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Assignment

Submitted To:

Mr. Anil Kumar Rajak

Faculty of Mathematics

Submitted By:

Name: Sudeep Kumar Singh

Roll No: 22/28021

Course: B.Sc. Computer Science Hons.

LaTeX Typesetting for Beginners

Sudeep Kumar Singh

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Question 1

i What is LaTeX?

LaTeX is a high-quality typesetting system used for producing professional documents, particularly those that contain complex elements like mathematical equations, technical diagrams, and bibliographies. It is widely used in academia, particularly in fields such as mathematics, physics, computer science, and engineering, where precision and clarity are essential. LaTeX documents are typically written in plain text, using a markup language, and are then compiled into a final document, usually in PDF format.

LaTeX allows authors to focus on the content rather than formatting, as it handles most of the layout and typographical details automatically. Here's an overview of LaTeX and its benefits:

i.1 Core Features of LaTeX

- **Mathematical Typesetting**: LaTeX is renowned for its ability to produce high-quality mathematical equations. It supports complex notation, such as fractions, integrals, matrices, and more, making it ideal for technical documents.

- **Automatic Numbering and Referencing**: LaTeX automatically numbers sections, subsections, figures, tables, equations, and references. It also manages cross-referencing, which ensures that citations and references are updated automatically as the document evolves.

- **Document Structure**: LaTeX uses a well-defined structure, separating content (such as text) from formatting (such as layout). Authors can organize their document into chapters, sections, subsections, etc., and the system handles the formatting.

- **Bibliographies and Citations**: LaTeX provides excellent support for managing references and generating bibliographies. Tools like `BibTeX` or `biblatex` help to organize and format citations automatically.

- **Cross-Platform Support**: LaTeX works across multiple platforms, including Windows, macOS, and Linux. It also has numerous integrated editors that simplify the document creation process.

- **High-Quality Output**: LaTeX is known for producing professional-quality documents with fine control over typography and layout, ensuring that the document is clear, readable, and aesthetically pleasing.

i.2 Benefits of Using LaTeX

- **Precise Control over Document Layout**: LaTeX provides fine-grained control over document structure, including font size, spacing, margins, and more. Users can create documents that adhere to strict formatting guidelines, which is particularly useful in academia and publishing.

- **Consistency**: One of the major advantages of LaTeX is its consistency. Once you set up a document style (e.g., headings, footnotes, citations), LaTeX ensures that the entire document follows the same style without requiring manual adjustments.

- **Ease of Mathematical Typesetting**: For documents involving mathematical formulas, LaTeX is the gold standard. Writing and displaying mathematical symbols, equations, and notation in LaTeX is far easier than in word processors like Microsoft Word. Complex formulas are rendered cleanly and precisely.

- **Version Control Friendly**: Since LaTeX documents are written in plain text, they are ideal for use with version control systems like Git. Authors can track changes, collaborate, and manage revisions much more easily than with proprietary file formats.

- **Separation of Content and Formatting**: LaTeX separates content from formatting, which means that authors can focus on writing their content without worrying about the layout. The system automatically handles formatting, which reduces the chance of errors and inconsistencies.

- **Wide Range of Packages**: LaTeX has a vast ecosystem of packages that extend its functionality. For example, the `graphicx` package allows users to include images, the `tikz` package is useful for creating high-quality graphics, and the `hyperref` package enables creating hyperlinks within the document.

- **Reliable References and Citations**: LaTeX makes referencing easy and automatic. As the document grows, LaTeX ensures that the numbering of citations, figures, and tables is correct, and it updates references automatically when sections or subsections are rearranged.

- **Bibliography Management**: Through tools like `BibTeX`, LaTeX allows authors to manage their references and bibliographies with ease. It can generate citations in various formats (e.g., APA, MLA, Chicago) and integrates seamlessly with external databases like Google Scholar or PubMed.

- **Professional Document Structure**: LaTeX is particularly well-suited for creating long-form documents like books, theses, and dissertations. Its support for chapters, sections, subsections, and references makes it easy to manage large documents while maintaining a professional structure.

i.3   When to Use LaTeX

LaTeX is most beneficial when creating documents with:

- Complex mathematical equations and technical content

- Detailed and extensive referencing (such as in academic papers)

- Large documents that require consistent formatting (e.g., books, theses, reports)

- High-quality typographic output, especially in documents with heavy use of symbols, citations, and structured data

ii   What do you mean by hypertext link? Write a command to create a hypertext link in LaTeX.

