

How can a researcher use LaTeX for writing a research paper.

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L^AT_EX



Introduction to L^AT_EX

- L^AT_EX is a software system for document preparation.
- L^AT_EX is using for typesetting text and mathematical formulas.
- Uses commands to create mathematical symbols.
- The document is written as a source file using a *markup language*.
- The final document is obtained by converting the source file (.tex file) into a pdf file.

Advantages of Using L^AT_EX

- High typeset quality.
- Essentially a Markup Language (like HTML, XML and RTF)
- It is the standard for scientific documents.
- Easy to include math formulas
- Processing mathematical (& other) symbols.
- Its FREE!

Work online/offline (Installing L^AT_EX)

- **Online :** <https://www.overleaf.com/>
 - Overleaf: An online LaTeX editor that is easy to use. No installation, real-time collaboration, version control, hundreds of LaTeX templates and more
- **Offline:**
- **Linux:**
 1. Install TeXLive from your package manager.
 2. Install a L^AT_EX editor of your choice: TeXstudio, TexMaker, etc.
- **Windows:**
 1. Install MikTeX from <http://miktex.org> (this is the L^AT_EX compiler).
 2. Install a L^AT_EX editor of your choice: TeXstudio, TeXnicCenter, etc.
- **Mac OS:**
 1. Install MacTeX (this is the L^AT_EX compiler for Mac).
 2. Install a L^AT_EX editor of your choice.

