LaTeX for beginners
An introduction to TeX and LaTeX

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Support documents at https://www.edpif.org/documents/latex/beginners/

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Contents

Summary

Introducing TEX

TEX is a system for producing high quality digital typesetting, especially mathematical typesetting.

- The first and still alive format for using TEX is the so called plain-TEX.
- LATEX is a high level format that use TEX, but things much more easy.

Name and pronunciation

The name TEX comes from Greek $\tau\varepsilon\chi\nu\sigma\nu$: the name is the acronym "tau-epsilon-chi". Hence X is a χ, to be pronounced like in "technology" or like in the Scottish "Loch"

What is TeX?

TEX:

- Is a computer program aimed at *typesetting* text and much more,
- Intend to conform to the fundamental rules of *typography*,
- Was developed by Donald E. KNUTH between 1968 and 1982, with the aim to exploit the new (at that time) arising digital printers, in the hope to reverse the deterioration of typographical quality that he experimented for his books and articles.

Fig. 1: Donald KNUTH

- Evolved along the time, the version released in 1982 was labeled 3.0, and the current version is 3.141592653

What more about TeX?

- TEX evolves slowly, is very stable and run on many kinds of platforms, and is reputed to be (almost) bug free.
- It is a full programming language, with a great facility to create simple macro, and the possibility to implement complex structure (wizards only :-))
- Being mostly aimed at handling text, it is very good at handling line breaking and an page breaking
- KNUTH being a mathematician, TEX features impressive ability to typeset maths.
- It has, out of the box, quite poor graphics capabilities, but many efficient solutions are now available, both in the TEX family or in the wide world of other programs companies or nonprofit organizations.

Main interest of TEX/LATEX

- TEX produces high quality typography.
- For mathematics, it is almost the only way !
- You are a scientist researcher, so — by default — you will like it.
- It is the *de facto* standard of scientific publishing.

$$e = 2 + \cfrac{1}{1 + \cfrac{1}{2 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{4 + \cfrac{1}{1 + \cfrac{1}{1 + \cdots}}}}}}}$$

- Many features, such as hyperlinking, labeling & referring, table of contents, citations, glossaries, indices etc.
- It is free and highly portable.
- Better (and easier ?) typesetting than word processors, such as Microsoft Word®, OpenOffice Writer®.

What is LATEX ?

- LATEX is a large set of TEX macros which provides a high-level language and enables the author to typeset complex documents with the typographic quality of TEXwith a document layout provided by LATEX documents classes.

- When providing the content, the author inserts "LaTeX commands" describing the logical structure of the text, which will be used to structure and format the output.

- It was first developed by Leslie LAMPORT in 1982/86 and was at this time the version 2.09, the current one is LATEX 2_ε released in 1994...

Fig. 2: Leslie LAMPORT

- One of the principal interest is its amazing ability to handle cross-references in the document, bibliographies and indexes (with companion programs), and it also adds several graphics capabilities.
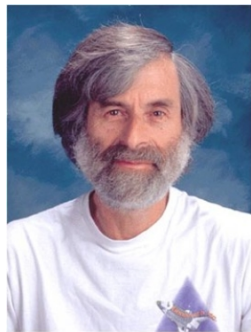
Some milestones for LATEX 2ε

LATEX 2ε (2_ε = largest number < 3) was created for the following reasons:

1988 Since 1982, due to the success of LATEX but the small number of "styles", a big mess of *incompatible* variants appeared to handle math articles, posters, presentations, newsletters etc.

1989 The new font selection scheme (PS)NFSS ebables the handling fonts other than CM, and namely the Postscript fonts (Adobe Type 1), and fixes awful problems.

1990 Cork encoding : KNUTH's CM font only provided ASCII text. In 1990, a TUG conference defined a new encoding (named T1) which encompasses 256 characters, thus providing true glyphs for the accented characters of occidental European languages. This finally resulted in the "Latin Modern" font.

1994 The maintainers of LATEX decided to create a new version (LATEX 2ε) containing all the capabilities of the variants as classes or packages, deeply based on PSNFSS, and compatible with various font encodings for different languages.

Summary

LATEX vs *-Office

Typeset by M$ Word

This is some text that intends to show you the difference between a Word processor and TeX when it comes to high quality typography.
There is a man called Dr. John, who likes the Binomial theorem, which says that for any positive integer n:

$$(x + a)^n = \sum_{k=0}^{n} \binom{k}{n} x^k \, a^{n-k}$$

Typeset by LATEX

This is some text that intends to show you the difference between a Word processor and TeX when it comes to high quality typography.
There is a man called Dr. John, who likes the Binomial theorem, which says that for any positive integer n:

$$(x + a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}$$

Why do *they* need LaTeX?

Why do *they* need LaTeX?

— third page, zoomed —

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An diesem Buch haben viele mitgewirkt, insbesondere:

Lektorat Isabella Bleissem, Erik Lipperts
Korrektorat Friederike Daenecke, Zülpich
Herstellung Maxi Beithe
Einbandgestaltung Bastian Illerhaus
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Dieses Buch wurde gesetzt aus der
Syntax Next Pro (10,25pt/14,25pt)
in Adobe InDesign.

This book was typeset with the
Syntax Next Pro (10.25pt/14.25pt)
in **Adobe InDesign.**

An instructive diagram
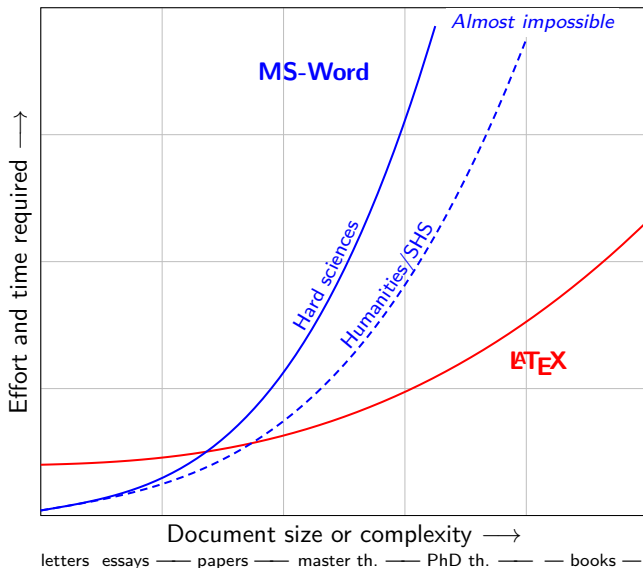
- Word/Writer are suitable for short documents, such as letters, cover pages or perhaps papers up to 50 pages. Basic functions with GUI are easy to learn.
- For a long/technical document, a book or your PhD-thesis it's much more efficient with LaTeX. The initial learning curve is steeper, but persist with it and you will be rewarded.
- Cross-references, equations, bibliographies are easily created/used, and even linguistic glosses, critical editions or music scores handling are eased by packages.

The WYSIWYG vs WYSIWYM paradigm

For the user essential difference is the approach of the work-flow :

*-Office: WYSIWYG

You see something looking to what you will obtain on printing:

What You See Is What You Get

You define the document layout and text formating interactively. And can be distracted by these visual details, to the detriment of the content. The result is often not consistent.
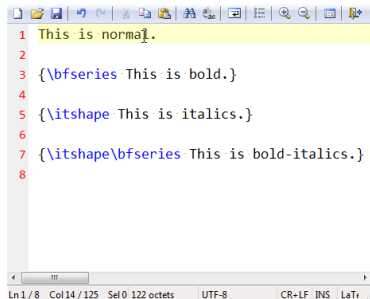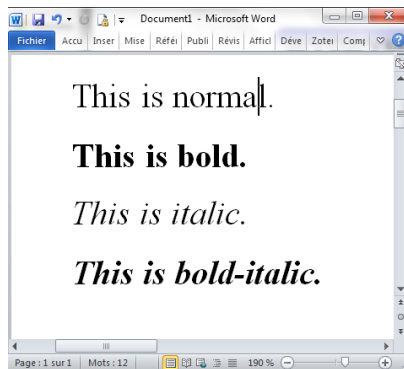
LaTeX: WYSIWYM

You have to compile from time to time to see the formatted result:

What You See Is What You Mean

You can concentrate on the text that you are writing, without care to the format which is well separated, and will be excellently handled by LaTeX.

