

INFO1 – First steps in \LaTeX

Wettl Ferenc, Simon András

2021-09-29

1 Introduction

2 T_EX and L^AT_EX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language L^AT_EX

- The L^AT_EX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

Author, typographer, typesetter, editor

- The classic stages of book writing:
 - the author writes her book,
 - proofreading,
 - typographer prepares the layout of the book
 - typesetting,
 - printing,
 - an editor is in charge of this process
- **Problem:** With sophisticated document editing software, the author can produce a camera-ready work, but the author is not a typographer or typesetter (the user interface contains authoring and typographic commands in bulk).
- **Solution:** A clear separation between the design of the visual appearance and the writing of the work, i.e. the typographic work and the author's work. This is what \LaTeX is good for: we provide the title, the author, we tell what to highlight, but we don't care what it looks like. \LaTeX will take care of that.

1 Introduction

2 T_EX and L^AT_EX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language L^AT_EX

- The L^AT_EX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

1 Introduction

2 T_EX and L^AT_EX

■ Basics

- Editing, compiling, viewing

3 The basics of the programming language L^AT_EX

- The L^AT_EX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

T_EX, L^AT_EX

- T_EX (pronounced “tech”) is typesetting system originally written by the computer scientist Donald Knuth.
- L^AT_EX (“laytech”) is a macro package (originally written by Leslie Lamport) on top of it.
- The T_EX commands T_EX and L^AT_EX produce the logos. Outside of T_EX, in a normal text file one writes TeX and LaTeX.

Advantages of L^AT_EX

See <http://www.nitens.org/taraborelli/latex>

- print quality output;
- its language is simple, can be program-generated; any text editor is good for editing the source (many have support, e.g. syntax colouring, graphical interface, . . .);
- language describes the **logical structure** of the document but the visual appearance can also be controlled;
- automatism (cross-references, bibliography, table of contents, . . .);
- produces mathematical formulas of the highest typographical quality;
- countless software packages for special tasks;
- its source code is open;
- runs on almost all operating systems on all types of computers;
- supports many national languages, multilingual documents are possible

Disadvantages of L^AT_EX (T_EX)

- in some tasks more cumbersome than usual WYSIWYG (What You See Is What You Get) systems;
- changing the layout of a document or creating a new layout is difficult; in addition to the L^AT_EX commands, deep knowledge T_EX is needed
- understanding error messages and correcting errors is sometimes a challenge;
- as a programming language, it is a bit unfriendly.

Accessing and getting acquainted with L^AT_EX

■ Distributions

- L^AT_EX in the browser: <http://www.overleaf.com>
- Windows: MiKTeX (<http://miktex.org>)
- Linux: TeXLive (<http://www.tug.org/texlive/>) This runs on the servers of the Math Institute. (And this is what **Overleaf** uses behind the scenes.)
- Macintosh: MacTeX – TeXLive based (<http://www.tug.org/mactex>)

■ Starting points

- CTAN (Comprehensive TeX Archive Network): <http://www.ctan.org/>
- TUG (T_EX User Group): <http://www.tug.org>

■ Books

- Knuth: The T_EXbook. Addison-Wesley, 1986. (freely downloadable)
- Tobias Oetiker &al. The Not So Short Introduction to L^AT_EX 2_ε (downloadable here: <http://metodos.fam.cie.uva.es/latex/bibliografia/lshort.pdf>)

1 Introduction

2 T_EX and L^AT_EX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language L^AT_EX

- The L^AT_EX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

T_EX/L^AT_EX editors

The source is a plain text file, from which the compiler (typically `pdflatex`) produces the document (which is typically a pdf (Portable Document Format) file). The text file should be generated by an editor that “understands” L^AT_EX to some extent.

The following is important *only if* you're not using [Overleaf](#).