Required Tools

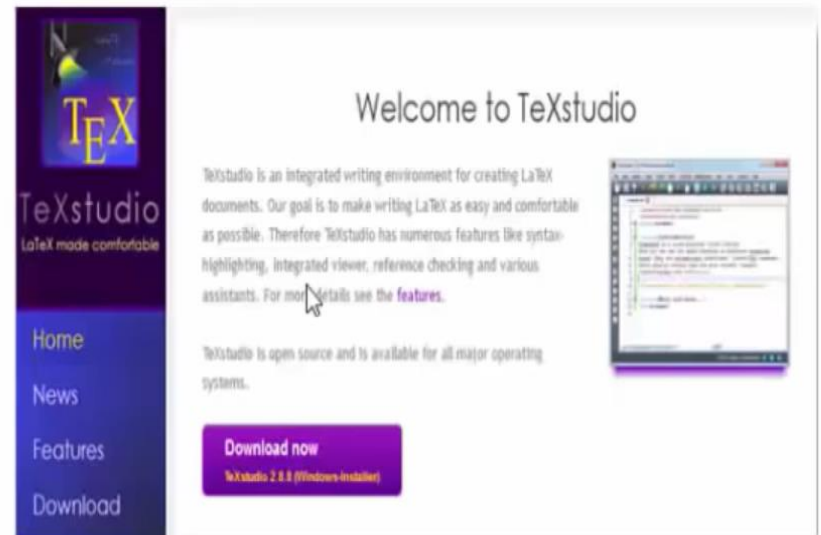
- Mac OS

compiler: MacTeX



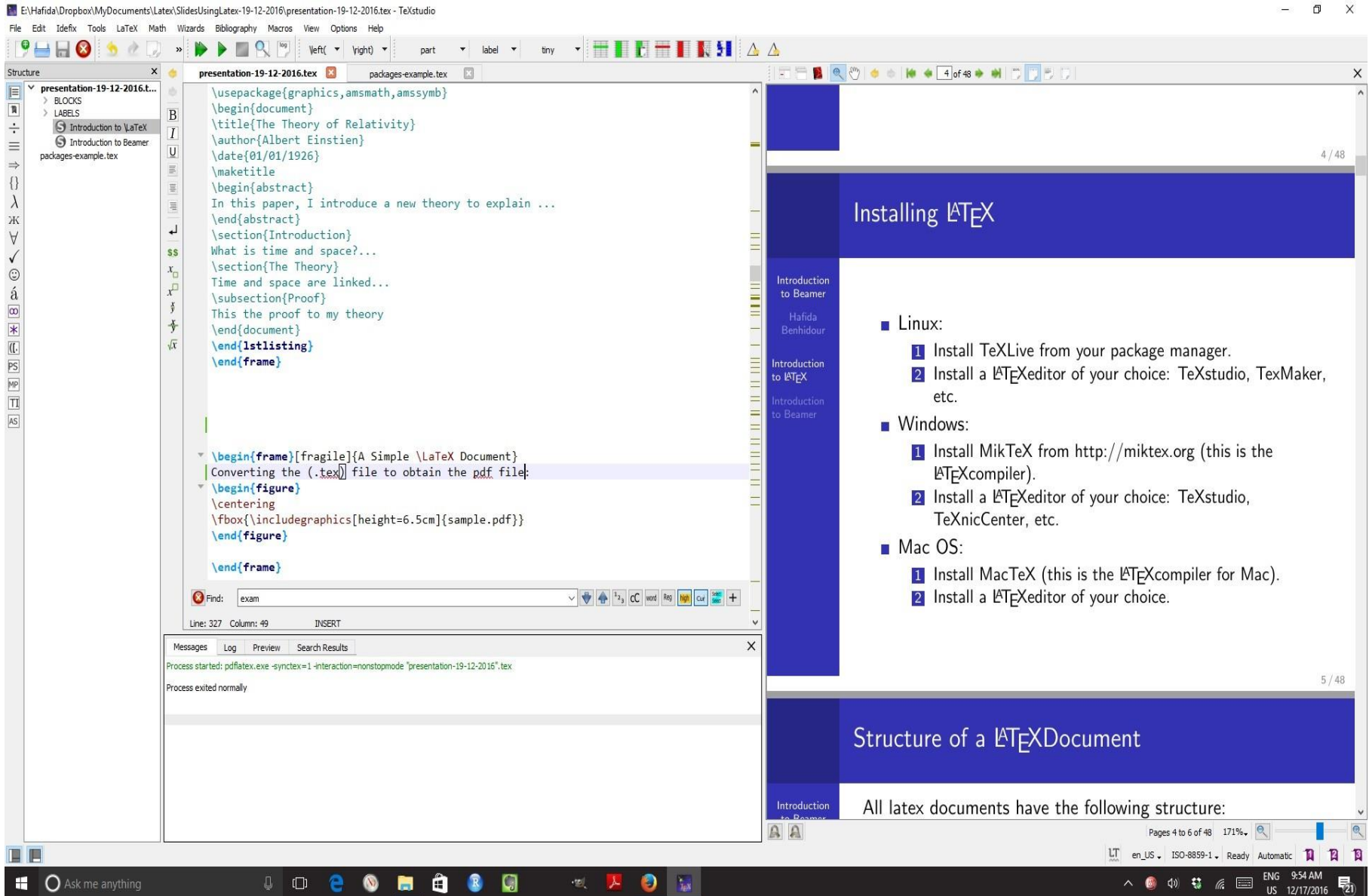
<https://tug.org/mactex/>

Editor: TeXstudio



www.texstudio.sourceforge.net/

TeXstudio



Structure of a L^AT_EX Document

All latex documents have the following structure:

```
\documentclass [... ]{...}  
\usepackage { ...}  
  
\begin{ document}  
...  
\end{ document}
```

- Commands always begin with a backslash \:
 - ❖ **\documentclass, \usepackage.**
- Commands are **case sensitive** and consist of letters only.
- Some commands have parameters.
 - Square brackets [] after the command name are for **optional** parameters.
 - Curly braces { } after the command name are for **required** parameters

The command: `\documentclass`

```
article  
\documentclass[options]{report}  
Book  
beamer
```

- First line of all L^AT_EX documents.
- Specifies the type of the document:
 - ❖ article (research paper), report (multi-chapter document), book (for books), beamer (for presentations).
- **[options]** can be used to set [font size](#) (10, 11, or 12 pt), set [paper size](#), use one or [two columns](#), etc.

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

Most publishers (Springer, Elsevier, IEEE, ACM etc.) have their own document classes. These are predefined classes.

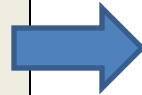
First Example

```
\documentclass{article}
```

```
\begin{document}
```

```
Hello World
```

```
\end{document}
```



Hello World

Sections of a Paper

First thing: you have to indicate the title and the author(s) of the paper:

```
\ title {title}  
\ author {authors}  
\ date {date}  
\ maketitle
```

Remark

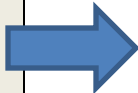
Without `\maketitle`, the title and authors do not appear in the output.

Example

```
\ title {An Approach for ....}  
\ author {Mohamed A.G. Hazber}  
\ date {01/01/1926}  
\ maketitle
```

First Example

```
\documentclass{article}  
\title{First Paper}  
\author{Mohamed A.G. Hazber}  
\date{Jan. 2020}  
\begin{document}  
\maketitle  
Hello World  
\end{document}
```

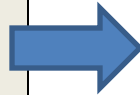


First Paper
Mohamed A.G. Hazber
Jan. 2020

Hello World

Example: If we deleted `\maketitle`

```
\documentclass{article}  
\title{First Paper}  
\author{Mohamed A.G. Hazber}  
\date{Jan. 2020}  
\begin{document}  
  
Hello World  
  
\end{document}
```



Hello World

Packages

```
\usepackage {package}
```

- Packages add new features and commands to LaTeX.
- Common packages:
 - ❖ **amsmath**, **amssymb**: for math symbols.
 - ❖ **graphicx**: for including graphics and images.

```
\documentclass{report}  
\usepackage {color}  
\usepackage {graphicx}  
\begin{document}  
...  
\color{blue}  
\end{document}
```

Input Text

The body of the text is written after the `\begin{document}` command:

```
\begin{document}  
Enter the document content here  
\end{document}
```

Remark

`\begin{...}` commands always need to be followed (finally) by

`\end{...}` commands.

A Simple L^AT_EX Document

The following is a very basic L^AT_EX document:

```
\documentclass{article}  
\usepackage{graphicx}  
\begin{document}  
    This is some  
        sample text .  
\end{document}
```

This gives the following
output:



This is some sample text.