An apparent drawback of WYSIWYM : ser interface

Summary

Which "friends" beside LaTeX?

- The TeX engine is `pdftex`. Modern siblings: `xetex` & `luatex`.
- Calling `tex` or `latex` actually launches the `pdftex` motor. By default, `pdftex` produces PDF output, more convenient than the old fashion DVI, but most journals don't accept yet submission in PDF-wise LaTeX. `pdflatex` is simply a wrapper for `pdftex` with `latex` format.
- The "companion programs" include notably `bibtex` and `biber` for the bibliography, `makeidx` for the index, `dvips`, `dvipdfm` to convert DVI, `**ht**` to produce `html` etc. More that 400 programs...
- A special mention about METAFONT, also written by D. KNUTH at the same time as TeX, and used to create new fonts, including the "Computer Modern", and METAPOST based on METAFONT for production of vectorial graphics.
- There also also the font files ($\sim 10\,000$ files for me), and all the package files ($\sim 50\,000$ files)

Some contributors to LaTeX 2$_\varepsilon$ or to LaTeX3 project

Frank Mittelbach*

Johannes Braams*

Michel Goossens

Sebastian Rahtz†

Hàn Thế Thành
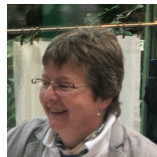
Ulrike Fischer*

Enrico Gregorio*

Heiko Oberdiek

David Carlisle*

Summary

The minimal LATEX file

The *very* minimal latex file contains only tree lines :

```
1 \documentclass[⟨someoptions⟩]{⟨classname⟩}
2 \begin{document}
3 Text body...
4 \end{document}
```

- Commands start with a "backslash" \ : general rule of TEX programming.
- Command arguments are enclosed in **curly** braces **{...}**, or in **square** braces **[...]** for **optional** arguments.
- The standard classes[1] ⟨classname⟩ =article, report or book produce "papers". There is also a letter class, less used, and this presentation is produced with the beamer class. Extension .cls.
- ⟨someoptions⟩ is an optional comma separated list of options like a4paper,11pt setting the sizes of paper and font[2].

[1] Don't write the ⟨⟩ which only delimit the placeholder.
[2] Further options: **titlepage, twoside, twocolumn, draft,french** ...

The minimal LaTeX preamble

- The "minimal" is not enough. You will always use instead:

```
1 \documentclass[a4paper,11pt]{article}
2 \usepackage[utf8]{inputenc}
3 \usepackage[french]{babel}
4 \usepackage[margin=28mm]{geometry}
5 \usepackage[T1]{fontenc}
6 \usepackage{lmodern}
7 \begin{document}
8 some text...
9 \end{document}
```

where the \usepackage command loads packages (.sty files) adding features to LaTeX's kernel, with their specific options.

- The lines between the \documentclass and \begin{document} form the so called "**preamble**".

- \usepackage, and most font-related definitions can only appear in the preamble. Also used to define options, commands and general settings.

- **No text can be output in preamble.**

About characters

- TeX defines 16 categories of input characters (catcodes 0 to 15)
- Valid characters are the 95 ASCII (7 bits) characters, (catcodes 11/12).
- Reserved characters are : (@ only for internal macros in `.sty`/`.cls` files)

Char	Use	codes
\	to introduce commands	0
{ }	to define "groups"	1,2
$	switch math mode on/off	3
&	for alignment structures	4
#	for macro argument names	6
^ _	supers/subscript in math	7,8
~	unbreakable space	13
%	to start a comment	14

- 8 bits chars via `inputenc` package, with option `latin1/latin9/`....

- Add more translations (as long as you can enter and read them in your editor) with several packages :

- `inputenc`: `\DeclareUnicodeCharacter}{`⟨hexa⟩`}{`⟨texcmd⟩`}`
- `newunicodechar`: `\newunicodechar{`⟨utf8-char⟩`}{`⟨texcmd⟩`}`, e.g. `\newunicodechar{`†`}{`$\dag$`}`.

Summary

What is needed to run LATEX?

MOST COMPUTERS JUST SLEEP!

In order to run LATEX you need several kind of tools...

A TeX distribution

Distribution refers to the huge set of "TeX and friends" files needed to compile, choose the fonts, define the layout, various kinds of formating, produce bibliography, etc. and tens of companion programs.

- On MS-Windows (8 to 11) the best choice is the `MiKTeX` distribution, to freely download from
  `https://miktex.org/download` ($\times$64 only)
  Install the `basic-miktex` bundle, the other packages will be downloaded latter, either manually or on the fly.
- On Mac OS-X, the simplest choice is to use the `TeXLive` distribution. Actually, it will install automatically when you will install `MacTeX` including both `TeXLive` and `TeXShop`
  `http://pages.uoregon.edu/koch/texshop`.
- On Unix/Linux, you will also use `TeXLive`, to download preferably from your package management utility.

These files are stored together in a so called « TDS-compliant » folder, generally named `texmf` (or `MiKTeX` for Window computers).

The "TeX Directory Structure" (TDS)


```
⟨texmf⟩
  bibtex ...
  tex
    generic...
    latex
      base
        article.cls
      tools
        layout.sty
  fonts ...
  doc
    latex
      base
        usrguide.pdf
  ???/bin
    pdflatex
  ...
```
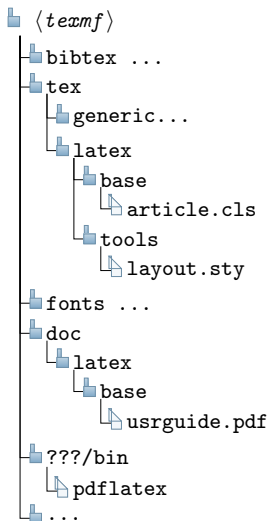
An editor

Any text editor, but you **need** a TEX oriented IDE featuaring :

- Support of UTF-8.
- Syntax highlighting.
- A spell-checker at least for English, French, and more ...
- A contextual help hot-key (or `texdoc ⟨package⟩` in the console).
- A button and/or hot-key to start the compilation.
- Compatibility with `Synctex`, for direct and inverse search.
- Parsing of the output console with the listing of errors and hyperlink jump to source.
- The possibility to edit the compilation command line.

If you *really* prefer the WYSIWIG paradigm, look at: **Scientific WorkPlace** or **BaKoMa TeX** ($ Win only) or at the free and multippatform **LyX** or **TeXmacs**.

Recommended editors

- Free multi-platform editor, and the best choices in this range are:
  - The `TeXWorks` editor/IDE (simple but efficient) included in `MiKTeX` and in `TeXLive`, can work "out of the box".
  - `TeXmaker` `http://www.xml1math.net/texmaker` or `TeXstudio` `https://www.texstudio.org`, with symbol palettes, project management, better autocompletion, and many tools.
- On MAC OS-X, one will likely use the free and excellent `TeXShop`, which is clearly the "champion in every category" for any platform.
- On Window, one has several alternative to the former, like the brilliant `WinEdt` (shareware) `http://www.winedt.com`
- On Unix/Linux, the uncontested leader was for a long time `Kile` `https://kile.sourceforge.io/` but it was perhaps superseded by `TeXmaker`,
- Many people stick to `emacs`, `VIM`, `Sublime Text`, `Atom`, `Visual Studio` which all have a LaTeX dedicated plugin.

Other Tools

- Programs to handle, create and edit postscript and PDF :
  * means functionality already included in `MiKTeX`/`TeXLive`
  - `Ghostscript`* (AGPL)
    `https://www.ghostscript.com/download`
  - `Ghostview http://pages.cs.wisc.edu/~ghost`
  - `pstoedit http://www.pstoedit.net`
  - `esptopdf`* `https://ctan.org/pkg/epspdf`
    or `https://ctan.org/pkg/epspdf-setup`
  - `pdftk` free `https://www.pdflabs.com`
    or `pdfsam https://pdfsam.org`
  - `jpeg2ps`, `sam2p https://pdfsam.org/fr`, etc.
- Vectorial drawing programs like
  - `inkscape https://inkscape.org`
  - `Xfig` or `winFIG`
    `https://projet-plume.org/fiche/xfig-winfig`
  - `TpX http://tpx.sourceforge.net`

Summary

Sizes

\normalsize is set by class option: `10pt`(def), `11pt`(recom.), `12pt`

Relative sizes

`{\tiny tiny}`	tiny
`{\scriptsize scriptsize}`	scriptsize
`{\footnotesize footnotesize}`	footnotesize
`{\small small}`	small
`{\normalsize normalsize}`	normalsize
`{\large large}`	large
`{\Large Large}`	Large
`{\LARGE LARGE}`	Large
`{\huge huge}`	huge
`{\Huge Huge}`	Huge

- Arbitrary sizes: `anyfontsize`, More sizes: `fontsize`
- Relative sizes: `relsize`;
- Other base document font sizes: `extsize`, KOMA-Script, `memoir`.

