	`{\o}`	ß	`{\ss}`
Æ	`{\AE}`	Ø	`{\O}`		

Pål sine høner på ...

```
P{\aa}l sine h{\o}ner p{\aa} ...
```

1.3 Text Mode Accents

ò	`\‘{o}`	ō	`\={o}`	o͡o	`\t{oo}`
ó	`\’{o}`	ȯ	`\.{o}`	o̧	`\c{o}`
ô	`\^{o}`	ŏ	`\u{o}`	ọ	`\d{o}`
ö	`\"{o}`	ǒ	`\v{o}`	o̲	`\b{o}`
õ	`\~{o}`	ő	`\H{o}`		

El Niño

```
El Ni\~{n}o
```

1.4 Miscellaneous Symbols

†	`\dag`	§	`\S`	©	`\copyright`
‡	`\ddag`	¶	`\P`	£	`\pounds`

Copyright © 1992 NERSC

```
Copyright \copyright\ 1992 NERSC
```

1.5 Spaces, Quotation Marks, Dashes, ...

In the subsequent paragraphs the different spaces, quotation marks and dashes in LaTeX are described.

1.5.1 Thin Space

A small amount of space may be inserted between two subsequent characters by the `\,` command:

xxx xx x

```
xxx\,xx\,\,x
```

1.5.2 Spaces After Periods, Parenthesis and Quotes

It is usual to put a little extra space after a sentence-ending period, and LaTeX assumes that a period ends a sentence. The only exception here is if the period follows an upper case letter. In this exceptional case, the command `\@` tells LaTeX that the period ends the sentence:

```
See case B.                    See case B\@.
```

As already stated, LaTeX is not able to distinguish between a sentence-ending period and a period within a sentence. If a period doesn't end a sentence, the command `\␣` tells LaTeX to put *ordinary* space after the (non-sentence-ending) period:

Ask, osp, or, osv. er med dette freda i og omkring Edv. Griegsvei 3a.

```
Ask, osp, or, osv.\ er med dette
freda i og omkring Edv.\ Griegsvei 3a.
```

The rules for space after a right hand parenthesis or quote followed by a period are identical to the rules for a period cited above:

Ask, osp og or (older evt.) er med dette freda i og omkring Edv. Griegsvei 3A.

```
Ask, osp og or (older evt.)\ er med
dette freda i og omkring Edv.\
Griegsvei 3A\@.
```

1.5.3 Arbitrary Spaces

Horizontal spaces are produced by the commands `\hspace*{`*len*`}` and `\hfill`. In the first command, *len* is the length of the space; it can be given in pt, inch, mm, cm or `em`. The latter length is about the width of an "M", and it depends on the font. If you want lengths which are automatically adjusted to the font type and size you use; use `em`! The `\hfill` command equals `\hspace*{\fill}`, and stretches the space as much as possible. Examples follow:

A space of 4 mm is easy to produce, and the `em` command is flexible indeed.

```
A space of 4 mm is\hspace*{4mm}easy to
produce, and the \verb+em+ command
is \hspace*{3em} flexible indeed.
```

An example of the `\hfill` command:

NERSC tjohei May 4, 1995

```
NERSC\hfill tjohei\hfill\today\\
```

In the above example, the command `\\` terminates a line (same as `\newline`), and `\today` produces todays date. The vertical space after a terminated line may be adjusted by the command `\\[`*len*`]`, where *len* is the actual space:

Notice the space between this
and this line.

```
Notice the space between this\\[5mm]
and this line.
```

Vertical spaces are produced by the vertical version of the `hspace` command, namely `\vspace*{`*len*`}`. The font dependent height is named `ex`, and gives the height of "x".

1.5.4 Quotation Marks

Quotation marks are typed by the ` and ' characters:

"I hate 'quotations'. Tell me what you know."

```
``I hate `quotations'.  Tell me what you know.''
```

Quotation marks within quotes are handled specially:

"'This' is what I just wrote, not 'that'"

```
``\,`This' is what I just wrote, not `that'\,''
```

1.5.5 Dashes

There are three types of dashes:

An intra-word dash, a medium dash for number ranges like 1–2, and a punctation dash—like this.

```
An intra-word dash, a medium dash for
number ranges like 1--2, and a
punctation dash---like this.
```

1.6 Footnotes

Footnotes are produced by the `\footnote` command:

Creating footnotes[a] is easy, very easy.

[a] Don't leave any space between the footnote-word and the \footnote command!

```
Creating footnotes\footnote{Don't
leave any space between the
footnote-word and the
\verb+\footnote+ command!} is easy,
very easy.
```

1.7 Font Types

The default font type in LaTeX is roman, and the basic font type in this paper is roman. The font types direct available in LaTeX are:

This is Roman font type, and
this is *Italic font type*, and
this is **Bold face font type**, and
this is *Slanted font type*, and
this is SMALL CAPS FONT TYPE, and
this is `Typewriter font type`, and
this is Sans serif font type; finito!

```
This is {\rm roman font type}, and
this is {\it Italic font type}, and
this is {\bf Bold face font type}, and
this is {\sl Slanted font type}, and
this is {\sc caps font type}, and
this is {\tt Typewriter font type}, and
this is {\sf Sans serif font type}; finito!
```

1.8 Font Sizes

The default text font size is normalsize, which in this paper is 11pt. The other text font sizes direct available in LaTeX are:


```
{\tiny These are ...}
{\footnotesize these ...}
{\small but still ...}
```

The normal world,
or a little bit larger,
but still smaller than
this font.
The huge fonts
are really big.

```
{\normalsize The normal ...}
{\large or a little ...}
{\Large but still ...}
{\LARGE this font.}
{\huge The huge fonts}
{\Huge are really big.}
```

You can therefore mix the font sizes and types as you like, but you should also have in mind the reader:

This text is not that easy to read.

The spacing between characters and lines are automatically adjusted according to the size of the characters on the line.

1.9 Underline and Emphasize

In addition to the different font types and sizes, text can be underlined and emphazised:

It is easy to underline text, and emphazise *text*, and deemphazise *emphazised text*.

```
It is easy to \underline{underline text}, and emphazise {\em text\/},
and {\em{\em deemphazise\/} emphazised \underline{text}}.
```

The command `\/` prevents that slanted fonts bump into vertical fonts.

1.10 Running LaTeX

Assume your LaTeX file is *text.tex*, then the following sequence compiles and produces a *PostScript* file of your document, and prints it on printer *lp2*.

latex text → dvips text → lpr -Plp2 text.ps

The *latex* command compiles the text.tex file. If there are syntax errors in the file, error messages are printed on the terminal. Some of the error messages may help you in identifying the errors, but not always. Anyway, notice the line number of which the error message is based. If the errors are not too serious, you can go further in the compilation by pressing the *return* key. To quit the compilation, press the *x* key.

When the tex-file is compiled, a *.dvi*-file is generated. The program *dvips* then converts the .dvi-file into a *PostScript* file named text.ps. There are some nice options connected with the dvips program, see *man dvips*. For instance, if you want to print pages 5 to 11 of your document, write

dvips -p5 -n6 text

where *p* denotes the starting page, and *n* the number of pages.

1.11 Preview

Any latex-compiled document can be previewed on a X-terminal by typing the command

xdvi document_name

The previewer is updated every time you LaTeX compile your document, it is therefore usual to run the xdvi program in background (for instance xdvi text &). Again, read *man xdvi* for the different options connected with the xdvi-program.

1.12 Spelling

There is a special spelling program for LaTeX files, named *texspell*. If your `tex` file is text.tex, then type

texspell text.tex

and the words in the text.tex file which is not found in the English dictionary are displayed on the terminal.

1.13 The Argument Style Files

- `article`: For short documents
- `report`: For longer documents
- `book`: For *books*
- `letter`: For American styling letters

1.14 Some Optional Style Files

- `no`: Norwegian text
- `a4wide`: For A4 paper
- `11pt`, `12pt`: 11 and 12 point font size
- `twocolumn`: Produces a two-column document
- `twoside`: Formats the output for printing on both sides of a page
- `doublespace`: Produces document with double line spacing
- `epsf`: Encapsulated *PostScript* files may be included in the document
- `leqno`: Cause the formula numbers to appear on the left instead of the right
- `lablst`: Prints label definitions at the end of the document
- `fleequ`: Cause displaced formulas to be aligned to the left, a fixed distance from the left margin, instead of being centered.

1.14.1 xarticle Style File

The style files in Subsec. 1.13 accept only 10pt (which is the default point size), 11pt or 12pt as the basic font size. With the `xarticle` file, however, the basic font sizes may be 7, 8, 9, 10, 11 or 12pt:

```
\documentstyle[8pt,a4wide]{xarticle}
```

gives a A4-document with 8pt basic font size. Similar syntax for the other basic font sizes.

1.15 Cross-References

Numbered environments (like section, subsection ..., figure, equation, ...) can be cross-referenced by the `ref` command, and pages can be cross-refenced by the `pageref` command. Each of the numbered environments you want to refer to are associated with a *key*, and the key is assigned by the `\label` command. A cross-reference to a page is carried out as follows:

The word kôkko can be found on page 7.

```
The word \label{pageA}k\^{o}kko can be found
on page \pareref{pageA}.
```

Here *key* is set to *pageA*. Examples of cross-references of the sectioning commands are given in Subsec. 1.16, and of mathematical expressions in the following section.

1.16 Sectioning

The sectioning hierarchy in LaTeX is as follows:

Part → Chapter → Section → Subsection → Subsubsection → Paragraph → Subparagraph

The chapter command is not defined in the `article` style, the `report` and `book` styles accept all of the above sectioning commands. For the `article` style, we then have:

Part I
Part

15 Section

Text ...

15.1 Subsection

Text ... 15.1.1

15.1.1 Subsubsection

Text ... 15 ...

Paragraph Text ...

Subparagraph Text ...

```
\part{Part}
\section{\label{sec:tja}Section}
Text ...
\subsection{Subsection}
Text ... \ref{subs:hei}
\subsubsection{\label{subs:hei}Sub...}
Text ... \ref{sec:tja} ...
\paragraph{Paragraph}
Text ...
\subparagraph{Subparagraph}
Text ...
```

An $*$ between any sectioning command and the left curly bracket produces an unnumbered sectioning:

Unnumbered sec... `\subsection*{Unnumbered sec...}`

Since there are no number associated with the above sectioning command, no cross-reference is possible.

The header of this document is based on the section and subsection names. If the section or subsection names are long, a shorter version of the strings may be typed in square brackets between the sectioning names and the argument:

`\subsection[`*opt. arg*`]{`*arg*`}`

In this case the *optional argument* is used in the header (see Subsec. 5.4) and the table of content (see Subsec. 5.3).

1.17 Appendix

Appendixes are generated by the command

`\appendix`

After this command, all of the sectioning commands are numbered A, B, ...

2 Cruising Into the World of TEXMath

There are two basic modes in LATEX; text- and math-mode. *Any* mathematical expression, in the text or displayed as equations, expressions ..., should be written in math-mode. Mathematical expressions in the text are enclosed by the symbol $:

Let x be y and y be high, and as we see $p = \sqrt{xy}$, as expected.

```
Let $x$ be $y$ and $y$ be high, and as we see $p=\sqrt{xy}$ ...
```

Notice the difference between the text and math fonts. Fractions in text is usually typed like this:

... and here we see that x/y is a common factor in the ...

```
... and here we see that $x/y$ is a common factor in the ...
```

Spaces in math-mode are ignored, so `$xy$`, `$x y$`, and `$x  y$` give all the same output: xy. Spaces in the text file are used to increase the readability of the expressions. In order to insert or remove spaces in the document, you can use the following space-commands:

`\,`	thin space; $xx\,x$	`$xx\,x$`
`\:`	medium space; $xx\:x$	`$xx\:x$`
`\;`	thick space; $xx\;x$	`$xx\;x$`
`\!`	negative thin space; $xx\!x$	`$xx\!x$`

Of these, only the command `\,` can be used in text mode.