Editor	Op sys		
Emacs/latex-mode	L	M	W
Emacs/AUCTeX	L	M	W
Kile http://kile.sourceforge.net/	L		
TeXnicCenter www.texniccenter.org/			W
Texmaker www.xmlmath.net/texmaker/	L	M	W
TeXworks www.tug.org/texworks/	L	M	W
WinShell www.winshell.org/			W

Compilation, viewing

Context-dependent. For example, in [Overleaf](#), one needs to click on the *Recompile* button (or press Ctrl-Enter), and the pdf will be shown beside the source or in another tab, depending on the settings in the *Layout* menu (near the top right corner). In a Linux terminal on the other hand:

```
$ pdflatex testlatex.tex
```

```
This is pdfTeXk, Version 3.141592-1.40.3 (Web2C 7.5.6)
```

```
...
```

```
Babel <v3.8h> and hyphenation patterns for english, usenglishm  
dumylang, nohyphenation, hungarian, ukenglish, loaded.
```

```
...
```

```
Output written on testlatex.pdf (1 page, 5644 bytes).
```

```
Transcript written on testlatex.log.
```

```
$ evince testlatex.pdf &
```

Error message

```
! Undefined control sequence.
```

```
1.35 \Lets
```

```
      see!
```

```
?
```

There is an error in line 35. We can react as follows:

ENTER: continue.

s ENTER: continue, and don't stop anymore.

q ENTER: continue hibaüzenet nélkül.

x ENTER: interrupt the translation.

? ENTER: help.

1 Introduction

2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language \LaTeX

- The \LaTeX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

1 Introduction

2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language \LaTeX

- The \LaTeX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

The structure of a \LaTeX document

```
\documentclass{article} % can be: article, book, ...
                        % preamble
\begin{document}
  Hello world!          % body of the document in the document environment
\end{document}
```

Usage of spaces: any number of spaces and tab characters, and at most one newline character sequence are all equivalent to one space; (at least) one blank line is a new paragraph.

The structure of a L^AT_EX document — further details

```
\documentclass[11pt]{article} % documentclass with options
                                %%%%%%%%% PREAMBLE
\usepackage[T1]{fontenc}        % internal encoding of fonts
\usepackage[utf8]{inputenc}    % input encoding
\usepackage[magyar]{babel}     % substitute your language in place of magyar
\usepackage{amsmath,graphicx} % extra math and graphical capabilities

\title{My first paper}
\author{John Smith}
\date{\today}

\begin{document}                %%%%%%%%% body
\maketitle                      % write the title, authorm etc.
\tableofcontents
\section{Introduction}
The text of my first paper      %
\end{document}                  %%%%%%%%% This is it.
```

```
\documentclass{book}

\title{Nonsense Novels}
\author{Stephen Leacock}
\date{1911}

\begin{document}
\maketitle

\chapter*{Gertrude the Governess}
```

It was a wild and stormy night on the West Coast of Scotland. This, however, is immaterial to the present story, as the scene is not laid in the West of Scotland. For the matter of that the weather was just as bad on the East Coast of Ireland.

But the scene of this narrative is laid in the South of England and ...

```
\end{document}
```

Document classes

article	article, amsart
book	book
report	report
presentation	beamer
letter	letter

A 10 speciális jelentésű karakter

- Almost all characters mean themselves.
- **10 printable ASCII characters with special meaning:**

`\ { } % $ & # _ ^ ~`

- If we want to actually display them, 7 of them can be escaped with an **escape** character (`\`):

`\{ \} \% \$ \& \# _`

- For the rest, we need to use a command:

<code>\</code>	<code>\textbackslash</code>	<code> \\$\backslash\$</code>	
<code>^</code>	<code>\textasciicircum</code>	<code>\^{ }</code>	
<code>~</code>	<code>\textasciitilde</code>	<code>\~{ }</code>	<code> \$ \sim\$</code>

- Example: He won 10\$ because he had to pay 50% less in the shops of B&C.

He won 10\\$ because he had to pay 50\% less
in the shops of B\&C.

Characters with special meaning: \, %, \$

■ Backslash (\): starts commands

- Some commands start with a backslash and then have a name consisting of letters only. E.g. \. Command names are terminated by a space, a number or any other “non-letter.”
- Some commands consist of a backslash and exactly one non-letter. E.g. \’o becomes ó.

■ Percent (%) sign: starts a comment

- When L^AT_EX encounters a % character while processing an input file, it ignores the rest of the present line, the line break, and all whitespace at the beginning of the next line.
- `stup%i`
`id example`
becomes “stupid example”.