Sections of a Paper

```
\ thanks { ... }  
\ begin{abstract} . . . . \ end{abstract}  
\ begin{keywords} . . . \ end{keywords}
```

`\thanks` creates a footnote with whatever is in the braces.
Usually used after authors' names for academic information
(corresponding authors)

Example

```
\ thanks {I want to thank the University of Hail for supporting  
         this work .}  
\ begin{abstract}  
In this paper, we introduce a new theory to explain ...  
\ end{abstract}  
\ begin{keywords}  RDB ; Ontology;... \ end{keywords}
```

Example

```
\documentclass{article}
\title{An Approach for .....}
\author{Mohamed A.g. Hazber\thanks{corresponding authors} \and
DEF\thanks{co-authors} \and GHI\thanks{XYZ}}
\begin{document}
\maketitle
The ....
\end{document}
```

\thanks

```
\author{Mohamed A.g.
Hazber\thanks{corresponding authors} \and
DEF\thanks{co-authors} \and GHI\thanks{XYZ}}
```

An Approach for

Mohamed A.g. Hazber* DEF† GHI‡

November 14, 2019

The

*corresponding authors
†co-authors
‡XYZ

Sections

The document should be divided into sections, subsections, etc.
Important commands:

```
\section{Title of first section}  
...  
\subsection{Title of the sub-section}  
...  
\section{Title of second section}  
...  
    \subsection{...}  
...  
    \subsubsection{...}  
...
```

L^AT_EX formats the section titles and numbers them according to the document class being used.

\Section

- To insert section used `\section` such as abstract, introduction, related work,...., conclusion
- Exp:

```
\section{Abstract}
```

Here type the abstract

```
\section{Introduction}
```

Here type the introduction

1 Abstract

here type the abstract

2 Introduction

here type the Introduction

A Simple Example

```
\documentclass{article}
\usepackage {graphics, amsmath, amssymb}
\begin{document}
\title{Mapping SQL into NO-SQL}
\author{Mohamed A.G. Hazber}
\date{01/01/1926}
\maketitle
\begin{abstract}
In this paper, we Introduce a new approach to map SQL into
NO-SQL . . .
\end{abstract}
\section{Introduction}
SQL is ....
\section{Approach }
There are two approaches ....
\subsection{ Approach 1 }
This .....
\end{document}
```

Converting the (.tex) file to obtain the pdf file:

Mapping SQL into NO-SQL

Mohamed A.G. Hazber

01/01/1926

Abstract

In this paper, we Introduce a new approach to map SQL into NO-SQL

...

1 Introduction

SQL is

2 Approach

There are two approaches

2.1 Approach 1

This

Cross-referencing(reference to `\section`

Cross references can be made using the commands `\label` and `\ref`.

Example

```
\section{ Introduction}
\label{ sec:intro}
This is the introduction ...
\section{ Conclusion}
As mentioned in Section \ref{ sec:intro} , we have ...
```

- L^AT_EX updates the references automatically.
- It is possible to use any identifier as a label.
- It is custom to use the prefixes: [sec:xxx](#) for section labels, [fig:xxx](#) for figure labels, [chap:xxx](#) for chapter labels, [tab:xxx](#) for table labels, [eq:xxx](#) for equation labels.

How to point `\ref` to any section

- Using `\ref{label name of section}`
- Exp:
 - `\section{Abstract}`
 - here type the abstract
 - `\section{Introduction}`
 - `\label{into}`
 - here type the Introduction `\cite{Hazber}`
 - `\section{Related works}`
 - As we mentioned in section `\ref{into}`

1 Abstract

here type the abstract

2 Introduction

here type the Introduction [1]

3 Related works

As we mentioned in section 2

subsection

- Use `\subsection`
- Exp:
- `\section{Abstract}`
- here type the abstract
- `\section{Introduction}`
- `\label{into}`
- here type the Introduction`\cite{Hazber}`
- `\subsection{overview}`
- here type overview



1 Abstract

here type the abstract

2 Introduction

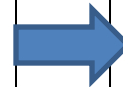
here type the Introduction[1]

2.1 overview

here type overview

subsection

- Use `\subsection`
- **Exp:**
- `\section{Abstract}`
- here type the abstract
- `\section{Introduction}`
- `\label{into}`
- here type the Introduction `\cite{Hazber}`
- `\subsection{overview}`
- here type overview
- `\subsubsection{problem statement}`



1 Abstract

here type the abstract

2 Introduction

here type the Introduction[1]

2.1 overview

here type overview

2.1.1 problem statement

Images | figures in LaTeX

- How to insert figures in LaTeX
 - `\usepackage{graphicx}`
 - `\includegraphic`
- Picture options and placement
- How to refer to a picture in text
 - As shown in Fig. 1....
- How to insert sub-figures?
 - `\usepackage{caption}`
 - `\usepackage{subcaption}`

Inserting Images

In general, a figure is included using:

```
\begin{figure}[options]  
\centering  
\includegraphics[options]{file name}  
\caption{Figure title}  
\label{label}  
\end{figure}
```

- In `\begin{figure}[options]`, you can specify the position option:
 1. t: top of page.
 2. h: here.
 3. !: let the compiler decide.
 4. Any combination can be used.
- The compiler tries its best to fulfill your wish, but not necessarily.
- In `\includegraphics[options]`, you can specify the height, the width, the angle of rotation of the image.

