



# **L<sup>A</sup>T<sub>E</sub>X**- Document Preparation System

**Manjusha Joshi**

Freelance Consultant in Scientific Computing,

Pune.

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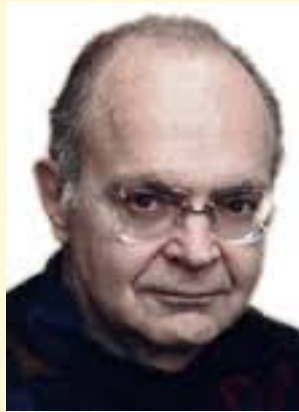
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and scientific documents like technical books, research papers, thesis, and many more.

- $\text{\LaTeX}$  is a Markup!  $\text{\LaTeX}$  can also work as a programming language.
- $\text{\LaTeX}$  is based on DONALD E. KNUTH's  $\text{\TeX}$  typesetting language.



## The Art of Computer Programming



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## 1.1. Free software

LaTeX is available as free software (under the terms of the LaTeX Project Public License)

1. <http://www.latex-project.org/>
2. <http://www.tug.org.in>
3. [www.tug.org](http://www.tug.org)



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## 1.2. Features of L<sup>A</sup>T<sub>E</sub>X

- O. S. independent
- Free Software, continuous development is going on.
- Flexible, user can define own commands.
- Supported by TUG community. Also, good support is available in India via TUGIndia mailing list.
- Default in Linux.



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## 1.3. Technical Documentation

- For writing Mathematical symbols, operators, Greek letters.

$$\sum_1^{\pi}, \int_0^{\infty}$$

- Automatic numbering for equations, sections, pages, chapters, list.

$$\sqrt[3]{m} = m^{\frac{1}{3}} \quad (1)$$



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- To write Matrices and Determinants:

$$\begin{bmatrix} \pi & \alpha & \beta \\ & \frac{2}{3} & \sqrt{x} \\ z^2 & m \times n & 0 \end{bmatrix}$$

Then length of the brackets is flexible according to number of rows in the matrices or determinants.

- [References](#) are provided by L<sup>A</sup>T<sub>E</sub>X In this example we can see the equation get automatically referred by saying for the equation ( 1 ) we can see that it is numbered and we can catch it's number for reference.



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## 1.4. Typesetting

L<sup>A</sup>T<sub>E</sub>X actually take care of all type of typesetting, so that author need not worry about **page layout** etc. Page layout is how the page looks like. It's margins like left/right margins, pages header, footer margin, what should be the running text written on it etc.



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$\text{\LaTeX}$  can generate automatically

- contents
- index
- Chapters and running heads
- Sections and subsections
- References, pagereferences
- Footnotes
- Automatic numbering for sections, chapters, equations pages, etc.
- Tabular form, various types of listings

More over,  $\text{\LaTeX}$  provides control over default settings also. That is one can change numbering style of pages from arabic i.e. 1,2 etc. to roman i.e. I,II etc.





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Here is an example of tables in  $\text{\LaTeX}$  :

Sr. No.	Name	Marks
204	ABC	87.5
205	XYZ	78



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## 1.5. Fonts and T<sub>E</sub>X

L<sup>A</sup>T<sub>E</sub>X uses it's own fonts.

Various fonts types and sizes are available with L<sup>A</sup>T<sub>E</sub>X.

This is tiny size.

# This is Huge size.

SMALL CAPITAL LETTERS This is another special font.

Times, scan serif fonts are also possible in L<sup>A</sup>T<sub>E</sub>X.  
In L<sup>A</sup>T<sub>E</sub>X you can add commercial fonts also. To  
get more information on fonts in L<sup>A</sup>T<sub>E</sub>X visit  
<http://www.math.utah.edu/~beebe/fonts/>



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## 1.6. More Facilities

Other than typesetting of technical documents  $\text{\LaTeX}$  provides more facilities such as,

- It can produce Devnagari, Gujrathi, Tamil, Kannada and many more Indian languages.
- Presentation packages like prosper, pdfscreen.