2.1 Displayed Expressions

Let us now go over to displayed mathematical expressions. All you have to do in LATEX in order to get an unnumbered displayed expression is to enclose the expression between the commands `\[` and `\]`:

$$y = \frac{4x}{y^2}$$

```
\[  y=\frac{4x}{y^2}\]
```

Enumerated expressions are enclosed by the commands `\begin{equation}` and `\end{equation}`:

$$I(x) = \int_0^x x^2 dx \tag{1}$$

```
\begin{equation}
    I(x) = \int_0^x x^2 dx  \label{eq:first}
\end{equation}
```

The `\label{eq:first}` command in the LATEX file enables you to refer to expression `first` later on in the paper:

... and if we take the difference between Eq. 1 and ...

```
... and if we take the difference between Eq.~\ref{eq:first} and ...
```

2.2 Sub- and Superscripts

$$x_2^4 = x^4_2 \qquad \texttt{x\^{}4\_2 = x\_2\^{}4}$$

$$x^{4x} \qquad \texttt{x\^{}\{4x\}}$$

$$x^{4^{4x}} \qquad \texttt{x\^{}\{4\^{}\{4 x\}\}}$$

2.3 Fractions

$$y = \frac{x^4 + x^3 + 3/x}{z_1^7 - z_2^{266}} \qquad \texttt{y = \backslash frac\{x\^{}4 +x\^{}3+ 3/x\}\{z\_1\^{}7 - z\_2\^{}\{266\}\}}$$

$$y = \frac{10 - \frac{x}{y}}{x^6 - 4} \qquad \texttt{y = \backslash frac\{10 - \backslash frac\{x\}\{y\}\}\{x\^{}6 - 4\}}$$

2.4 Roots

$$y = \sqrt{\frac{x^4}{p}} \qquad \texttt{y = \backslash sqrt\{\backslash frac\{x\^{}4\}\{p\}\}}$$

$$y = \sqrt[n]{x} \qquad \texttt{y = \backslash sqrt[n]\{x\}}$$

2.5 Summations

$$y = \sum_{n=-\infty}^{\infty} x^n \qquad \texttt{y = \backslash sum\_\{n = -\backslash infty\}\^{}\{n = \backslash infty\} x\^{}n}$$

2.6 Products and Coproducts

$$y = \prod_{p=4}^{6} p^{1/2} \qquad \texttt{y = \backslash prod\_\{p = 4\}\^{}\{6\} p\^{}\{1/2\}}$$

$$y = \coprod_{p=4}^{6} p^{1/2} \qquad \texttt{y = \backslash prod\_\{p = 4\}\^{}\{6\} p\^{}\{1/2\}}$$

2.7 Integrals

$$y = \int_0^{20} \sqrt{\exp x^4}\, dx \qquad \texttt{y = \backslash int\_0\^{}\{20\} \backslash sqrt\{\backslash exp x\^{}4\}\backslash , dx}$$

$$y = \oint_a^b \arccos f(\beta)\, d\beta \qquad \texttt{y = \backslash oint\_a\^{}b \backslash arccos f(\backslash beta) \backslash , d\backslash beta}$$

2.8 Delimeters

$$y = \begin{cases} x^4 & \text{for } x > 3/4 \\ 3 & \text{for } x \leq 3/4 \end{cases}$$

```
\[y = \left\{ \begin{array}{ll}
                x^4 & \mbox{ for $x>3/4$}\\
                3   & \mbox{ for $x\leq3/4$}
              \end{array}
     \right.\]
```

$$y = \left(\begin{array}{ccc} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{array} \right)$$

```
\[ y = \left( \begin{array}{ccc}
                a_{11}&a_{12}&a_{13}\\
                a_{21}&a_{22}&a_{23}\\
                a_{31}&a_{32}&a_{33}
              \end{array}
       \right)\]
```

$$y = \left[\begin{array}{cccc} a_{11} & a_{12} & & \\ a_{21} & a_{22} & & \\ & & \ddots & \\ & & & a_{nn} \end{array} \right|$$

```
\[ y = \left[ \begin{array}{cccc}
                a_{11}&a_{12}&      &\\
                a_{21}&a_{22}&      &\\
                      &      &\ddots&\\
                      &      &      &a_{nn}
              \end{array}
       \right|\]
```

2.8.1 The Different Delimeters (math mode)

(	(	)	)
[	[	]	]
{	\{	}	\}
⌊	\lfloor	⌋	\rfloor
⌈	\lceil	⌉	\rceil
/	/	\	\backslash
|	\vert	‖	\Vert
↑	\uparrow	⇑	\Uparrow
↓	\downarrow	⇓	\Downarrow
↕	\updownarrow	⇕	\Updownarrow

2.9 Greek Letters (math mode)

α \alpha	θ \theta	o 0	τ \tau
β \beta	ϑ \vartheta	π \pi	υ \upsilon
γ \gamma	ι \iota	ϖ \varphi	ϕ \phi
δ \delta	κ \kappa	ρ \rho	φ \varphi
ϵ \epsilon	λ \lambda	ϱ \varrho	χ \chi
ε \varepsilon	μ \mu	σ \sigma	ψ \psi
ζ \zeta	ν \nu	ς \varsigma	ω \omega
η \eta	ξ \xi		
Γ \Gamma	Λ \Lambda	Σ \Sigma	Ψ \Psi
Δ \Delta	Ξ \Xi	Υ \Upsilon	Ω \Omega
Θ \Theta	Π \Pi	Φ \Phi	

2.10 Variable-Sized Symbols (math mode)

The left columns give the symbols used in text (enclosed by $'s), the right columns give the symbols in displayed expressions (basically in \[and \], or in \begin{equation} and \end{equatin} environments)

$\sum$	$\displaystyle\sum$	\sum	$\bigcap$	$\displaystyle\bigcap$	\bigcap
$\prod$	$\displaystyle\prod$	\prod	$\bigcup$	$\displaystyle\bigcup$	\bigcup
$\coprod$	$\displaystyle\coprod$	\coprod	$\bigsqcup$	$\displaystyle\bigsqcup$	\bigsqcup
$\int$	$\displaystyle\int$	\int	$\bigvee$	$\displaystyle\bigvee$	\bigvee
$\oint$	$\displaystyle\oint$	\oint	$\bigwedge$	$\displaystyle\bigwedge$	\bigwedge
$\bigodot$	$\displaystyle\bigodot$	\bigodot	$\bigotimes$	$\displaystyle\bigotimes$	\bigotimes
$\bigoplus$	$\displaystyle\bigoplus$	\bigoplus	$\biguplus$	$\displaystyle\biguplus$	\biguplus

2.11 Relations (math mode)

$\leq$	\leq	$\geq$	\geq	$\prec$	\prec	$\succ$	\succ
$\preceq$	\preceq	$\succeq$	\succeq	$\ll$	\ll	$\gg$	\gg
$\subset$	\subset	$\supset$	\supset	$\subseteq$	\subseteq	$\supseteq$	\supseteq
$\sqsubset$	\sqsubset	$\sqsupset$	\sqsupset	$\sqsubseteq$	\sqsubseteq	$\sqsupseteq$	\sqsupseteq
$\in$	\in	$\ni$	\ni	$\vdash$	\vdash	$\dashv$	\dashv
$\smile$	\smile	$\frown$	\frown	$\mid$	\mid	$\parallel$	\parallel
$\neq$	\neq	$\equiv$	\equiv	$\sim$	\sim	$\simeq$	\simeq
$\asymp$	\asymp	$\approx$	\approx	$\perp$	\perp	$\cong$	\cong
$\bowtie$	\bowtie	$\propto$	\propto	$\models$	\models	$\doteq$	\doteq
$\Join$	\Join						

2.12 Binary Operations

$\pm$	\pm	$\mp$	\mp	$\cap$	\cap	$\cup$	\cup
$\setminus$	\setminus	$\uplus$	\uplus	$\sqcap$	\sqcap	$\sqcup$	\sqcup
$\cdot$	\cdot	$\times$	\times	$*$	\ast	$\star$	\star
$\diamond$	\diamond	$\circ$	\circ	$\bullet$	\bullet	$\div$	\div
$\triangleleft$	\triangleleft	$\triangleright$	\triangleright	$\wr$	\wr	$\bigcirc$	\bigcirc
$\bigtriangleup$	\bigtriangleup	$\bigtriangledown$	\bigtriangledown	$\lhd$	\lhd	$\rhd$	\rhd
$\vee$	\vee	$\wedge$	\wedge	$\odot$	\odot	$\amalg$	\amalg
$\oplus$	\oplus	$\ominus$	\ominus	$\otimes$	\otimes	$\oslash$	\oslash
$\dagger$	\dagger	$\ddagger$	\ddagger	$\unlhd$	\unlhd	$\unrhd$	\unrhd

2.13 Arrows (math mode)

$\leftarrow$	\leftarrow	$\longleftarrow$	\longleftarrow
$\Leftarrow$	\Leftarrow	$\Longleftarrow$	\Longleftarrow
$\rightarrow$	\rightarrow	$\longrightarrow$	\longrightarrow
$\Rightarrow$	\Rightarrow	$\Longrightarrow$	\Longrightarrow
$\leftrightarrow$	\leftrightarrow	$\longleftrightarrow$	\longleftrightarrow
$\Leftrightarrow$	\Leftrightarrow	$\Longleftrightarrow$	\Longleftrightarrow
$\mapsto$	\mapsto	$\longmapsto$	\longmapsto
$\hookleftarrow$	\hookleftarrow	$\hookrightarrow$	\hookrightarrow
$\leftharpoonup$	\leftharpoonup	$\rightharpoondown$	\rightharpoondown
$\rightleftharpoons$	\rightleftharpoons	$\leadsto$	\leadsto
$\uparrow$	\uparrow	$\Uparrow$	\Uparrow
$\downarrow$	\downarrow	$\Downarrow$	\Downarrow
$\updownarrow$	\updownarrow	$\Updownarrow$	\Updownarrow
$\nearrow$	\nearrow	$\searrow$	\searrow
$\swarrow$	\swarrow	$\nwarrow$	\nwarrow

2.14 Micellaneous Symbols (math mode)

$\aleph$	\aleph	$\hbar$	\hbar	$\imath$	\imath	$\jmath$	\jmath
ℓ	\ell	$\wp$	\wp	$\Re$	\Re	$\Im$	\Im
∂	\partial	∞	\infty	$\Box$	\Box	$\forall$	\forall
$\exists$	\exists	$\neq$	\neq	$\flat$	\flat	$\natural$	\natural
$\mho$	\mho	$\prime$	\prime	$\emptyset$	\emptyset	∇	\nabla
$\surd$	\surd	$\top$	\top	$\bot$	\bot	l	\l
$\angle$	\angle	$\triangle$	\triangle	$\backslash$	\backslash	$\Diamond$	\Diamond
$\clubsuit$	\clubsuit	$\diamondsuit$	\diamondsuit	$\heartsuit$	\heartsuit	$\spadesuit$	\spadesuit
$\sharp$	\sharp	$\natural$	\natural				

2.15 "Log-Like" Functions (math mode)

```
\arccos   \csc   \ker      \min
\arcsin   \deg   \lg       \Pr
\arctan   \det   \lim      \sec
\arg      \dim   \liminf   \sin
\cos      \exp   \limsup   \sinh
\cosh     \gcd   \ln       \sup
\cot      \hom   \log      \tan
\coth     \inf   \max      \tanh
```

2.16 Math Mode Accents (math mode)

$\hat{a}$	`\hat{a}`	$\check{a}$	`\check{a}`	$\tilde{a}$	`\tilde{a}`	$\acute{a}$	`\acute{a}`
$\grave{a}$	`\grave{a}`	$\dot{a}$	`\dot{a}`	$\ddot{a}$	`\ddot{a}`	$\breve{a}$	`\breve{a}`
$\bar{a}$	`\bar{a}`	$\vec{a}$	`\vec{a}`				

2.17 Over- and Underlining

The `\overline` command puts a horizontal line above its argument, the `\underline` command puts a horizontal line below its argument:

$$\overline{x+4\cdot \underline{y\alpha}}$$ `\overline{x+4\cdot y\underline{\alpha}}`

In a similar way, horizontal braces are put above and below an expression with the `\overbrace` and `\underbrace` commands:

$$\underbrace{x^4+3x^3+7x^2+\overbrace{x-328540456.55}^{\text{Linear part}}}_{\text{4th order polynomial}}$$

```
\underbrace{x^4+3x^3+7x^2+\overbrace{x-3..}^{\mbox{Linear part}}}_{\mbox{4th order polynomial}}
```

2.18 Stacking Symbols

The `\stackrel` command stacks one symbol over another:

$$\alpha \stackrel{\text{def}}{=} x^7$$ `\alpha\stackrel{\rm def}{=}x^7`

2.19 Math Style

There are four math styles when LaTeX typesets formulas:

display For normal symbols in formula.

text For normal symbols in in-text formula.

script For subscript and superscript.

scriptscript For further levels of sub- and superscripting.