A hypertext link in LaTeX allows you to create clickable text that redirects to a URL or a specific part of the document. It is enabled by the `hyperref` package.

Command to create a hypertext link:

```
\usepackage{hyperref}
\href{https://github.com/sudeepwebdev}{My GitHub Profile}
```

Output:
My GitHub Profile
DevDocuments – Online Compiler

iii   Write the command to insert an image in LaTeX.

To insert an image in LaTeX, use the `graphicx` package and the `\includegraphics` command.

Example:

```
\usepackage{graphicx}
\includegraphics[width=\textwidth]{Images/arsd_logo.png}
```

Output:

iv   What is the difference between \hfill and \vfill commands?

- \hfill: Inserts horizontal space that stretches across the available width. It is used to align elements horizontally.

- \vfill: Inserts vertical space that stretches across the available height. It is used to align elements vertically.

Example:

```
A \hfill B \hfill C
X

\vfill

Y
```

Output:

A   B   C
X

Y

v   What is the role of the geometry package?

The geometry package in LaTeX is used to set page dimensions, such as margins, paper size, and layout. It allows precise control over the document's formatting.

Example:

```
\usepackage[a4paper, margin=1in]{geometry}
```

Effect: The document will have an A4 paper size with 1-inch margins.

vi What does the \noindent command do in LaTeX?

The \noindent command prevents the automatic indentation of the first line of a paragraph. It is useful when the default behavior is not desired.

Example:

```
This paragraph is indented.

\noindent This paragraph is not indented.
```

Output:

This paragraph is indented.
This paragraph is not indented.

vii Write the syntax for generating an index for a document in LaTeX. Illustrate with an example.

To create an index, use the makeidx package. The steps are as follows:

1. Include the makeidx package in the preamble.

2. Use the \makeindex command in the preamble.

3. Mark index entries using the \index{} command in the document.

4. Add the \printindex command at the end of the document to display the index.

Example Code:

```
\documentclass{article}
\usepackage{makeidx}
\makeindex

\begin{document}

This document explains how to create an \index{index} in LaTeX.

LaTeX is a powerful \index{typesetting} tool.

\printindex

\end{document}
```

Output: The generated index will appear at the end of the document with entries like:

```
index .......... 1
typesetting .... 2
```

Question 2

i Explain Basic Structure of LaTeX Document with a Suitable Example

A LaTeX document has a clear and systematic structure. The main components of a LaTeX document are the preamble, the body, and optional components such as the bibliography and appendices. Below is an in-depth explanation of the basic structure, including chapters, sections, and subsections.

i.1 The Preamble

The preamble is the section of the LaTeX document that comes before the `\begin{document}` command. This part contains several elements that configure the document:

- **Document Class**: Specifies the document format, like `article`, `report`, or `book`.

- **Packages**: These add extra functionality to the document, such as mathematical formatting (`amsmath`), image inclusion (`graphicx`), or creating hyperlinks (`hyperref`).

- **Custom Settings**: Define layout-related settings, like font size, page margins, line spacing, and more.

i.2 Document Body

The body of the document is enclosed between the `\begin{document}` and `\end{document}` commands. The body contains the main content, including:

- Title page elements, such as `\maketitle`.

- **Chapters, Sections, and Subsections**: Organizing your document into structured sections, subsections, and subsubsections.

- Other content such as tables, figures, mathematical equations, and images.

i.3 Chapters, Sections, and Subsections

In LaTeX, documents can be divided into chapters, sections, subsections, and subsubsections, depending on the document class. These components provide hierarchical organization:

- **Chapter**: Typically used in books and reports. The `\chapter` command starts a new chapter.

- **Section**: Divides the document into major sections. It is used within the body of the document with `\section`.

- **Subsection**: Divides a section into smaller parts using the `\subsection` command.

- **Subsubsection**: Further divides a subsection into even smaller parts using `\subsubsection`.

