# LaTeX Document Package

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### Abstract

This document serves as comprehensive documentation for the `document.sty` package, a versatile LaTeX $2_\varepsilon$ style file designed to streamline document creation with professional formatting and advanced features. The package integrates over 40 carefully selected LaTeX packages, providing a unified interface for mathematics typesetting, theorem environments, code listings, bibliography management, and document structuring.

Key features include: customizable headers and footers with formal and default styles; rich theorem-like environments (definition, theorem, lemma, corollary, proof, example, and more) with elegant colored boxes; comprehensive mathematics support through AMS packages, special symbols, and SI units; syntax-highlighted code listings for LaTeX and Python; professional table and figure formatting with captions and subcaptions; algorithm typesetting with pseudocode; flexible bibliography management via biblatex; and modular content organization with directory-based inclusion.

The package offers several configurable options including theorem environment toggle, color scheme control, code listing support, font selection, header styles (default or formal), and bibliography styles. This documentation demonstrates all features through practical examples, including algorithm implementations, publication-quality tables, figure inclusion with TikZ graphics, and all available theorem-like environments.

# Contents

LaTeX
document

# 1 Format

The style file `document.sty`, written in LaTeX 2$_\varepsilon$, provides a comprehensive document formatting solution. The theorem-like environments are inspired by the template [1]. For detailed implementation, refer to the GitHub repository [2].

## 1.1 Package Usage and Options

To use this package, add `\usepackage{document}` after the `\documentclass` command. The package accepts several key-value options:

**theorems=true/false** (default: `true`) Enable or disable theorem-like environments (definition, theorem, lemma, corollary, proof, example, etc.). When `false`, the `thmtools` and `tcolorbox` packages are not loaded, and all theorem-like environments become unavailable.

**colors=true/false** (default: `true`) Enable extended color support. When `true`, loads `xcolor` with `dvipsnames` option for additional color names.

**code=true/false** (default: `true`) Enable syntax-highlighted code listings. When `true`, loads the `minted` package with pre-configured environments for LaTeX and Python code.

**timesfont=true/false** (default: `true`) Use Times font family for the document text.

**header=default/formal** (default: `default`) Select header style. The `default` style shows section titles at the center with page numbers in the footer. The `formal` style displays purpose, title, author, institute, and page count.

**bibstyle=style** (default: `ieee`) Set bibliography style for `biblatex`. Common options include `ieee`, `apa`, `nature`, `numeric`, or `alphabetic`.

Example usage:

```latex
\usepackage[
  theorems=true,
  colors=true,
  code=true,
  header=formal,
  bibstyle=ieee
]{document}
```

## 1.2 Imported Packages

The `document.sty` package imports and configures numerous packages organized by functionality:

**Parsing and Options**

- `xparse` — Advanced command definition with flexible argument parsing

- `ifthen` — Conditional statements and logic

- `etoolbox` — Programming facilities and command patching

- `kvoptions` — Key-value option handling for package options

**Page Layout**

- `geometry` — Page dimensions and margins (0.5in sides, 1.5in bottom)

- `emptypage` — Clean formatting for empty pages

- `fancyhdr` — Customizable headers and footers

- `lastpage` — Reference to the last page number (for formal header)

**Text Encoding and Fonts**

- `inputenc` (utf8) — Unicode character input support

- `fontenc` (T1) — Font encoding for proper character rendering

- `times` — Times Roman font family (when `timesfont=true`)

- `textcomp` — Additional text symbols and companion fonts

- `fontawesome` — Icon font support for symbols like 

**Mathematics**

- `amsmath` — Enhanced mathematics environments and commands

- `amsfonts` — Mathematical fonts including blackboard bold

- `amsthm` — Theorem environment support

- `amssymb` — Extended mathematical symbols

- `mathtools` — Enhancements and fixes for `amsmath`

- `mathrsfs` — Ralph Smith's Formal Script font for math

- `mathdots` — Commands for improving the appearance of dots in math

- `nicefrac` — Typeset nice diagonal fractions

- `cancel` — Cross out mathematical expressions

- `MnSymbol` — Additional mathematical symbols

- `dsfont` — Doublestroke font for mathematical alphabets

- `upgreek` — Upright Greek letters in mathematics

- `systeme` — Systems of linear equations formatting

- `siunitx` — Consistent SI units and number formatting

- `pifont` — Access to Pi fonts for special symbols

**Colors and Hyperlinks**

- `xcolor` — Color support with optional `dvipsnames` palette

- `hyperref` — Hyperlinks and PDF metadata with color configuration

**Text Formatting**

- `soul` — Letter spacing and highlighting (`\spaceout` command)

