1 Basic Introduction of LATEX

Latex is a computer typesetting system that specilizes in producing mathematically oriented documents. It can be used to produce a range of documents, including class handouts, reports, letters, overhead transparencies, theses, journal articles, and books.

1.1 Motivation

There are several good reasons for learning LATEX:

- LATEX like tex is an open software system, available free of charge.

- Mathematical formulas can be produced quite easily. LATEX incorporates a great deal of knowledge about formatting mathematics and the document will looks polished.

- Equations, citations, figures, tables etc. can be labeled, so that cross referencing is automated.

- LATEX is installed at many universities and research instutions and can be run on PCs, workstations, and mainframe computers.

- The LATEX programs as well as much of the informations about various commands is freely available on the internet.

- The tex files have the standred ASCII format and hence they can be written in your favouriate text editor.

- The dvi files produced by the system can be sent to a variety fo output devices, including the computer screen and virtually all types of printers.

1.2 How to run LATEX

The precise details of how to run LATEX depend upon the type of computer that you are using. Depending on that, commands changes slightly but general commands are same. It is first of all required to create a file with tex extension like hello.tex which will contain text of your document. To run LATEX on hello.tex file, we use the command 'latex hello.tex' in linux. This is the first step of compilation. Running this command will produce a file hello.dvi where dvi stands for device independent. This file can be understood by several output devices like it can be displayed on the screen or sent to a printer.

While creating hello.dvi, other files with extensions aux & log will also be created. There is a problem using dvi file that is, it is very large & take lots of apace. So these are further converted into other files like PDF, HTML

etc. Dvi file is converted into pdf using the command 'dvipdf filename.dvi' or the tex file can be directly converted into pdf using the command 'pdflatex filename.tex'. To run the pdf file, we use the command 'evince filename.pdf'.

1.3 Getting started with latex

We start writing in latex with the command

$$\backslash documentclass[a4paper, 11pt]\{article\}$$

This command tells latex that the document is to have the article class with a4 size paper and font size 11. The other classes available are report, book, slides, letter etc. The article class is generally used for short document such as journal papers while report is used for longer works. Taking 11pt will take font size 11 otherwise it will take the default size that is 10.

We begin our document with the command

$$\backslash begin\{document\}$$

All the contents of the document are written in between the commands

$$\backslash begin\{document\}$$
$$document - content$$
$$\backslash end\{document\}$$

Some of the commands such as

$$\backslash usepackage\{\}$$

are written in between $\backslash documentclass$ and $\backslash begin\{document\}$. The set of commands that appear between $\backslash documentclass$ and $\backslash begin\{document\}$ are called Preamble. The command $\backslash usepackage\{\}$ is used to enhance the capability of LATEX. A package is actually a file with sty extension and are in built and perform some selected task. Eg. the command $\backslash usepackage\{graphics\}$ enables latex to include graphs and figures etc. and the command $\backslash usepackage\{color\}$ enables latex to use colours in the document. Generally used packages in latex are fullpage, subfig, amsfonts, Mnsymbol, feynmp etc.

1.4 Sectioning commands

The command

$$\backslash section\{Introduction\}$$

creates a section with the heading Introduction. It will itself do the numbering i.e. section-number is generated automatically.
To make a sub-section, we use the command

$$\backslash subsection\{\}$$

To make a sub-section inside a sub-section, we use

$$\backslash subsubsection\{\}$$

& so on.
If we use $*$ in the command like \section∗{}, then it will not do the numbering automatically.

1.5 Environments

These are the portion of the document that we want latex to treat differently from the main body. They are generally created by enclosing the text between the commands

$$\backslash begin\{environment\ name\}$$
$$text\ of\ document$$
$$\backslash end\{environment\ name\}$$

There are various kind of environments defined in latex. These are

1.5.1 List environment

This environment is used to make a list. If we want to make a list with bullets then we use

$$\backslash begin\{itemize\}$$
$$\backslash item$$
$$\backslash end\{itemize\}$$

and to make a list with numbering, we use

$$\backslash begin\{enumerate\}$$
$$\backslash item$$
$$\backslash end\{enumerate\}$$

1.5.2 Equation environment

This environment is used to display the equations in the document. A mathematical expression can be displayed in the document by enclosing it in

$$\backslash begin\{equation\}$$
$$mathematical\ expression$$
$$\backslash end\{equation\}$$

This is used to enclose a small expression. If the expression is large then we use

$$\backslash begin\{eqnarray\}$$
$$mathematical\ expression$$
$$\backslash end\{eqnarray\}$$

Using these will automatically specify the number of equations. However, if we do not want to number the equations, then we use

$$\backslash begin\{equation*\}$$
$$mathematical\ expression$$
$$\backslash end\{equation*\}$$

Similarly for the array of equations.

Also, if some of the equations are to be numbered and some are not then this can be done explicitly by using '\nonumber' command after that particular equation inside \begin and \end commands like

$$\backslash begin\{equation\}$$
$$mathematical\ equation\backslash\backslash$$
$$mathematical\ equation\ \backslash nonumber\backslash\backslash$$
$$\backslash end\{equation\}$$

This command will number the first equation but not the second.