Styles

- Styles, defined as 1-argument commands or switches:
  `\textrm{Roman}`   `{\rmfamily Roman}`   Roman
  `\textit{Italics}`   `{\itshape Italics}`   *Italics*
  `\textmd{Medium}`   `{\mdseries Medium}`   Medium
  `\textbf{Boldface}`   `{\bfseries Boldface}`   **Boldface**
  `\textsl{Slanted}`   `{\slshape Slanted}`   *Slanted*
  `\textsf{Sans serif}`   `{\sffamily Sans serif}`   Sans serif
  `\textsc{Small caps}`   `{\scshape Small caps}`   SMALL CAPS
  `\texttt{Typewriter}`   `{\ttfamily Typewriter}`   Typewriter

- Old-fashioned `\rm`, `\it`, `\sc`, `\em` are **obsolete for more than 25 years**!

- `\emph{⟨some text⟩}` → "*some text*" must bee preferred to `\textit`, as it toggles between `\textit` and `\textrm` and corrects the spacing.

- Styles modifications can be locally inverted with the commands:
  – `\textnormal` or `\normalfont` : return to main document font;
  – `\textup` or `\upshape` : the opposite of slanted.

- Styles and size can also be used as `\begin{small}`…`\end{small}` or `\begin{slshape}`…`\end{slshape}`.

Summary

Sectioning commands in `article` and `book`

Commands : `\chapter[]{}`, `\section[]{}`, `\subsection{}`,
`\subsubsection{}`, `\paragraph{}`, `\subparagraph{}`

Article:

(No `\chapter` command)

1   Section

A section...

1.1   Subsection

A subsection...

1.1.1   Subsubsection

A subsubsection...

Paragraph   A paragraph...

Subparagraph   A subparagraph...

2   Another section

Report/Book:

Chapter 1

My firstchapter

1.1   Section

A section...

1.1.1   First subsection

A subsection...

1.1.1.1   Subsubsection

A subsubsection...

Paragraph   A paragraph...

Subparagraph   A subparagraph...

1.1.2   New subsection

Page layout for the standard `article` class
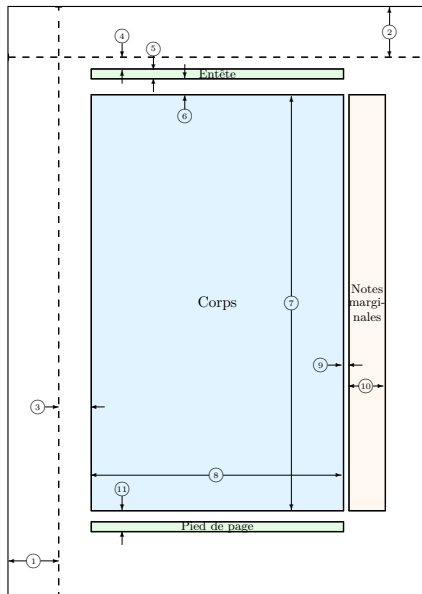
Default for `article` with `11pt`

```
 1    un pouce + \hoffset
 2    un pouce + \voffset
 3    \oddsidemargin = 16.167 mm
 4    \topmargin = 6.326 mm
 5    \headheight = 4.218 mm
 6    \headsep = 8.786 mm
 7    \textheight = 209.118 mm
 8    \textwidth = 126.525 mm
 9    \marginparsep = 3.515 mm
10    \marginparwidth = 17.573 mm
11    \footskip = 10.544 mm
      Non affichés :
      \marginparpush = 1.757 mm
      \hoffset = 0 mm
      \voffset = 0 mm
      \paperwidth = 209.821 mm
      \paperheight = 296.983 mm
```

To adjust it, exclusively use the
geometry package !

Produced by the (customized) `\layout` command defined by the `layout` package

Headers and footers

Defined by the command `\pagestyle{⟨style⟩}` in the preamble.
A local change is made with `\thispagestyle{⟨style⟩}`.

These ⟨style⟩ are :

- `empty`: headers and footers are ... empty !
- `plain` (def. for `article`): empty header, page number centered in footer
- `headings` (def. for `book`): empty footer, titles & page numbers in header, chapter on left pages & section on right pages,
- `myheadings`: similar to `headings`, but the headings are manually defined by the commands `\markright{...}` and `\markboth{...}{...}`, instead of automatically used by `\chapter` or `\section` in `headings` case.
- `fancy` : when customized with the `fancyhdr` package.

Environments

- Structure delimited by `\begin{⟨envname⟩}`...`\end{⟨envname⟩}` like the main environment `document`. Below `verse` (with `gmverse`)

```
\begin{verse}\itshape
Voici venir les temps où vibrant sur sa tige
Chaque fleur s'évapore ainsi qu'un encensoir,
Les sons et les parfums tournent dans l'air du soir,
Valse mélancolique et langoureux vertige
\end{verse}
```

> *Voici venir les temps où vibrant sur sa tige*
> *Chaque fleur s'évapore ainsi qu'un encensoir,*
> *Les sons et les parfums tournent dans l'air du soir,*
> *Valse mélancolique et langoureux vertige*

- `abstract` : Prints the `\abstracname` and increases margins
- `enumerate` (`itemize`): creates a (non-) numbered) list
- `minipage`: creates a "minipage" box ! (no pagebreaks nor floats)
- `figure`/`table` creates a floating figure/table

Summary

Handling of (cross-)references and citations

A great advantage of LaTeX is the elementary handling of references.

- The target of a cross-reference is marked with `\label{⟨mylabel⟩}`, where ⟨mylabel⟩ is a valid *alphanumeric* string³, that is not printed.

- For the callback, one use the command `\ref{⟨mylabel⟩}`.

- This holds for all sectioning titles, tables and figures, lists and their `\item`s, equations, `\footnote`s, etc

- There are specialized versions like `\pageref{⟨mylabel⟩}`, or `\eqref{⟨mylabel⟩}` (pkg amsmath), `\titleref{⟨mylabel⟩}` (package titleref), or `\nameref{⟨mylabel⟩}` (pkg hyperref)...

- Command `\eqref` formats the number and adds the parenthesis.

---

³It can contain some of the reserved characters, but avoid them, except "_". From 2021, utf-8 characters are also allowed

References

Example of references in a two pages document

```
1 \section{A first Section}\label{sectionone}
2 This simple text contains a reference to the nextpage
3 (p.~\pageref{anothersection}),
4 which contains the equation \eqref{niceequation} in the
5 \S~\ref{anothersection}. \clearpage
6 \section{Section with equation}\label{anothersection}
7 Equation referenced in section \titleref{sectionone}:
8 \begin{equation}\label{niceequation}
9 E=mc^2
10 \end{equation}
```

1   A first Section

This simple text contains a reference to the nextpage (p. 2), which contains the equation (1) in the § 2.

1

2   Section with equation

Equation referenced in section "A first Section" :

$$E = mc^2 \qquad (1)$$

2

Basic use of hyper-references

The package `hyperref` takes advantage of the hypertext potentiality of thr PDF format to add hyperlinks to the references (and citations).

- For this purpose `hyperref` modifies most semantic commands (sectioning, labels etc.) into commands that add a suitable *hypertarget*.

- At the same time, all the `\ref` and siblings are turned into *hyperlinks*, allowing to jump from the `\ref` to the `\label`.

- For the callback, one still use the same command `\ref{⟨mylabel⟩}`.