- `fancyvrb` — Enhanced verbatim text for inline code

- `csquotes` — Context-sensitive quotation marks

- `enumitem` — Enhanced control over list environments

**Code Listings**

- `minted` — Syntax highlighting using Pygments (when `code=true`)

**Tables**

- `booktabs` — Publication-quality table rules

- `arydshln` — Dashed lines in tables

- `multirow` — Cells spanning multiple rows

- `multicol` — Multiple column environments

**Floats and Captions**

- `float` — Improved float control with H placement specifier

- `caption` — Customizable caption formatting

- `subcaption` — Support for subfigures and subtables

**Algorithms**

- `algorithm` — Floating environment for algorithms

- `algpseudocode` — Pseudocode formatting commands

**Graphics and Plotting**

- `graphicx` — Enhanced graphics inclusion

- `tikz` — Powerful graphics and diagram creation

- `pgfplots` — High-quality function and data plots

- `multimedia` — Multimedia content embedding

**Additional Utilities**

- `pbox` — Fixed-width paragraph boxes

- `nameref` — Reference by section names

**Document Structure**

- `appendix` — Appendix formatting and management

**Bibliography**

- `biblatex` — Advanced bibliography management with Biber backend

**Theorem Environments**

- `thmtools` — Enhanced theorem configuration (when `theorems=true`)

- `tcolorbox` — Colored and framed boxes for theorems (when `theorems=true`)

## 1.3   Metadata Commands

The package provides enhanced metadata commands with optional short forms:

**`\author[short]{full}`**  Define document author. The optional `short` form is used in headers.

**`\title[short]{full}`**  Define document title. The optional `short` form is used in headers.

**`\purpose{text}`**  Specify the document's purpose (displayed in formal header).

**`\institute{text}`**  Specify the institution or affiliation (displayed in formal header).

Example:

```
1  \title[Short Title]{Full Document Title}
2  \author[J. Doe]{John Doe}
3  \purpose{Technical Report}
4  \institute{Department of Computer Science}
```

## 1.4   Header & Footer

The package uses the `fancyhdr` package to create professional headers and footers.  Two header styles are available, selectable via the `header` option:

**Default Header Style**   The default style is simple and clean:

- Header: Section title centered

- Footer: Page number centered

- Header height: 0.75 inches

**Formal Header Style**    The formal style provides comprehensive document information:

- Left header (top line): Purpose and short title with author

- Left header (bottom line): Institute and page count ("page X of Y")

- No header rule

- Header height: 0.75 inches

Page margins are configured as 0.5 inches on left and right sides, with 1.5 inches at the bottom. Empty pages (in two-sided printing) are automatically cleaned using the `emptypage` package.

Footnotes should be used sparingly and are created using the `\footnote{text}` command. The footnote text is automatically numbered, formatted and placed at the bottom of the page.[1]

## 1.5    Document Structure

The package provides commands for modular document organization:

**\setdirectory[path]**    Set the base directory for content files (default: current directory).

**\setappendix[path]**    Switch to appendix mode and set the directory for appendix files.

**\addcontent{filename}**    Include content from the specified file in the current directory.

Example usage:

```
1  % Include main content
2  \setdirectory[content]
3  \addcontent{1_introduction}
4  \addcontent{2_methodology}
5
6  % Include appendices
7  \setappendix[appendix]
8  \addcontent{1_proofs}
9  \addcontent{2_data}
```

The default document class is `article` with 11pt font size and two-sided printing. Sections are numbered automatically with hierarchical structure: section, subsection, and subsubsection.

**Section**    Create a new section with `\section{Section title}`. Within sections, use `\subsection{Subsection titl`
for subsections and `\subsubsection{Subsubsection title}` for deeper nesting.

**Paragraph**    Create a titled paragraph with `\paragraph{Paragraph title}`. The paragraph title appears in bold-face, with text following on the same line. To start a new paragraph without a title, simply leave a blank line.

## 1.6    Hyperlink & Reference

The `hyperref` package creates clickable hyperlinks in the PDF output. All links use the default text color (no colored boxes) for print-friendly documents.

