Introduction to LaTeX

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Basics of LaTeX

- LaTeX(pronounced /'lɑːtɛx/, /'lɑːtɛk/, /'leɪtɛx/, or /'leɪtɛk/) (Wikipedia) is a computer program for typesetting text and mathematical formulas.
- Uses commands to create mathematical symbols.
- Not a WYSIWYG program. It is a WYWIWYG (what you want is what you get) program!
- The document is written as a source file using a markup language (like HTML).
- The final document is obtained by compiling the source file.

Advantages of Using LaTeX

- Professional typesetting: Best output.
- It is the standard for scientific documents.
- Processing mathematical (& other) symbols.
- Meaning based structuring (rather than appearance).
- Knowledgeable and helpful user group.
- Its FREE!
- Platform independent.

Installing LaTeX

- Linux:
  1. Install TeXLive from your package manager.
  2. Install a LaTeXeditor of your choice: TeXstudio, TexMaker, etc.
- Windows:
  1. Install MikTeX from http://miktex.org (this is the LaTeXcompiler).
  2. Install a LaTeXeditor of your choice: TeXstudio, TeXnicCenter, etc.
- Mac OS:
  1. Install MacTeX (this is the LaTeXcompiler for Mac).
  2. Install a LaTeXeditor of your choice.

Structure of a LaTeX Document

All latex documents have the following structure:

```
\documentclass[...]{...}
\usepackage{...}

\begin{document}
...
\end{document}
```

LaTeX Commands

- Always begin with a backslash \: \documentclass, \usepackage.
- Case sensitive.
- Consist of letters only.
- Some 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

```
\documentclass[options]{ article
                         report   }
                         book
                         letter
                         ...
```

- First line of all LaTeXdocuments.
- Specifies the type of the document:
  - article: Research paper.
  - report: Multi-chapter document.
  - book: For books.
  - letter: For letters.
- **[options]** can be used to set font size (10, 11, or 12 pt), set paper size, use one or two columns, etc.
- These are predefined classes. Most science publishers (Springer, Elsevier, IEEE, ACM etc.) have their own document classes.

Packages

```
\usepackage{package}
```

- Packages add new features and commands to LaTeX.
- Common packages:
  - amsmath, amssymb: for math symbols.
  - graphicx: for including graphics and images.
- Can also define new commands in the preamble, specify page numbering, etc.

Input the Text

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

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

Remark

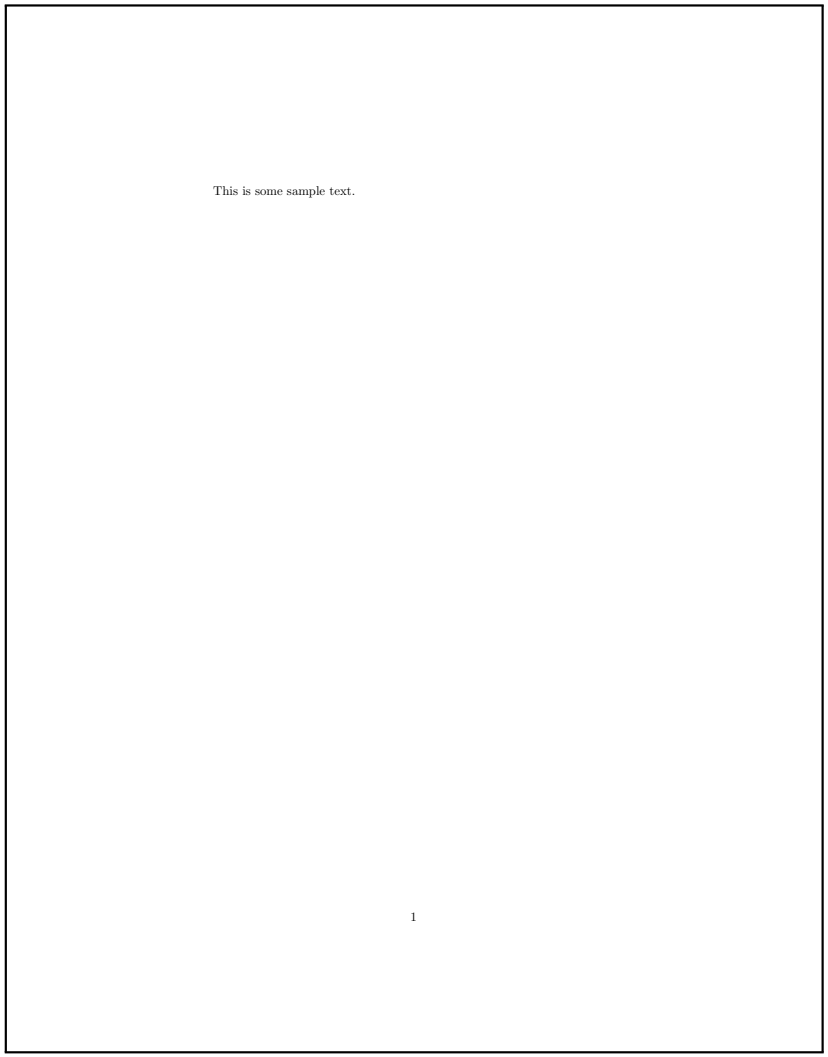
\begin{...} commands always need to be followed (eventually) by \end{...} commands.