Example:

An in-text formula $\oint \sqrt{x^2}$; and the same expression using the `displaystyle` command $\displaystyle{\oint \sqrt{x^2}}$ makes a lot of difference.

```
An in-text formula $\oint
\sqrt{x^2}$; and the same
expression using the {\tt
displaystyle} command
$\displaystyle{\oint
\sqrt{x^2}}$ makes a
lot of difference.
```

3 LaTeX Environments

3.1 Abstract

\begin{abstaract} *text* \end{abstract}

generates an abstract, with *text* as its contents. The abstract is placed on a page by itself in the `report` style or `titlepage` style option (see Subsec. 3.21). It is not available in the `book` document style.

3.2 Array

Frequently used environment, notice the

$$\begin{array}{clrc} x+y+z & k^2-3 & z_2^7/\sin\pi & g \\ \alpha & g & x & \beta \end{array}$$

difference between the right (`r`), centered (`c`), and left (`l`) arguments.

```
Frequently used environment, ...
\[\array{clrc}
      x+y+z  & k^2-3 & z_2^7/\sin\pi & g\\
      \alpha & g     & x            & \beta
  \end{array}\]
difference between the right  ({\tt r}) ...
```

3.3 Center

This
text
is centered,
OK?

```
\begin{center}
This\\text\\
is centered,\\
OK?
\end{center}
```

3.4 Description

The items are presented in Bold fase types in this environment, and

Coccoliths: $CaCO_3$ forming organisms in the sea

Diatoms: $SiO_2.nH_2O$ forming zooplankton in the sea

notice the nice indentation.

```
... text ...
\begin{description}
\item[Coccolith:] CaCO$_3$ form ...
\item[Diatoms:] SiO$_2$.$n\/$H$_2$O
forming zooplankton in the sea
\end{description}
... text ...
```

3.5 Displaymath

\[*formula* \]

produces a centered formula with no equation number.

3.6 Enumerate

The enumerate environment enclosed by text by text by text ...

1. This is the first item
2. ... and this the second,
3. third ...

looks like this.

```
... text ...
\begin{enumerate}
\item This is the first item
\item ... and this the second,
\item third ...
\end{enumerate}
... text ...
```

The `\item` command has an optional argument;

`\item[`*arg*`]`

produces *arg* instead of numbers.

3.7 Eqnarray

Notice that the equations are centered on the page, and that the ='s are vertically adjusted

$$x = 4\pi$$
$$y + x - a = x/2 \quad (2)$$
$$z = 2 \quad (3)$$

independent of the length of the right- or lefthand sides of the equations.
`eqnarray*` produces no numbers:

$$x = 4\pi$$
$$y + x - a = x/2$$
$$z = 2$$

but is otherwise similar to `eqnarray`.

```
Notice that ...
  .
\begin{eqnarray}
x & = & 4\pi\nonumber\\
y + x - a & = & x/2\\
z & = & 2
\end{eqnarray}
independent of the length ...
  .
  .
{\tt eqnarray*} produces no numbers:
\begin{eqnarray*}
x & = & 4\pi\nonumber\\
y + x - a & = & x/2\\
z & = & 2
\end{eqnarray*}
but is otherwise similar ...
```

3.8 Equation

The standard environment for equations, expressions ...

$$\frac{\sin x}{x} = \sin \quad (4)$$

Eq. 4 is obvious, isn't it?

```
The standard environment for equations,
expressions ...
\begin{equation}
\frac{\sin x}{x} = \sin \label{eq:M011}
\end{equation}
Eq.~\ref{eq:M011} is obvious, isn't it?
```

3.9 Figure

`\begin{figure}[`*loc*`]` *body* `\end{figure}`

produces a single-column floating figure. In two-column format, the additional form

\begin{figure*}[*loc*] *body* \end{figure*}

produces a double-column figure.

The *loc* argument is a sequence of zero to four letters, each one specifying where the figure may be placed:

`h` *Here*; at the position in the text where the figure appears.

`t` *Top*; at the top of a text page.

`b` *Bottom*; at the bottom of the text page.

`p` *Page of floats*; on a separate page containing no text, only figures and tables.

The first letter has highest priority, then the second, third and fourth letter.

Inside the *body* one ore more

\caption[*entry*]{*heading*}

commands may occur. Here *entry* is the text string used in the list of figures (see Subsec. 5.3). If *entry* is missing, the *heading* argument is used. *heading* is the text of the caption. If you want to refer to expressions, references, ... in the caption-string, use the `\protect` command:

```
\protect\ref{eq:first}          \protect\cite{hau90}
```

The *body* may be everything. A empty figure is produced by the `\vspace*{`*len*`}` command, for instance a 10 cm high figure environment is produced by typing:

```
\begin{figure}[htb]
\vspace*{100mm}
\caption{\label{fig:empty} ...text...}
\end{figure}
```

The `\caption` command produces the caption *and* the figure number, omitting the `\caption` command results in an unnumbered figure. The `\label` command has to be placed inside the `\caption` command in order to get the correct number of the figure for cross-references.

If the `epsf` style is included in the document, *PostScript* figures may be included in the figure. The NERSC logo is named *logo.eps*, and may be included into a figure in the following way:

```
\begin{figure}[thpb]
\begin{center}
\mbox{\fbox{\epsfxsize=0.5\textwidth\epsffile{logo.eps}}}
\caption{\label{fig:logo}The NERSC logo.}
\end{center}
\end{figure}
```

The size of the figure is adjusted according to the size of the *PostScript* file. For the figure environment, the `\fbox` produces the framed box around the logo, and the horizontal size of the logo is set to 0.5 times the width of the page. The caption occurs in the figure where it is typed. `tex` files (here assumed to be `fig.tex`) is included by the command

```
\include{fig}
```

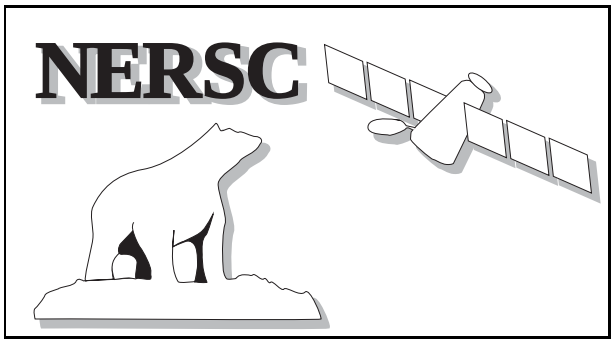

Figure 1: The NERSC logo.

3.10 Flushleft

`\begin{flushleft}` *text* `\end{flushleft}`

is as the `center` environment, but the text is moved to the left margin.

3.11 Flushright

As above with `flushleft` substituted by `flushright`, but the text is moved to the left margin.

3.12 Itemize

The default environment gives you as many •'s as you please:

- A bullet for this item ...
- ... and this ...

```
\begin{itemize}
\item A bullet for this item ...
\item ... and this ...
\end{itemize}
```

The optional argument of the `\item` command

`\item[`*arg*`]`

produces *arg* instead of bullets:

♠ Item 1,

⇝ item 2.

```
\begin{itemize}
\item[$\spadesuit$] Item 1,
\item[$\leadsto$] item 2.
\end{itemize}
```

3.13 Math

`$` *formula* `$`

produces *formula* within text.

3.14 Minipage

\begin{minipage}[*pos*]{ *width*} *text* \end{minipage}

produces a box of width *width* on the page. The *pos* argument is either `b` or `t`:

`b` The bottom line of the minipage is aligned with the current line of the text.

`t` The top line is aligned with the current line of text.

The two-column examples of this document have been produced by the `minipage` environment.

3.15 Picture

The way to create pictures or figures in LaTeX. The environment is coordinate based. Not especially user-friendly, use Xfig! See the LaTeX manual pp. 196 for an explanation of the environment.

3.16 Quote and Quotation

\begin{quote} *text* \end{quote}

produces an environment where the left and right margins are indented equally, no paragraph indentation, and extra vertical space is added between the paragraphs.

\begin{quotation}*text* \end{quotation}

produces an environment where the left and right margins are indented equally, normal paragraph indentation and interparagraph vertical space is used.

3.17 Tabbing

\begin{tabbing} *rows* \end{tabbing}

produces an environment where a sequence of lines are aligned in columns. See example below and the corresponding description (for further information; see the LaTeX manual!)

Hello, how do you do?
1 2 3
4 5

```
\begin{tabbing}
Hello, \= how do \= you do?\\
1      \>  2     \>  3\\
   4   \>        \>  5
\end{tabbing}
```

The command `\=` defines the columns, and the command `\>` start the text on the next column. The strength of the environment is that it may go over several pages.

3.18 Table

Identical to the `figure` environment when `figure` is changed to `table`.

3.19 Tabular

\begin{tabular}[*pos*]{*cols*} *rows* \end{tabular}

\begin{tabular*}{*width*}[*pos*]{*cols*} *rows* \end{tabular*}

produces tabulars. *width* specifies the width of the `tabular*` environment. *pos* specifies the vertical positioning; the default is alignment on the center of the environment, `t` align on top row, `b` align on bottom row. *col* specifies the column formatting; left (`l`), center (`c`), right (`r`) and a vertical line (`|`):

Pressure (bar)	Temperature (°C)						
	-2	0	4	10	13	16	19
0	0.0261	0.0541	0.1049	0.1713	0.2010	0.2287	0.2551
100	0.0570	0.0825	0.1292	0.1902	0.2176	0.2434	0.2679

```
\begin{tabular}{|c|ccrclcc|}
\hline
Pressure&\multicolumn{7}{c|}{Temperature ($^{\circ}$C)}\\\cline{2-8}
(bar)&-2&0&4&10&13&16&19\\\hline\hline
0&0.0261&0.0541&0.1049&0.1713&0.2010&0.2287&0.2551\\
100&0.0570&0.0825&0.1292&0.1902&0.2176&0.2434&0.2679\\\hline
\end{tabular}
\end{center}
```

Here `\hline` draws a horizontal line extending the full width of the environment, `\cline{`col_1`-`col_2`}` draws a horizontal line across columns col_1 through col_2, `\multicolumn{`*num*`}{`*col*`}{`*item*`}` makes *item* the text of a single item spanning *num* columns, positioned as specified by *col*. The command `&` separates the items on each row, and `\\` ends the rows.

