

Chapter 18: Significance of LaTeX like AI Tool in Preparation of Mathematical Research Papers and Scientific Documents

Pandit U. Chopade

Department of Mathematics

Dnyanopasak Shikshan Mandal's Arts, Commerce & Science College, Jintur, Dist. Parbhani (MS),
INDIA

Email ID: chopadepu@rediffmail.com

Introduction

Latex is a software for typesetting documents. In other words, it is a document preparation system. LaTeX is not a word processor, but is used as a document markup language. LaTeX is especially well-suited for scientific documents. Its superior typesetting of mathematical formulas is legendary. If you are a student or a scientist, then LaTeX is by far the best choice, and even if you don't need its scientific capabilities, there are other uses- it produces very high quality output, it is extremely stable, and handles complex documents easily no matter how large they are.

Further remarkable strengths of LaTeX are its cross- referencing capabilities, its automatic numbering and generation of lists of contents, figures and tables, indexes, glossaries and bibliographies. It is able to use PostScript and PDF features.

Apart from being perfect for scientists, LaTeX is incredibly flexible- there are templates for letters, presentation and books. Hundreds of LaTeX users have written thousands of templates, styles, and tools useful for every possible purpose.

Separation of form and content

A basic principle of LaTeX is that the author should not be distracted too much by the formatting issues. LaTeX uses style files extensively called class and packages, making it easy to design and to modify the appearance of the whole document and all of its details.

Creating the document

We want to use the basic structure of a LaTeX document.

1. Launch the **TeXworks** editor by clicking on the desktop icon or open it in the Start menu.
2. Click on the **New** button.
3. Enter the following lines:

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

AI for Everyone: Applications

“Without mathematics, there’s nothing you can do. Everything around you is mathematics. Everything around you is numbers.”

```
\end{document}
```

4. Click on the **Save** button and save the document. Choose the location where you want to store your LaTeX documents.
5. In the drop-down field in the TeXworks toolbar, choose **pdfLaTeX**.
6. Click the **Typeset** button.
7. The output window will automatically open as with

Without mathematics, theres nothing you can do. Everything around you is mathematics. Everything around you is numbers.

Exploring the document structure

A LaTeX document doesn’t stand alone-commonly the document is based on versatile templates, such a fundamental template is called a class. If we choose the article class, a standard LaTeX class suitable for smaller document.

The first line starts with `\documentclass`. This word begins with a backslash; such a word is called a command. We used commands to specify the class and to state document properties: title, author, and date.

This first part of the document is called the preamble of the document. This is where we choose the class, specify properties, and in general, make document-wide definitions.

`\begin{document}` marks the end of the preamble and the beginning of the actual document. `\end{document}` marks the end of it. Everything that follows would be ignored by the LaTeX. Such a piece of code framed by a `\begin ... \end` command pair, is called an environment.

In the actual document, we’ve used the command `\maketitle` that prints the title, author, and date in a nicely formatted manner.

Let’s understood with example:

```
\documentclass{article}
```

```
\usepackage{amssymb}
```

```
\begin{document}
```

```
\title{\Large\bf Significance of LaTeX in Preparation of Mathematical Research Papers and Scientific Documents}
```

```
\footnotesize{\author
```

AI for Everyone: Applications

ISBN: 978-81-957387-4-8

```

{\bf Pandit U. Chopade}\\
\small {Department of Mathematics}\\
{Dnyanopasak Shikshan Mandal's}\\
{Arts, Commerce and Science College, Jintur-431 509,(MS), INDIA}\\
}}
\maketitle
\date{}
\end{document}

```

PDF output is as follows:

**Significance of LaTeX in Preparation of
 Mathematical Research Papers and Scientific
 Documents**
Pandit U. Chopade
 Department of Mathematics
 Dnyanopasak Shikshan Mandal's
 Arts, Commerce and Science College, Jintur-431 509,(MS), INDIA
 August 11, 2023

Understanding LaTeX commands

LaTeX commands begin with a backslash, followed by big or small letters. LaTeX commands are usually named with small letters and in a descriptive way. Commands may have arguments, given in curly braces or in square brackets.

Writing basic formulas

LaTeX knows three general modes such as paragraph mode, left-to-right mode, and math mode. In the math mode, letters are treated as math symbols. That's why they're typeset in italic shape, which is common for variables. This mode is required for all math expressions.

We shall illustrate math mode with the simple example:

1. Start a new document


```

\documentclass{article}
\begin{document}

```
2. State the quadratic equation with its conditions. Use an equation environment for it. Surround small pieces of math within text by (\dots) :

AI for Everyone: Applications

The quadratic equation

```
\begin{equation}
```

```
\label{quad}
```

```
ax^2+bx+c=0,
```

```
\end{equation}
```

Where (a, b) and (c) are constants and $(a \neq 0)$, has two solutions for the variable (x) :

- Use another equation for the solutions. The command for the square root is `\sqrt` . The command for a fraction is `\frac` :

```
\begin{equation}
```

```
\label{root}
```

```
x_{1, 2} = \frac{-b \pm \sqrt{b^2-4ac}}{2a}.
```

```
\end{equation}
```

- Let's introduce the discriminant and discuss the case zero. To get an unnumbered displayed equation, we surround the formula with `\[... \]` :

```
\[ \Delta = b^2-4ac \]
```

Is zero, then the equation (`\ref {quad}`) has a double solution :

(`\ref {root}`) becomes

```
\[
```

```
X = - \frac{b}{2a}.
```

```
\]
```

```
\end{document}
```

- Typeset twice and look at the result:

Quadratic equations

The quadratic equation

$$ax^2 + bx + c = 0, \tag{1}$$

Where a, b and c are constants and $a \neq 0$, has two solutions for the variable x :

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}. \tag{2}$$

If the *discriminant* Δ with

$$\Delta = b^2 - 4ac$$

is zero, then the equation (1) has a double solution : (2) becomes

$$x = -\frac{b}{2a}.$$

Write the command for the Pythagoras Theorem in LaTeX.