A Simple LaTeX Document

The following is a very basic LaTeX document:

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

This gives the following output:



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{The Theory of Relativity}
\author{Albert Einstein}
\date{01/01/1926}
\maketitle
```

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

Example

```
\thanks{I want to thank the University of Princeton for
    supporting this work.}
\begin{abstract}
In this paper, I introduce a new theory to explain how time
    and space are related.
\end{abstract}
\begin{keywords} Relativity; space; time \end{keywords}
```

Sections

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

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

LaTeX formates the section titles and numbers them according to the document class being used.

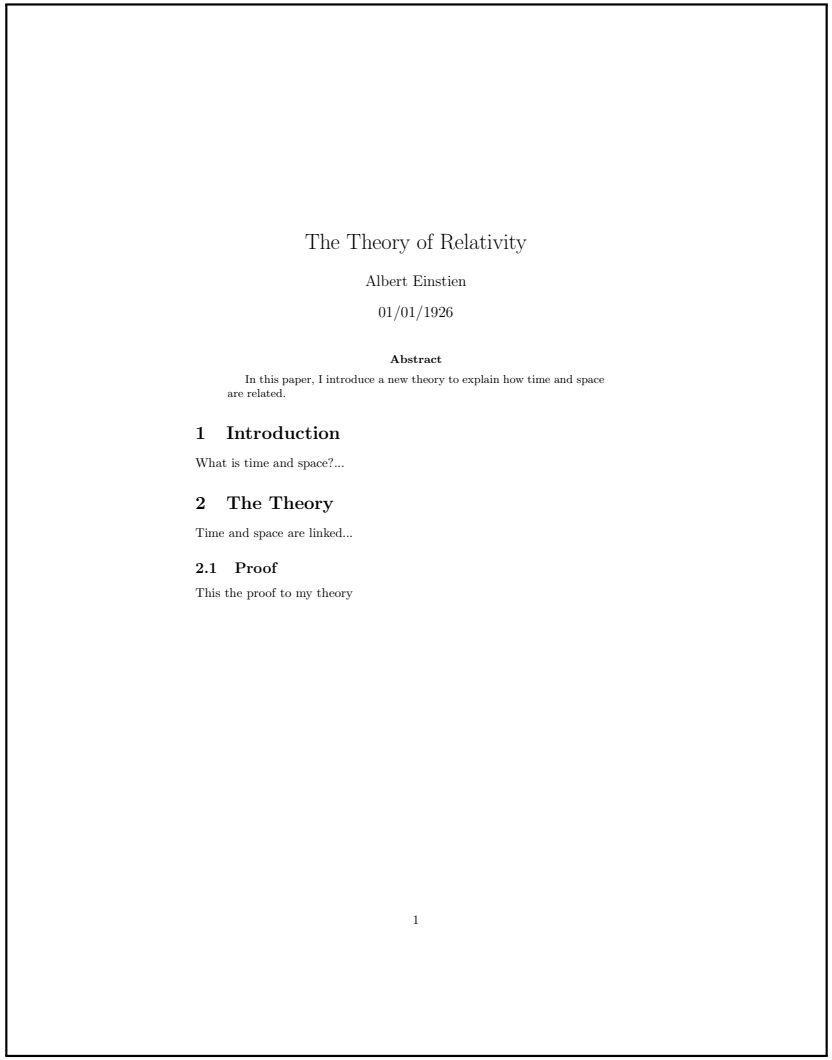
A Simple LaTeX Document

The following is a sample LaTeX document:

```
\documentclass{article}
\usepackage{graphics,amsmath,amssymb}
\begin{document}
\title{The Theory of Relativity}
\author{Albert Einstien}
\date{01/01/1926}
\maketitle
\begin{abstract}
In this paper, I introduce a new theory to explain how time
    and space are related.
\end{abstract}
\section{Introduction}
What is time and space?...
\section{The Theory}
Time and space are linked...
\subsection{Proof}
This the proof to my theory
\end{document}
```

A Simple LaTeX Document

This gives the following output:



The Theory of Relativity

Albert Einstien

01/01/1926

Abstract

In this paper, I introduce a new theory to explain how time and space are related.

1 Introduction

What is time and space?...

2 The Theory

Time and space are linked...

2.1 Proof

This the proof to my theory

1

Cross-referencing

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 ...
```

- LaTeXupdates 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.

Inserting Tables

To include tables, you must use the following commands.

Example

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

\begin{table}
\caption{An Example of a
    Table}
\label{table_example}
\centering
\begin{tabular}{|c|c|}
\hline  Table Head &
    Column Head \\
\hline  Copy & More \\
\hline
\end{tabular}
\end{table}
```

Table 1 shows a table.

Table 1 : An Example of a Table

Table Head	Column Head
Copy	More

Inserting Images

To include images, you must use a graphics package. The most common is *graphicx*.

Example

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

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

Figure 1 shows the painting.

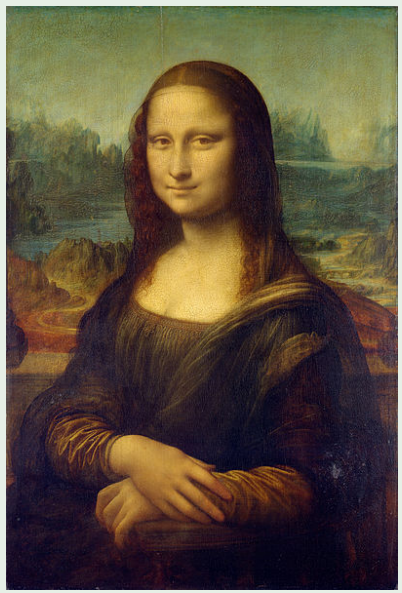


Figure 1 : The Monalisa

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.

Inserting Images

Example

```
\begin{figure}
\centering % To center
    the image
\includegraphics[width
    =2.5cm, angle= 45]{
    monalisa.jpg} % Path
    and file name
\caption{The Monalisa}
\label{fig:monalisa2}
\end{figure}

Figure \ref{fig:monalisa2
    } shows the painting.
```

Figure 2 shows the painting rotated.

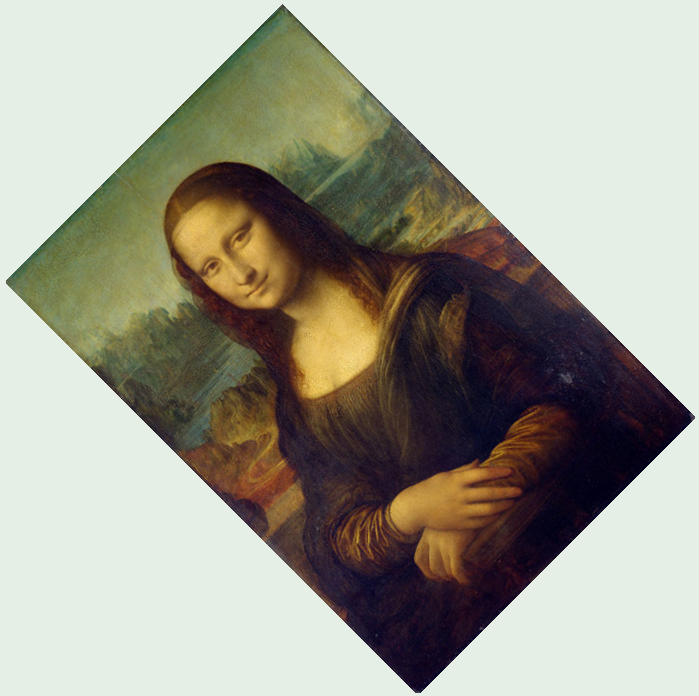


Figure 2 : The Monalisa rotated

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

Code:

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

Output:

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

Typesetting Mathematical Equations

- Equations on a separate line are enclosed between \[and \].

Example

Code:

```
Assume that:
\[
\alpha x + \beta y =1,
\]
then ...
```

Output:

Assume that:

$$\alpha x + \beta y = 1,$$

then ...

Typesetting Mathematical Equations

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

Example

Code:

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

Output:

Assume that:

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

then ...

Typesetting Mathematical Equations

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

Example

Code:

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

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

Output:

By using Equation (1), we obtain:

$$\alpha x = 1 - \beta y. \tag{2}$$

Typesetting Mathematical Equations

- There are other equation environments: for example *align*.

Example

Code:

```
Here is the derivation of a famous equation:
\begin{align}
( x-y ) ( x+y ) &= x  ( x+y) - y ( x+y)\\
                &= x^2+x y - y x - y^2\\
                &= x^2 - y^2.
\end{align}
```

Output:

Here is the derivation of a famous equation:

$$
\begin{aligned}
(x-y)(x+y) &= x(x+y) - y(x+y) && (3)\\
&= x^2 + xy - yx - y^2 && (4)\\
&= x^2 - y^2. && (5)
\end{aligned}
$$

Typesetting Mathematical Equations

- To remove the numbering use *align** instead.

Example

Code:

```
Here is the derivation of a famous equation:
\begin{align*}
( x-y ) ( x+y ) &= x  ( x+y) - y ( x+y)\\
                &= x^2+x y - y x - y^2\\
                &= x^2 - y^2.
\end{align*}
```

Output:

Here is the derivation of a famous equation:

$$\begin{aligned}(x-y)(x+y) &= x(x+y) - y(x+y)\\ &= x^2 + xy - yx - y^2\\ &= x^2 - y^2.\end{aligned}$$

Typesetting Mathematical Equations

- For long equations use *multline*. You can also remove the numbering by using *multline**.

Example

Code:

```
This is a very long equation:

\begin{multline}
( x-y ) ( x+y ) = x  ( x+y) - y ( x+y)= x^2 \\ +x y - y x
- y^2 = x^2 - y^2.
\end{multline}
```

Output:

This is a very long equation:

$$(x-y)(x+y) = x(x+y) - y(x+y) = x^2 + xy - yx - y^2 = x^2 - y^2. \quad (6)$$

Typesetting Mathematical Equations

- You can write fractions, integrals, sums, products etc.

Example

Code:

```
This a very complicated equation:
\[
\log (\prod_{i=1}^n u_i)= \sum_{i=1}^{n} \log(u_i).
\]
```

Output:

This a very complicated equation:

$$\log(\prod_{i=1}^{n} u_i) = \sum_{i=1}^{n} \log(u_i).$$

Typesetting Mathematical Equations

- You can write fractions, integrals, sums, products etc.

Example

Code:

```
This a very complicated equation:
\[
\int_{1}^{y} \frac{1}{x} dx= \log(y).
\]
```

Output:

This a very complicated equation:

$$\int_{1}^{y} \frac{1}{x} dx = \log(y).$$

Typesetting Mathematical Equations

- There is a large number of predefined mathematical symbols.

Example

Code:

```
Some \LaTeX math symbols:
\[
\gamma + \Gamma + \pi + \hat{x} - \bar{y} = 0. \]
\[
(P \lor Q) \implies R \Leftrightarrow
(P \implies R) \land (Q \implies R) \]
```

Output:

Some LaTeX math symbols:

$$\gamma + \Gamma + \pi + \hat{x} - \bar{y} = 0.$$

$$[(P \lor Q) \Longrightarrow R] \Leftrightarrow [(P \Longrightarrow R) \land (Q \Longrightarrow R)]$$

Typesetting Mathematical Equations

- You can also write matrices.

Example

Code:

```
$A$ is a matrix and $b$ is a vector defined by:
\[ A= \begin{bmatrix}
1 & 2\\
-1 & 0
\end{bmatrix},
b= \begin{bmatrix} 2\\ 1 \end{bmatrix}
\]
```

Output:

A is a matrix and b is a vector defined by:

$$A = \begin{bmatrix} 1 & 2 \\ -1 & 0 \end{bmatrix}, b = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

Using Graphical Equation Editors

- The **best** way to write an equation is to write it directly as **text**: it is faster and you have more control.
- You can, however, use some graphical editors to help you write the equations until you master LaTeX.
- Some LaTeX editors (like TexStudio) offer some tool-bars with buttons that can help you write math symbols or even draw the math symbols (like the Math wizard in TexStudio).
- There are also online LaTeX equation editors, for example: http://www.codecogs.com/latex/eqneditor.php.

Bibliography

The bibliography is usually inserted at the end of the document, before \end{document}:

```
\bibliographystyle{bibliography style}
\bibliography{bibliography file (.bib file)}
```

- The bibliography style indicates to LaTeXhow to format your references.
- Usually the bibliography style is indicated by the publisher. Common styles: plain, apalike, acm, ieeetr, siam, ...
- The bibliography file is of type BibTeX (extension .bib) containing all your references (not necessary only those used in your document).

Example

```
....
\bibliographystyle{plain}
\bibliography{my-bibliography}
\end{document}
```

Bibliography: the BibTeX file

The BibTeX format for a journal paper:

Example

```
@article{kornack2001,
author="D. Kornack and P. Rakic",
title="Cell Proliferation without Neurogenesis in Adult
    Primate Neocortex,",
journal="Science",
volume="294",
pages="2127-2130",
month="Dec",
year="2001",
}
```

```
article: an article from a journal or magazine.
Required fields: AUTHOR, TITLE, JOURNAL, YEAR
Optional fields: VOLUME, NUMBER, PAGES, MONTH, NOTE, KEY
```

Bibliography: the BibTeX file

The BibTeX format for an conference paper:

Example

```
@inproceedings{goto2007,
author = "H. Goto, Y. Hasegawa, and M. Tanaka",
title = "Efficient Scheduling Focusing on the Duality of MPL
    Representatives",
booktitle = "IEEE Symp.Computational Intelligence in
    Scheduling (SCIS 07)",
publisher = "IEEE Press",
pages = "57-64",
year = "2007",
}
```

```
inproceedings: an article in a conference proceedings.
Required fields: author, title, booktitle, year
Optional fields: editor, volume/number, series, pages,
    address, month, organization, publisher, note, key
```

Bibliography: the BibTeX file (.bib)

Example

```
@book{thalmann2012crowd,
  title={Crowd Simulation},
  author={Thalmann, Daniel and Musse, Soraia Raupp},
  year={2012},
  publisher={Springer}
}
@article{pelechano2008virtual,
  title={Virtual crowds: Methods, simulation, and control},
  author={Pelechano, Nuria and Allbeck, Jan M and Badler,
      Norman I},
  journal={Synthesis Lectures on Computer Graphics and
      Animation},
  volume={3},
  number={1},
  pages={1--176},
  year={2008},
  publisher={Morgan \& Claypool Publishers}
}
```

Bibliography: citations

Citations are made using the command \cite{Label of the reference}.

Example

