LaTeX Cheat Sheet

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This document is created for my own personal reference while learning LaTeX. Most of the material is gathered by surfing Internet and the credit goes to their original authors. I hope some day I could organize this document well.

1 Sample Document

```
\documentclass[twocolumn,a4paper, 12pt]{article}

\title{Introducing {\LaTeX}}
\author{Kamlesh \and Kunal}

\setlength{\parindent}{6mm}
\setcounter{topdepth}{4}

\begin{document}
   \maketitle
   \listoffigures
   \listoftables
   \tableofcontents

   \begin{abstract}
      This is abstract
   \end{abstract}

   \section{Introduction}
      Let me introduce the topic

     \subsection{First}
       section can have subsections

     \subsection{Second}
       subsection can have subsubsections

     \subsubsection{Third}
\end{document}
```

1.1 Document structure

A latex document can be of type of an article or a book.

```
\documentclass{article}
\documentclass[twocolumn,a4paper, 12pt]{article}
\documentclass{book}

\author{Kamlesh \and Kunal}

\hoffset=-2.0pt
\voffset=-2.0pt
\marginparsep=0.0pt
\evensidemargin=0.0pt
\oddsidemargin=60.0pt
\topmargin=0.0pt
\marginparwidth=0.0pt
```

1.2 Font, space

```
\thispagestyle{empty}
\pagenumbering{roman}
\hrulefill
\rule{250pt}{0.5pt} Horizontal line

\textsc{\thesisTitle} \normalsize
\texttt{ktiwari@iitk.ac.in}

\vfill
\\[1cm] newLine after 1cm empty space.

\newpage  \clearpage
\newline
\setcounter{page}{1}
\def\name{Kamlesh Tiwari}

\include{coverPages}
\cleardoublepage  \input{thesisChapter01}
```

For setting up line spacing in document following code can be used.

```
\usepackage{setspace}
\doublespacing  \singlespacing
\onehalfspacing \setstretch{1.8}

\hspace{1cm}
```

To Write text in box use fbox.

```
\fbox{To Write text in box use fbox.}
```

Writing a text in vertical direction or at any other angle one can use \rotatebox command as below with the inclusion of graphicx package.

```
A\rotatebox{90}{B}C
A\rotatebox{270}{B}C
A\rotatebox[origin=c]{270}{B}C
```

A C A C A C

Use \! to bring the things closer and \; to push them farther away. See example: ab ab a b

Following code can be used for customizing the appearence fonts by stretching.

```
\usepackage{rotating} % in preamble

\resizebox{5cm}{0.5cm}{\textbf{IIT Kanpur}}
```

IIT Kanpur

1.3 Margin Notes

For one-sided layout (simplex), the text will be placed in the right margin, starting from the line where it is defined. For two-sided layout (duplex), it will be placed in the outside margin and for two-column layout it will be placed in the nearest margin.

```
\marginpar{margin text}
\marginpar[left text]{right text}
```

To change the whole document in *landscape* mode use geometry-package as \usepackage[landscape]{geometry} or \documentclass[landscape]{report}. A single pages can be changed with package *lscape* in preamble and writing contents as

```
\begin{landscape}
...
\end{landscape}
```

To write anything in circle use \packege{tikz} and write following line in main text.

```
\usepackage{tikz}

\tikz \node[draw,circle]{Text};
```

1.4 Writing in Hindi

We can also create the documents in native languages like **HINDI**, read the article[1] on internet. It requires the use of package **devanagari**.

1.5 Few Symbols

	Latex command	Package to include
Γ	Gamma	
$\varSigma$	varSigma	
Σ	Sigma	
δ	delta	
Δ	Delta	
ξ	xi	
$\subseteq$	subseteq	
$\setminus$	setminus	
$\cap$	cap	
$\rightarrow$	rightarrow	
$\mid$	mid	
$\bigcup$	bigcup	
✓	checkmark	amssymb
π	pi	
$\subset$	subset	
$\forall$	forall	
$\Leftrightarrow$	Leftrightarrow	
⌞	llcorner	amssymb
⌟	lrcorner	amssymb
$\mapsto$	mapsto	
□	square	amssymb
▷	rhd	amssymb
∇	nabla	
$\triangle$	triangle	
α	alpha	
$<$	textless	
$>$	textgreater	
$\bigwedge$	bigwedge	
$\bigvee$	bigvee	
⊠	XBox	wasyaym
☑	CheckedBox	wasyaym
$\Rightarrow$	Rightarrow	
←	textleftarrow	textcomp
φ	varphi	
$\star$	star	
$\subsetneq$	subsetneq	
$\neq$	neq	
$\overset{o}{\kappa}$	\overset{o}{\kappa}	amsmath
$\rightsquigarrow$	rightsquigarrow	
$\bigcup$	bigcup	
ϵ	epsilon	
$\mathbb{N}$	mathbb{N}	
∞	infty	
$\hookrightarrow$	hookrightarrow	
☛	ding(n), $n = 32...254$	pifont
\	textbackslash	
$\otimes$	otimes	
ab	a\!b	
a b	a\,b	
$\vdots$	vdots	
...	hdots	
$\ddots$	ddots	
$($	big{(}	
$\vec{a}$	vec{a}	
$\mathfrak{AB}$	mathfrak{AB}	
AB	mathbf{AB}	
$\mathbb{R}$	mathbb{R}	
$\mathscr{AB}$	mathscr{AB}	mathrsfs
📱	Mobilefone	marvosym
✉	Letter	marvosym
🌍	Mundus	marvosym
☎	phone	wasysym
½	textonehalf	
4/7	nicefrac{4}{7}	nicefrac

Some more symbols: alpha α, beta β, gamma γ, Gamma Γ, delta δ, Delta Δ, epsilon ϵ, zeta ζ, eta η, theta θ, Theta Θ, kappa κ, lambda λ, Lambda Λ, mu μ, nu ν, xi ξ, Xi Ξ, pi π, Pi Π, rho ρ, sigma σ, tau τ, phi ϕ, Phi Φ, chi χ, psi ψ, Psi Ψ, omega ω, Omega Ω

1.6 Modifying character appearance

- $\overset{?}{=}$

```
\overset{?}{=}        %usepackage{amsmath}
```

- $\xrightarrow[g^b]{g^a}$

```
\xrightarrow{g^a}     %usepackage{amsmath}
\xleftarrow{g^b}
```

- $\mathbb{Z}$

```
\mathbb{Z}
```

- $\overbrace{Text}^{I am above}$

```
\overbrace{Text}^{I am above}
```

In the same way **\underbrace** can be used.