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## 1.7. Various outputs with L<sup>A</sup>T<sub>E</sub>X

L<sup>A</sup>T<sub>E</sub>X code is written in .tex file one can obtain basic .dvi file from it by compiling with the command

```
$ latex myfile.tex
```

This will convert myfile.tex to myfile.dvi

Other options with the T<sub>E</sub>X files are:

- `pdflatex` write output from .tex file to .pdf file
- `dvips` write output of .dvi file to .ps file, printer friendly.
- `tex4ht` write output of .tex file to .html file.



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## 1.8. $\text{\LaTeX}$ Business

All International journals forces to write articles, papers in  $\text{\TeX}$ . Mostly Mathematics books, many technical books are typeset now-a-days using  $\text{\LaTeX}$ .

In India, at Navi Mumbai, Chennai, Trivandram, Delhi, Bangalore companies are using  $\text{\LaTeX}$  for publications.



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## 1.9. L<sup>A</sup>T<sub>E</sub>X Community

TUG -T<sub>E</sub>XUsers Group - Internation TUG is very active, arranges yearly conferences, publishes TUGBoat International journal. `www.tug.org`

TUG-India, is also not behind, very active mailing list, on which good technical support is available with in an hour also. `www.tug.org.in`

Arranged TUG-2002 at Trivandram.

TUG-2011 arranged in Trivandrum, Kerala, India.



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## 2. Get ready to start...



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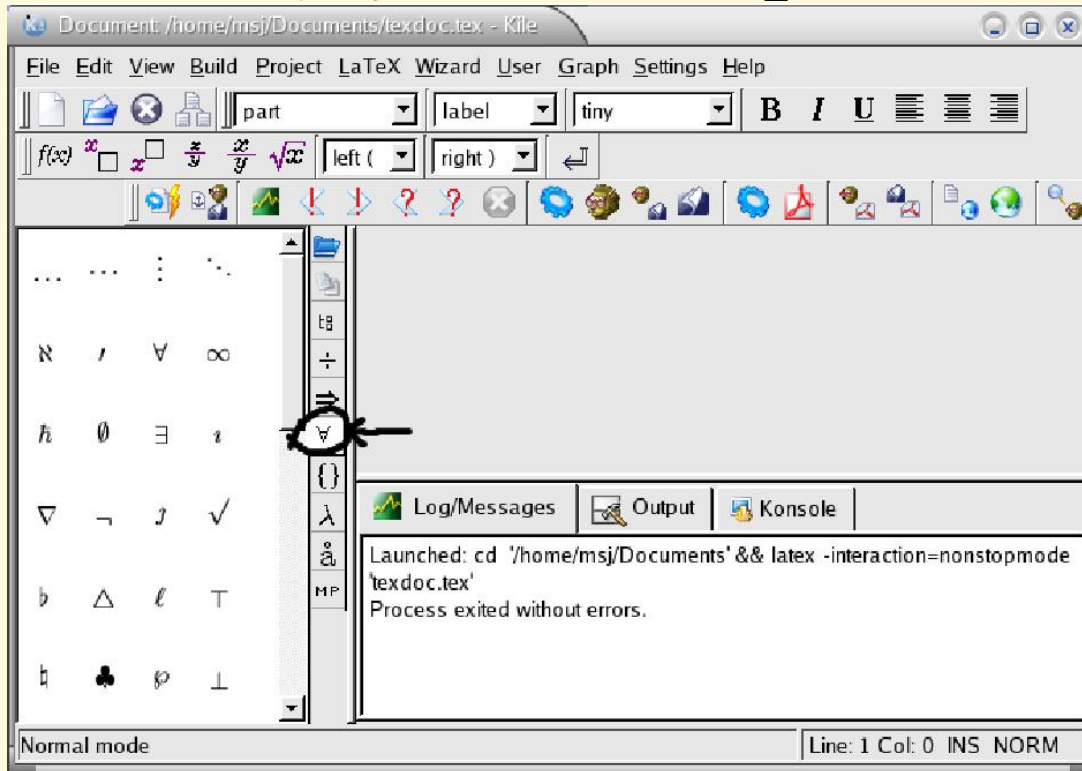
## 2.1. What you need is...