Example :Insert Figure

- `\begin{figure}`
- `\label{Fig1}`
- `\centering`
- `\includegraphics[width=0.5\textwidth]{Fig1.eps}`
- `\end{figure}`

Inserting Images with `\ref`

To include images, you must use a `graphics` package. The most common is `graphicx` (`graphicx` is an extension of `graphics`).

```
Figure\ref{fig:monalisa}  
shows the painting.
```

```
\begin{figure}  
\centering %To center  
the image  
\includegraphics[width  
=2.5cm]{monalisa.jpg}  
%Path and filename  
\caption{The Monalisa}  
\label{fig:monalisa}  
\end{figure}
```

link

Figure 1 shows
the painting.



Figure: The Monalisa

Exp_Picture

Pictures in LaTeX

November 3, 2019

1 Introduction

In the Fig.1

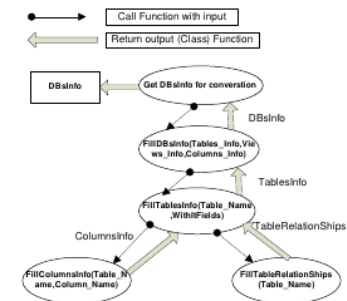
2 Related Work

3 Method

4 Experimental

5 Discussion

6 Conclusions



```
\documentclass{article}
\usepackage{graphicx}
\title{Pictures in LaTeX}
```

```
\begin{document}
\maketitle
```

```
\section{Introduction}
```

In the Fig.\ref{Fig1}

```
\begin{figure}
```

```
\label{Fig1}
```

```
\centering
```

```
\includegraphics[width=0.5\textwidth]{Fig1.eps}
```

```
\end{figure}
```

```
\section{Related Work}
```

```
\section{Method}
```

```
\section{Experimental}
```

```
\section{Discussion}
```

```
\section{Conclusions}
```

```
\end{document}
```

Put the figure in the same place referred in text

```
\section{Introduction}
In the Fig.\ref{Fig1}
\begin{figure}[h]
\label{Fig1}
\centering
\includegraphics[width=0.5\textwidth]{Fig1.eps}
\end{figure}
```

1 Introduction

In the Fig.1



Add caption using `\caption{....}`

```
\section{Introduction}
In the Fig.\ref{Fig1}
\begin{figure}[h]
\label{Fig1}
\centering
\includegraphics[width=0.5\textwidth]{Fig1.eps}
\caption{Processor of algorithms for extracting RDB metadata
(DBsInfo)}
\end{figure}
```

1 Introduction

In the Fig.1



Figure 1: Processor of algorithms for extracting RDB metadata (DBsInfo)

Using `\columnwidth`

- If your article in **two column**, it is better to change the width of figure as `\columnwidth`.
- `\documentclass[twocolumn]{article}`
-
- `\includegraphics[width=0.5\columnwidth]{Fig1.eps}`

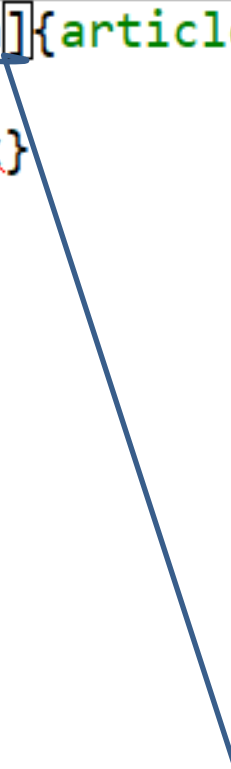
Example

```
\documentclass[twocolumn]{article}
\usepackage{graphicx}
\title{Pictures in LaTeX}

\begin{document}
\maketitle

\section{Introduction}

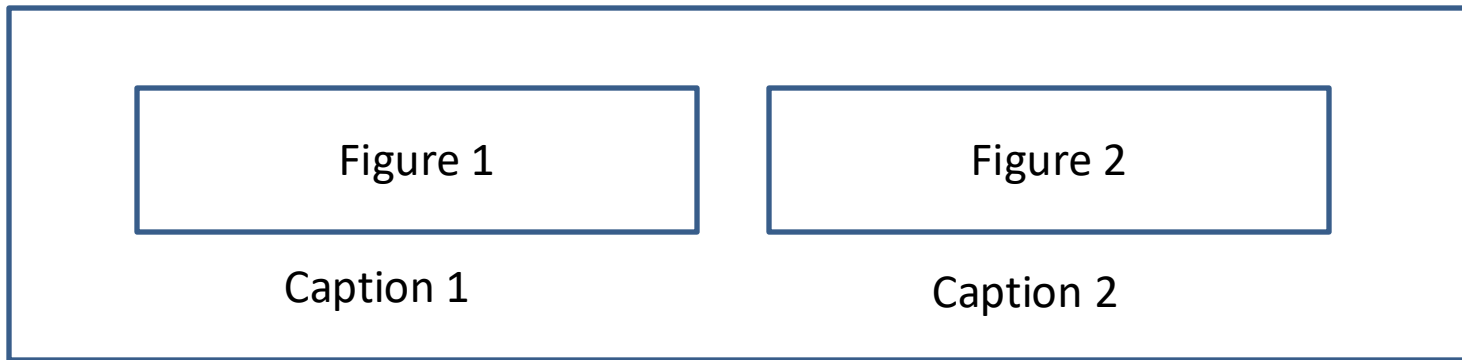
In the Fig.\ref{Fig1}
\begin{figure}[h]
\label{Fig1}
\centering
\includegraphics[width=0.5\columnwidth]{Fig1.eps}
\caption{Processor of algorithms for extracting RDB metadata
(DBsInfo)}
\end{figure}
```