- $$M(x) = \begin{cases} 0 & \text{if } M \text{ does NOT accepts } x \\ 1 & \text{if } M \text{ accepts } x \end{cases}$$

[1] http://pravin.insanitybegins.com/posts/using-devanagari-in-latex/

```
\[
M(x)= \left\{
 \begin{array}{l l}
 0 &  \mbox{if $M$ does NOT accepts $x$}\\
 1 &  \mbox{if $M$ accepts $x$}\\
 \end{array}
 \right.
\]
```

1.7 Document Properties

```
\hypersetup{
        pdfauthor={Kamlesh Tiwari},
        pdfsubject={Securities},
        pdftitle={Learn Latex},
        pdfkeywords={latex, help, ok ...}
}
```

Making references (index entries and citations) as hyperlinks (clickable). Write following in preamble.

```
\usepackage{hyperref}
\hypersetup{
    colorlinks=false,
    citecolor=blue,
    filecolor=black,
    linkcolor=blue,
    urlcolor=black
}
```

1.8 Colored text

```
\usepackage{color}
Writing in \textcolor{red}{red color} is easy.
```

Writing in color like red, blue, green, cyan is easy.

1.9 Lists

Lists can be of following types

- ```
  \begin{itemize}
   \item one
   \item two
   \item three
  \end{itemize}
  ```

  – one
  – two
  – three

- ```
  \begin{enumerate}
   \item Apple
   \item Banana
   \item Grapes
  \end{enumerate}
  ```

  1. Apple
  2. Banana
  3. Grapes

- ```
  \usepackage{enumerate}

  \begin{enumerate}[I]
   \item Apple
   \item Banana
   \item Grapes
  \end{enumerate}
  ```

  I Apple
  II Banana
  III Grapes

  \begin{enumerate}[I] is used for capital roman numbers and in similar way **\begin{enumerate}[(a)]** is used for small alpha-characters within brackets. Tokens A, a, I, i, and 1 are allowed.

- ```
  \begin{description}
   \item[Apple] red color
   \item[Banana] yellow color
  \end{description}
  ```

  Apple red color
  Banana yellow color

- ```
  \begin{tabbing}
     \hspace{1cm}\= \hspace{3cm}\= \\
     \> ($A_1$ \> $A_1\oplus I)$ \\
     \> ($A_2$ \> $A_2\oplus I)$ \\
     \> :                \> \\
     \> ($A_t$ \> $A_t\oplus I)$\\
  \end{tabbing}
  ```

  $(A_1 \quad A_1 \oplus I)$
  $(A_2 \quad A_2 \oplus I)$
  :
  $(A_t \quad A_t \oplus I)$

- The **bullets can be changed** for each level using the following command:

  ```
  \renewcommand{\labelitemi}{$\bullet$}
  \renewcommand{\labelitemii}{$\cdot$}
  \renewcommand{\labelitemiii}{$\diamond$}
  \renewcommand{\labelitemiv}{$\ast$}
  ```

- The **space between different items** can be controlled with the *itemsep* command:

  ```
  \begin{itemize}\itemsep2pt
  ```

- To **change enumerated lists counters** itemize labels are accessed via \labelitemi, \labelitemii, \labelitemiii, \labelitemiv, for the four respective levels.

  ```
  \begin{enumerate}
    \item First one
    \setcounter{enumi}{4}
    \item fifth element
  \end{enumerate}
  ```

  1. First one
  5. fifth element

- **Inline lists** are the lists in the running text. We have to use packege *paralist* for the purpose.

  ```
  \usepackage{paralist}

  \textbf{Inline lists}, which are sequential in nature, just like enumerated lists, but are
  ```
  ```

```
\begin{inparaenum}[\itshape a\upshape)]
\item formatted within their paragraph;
\item usually labelled with letters; and
\item usually have the final item prefixed
with 'and' or 'or',
\end{inparaenum} like this example.
```

Inline lists, which are sequential in nature, just like enumerated lists, but are *a*) formatted within their paragraph; *b*) usually labelled with letters; and *c*) usually have the final item prefixed with 'and' or 'or', like this example.

- **Custom Lists** can be created by two step process. First cteating tamplate and then creating the list.

```
%In preamble (before begin{document}) write
=============================================
\newcommand{\mylist}{
  \begin{list}{$\star$}{
   \setlength{\itemsep}{0pt}
   \setlength{\parsep}{3pt}
   \setlength{\topsep}{1pt}
   \setlength{\partopsep}{0pt}
   \setlength{\leftmargin}{3em}
   \setlength{\labelwidth}{1em}
   \setlength{\labelsep}{0.5em}
  }
}
\newcommand{\mylistend}{
  \end{list}
}
=============================================

%In main document  write
\mylist
    \item  C\#, Perl, VC++, system-C,
    \item  OpenMP, P-Thread
    \item  MS Access, FoxPro
    \item  Lettix, Kile, Cmap, VB.net,
    \item  Eclipse, NetBeans
    \item  HTML, XML, PHP, Java Script,
\mylistend
```

  - ⋆ C#, Perl, VC++, system-C,
  - ⋆ OpenMP, P-Thread
  - ⋆ MS Access, FoxPro
  - ⋆ Lettix, Kile, Cmap, VB.net,
  - ⋆ Eclipse, NetBeans
  - ⋆ HTML, XML, PHP, Java Script,

1.10 Inserting images

After using the package *graphicx*, you can use **includegraphics** command to include a .png, .gif, .jpg, .jpeg or .pdf file. you can specify values like width=xx, height=xx, keepaspectratio, scale=xx, angle=xx, trim=l b r t, clip, page=x

```
\usepackage{graphicx}

\includegraphics
   [attr1=val1, ..., attrn=valn]{imagename}

\includegraphics[scale=0.5, angle=180]{figName}
   [width=0.5\linewidth]  [height=60mm]
   [trim = 10mm 80mm 20mm 5mm, clip, width=3cm]
```

A proper way to insert the graphics with a *border* around it and with a describing *title* is as below

```
\begin{figure}[htbp]
  \centering

    \includegraphics{filename}

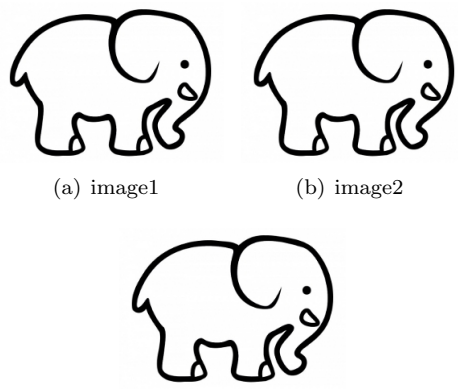
  \caption{White Token}
  \label{labelname}
\end{figure}
```

Note: To include a **.eps** image (1) uese package *graphicx* and *epsfig* in preamble and insert image by \includegraphics (2) Compile by "*latex fileName.tex*" and then convert to pdf by "*dvips -Ppdf fileName.dvi*" you will get *fileName.pdf*

1.10.1 Special effects in image appearence

Package *subfigure* is used when we need to include more than one figure in a row. New line operator \\will produce another row. Following is the command and output.