1.5.3 Table environment

Tables are formed by using the command

$$\backslash begin\{tabular\}\{format\}$$
$$table - content$$
$$\backslash end\{tabular\}$$

where format tells latex how many columns there are to be and whether they are left justified(l), centered(c) or right justified(r). For example,

$$\begin{array}{c}
\backslash begin\{tabular\}\{lcr\} \\
Name \quad \& Marks \quad \& Grade \backslash\backslash \\
\backslash hline \\
A \quad \& 99 \quad \& A+ \backslash\backslash \\
B \quad \& 81 \quad \& A- \backslash\backslash \\
C \quad \& 60 \quad \& B+ \backslash\backslash \\
\backslash end\{tabular\}
\end{array}$$

It will appear as

Name	Marks	Grade
A	99	A+
B	81	A-
C	60	B+

So {lcr} means there are three columns, one is left justified, one is centered and one is right justified. And the command \ hline will introduce a horizontal line.

1.5.4 Arrays and matrices

Array environment is defined for it and is very similar to table environment. Here also, just like table environment, each row of array must contain same number of entries seperated by & and all rows except the last are terminated with \\.

One important thing about array environment is that does not occur as an independent environment like the above ones but must be defined inside any of the above environments or it must be defined within \[and \]. For example

$$\begin{array}{c}
\backslash[\\
\backslash begin\{array\}\{lcr\} \\
A \quad \& 99 \quad \& A+ \backslash\backslash \\
B \quad \& 81 \quad \& A- \backslash\backslash \\
C \quad \& 60 \quad \& B+ \backslash\backslash \\
\backslash end\{array\} \\
\backslash]
\end{array}$$

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It will appear as

$$
\begin{array}{lcr}
A & 99 & A+ \\
B & 81 & A- \\
C & 60 & B+
\end{array}
$$

When arrays are enclosed in braces then it becomes matrices. As

$$
\backslash[
$$
$$
\backslash left[
$$
$$
\backslash begin\{array\}\{lcr\}
$$
$$
A \quad \&99 \quad \&A + \backslash\backslash
$$
$$
B \quad \&81 \quad \&A - \backslash\backslash
$$
$$
C \quad \&60 \quad \&B + \backslash\backslash
$$
$$
\backslash end\{array\}
$$
$$
\backslash right]
$$
$$
\backslash]
$$

It will appear as

$$
\left[\begin{array}{lcr}
A & 99 & A+ \\
B & 81 & A- \\
C & 60 & B+
\end{array} \right]
$$

1.5.5 Centering of the environment

Using the command

$$
\backslash begin\{center\}
$$
$$
Environment
$$
$$
\backslash end\{center\}
$$

will place the environment in the center.

1.6 Spaces

In latex, while writing, one or more spaces or enter key is considered as a single space. If we leave a blank line or more than one blank lines, then it is considered as the start of a new paragraph. To start a newline and not a new paragraph, we use the newline command '\\' at the end of the previous line or at the start of the newline.

We can also manually specify the desired space using the commands '\hspace{}' for horizontal space and the command '\vspace{}' for vertical space. Here inside the braces the space is defined in either cm or in inches. Also the commands '\smallskip", '\midskip", '\bigskip' can be used for vertical spacings.

1.7 Font Styles

LATEX has a very wide range of font styles defined in it. There are various commands in latex that has the declaration like '\ command{ text }', depending on the command it will change the font type of the text inside the braces. Various commands are
\ textit { text } will change the font in italic type
\ textsl { text } will change the font in slanted type
\ textbf { text } will change the font in boldface type
\ color { text } will color the text inside the braces etc

Apart from default size of 10 points for document, sometimes some text is required in different size, this is done by the declarations
\ Huge \ huge \ Large \ large \ small \ footnotesize \ tiny etc. These declarations, and the words to which they apply are enclosed in curly braces to limit their scope.

1.8 Title of the document

Title of the document is defined by declaring the commands

$$\title\{\}$$
$$\author\{\}$$
$$\date\{\}$$
$$\maketitle$$

just after the \ begin {document} command.

1.9 Some more important points about LATEX

- The command '\ tableofcontents' at the required place will make the table of contents based on the sections or subsections in the document.

- Every command in the latex starts with \ (backslash).

- A line starting with % sign without preceding with \ is considered as a commant in latex and is ignored.

- Curly braces have special meaning in latex. Whenever it is required to enclose some part in brackets, always curly braces are used. If it is required to print a curly brace then we use '\{' or '\}' command. Using the commands '\ left \{' or '\ right \}', latex will itself choose braces of appropriate size.

- A mathematical expression is included in between the text by using $ sign, the expression is included between two $ signs.

- To write as subscript, we use A_{x}, it appears as A_x. and to write as superscript, we use A^{x}, it appears as A^x. Generally, the subscript or superscript should be included in braces to avoid confusion.

- To include special symbols like β, α, γ etc., latex has commands like \$\beta\$, \$\alpha\$, \$\gamma\$ etc.

- Inserting symbols like & or @ etc are also required to enclosed inside \$ signs and some of them are required to be followed by \ but some are not as here & is required to be followed by \ but @ not.

- To write as fraction, we use the command \ frac {Numerator}{Denominator}.

- Trignometric expressions, Integration or differentation symbols should also be enclosed in \$ signs.

- There are commands in latex for squareroot, limit, summation etc.

- Latex has a wide number of commands to include various type of arrows or special symbols like the command \ leftarrow appears as $\leftarrow$, the command \ downarrow appears as $\downarrow$ and so on.