■ \$ sign: inline math

- `$a+b_n^3$`, `$2^{\{10\}}\neq 10^3$`:
- $a + b_n^3$, $2^{10} \neq 10^3$

Character with special meaning: creating blocks with {, }

- The character { opens a new block which can be closed by }. E.g.:
Be `{\em careful}`! Be *careful*!
- We write the arguments of commands between braces, too. E.g.:
Be `\emph{careful}`! Be *careful*!
- `$$\frac{1}{2}`, `\frac{1}{2}`, `\frac ab`, `\frac{a}{b}`\$: $\frac{1}{2}$, $\frac{1}{2}$, $\frac{a}{b}$, $\frac{a}{b}$
- `$$\frac{123}`, `\frac{12}{3}`, `\frac{1}{23}`\$: $\frac{1}{2}3$, $\frac{12}{3}$, $\frac{1}{23}$
- `\frac{ab}` results in an error!
- *Optional* blocks: e.g.: `$$\sqrt{23}`\$: $\sqrt{23}$, `$$\sqrt[3]{23}`\$: $\sqrt[3]{23}$
- An *environment* also signals a new block: `\begin{name}` *text*
`\end{name}`
- Blocks cannot “cross” each other. This is illegal:
`{... \begin{small}...}... \end{small}`

Characters with special meanings

- **&** marks a new column in a table,
- **#** #1, #2 stands for the first and second argument in a macro definition,
- **~** non-breaking space: for example it's good practice to write names this way: J.~Jones

Exotic characters

Even if all we have is an English keyboard, we can write in exotic languages:

- `\'arv\'izt\H{u}r\H{o} t\"uk\"orf\'ur\'og\'ep`: árvíztűró
tükörfűrógép
- `Bak\i, La Coru~na, Kor\c{c}\"e, N^imes, R\={\i}ga`
Bakı, La Coruña, Korçë, Nîmes, Rīga
- `Helsing{\o}r Gie{\ss}en {\AA}rdal \L\'od.z Gr{\oe}nland`
Helsingør, Gießen, Årdal, Łódź, Grønland

T1 encoding

If we write in a European language that has special letters, write this in the preamble:

```
\usepackage[T1]{fontenc}
\usepackage[utf8]{inputenc}
\usepackage[yourlanguagehere]{babel}
```

This will solve a lot of problems.

Quotation marks:

- ‘ ‘double’ ’ : “double”; ‘simple’ : ‘simple’
- the way they come out depends on what language we are using
- The american way is to write “ ‘Yes,’ he said.” and not “ ‘Yes’, he said.”
- One can also write >>xx ,yy‘ xx<<: »xx ,yy‘ xx« (German) or << xxx << yyy >> xxx >>: « xxx « yyy » xxx » (French)

Dashes and ellipsis: -, --, ---, ...

- **hyphen:** - daughter-in-law, X-rated: daughter-in-law, X-rated
- **en-dash:** -- pages 13--67: pages 13–67
- **em-dash:** --- yes---or no?: yes—or no?
- **minus** and there's also the mathematical minus sign: \$10-1=9\$:
 $10 - 1 = 9$
- **ellipsis:** ... apples, oranges, \dots: apples, oranges, ...

1 Introduction

2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language \LaTeX

- The \LaTeX document
- **Some important environments**
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

Theorems, enumerations, ...

```
\begin{theorem}\label{thm:good}
```

```
The multiplication of polynomials over a field is commutative.
```

```
\end{theorem}
```

```
\begin{proof}Follows from the fact that multiplication  
in any field is commutative.
```

```
\end{proof}
```

Theorem

The multiplication of polynomials over a field is commutative.

Proof.

Follows from the fact that multiplication in the field is commutative. □

Theorems, enumerations, ... 2.

```
\begin{enumerate}
\item This is a thing.
\item This is another one.
\end{enumerate}
```

- 1 This is a thing.
- 2 This is another one.

```
\begin{itemize}
\item This is a thing.
\item This is another one.
\end{itemize}
```

- This is a thing.
- This is another one.

```
\begin{verbatim}
We can safely write $s and \s here!
\end{verbatim}
```

We can safely write \$s and \s here!

We will see other environments later.

1 Introduction

2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language \LaTeX

- The \LaTeX document
- Some important environments
- Sections, chapters,...
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

Sections, chapters,...

