Technical Report Writing using LaTeX

Presentation
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Outline

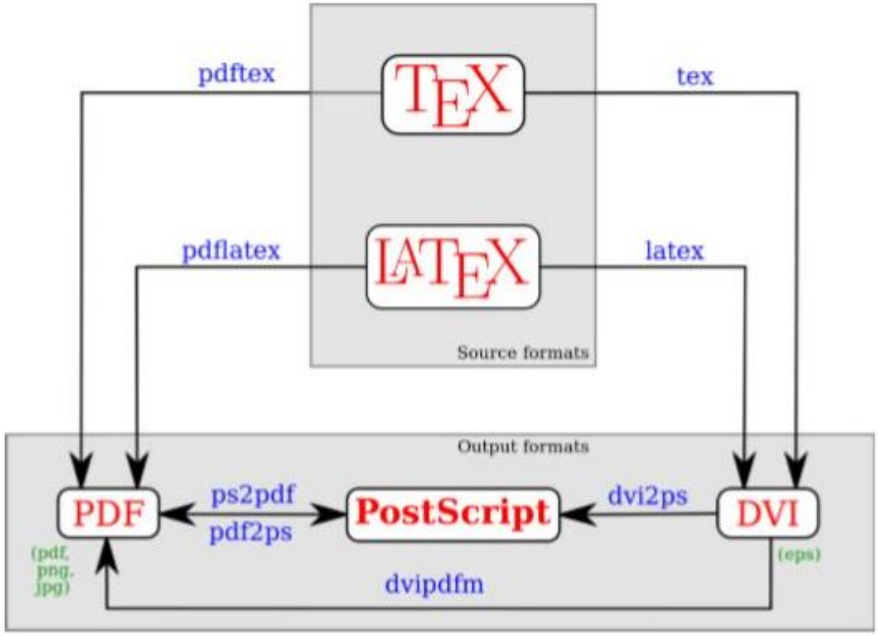
- Why LaTeX?
- Introduction to LaTeX
- Documents Structure of LaTeX
- Few Basics (EXAMPLE: 1 (Simple Document) & EXAMPLE: 2 (Two Column Document of IEEEtran class))
- Mathematical Equation in LaTeX
- Mathematical Equation in LaTeX(EXAMPLE: 3)
- Creating Tables in LaTeX(EXAMPLE: 4 & EXAMPLE: 5)
- Importing Figures in LaTeX(EXAMPLE: 6 & EXAMPLE: 7)
- Reference & Citation (EXAMPLE: 8)
- How to write proofs of theorems (EXAMPLE: 9)
- How to write Algorithms (EXAMPLE: 10)

Why LaTeX?

1. It's **free** and **portable**.
2. You can use the editor of your choice (Even MS Word).
3. Including **mathematical expressions** in LaTeX involves typing a few appropriate characters. By contrast, including mathematics in Word requires Equation Editor, a cumbersome and slow graphical user interface
4. **Style changes are neater** in LaTeX. **Style files for many periodicals exist**.
5. Almost all mathematical and scientific **notations** are easily achievable in LaTeX.
6. **Repetitive tasks** can more easily be **automated**.
7. Don't bother about the **format**, concentrate on the **content**.