3.20 Theorem

For theorem-like structures. The structure, here assumed to be a lemma, is defined by the command

\newtheorem{lemma}{Lemma}[section]

The above string is usually placed before `\begin{document}`; it has to be placed before the actual structure is used. `lemma` is the name of the environment, `Lemma` will be printed in bold face types in the document, and the optional argument `section` indicates that the numbering should follow the section number. In order to crate a lemma, type in your `tex` file:

```
\begin{lemma}[Rolle's theorem]
   Let $f$ be defined on $[a,b]$, $a\neq b$. Assume that ...
\end{lemma}
```

... which in the document becomes

Lemma 3.1 (Rolle's theorem) *Let f be defined on $[a, b]$, $a \neq b$. Assume that ...*

The text enclosed between the square brackets (Rolle & Co.) is optional.

Another example:

```
\newtheorem{defi}{Definition}[subsection]
```

This command should produce a definition-structure named `defi` and numbered after the actual subsection number. If the `text` file looks like

```
\begin{defi}
Let $f(x)$ be a function defined in some neighborhood of $x=a$ ...
\end{defi}
```

the output becomes

Definition 3.20.1 *Let $f(x)$ be a function defined in some neighborhood of $x = a$ ...*

3.21 Titlepage

`\begin{titlepage}` *text* `\end{titlepage}`

produces a titlepage with *text*, but otherwise empty (no page number, no header). The number of the following page is set to one.

3.22 Verbatim

`\begin{verbatim}` *text* `\end{verbatim}`

typesets *text* exactly as typed, including special characters, spaces and line breaks, using a typewriter (`\tt`) type style. The `verbatim*` environment prints spaces as ␣ symbols. In the `verbatim*` environment, the last lines of this paragraph looks like:

```
breaks,␣using␣a␣typewriter␣(\verb+\tt+)␣type␣style.␣The␣\verb+verbatim*+
environment␣prints␣spaces␣as␣\verb*+␣+␣symbols.␣In␣the␣\verb+verbatim*+
environment,␣the␣last␣lines␣of␣this␣paragraph␣looks␣like:
```

See also Subsec. 5.6.

3.23 Verse

`\begin{verse}` *text* `\end{text}`

produces an environment well suited for poetry; a new stanza is begun with one or more blank lines; lines within a stanza are separated by a `\\` command:

En telegrafist ifra Rena
til daglig kalt trådløse Lena
hun solte seg bar
og sa som det var
jeg tives med sol mellom bena

```
\begin{verse}
En telegrafist ifra Rena\\
til daglig kalt tr{\aa}dl{\o}se Lena

hun solte seg bar\\
og sa som det var\\
jeg trives med sol mellom bena
\end{verse}
```

4 BibTeXing

There are two basic ways to use the bibliography system including cross-references (i.e. citing) in LaTeX, in the following a short description of the bibliography database system is given.

4.1 The Database Itself

All of your articles, books, tech-reports, manuals, proceedings, ... should be typed in one (or several) *.bib* file(s), for instance *ref.bib*. BibTeX classifies the references according to the entry types:

article	**book**	**booklet**
conference	**inbook**	**incollection**
inproceedings	**manual**	**masterthesis**
misc	**phdthesis**	**proceedings**
techreport	**unpublished**	

Depending on the entry type, the following fields are used to describe the references:

address	**annote**	**author**	**booktitle**
chapter	**edition**	**editor**	**howpublished**
institution	**journal**	**key**	**month**
note	**number**	**organization**	**pages**
publisher	**school**	**series**	**title**
type	**volume**	**year**	

Before we go through the actual fields used for the different entries, a list of a .bib file is given below:

```
@STRING{MEPS="Mar. Ecol. Prog. Ser."}
@STRING{JGR="J. Geophys. Res."}
@STRING{N="Nature"}
@STRING{DSR="Deep Sea Res."}
@STRING{LO="Limnol. Oceanogr."}
@STRING{GBC="Global Biogeochem. Cycles"}
@STRING{PHILA="Phil. Trans. R. Soc. Lond. A"}
@STRING{PROCB="Proc. R. Soc. Lond. B"}
@STRING{T="Tellus"}
@STRING{JPO="J. Phys. Oceanogr."}

@ARTICLE{men60,
    AUTHOR  = "D. W. Menzel and J. H. Ryther",
    TITLE   = "{The annual cycle of primary production in the Sargasso
               Sea off Bermuda}",
    JOURNAL = DSR,
    VOLUME  = "6",
    YEAR    = "1960",
    PAGES   = "351--367"}

@BOOK{kin69,
    AUTHOR  = "M. B. King",
    TITLE   = "{Phase Equilibrium in Mixtures}",
    PUBLISHER = "Pergamon Press",
    ADDRESS = "Oxford",
```

```
    YEAR    = "1969"}

@INBOOK{hun85,
    EDITOR  = "O. Huntzinger",
    TITLE   ="{The Handbook of Environmental Chemistry}",
    PAGES = "30--81",
    PUBLISHER = "Springer-Verlag",
    ADDRESS = "Berlin",
    YEAR    = "1985"}

@INCOLLECTION{jan92,
    AUTHOR = "Eystein Jansen",
    TITLE  = "{Deglaciation, Impact on Ocean Circulation}",
    BOOKTITLE = "{Encyclopedia of Earth system Science}",
    PUBLISHER = "Academic Press",
    YEAR = "1992",
    PAGES = "35--45",
    NOTE = "Volume 2"}

@INPROCEEDINGS{lis86,
    AUTHOR  = "Peter S. Liss and Liliane Merlivat",
    EDITOR = "P. Buat-M\'{e}nard",
    TITLE   = "{Air-sea gas exchange: Introduction and synthesis}",
    BOOKTITLE = "{The Role of Air-Sea Exchange in Geochemical Cycling}",
    PUBLISHER = "Reidel",
    ADDRESS = "Dordrecht",
    YEAR    = "1986",
    PAGES   = "113-127"}

@MISC{mor92,
    TITLE = "{Jet Mixing Model of CO$_2$ Injected into a Deep Ocean}",
    AUTHOR = "Masao Morishita and Gilbert Stegen",
    HOWPUBLISHED = "Poster paper presented at ICCDR Amsterdam,
                    March 4--6",
    YEAR = "1992"}

@PROCEEDINGS{nih90,
    EDITOR = "Jacques C. J. Nihoul and S. Djenidi",
    TITLE  = "Introduction to system analysis and mathematical modelling
              applied to the marine system",
    PUBLISHER = "GEHR; University of Liege",
    ADDRESS = "Liege",
    ORGANIZATION = "The European Association of Marine Sciences and
    Techniques",
    YEAR = "1990"}

@TECHREPORT{lee80,
    AUTHOR  = "D. W. Lee",
    TITLE   = "{An Analytical Model for a Vertical Buoyant Jet}",
    YEAR    = "1980",
    INSTITUTION = "Oak Ridge National Laboratory",
    ADDRESS = "Oak Ridge, Tennessee",
    NUMBER = "ORNL/TM--7140"}

@UNPUBLISHED{hau90,
    AUTHOR  = "Peter M. Haugan and Eystein Jansen and Ola M. Johannessen
               and Ulf Lie",
```

```
TITLE   = "{Havets innvirkning p{\aa} det atmosf{\ae}riske
           CO$_2$-budsjettet og den globale klimautviklingen}",
YEAR    = "1990",
NOTE    = "The Nansen Environmental and Remote Sensing Center"}
```

Notice that authors are separated by *and*, and that strings of text should be enclosed by curly brackets. If the curly brackets are not used, BibTeX ignores capital letters in the text strings. Notice also that commonly used strings can be pre-defined; in stead of typing *J. Geophys. Res.*, you can type `JGR` when the string

```
@STRING{JGR = "J. Geophys. Res."}
```

For the last of the above entries, the `@UNPUBLISHED` states that this is an entry of type *unpublished*. The 'word' *hau90* is the key of the entry. For instance, if you type

```
\cite{hau90}
```

the LaTeX compiler (with some BibTeX manoeuvres to be described below) will read through your bib-database, and pick out the unpublished work by Haugan *et al.*...

... in an excellent work, Haugan *et al.*, 1990, describes the expected effects of global warming on the transatlantic population of wrens.

```
... in an excellent work, \cite{hau90},
describes ...
```

... and print the entire reference where you would like it in the document, usually at the end:

Haugan, P. M., Jansen, E., Johannessen, O. M., and Lie, U. (1990), Havets innvirkning på det atmosfæriske CO_2 budsjettet og den globale klimautviklingen, The Nansen Environmental and Remote Sensing Center.

```
\bibliography{/usr/people/karbon44/helge/Bib/ref}
\bibliographystyle{nice}
```

Here `\bibliography` specifies that the source file is ref.bib, and that this file is placed on the directory /usr/people/karbon44/helge/Bib. The `\bibliographystyle` command reads the nice.sty file, and this file (i.e. nice) describes how the references are printed in the paper. The references in th text with one, two, or more authors are as follows:

```
\cite{kin69}, is an example of a single author reference, whereas
\cite{men60}, represents a reference for two authors. When there are
three or more authors, the output in the text becomes like this:
\cite{hau90}.
```

produces

King, 1969, is an example of a single author reference, whereas Menzel and Ryther, 1960, represents a reference for two authors. When there are three or more authors, the output in the text becomes like this: Haugan *et al.*, 1990.

In order to standarize the citation keys, one can use the first three letters of the principal authors second name, followed by the year of publication. If there are two or more identical keys, add a, b, c ..., to the keys. This system is simple, safe and easy to memorize. The strength of the BibTeX database system is that everyone which is connected to a LaTeX-machine can use it for references. The .bib files should then be placed on a 'bib directory', say /usr/local/lib/tex/bib. The number of .bib-files may be arbitrary; for several files, type

```
\bibliography{/usr/local/lib/tex/bib/refa,/usr/local/lib/tex/bib/refb,
/usr/local/lib/tex/bib/refc,/usr/local/lib/tex/bib/refd}
```

OBS! There should not be any spaces between the curly braces in the above command.

4.2 Stabdard Bibliography Styles

There are four standard bibliography styles in LaTeX:

`plain` Entries are sorted alphabetically and are labeled with numbers.

`unsrt` The same as `plain` except that entries appear in the order of their first citation.

`alpha` The same as `plain` except that entry labels like "Knu66", formed from the author's name and the year of publication, are used.

`abbrv` The same as `plain` except that entries are a bit more compact because first names, month names, and journal names are abbreviated.

```
\bibliographystyle{plain}
```

specifies that entries should be formatted according to the `plain` bibliography style.