How to Insert Sub-Figures

- If I want to add two figures together
 - `\usepackage{caption}`
 - `\usepackage{subcaption}`

Figure



Caption for all

The steps for add subfigures

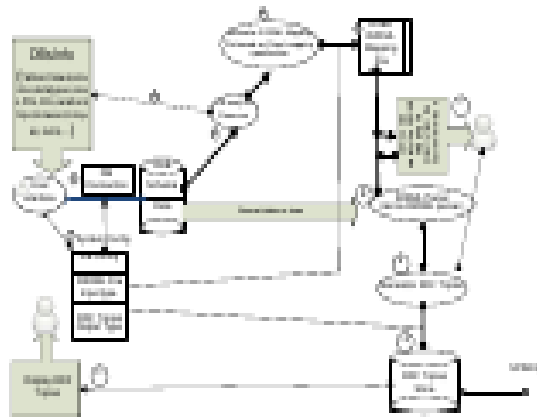


```
\begin{figure}  
  \centering
```

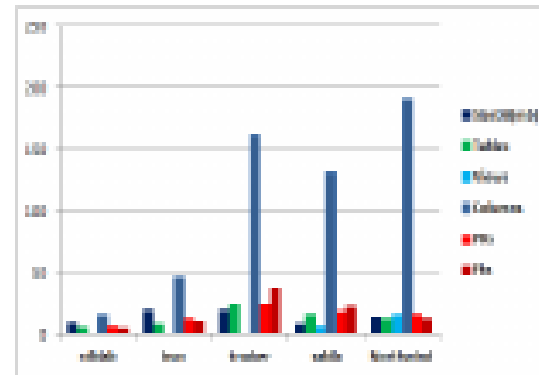
```
\end{figure}
```

`\textwidth` is the (constant) width of the total text block

output



(a) Prototype



(b) Chart

Figure 2: Two simple graphs

Inserting Tables

To include tables, you must use the following commands.

```
\begin{table}  
\caption{An Example of a  
Table}  
\label{table example}  
\centering  
\begin{tabular}{|c|c|}  
\hline Student & Grade\\  
\hline 12 & 13 \\  
\hline  
  
\end{tabular}  
\end{table}
```

```
Table \ref{table example}  
shows a table.
```

Table: An Example of a Table

Student	Grade
12	13

The results of the experiments are shown in Table [1](#).

`\hline` This will insert a horizontal line on top of the table and at the bottom too. There is no restriction on the number of times you can use `\hline`.

References in Latex

- There are two ways of producing a bibliography.
- You can either produce a bibliography by
 - manually listing the entries of the bibliography or
 - producing it automatically using the BibTeX program of LaTeX.

Manually Creating a Bibliography

- The bibliography is produced manually with the environment:

```
\begin{thebibliography}{widest entry}
  \bibitem[label1]{cite_key1} bibliographic information
  \bibitem[label2]{cite_key2} bibliographic information
  ...
\end{thebibliography}
```

label is an optional argument and `cite_key` is a mandatory argument.

The mandatory argument `cite_key` is a reference keyword that does not appear in the bibliography but it is used to as a quick name to cite a reference.

Without the optional argument label, `\bibitem` produces a running number in square brackets as the label for the reference in the text.

Example References:

Manually Creating a Bibliography

- `\begin{document}`
- `\maketitle`
- `\section{Abstract}`
- here type the abstract
- `\section{Introduction}`
- here type the Introduction `\cite{Hazber}`
- `\section{Related works}`
- here type the related works
- `\section{...}`
- ...
- `\section{Conclusion}`
- here type the conclusion
- `\begin{thebibliography}{4}`
- `\bibitem{Hazber}` Hazber, M.A.G., Li, R., Zhang, Y., Xu, G.: An Approach for Mapping Relational Database into Ontology. In: Proceedings of the 12th Web Information System and Application Conference (WISA2015), pp. 120-125. Jinan, Shangdong, China (2015)
- `\end{thebibliography}`
- `\end{document}`

1 Abstract

here type the abstract

2 Introduction

here type the Introduction [1]

3 Related works

here type the related works

4 ...

...

5 Conclusion

here type the conclusion

References

- [1] Hazber, M.A.G., Li, R., Zhang, Y., Xu, G.: An Approach for Mapping Relational Database into Ontology. In: Proceedings of the 12th Web Information System and Application Conference (WISA2015), pp. 120-125. Jinan, Shangdong, China (2015)

Creating a Bibliography Automatically Using BibTeX

You can use the following commands in your LaTeX document:

- `\cite{label}` To insert a **citation** where label is the label of a bibliographic entry in a **.bib file**.
- `\bibliography{bibfilename}` To insert a bibliography where bibfilename is the name of a **.bib** file.
- `\bibliographystyle{bstfilename}`

Bibliography Database | filename (.bib)

- The entries in a bibliography database are of the form

```
@entry_type{cite_key,  
    field_name = { field text},  
    ...  
    field_name={field text}  
}
```

- For example, if the reference is a book:

```
@BOOK{HK,  
    AUTHOR={H. Kopka and P. W. Daly},  
    TITLE={A Guide to LaTeX},  
    PUBLISHER={Addison-Wesley},  
    ADDRESS={Reading, MA},  
    YEAR=1999.  
}
```