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[1]The footnote text is automatically numbered, formatted and placed at the bottom of the page like this.

**External Links**   Create hyperlinks with `\href{url}{text}`, where `url` is the web address and `text` is the displayed link text.

**Internal References**   The package provides convenient reference commands for different element types:
### Standard references:

- `\ref{label}` — Basic reference to labeled item

- `\nameref{label}` — Reference by section name

- `\pageref{label}` — Reference to page number

### Specialized reference commands:

- `\refalg{name}` — Reference to Algorithm `\ref{alg:name}`

- `\reffig{name}` — Reference to Figure `\ref{fig:name}`

- `\reftab{name}` — Reference to Table `\ref{tab:name}`

### Corresponding label commands:

- `\labelalg{name}` — Equivalent to `\label{alg:name}`

- `\labelfig{name}` — Equivalent to `\label{fig:name}`

- `\labeltab{name}` — Equivalent to `\label{tab:name}`

When the `theorems` option is enabled, additional reference commands are available for theorem-like environments (see Section 2.7).

## 1.7   Citation & Bibliography

The `biblatex` package manages citations and bibliographies with the Biber backend. Biber provides superior Unicode support, advanced sorting, and better handling of complex bibliography requirements compared to BibTeX.

**Setup**   Specify the bibliography file in the preamble:

```
\addbibresource{references.bib}
```

**Citations**   Create citations using:

- `\autocite{key}` — Context-sensitive citation (recommended)

- `\cite{key}` — Standard citation

- `\textcite{key}` — Textual citation (e.g., "Author (2023) shows...")

- `\parencite{key}` — Parenthetical citation

Citations appear with square brackets (e.g., [1]) regardless of the bibliography style.

**Bibliography**    Print the bibliography at the document end:

```
1 \printbibliography
```

The bibliography style is set via the `bibstyle` package option (default: `ieee`). Common styles include `numeric`, `alphabetic`, `ieee`, `apa`, and `nature`.

# 2    Environment

An *environment* in LaTeX is a section of the document formatted in a specific way. This document demonstrates various environments, including lists, quotes, code blocks, scripts, tables, figures, algorithms, and framed theorem-like environments. The basic syntax of an environment is:

```
1 \begin{environment}
2   content included in the environment
3 \end{environment}
```

## 2.1    Lists and Quotes

Common text environments include `enumerate` (numbered lists), `itemize` (bulleted lists), and `displayquote` (block quotations). These environments can be customized using the `enumitem` package for lists and `csquotes` package for quotations.

1. First item in an enumerated list.

2. Second item in the same list.

3. Third item and more ...

```
1 \begin{enumerate}
2   \item First item in an enumerated list.
3   \item Second item in the same list.
4   \item Third item and more ...
5 \end{enumerate}
```

- First item in an unordered list.

- Second item in the same list.

- Third item and more ...

```
1 \begin{itemize}
2   \item First item in an unordered list.
3   \item Second item in the same list.
4   \item Third item and more ...
5 \end{itemize}
```

*This is a quote, which uses the* `csquotes` *package with customization set inside the* `document.sty` *file.*

```
1 \begin{displayquote}
2   This is a quote, which uses the \verb|csquotes|
  ↪   package with customization set inside the
  ↪   \verb|document.sty| file.
3 \end{displayquote}
```

## 2.2 Script

**Inline Code**   Use the `fancyvrb` package's `\Verb` command for inline code. For example, `\Verb|print("Hello, World!`
produces `print("Hello, World!")`. The delimiter (typically `|`) can be any character not appearing in the code.

**Code Blocks**   The `minted` package provides syntax-highlighted code blocks for various programming languages. When
the `code=true` option is enabled, the package pre-configures `latexcode` and `pythoncode` environments.
   **Python example:**

```python
def fibonacci(n):
    """Calculate nth Fibonacci number."""
    if n <= 1:
        return n
    return fibonacci(n-1) + fibonacci(n-2)

# Compute first 10 Fibonacci numbers
for i in range(10):
    print(f"F({i}) = {fibonacci(i)}")
```

```
\begin{pythoncode}
def fibonacci(n):
    """Calculate nth Fibonacci number."""
    if n <= 1:
        return n
    return fibonacci(n-1) + fibonacci(n-2)

# Compute first 10 Fibonacci numbers
for i in range(10):
    print(f"F({i}) = {fibonacci(i)}")
\end{pythoncode}
```

   The `minted` package supports many languages including Python, C, C++, Java, JavaScript, and more. Custom language
environments can be added using the `\newminted` command (see lines 211-235 in `document.sty` for examples of
`latexcode` and `pythoncode` configurations).