- L<sup>A</sup>T<sub>E</sub>X installed on you computer
- An Editor to write tex file
- Viewer to see the output





Kile is very good IDE for  $\text{\LaTeX}$  on linux.



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## 2.2. First T<sub>E</sub>X file

```
\documentclass{article}  
\begin{document}
```

What ever I type will be printed.

No cout no printf.

```
\end{document}
```

What ever I type will be printed.

No cout no printf.



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## 2.3. To get formatted output

Many softwares see towards  $\text{\LaTeX}$  to get their output formatted as  $\text{\LaTeX}$ .

In  $\text{\LaTeX}$  you can align limits properly e.g.

$$\sum_{i=0}^{\infty}$$

Another example is

$$\lim_{n \rightarrow \infty}$$



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In technical type documents there are **two main types**:

- plain text
- mathematical terms or expressions

So does  $\text{\LaTeX}$ .

It understands text mode by default and to switch from text to math mode we need to write  $\$$  and again to come back one more  $\$$  is required. So in pair of  $\$$  math expressions can be written.



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Also  $\text{\LaTeX}$  has idea of having special characters i.e. it has some special meaning for  $\text{\LaTeX}$  compiler.

There are 10 such special characters:

Namely,

$\$ \ \& \ \# \ \% \ \sim \ ^ \ \_ \ \{ \ \} \ \backslash$

If you want to write E & TC. You need to use  $\backslash&$



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## 2.4. Commands

- Commands starts with \
- Commands are case sensitive i.e. \large is different from \Large
- Command terminates with space i.e. \my name cannot be a command



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So always check your mode of working i.e. math mode or text mode.

To get basic effects in text mode here are few commands.

<code>\bf</code>	To make bold face so e.g. is <code>{\bf Bold text}</code> <b>Bold text</b>
<code>\it</code>	To make italics so e.g. is <code>{\it italics text}</code> <i>italics text</i>
<code>\centerline</code>	To make centerline so code is <code>\centerline{centered text}</code>
<code>\vskip2mm</code>	skip vertical space 2mm
<code>\noindent</code>	no indentation when new para starts
<code>\\</code>	forceful line break
<code>%</code>	will comment the line
	<code>{\textit {\textbf {Here you go}}}</code>



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Now let us have look on some basic math mode commands:

$\$a^m\$$

power of some thing  $a^m$

$\$a_i\$$

subscript of some thing  $a_i$

$\$a^{m+1}\$$

expression as a power o  $a^{m+1}$

$\$a_{i+1}\$$

expression as a subscript  $a_{i+1}$

$\$\frac{2}{n}\$$

fractions  $\frac{2}{n}$

$\$\frac{2+x-x^2}{x+1}\$$

expressions in fractions  $\frac{2+x-x^2}{x+1}$

$\$\sqrt{36}\$$

square root sign  $\sqrt{36}$

$\$\sqrt[n]{m+1}\$$

$n$ th root of  $m + 1$   $\sqrt[n]{m+1}$





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$f'$   
 $f''$

$f'$   
 $f''$

$\lim_{n \rightarrow \infty} \frac{1}{n}$

$\lim_{n \rightarrow \infty} \frac{1}{n}$



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## 2.5. Environments in L<sup>A</sup>T<sub>E</sub>X

When ever we want to format text or maths in some particular way we need to use environments.

e.g.

```
\begin{center}
```

What ever type here will come at centre.

```
\\1\\ *****
```

```
\end{center}
```

What ever type here will come at centre.