References

Example of references in a two pages document

```latex
 1 \section{A first Section}\label{sectionone}
 2 This simple text contains a reference to the nextpage
 3 (p.~\pageref{anothersection}),
 4 which contains the equation \eqref{niceequation} in the
 5 \S~\ref{anothersection}. \clearpage
 6 \section{Section with equation}\label{anothersection}
 7 Equation referenced in section \titleref{sectionone}:
 8 \begin{equation}\label{niceequation}
 9 E=mc^2
10 \end{equation}
```

1   A first Section

This simple text contains a reference to the nextpage (p. 2), which contains the equation (1) in the § 2.

1

2   Section with equation

Equation referenced in section "A first Section" :

$$E = mc^2 \qquad (1)$$

2

Hyper-references in action

Example of hyper-references in the same two pages document

```
1 % \usepackage[colorlinks]{hyperref}
2 \section{A first Section}\label{sectionone}
3 This simple text contains a reference to the nextpage
4 (p.~\pageref{anothersection}),
5 which contains the equation \eqref{niceequation} in the
6 \S~\ref{anothersection}. \clearpage
7 \section{Section with equation}\label{anothersection}
8 Equation referenced in section \titleref{sectionone}:
9 \begin{equation}\label{niceequation}
10 E=mc^2
11 \end{equation}
```

1   A first Section

This simple text contains a reference to the nextpage (p. 2), which contains the equation (1) in the § 2.

1

2   Section with equation

Equation referenced in section "1":

$$E = mc^2 \qquad (1)$$

2

Other uses of hyperref

- `hyperref` also turns the `\tableofcontents` into a list of hyperlinks
- It can produce `bookmarks` (in French : « signets ») that make browsing much easier.
- It turns the `\cite{...}` commands, and similar (see below) into hyperlinks pointing to the relative bibliographic references.
- In some conditions, "back links" can be created.
- Custom hyperlinks can be produced anywhere with the commands : `\url{⟨someurl⟩}` or `\href{⟨someurl⟩}{⟨any text⟩t}`.
- Can set PDF metadata parameters, with `pdfinfo` option.
- Many option can be added after loading with `\hypersetup`, e.g.:
  `\hypersetup{pdfdisplaydoctitle=true,`
  `bookmarksopen=true,bookmarksnumbered=true, pdfpagemode=Use`
  `breaklinks=true, linktocpage=true, colorlinks=true, menuco`
  `citecolor=tial, urlcolor=pink}`
- With package `pdfx`, it can be used to create PDF/A ou PDF/X files

Summary

About commands names

Commands in LaTeX can be :

1 \ followed by a string made from **ASCII letters** (a-z,A-Z) (@ in `.sty` files)
  - They are case-sensitives : `\large` is not `\Large`.
  - Digits are (usually) excluded, so `$\sqrt{2}$`≡`$\sqrt2$`→ $\sqrt{2}$.

2 \ followed by a single **non-letter symbol**:
  - Reserved characters preceded by a backslash, e.g. `\%` gives %;
  - `\␣` inserts an explicit space; `\\` inserts a line-break ;
  - `\,`, `\;`, `\:`, `\>`, `\/`,`\!` are spacing commands, describes later.
  - Diacritics can be entered as (avoid for western European languages):

cmd	`\'` `\'` `\^` `\"` `\H` `\~` `\c` `\k` `\=` `\b` `\.` `\s` `\r` `\u` `\v` `\t`
result	ò ó ô ö ő õ ç ą ō o̱ ȯ o̦ å ǒ š o͡o

  - `\(` and `\)` delimit "inline" maths; `\[` and `\]` delimit "display" maths;
  - `\+`, `\-`, `\'`, `\<`, `\>`, `\=` are special in `tabbing` environment;
  - In math mode `\|` is a shortcut for `\Vert`, producing ∥.

3 Special *active* characters (catcode 13) like ~ (see Babel section).

About declarations

- "Declarations" define settings (for formatting or sectioning, etc.) without printing any text. Examples: `\pagestyle{headings}`, `\large`, `\bfseries`, etc..

- Others commands operate on a given content (explicit or not) and print it according to their meaning. Examples: `\tableofcontents`, `\textbf{Some bold text}`, `\section[⟨short title⟩]{⟨Long title⟩}`.

- Both kinds can have none, one or several arguments (up to 9). Most declarations don't have argument. Mandatory can sometimes be empty groups `{}`, but generally a meaningful value is expected. Example : `\section{}` is valid, `\pagestyle{}` isn't.

- Usually, optional argument (if any) is given *before* mandatory.

- Some declaration are global for the document and will generally be declared in the preamble. Some other are local to the enclosing group. `{\bfseries\small a text}\& another` → **a text** & another

Using counters

TEX and LATEX use many `counters`, mostly for the numbering of (chapters) sections and children, pages, figures, equations, enumi, etc.

- Counters are *integers* only, between $2^{31} - 1$ and -2^{31}.
- Create counter ⟨cntnam⟩ with `\newcounter{`⟨cntnam⟩`}` (no `\`);
  Variant `\newcounter{`⟨cntnam⟩`}[`⟨othercntnam⟩`]` also requests that it is reset each time ⟨othercntnam⟩ is increased.
- An existing counter ⟨cntnam⟩ can be modified by:
  - `\setcounter{`⟨cntnam⟩`}{`⟨value⟩`}` to set it to given ⟨value⟩
  - `\stepcounter{`⟨cntnam⟩`}` to increment it (by 1), or `\refstepcounter{`⟨cntnam⟩`}` for increment with label creation
  - `\addtocounter{`⟨cntnam⟩`}{`⟨incr⟩`}` to add ⟨incr⟩ to current value and `\resetcounter{`⟨cntnam⟩`}` to set it to zero.
- The value of a counter ir printed with the macro `\the`⟨cntname⟩

For example, the command `\section` automatically does `\refstepcounter{section}` (which also reset counters `subsection` and children, and also `equation`, `figure` etc. and then use `\thesection` in the captioning.

Using lengths   (Max = 16384 pt ≈ 5.758 m, Min =1 sp≈ 5.36 nm)

- Length's default unit, is the TeX-point `1 pt=1 in/72.27`≈`0.3515 mm` ;
  but they are defined as integer numbers of scaled points `1 sp=1 pt/65536`.

in	pt	sp	mm	cm	em	ex
25.4 mm	$\frac{1 \text{ in}}{72.27} \approx$ 0.3315 mm	$\frac{1 \text{ pt}}{65536} \approx$ 5.36 nm	.394 pt	3.94 pt	length(M)	height(x)

  and also oyhers units like `bp`, `pc`, `dd`, `cc`, `nd`, `nc`, see en.wikibooks.org/wiki

- Definition and setting of lengths : `\newlength{\mylen}`,
  `\setlength{\mylen}{12pt}`, `\addtolength{\mylen}{-5cm}`,
  `\settowidth{\mylen}{some text}`.

- Many length are defined as "rubber length", for example :
  `\setlength{\parskip}{1ex plus0.5ex minus0.2ex}`

- Some predefined lengths : `\textheight`, `\textwidth`, `\linewidth`,
  `\baselineskip`,`\parskip`, `\parindent`,`\topskip`, `\itemindent`

- To see the value e.g. `\linewidth` do: `\the\linewidth` → 335.62862pt

- Length can be multiplied by literal numbers, like `0.5\linewidth`.

- Compute a length OTF, e.g.b`\dimexpr\topsep-0.5\parskip+1em\relax`.

Some hints about (horizontal) spacing

- Successive spaces (including tabs and carriage returns) are interpreted as a single space with the following exceptions :
  - Blank spaces following a declaration are not typeset
  - Two consecutive carriage returns (i.e. blank line) close a paragraph, as does the `\par` command;
  - The explicit spaces `\␣` and the unbreakable `~` are observed.
  - `\,` (or `\thinspace`) produces a small unbreakable space (0.167 em).
  - In math mode, blank spaces ate not significant.
- Larger horizontal space is obtained with `\enskip`,`\quad` or `\qquad` of respectively half, one or two ems.
- Arbitrary space obtained with `\hspace{⟨length⟩}` or `\hspace*{⟨length⟩}`, where ⟨length⟩ is either a literal or defined or computed length, than can be negative. It can also be a "rubber" length (see previous slide).
  The starred version can be used at the beginning or the end of a line.