```
In \cite{pelechano2008virtual}, the authors present ... .
In \cite{pelechano2008virtual,thalmann2012crowd}, crowd ...
```

Output

In [1], the authors present ... .

In [1,2], crowd ...

List of references

In the previous example, the plain style is used.

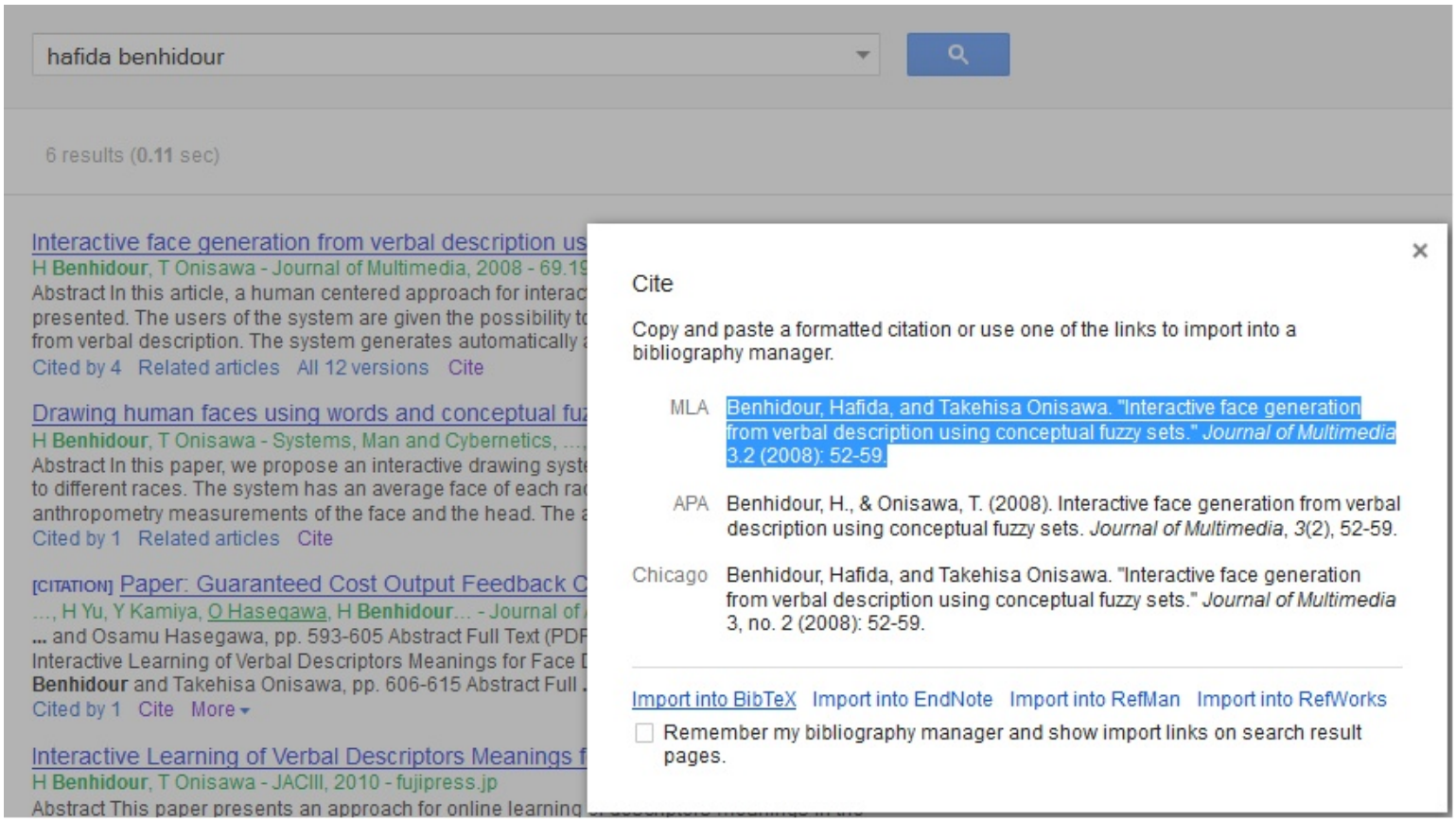
```
\bibliographystyle{plain}
\bibliography{my-bibliography}
\end{document}
```


[1] Nuria Pelechano, Jan M Allbeck, and Norman I Badler. Virtual crowds: Methods, simulation, and control. *Synthesis Lectures on Computer Graphics and Animation*, 3(1):1–176, 2008.

[2] Daniel Thalmann and Soraia Raupp Musse. *Crowd Simulation*. Springer, 2012.

How to Obtain BibTeX Entries

- Most online databases (IEEE, Elsevier, ACM etc.) can export citations to the BibTeX format.
- You can also use websites such as: citeulike.org or Google Scholar.



Help

- Forums.
- en.wikibooks.org, search for the command that you do not know how to use it, you will find a lot of examples.
- A brief description on how to install LaTeXand this presentation are available on my homepage http://fac.ksu.edu.sa/hbenhidour