- where **BOOK** is the entry type, **HK** is the cite_key which is used as `\cite{HK}` to refer to this book in the text

Example : Exp_References

sample - Notepad

File Edit Format View Help

Sample.bib

```
@article{einstein,
  author = "Albert Einstein",
  title = "{Zur Elektrodynamik bewegter K{\o}rper}. ({German})
    [{On} the electrodynamics of moving bodies]",
  journal = "Annalen der Physik",
  volume = "322",
  number = "10",
  pages = "891--921",
  year = "1905",
  DOI = "http://dx.doi.org/10.1002/andp.19053221004"
}

@book{latexcompanion,
  author = "Michel Goossens and Frank Mittelbach and Alexander Samarin",
```

```
\documentclass{article}
\begin{document}
  This document is an example of BibTeX using in
  bibliography management.
  Three items are cited: \textit{The \LaTeX\
  Companion} book \cite{latexcompanion}, the Einstein
  journal paper \cite{einstein}, and the Donald
  Knuth's website \cite{knuthwebsite}.
  The \LaTeX\ related items are
  \cite{latexcompanion,knuthwebsite}.

  \medskip %leave a vertical space of some amount
  predefined by the class

  \bibliographystyle{unsrt}
  \bibliography{sample}
\end{document}
```

Output:pdf

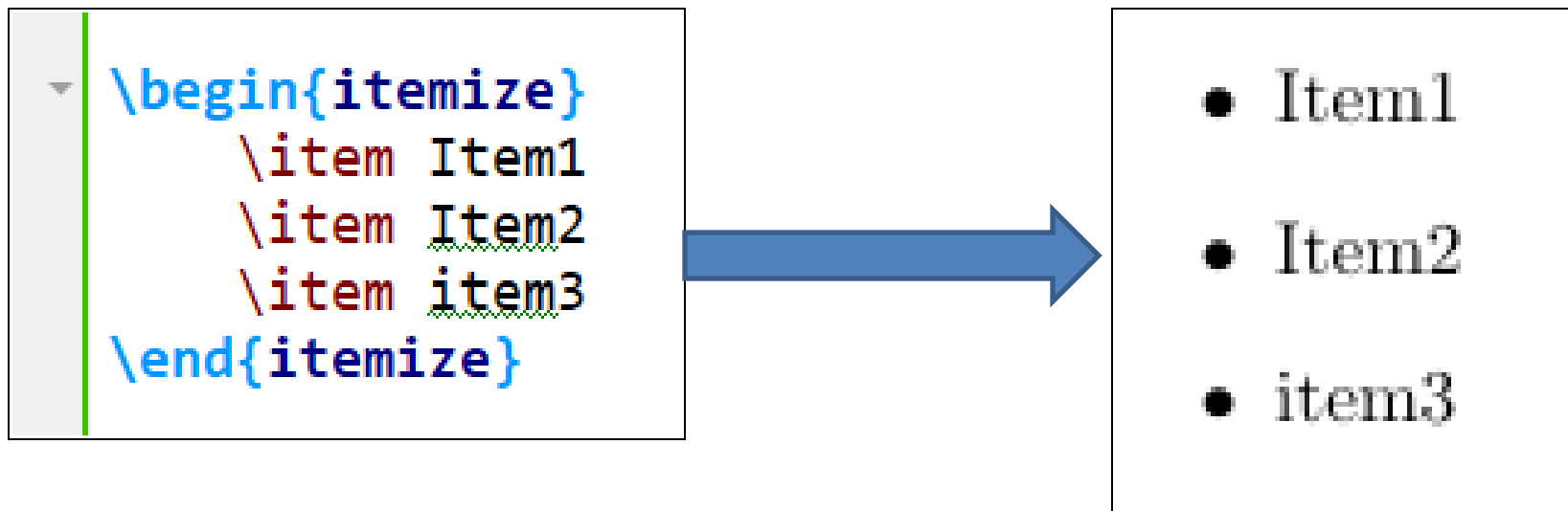
This document is an example of BibTeX using in bibliography management. Three items are cited: *The L^AT_EX Companion* book [1], the Einstein journal paper [2], and the Donald Knuth's website [3]. The L^AT_EX related items are [1, 3].

References

- [1] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The L^AT_EX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.
- [2] Albert Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905.
- [3] Donald Knuth. Knuth: Computers and typesetting.

Lists: itemize

- **Lists:** Lists are basic elements in a document, when used correctly they keep concepts organized and structured.
- **Unordered lists:** The unordered (unnumbered) lists are produced by the **itemize** environment. Each entry must be preceded by the control sequence **\item**.