4.3 How To Run BibTeX

In order to read and generate the references, the following procedure has to be followed (assuming the latex file is text.tex):

1. latex text
2. bibtex text
3. latex text
4. latex text

4.4 The Entry Types: Which and When

article An article from a journal or magazine. Required fields: `author`, `title`, `journal`, `year`. Optional fields: `volume`, `number`, `pages`, `month`, `note`.

book A book with an explicit publisher. Required fields: `author` or `editor`, `title`, `publisher`, `year`. Optional fields: `volume`, `series`, `address`, `edition`, `month`, `note`.

booklet A work that is printed and bound, but without a named publisher or sponsoring institution. Required field: `title`. Optional fields: `author`, `howpublished`, `address`, `month`, `year`, `note`.

conference The same as **inproceedings**.

inbook A part of a book, which may be a chapter and/or a range of pages. Required fields: `author` or `editor`, `title`, `chapter` and/or `pages`, `publisher`, `year`. Optional fields: `volume`, `series`, `address`, `edition`, `month`, `note`.

incollection A part of a book having its own title. Required fields: `author`, `title`, `booktitle`, `publisher`, `year`. Optional fields: `editor`, `chapter`, `pages`, `address`, `month`, `note`.

inproceedings An article in a conference proceedings. Required fields: `author`, `title`, `booktitle`, `year`. Optional fields: `editor`, `pages`, `organization`, `publisher`, `address`, `month`, `note`.

manual Technical documentation. Required field: `title`. Optional fields: `author`, `organization`, `address`, `edition`, `month`, `year`, `note`.

mastersthesis A Master's thesis. Required fields: `author`, `title`, `school`, `year`. Optional fields: `address`, `month`, `note`.

misc Use this type when nothing else fits. Required fields: none. Optional fields: `author`, `title`, `howpublished`, `month`, `year`, `note`.

phdthesis A Ph.D. thesis. Required fields: `author`, `title`, `school`, `year`. Optional fields: `address`, `month`, `note`.

proceedings The proceedings of a conference. Required fields: `title`, `year`. Optional fields: `editor`, `publisher`, `organization`, `address`, `month`, `note`.

techreport A report published by a school or other institution, usually numbered within a series. Required fields: `author`, `title`, `institution`, `year`. Optional fields: `type`, `number`, `address`, `month`, `note`.

unpublished A document having an author and title, but not formally published. Required fields: `author`, `title`, `note`. Optional fields: `month`, `year`.

In addition to the fields listed above, each entry type also has an optional `key` field, used for alphabetizing and forming a `\bibitem` label in some styles. You should include a `key` field for any entry whose `author` and `editor` fields are both missing.

4.5 Fields

Below is a list of all fields recognized by the standard bibliography styles.

address Publisher's address. For major publishing houses, just the city is given. For small publishers, you can help the reader by giving the complete address.

annote An annotation, used only for annotated bibliography styles (which are not among the standard ones).

author The name(s) of the author(s), in the format described above.

booktitle Title of a book, part of which is being cited. See above for how to type titles.

chapter A chapter number.

edition The edition of a book—for example, "second".

editor Name(s) of editor(s), typed as indicated above. If there is also an **author** field, then the **editor** field gives the editor of the book or collection in which the reference appears.

howpublished How something strange has been published.

institution The institution that published the work.

journal A journal name. Abbreviations are provided for many journals; see the *Local Guide*.

key Used for alphabetizing and creating a label when the **author** and **editor** fields are missing. This field should not be confused with the key that appears in the `\cite` command and at the beginning of the entry.

month The month in which the work was published or, for an unpublished work, in which it was written. See above for abbreviations.

note Any additional information that can help the reader.

number The number of a journal, magazine, or technical report. An issue of a journal or magazine is usually identified by its volume and number; the organization that issues a technical report usually gives it a number.

organization The organization sponsoring a conference.

pages A page number or range of numbers such as `42--111`; you may also have several of these, separating them with commas: `7,41,73--97`.

publisher The publisher's name.

school The name of the school where a thesis was written.

series The name of a series or set of books. When citing an entire book, the the **title** field gives its title and an optional **series** field gives the name of a series in which the book is published.

title The work's title, typed as explained above.

type The type of a technical report—for example, "Research Note".

volume The volume of a journal or multivolume book work.

year The year of publication or, for an unpublished work, the year it was written. This field's text should contain only numerals.

5 Miscellaneous

5.1 User Defined Commands

The commands in LaTeX tend to explain rather than to be brief. Frequently-used command can be redefined by the `\newcommand` command. Example:

```
\newcommand{\be}{\begin{equation}}
\newcommand{\ee}{\end{equation}}
```

The commands `\be` and `\ee` are now equivalent to `\begin{equation}` and `\end{equation}`. More sofisticated `\newcommand`'s are

```
\newcommand{\Dd}[2]{\frac{d^2 #1}{d {#2}^2}}
\newcommand{\Dp}[2]{\frac{\partial #1}{\partial #2}}
```

Here `2` denotes that the user-defined commands have two arguments; `#1` and `#2`. The output of the commands are:

$$\frac{d^2 r}{dt^2}$$

```
\[\Dd{r}{t}\]
```

$$\frac{\partial \alpha}{\partial \xi}$$

```
\[\Dp{\alpha}{\xi}\]
```

The user-defined commands may be collected in a `def.tex` file, and taken into the document by the `\input` command;

```
\documentstyle{article}
\input{def}
\begin{document}
    .
    .
    .
\end{document}
```

If several users are going to edit on one and the same document, the user-defined commands may be confusing. A better approach—at least for those who are using the VI editor—is to use the mapping commands in VI, see Geir Evensen: *A seminar series on UNIX*, NERSC, March 21, 1992.

5.2 Splitting TeXImage

Documents over some pages should be splitted into several smaller parts. There are two principal ways to split the document in LaTeX; either by using the `\input` command or by using the `\include` command. In both cases there is a *root* file, and it is the name of the root file you type when you run LaTeX.

Using the `\input` command, the root file may look like

```
\documentstyle{article}
\begin{document}
\input{file1}
\input{file2}
\input{file3}
\end{document}
```

Here `file1`, `file2` and `file3` are all `tex` files, and these files contain the text of the document. The text may be split in any way; the content of the files are treated as a continuos stream of text.

A somewhat more elegant way to design the *root* file is to use the `\include` command. An example is given below:

```
\documentstyle{article}
   \newcommand{\all}{file1,file2,file3}
   \typein[\IncludeOnlyArgument]
       {Enter IncludeOnlyAargument(s): (\all) or (backslash all):}
   \includeonly{\IncludeOnlyArgument}
\begin{document}
\include{file1}
\include{file2}
\include{file3}
\end{document}
```

When you LaTeX compile this root file, the following text appears on your screen:

```
Enter IncludeOnlyAargument(s): (file1,file2,file3) or (backslash all):

\IncludeOnlyArgument=
```

If you now type `\all`, all of your files is compiled; if you type `file2`, only file2 is compiled. This flexibility is very useful for large documents. There is, however, one drawback connected with the `\include` command; the text in the included file always starts a new page.

5.3 Table of Content, List of Figure and Table

LaTeX may automatically generate table of contents, and list of figure and table when the following commands are typed in your LaTeX file:

```
   .
   .
\begin{document}
\pagenumbering{roman}
\tableofcontents
\clearpage
\listoffigures
\clearpage
\listoftables
\clearpage
```

```
\pagenumbering{arabic}
    .
    .
```

The `\tableofcontents`, `\listoffigures` and `\listoftables` commands are self explanatory, the `\pagenumbering{roman}` command produces roman page numbering for the contents/list of figures/list of tables pages, the ordinary text has arabic pagenumbering. The basis for all of these tables is the sectioning names, and the text in the figure and table captions. If the optional argument of the sectioning names or captions are used, the optional name is printed in the contents. The `\clearpage` command starts a new page. In this document, only the `\tableofcontents` is used.

5.4 Headings

The following is basically taken from the file `fancyheadings.doc` on the `tex/inputs` directory.

The stylefile `fancyheadings` produces headers and footers in a simple way. The fancyheadings is generated by the command `\pagestyle{fancy}` or `\pagestyle{fancy}` which should be placed after any changes made to textwidth. It combines features that were separately available in other pagestyles, without introducing much complexity. You can define:

- three-part headers and footers
- rules in header and footer
- headers and footers wider than `\textwidth`
- multiline headers and footers
- separate headers and footers for even and odd pages
- separate headers and footers for chapter pages

To use this pagestyle, you must include the "fancyheadings" style option in your `\documentstyle`, and issue the `\pagestyle{fancy}` command. The `\pagestyle{fancy}` command should be issued after any changes made to `\textwidth`.

The page layout will be as follows:

```
LHEAD          CHEAD          RHEAD
---------------------------------- (rule)

     page body


---------------------------------- (rule)
LFOOT        CFOOT       RFOOT
```

The L-fields will be leftadjusted, the C-fields centered and the R-fields rightadjusted. Each of the six fields and the two rules can be defined separately.

5.4.1 Simple Use

The header and footer fields can be defined by commands `\lhead{LHEAD}` and so on for the other fields. If the field depends on something in the document (e.g. section titles) you must in general use the `\markboth` and `\markright` commands, otherwise a title may end on the wrong page. You can do this e.g. by redefining the commands `\chaptermark`, `\sectionmark` and so on (see example below). The defaults for these marks are as in the standard pagestyles. The marks can be put into a header or footer field by referencing `\leftmark` and `\rightmark`.

5.4.2 Rules in Header and Footer

The thickness of the rules below the header and above the footer can be changed by redefining the length parameters `\headrulewidth` (default 0.4pt) and `\footrulewidth` (default 0). These may be redefined by the `\setlength` command. A thickness of 0pt makes the rule invisible. If you want to make more complicated changes, you have to redefine the commands `\headrule` and/or `\footrule`.

5.4.3 Headers and Footers Wider Than `\textwidth`

The headers and footers are set in a box of width `\headwidth`. The default for this is the value of `\textwidth`. You can make it wider (or smaller) by redefining `\headwidth` with the `\setlength` or `\addtolength` command. The headers and footers will stick out the page on the same side as the marginal notes. For example to include the marginal notes, add both `\marginparsep` and `\marginparwidth` to `\headwidth` (see also the example below).

5.4.4 Multiline Headers and Footers

Each of the six fields is set in an appropriate parbox, so you can put a multiline part in it with the `\\` command. It is also possible to put extra space in it with the `\vspace` command. Note that if you do this you will probably have to increase the `\headheight` or `\footskip` lengths.

5.4.5 Separate Headers and Footers for Even and Odd Pages

If you want the headers and footers to be different on even- and odd-numbered pages in the "twoside" style, the field-defining macros can be given an optional argument, to be used on the even-numbered pages, like `\lhead[EVEN-LHEAD]{ODD-LHEAD}`.

5.4.6 Separate Headers and Footers for Chapter Pages

LaTeX gives a `\thispagestyle{plain}` command for the first page of the document, the first page of each chapter and a couple of other pages. It might be incompatible with your pagestyle. In this case you can use a slightly different version of the pagestyle, called `\pagestyle{fancyplain}`. This pagestyle redefines the pagestyle "plain" to also use pagestyle "fancy" with the following modifications:

- the thicknesses of the rules is defined by `\plainheadrulewidth` and `\plainfootrulewidth` (both default 0).
- the 6 fields may be defined separately for the plain pages by giving them the value `\fancyplain{PLAIN-VALUE}{NORMAL-VALUE}`. This construct may be used in both the optional argument and the normal argument. Thus `\lhead[\fancyplain{F1}{F2}]{\fancyplain{F3}{F4}}` specifies the `LHEAD` value in a two-sided document:
  - F1 on an even-numbered "plain" page
  - F2 on an even-numbered normal page
  - F3 on an odd-numbered "plain" page
  - F4 on an odd-numbered normal page.