## 2.3 Mathematics

The package includes comprehensive mathematics support through AMS packages and specialized math fonts.

**Inline and Display Math**   Inline math: $E = mc^2$ is typeset with `$E = mc^2$`. Display math uses `\[...\]` or
`equation` environment:

$$\int_{-\infty}^{\infty} e^{-x^2}\, dx = \sqrt{\pi}$$

**Special Symbols and Fonts**   The package provides extensive symbol support:

- Blackboard bold: $\mathbb{R}, \mathbb{C}, \mathbb{N}, \mathbb{Z}, \mathbb{Q}$

- Doublestroke: $\mathbb{1}, \mathbb{R}$

- Calligraphic: $\mathcal{L}, \mathcal{F}, \mathcal{H}$

- Script: $\mathscr{L}, \mathscr{F}, \mathscr{H}$

- Fraktur: $\mathfrak{g}, \mathfrak{h}, \mathfrak{su}$

- Upright Greek: $\pi, \mu, \sigma$

**Fractions and Units**   Nice diagonal fractions: $1/2, a/b$ using `\nicefrac{1}{2}`. SI units with `siunitx`: $299\,792\,458\,\mathrm{m\,s^{-1}}$
(speed of light), $1.602 \times 10^{-19}\,\mathrm{C}$ (elementary charge), $6.626 \times 10^{-34}\,\mathrm{J\,s}$ (Planck constant).

**Algorithm 1** Quicksort algorithm

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**Require:** Array $A[1..n]$ of comparable elements
**Ensure:** Array $A$ sorted in non-decreasing order

  1: **function** QUICKSORT($A$, left, right)
  2:     **if** left < right **then**
  3:         pivotIndex ← PARTITION($A$, left, right)
  4:         QUICKSORT($A$, left, pivotIndex − 1)         ▷ Sort left subarray
  5:         QUICKSORT($A$, pivotIndex + 1, right)        ▷ Sort right subarray
  6:     **end if**
  7: **end function**
  8:
  9: **function** PARTITION($A$, left, right)
10:     pivot ← $A[\text{right}]$         ▷ Choose last element as pivot
11:     $i$ ← left − 1
12:     **for** $j$ ← left **to** right − 1 **do**
13:         **if** $A[j]$ ≤ pivot **then**
14:             $i$ ← $i$ + 1
15:             **swap** $A[i]$ and $A[j]$         ▷ Move smaller elements to left
16:         **end if**
17:     **end for**
18:     **swap** $A[i+1]$ and $A[\text{right}]$        ▷ Place pivot in correct position
19:     **return** $i + 1$         ▷ Return pivot index
20: **end function**

---

**Systems of Equations**   The `systeme` package formats systems elegantly:

$$\begin{cases} x + \phantom{2}y + z = 6 \\ 2x - \phantom{2}y + z = 3 \\ x + 2y - z = 2 \end{cases}$$

## 2.4   Algorithm

Algorithms should be presented clearly and concisely, typically placed at the top of a page using the `[t]` placement specifier. The `algorithm` package provides the floating environment, while `algpseudocode` provides pseudocode formatting commands. See Algorithm 1 for an example.
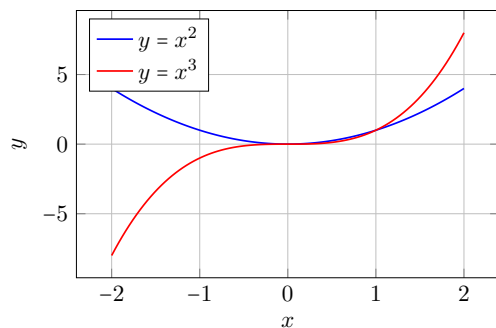
## 2.5   Table