Depending on the document class,

`\section{Title of the new section}`,

`\section*{Title of the new, unnumbered section}`,

`\chapter{Title of the new chapter}`,

The possibilities:

command	level	
	article	book report
<code>\part</code>	0	-1
<code>\chapter</code>		0
<code>\section</code>	1	1
<code>\subsection</code>	2	2
<code>\subsubsection</code>	3	3
<code>\paragraph</code>	4	4
<code>\subparagraph</code>	5	5

1 Introduction

2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language \LaTeX

- The \LaTeX document
- Some important environments
- Sections, chapters, . . .
- **Cross references**
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

Cross references

- Putting a label on the item to be marked (for referencing from other parts of the document): `\label{name of the label}`.
- One can label numbered items (theorems, sections, figures, ...

- For example

```
\chapter{Introduction to running}\label{cha:intro}
\section{First steps}\label{sec:first}
```

- `\label{eq:Cauchy}`, `\label{tab:income}`, `\label{pic:buli}`,
`\label{fig:sin(x)/x}`,
- referencing a labelled place: `\ref{name}`, `\pageref{name}`.

- We explained all these things
in chapter~`\ref{cha:intro}`
on page~`\pageref{cha:intro}`.

We explained all these things in chapter 1 on page 23.

Notes

- Footnotes¹ are often used by people using \LaTeX .
Footnotes `\footnote{This is a footnote.}` are often used by people using `\LaTeX`.
- Marginal note (only in books):
Marginal note `\marginpar{This is on the margin.}` aren't often used.

¹This is a footnote.

Contents and other lists

- table of contents: `\tableofcontents`,
- list of figures: `\listoffigures`,
- list of tables: `\listoftables`

These will appear where the command is.

1 Introduction

2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language \LaTeX

- The \LaTeX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- **Floating objects – tables**
- Floating objects – figures, pictures
- Citations, index

Table

Shopping		Price
What	Where	\$
Apple	Market	200
Tomato	Supermarket	300
Carrot	Grocery	1200
The T _E X Book	Bookstore	13 000

```

\begin{tabular}{|l|l|r|}
\hline
\multicolumn{2}{|c|}{Shopping} & \multicolumn{1}{|r|}{Price} \\
\hline
What & Where & \$ \\
\hline
Apple & Market & 200 \\
Tomato & Supermarket & 300 \\
Carrot & Grocery & 1200 \\
The \TeX\ Book & Bookstore & 13\,000 \\
\hline
\end{tabular}

```

Embedding a table

Tables should be placed as *floating objects*: the location of these is decided by L^AT_EX, which is usually better than if we had to. This is achieved here by using the `table` environment. Its optional argument (`[!h]` in the example) can still be used to give it placement advice. This can be: `h` (here), `t` (top), `b` (bottom), `p` (page – separate page), `!` (request to ignore some of L^AT_EX's rules to put the floating object where we suggest).

```
\begin{table}[!h]
\caption{Title of the table}\label{tab:1}
  \begin{center}
    \begin{tabular}{|l|l|r|}
      ... % definition of the table
    \end{tabular}
  \end{center}
\end{table}
```

We can put `\caption` and `\label` in this environment, so we can reference it.

1 Introduction


2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing

3 The basics of the programming language \LaTeX

- The \LaTeX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- **Floating objects – figures, pictures**
- Citations, index

Embedding pictures

- To embed pictures: `\usepackage{graphicx}`
- This is how: `\includegraphics{file.jpg}` The picture's format may be PDF, PNG or JPG. It will be put in the document as a single letter. Like here: 
- In general, you should also treat images as floating objects (unlike in the previous example), using the `figure` environment. Its optional argument controls the placement, just as with `table`.

```
\begin{figure}[!h]
  \centering %% so the picture appears centered
  \includegraphics[width=3cm]{kep.jpg}
  \caption{Hand}
  \label{pic:first}
\end{figure}
```

- As in the case of `table`, it is useful to put a caption (`\caption`) and a label (`\label`) in the environment so we can refer to it.

Embedding pictures 2.

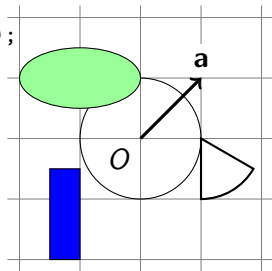


Hand

Making drawings – TikZ

Drawings can be created using \LaTeX 's own `\begin{picture}` environment (but only very simple drawings), and the TikZ package (recommended), as well as external programs.