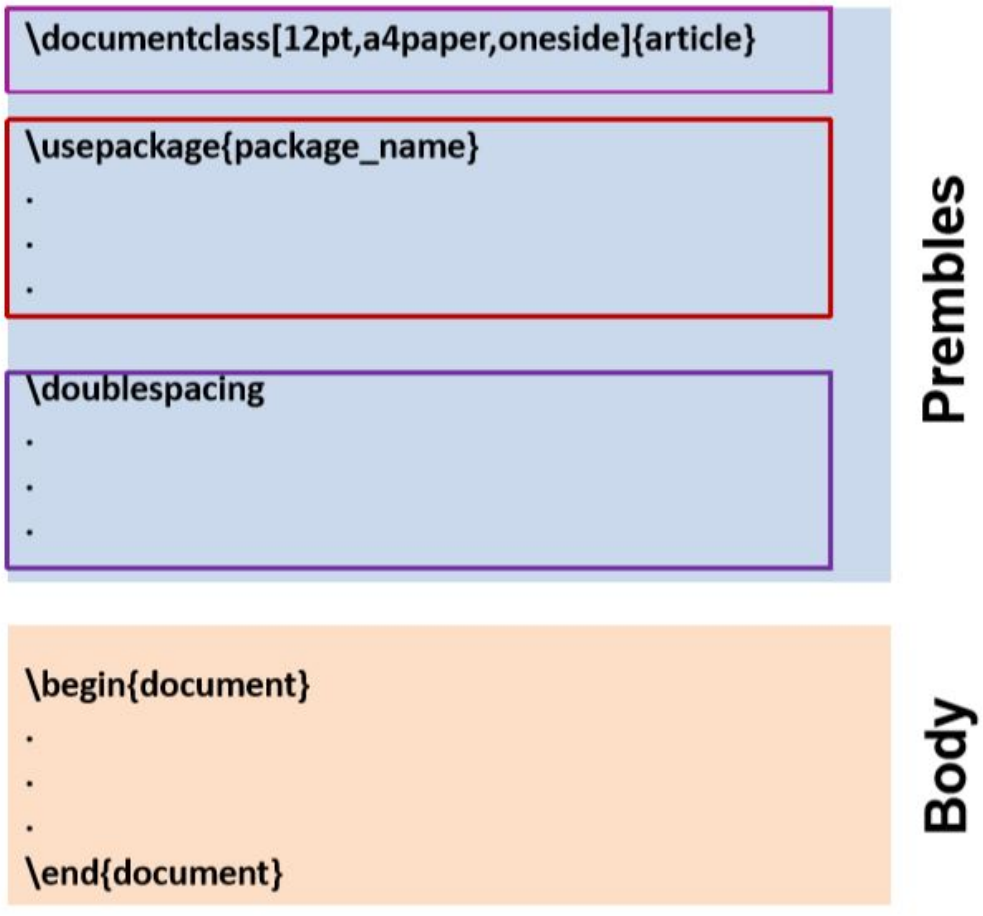
Introduction to LaTeX

- TEX is a low-level **mark-up Language**
- LATEX is macro package based on TEX to simplify its typesetting especially for writing mathematical formulae.



TeX compilation process

Document Structure of LaTeX



Few Basics of LaTeX

1. Spaces
2. Reserved Characters

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

h	right here
t	top of a page
b	bottom of a page
p	at then end of this chapter/section/document
!	ignore LaTeXand just do as I say!

3. Commands
4. Environments
5. Groups
6. Comments - Comment a section with %

EXAMPLE: 1

Go to https://www.writelatex.com/

Create an user account

Create a new paper

Create a simple document.

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

\begin{document}
\title{This is a Test Report}
\author{A. Author}
\date{}
\maketitle
\section{Introduction}
\textbf{Hello World!}
\\ Start using LaTeX.
\end{document}
```

EXAMPLE: 2

Create a two-column document of **IEEETran** class.

```
\documentclass[journal]{IEEEtran}

\begin{document}

\title{This is a Test Report}
\author{A. Author \thanks{author's affiliation}}
\maketitle

\begin{abstract}
\end{abstract}

\begin{IEEEkeywords}
\end{IEEEkeywords}

\IEEEpeerreviewmaketitle

\section{Introduction}
\section{Work Done}
\section{Conclusion}

\end{document}
```

Mathematical Equation in LaTeX

LaTeX typesets maths notation differently from normal text

Inline math notations:

- Use the **'dollar' ($)** sign at the start and end of the equation.
- Example:
  - "**$(x-y) = 4$.**"

Separate formula:

- For creating separate formula, use the **equation** environment.
- Example:

```
\begin{equation}
\label{eq1}
    (x-y) = 4
\end{equation}
```

- Use **equation*** (instead of **equation**) if you want to suppress the numbering.

Mathematical Equation in LaTeX

Multiline Equations

```
\begin{align}
\label{eq3}
   & x-y = 4 \nonumber \\
   \Rightarrow & x =y + 4
\end{align}
```

Fraction

```
\begin{equation}
\label{eq4}
    \left(\frac{x}{2}-y\right) = 4
\end{equation}
```

Super/Sub-scripts

```
\begin{equation}
\label{eq5}
    x_1^2-y=4
\end{equation}
```

Use **amsmath** package for mathematics

Symbol/Operator	Syntax
$\sqrt{}$	\sqrt{…}
$\leq$	\leq
$\geq$	\geq
$\pm$	\pm
$\times$	\times
$\int$	\int
$\approx$	\approx
$\sum$, Ω, Δ	\Sigma, \Omega, \Delta
μ, λ, γ	\mu, \lambda, \gamma

Latex syntax of few important mathematical symbols/operators

A comprehensive list of symbols/operators can be found here:
http://www.artofproblemsolving.com/Wiki/index.php/LaTeX:Symbols

EXAMPLE: 3

Write an equation in LaTeX and **refer to the equation in text**

```
\begin{equation}
\label{eq1}
    \mu_1^2 \geq
\frac{x}{1+x^2}
\end{equation}
```

$$\mu_1^2 \geq \frac{x}{1+x^2} \tag{1}$$

Write a multi-line equation

```
\begin{align}
\label{eq2}
    & x-y = 4 \nonumber \\
    \Rightarrow & x=y+4
\end{align}
```

$$\begin{aligned} x - y &= 4 \\ \Rightarrow x &= y + 4 \end{aligned} \tag{2}$$

Creating Tables in LaTeX

Basic table is very easy to create

Complicated tables may be generated by a third-party tool and corresponding LaTeX code can be imported to the main tex file.

- Example: : http://www.tablesgenerator.com/latex tables#

You may use **tabularx** package for tables.

Enclosed in **\begin{table}...\end{table}**

EXAMPLE: 4

Create a simple table