Tables should be centered, legible, and positioned at the top of the page. Table captions appear *before* the table content and use sentence case (capitalize only the first word and proper nouns). Publication-quality tables avoid vertical rules [3]. The `booktabs` package provides professional horizontal rules: `\toprule`, `\midrule`, `\cmidrule`, and `\bottomrule`. Additional packages support dashed lines (`arydshln`), multi-row cells (`multirow`), and multi-column layouts (`multicol`). See Table 1 for an example.
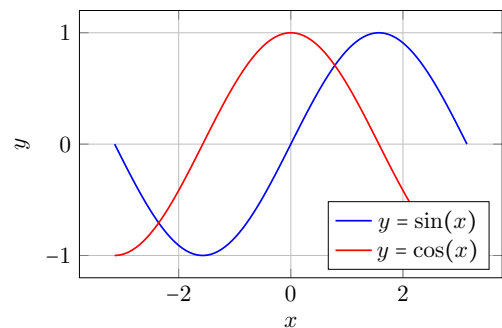
## 2.6   Figure

Figures must be centered, legible, and positioned at the top of the page. Figure captions appear *after* the figure content, using sentence case and a smaller font than the main text. The `caption` and `subcaption` packages enable sophisticated

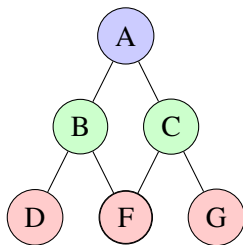**Table 1.** Performance comparison of sorting algorithms

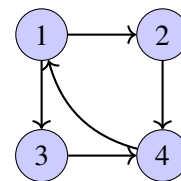| Algorithm | Best Case | Average Case | Worst Case |
|---|---|---|---|
| Bubble Sort | $\mathcal{O}(n)$ | $\mathcal{O}(n^2)$ | $\mathcal{O}(n^2)$ |
| Insertion Sort | $\mathcal{O}(n)$ | $\mathcal{O}(n^2)$ | $\mathcal{O}(n^2)$ |
| Selection Sort | $\mathcal{O}(n^2)$ | $\mathcal{O}(n^2)$ | $\mathcal{O}(n^2)$ |
| Merge Sort | $\mathcal{O}(n\log n)$ | $\mathcal{O}(n\log n)$ | $\mathcal{O}(n\log n)$ |
| Quick Sort | $\mathcal{O}(n\log n)$ | $\mathcal{O}(n\log n)$ | $\mathcal{O}(n^2)$ |
| Heap Sort | $\mathcal{O}(n\log n)$ | $\mathcal{O}(n\log n)$ | $\mathcal{O}(n\log n)$ |



**(a)** Polynomial functions



**(b)** Trigonometric functions



**(c)** Binary tree structure



**(d)** Directed graph

**Figure 1.** Examples of figures created with TikZ and PGFPlots. The package supports mathematical plots, tree structures, and graph visualizations.

caption formatting including subfigures. The package supports multiple graphics formats via `graphicx` and provides TikZ/PGFPlots for creating publication-quality diagrams and plots. Colored figures are acceptable when they remain legible in both color and grayscale printing. See Figure 1 for examples.

## 2.7 Frame

When the `theorems=true` option is enabled, the package provides elegant theorem-like environments using `tcolorbox` with color-coded frames. All environments share the same counter (numbered within subsections) and support three arguments: title, label, and content.

**Definition 2.7.1** (Continuity) A function $f : \mathbb{R} \to \mathbb{R}$ is *continuous* at point $x_0$ if for every $\epsilon > 0$, there exists $\delta > 0$ such that $|x - x_0| < \delta$ implies $|f(x) - f(x_0)| < \epsilon$.

**Assumption 2.7.2** (Bounded Domain) We assume the domain $\Omega \subset \mathbb{R}^n$ is bounded, connected, and has a piecewise smooth boundary $\partial\Omega$.

**Conjecture 2.7.3** (Collatz Conjecture) For any positive integer $n$, the iterative sequence defined by $a_{i+1} = a_i/2$ if $a_i$ is even, or $a_{i+1} = 3a_i + 1$ if $a_i$ is odd, eventually reaches 1.

**Lemma 2.7.4** (Triangle Inequality) Based on Definition 2.7.1, for any $x, y \in \mathbb{R}^n$, we have $\|x + y\| \leq \|x\| + \|y\|$, where $\|\cdot\|$ denotes the Euclidean norm.

**Proof**
By the Cauchy-Schwarz inequality, $\langle x, y \rangle \leq \|x\|\|y\|$. Then:

$$\|x + y\|^2 = \|x\|^2 + 2\langle x, y \rangle + \|y\|^2 \leq \|x\|^2 + 2\|x\|\|y\| + \|y\|^2 = (\|x\| + \|y\|)^2$$

Taking square roots of both sides yields the result. ∎

**Theorem 2.7.5** (Fundamental Theorem of Calculus) If $f$ is continuous on $[a, b]$ and $F$ is an antiderivative of $f$ on $[a, b]$, then $\int_a^b f(x)\,dx = F(b) - F(a)$.