Command:

AI for Everyone: Applications

ISBN: 978-81-957387-4-8

```

\documentclass{article}
\usepackage{amssymb}
\usepackage{amsmath}
\begin{document}
\noindent {\bf Pythagorous Theorem :}
In a right angle  $\triangle ABC$ , with  $\angle C=90^\circ$ ,  $c^2=a^2+b^2$ 
\end{document}

```

Save the document and Typeset it looks as:

Pythagorous Theorem: In a right angle
 $\triangle ABC$,
with $\angle C = 90^\circ$,
 $c^2 = a^2 + b^2$

To write the commands in LaTeX for the following:

1. $1 + 2 + 3 + \dots + 100 = 5050$
2. $1 + 2 + 3 + \dots + 100 = \frac{n(n+1)}{2}$
3. $1 + 2 + 3 + \dots + 100 = \frac{n(n+1)}{2}$

Commands:

```

\documentclass{article}
\usepackage{amssymb}
\usepackage{amsmath}
\begin{document}
\begin{enumerate}
\item  $1+2+3+ \cdots +100=5050$ 
\item  $1+2+3+ \cdots +n=n(n+1)/2$ 
\item  $1+2+3+ \cdots +n=\frac{n(n+1)}{2}$ 
\end{enumerate}
\end{document}

```

AI for Everyone: Applications

ISBN: 978-81-957387-4-8

$$1. 1 + 2 + 3 + \dots + 100 = 5050$$

$$2. 1 + 2 + 3 + \dots + n = n(n + 1)/2$$

$$3. 1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$$

Write the commands in LaTeX for the expression below and give labeling and referring:

There are no positive integers a, b, c such that

$$x^n + y^n = z^n$$

where $n > 2$. The above equation 2 has positive integer as solutions for $n = 1, 2$.

Commands:

```
\documentclass{article}
```

```
\usepackage{amssymb}
```

```
\usepackage{amsmath}
```

```
\begin{document}
```

There are no positive integers a, b, c such that

```
\begin{equation}
```

```
\label{Fermat} x^n+y^n=z^n
```

```
\end{equation}
```

where $n > 2$

The above equation \ref{Fermat} has positive integer as solutions for $n=1, 2$.

```
\end{document}
```

Its output will look like:

There are no positive integers a, b, c such that

$$x^n + y^n = z^n \tag{1}$$

where $n > 2$. The above equation 1 has positive integer as solutions for $n = 1, 2$.

Write the following Table in LaTeX environment:

Sr. No.	Name of the student	Class
1	Ghuge Mohini	B. Sc. First Year
2	Narayan Sangekar	Second Year
3	Katarina Kaiff	TY

Commands:

```
\documentclass{article}
\usepackage{amssymb}
\usepackage{amsmath}
\begin{document}
\begin{table}[ht]
\centering
\begin{tabular}{|c|c|c|}
\hline
Sr. No. & Name of the student & Class\\
\hline
1 & Ghuge Mohini & B. Sc. First Year\\
\hline
2 & Narayan Sangekar & Second Year\\
\hline
3 & Katarina Kaiff & TY\\
\hline
\end{tabular}
\end{table}
\end{document}
```

Sr. No.	Name of the student	Class
1	Ghuge Mohini	B. Sc. First Year
2	Narayan Sangekar	Second Year
3	Katarina Kaiff	TY

Write the following references in the LaTeX environments:

1. **S. C. Malik and Savita Arora**, "Mathematical Analysis", New Age International (P) Ltd, Fourth Edition 2012 (Reprint 2014).
2. **Thamaraiselvi A, Santhi R**, "A new approach for optimization of real life transportation problem in neutrosophic environment", Mathematical Problems in Engineering, 2016.

Commands:

```

\documentclass{article}
\usepackage{amssymb}
\usepackage{amsmath}
\begin{document}
\begin{thebibliography}{}
\bibitem{}{\bf S. C. Malik and Savita Arora, } "Mathematical Analysis", New Age
International (P) Ltd, Fourth Edition 2012 (Reprint 2014)
\bibitem{}{\bf Thamaraiselvi A, Santhi R, } "A new approach for optimization of real life
transportation problem in neutrosophic environment", Mathematical Problems in
Engineering, 2016.
\end{thebibliography}{}
\end{document}

```


References

- [1] **S. C. Malik and Savita Arora**, "Mathematical Analysis", New Age International (P) Ltd, Fourth Edition 2012 (Reprint 2014)
- [2] **Thamaraiselvi A, Santhi R**, "A new approach for optimization of real life transportation problem in neutrosophic environment", Mathematical Problems in Engineering, 2016.

References:

1. **E. Krishnan (Editor)**, LaTeX Tutorials-A Primer, Indian TeX Users Group, Trivandrum, India, 2003, September.
2. **Stefan Kottwitz**, LaTeX Beginner's Guide, published by Packt Publishing Ltd. 32 Lincoln Road, Olton, Birmingham, UK, 2011.