```
\begin{figure}[htp]
  \begin{center}
    \subfigure[image1]
       {\label{fig:edge-a}
        \includegraphics[scale=0.3]{kt.jpg}}
    \subfigure[image2]
       {\label{fig:edge-b}
        \includegraphics[scale=0.3]{kt.jpg}} \\
    \subfigure[image3]
       {\label{fig:edge-c}
        \includegraphics[scale=0.3]{kt.jpg}}
  \end{center}
  \caption{More than one figure in a row}
  \label{fig:edge}
\end{figure}
```



(a) image1 (b) image2

(c) image3

Figure 1: More than one figure in a row

Wrapping figures can be included by using package *wrapfig*. This would give access to the \{*wrapfigure*}{*alignment*}{*width*} command. Alignment can be either *l* for left, or *r* for right. as below

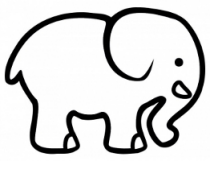


Figure 2: me

```
\begin{wrapfigure}{r}{40mm}
  \begin{center}
    \includegraphics{kt.jpg}
  \end{center}
  \caption{The Toucan}
\end{wrapfigure}
```

Some times you may get an error saying "to many umprocessed floats". This can be corrected by placing \clearpage at right place.

1.11 Table of contents, bibliography, and index

- Table of contents can be generated by

```
\tableofcontents
\listoffigures
\listoftables
```

- Printing of index is a two stage process. First use command **\index** to create an index entry for the file and then using **\printindex**.

```
\index{late binding}
\index{algorithm!recursive}
 :
 Contents
 :
\printindex
```

- To include all references written in file *eCashRefOld.bib* and to add the reference in table of contents write as below.

eCashRefOld.bib

```
@article{varadharajan1999der,
  title={On the design...h schemes},
  author={Varadharaj.... Mu, Y.},
  journal={Theoretical Computer Science},
  volume={226},
  number={1-2},
  pages={173--184},
  year={1999},
  publisher={Elsevier}
}

@conference{chaum1983bsu,
  title={{Blind signatures for..payments}},
  author={Chaum, D.},
  booktitle={Advances i....of Crypto},
  volume={82},
  pages={199--203},
  year={1983}
}

@misc{chaum:uec,
  title={Untraceable Elec.... LNCS 403},
  author={Chaum, D.  and Naor, M.},
  publisher={Springer-Verlag}
}

@misc{ThRef2,
  title={The {PolyU} Palmprint Database:},
  note ={http://www.comp.polyu.edu.hk},
}


@book{brands1995rbs,
  title={{Restrictive blin...ertificates}},
  author={Brands, S.},
  year={1995},
  publisher={Springer}
}
```

In the source file say *myPaper.tex* write following lines at the end of document before the \end{document}

in myPaper.tex document

```
\def \bibname{References etc.. }

\nocite{*} \bibliographystyle{plain}
\ bibliography{eCashRefOld}
```

In the document *myPaper.tex* to refer an entry of *eCashRefOld.bib* (say article *varadharajan1999der*), write **\cite{varadharajan1999der}** at the place. Note that spaces are not accepted so **\cite{varadharajan1999der }** or **\cite{ varadharajan1999der}** will be an error.

we can write an additional line \addcontentsline{toc}{chapter}{References} to include the word *Reference* in table-of-contents as chapter.

- note the in .bib file an item for **book** must have (title, author, year, publisher), **inproceedings** must have (title, author, booktitle, pages, year), **article** must have (title, author, journal, volume, number, pages, year). Always avoid following errors

```
@article{varadharajan1999der,
  title={On the design...h schemes},
  author={Mu, Y.}   ERROR: no comma at end
  journal={TK{\"o}ln, X}, ERROR:avoid {\"o}
  volume={226},
  number={1-2},%some thing  ERROR: avoid %
  pages={173-184},  ERROR: write {173--184}
  year={1999},
  publisher={Elsevier}
}
```

- While submitting source files in journal (say **neurocomputing**) requires to create a .bbl file, (use command $ latex main; $ bibtex main; $ latex main; $ latex main). Also you may have to convert all .jpg files in .pdf (or .eps) format (you can use pdflatex than). Be ready with your picture and short biography while uploading.

- While preparing manuscript for ACM transactions, it requires the balancing of references in the two columns. This can be done by placing \vfill\eject at the required place in the bibliography list of .bbl file. Further, uou can use the program *pdf2ps* to .ps file for upload.

- Title is automatically changed to lower case by latex for example if you write the title as "The PolyU database" then it is automatically converted to "The polyu database". to prevent this unwanted lowering of PolyU one can write this in curly brackets as "The {PolyU} database". A similar example is shown for misc in reference ThRef2 above.

- Back referencing which prints the page numbers where the particular reference is quoted, can be done by just including *hyperref* package in the preamble. Include following line.

  \usepackage[backref=page]{hyperref}

  Removing ugly boxes: This package draws boxes around the references which looks ugly. They can be suppressed by including following lines in the preamble.

```
\usepackage[backref=page]{hyperref}
\usepackage{xcolor}
\hypersetup{
    colorlinks,
    linkcolor={red!50!black},
    citecolor={blue!50!black},
    urlcolor={blue!80!black}
}
```

1.12 Question paper / multi-column

Some times we want to have more then one column in the document in between the text. Like in prepairing question papers, we want answer choices in two column. Use package *multicol*.

```
  Do you know the answer of a question given
  here in this text? If yes please select one
  choice from the list given below from

\begin{multicols}{2}    % 2 columns
   \begin{enumerate}
       \item Choice one
       \item Choice two
       \item Choice three
       \item Last choice
   \end{enumerate}
\end{multicols}
```

Do you know the answer of a question given here in this text? If yes please select one choice from the list given below from

1. Choice one
2. Choice two
3. Choice three
4. Last choice

1.12.1 Listing package

```
Preamble
=========
\usepackage{listings}
\renewcommand{\lstlistingname}{Program }
\renewcommand{\lstlistlistingname}
                        {List of Prog.}

In Begin Document
=================
\lstset{language=C++,
        showstringspaces=false,
        stringstyle=\ttfamily,
        basicstyle=\small}
```

When writing a program in file, write as below.