Ordered lists

- Ordered list have the same syntax inside a different environment:

```
\begin{enumerate}  
\item Input  
\item process  
\item output  
\end{enumerate}
```



```
1. Input  
2. process  
3. output
```

sub item(Nested Lists)

- In LATEX you can insert a list inside another list. The above lists may be included within one another, either mixed or of one type, to a depth of four levels.

```
\begin{enumerate}  
  \item Input  
    \begin{itemize}  
      \item Keyboard  
      \item mouse  
    \end{itemize}  
  \item process  
  \item output  
\end{enumerate}
```



1. Input
 - Keyboard
 - mouse
2. process
3. output

List styles

- As many other LATEX elements, unordered and ordered list styles can be personalized.
- The numbering styles **change depending on the depth of the nested lists:**

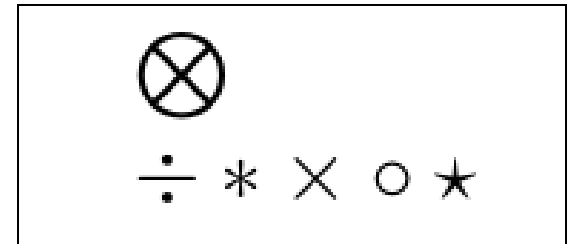
```
\begin{enumerate}  
  \item First level item  
  \item First level item  
  \begin{enumerate}  
    \item Second level item  
    \item Second level item  
    \begin{enumerate}  
      \item Third level item  
      \item Third level item  
      \begin{enumerate}  
        \item Fourth level item  
        \item Fourth level item  
      \end{enumerate}  
    \end{enumerate}  
  \end{enumerate}  
\end{enumerate}
```



1. First level item
2. First level item
 - (a) Second level item
 - (b) Second level item
 - i. Third level item
 - ii. Third level item
 - A. Fourth level item
 - B. Fourth level item

Write any symbol in LaTeX

- Use $\$$
- Syntax
 $\$$ type your symbol $\$$
- Example
- $\$ \backslash bigotimes \$ \backslash$
- $\$ \backslash div \ \backslash ast \backslash times \backslash circ \backslash star \$$



Equations in LaTeX

- Basic equations in LATEX can be easily "programmed", for example:

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

$$\alpha + \beta + 1 \tag{1}$$

$$X = A \cup B \cap C$$

$$\omega = \sum_{k=i}^r \omega_k$$

$$\omega = \sum_{k=i}^n \omega_k$$

- Packages
 - `\usepackage{amsmath}`
 - `\usepackage{amssymb}`

Typesetting Mathematical Equations

- Latex is extremely good at typesetting math equations.
- Equations are written as text.
- **Inline equations** (equations within the text) are written between $\$$ and $\$$.

Example

Tex document:

```
Assume that  $\alpha x + \beta y = 1$ , then
```

Pdf document:

Assume that $\alpha x + \beta y = 1$, then

Example : Equation - inline

```
 $X=A\cup B\bigcap C$   
 $\omega=\sum_{k=i}^r \omega_k$   
 $\omega=\sum_{k=i}^n \omega_k$ 
```



$$X = A \cup B \cap C$$
$$\omega = \sum_{k=i}^r \omega_k$$
$$\omega = \sum_{k=i}^n \omega_k$$

Symbol	LaTeX	Comment
$\cap$ {\displaystyle \cap }	<code>\cap</code>	set intersection
$\cup$ {\displaystyle \cup }	<code>\cup</code>	set union
$\uplus$ {\displaystyle \uplus }	<code>\uplus</code>	multiset addition
$\sqcap$ {\displaystyle \sqcap }	<code>\sqcap</code>	

 $\mathbf{x}_2$

subscript

 $\mathbf{x}^2$

Superscript

Typesetting Mathematical Equations

- Numbered equations are written within the *equation* environment.

Example

Tex document:

```
Assume t h a t :  
\begin{equation}  
\label{eq:my-equation} % <= The equation label  
\alpha x + \beta y = 1 ,  
\end{equation}  
then ...
```

Pdf document:

Assume that:

$$\alpha x + \beta y = 1, \tag{1}$$

then ...

Equation

- **Syntax**

`\begin{equation}`

Type your equation here
without use \$ \$

`\end{equation}`

Example: Equations

```
\begin{equation}  
  \alpha + \beta + 1  
\end{equation}
```



$$\alpha + \beta + 1$$

(1)

Equation

In the equation (1) we measure β

```
\begin{equation}
```

```
\beta=\sum_{k=5}^m \omega_k
```

```
\end{equation}
```



In the equation (1) we measure β

$$\beta = \sum_{k=5}^m \omega_k \quad (1)$$

Typesetting Mathematical Equations

- To refer a numbered equation, use the command `\ref`. The equation numbers are updated automatically.

Example

Tex document:

```
By using Equation \ref{eq:my-equation} , we obtain  
:...
```

```
\begin{equation}  
\label{eq:my-equation2}  
\alpha x= 1- \beta y.  
\end{equation}
```

Pdf document:

By using Equation (1), we obtain:

$$\alpha x = 1 - \beta y. \quad (2)$$

Equation – reference to

In the equation (1) we measure ω

In the equation (\ref{omega_2}) we measure ω

```
\begin{equation}
  \beta = \sum_{k=5}^m \omega_k
\end{equation}
```

```
\begin{equation}
\label{omega_2}
  \beta = \sum_{k=3}^m \omega_k
\end{equation}
```

Without label
so we can not
refer to it by
`\ref`, but we can
use the number of
equation,
what is the
problem?