Some hints about (horizontal) spacing

- Successive spaces (including tabs and carriage returns) are interpreted as a single space with the following exceptions :
  - Blank spaces following a declaration are not typeset.
  - Two consecutive carriage returns (i.e. blank line) close a paragraph, as does `\par`.
  - The explicit spaces `\␣` and the unbreakable `~` are observed.
  - `\,` (or `\thinspace`) produces a small unbreakable space (0.167 em).
  - In math mode, blank spaces are not significant at all.
- Larger horizontal space is obtained with `\enskip`,`\quad` or `\qquad` of respectively half, one or two ems.
- Arbitrary space obtained with `\hspace{⟨length⟩}` or `\hspace*{⟨length⟩}`, where ⟨length⟩ is either a literal or defined or computed length, than can be negative. It can also be a "rubber" length (see previous slide). The starred version can be used at the beginning or the end of a line.

Summary

Babel translations

Package `babel` translates the *captions* of latex structure words like "Chapter" according to the language passed as an option. Some important translated strings:

String	english	french
`\abstractname`	Abstract	Résumé
`\appendixname`	Appendix	Annexe
`\bibname`	Bibliography [†]	Bibliographie
`\refname`	References [*]	Références
`\chaptername`	Chapter [†]	Chapitre
`\contentsname`	Contents	Table des matières
`\figurename`	Fig.	Figure
`\tablename`	Table	Table
`\glossaryname`	Glossary	Glossaire
`\indexname`	Index	Index
`\listfigurename`	List of Figures	Table des figures
`\listtablename`	List of Tables	Liste des tableaux
`\pagename`	Page	page
`\prefacename`	Preface	Préface
`\proofname`	Proof	Démonstration

Other strings are also translated, like ordinals or fields used by the `letter` class.

And `\partfirst`, `\partsecond`, `\seename`, `\alsoname` etc.

[*] in `article` class
[†] in `report` and `book` classes.

Babel usage

- When loading several languages, **the last one is active**.
- Babel, in conjunction with `\usepackage[T1]{fontenc}` and UTF8, enable hyphenation in the requested languages.
- Switch globally: `\selectlanguage{lan}`, or locally: `\foreignlanguage{lan}{text}`
- Babel also defines for each loaded language a macro named `\captions⟨lan⟩` enabling further customization e.g. like in:
  ```
  \addto\captionsfrench{\renewcommand{\figurename}{Fig.}}
  \addto\captionsfrench{\renewcommand{\bibname}{Articles}}
  ```
- Babel (for French) also makes active the 4 double punctuation signs to ensure proper spacing before and after. This can be toggled on/off with `\shorthandon{;:!?}`/`\shorthandoff{;:!?}`.

Babel for french

For French, `babel` adapts typesetting rules (if `french` is the main language):

1. the first paragraph of each section is indented; the default mark in !itemize! is set to "—" instead of ●, and the vertical spacing in lists is reduced.

2. Footnotes are displayed « *à la française* ».

3. Beside activation of `;`, `:`, `!` and `?`, the space after `\dots` is removed.

4. French quotation marks are the commands `\og`/`\fg` or better use « / » with
   `\DeclareUnicodeCharacter{00AB}{\guillemetleft\;\ignorespaces}`
   `\DeclareUnicodeCharacter{00BB}{\unskip\;\guillemetright}`

5. « Boxed scshape » for Family names, with `\bsc{`name`}` (avoids hyphenation).

6. Translate `\today` & `\frenchdate{`year`}{`month`}{`day`}` for any date.

7. Ordinals `\ier`, `\iere`, `\iers`, `\ieres`, `\ieme`, `\iemes` for correct abbreviation 1er, 2e, 3es; Latin enumeration `\primo`, `\secundo`, and `\FrenchEnumerate{`num`}` ; Abbrev. for « numéro(s) » `\No`=N°, `\Nos`, `\no`, `\nos`=n^{os} and degree symbols for both angle and temperature.

8. A generic command `\up` is provided for other superscripts (or `\textsuperscript`).

Summary

LATEXdefines three type of lists (can be nested up to 4 levels)

Itemize

```
\begin{itemize}
  \item the first item formatted\\
  \quad according French rules
  \item[\textbullet] the second
  \item[2] the third item
\end{itemize}
```

— the first item formatted
   according French rules
• the second
2 the third item

Enumerate

```
\begin{enumerate}
  \item the first item
  \item the second item
  \item the third item
\end{enumerate}
```

1. the first item

2. the second item

3. the third item

Description

```
\begin{description}
  \item[TeX] is a program
  \item[LaTeX] is a set of macros
  \item[Amsmath] enhances maths
\end{description}
```

TeX is a program

LaTeX is a set of macros

Amsmath enhances maths

Customized lists with `enumitem`

- Lists can be customized with the `enumitem` package.
  All the lengths, counters and labeling can be efficiently customized.

- In the following example we have an enumerate with italic alphabetic labels
  protruding in the margin, and another with Greek label:

```
\setlist[enumerate]{leftmargin=*,nosep}
Lorem ipsum dolor ...
\begin{enumerate}[label=\emph{\alph*}),
labelindent=-1em,leftmargin=0pt]
\item Donec vehicula ...
\item Mauris ut leo.
\end{enumerate}
Lorem ipsum dolor ...
\begin{enumerate}[label=\cgreek* -]
\item Mauris ut leo.
\item Donec vehicula ...
\end{enumerate}
\end{minipage}
```

Lorem ipsum dolor ...
a) Donec vehicula ...
b) Mauris ut leo.

Lorem ipsum dolor ...
* - Mauris ut leo.
* - Donec vehicula ...

- You can create your own style, clone a standard one & set its properties:
  `\newlist{myit}{itemize}{2}`,& `\setlist[myit]{label=...}`.

Environments tabular and array

tabular a text-only environment to create a tabular presentation[*]

array a math-only environment for aligned content like matrix or systems.

Separator Both use of the character & to delimit the cells in a row.

Basic examples :

```
\begin{tabular}{lccc}
Color: &red & green & blue\\
HTML : &\#F00 & \#0F0 &\#00F
\end{tabular}
```

$$\begin{array}{lccc}
\text{Color :} & \text{red} & \text{green} \\
\text{HTML :} & \#F00 & \#0F0
\end{array}$$

```
$ \left(
\begin{array}{lcr}
123 & 0  & 321\\
0  & 123 &  0
\end{array}
\right) $
```

$$\left(\begin{array}{lcr}
123 & 0 & 321 \\
0 & 123 & 0
\end{array}\right)$$

Notice the unusual alignment in the matrix

[*] do not confuse with the **table** floating environment, described latter.

Alignment in tabular and array

- In the argument of the environment the tree letters `l`, `r`, `c` define the alignment of the cells of the corresponding rows.
- They can be interleaved with vertical bars `|` and/or `\hline` to draw the vertical/horizontal borders.

```
\begin{tabular}{|l|ccc|}
\hline
Color &red & green & blue\\
\hline
HTML &\#F00 &\#0F0 & \#00F\\
\hline
\end{tabular}
```

Color	red	green	blue
HTML	#F00	#0F0	#00F

- Repeated entries can be grouped with `*{⟨num⟩}{⟨align⟩}` E.g. `|l|*{3}{c}` for the the previous tabular.
- The options `l c r`, typeset in LR-mode, can be replaced by `p{⟨width⟩}` which inserts a `\parbox[t]`, allowing "vertical" content
- In preamble, `@{⟨text⟩}` prepends ⟨text⟩ to the next cell.

Improve `tabular`/`array` with `array`

More formating options are enabled by the package `array`, providing:

- The columns type m`{⟨width⟩}` & b`{⟨width⟩}` like p`{⟨width⟩}` but with alignment middle/bottom

- Formating ⟨code⟩ can be prepended/appended to the cells with >`{⟨code⟩}` / <`{⟨code⟩}`, while !⟨code⟩ replaces | by ⟨code⟩.

- A (stupid) example:

```
\begin{tabular}{p{3em}%
>{$\sim}r<{\:$kg} >{$\sim}r<{\:$m}}
Man & 70 & 175 \\
Woman & 55 & 165 \\
Kid & 35 & 120
\end{tabular}
```

Man	$\sim 70\,\mathrm{kg}$	$\sim 175\,\mathrm{m}$
Woman	$\sim 55\,\mathrm{kg}$	$\sim 165\,\mathrm{m}$
Kid	$\sim 35\,\mathrm{kg}$	$\sim 120\,\mathrm{m}$

- Regularly used columns formats can be named: e.g. with `\newcolumntype{C}{>{$}c<{$}}`, `C` used instead of `c` switches to math mode in `tabular` and to LR-mode in `array`

- Option `[t]` & `[b]` : alignment with respect to surrounding text.