5.4.7 Defaults

```
\headrulewidth        0.4pt
\footrulewidth 0pt
\plainheadrulewidth 0pt
\plainfootrulewidth 0pt

\lhead[\fancyplain{}{\sl\rightmark}]{\fancyplain{}{\sl\leftmark}}
```

```
%  i.e. empty on ``plain'' pages \rightmark on even, \leftmark on odd pages
\chead{}
\rhead[\fancyplain{}{\sl\leftmark}]{\fancyplain{}{\sl\rightmark}}
%  i.e. empty on ``plain'' pages \leftmark on even, \rightmark on odd pages
\lfoot{}
\cfoot{\rm\thepage} % page number
\rfoot{}
```

5.4.8 Examples

To put two lines containing the section title and the subsection title in the righthandside corner, use:

```
\documentstyle[fancyheadings]{article}
\pagestyle{fancy}
\renewcommand{\sectionmark}[1]{\markboth{#1}{}}
\renewcommand{\subsectionmark}[1]{\markright{#1}}
\rfoot{\leftmark\\\rightmark}
```

The following definitions give an approximation of the style used in the LaTeX book:

```
\documentstyle[fancyheadings]{book}
\pagestyle{fancyplain}
\addtolength{\headwidth}{\marginparsep}
\addtolength{\headwidth}{\marginparwidth}
\renewcommand{\chaptermark}[1]{\markboth{#1}{#1}} % remember chapter title
\renewcommand{\sectionmark}[1]{\markright{\thesection\ #1}}
                                                % section number and title
\lhead[\fancyplain{}{\bf\thepage}]{\fancyplain{}{\bf\rightmark}}
\rhead[\fancyplain{}{\bf\leftmark}]{\fancyplain{}{\bf\thepage}}
\cfoot{}
```

5.4.9 Using Section Titles etc. in the Headers and/or Footers

You can't just change the header and/or footer fields in the middle of some text (e.g. after a section header). This is because TeX may have processed a bit more text before deciding to make up the page. It may have passed a section beginning, causing the wrong title on the page. TeX has a mechanism called 'marks' to solve this problem. There is in LaTeX a `\leftmark` and a `\rightmark`. Usually `\leftmark` is a chapter title and `\rightmark` is a section title. To set the marks there are two commands: `\markboth{L}{R}` sets the `\leftmark` to `L` and the rightmark to `R`, and `\rightmark{R}` sets only the rightmark to `R`. The default definitions of `\section` etc. do this already for you.

5.4.10 An Example Follows

```
left page right page
--------- ----------

2      CHAPTER 1. Introduction | 1.2 Some section                      3
------------------------------- | ---------------------------------------
                                |
Text                            | more text
Text                            | more text
Text                            | more text
                                |
                                |
                                |
```

This can be easily done with fancyheadings as follows:

```
\pagestyle{fancy}
\setlength{\headrulewidth}{1pt}
\lhead[\rm\thepage]{\sl\rightmark}
\rhead[\sl\leftmark]{\rm\thepage}
```

This specifies that on even pages (the `[]` parts) the leftheadpart is page number and rightheadpart is `\leftmark`, which is the chapter title (because that is given as the left argument of `\markboth` (see page 162 of the LaTeX book)

On odd pages (the parts between `{}`) the leftheadpart is `\rightmark` (which is the last section title because that is given as argument to `\markright` (see the same page), and the rightheadpart is the page no.

Now suppose you don't want the section number and you want the section title in upper case—you add the following to your preamble:

```
\renewcommand{\sectionmark}[1]{\markright{\uppercase{#1}}}
```

Or if you don't want the chapter number but only the chapter title (not in uppercase):

```
\renewcommand{\chaptermark}[1]{\markboth{#1}{ }}
```

Note: the parameter in both cases is the (section—chapter) title.

5.4.11 Known Problems

Sometimes you will get a warning message from LaTeX concerning "overfull vbox during output". In this case you have to increase the `\headheight` or `\footskip` lengths or both (with `\addtolength` or `\setlength`).

5.4.12 The Header/Footer of This Paper

```
\pagestyle{fancyplain}
\renewcommand{\sectionmark}[1]{\markboth{#1}{#1}}
                % remember section title
\renewcommand{\subsectionmark}[1]{\markright{\thesubsection\ #1}}
                % subsection number and title
\lhead[\fancyplain{}{\bf\thepage}]{\fancyplain{}{\bf\rightmark}}
\rhead[\fancyplain{}{\bf\leftmark}]{\fancyplain{}{\bf\thepage}}
\cfoot{}
```

5.5 Style File for Equations

This subsection contains a collection of macros to aid in constructing displayed equations in LaTeX. Written by:
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with some ideas and macros borrowed from John Hobby and Stephen Gildea.

—USER DOCUMENTATION—

Use this as a style option, e.g.,

```
\documentstyle[equations]{article}
```

These probably don't work in conjunction with the leqno option.
This implements the following:

1. `\yesnumber` turns on an equation number in an eqnarray* environment (just as `\nonumber` turns it off in an eqnarray environment). E.g.,

```
\begin{eqnarray*}
   a &=& b \\
     & & + c \\
     & & + d \\
     & & + e \\
     & & + f \\
     & & + g \yesnumber
\end{eqnarray*}
```

$$\begin{aligned} a &= b \\ &\quad +c \\ &\quad +d \\ &\quad +e \\ &\quad +f \\ &\quad +g \end{aligned} \tag{5}$$

2. The eqalign environment is just like Plain TeX's `\eqalign`. E.g.,

```
\begin{equation}
      \begin{eqalign}
         a &= b, \\
         c &= d.
      \end{eqalign}
\end{equation}
```

$$\begin{aligned} a &= b, \\ c &= d. \end{aligned} \tag{6}$$

   Note that `\begin{equation} \end{equation}` or equivalent is needed.

3. The eqalignno environment is just like Plain TeX's `\eqalignno`. E.g.,

```
\begin{eqalignno}
   a &= b, \label{foo}\\
   c &= d. \label{bar}
\end{eqalignno}
```

$$a = b, \tag{7}$$

$$c = d. \tag{8}$$

Note the absence of `\begin{equation} \end{equation}`. `\nonumber` can be used to suppress the equation number. eqalignno* is the same except that the equation numbers are suppressed (unless a `\yesnumber` appears).

4. The eqaligntwo environment is a two-equation per line equivalent of eqalignno. E.g.,

```
\begin{eqaligntwo}
   a &= b, & x &= y, \label{foo} \\
   c &= d, & z &= w. \label{bar}
\end{eqaligntwo}
```

$$a = b, \qquad x = y, \tag{9}$$

$$c = d, \qquad z = w. \tag{10}$$

eqaligntwo* is defined similarly.

5. The cases environment is just like Plain TeX's `\cases`. E.g.,

```
\begin{equation}
   u(x) =
      \begin{cases}
        0, & for $x < 0$, \\
        1, & for $x \ge 0$.
      \end{cases}
\end{equation}
```

$$u(x) = \begin{cases} 0, & \text{for } x < 0, \\ 1, & \text{for } x \ge 0. \end{cases} \tag{11}$$

Note the first column is treated as math, the second column as text.

6. I've borrowed John Hobby's modifications to the eqnarray environment (to fix up the spacing around the operator), and to the `\big, \bigg`, etc. operators (to make them scale with the point size).

7. I've borrowed Stephen Gildea's subequations environment, and fixed it so that it ignores spaces after the environment and so that you can refer both to the overall set of equations and to individual subequations. E.g.,

```
\begin{subequations} \label{foo}
  \begin{eqalignno}
     a &= b, \label{foo-a} \\
     c &= d, \label{foo-b}
  \end{eqalignno}
  text text text text ...
```

```
  \begin{equation}
     e = f. \label{foo-c}
  \end{equation}
\end{subequations}
```

$$a = b, \tag{12a}$$

$$c = d, \tag{12b}$$

text text text text ...

$$e = f. \tag{12c}$$

Now `\ref{foo}, \ref{foo-a}, \ref{foo-b}, \ref{foo-c}`, produce 12, 12a, 12b, 12c.

5.6 Misc.sty

Usage of misc.sty (example):

```
\documentstyle[misc,12pt]{report}
```

Following commands implemented here (see the comments below for more info):

```
\timeofday
\verbfile
\listing
```

5.6.1 Timeofday

`\timeofday` (12:43) is just like `\today` (May 4, 1995); it gives the current time of day in the form $hh : mm$ as in the military style. It eats up a blank so normally one would say: `\timeofday\` . From: Tim Morgan ¡morgan@uci-icsa¿

5.6.2 Verbatim macros

Here are some macros which I mostly stole from the TeXbook source and other places. You can say

```
\verbfile{filename}
```

to `\input` all of "filename" in verbatim mode. The end of the file is the only thing that gets you back out of verbatim – no characters are special.

```
\listing{filename}
```

is the same except that each line of the file is automatically numbered. See also Subsec. 3.22.

5.7 Subfigure

The style file `subfigure` is an extension to LaTeX's `figure` environment. Several subfigures are put together in a figure-like environment and labelled (a), (b), ... Example:

```
\begin{figure}[htbp]
   \begin{center}
      \begin{tabular}[t]{c}
         \subfigure[First.]{\mbox{\fbox{
            \epsfxsize=0.45\textwidth\epsffile{logo.eps}}}}
         \subfigure[Second.]{\mbox{\fbox{
            \epsfxsize=0.45\textwidth\epsffile{logo.eps}}}}\\
         \subfigure[Third.]{\mbox{\fbox{
            \epsfxsize=0.8\textwidth\epsffile{logo.eps}}}}
      \end{tabular}
    \end{center}
  \caption{\label{fig:subf}Three Subfigures.}
\end{figure}
```

... and the output is shown in Fig. 2.

5.8 Subtable

As `subfigure`, but for the table environment.

5.9 toc_entry.sty

Will produce the right space for sectionnumbers in the tableofcontents. Necessary for entries where the number for each kind of section is greater 10 (e.g. "12.14.18 Sectionname").

5.10 Bold Sans Serif

Bold sans serif font types like these, are produced by the `\bsf` command when `bsf` is included into the `\documentstyle` command.

5.11 drafthd.sty

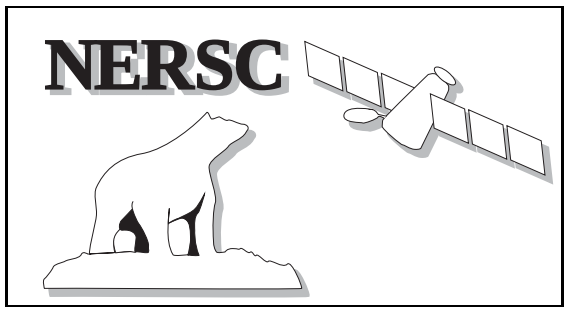
Puts "DRAFT" with date and time at top of each page. If the document is set with headings like this document, the `drafthead.sty` file is ignored.

5.12 The `ifthen` Style Option

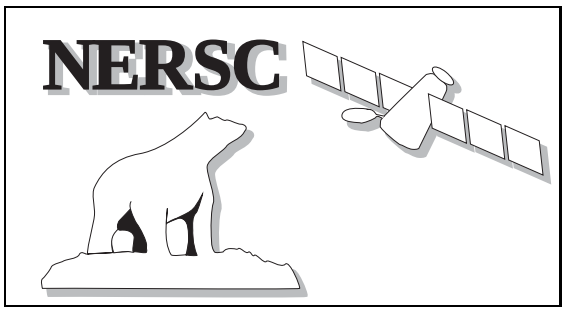
This option provides two programming language features that are useful only for people who already know how to program. It defines the two commands

`\ifthenelse{`*test*`}{`*then clause*`}{`*else clause*`}`
`\whiledo{`*test*`}{`*do clause*`}`

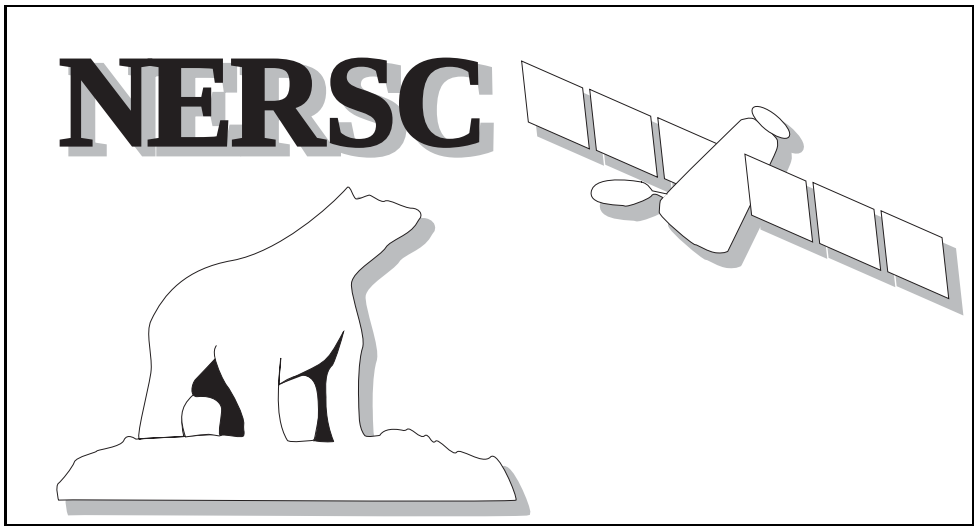
that implement the following two Pascal language structures



(a) First.