**Proof sketch**
Define $G(x) = \int_a^x f(t)\,dt$. By continuity of $f$, we have $G'(x) = f(x)$. Since both $F$ and $G$ are antiderivatives of $f$, they differ by a constant: $F(x) = G(x) + C$. Evaluating at $x = a$ gives $C = F(a)$, and at $x = b$ gives the result. ∎

**Corollary 2.7.6** (Integration by Parts) If $u$ and $v$ are continuously differentiable functions, then $\int u\,dv = uv - \int v\,du$.

**Proof**
This follows directly from Theorem 2.7.5 applied to the product rule: $(uv)' = u'v + uv'$. ∎

**Proposition 2.7.7** (Derivative of Exponential) For the exponential function $e^x$, we have $\frac{d}{dx}e^x = e^x$.

**Proof**
Using the limit definition:

$$\frac{d}{dx}e^x = \lim_{h \to 0} \frac{e^{x+h} - e^x}{h} = e^x \lim_{h \to 0} \frac{e^h - 1}{h} = e^x$$

∎

**Remark 2.7.8** (Uniqueness of Exponential) The exponential function is the only function (up to scaling) that is its own derivative, making it fundamental in differential equations.

**Note 2.7.9** (Notation Convention) Throughout this document, we use $\mathbb{N}$ for natural numbers, $\mathbb{Z}$ for integers, $\mathbb{Q}$ for rationals, $\mathbb{R}$ for reals, and $\mathbb{C}$ for complex numbers.

**Example 2.7.10** (Computing a Derivative) Find the derivative of $f(x) = x^2 \sin(x)$ using the product rule.

**Solution**
By the product rule: $f'(x) = (x^2)' \sin(x) + x^2 (\sin(x))' = 2x \sin(x) + x^2 \cos(x)$. □

**Problem 2.7.11** (Optimization Problem) A rectangular box with square base must have volume $1000 \,\mathrm{cm}^3$. Find the dimensions that minimize the surface area.

**ToDo 2.7.12** (Future Enhancement) Extend the package to support additional theorem styles and custom color schemes for different document themes.

These environments are designed to enhance the readability and organization of mathematical documents. Each environment has a specific purpose and style, making it easier for readers to follow the logical flow of the content.

**Reference Commands** The package provides convenient reference commands for theorem-like environments:

- `\refdef{label}` — Reference to Definition (equivalent to `\ref{def:label}`)
- `\refasm{label}` — Reference to Assumption (equivalent to `\ref{asm:label}`)
- `\refconj{label}` — Reference to Conjecture (equivalent to `\ref{conj:label}`)
- `\reflem{label}` — Reference to Lemma (equivalent to `\ref{lem:label}`)
- `\refthm{label}` — Reference to Theorem (equivalent to `\ref{thm:label}`)
- `\refcor{label}` — Reference to Corollary (equivalent to `\ref{cor:label}`)
- `\refprop{label}` — Reference to Proposition (equivalent to `\ref{prop:label}`)
- `\refremk{label}` — Reference to Remark (equivalent to `\ref{remk:label}`)
- `\refnote{label}` — Reference to Note (equivalent to `\ref{note:label}`)
- `\refex{label}` — Reference to Example (equivalent to `\ref{ex:label}`)
- `\refprob{label}` — Reference to Problem (equivalent to `\ref{prob:label}`)
- `\reftodo{label}` — Reference to ToDo (equivalent to `\ref{todo:label}`)

These commands automatically include the environment type (e.g., "Definition") and number, creating clear cross-references throughout the document.

# Appendices

# References

[1] sleepymalc, *Latex template*, `https://github.com/sleepymalc/LaTeX-Template/releases/tag/v1.0`, 2022.

[2]  H.-S. Chang, *LaTeX document template*, `https://github.com/hanson-hschang/LaTeX-Document-Template`, 2025.

[3]  NeurIPS. "Neurips latex template," Accessed: Jul. 24, 2025. [Online]. Available: `https://neurips.cc/Conferences/2023/PaperInformation/StyleFiles`.