```
\begin{lstlisting}[frame=lines,
                   caption={Write a program ...}]
 #include<stdio.h>
 void main()
 {
    int a, b, sum;
    printf("\nEnter first number");
    scanf("%d", &a);
    printf("\nEnter second number");
    scanf("%d", &b);
    sum = a + b;
    printf("\nSum  is %d", sum );
  }
\end{lstlisting}
```

The produced effect will be as below.

Listing 1: Write a program ...

```
#include<stdio.h>
void main()
{
   int a, b, sum;
   printf("\nEnter first number");
   scanf("%d", &a);
   printf("\nEnter second number");
   scanf("%d", &b);
   sum = a + b;
   printf("\nSum  is %d", sum );
 }
```

In our case to print list of programs, write following statement.

```
\lstlistoflistings
```

NOTE: the simplest way to write programs in latex document is by using *verbatim* command as below

```
\begin{verbatim}
 eqn:=diff(y(t),t,t)+4*y(t)=0:
  inits:=y(0)=1,D(y)(0)=-1:
   dsolve({eqn,inits},y(t));
Whatever you write here, will go as it is
in output
\end{verbatim}
```

2 Mathematics

2.1 Integration

When working in math mode (thins are within { } or \[\] bracket) Integration can be produced in two ways as below.

1. `\int_{-\pi}^{+\pi}`

$$\int_{-\pi}^{+\pi}$$

2. `\iint_{-\pi}^{+\pi} \sin x \; dx \times \iiint_{-\pi}^{+\pi} \cos x \; dx`

$$\iint_{-\pi}^{+\pi} \sin x \; dx \times \iiint_{-\pi}^{+\pi} \cos x \; dx$$

3. `\mathop{\int}_{-\pi}^{+\pi} ( \big( \Big( \bigg( \Bigg( x ) \big) \Big) \bigg) \Bigg)`

$$\int_{-\pi}^{+\pi} ((((\Big(\bigg(x)\big)\Big)\bigg)\Bigg)$$

4. Also consider

`\mathop{\int\!\!\!\int\!\!\!\int}_{-\pi}^{+\pi}`

$$\iiint_{-\pi}^{+\pi}$$

2.2 Text in math mode

Include package *amsmath* and use \text{} to write text in math environment.

```
\[ x= \sin (x\times
   \text{This is text in math mode})
   but this is not
\]
```

$$x = \sin(x \times \text{This is text in math mode}) \mathit{butthisisnot}$$

2.3 Inline and Displayed Formulas

- ```
  \[\lim_{x \to \infty} \frac{x}{x-1}\]
  ```

$$\lim_{x \to \infty} \frac{x}{x-1}$$

- ```
  $x=\frac{1+y}{1+2z^2}$
  ```

$x = \frac{1+y}{1+2z^2}$

- ```
  $$x=\frac{1+y}{1+2z^2}$$
  ```

$$x = \frac{1+y}{1+2z^2}$$

- ```
  $\int_0^\infty e^{-x^2} dx=
              \frac{\sqrt{\pi}}{2}
                 = \sqrt[10]{x^{10}}$
  ```

$\boxed{\int_0^\infty e^{-x^2} dx = \frac{\sqrt{\pi}}{2} = \sqrt[10]{x^{10}}}$

- ```
  $$\int_0^\infty e^{-x^2} dx=
              \frac{\sqrt{\pi}}{2}$$
  ```

$$\int_0^\infty e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$$

- ```
  $\displaystyle \int_0^\infty
                       e^{-x^2} dx$
  ```

$\boxed{\displaystyle \int_0^\infty e^{-x^2} dx}$

- ```
  $$
   \frac{1}{\displaystyle 1+
     \frac{1}{\displaystyle 2+
     \frac{1}{\displaystyle 3+x}}} +
   \frac{1}{1+\frac{1}{2+\frac{1}{3+x}}}
  $$
  ```

$$\frac{1}{\displaystyle 1+\frac{1}{\displaystyle 2+\frac{1}{\displaystyle 3+x}}} + \frac{1}{1+\frac{1}{2+\frac{1}{3+x}}}$$

- ```
  $\sqrt{2} \sin x$, $\sqrt{2}\,\sin x$
  ```

$\sqrt{2}\sin x$, $\sqrt{2}\,\sin x$

- ```
  $\int \!\! \int f(x,y)\,
                 \mathrm{d}x\mathrm{d}y$
  ```

$\int\!\!\int f(x,y)\,\mathrm{d}x\mathrm{d}y$

- ```
  $$
   \mathop{\int \!\!\! \int}_
                {\mathbf{x} \in \mathbf{R}^2}
   \! \langle \mathbf{x},\mathbf{y}\rangle
   \,d\mathbf{x}
  $$
  ```

$$\mathop{\int \!\!\! \int}_{\mathbf{x} \in \mathbf{R}^2} \! \langle \mathbf{x},\mathbf{y}\rangle \,d\mathbf{x}$$

- ```
  $$ x_1 = a+b \mbox{ and } x_2=a-b $$
  ```

$$x_1 = a+b \mbox{ and } x_2 = a-b$$

- ```
  $$ x_1 = a+b ~~\mbox{and}~~ x_2=a-b $$
  ```

$$x_1 = a+b \;\; \mbox{and} \;\; x_2 = a-b$$

- ```
  \begin{eqnarray}
   y &=& x^4 + 4       \nonumber \\
     &=& (x^2+2)^2 -4x^2 \nonumber \\
     &\le&(x^2+2)^2
  \end{eqnarray}
  ```

$$\begin{aligned} y &= x^4 + 4 \\ &= (x^2+2)^2 - 4x^2 \\ &\le (x^2+2)^2 \end{aligned} \tag{1}$$

- ```
  \begin{eqnarray*}
   e^x &\approx& 1+x+x^2/2! + \\
     && {}+x^3/3! + x^4/4! + \\
     && + x^5/5!
  \end{eqnarray*}
  ```

$$\begin{aligned} e^x &\approx 1 + x + x^2/2! + \\ &\quad + x^3/3! + x^4/4! + \\ &\quad + x^5/5! \end{aligned}$$

- ```
  \begin{eqnarray*}
   \lefteqn{w+x+y+z = }\\
     && a+b+c+d+e+\\
     && {}+f+g+h+i
  \end{eqnarray*}
  ```

$$\begin{aligned} \lefteqn{w+x+y+z =} \\ &\quad a+b+c+d+e+ \\ &\quad + f+g+h+i \end{aligned}$$