(b) Second.



(c) Third.

Figure 2: Three Subfigures.

if *test* **then** *then clause*
else *else clause*
while *test* **do** *do clause*

The *then*, *else*, and *do* clauses are ordinary LaTeX input; *test* is one of the following:

- A relation between two numbers formed with `<`, `>`, or `=`; for example, `\value{page}>3`.
- `\equal{`*string1*`}{`*string2*`}`, which evaluates to *true* if *string1* and *string2* are the same strings of characters after all commands have been replaced by their definitions. (Upper- and lower-case letters are unequal.)
- A logical combination of the above two kinds of tests using the operators `\or`, `\and`, and `\not` and the parentheses `\(` and `\)`—for example:

```
\not \( \value{section} = 1  \and  \equal{Jones}{\myname} \)
```

These commands, together with `\renewcommand` and the commands of Section C.7.4 in the LaTeX book for manipulating counters, open up a whole new world of hacking.

5.13 Colored Output

Colored LaTeX text can be produced if the compand `\onput{color}` is placed between the `\documentstyle` and `\begin{document}` commands. The colors direct available are green, red, pink, indigo, yellow and blue. Example of usage (if the compiled *PostScript* file is sent to a color printer):

```
   \green
This text is green,
   \red
and this red
   \black
and black ...
```

5.14 Slide Layout

`\input{slide}` and `\input{slidec}` enable you to write NERSC slides in an easy way; the `slide` command is for slides with B&W NERSC logo, `slidec` for colored NERSC logo. In order to activate the two slide options, write

`\slide{`*arg*`}`

where *arg* denotes the content of the slide.

5.15 LaTeX Page Layout

The figures in this section is taken from Nelson Beebe (U of Utah), see *layout.tex* on the /tex/inputs directory.

Figure 3: LaTeX single-column page layout. The actual proportions correspond to parameter values in the 11pt BOOK document style. Note that standard-conforming DVI drivers are required to place the TeX upper-left page corner one inch over and down from the corner of the physical output page. This figure is scaled to \SCALEFACTOR{} of actual page size.

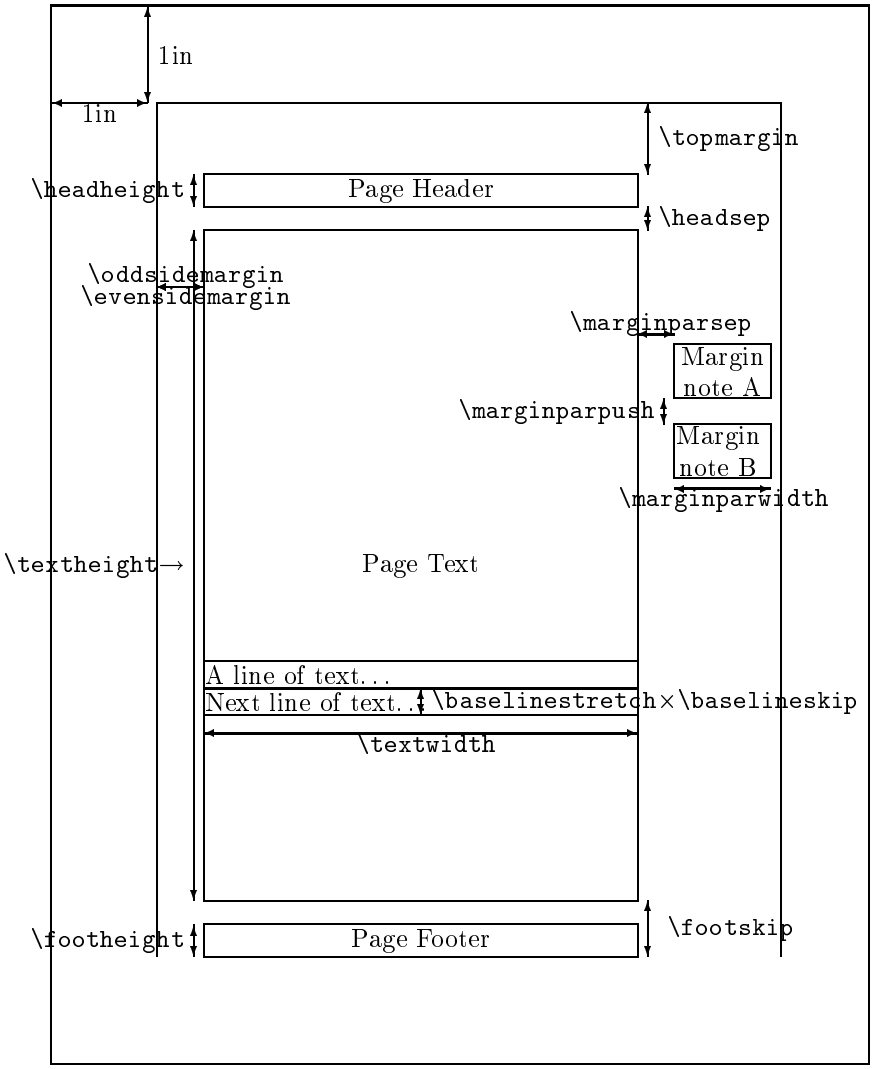


Figure 4: LaTeX double-column page layout. The actual proportions correspond to parameter values in the 11pt BOOK document style. Note that standard-conforming DVI drivers are required to place the TeX upper-left page corner one inch over and down from the corner of the physical output page. This figure is scaled to \SCALEFACTOR{} of actual page size.

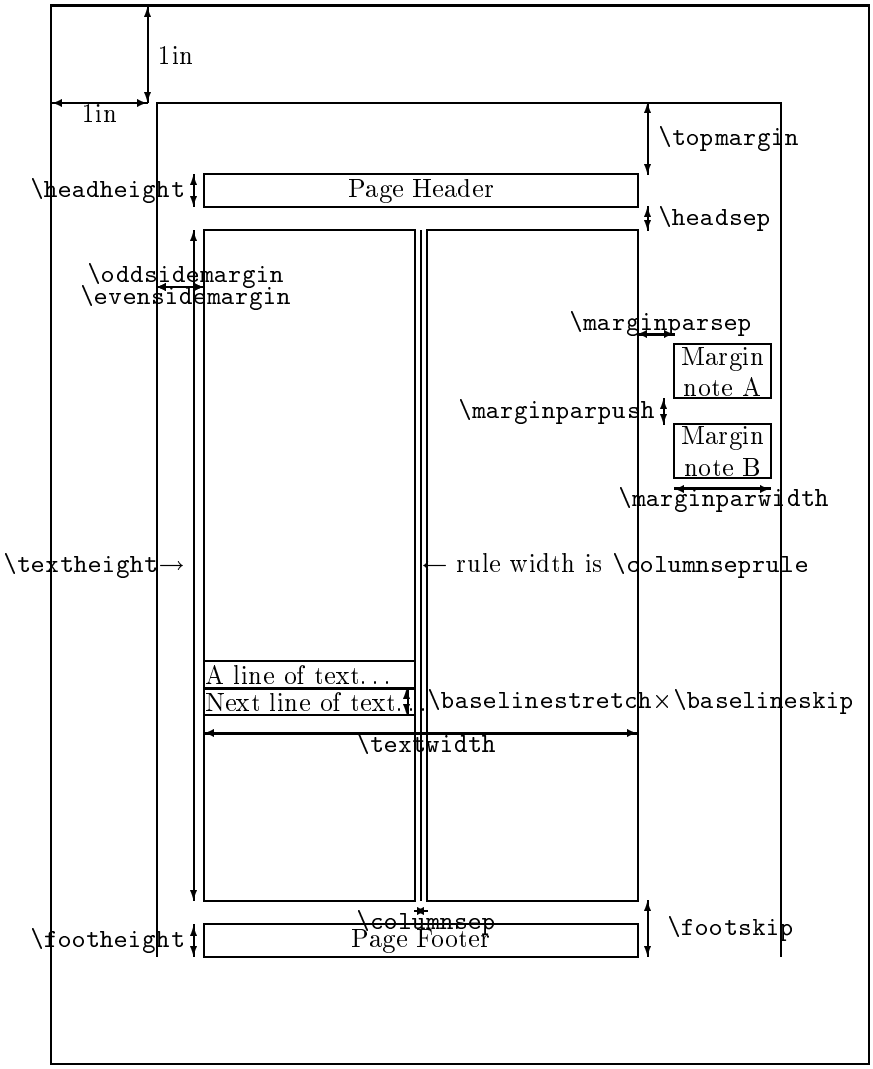


Figure 5: Page layout parameters (in centipoints) for preceding figures. It was produced on May 4, 1995 at 12:43.

\BASELINESKIP	2000
\COLUMNSEPRULE	0
\COLUMNSEP	1000
\COLUMNTWOX	20374
\COLUMNXMIDDLE	19874
\DVIXOFFSET	7227
\DVIYOFFSET	7227
\EVENSIDEMARGIN	10841
\FOOTHEIGHT	2400
\FOOTNOTESEP	665
\FOOTSKIP	4207
\HEADHEIGHT	2400
\HEADSEP	1807
\HEADYORIGIN	56414
\INNERHEIGHT	64234
\INNERWIDTH	46976
\MARGINNOTEHEIGHT	4000
\MARGINNOTEXORIGIN	38935
\MARGINNOTEYA	42007
\MARGINNOTEYB	36007
\MARGINPARPUSH	2000
\MARGINPARSEP	2800
\MARGINPARWIDTH	7227
\ODDSIDEMARGIN	3613
\PAGEHEIGHT	79497
\PAGEWIDTH	61430
\PAGEXORIGIN	7227
\PAGEYORIGIN	8036
\PAGEYTOP	72270
\RIGHTEDGE	36135
\TAD	800
\TEXTHEIGHT	50400
\TEXTWIDTH	32522
\TEXTWIDTHY	16800
\TOPMARGIN	5420

6 GNUPLOT and *Xfig*

GNUPLOT is an interactive plotting program, primarily developed for 2D graphics, but version 3.0 also contain some 3D options. The following is limited to 2D graphics.

6.1 Starting GNUPLOT

GNUPLOT can either be activated by typing `GNUPLOT` on your terminal, or `GNUPLOT input.file`, in which GNUPLOT reads the file `input.file`. It is most convenient to use the last option.