  For example:

```
\chapter{Chapter Title}
\section{Section Title}
\subsection{Subsection Title}
\subsubsection{Subsubsection Title}
```

i.4 Optional Components

In addition to the body, LaTeX supports optional components like bibliographies, indexes, and appendices:

- **Bibliography**: Added using the `biblatex` package or the traditional `bibliography` environment.

- **Index**: Generated using the `makeidx` package to automatically create an index of terms.

- **Appendices**: You can add appendices to your document with the `appendix` package or simply use the `\appendix` command.

i.5 Example of a Basic LaTeX Document

Below is a basic example that illustrates the structure of a LaTeX document, including chapters, sections, and some essential components:

```
\documentclass[12pt, a4paper]{book} % Use 'book' document class for chapters

% Preamble
\usepackage{amsmath}   % For mathematical equations
\usepackage{graphicx}  % For including images
\usepackage{hyperref}  % For hyperlinks
\usepackage[margin=1in]{geometry} % Adjust margins

% Document Metadata
\title{Introduction to LaTeX}
\author{Sudeep Kumar Singh}
\date{\today}

% Begin the document
\begin{document}

\maketitle % Creates the title page with title, author, and date

\tableofcontents % Generates the Table of Contents
\newpage % Start a new page after the Table of Contents

% Chapter 1: Introduction
\chapter{Introduction}
LaTeX is a powerful typesetting system that is widely used for creating professional-quality documen

% Section 1.1: Why LaTeX?
\section{Why LaTeX?}
LaTeX provides high-quality typesetting, precise control over layout, and automatic numbering and fo

% Chapter 2: Basic Structure of a LaTeX Document
\chapter{Basic Structure of a LaTeX Document}
A LaTeX document follows a structured format to ensure readability and organization.
\section{The Preamble}
The preamble of the LaTeX document is where you set up packages, fonts, and document options.

\section{Document Body}
The body of the document is where you will write the actual content. It begins with \texttt{\textbac

% Chapter 3: Advanced Features
\chapter{Advanced Features}
LaTeX supports advanced features like automatic table of contents, referencing, mathematical typeset

\end{document}
```

i.6   Explanation of the Example

The document above is created using the `book` class, which is ideal for documents divided into chapters. Here is what happens:

- The document begins with the `\documentclass` command that specifies the class as `book`, suitable for documents with chapters.

- The `\usepackage` commands load necessary packages for mathematics, graphics, and hyperlinks.

- The `\begin{document}` marks the start of the document content.

- The `\chapter` and `\section` commands organize the content into chapters and sections.

- The `\tableofcontents` command generates the table of contents based on chapters and sections.

ii   Conclusion

Understanding the basic structure of a LaTeX document is crucial for efficiently creating well-organized, professional-quality documents. LaTeX's use of chapters, sections, and subsections provides powerful tools for formatting large and complex documents.

Question 3

(i) Write the command to produce

$$\delta_{ij} = \begin{cases} 0 & \text{if } i \neq j, \\ 1 & \text{if } i = j. \end{cases}$$

LaTeX Code:

```
\delta_{ij} =
\begin{cases}
0 & \text{if } i \neq j, \\
1 & \text{if } i = j.
\end{cases}
```

(ii) Write the command for

$$x^2 \frac{d^2 y}{dx^2} + x\frac{dy}{dx} + (x^2 - v^2)y = 0,$$

the solution of which is

$$y = AJ_v(x) + BY_v(x),$$

if v is non-integer, and

$$y = AJ_v(x) + BJ_{-v}(x), \quad \text{if } v \text{ is not integer.}$$

LaTeX Code:

```
x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (x^2 - v^2) y = 0,
\]
the solution of which is
\[
y = A J_v(x) + B Y_v(x),
\]
if \( v \) is non-integer, and
\[
y = A J_v(x) + B J_{-v}(x), \quad \text{if } v \text{ is not integer}.
```

Question 4

(i) Write the command to produce the following table:

List of Topper Students			
Course	**Student Name**	**Position**	**Percentage**
B.Sc (H) Maths	A	First	99
	B	Second	98
	C	Third	97.5
	D	Fourth	97