- ```
  \begin{eqnarray*}
   x&=&\sin \alpha = \cos \beta\\
    &=&\cos(\pi-\alpha) = \sin(\pi-\beta)
  \end{eqnarray*}
  ```

$$\begin{aligned} x &= \sin\alpha = \cos\beta \\ &= \cos(\pi-\alpha) = \sin(\pi-\beta) \end{aligned}$$

- ```
  {\setlength\arraycolsep{0.1em}
   \begin{eqnarray*}
    x&=&\sin \alpha = \cos \beta\\
     &=&\cos(\pi-\alpha) = \sin(\pi-\beta)
   \end{eqnarray*}
  }
  ```
  ```

$$x = \sin\alpha = \cos\beta$$
$$= \cos(\pi-\alpha) = \sin(\pi-\beta)$$

- ```
  $$\setlength\arraycolsep{0.1em}
   \begin{array}{rclcl}
    x&=&\sin \alpha &=& \cos \beta\\
     &=&\cos(\pi-\alpha) &=& \sin(\pi-\beta)
   \end{array}
  $$
  ```

$$\begin{array}{rclcl} x &=& \sin\alpha &=& \cos\beta \\ &=& \cos(\pi-\alpha) &=& \sin(\pi-\beta) \end{array}$$

- ```
  \begin{equation} x=y+3 \label{eq:xdef1}
  \end{equation}
  In equation (\ref{eq:xdef1}) we saw $\dots$
  ```

$$x = y + 3 \tag{2}$$

In equation (2) we saw ...

- ```
  \usepackage{leqno}
  ...
  \begin{equation} x=y+3 \label{eq:xdef2}
  \end{equation}
  In equation (\ref{eq:xdef2}) we saw $\dots$
  ```

...

$$x = y + 3 \tag{3}$$

In equation (3) we saw ...

- ```
  \begin{equation}
  \begin{array}{l}
  \displaystyle \int 1 = x + C\\
  \displaystyle \int x = \frac{x^2}{2} + C \\
  \displaystyle \int x^2 = \frac{x^3}{3} + C
  \end{array}
  \label{eq:xdef3}
  \end{equation}
  ```

$$\begin{array}{l} \displaystyle \int 1 = x + C \\ \displaystyle \int x = \frac{x^2}{2} + C \\ \displaystyle \int x^2 = \frac{x^3}{3} + C \end{array} \tag{4}$$

- ```
  \begin{eqnarray}
  && \int 1 = x + C \nonumber\\
  && \int x = \frac{x^2}{2} + C \nonumber\\
  && \int x^2 = \frac{x^3}{3} + C
                              \label{eq:xdef4}
  \end{eqnarray}
  ```

$$\begin{aligned} \int 1 &= x + C \\ \int x &= \frac{x^2}{2} + C \\ \int x^2 &= \frac{x^3}{3} + C \end{aligned} \tag{5}$$

- ```
  $\left] 0,1
  \right[
   + \lceil x \rfloor - \langle x,y\rangle$
  ```

$$]0,1[+ \lceil x \rfloor - \langle x, y \rangle$$

- ```
  $$
  {n+1\choose k} = {n\choose k} +
                          {n \choose k-1}
  $$
  ```

$$\binom{n+1}{k} = \binom{n}{k} + \binom{n}{k-1}$$

- ```
  $$
  |x| = \left\{ \begin{array}{rl}
   -x &\mbox{ if $x<0$} \\
    x &\mbox{ otherwise}
         \end{array} \right.
  $$
  ```

$$|x| = \begin{cases} -x & \text{if } x < 0 \\ x & \text{otherwise} \end{cases}$$

- ```
  $$
  F(x,y)=0 ~~\mbox{and}~~
  \left| \begin{array}{ccc}
    F''_{xx} & F''_{xy} &  F'_x \\
    F''_{yx} & F''_{yy} &  F'_y \\
    F'_x     & F'_y     & 0
    \end{array}\right| = 0
  $$
  ```

$$F(x,y)=0 \quad \text{and} \quad \begin{vmatrix} F''_{xx} & F''_{xy} & F'_x \\ F''_{yx} & F''_{yy} & F'_y \\ F'_x & F'_y & 0 \end{vmatrix} = 0$$

- ```
  $$
  \underbrace{n(n-1)(n-2)\dots(n-m+1)}_
  {\mbox{total of $m$ factors}}
  $$
  ```

$$\underbrace{n(n-1)(n-2)\dots(n-m+1)}_{\text{total of } m \text{ factors}}$$

- Accents in text mode:

```
gar\c con \'\i{} i
t\`o\'s\.g\^o na\"\i ve na\"ive
Ha\v cek
\r Angstr\"om
```

garçon í i tòśġô naïve naïve Haček Ångström

- Accents in math mode:

```
$\hat{x}$, $\check{x}$, $\tilde{a}$,
$\bar{\ell}$, $\dot{y}$, $\ddot{y}$,
$\vec{z_1}$, $\vec{z}_1$
```

$\hat{x}$, $\check{x}$, $\tilde{a}$, $\bar{\ell}$, $\dot{y}$, $\ddot{y}$, $\vec{z_1}$, $\vec{z}_1$

- Wide accents, under and overline:

```
$\hat{T} = \widehat{T}$,
$\bar{T} = \overline{T}$, $\widetilde{xyz}$,
$\overbrace{a+\underbrace{b+c}+d}$
```

$\hat{T} = \widehat{T}$, $\bar{T} = \overline{T}$, $\widetilde{xyz}$, $\overbrace{a+\underbrace{b+c}+d}$

- ```
  $$
   \overline{\overline{a}^2+\underline{xy}
   +\overline{\overline{z}}}
  $$
  ```
  ```

$$\overline{\overline{a^2} + \underline{xy} + \overline{\overline{z}}}$$

- ```
  $$ \left[
    \begin{array}{ c c }
       1 & 2 \\
       3 & 4
    \end{array} \right]
  $$
  ```

$$\left[\begin{array}{ c c } 1 & 2 \\ 3 & 4 \end{array} \right]$$

- ```
  $$
  \underbrace{a+\overbrace{b+\cdots}^{=t}+z}
  _{\mathrm{total}} ~~
  a+{\overbrace{b+\cdots}}^{126}+z
  $$
  ```

$$\underbrace{a+\overbrace{b+\cdots}^{=t}+z}_{\mathrm{total}} \quad a+\overbrace{b+\cdots}^{126}+z$$

- ```
  $$
  \text{comb}(x,y,\Delta x,\Delta y)
     \overset{\Delta}{=}
     \mathop{\sum\sum}_{m,n=-\infty}^{\infty}
     \delta(x-m\Delta x, y-n\Delta y)
  $$
  ```

$$\text{comb}(x,y,\Delta x,\Delta y) \overset{\Delta}{=} \mathop{\sum\sum}_{m,n=-\infty}^{\infty} \delta(x-m\Delta x, y-n\Delta y)$$

3 Creating table

- ```
  \begin{tabular}[h]{|lr|}\hline
    S.No. &  Name \\ \cline{2-2}
    \multicolumn{2}{|c|}{ In2column} \\\hline
  \end{tabular}
  ```

S.No.	Name
In2column	

- @{xxx} is used to make xxx as column seprator.