1

\*\*\*\*\*

## 2.6. Environments continued...

One popular requirement with documents is one needs listed format.  $\text{\LaTeX}$  provides special environment for this

e.g.

```
\begin{enumerate}
\item This is numbered objects.
\item Each object treated as seperate object with occur
\item
\item Numbers are given automatically.
\item If you insert new item in between old items
list will be renumbered accordingly.
\end{enumerate}
```

1. This is numbered objects.
2. Each object treated as seperate object with occurence of `\item`
- 3.
4. Numbers are given automatically.
5. If you insert new item in between old items list will be renumbered accordingly.



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```
\begin{itemize}
\item This is other type of listing
\item nested listing is allowed in both type of lists.
\begin{itemize}
\item This is part of sublist.
\item There will be two \end{itemize}.
\end{itemize}
\end{itemize}
```

- This is other type of listing
- nested listing is allowed in both type of lists.
  - This is part of sublist.
  - There will be two \end{itemize}



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## 2.7. To write a footnote

When ever we saw footnote<sup>a</sup> in the book, we feel that some thing very complecated we need to do this to be printed. Ans also how one should make sure about the footnote should come at the right place where ever it is referred.

When ever we saw footnote\footnote{This is a footnote I wanted to write in a stylish way..... and whats more?}

---

<sup>a</sup>This a footnote I wanted to write in a stylish way. Observe that it is num-bered by alphabet and also I can change it's numbering style like † and ‡ and whats more?



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```
\section{Unlimited }
```

This will print following output:

### 3. Unlimited

`\section*{Introduction}` will produce unnumbered sections. `\chapter{Basic Idea}` will produce chapter heading with **report** class and book class.

Report class is appropriate for thesis writing.

You can try other commands like `\subsection`, `\subsubsection`



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## 3.1. Greek Letters

<code>\$\alpha\$</code>	$\alpha$
<code>\$\pi\$</code>	$\pi$
<code>\$\infty\$</code>	$\infty$
<code>\$\sigma\$</code>	$\sigma$
<code>\$\xi\$</code>	$\xi$



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## 3.2. Maths operators

<code>\$_sum\$</code>	$\Sigma$
<code>\$_int\$</code>	$\int$
<code>\$_times\$</code>	$\times$
<code>\$_prod\$</code>	$\Pi$
<code>\$_oint\$</code>	$\oint$





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### 3.3. Math mode accents

`$\widehat{a+1}$`

`$\vec{x}$`

`$\stackrel{\rightarrow}{a+b}$`

`$\overbrace{x^2+3xy+y}^{100}$`

`$\underbrace{x^2+3xy+y}_{200}$`

$\widehat{a+1}$

$\vec{x}$

$\stackrel{\rightarrow}{a+b}$

$\overbrace{x^2+3xy+y}^{100}$   
 $\underbrace{x^2+3xy+y}_{200}$

### 3.4. Text mode accents

`\' {o} ó`

`\" {o} ö`



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To produce a table, here is the code:

Sr. No.	Name	Marks
204	ABC	87.5
205	XYZ	78

```
\begin{tabular}{||l|r|c||}  
\hline \hline  
Sr. No.& Name & Marks\\ \hline  
204&ABC&87.5\\  
205&XYZ&78\\  
\hline \hline  
\end{tabular}
```



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To write Matrices and Determinants:

$$\begin{bmatrix} \pi & \alpha & \beta \\ z^2 & m \times n & 0 \end{bmatrix}$$

```
$$\left[ \begin{array}{ccc} \pi & \alpha & \beta \\ z^2 & m \times n & 0 \end{array} \right]$$
```



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## Automatic numbering for equations

```
\begin{equation}  
\sqrt[3]{m}=m^{\frac{1}{3}}  
\end{equation}
```

$$\sqrt[3]{m} = m^{\frac{1}{3}} \quad (2)$$



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To refer some thing automatically numbered.

```
\begin{equation}
\sqrt[4]{m}=m^{\frac{1}{4}}
\label{myeq}
\end{equation}
```

$$\sqrt[4]{m} = m^{\frac{1}{4}} \quad (3)$$

Want to refer the equation. Just refer it as follows:

see the equation 3 this effect will come by adding

```
\ref{myeq}
```



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`\usepackage{hyperref}` This will link your referred things.