```
\begin{table}[ht!]
\centering
\caption{Basic table structure}
\begin{tabular}{|c|c|c|} \hline
Clo.1 & Col.2 &  Col.2 \\ \hline
& & \\ \hline
& & \\ \hline
& & \\ \hline
\end{tabular}
\label{tab:table_1}
\end{table}
```

TABLE I
BASIC TABLE STRUCTURE

Clo.1	Col.2	Col.2

EXAMPLE: 5

Create a more complicated table

```
\begin{table}[ht!]
\centering
\caption{A nested table structure}
\begin{tabular}{|c|c|c|c|c|}
\hline
\multirow{2}{*}{Col. 1} & \multicolumn{2}{c|}{Col. 2} & \multicolumn{2}{c|}{Col. 3} \\ \cline{2-5}
                & Col. 2.1   & Col. 2.2   & Col. 3.1   & Col. 3.2   \\ \hline
\multirow{2}{*}{R1}   & a1       & b1       & c1       & d1       \\ \cline{2-5}
                & a2       & b2       & c2       & d2       \\ \hline
\multirow{2}{*}{R2}   & w1       & x1       & y1       & z1       \\ \cline{2-5}
                & w2       & x2       & y2       & z2       \\ \hline
\end{tabular}
\label{table_2}
\end{table}
```

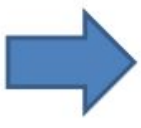


TABLE II
A NESTED TABLE STRUCTURE

Col. 1	Col. 2		Col. 3	
	Col. 2.1	Col. 2.2	Col. 3.1	Col. 3.2
R1	a1	b1	c1	d1
	a2	b2	c2	d2
R2	w1	x1	y1	z1
	w2	x2	y2	z2

Importing Figures in LaTeX

Import figures in **EPS** format

Requires **graphicx** style package (or sometimes requires additional packages)

Enclosed in **\begin{figure}...\end{figure}**

Images can be **scaled** and **cropped**

You can create **subfigures**

EXAMPLE: 6

Import a figure (EPS format)

```
\begin{figure}[h!]
\centering
\includegraphics[scale=0.3]{logo.eps}
\caption{IITKGP Logo}
\label{fig_1}
\end{figure}
```

Create Subfigures

```
\begin{figure}[!ht]
\centering
\subfigure[Logo
1]{\label{fig_2}\includegraphics[scale=0.3]{logo.eps}}
\hspace{.2in}
\subfigure[Logo
2]{\label{fig_3}\includegraphics[scale=0.3]{logo.eps}}
\caption{IITKGP Logo}
\end{figure}
```

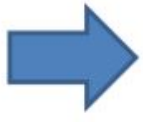
EXAMPLE: 7

Create a bulleted list

```
\begin{itemize}
\item Item 1
\item Item 2
\item Item 3
\end{itemize}
```

Create a numbered List

```
\begin{enumerate}
\item Item 1
\item Item 2
\item Item 3
\end{enumerate}
```



1) Item 1
2) Item 2
3) Item 3

EXAMPLE: 8

Create your own reference.bib file

```
@ARTICLE{ref1,
author={Author},
journal={IEEE Journal},
title={Paper Title},
year={2014},
month={October},
volume={21},
number={5},
pages={1-10}}
```

Include the bibtex file in the main tex file

```
\bibliographystyle{IEEEtran}
\bibliography{reference}
```

Cite references in the document body

```
\cite{ref1}
```

How to Write Proofs of Theorems

Use packages like **amsthm**.

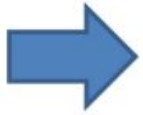
You can write *theorems*, *corollaries*, *definitions*, *lemmas*.

Enclosed in **\begin{theorem}...\end{theorem}**

EXAMPLE: 9

Write a proof of theorem

```
\begin{theorem}
This is a simple theorem.
\label{theorem1}
\end{theorem}
\begin{proof}
Here goes the proof of your
theorem.
\end{proof}
```

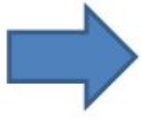


Theorem 1. *This is a simple theorem.*

Proof. Here goes the proof of your theorem.

Write a Lemma

```
\begin{lemma}
This is a simple lemma.
\label{lemma1}
\end{lemma}
\end{theorem}
\begin{proof}
Here goes the proof of your
lemma.
\end{proof}
```



Lemma 1. *This is a simple lemma.*

Proof. Here goes the proof of your lemma.

How to Write Algorithms

Use packages like **algorithm2e** or **algorithmic** or **algorithmicx**.

You can write set of instructions or pseudo codes.

Enclosed in **\begin{algorithm}...\end{algorithm}**

EXAMPLE: 10

Write an algorithm

```
\begin{algorithm}[!h]
\KwData{this text}
\KwResult{how to write algorithm
with \LaTeX}
initialization\;
\While{Some condition is true}{
read current\;
\elf(\tcc
*
[f]{then comment})
{if current is something}{
do some work\;
}{
do some more work\;
}
}
\caption{How to write algorithms}
\end{algorithm}
```

Algorithm 1: How to write algorithms

Data: this text
Result: how to write algorithm with LaTeX

```
1 initialization;
2 while Some condition is true do
3     read current;
4     if if current is something then /* then comment
      */
5         do some work;
6     else
7         do some more work;
```