```
\begin{tabular}{|r@{.}l|}
  3&14159\\
  16&2\\
  123&456\\
\end{tabular}
```

3	14159
16	2
123	456

```
\begin{tabular}{|r@{\hspace{12pt}}ll@{}l|}
  3&14159&kt&xx\\
  16&2&ok&yy\\
  123&456&no&zz\\
\end{tabular}
```

3	14159	kt	xx
16	2	ok	yy
123	456	no	zz

- By array package >{\cmd} are used to alter column specifications <{\cmd}.

- To create multi-row tables following code can be used.

```
\usepackage{multirow}

\begin{tabular}[h]{|@{}l|l|}\hline
 Team. &  \cellcolor[gray]{0.9}Name \\\hline
 \multirow{3}{*}{1.}& Kamlesh\\
                    & Amit Agrawal\\
                    & Mukesh\\\hline
                  2. & Kunal\\\hline
\end{tabular}
```

Team.	Name
1.	Kamlesh Amit Agrawal Mukesh
2.	Kunal

- **Table with colored cell** is easy, a particular cell in the table can be colored by preceding it by *\cellcolor[gray]{0.9}* include the package \usepackage[table]{xcolor}

```
\begin{tabular}{|l|l|l|l|l|l|}\hline
  \rowcolor[gray]{0.9}Sun&&07&14&21\\\hline
 Mon &01&08&15&
      \cellcolor[rgb]{0.2,0.8,0.2}22\\\hline
 Tue&02&09&16&23\\\hline
 Wed&03&10&17&24\\\hline
 Thu&04&11&18&25\\\hline
 Fri&05&12&19&26\\\hline
 Sat&06&\cellcolor[gray]{0.5}13&20&7\\\hline
\end{tabular}
```

Sun		07	14	21
Mon	01	08	15	22
Tue	02	09	16	23
Wed	03	10	17	24
Thu	04	11	18	25
Fri	05	12	19	26
Sat	06	13	20	7

- **Table can have a caption and label**

```
    \begin{table}[htb]
        \begin{center}
          \begin{tabular}{|l|l|}\hline
            X & X * X\\\hline
            2 & 4\\\hline
            10 & 100\\\hline
          \end{tabular}
        \end{center}

      \caption{Table is describes as ....}
      \label{thisCanBeUsedAsRef}
    \end{table}
```

X	X * X
2	4
10	100

Table 1: Table is describes as ....

- **Alternate Row Colors in Tables**

```
\usepackage[table]{xcolor}

\rowcolors{1}{green}{pink}
\begin{tabular}{lll}
   odd      & odd    & odd \\
```

```
    even    & even  & even\\
   odd      & odd   & odd \\
   even     & even  & even\\
\end{tabular}
```

odd	odd	odd
even	even	even
odd	odd	odd
even	even	even

- **Multi page table**

```
\usepackage{longtable}

\begin{longtable}{|lp{4cm}|lp{4cm}|}\hline
    t1& t2& t3& t4\\ \endhead
    zip& Zip archive &
    pdf& PDF Document\\\hline
\end{longtable}
```

Whatever comes before **\endhead** is repeated on every new page of the table.

- **Rotating text:** To create a table with rotated column text use the following code can be used

```
\usepackage{rotating}

\begin{tabular}{|r|r|}\hline
     \begin{sideways}
            Paper
     \end{sideways}
   &
     \begin{sideways}
            Static
     \end{sideways}\\\hline

   HAR1994j & Journal \\
   SWRT1996c & Conference \\\hline
\end{tabular}
```

Paper	Static
HAR1994j	Journal
SWRT1996c	Conference

3.1 Mini page

To produce the effect below the code is given below.

```
{  %These brackets are required
\begin{minipage}{0.4\textwidth}
  First part\\
  is written as it is\\
  without care
\end{minipage}
\begin{minipage}{0.4\textwidth}
  Second part\\
  is also written as it is\\
  without care
\end{minipage}
}
```

First part
is written as it is
without care

Second part
is also written as it is
without care

3.2 Side by side table

Two tables on a same page can be produced as below. Use an additional package *caption*. Begin and end figure are used to make the minipage as a floating environment.

```
\begin{figure}[t]
\begin{minipage}{.45\linewidth}
\centering
  \begin{tabular}{|l|l|}\hline
      Name & marks\\\hline
      Rajesh&15\\\hline
      Rahul&33\\\hline
      Kunal&21\\\hline
  \end{tabular}
  \captionof{table}{First list}
\end{minipage}\hfill
\begin{minipage}{.45\linewidth}
\centering
  \begin{tabular}{|l|l|}\hline
      Name & marks\\\hline
      Rajesh&15\\\hline
      Rahul&33\\\hline
      Kunal&21\\\hline
  \end{tabular}
  \captionof{table}{First list}
\end{minipage}
\end{figure}
```

Name	marks
Rajesh	15
Rahul	33
Kunal	21

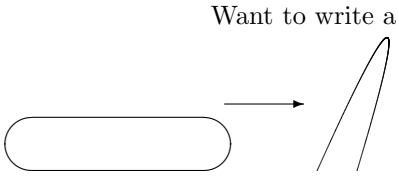
Table 2: First list

Name	marks
Rajesh	15
Rahul	33
Kunal	21

Table 3: First list

4 Picture environment

```
\setlength\unitlength{5pt}
\begin{picture}(40,20)(-2,0)
\put(5,3){\oval(17,4)}
\put(12 ,12){Want to write a text ?}
\put(13,6){\vector(1,0){6}}
\qbezier(32,1)(29,-5)(23,1)
\end{picture}
```



Another approach is very exciting

1. Create picture using **xfig**
2. Save and export to latex picture. Say with name *p1.tex*
3. Use following packages.[2] **[tikz]+[arrows]** OR color+epsfig [3]
4. Write following lines to include the picture in your .tex source file.