Enhanced `tabular`/`array` with colors and `booktabs`

- Text & bkgd colors : `>{\color{⟨color⟩}}` & `>{\cellcolor{⟨color⟩}}`

  `\color` (uses `xcolor`)

Color	red	green	blue
HTML	#F00	#0F0	#00F

  `\cellcolor` (uses also `colortbl`)

Color	red	green	blue
HTML	#F00	#0F0	#00F

- Define new column types:

```
\newcolumntype{R}{>{\cellcolor{red}\color{blue}}c}
\newcolumntype{G}{>{\cellcolor{teal}\color{black}}c}
\newcolumntype{B}{>{\cellcolor{cyan}\color{purple}}c}
\begin{tabular}{|l|RGB|} \hline
Color &red & green & blue\\ \hline
HTML & #F00 & #0F0 & #00F\\ \hline
\end{tabular}
```

Color	red	green	blue
HTML	#F00	#0F0	#00F

- Use `booktabs` and suppress vertical lines:

```
\begin{tabular}{lRGB}
\toprule Color& red& green& blue\\ \midrule
 HTML & #DDB6B6 & #32CD32 & # 40FFFF\\
\bottomrule
\end{tabular}
```

Color	red	green	blue
HTML	#F00	#0F0	#00F

Summary

Regulars floats : `figure` and `table`

A float is an environment placed by LaTeX at an optimized position (after its definition), trying to keep the page organization as clever as possible.

- LaTeX defines two floats: `figure` and `table`. The difference is semantics, as their content can be anything that doesn't concern page breaking.
- Example:

```
\begin{figure}[thbp]
\centering
\includegraphics[width=0.9\textwidth]{mafigure}
\caption{Ma belle figure}
\label{f-belle}
\end{figure}
```

- Floats have a *critical* placement *option*, a combination of `t,b,h,p` defining the *allowed* positions: `t,b` for top/bottom of pages, `p` full page of float(s), `h` for here.

Notice the `\includegraphics[]{}`, the swiss-army-knife to insert external content...

Including (external) graphics : `graphicx` package

- Inclusion is performed by the macro `\includegraphics` defined in the (low level) `graphics` package.
- The `graphicx` package loads the former and defines high level interface for `\includegraphics` with the `key=value` syntax.
- Regular LaTeX with `dvips` handles vectorial EPS and bitmap JPG. pdfLaTeX natively handles vectorial PDF and bitmaps PNG & JPG.
- The `Bounding box` of the picture is automatically read in the vectorial files, but pixel-size must be provided for bitmaps.
- On the fly conversion of EPS (to PDF) is performed by the package `epstopdf`. The same holds for SVG by using `svg` package and its `\includesvg` (OTF conversion uses `Inskscape`).
- **Example:**

```
\includegraphics[width=0.8\linewidth, rotate=90, page=3,
            trim=left bottom right top, clip]{nicepicture}
            %other options bb, keepaspectratio, origin, draft
```

- For internally defined figures: `PStricks`, `pict2e`, `PFG/TikZ`. . .

Float placement

Placement of floats is the worst headache that LaTeX users can experience.

- The best position is generally `top`, but what ever you choose, it will interfere with page breaking control, and eventually LaTeX could "float" the floats to the end of chapter or document.
- `h` & `!h` most often have *badness* maximal and must be avoided.
- To ensure that floats are not floated to the end one can allows LaTeX to be more tolerant about floats placement by releasing constraints with:

```
\renewcommand\topfraction{.8}        % max float fract at top  (def .7)
\renewcommand\bottomfraction{.4}     % max float fract at bot  (def .3)
\renewcommand\textfraction{.15}      % min text with floats    (def .2)
\renewcommand\floatpagefraction{.4}  % min fl fract on p—page   (def .5)
\setcounter{topnumber}{3}            % max float number at top  (def  2)
\setcounter{bottomnumber}{2}         % max float number at bot  (def  1)
\setcounter{totalnumber}{4}          % max fl number on page    (def  3)
```

- Or use `afterpage` to force a float page with `\afterpage{\clearpage}`
- Ot use `placeins` defining `\FloatBarrier` which prevents to float further.
  `\usepackage[section]{placeins}` adds `\FloatBarrier` to command `\section`.

Floats (not floating) in text

1.2 Carrière d'universitaire

En 1889, il enseigna au lycée Saint-Louis puis à partir de 1890 au Lycée Buffon. Il eut comme élève Maurice FRÉCHET et eut des contacts avec Émile BOREL à l'École normale, jusqu'au départ de ce dernier pour la faculté des sciences de Lille en 1893. Il obtint son doctorat en 1892, sous la direction d'Émile PICARD, pour des recherches sur les fonctions définies par séries de Taylor. Il enseigne alors à la faculté des sciences de l'université de Bordeaux en tant que chargé de cours de juillet 1893 à février 1896, puis professeur titulaire. Il retourna ensuite à Paris en tant que maître de conférences (en remplacement de Paul PAINLEVÉ) à la faculté des sciences de l'université de Paris, et obtient le titre de professeur-adjoint en février

Jacques HADAMARD

1900. En novembre 1897, il devient également suppléant de Maurice LÉVY à la chaire de mécanique analytique et mécanique céleste du Collège de France (à la suite de Paul PAINLEVÉ).

Floats (not floating) in text

- Packages `wrapfig`, `picins` and `floatflt` allow to place small floating figures inside text like `\includegraphics[width=\linewidth]{PagesfromHadamard}` as shown on previous slide.
- Specify the requested width, and the placement (r/l).
- Example : The figure on last slide is produced by:

```
\subsection{Carrière universitaire}
\begin{wrapfigure}[10]{r}{35mm}
 \flushright
 \vspace*{-1.75\baselineskip}
 \includegraphics[width=31mm]{hadamard-pic.jpg}
 Jacques \textsc{Hadamard}
\end{wrapfigure}
En 1889, il enseigna au lycée Saint-Louis puis à partir de 1890 au
Lycée Buffon [...]
```

- These floats conflict with lists, and often with sectioning commands.
- `wrapfig` & `picins` are said deprecated in favor of `floatflt`, but `wrapfig` remains the most popular, and easier to use.

Captions

- Floats generally include captions, explaining the content, defined by:

```
\begin{figure}[htbp]
\includegraphics[width=35mm]{hadamard-pic}
\caption[Portrait de Jacques Hadamard] % Short title for \lof
{Jacques \textsc{Hadamard}, photographie prise en 1898 \ldots}
\end{figure}
```

- Package `caption` for genuine captions for "non-floating" stuff (with numbering etc.):

```
\usepackage{caption}
[...]
\begin{minipage}{14cm}
\includegraphics[width=35mm]{hadamard-pic}
\captionof{figure}{Portrait de Jacques Hadamard}
\end{minipage}
```

- Package `caption` enables customization with, for example:

```
\captionsetup[figure]{labelsep=endash,labelfont={rm,bf},%
  textfont=sl,font=small}
```
wh

can be set globally or inside a given `figure`.

Subcaptions

- Package `subcaption` allows captioning of composite figures :

```
\usepackage{subcaption} % loads caption
[...]
\begin{figure}
  \begin{subfigure}[t]{0.7\textwidth}
    \includegraphics[width=0.7\textwidth]{example-image-a}
    \caption{For subfig a}
  \end{subfigure}
  \begin{subfigure}[t]{0.49\textwidth}
    \includegraphics[width=0.7\textwidth]{example-image-b}
        \caption{For subfig b}
  \end{subfigure}
  \caption{For whole figure}
\end{figure}
```

- The `subfigure` environment is defined in `subcaption`, but is not mandatory: any grouping is sufficient.

- `subfigure` & `subfig` are obsolete/incompatible with `hyperref`.