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## 3.5. Errors

There are basically errors

- Due to missing of ending bracket.
- Due to missing ending \$
- Due to wrong spelling of the command
- Due to missing `\end{environment}`





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### 3.6. Font sizes

The part of .tex file before `\begin{document}` is called as **preamble**.

Global font sizes are declared in preamble.

```
\documentclass[11pt]{article}
```

or

```
\documentclass[12pt]{article}
```

Otherwise, `{\large word}` will make the text inside the bracket larg. `{\Huge big}` will make the text very big.



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### 3.7. Change numbering

To change page numbering we can use

```
\setcounter{page}{41}
```



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### 3.8. Equation references

$$a + b = \frac{n + 1}{2}; c + d = \frac{n - 1}{2} \quad (4)$$

```
\setcounter{section}{4}
\renewcommand{\theequation}
{\thesecion.\arabic{equation}}
\begin{equation}
trA = ((a-b)+(c-d)i)\sqrt{n}.
\label{eq-a}
\end{equation}
```

This gives label to the equation. `\label{eq-a}`

$$trA = ((a - b) + (c - d)i)\sqrt{n}. \quad (4.5)$$

On the other hand.... From 4.5... Here we are calling that equation which has given label as `\ref{eq-a}`.



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## 4.9. References

For more information see [1, 2].  
For more information see `\cite{Lam,Don}`.  
This environment is used for References.

1. It automatically generates the word “References”
2. It is similar to `\begin{enumerate}`
3. With `\bibitem {key}` one has to give key, like a label and then for referencing it `\cite{key}` will produce number like [1] automatically.

So `\bibitem`, `\cite`, `\label`, `\ref`, `\pageref` are for referencing automatically generated numbers.

**Theorem 1 (Diagonalization)** *The matrix  $A$  is similar to a diagonal matrix  $D$  if and only if it has  $n$  linearly independent eigenvectors. If  $A$  is similar to  $D$ , then*

$$\begin{aligned} \mathbf{V}^{-1} \mathbf{A} \mathbf{V} &= \mathbf{D} = \text{diag}(\lambda_1, \lambda_2, \dots, \lambda_n) \\ \mathbf{V} &= [\mathbf{V}_1, \mathbf{V}_2, \dots, \mathbf{V}_n], \end{aligned}$$

where the  $n$  eigenpairs are  $\lambda_j, \mathbf{V}_j$  for  $j = 1, 2, \dots, n$ .

```
\newtheorem{thm}{Theorem}
\begin{thm}[Diagonalization] The matrix  $A$  is similar
to a diagonal matrix  $D$  if and only if it has
linearly independent eigenvectors. If  $A$  is
similar to  $D$ , then
```

```
\begin{eqnarray*}
\mathbf{V}^{-1} \mathbf{A} \mathbf{V} &= \mathbf{D} = \mathrm{diag}
(\lambda_1, \lambda_2, \ldots, \lambda_n) \\
\mathbf{V} &= [\mathbf{V}_1, \mathbf{V}_2, \ldots, \mathbf{V}_n], \\
\end{eqnarray*}
```

where the  $n$  eigenpairs are  $\lambda_j, \mathbf{V}_j$  for  $j=1, 2, \ldots, n$ .


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## 4.11. Theorem style and numbering

**Definition 4.12** *If  $\lambda_1$  is an eigen value of  $A$  that is larger in absolute value than any other eigenvalue, it is called the **dominant eigenvalue**. An eigen vector  $\mathbf{V}_1$  corresponding to  $\lambda_1$  is called a **dominant eigenvector**.*

`\begin{defn}`

If  $\lambda_1$  is an eigen value of  $A$  that is larger  
{\sf absolute value} than any other eigenvalue, it is c  
{\bf dominant eigenvalue}. An eigen vector  $\mathbf{V}_1$   
corresponding to  $\lambda_1$  is called a {\bf dominant  
`\end{defn}`