```
    \begin{figure}[t]
    \centering
    \scalebox{0.8}{\input{p1}}
    \caption{Example hd(A,B)}
    \label{fig:hd}
    \end{figure}
```

[2] \usepackage{tikz} \usepackage{arrows}
[3] \usepackage{color} \usepackage{epsfig}

5 Footnote

Simple footnote can easily be inserted by writing

```
\footnote{Text to be put in footnote}
```

The footnote will appear as[4] by showing a number to link the footnote text. Some times it is required to use **symbols to link the footnote**, for those cases we can use following code.

```
% In preamble (before begin document)
\long\def\symbolfootnote[#1]#2
   {\begingroup\def\thefootnote{
        \fnsymbol{footnote}}\footnote[#1]{#2}
   \endgroup}

% within the document
\symbolfootnote[2]{Let ....}
```

6 Page Margins Adjustment

Write these in preamble

```
\usepackage[top=1cm, bottom=1cm,
            left=1cm, right=1cm]{geometry}
```

7 Fancy Headres

Write these in preamble

```
\usepackage{babel}
\usepackage{lastpage}
\usepackage{fancyhdr}
\pagestyle{fancy}

\fancyhead{}
\fancyfoot{}

\lhead{CS640: Computational Complexity}
\chead{-: Doodle Notes :-}
\rhead{Instructor: Prof. Somenath Biswas (sb@)}

\lfoot{CSE, IIT Kanpur}
\cfoot{Page: \thepage/\pageref{LastPage}}
\rfoot{ktiwari@cse.iitk.ac.in}

\renewcommand{\headrulewidth}{0.4pt}
\renewcommand{\footrulewidth}{0.4pt}
```

8 Page Border

Write these in preamble. For single border try this

```
\usepackage{fancybox}
\fancypage{\fbox}{}
```

and for double boredr try below

```
\usepackage{fancybox}
\fancypage{\setlength
            {\fboxsep}{10pt}\fbox}{}
```

[4]Text to be put in footnote

9 Line between columns for two column document

Write these in preamble.

```
\usepackage{multicol}
\setlength{\columnseprule}{0.4pt}
\setlength{\columnsep}{15pt}
```

10 Custom Function

```
\newcommand{\f}[2]{
  \textbf{#1} {#2}
}

\newcommand{\conpc} {
  \textbf{coNP}-\textit{complete}
}
```

11 Custom Counter

```
 \newcounter{lNo}
\newcommand{\Lecture}[2] {
  \stepcounter{lNo}
  Lecture\# \thelNo &  {#1}
  \textbf{#2}
}
```

12 LaTeX Counters

Everything LaTeX numbers for you has a counter associated with it. The name of the counter is the same as the name of the environment or command that produces the number. Below is a list of the counters used LaTeX's standard document styles to control numbering.

part	part	figure	enumi
chapter	subparagraph	table	enumii
section	page	footnote	enumiii
subsection	equation	mpfootnote	enumiv
subsubsection			

- \addtocounter{counter}{value} increments counter by the amount, which can be negative
- \alph{counter}, \Alph{counter} print the value of the counter as a lower or upper case letter.
- \arabic{counter} print the value of the counter as an arabic number
- \fnsymbol{counter} print the counter as a footnote symbol
- \newcounter define a new counter
- \roman{counter}, \Roman{counter} print the value of the counter as a roman letter using lower or upper case letters
- \setcounter{counter}{value} assign the value to the counter
- \usecounter{counter} to be used in list environment.
- \value{counter} get the value of the counter.

13 if .. then ..

```
\usepackage{ifthen}

\ifthenelse {\equal{\theX}{0}}
    { \paragraph*{} }
    { \hrulefill  \paragraph*{} }
```

14 For loop in latex

Write follwoing lines in preamble

```
\newcommand{\forloop}[5][1]
{
 \setcounter{#2}{#3}
 \ifthenelse{#4}
  {
  #5
  \addtocounter{#2}{#1}

  \forloop[#1]{#2}{\value{#2}}{#4}{#5}
  }
  Else
  {
    Fail
  }
}
```

And these in main document.

```
\newcounter{ct}
\forloop{ct}{1}{\value{ct} < 10}
{
 \arabic{ct} Happy B'Day
}
```

1 Happy B'Day
2 Happy B'Day
3 Happy B'Day
4 Happy B'Day
5 Happy B'Day
6 Happy B'Day
7 Happy B'Day
8 Happy B'Day
9 Happy B'Day
Else Fail lse Fail lse Fail lse Fail lse Fail lse Fail lse Fail lse Fail lse Fail lse Fail

15 Plotting Graphs with points

We can use very useful package *tikz* and *pgfplots* in preamble to write following code in main document.

```
\begin{tikzpicture}[scale=0.8]
  \begin{axis}[title=Test,
    ylabel= Y axis, xlabel= X axis,
    xtick=\empty, extra x ticks={1,2,3,4},
    extra x tick labels={18-25,26-40,41-60,60+},
    legend style={at={(0,-0.2)},
          anchor=north west,legend columns=3}]

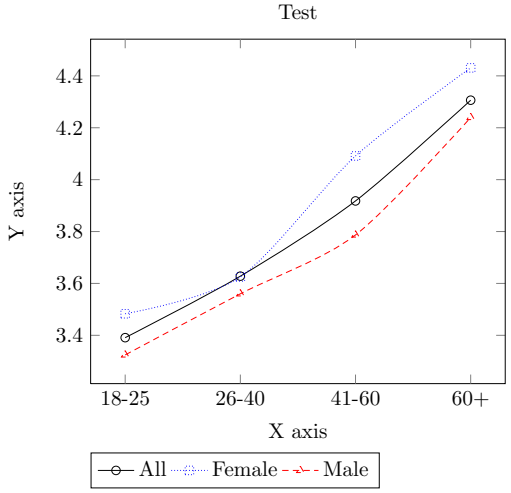
    \addplot[smooth,mark=o,color=black,solid]
    plot coordinates {(1, 3.390968) (2, 3.628)
                      (3, 3.917949)(4, 4.3062)};
    \addlegendentry{All }


    \addplot[smooth,mark=square,color=blue,
    densely dotted]
    plot coordinates {(1, 3.483077)(2, 3.625)
      (3, 4.091270)(4, 4.430769)};
    \addlegendentry{Female }

    \addplot[smooth,mark=triangle,color=red,
    densely dashed]
    plot coordinates {(1, 3.324445)(2, 3.560)
      (3, 3.786787)(4, 4.239669)};
    \addlegendentry{Male }