In the equation (1) we measure ω
In the equation (2) we measure ω

$$\beta = \sum_{k=5}^m \omega_k \quad (1)$$

$$\beta = \sum_{k=3}^m \omega_k \quad (2)$$

Equation – reference to

In the equation (1) we measure ω

In the equation (\ref{omega_2}) we measure ω

```
\begin{equation}
```

```
\beta=\sum_{k=5}^m \omega_k
```

```
\end{equation}
```

```
\begin{equation}
```

```
\beta=\sum_{k=5}^m \omega_k
```

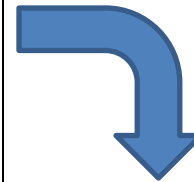
```
\end{equation}
```

```
\begin{equation}
```

```
\label{omega_2}
```

```
\beta=\sum_{k=3}^m \omega_k
```

```
\end{equation}
```



In the equation (1) we measure ω
In the equation (3) we measure ω

$$\beta = \sum_{k=5}^m \omega_k \quad (1)$$

$$\beta = \sum_{k=5}^m \omega_k \quad (2)$$

$$\beta = \sum_{k=3}^m \omega_k \quad (3)$$

Equation-fraction

```
\begin{equation}  
\beta=\frac{S*5}{9}  
\end{equation}
```



$$\beta = \frac{S * 5}{9}$$

Equation without numbered

- Add * to equation

```
\begin{equation*}
```

```
\beta=\sum_{k=5}^m \omega_k
```

```
\end{equation*}
```



$$\beta = \sum_{k=5}^m \omega_k$$

Multiline equations using align

- `\begin{align*}`

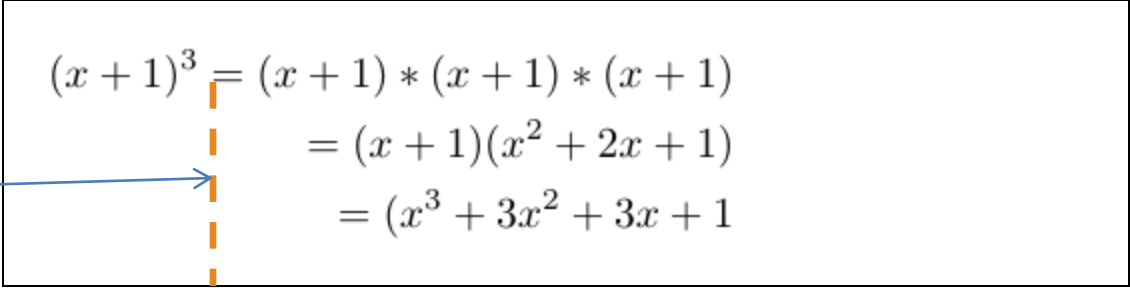
$$(x+1)^3=(x+1)*(x+1)*(x+1)\\$$

$$=(x+1)(x^2+2x+1)\\$$

$$=(x^3+3x^2+3x+1$$

- `\end{align*}`

The alignment
here is as right
but = not
sequential
above some.


$$\begin{aligned}(x+1)^3 &= (x+1)*(x+1)*(x+1) \\ &= (x+1)(x^2+2x+1) \\ &= (x^3+3x^2+3x+1\end{aligned}$$

Multiline equations using align

- To solve use & before =, like

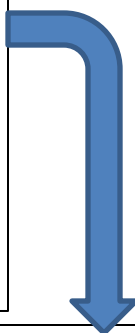
- `\begin{align*}`

$$(x+1)^3&=(x+1)*(x+1)*(x+1)\\$$

$$&=(x+1)(x^2+2x+1)\\$$

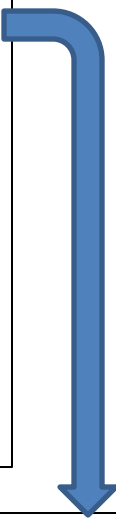
$$&=(x^3+3x^2+3x+1$$

- `\end{align*}`


$$\begin{aligned}(x+1)^3 &= (x+1) * (x+1) * (x+1) \\ &= (x+1)(x^2 + 2x + 1) \\ &= (x^3 + 3x^2 + 3x + 1\end{aligned}$$

Put multiline in one equation

```
\begin{equation}
\label{eq1}
\begin{split}
A &= \frac{\pi r^2}{2} \\
&= \frac{1}{2} \pi r^2
\end{split}
\end{equation}
```


$$\begin{aligned} A &= \frac{\pi r^2}{2} \\ &= \frac{1}{2} \pi r^2 \end{aligned} \tag{4}$$

More equation Example

```
\documentclass{article}
\usepackage{amsmath}
\begin{document}
  \begin{center}
    {\large
      $$ y=\frac{a^3+2c_x}{1+\sqrt{b_x}} $$ \\
      \vspace{0.2in}
      $$
      Q=\sum_{i=1}^j \int_{\mu}^{\infty} f(x_j) dx
      x $$ \\
      \vspace{0.2in}
      $$ \Psi = \oint_{-\infty}^{\infty} f_{xy}(\frac{\partial Q_x}{\partial Q_y})^{\Im_{\pi}'}
      \vspace{0.2in}
    }
  \end{center}
\end{document}
```



$$y = \frac{a^3 + 2c_x}{1 + \sqrt{b_x}}$$

$$Q = \sum_{i=1}^j \int_{\mu}^{\infty} f(x_j) dx$$

$$\Psi = \oint_{-\infty}^{\infty} f_{xy} \left(\frac{\partial Q_x}{\partial Q_y} \right)^{\Im_{\pi}'}$$

Some Examples