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## 4.12. Numbering styles

### Different types of numbering

<code>\arabic</code>	1,2,3
<code>\roman</code>	i,ii
<code>\Roman</code>	I,II
<code>\alph</code>	a,b,c
<code>Alph</code>	A,B,C



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## 4.13. More commands

To forcefully go to the next page `\eject`, `\newpage`  
To enlarge some page slightly  
`\enlargethispage*{3mm}`  
`\smallskip`  
`\medskip`  
`\bigskip`





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## 4.14. Maths special

1. To write Binomial coefficient  $\binom{n}{2}$   
 $\$ \{ \{ n \} \setminus \text{choose} \{ 2 \} \} \$$
2.  $a \equiv \quad (\text{mod } 17)$
3.  $a \equiv \quad (\text{mod } 17)$
4.  $a \equiv \text{mod } 4$



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## 4.15. Line spacing

To obtain double spacing

```
\renewcommand{\baselinestretch}{2}
```



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## 4.16. Maths fonts

`\mathrm`

`\mathit`

`\mathtt`

`\mathsf`

`\mathbf`

These effects only text in math mode.

`\mathversion{bold}` Changes to bold for all mathematics including symbols until it is disable with

`\mathversion{normal}`



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## 4.17. Figures

To include ready figure use this command. You require one more thing `\usepackage{graphics,graphicx}`  
This will allow to include .jpg file for pdf type output. An .eps type file for .ps type output.

```
\includegraphics{figfile.jpg}
```



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There are different types of output possible with different commands:

- Basically `.tex` will produce `.dvi` output with `latex filename`
- With `dvips` command `.dvi` will produce `.ps` output with `dvips filename`
- With `pdflatex` command `.tex` will produce `.pdf` output with `pdflatex filename`
- With `latex2html` command `.tex` will produce `.html` output with `latex2html filename`



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## 4.18. Slides

Very easy conversions from .tex document to slides is possible by just saying `\documentclass{slides}`

There are other classes like book, report etc.



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Can change page number with  
`\setcounter{page}{27}`



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## 4.19. TeX and friends

In free software community T<sub>E</sub>X has many friends. For figures and figures conversion for T<sub>E</sub>X

Pstricks

Drgeo

Gimp

Dia

etc.





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## 4.20. Table of Contents

Can get automatic contents. `\tableofcontents` write it just near `\begin{documents}`

This will produce contents with entries from sections, sub-sections and its page numbers. You need to `latex` **twice** for that.



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## 4.21. Indexing

Can get automatic Index.

`\usepackage{makeidx}` in the preamble.

add `\makeindex` in the preamble

`\printindex` before the `\end{document}`

`\index{entry-name}` will automatically print the entry-name in the Index, with the page number.



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To include some code or commands as it is in the output:

`\ verb | in between write the code |`

will print the actual command and not the effect. This will be useful when one needs to include actual code in the report.

```
\begin{verbatim}
```

```
  You code here will get displayed as it is
```

```
#include<iostream.h>
```

```
\end{verbatim}
```



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## 4.22. Useful packages

hyperref

graphics,graphicx

algorithms,algorithmic

listing

tikz

hyperlinking

figure handling

algorithm

adding code in  $\text{\LaTeX}$

drawing graphics in  $\text{\LaTeX}$



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## 4.23. Document class

class	useful for
beamer	presentations
IEEEtrans	IEEE paper
report	Thesis
article	General purpose document
book	Writing book



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## 4.24. References

Can get automatic reference.

```
\begin{thebibliography}{99}
\bibitem{Lam}Leslie Lamport, LaTeX User's guide and Reference Manual.
\bibitem{Don}Donald Knuth, The TeX Book.
\bibitem{} LaTeX Companion
\end{thebibliography}
```

We can refer entry in references with `\cite{Don}` this will produce reference number like this:[2]

## References

- [1] Leslie Lamport, *LaTeX User's guide and Reference Manual*
- [2] Donald Knuth, *The TeX Book*.
- [3] *LaTeX Companion*

Thanks!

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Any Question?