  \end{axis}
\end{tikzpicture}
```

the result is as below.

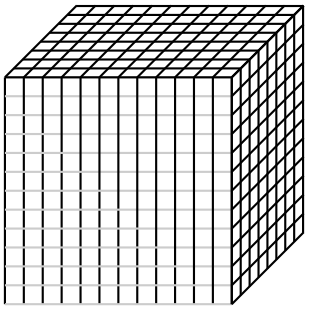


16 Drawing objects with tikz

One can define own drawing objects by using tikz package. One object named myCube is defined below. Call it as \myCube{12}{0.2}

```
\newcommand{\mycube}[2]{
\begin{tikzpicture}[scale=#2]
 \foreach \x in {0,...,#1} % Front Box
 {
  \draw[thick] (0,-\x) -- (#1,-\x);
  \draw[color=gray!40, thick] (\x,0) -- (\x,-#1);
 }
 \foreach \x in {0,...,#1} % Top & Side rays
 {
  \draw[thick] (\x,0)--(\x+3.8,3.8);
  \draw[thick] (#1,-\x)--(#1+3.8,-\x+3.8);
 }

 \foreach \x in {0,0.4714,...,4} % Top box
 {
  \draw[thick] (\x,\x)--(#1+\x, \x);
  \draw[thick] (#1+\x, \x)--(#1+\x, \x-#1);
 }
 \end{tikzpicture}
}
```



17 Algorithms

To write algorithm you have to use *algorithm2e* package. When using the package algorithm2e you may have to download file **algorithm2e.sty** and put that in same directory. The \bagin{algorithm*} is used instead of algoritm in twocolumn mode.

```
% Write in preamble
=============================================
\usepackage[algoruled,resetcount,
            linesnumbered]{algorithm2e}

% In main document
=============================================
\begin{algorithm}
\KwIn{$O_n$: Object set .... }
\KwOut{$PR$: List of objects in range}
\For{ $i \leftarrow 1$ \KwTo $n$ } {
   Find  object $O_i$ query object $Q$ in D.\\
   Compute feature v  \\
   Compute distance \\
   \uIf {$EMD[i] \leq R$} { Count++.\\
     Add $O_i$ to $PR$\\
   }
   \uElseIf{x=8}{ this can be done\\
   }
   \Else{ Dot this
   }
\tcc*[f]{ This is a good comment HaHaHa}\\
\Repeat{this stop condition}{
 ..... what to do
  }
\tcc*[f]{ This is a good comment HaHaHa}\\
\lRepeat{stop}{a one line loop}
 }
\Switch{the value of T}{
  \uCase{a value}{
    do this\;
    do that\;
  }
  \lCase{another value}{one line}\;
  \Case{last value}{
    do this\;
    break\;
  }
  \Other{
    for the other values\;
    do that \tcc*[f]{Another comment}
  }}
   \lIf {$EMD[i] \leq R$} { Count++ }

\Return $PR$.\
\caption{Range Query using EMD} \label{alg1}
\end{algorithm}
```

Algorithm 1: Range Query using EMD

Input: O_n: Object set ....
Output: PR: List of objects in range

1 **for** $i \leftarrow 1$ **to** n **do**
2 | Find object O_i query object Q in D.
3 | Compute feature v
4 | Compute distance
5 | **if** $EMD[i] \leq R$ **then**
6 | | Count++.
7 | | Add O_i to PR
8 | **else if** *x=8* **then**
9 | | this can be done
10 | **else**
11 | | Dot this
12 | **end**
| /* This is a good comment HaHaHa */
13 | **repeat**
14 | | ..... what to do
15 | **until** *this stop condition*;
16 | **repeat** a one line loop **until** *stop*
17 **end**
18 **switch** *the value of T* **do**
19 | **case** *a value*
20 | | do this;
21 | | do that;
22 | **case** *another value* one line;
23 | **case** *last value*
24 | | do this;
25 | | break;
26 | **endsw**
27 | **otherwise**
28 | | for the other values;
29 | | do that /* Another comment */
30 | **endsw**
31 **endsw**
32 **if** $EMD[i] \leq R$ **then** Count++
33 **return** PR.

Some more stuff that can be used ..

```
\SetVline
\If{cond2}{ \lIf{ \Else{ \uElseIf{ \ElseIf{
\SetLine   \uIf{  \uElseIf{  \Else{

\begin{algorithm}[H]
 \ForAll  \KwTo
\end{algorithm}
```

NOTE: in beamer this package requires \begin{algorithm}[H] instead of \begin{algorithm}

18 To provide *listofX*

When a new command \Q in the code file[5] can be produced as below

```
\usepackage{tocloft}
\usepackage[english]{babel}
\newcommand{\listXname}{List of Questions}
\newlistof{X}{exp}{\listXname}

\newcommand{\Q}[1]{
    \refstepcounter{X}
    \par
    \noindent{\textbf{\fbox{Q.\theX} #1 }}

    \addcontentsline{exp}{X}{
        \protect\numberline{\textbf{[Q\theX.]}}
        \hspace{24pt} #1% (See \thesection)
    }
    \par
}
```

we can write \listofX to print the list.

19 Writing letter

```
\documentclass{letter} \address{ I2 SBRA}
\name{Kamlesh Tiwari} \signature{Kamlesh Tiwari}

\begin{document}
\begin{letter}{
To,\\Principal .. \\\underline{Subject: ...}}

\opening{Dear Sir,}
This is  ... with regards.
\closing{Yours faithfully,}
\cc{ .... }
\encl{ ... }
\end{letter}
\end{document}
```

20 Sample Front Page

```
\documentclass[a4paper, 12pt]{article}

\title{\textsc{ EE604:Term Paper} \\[40pt]
{\large \textbf{TITLE:}
 \textsc{\textbf{On Image Compression DWT-DCT
Algorithm}}\\\textbf{AUTHOR:}
\textit{How Sun Dee, Varun Jeoti}}\\[30pt]
   {\large
    Instructor: Prof. Sumana Gupta
    \\[45pt] Report By
    \\[30pt] Kamlesh Tiwari,\texttt{ktiwari}
    \\[10pt] Deepak Singhal,\texttt{sdeep}
    \\[70pt]
    \includegraphics[scale=0.4]{iitkLogo.jpg}
    \\[30pt] Department of EE
    \\Indian Institute of Technology, Kanpur
  }}
\date{}

\begin{document}

\maketitle
\thispagestyle{empty}
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\doublespacing

\section{Introduction}
        The paper proposes a Hybrid Transform
which does following two things on any
image.....

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[5] see document qbFinal.tex