Table 1: List of Topper Students

LaTeX Code:

```
\begin{table}[ht]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
\multicolumn{4}{|c|}{\textbf{List of Topper Students}} \\
\cline{2-4}
& \textbf{Course} & \textbf{Student Name} & \textbf{Position} & \textbf{Percentage} \\
\hline
\multirow{4}{*}{\textbf{B.Sc (H) Maths}} & A & First & 99 \\
& B & Second & 98 \\
& C & Third & 97.5 \\
& D & Fourth & 97 \\
\hline
\end{tabular}
\caption{List of Topper Students}
\end{table}
```

(ii) Write the command for the following table:

		No. of Students				Total
		B.Sc (H)	**B.Sc (P)**	**B.A. (H)**	**B.A. (P)**	
Class	II	15	17	18	18	64
	III	10	10	5	10	40
Total		25	27	28	28	109

Table 2: No. of Students in Different Courses

LaTeX Code:

```
\begin{table}[ht]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
\multirow{2}{*}{} & \multirow{2}{*}{} & \multicolumn{4}{c|}{\textbf{No. of Students}} & \mul
\cline{3-6}
& & \textbf{B.Sc (H)} & \textbf{B.Sc (P)} & \textbf{B.A. (H)} & \textbf{B.A. (P)} & \\
\hline
\multirow{2}{*}{\textbf{Class}} & II & 15 & 17 & 18 & 18 & 64 \\
& III & 10 & 10 & 5 & 10 & 40 \\
\hline
\multicolumn{2}{|c|}{\textbf{Total}} & 25 & 27 & 28 & 28 & 109 \\
\hline
\end{tabular}
```

```
\caption{No. of Students in Different Courses}
\end{table}
```

Question 5. Write the Syntax in Latex to Produce the Subplot

(a) ARSD Logo

(b) DU Logo

Figure 1: ARSD and DU Logos

```
\begin{figure}[ht]
    \centering
    \begin{minipage}{0.45\textwidth}
        \centering
        \includegraphics[width=\textwidth]{Images/arsd_logo.png}
        \subcaption{ARSD Logo}
    \end{minipage}\hfill
    \begin{minipage}{0.45\textwidth}
        \centering
        \includegraphics[width=\textwidth]{Images/du_logo.png}
        \subcaption{DU Logo}
    \end{minipage}
    \caption{ARSD and DU Logos}
\end{figure}
```

Q6: Explanation of the following commands

(a) **\frontmatter**

- **Purpose**: The \frontmatter command is used to begin the front matter of a document. This includes the title page, abstract, table of contents, etc. It alters the numbering style to lowercase Roman numerals (i, ii, iii, ...).
- **Function**: This command resets the page number to Roman numerals and formats chapters/sections with Roman numeral numbering.

Example:

```
\frontmatter
\title{My Book Title}
\author{Author Name}
\maketitle
```

(b) **\mainmatter**

- **Purpose**: The \mainmatter command starts the main content of a document. It resets page numbering to Arabic numerals (1, 2, 3, ...) and typically begins the chapters of the book.
- **Function**: This command changes the document from Roman numerals to Arabic numerals and starts chapter/section numbering from 1.

Example:

```
\mainmatter
\chapter{Introduction}
```

(c) **\backmatter**

- **Purpose**: The \backmatter command signals the start of the back matter in the document. This typically includes references, appendices, indices, etc.
- **Function**: It continues chapter/section numbering in Arabic numerals but marks the end of the main content, focusing on supplementary material.

Example:

```
\backmatter
\chapter{Appendix}
\bibliography{references}
```

(d) **\include**

- **Purpose**: The \include command is used to insert an entire LaTeX file (typically a chapter or section) into the main document.
- **Function**: This command allows for modular document design, where separate '.tex' files are combined to create the full document.

Example:

```
\include{chapter1}  % Includes content from chapter1.tex
```

(e) **\includeonly**

- **Purpose**: The \includeonly command is used to specify which files to include in the compilation process, while skipping others. It is useful when working with large documents.

- **Function**: Only the files mentioned in the \includeonly command will be compiled, speeding up the compilation process by excluding other files.

Example:

```
\includeonly{chapter1, chapter3}  % Only includes chapter1.tex and chapter3.tex
```

Index

Index