Summary

Line breaking

- Three ways to break a line : `\newline`, `\linebreak` and `\\` (with an optional vertical spacing). Compare effects :

`\newline`	Lorem ipsum dolor sit amet, consectetuer⏎
or `\\`	adipiscing elit. Curabitur dictum gravida mauris.
`\linebreak`	Lorem ipsum dolor sit amet, consectetuer⏎
	adipiscing elit. Curabitur dictum gravida mauris.

- Line ending can be hinted with conditional hyphenation `\-`

adi`\-`piscing	Lorem ipsum dolor sit amet, consectetuer adi-
	piscing elit. Curabitur dictum gravida mauris.
adipisc`\-`ing	Lorem ipsum dolor sit amet, consectetuer adipisc-
	ing elit. Curabitur dictum gravida mauris.

- `\hfill`, `\hrulefill`, `\dotfill` can also influence line breaking: Lorem ipsum dolor sit amet, consectetuer adipiscing elit. This is a `\dotfill` . . . . , and here is a `\hrulefill` _____.

Vertical spacing

- Between lines : `\baselineskip` (don't modify!)
  If you really need larger spacing : `\usepackage{setspace}` and
  `\doublespacing` or `\onehalfspacing`
- Between paragraph : `\parskip` (don't modify!)
- Fixed skips : `\smallskip`, `\medskip`, `\bigskip`
  There are also `\smallbreak`, `\medbreak`, `\bigbreak` with the same
  effect, plus reducing break-page penalty.
- Line breaking with additional space:

  `\\[6pt]`
  $\begin{cases} \text{Lorem ipsum dolor sit amet, consectetuer} \\ \\ \text{adipiscing elit. Curabitur dictum gravida mauris.} \end{cases}$

  `\\[-1ex]`
  $\begin{cases} \text{Lorem ipsum dolor sit amet, consectetuer} \\ \text{adipiscing elit. Curabitur dictum gravida mauris.} \end{cases}$

- Arbitrary skip : `\vspace{length}` or `\vspace*{length}`, like
  `\hspace`
- `\vfill` acting like `\hfill` but in vertical direction.

Summary

Math in standard LaTeX(I)

By conception, TeX is specially efficient for typesetting math.
Only the basic maths of LaTeX are described here, and enhanced
mathematical typesetting is deferred to another workshop.

- TeX defines "mathmode" in two versions and four styles:
  - *In-line* mode, with `$...$`, or `\(...\)`, or environment `math`.
  - *Display* mode, with `\[...\]` or environment `displaymath`.
  - `\displaystyle`, `\textstyle`, `\scriptstyle` and
    `\scriptscriptstyle`, are related to size of symbols, fractions, etc.
- In mathmode, each letter is supposed to be a *single* variable, so that
  `$abfc$` gives $abfc$ and not $abfc$.
- TeX ignores the typed spaces ans adds the required spacing according to
  the class of symbols, variables, operators, delimiter, binary relations,
  etc. Tweaking this spacing is sometimes required, with the commands:

`\quad`	`\qquad`	`\ `	`\;`	`\;`	`\,`	`\!`
18mu	36mu	9mu	5mu	4 mu	3mu	-3mu

where `1mu`$=1/18$em.

Math in standard LaTeX(II)

Basic math constructions

- Indices and exponents:

`$2^3=8$` $\to 2^3 = 8$	`$\delta_{ij}=\pm1$` $\to \delta_{ij} = \pm 1$
`$a^3^2$` $\to$ `Error`	`$a^{(3^2)}=a^{9}$` $\to a^{(3^2)} = a^9$
`$C_2^4=6$` $\to C_2^4 = 6$	`$\mathrm{H_3O^+}$` $\to \mathrm{H_3O^+}$

- Primes :

`$x'=1$` $\to x' = 1$	`$(x^2)'=2x$` $\to (x^2)' = 2x$
`$x''=0$` $\to x'' = 0$	`$(x^2)''=2$` $\to (x^2)'' = 2$

- Fractions and roots:

`$\frac{a}{b}$` $\to \frac{a}{b}$	`$\sqrt{4}=2$` $\to \sqrt{4} = 2$
`\[\frac{a}{b}\]` $\to \dfrac{a}{b}$	`$\sqrt[3]{27}=3$` $\to \sqrt[3]{27} = 3$

Math in standard LaTeX(III) : Integrals, sums and limits

The Euler-Mascheroni constant γ

- In `\textstyle` (in-line math) the definition of γ $\boxed{\lim_{n\to\infty}(\sum_{k=1}^n \frac{1}{k} - \int_1^n \frac{dx}{x})}$
  is produced by the command:

  `\lim_{n\to\infty}(\sum_{k=1}^n \frac{1}{k}-\int_1^n \frac{dx}{x})`

  inserted in `$...$` or `\(...\)` or `\begin{math}...\end{math}`.

- The same code typeset in `\displaystyle` gives:
  - In `displaymath` environment defined by `\[...\]` or
    `\begin{displaymath}...\end{displaymath}`

    $$\lim_{n\to\infty}\left(\sum_{k=1}^n \frac{1}{k} - \int_1^n \frac{dx}{x}\right)$$

  - By prepending the formula with `\displaystyle`

- To change the default behavior, the limits position can be controlled with
  commands `\limits` or `\nolimits` inserted between operator and limits.

  One get the limits on the side with the code: $\boxed{\lim_{n\to\infty}\left(\sum\nolimits_{k=1}^n \frac{1}{k} - \int_1^n ...\right)}$
  - In `textstyle`:

    `$\lim\limits_{n\to\infty}(\sum_{k=1}^n-\int_1^n\dots))$`
  - In `displaystyle`:

    `\[\lim_{n\to\infty}(\sum\nolimits_{k=1}^n-\int\nolimits_1^n\dots)\]`

Math in standard LᴬTₑX(IV) Fonts

Regular math is in "$mathematical\ italic$" (`lmmi` for `latinmodern`)

Styles and families work like in text, but with `\math`⟨`style`⟩:
Samples : mathrm, $\mathtt{mathtt}$, mathsf, $\mathbf{mathbf}$, mathit

Symbols are not embolden by `\mathbf`:
`$\mathbf{\sum\int\beta}$` $\to \sum \int \beta \leftarrow$ `$\sum\int\beta$`
Use instead package `bm` and `$\bm{\sum\int\beta}$` $\to \sum \int \beta$

Other styles (with packages)
`\mathcal{ABCNRa12ab}`	$\to \mathcal{ABCNR}$✗✗✗✗	`latex`
`\mathfrak{ABCNR12ab}`	$\to \mathfrak{ABCNR12ab}$	`amsfonts`
`\mathbb{ABCNR12ab}`	$\to \mathbb{ABCNR}$✗✗✗✗	`amsfonts`
`\mathbbm{ABCNR12ab}`	$\to \mathbb{ABCNR12ab}$	`bbm`
`\mathds{ABCNR12ab}`	$\to \mathbb{ABCNR1}$✗✗✗	`dsfont`
`\mathscr{ABCD12ab}`	$\to \mathscr{ABCNR}$✗✗✗✗	`mathrsfs`
`\upalpha\upbeta`...	$\to \alpha\beta$...	`upgreek`

And many more with `eulervm`, `BOONDOX fonts`, etc...

Math in standard LaTeX (V): operators and relations

"Binary operators", "Binary relations"and "unary operators". E.g.:

Bin ops, automatically surrounded by medium space (4 mu):

`\pm`	$\pm$	`\cap`	$\cap$	`\diamond`	$\diamond$	`\times`	$\times$
`\mp`	$\mp$	`\cup`	$\cup$	`\ast`	$*$	`\div`	$\div$
`\bullet`	$\bullet$	`\cdot`	$\cdot$	`\setminus`	$\setminus$	`\otimes`	$\otimes$

Binrels, automatically surrounded by small space (3 mu):

`=`	$=$	`\equiv`	$\equiv$	`\approx`	$\approx$	`\sim`	$\sim$
`>`	$>$	`\leq`	$\leq$	`\ll`	$\ll$	`\simeq`	$\simeq$
`<`	$<$	`\geq`	$\geq$	`\gg`	$\gg$	`\propto`	$\propto$

Log-like, automatically preceded by small space (3 mu):

`\arccos`	arccos	`\cos`	cos	`\exp`	exp	`\lim`	lim	`\min`	min
`\arcsin`	arcsin	`\cosh`	cosh	`\deg`	deg	`\gcd`	gcd	`\ln`	ln
`\cot`	cot	`\det`	det	`\log`	log	`\sec`	sec	`\tan`	tan

New versions can be defined with `\newcommand{`\name`}{`...`}`, where ...
is either `\mathbin{`name`}`, `\mathrel{`name`}` or `\mathop{`name`}`.