6.2 The GNUPLOT File

A typical GNUPLOT file looks like:

```
set terminal tek40xx
#set size 1.1,1; set terminal postscript color portrait "Times-Roman" 20
#set output "CO2_water.ps"
g(x) = 34.8649 + 0.90485*x + \
        0.0108504*x**2
set noyzeroaxis
set xlabel "Temperature  (C)"
set ylabel "Pressure  (bar)"
set title  "P-T Lines for CO2 in Water"
set xtics(-1.7,0,5,"Ten" 10,15,20)
set yrange [10:58]
set key 17,25
plot [x=-1.7:20] g(x) t "Condensation Line" w l 1,\
       "hydrate_mitsu_tp"  t "Hydrate Line Seawater" w l 3,\
       "hyd.data" t "Freshwater" w l 4,\
       "CO2_hyd.data" t "slett"
```

The first line select the type of device for which GNUPLOT will produce output, in this case Macintocsh terminals. For output on X-terminals, type `set terminal X11`. The text to the right of the character # is treated as comments and ignored (the # in GNUPLOT has nothing to do with the # in LaTeX). The second line produces a scaled color plot in *PostScript* format with text in *Times-Roman* 20 pt, and the *PostScript* file is written on the file `CO2_water.ps`. So when the 2D graphics is ready to be printed, the comment characters are deleted from the `postscript` and `output` commands, and the command `GNUPLOT file_name` produces `CO2_water.ps`. If the word `portrait` is deleted from the `postscript` command, the graphics is produced in landscape mode.

The next two lines of the GNUPLOT file defines the function `g(x)`. Notice the character `\` which should be used for multiple-line expressions or commands in GNUPLOT. By default, GNUPLOT indicates the x- and y-axes on a plot; in order to turn off these axes, use the `noxzeroaxis` and `noyzeroaxis` commands. The x-, y- and title-labels are enclosed by "'s. Super- and subscripts in the label text strings are not available for *PostScript* graphics. The default x- and y-axes tics may be adjusted by the commands `xtics` and `ytics`. Notice that text enclosed by quotes may be used as tics. The default x- and y-ranges of the plot may be adjusted by the `xrange` and `yrange` commands.

By default, GNUPLOT puts information of the curves in the upper right corner of the plot. The position of the key is adjusted by the `key` command. If no key is to be plotted, use the `nokey` command. The information is either the mathematical expression, the name of the function, or the name of a data-file if data points are plotted.

The plotting is activated by the `plot` command followed by the x-range of the plot (`g(mm)` and `plot [mm=-1.7:20]` is as good as `g(x)` and `plot [x=-1.7:20]`). The command `g(x) t "Condensation Line" w l 1` means that the function `g(x)` is plotted with line type 1, and that the key of the function is `Condensation Line`. The `t` is an abbreviation for `title` and `w l` is an abbreviation for `with line`; any command in GNUPLOT may be abbreviated. Files of data are enclosed by quotes, and the data points are plotted by symbols. A black-white version of the above GNUPLOT file is shown in Fig. 6.

If one or several of the `key` labels should be deleted, one has to go into the *PostScript* file and edit on it. For instance, to delete `slett` from Fig. 6, one can delete `slett` in the file `CO2_water.ps`.

The lines in GNUPLOT can be made thicker by adjusting the `gnulinewidth` command in the GNUPLOT /PS/ file. By default, `/gnulinewidth 5.000 def`, whereas `/gnulinewidth 10.000 def` may be more appropriate. Furthermore, the `xlabel` text should be adjusted downwards and the `ylabel` text to the right. In the *PostScript* file generated by GNUPLOT, the coordinates for the x and y labels are in the form:

```
200 2620 M
currentpoint gsave translate 90 rotate 0 0 moveto
(Pressure  \(bar\)) Cshow
grestore
4168 301 M
(Temperature  \(C\)) Cshow
```

The y-coordinate of the x-label should be decreased by 100 units, and the x-coordinate of the y-label should be increased by 500 units:

```
700 2620 M
currentpoint gsave translate 90 rotate 0 0 moveto
(Pressure  \(bar\)) Cshow
grestore
4168 201 M
(Temperature  \(C\)) Cshow
```

In addition, the default bounding box should be somewhat adjusted. If no `title` is plotted, increase the first coordinate of the bounding box by 50 units, and decrease the forth coordinate by 50 units. Therefore, if the default bounding box is `%%BoundingBox: 50 50 770 554`, adjust the coordinates to `%%BoundingBox: 100 50 770 524`. If the `title` is plotted, increase the first coordinate of the bounding box by 50 units only.

For comparison, Fig. 6 with the `slett` key deleted, the xy-labels and the bounding box adjusted, the `title` deleted, and `/gnulinewidth 10.000 def` is shown in Fig. 7.

There are nine different line types available in GNUPLOT:

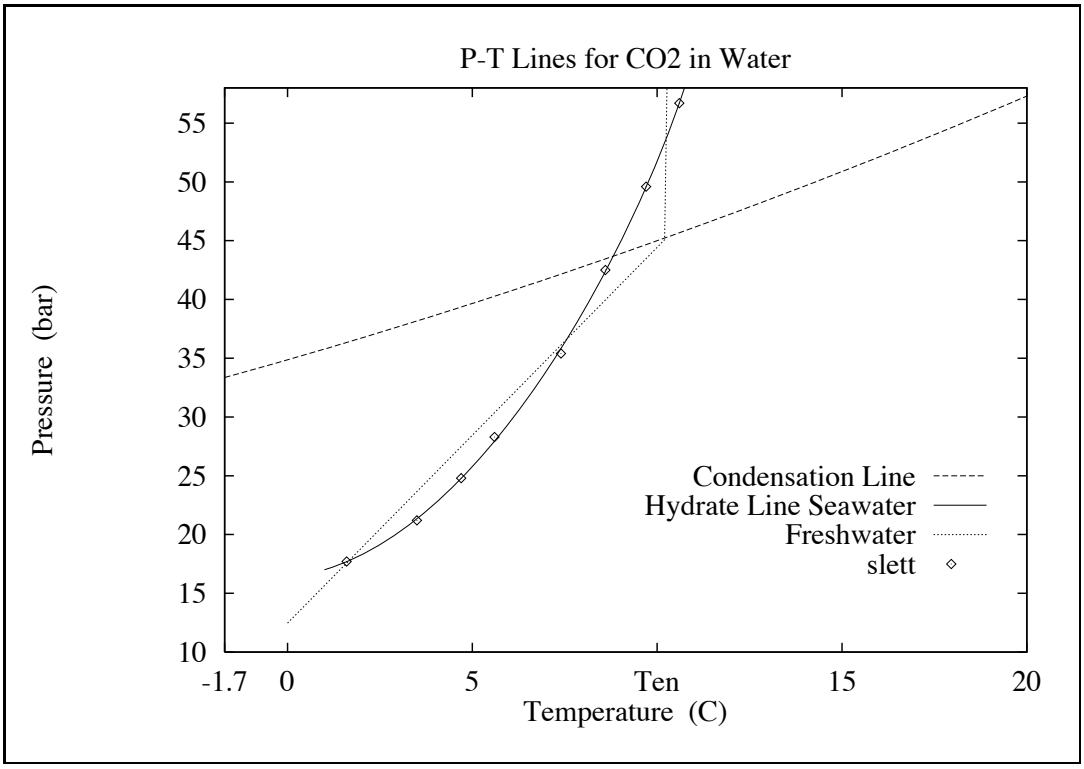


Figure 6: An example of GNUPLOT graphics.

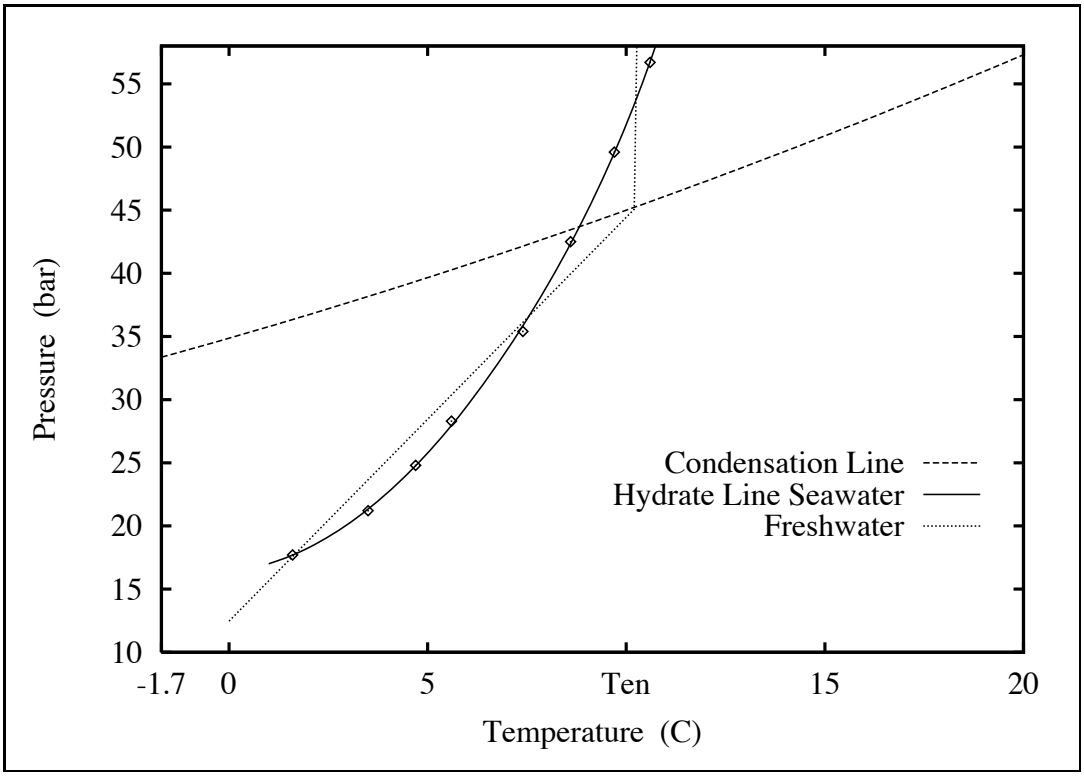


Figure 7: Another example of GNUPLOT 2D-graphics.

Line 1	Solid
Line 2	Long dashed
Line 3	Short dashed
Line 4	Dotted
Line 5	Dash-short space-dot
Line 6	Dash-long space-dot
Line 7	Two times short dashed
Line 8	Three times short dashed
Line 9	Four times short dashed

For color plots, the different lines corresponds to the following colors:

Line 1	Black
Line 2	Green
Line 3	Red
Line 4	Pink
Line 5	Indigo
Line 6	Yellow
Line 7	Blue
Line 8	Orange
Line 9	Grey

Of these colors, *yellow* should not be used. By default, the entire `key` string is colored, which might be a little too fancy. This coloring may be avoided by a small change in the *PostScript* file, the default file looks like

```
LT1
6143 1900 M
(Condensation Line) Rshow
6263 1900 M
6623 1900 L
```

Here `LT1` is the code of the *green* color, the next line the coordinate of the `Condensation Line`, and the following two lines the coordinates of the `key` line. The `key` line should be colored, but not the text. This can be done in the following way:

```
LT0
6143 1900 M
(Condensation Line) Rshow
LT1
6263 1900 M
6623 1900 L
```

Now the `Condensation Line` is set in black (line type `LT0`), and the `key` line in green.

6.3 *Xfig*

Xfig is an excellent tool for producing high quality *PostScript* figures. You start *Xfig* by writing `xfig` on a X-terminal. Save the figure as `file_name.fig`. In order to convert `file_name.fig` from *fig* to *PostScript* format, type

```
fig2dev -L ps file_name.fig > file_name.ps
```

The *PostScript* file can now be imported directly into your LaTeX file by the `\epsffile` command (see Subsec. 3.9). Don't forget the `epsf` style in the `\documentstyle` command!