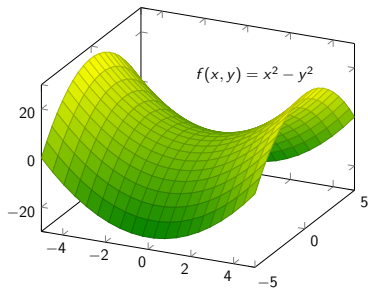
```
\begin{tikzpicture}[scale=.8]
  \draw[gray, very thin] (-2.2,-2.2) grid (2.2,2.2);
  \draw (0,0) circle (1) node[below left] {$O$};
  \draw[fill=green!40] (-1,1) ellipse (1 and .5);
  \draw[very thick,->] (0,0) -- (1,1)
    node[above,fill=white] {$\mathbf{a}$};
  \draw[fill=blue] (-1.5,-2) rectangle (-1,-.5);
  \draw[thick] (1,0) -- +(-30:1)
    arc(-30:-90:1) -- cycle;
\end{tikzpicture}
```



Making drawings – TikZ 2.

Drawings should also be made into floating objects.

```
\begin{figure}
  \begin{tikzpicture}
    \tikzstyle{every node}=[font=\small]
    \begin{axis}[colormap/greenyellow]
      \addplot3[
        surf,
        samples=20,
        ]
        {x^2-y^2} node[color=black,above=2.3cm]
        {$f(x,y)=x^2-y^2$};
    \end{axis}
  \end{tikzpicture}
  \caption*{Saddle point}
\end{figure}
```



Saddle point

1 Introduction

2 \TeX and \LaTeX

- Basics
- Editing, compiling, viewing



3 The basics of the programming language \LaTeX

- The \LaTeX document
- Some important environments
- Sections, chapters, . . .
- Cross references
- Floating objects – tables
- Floating objects – figures, pictures
- Citations, index

Bibliography (manual)

```
\begin{thebibliography}{9}  
\bibitem{texbook} Donald E. Knuth, \textit{The \TeX book},  
Addison-Wesley, Reading, 1984.  
\bibitem{latexbook} Leslie Lamport, \textit{\LaTeX\ A Document  
Preparation System}, 2nd ed. Addison-Wesley, 1994.  
\end{thebibliography}
```

This is how it looks in a presentation:

-  Donald E. Knuth, *The T_EXbook*, Addison-Wesley, Reading, 1984.
-  Leslie Lamport, *L^AT_EX A Document Preparation System*, 2nd ed. Addison-Wesley, 1994.

Bibliography (manual) 2.

But not in articles and books, of course; there, there are labels (numbers by default) instead of icons to which one can refer to:

See in Knuth's book `\cite[120.~oldal]{texbook}`.

See in the book `\cite{latexbook}`.

See in Knuth's book [1, page 120]. See in the book [2].

BIB \TeX

The alternative is to have \LaTeX read the data from a “database” (bib-file — which is also a plain text file).

```
\documentclass{article}
\begin{document}
  The book \cite{book}, and the \cite{art}.
  \bibliography{mybib}
  \bibliographystyle{plain}
\end{document}
```

The fourth line says that the database is in the file `mybib.bib`.

Bib \TeX 2.

mybib.bib should at least contain something like the following:

```
@article{art,  
  author   = {Almond, W. E. and Biggs, A. D.},  
  title    = {Title of article},  
  year     = {1983},  
  journal  = {Journal of Something},  
  volume   = {10},  
  number   = {2},  
  pages    = {347--359}  
}
```

```
@book{book,  
  author    = "Joe Smith and Tom Johns",  
  title     = "Title of the book",  
  publisher = "Nice books",  
  year      = 2010,  
}
```

Bib \TeX 3.

From this and the file `article.aux` that is created when compiling the \LaTeX file `article.tex`, the `bibtex` command creates another file that can be used by `pdflatex` during the next run. So the argument of the `bibtex` command is not `mybib.bib`, but `article.aux` (or just `article`).

One can get used to this.

Index

This is only interesting for a book (e.g. a thesis). So for now, it's enough to know that indexing can be done. But here are the details anyway:

```
\documentclass{article}
\makeindex
\begin{document}
  This word\index{word} will get into the index.
  \input{file.ind} %<<the index will appear at this point
\end{document}
```

After compiling this, one should do `makeindex file`, and then compile again.