Math in standard LaTeX (VI): symbols, arrows, delimiters

LaTeX also has various kind of symbols. Some examples :

Symbols (variable-sized) automatically surrounded by space:

`\sum`	$\sum$	`\bigcap`	$\bigcap$	`\bigodot`	$\bigodot$	`\prod`	$\prod$
`\bigcup`	$\bigcup$	`\bigotimes`	$\bigotimes$	`\coprod`	$\coprod$	`\bigsqcup`	$\bigsqcup$

Arrows : (no space added)

`\leftarrow`	$\leftarrow$	`\longleftarrow`	$\longleftarrow$	`\uparrow`	$\uparrow$
`\Leftarrow`	$\Leftarrow$	`\Longleftarrow`	$\Longleftarrow$	`\Uparrow`	$\Uparrow$
`\rightarrow`	$\rightarrow$	`\longrightarrow`	$\longrightarrow$	`\downarrow`	$\downarrow$

Delimiters automatically surrounded by small space (3 mu):

`(`	(	`)`	)	`\{`	{	`\uparrow`	$\uparrow$	`\Uparrow`	$\Uparrow$
`[`	[	`]`	]	`\}`	}	`\downarrow`	$\downarrow$	`\Downarrow`	$\Downarrow$

Big delims obtained with:

`\Bigg(\bigg(\Big(\big( ( ) \big)\Big)\bigg)\Bigg)`

but the correct spacing would require:

`\Biggl(\biggl(\Bigl(\bigl( ( ) \bigr)\Bigr)\biggr)\Biggr)`

$$\left(\Bigg(\bigg(\Big(\big(((()))\big)\Big)\bigg)\Bigg)\right)$$

Math in standard LaTeX(VII): Greek letters

`\alpha`	α	`\imath`	$\imath$	`\rho`	ρ	`\varepsilon`	ε
`\beta`	β	`\kappa`	κ	`\sigma`	σ	`\vartheta`	ϑ
`\gamma`	γ	`\lambda`	λ	`\tau`	τ	`\varkappa`	$\varkappa$
`\delta`	δ	`\mu`	μ	`\upsilon`	υ	`\varpi`	ϖ
`\epsilon`	ϵ	`\nu`	ν	`\phi`	ϕ	`\varsigma`	ς
`\zeta`	ζ	`\xi`	ξ	`\chi`	χ	`\varrho`	ϱ
`\eta`	η	`o`	o	`\psi`	ψ	`\varphi`	φ
`\theta`	θ	`\pi`	π	`\omega`	ω		

`\Gamma`	Γ	`\Lambda`	Λ	`\Sigma`	Σ	`\Psi`	Ψ
`\Delta`	Δ	`\Xi`	Ξ	`\Upsilon`	Υ	`\Omega`	Ω
`\Theta`	Θ	`\Pi`	Π	`\Phi`	Φ		

`\varGamma`	$\varGamma$	`\varLambda`	$\varLambda$	`\varSigma`	$\varSigma$	`\varPsi`	$\varPsi$
`\varDelta`	$\varDelta$	`\varXi`	$\varXi$	`\varUpsilon`	$\varUpsilon$	`\varOmega`	$\varOmega$
`\varTheta`	$\varTheta$	`\varPi`	$\varPi$	`\varPhi`	$\varPhi$		

Slanted capital are also obtained with `\mathnormal{\Gamma}` $\rightarrow \varGamma$

Upright Greek lower case with package `upgreek`

Math in standard LaTeX(VIII): more symbols

Some are directly avaliable, other require packages `latexsym` or `amssymb`.

`\ldots`	…	`\cdots`	⋯	`\vdots`	⋮	`\ddots`	⋱
`\aleph`	ℵ	`\prime`	′	`\forall`	∀	`\infty`	∞
`\hbar`	ℏ	`\emptyset`	∅	`\varnothing`	∅	`\exists`	∃
`\imath`	ı	`\nabla`	∇	`\neg`	¬	`\Diamond`	◇
`\jmath`	ȷ	`\surd`	√	`\flat`	♭	`\triangle`	△
`\ell`	ℓ	`\top`	⊤	`\natural`	♮	`\clubsuit`	♣
`\wp`	℘	`\bot`	⊥	`\sharp`	♯	`\diamondsuit`	♢
`\Re`	ℜ	`\backslash`	∖	`\heartsuit`	♡	`\Box`	□
`\Im`	ℑ	`\angle`	∠	`\partial`	∂	`\spadesuit`	♠
`\mho`	℧	`!`	factorial	`.`	dec. sep.		

Math in standard LaTeX(XI) : Decorations

Math mode accents

`\hat{a}` $\hat{a}$ `\acute{a}` $\acute{a}$ `\bar{a}` $\bar{a}$ `\dot{a}` $\dot{a}$

`\breve{a}` $\breve{a}$ `\check{a}` $\check{a}$ `\grave{a}` $\grave{a}$ `\vec{a}` $\vec{a}$

`\ddot{a}` $\ddot{a}$ `\tilde{a}` $\tilde{a}$

Other constructions

`\widetilde{abc}` $\widetilde{abc}$ `\widehat{abc}` $\widehat{abc}$

`\overleftarrow{abc}` $\overleftarrow{abc}$ `\overrightarrow{abc}` $\overrightarrow{abc}$

`\overline{abc}` $\overline{abc}$ `\underline{abc}` $\underline{abc}$

`\overbrace{abc}^d` $\overbrace{abc}^d$ a `\underbrace{efg}_h` $\underbrace{efg}_h$

Extensible delimiters The `\Bigg\bigg\Big\big` delimiters are sometimes to small. Get larger delimiters as shown here with:
`\left⟨delim1⟩ content\right⟨delim2⟩`.
`\left` and `\right` must be paired but the delimiters ⟨delim1⟩ and ⟨delim2⟩ can differ. Use `\left.`/`\right.` for no visible delimiter.
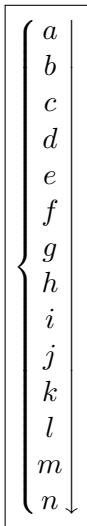
$$\left(\begin{array}{c} a \\ b \\ c \\ d \\ e \\ f \\ g \\ h \\ i \\ j \\ k \\ l \\ m \\ n \end{array} \right\downarrow$$

Summary

Basic LaTeX mechanism

- LaTeX defines the environment `thebibliography`, a list where `\item` is replaced by `\bibitem{⟨key⟩}`, where ⟨key⟩ is the (unique) identifier of a reference.

  Example:

  ```
  \begin{thebibliography}{10}
  \bibitem{einstein05} %<== key
  A.~\textsc{Einstein};
  ``Zur Elektrodynamik bewegter K{\"o}rper'';
  \emph{Annalen der Physik}, \textbf{322}, p.~891--921 (1905);
  URL:~\url{http://dx.doi.org/10.1002/andp.19053221004}.
  \end{thebibliography}
  ```

  Giving:

  > [1] A. EINSTEIN ; "Zur Elektrodynamik bewegter Körper" ; *Annalen der Physik*, **322**, p. 891–921 (1905) ; URL : http://dx.doi.org/10.1002/andp.19053221004.

- Citations are inserted in the text by the mean of the `\cite{⟨key⟩}` .
  e.g. `\cite[equ.~3]{einstein05}`, giving [1, equ. 3].

"Handmade" or automatic bibliography

When the `thebibliography` is present in the .tex file, it is handled by LaTeX in the following way :

- Formated bibliography is inserted in the output file, and `\cite` and `\bibitem` keys are written in the .aux file.

- At the next compile time, LaTeX resolves the link between citations and bibliography, as the usual way for latex references.
  Hence the minimal work-flow is : pdflatex pdflatex (or latex latex).

Writing by hand the `\bibitem`s is not really user-friendly, especially if the *same* references have to be formatted in different *formats* for different journals or publications.

- For this reason, Oren PATASHNIK and Leslie LAMPORT developed the BibTeX program in 1985, with the purpose to separate the reference data, stored in a .bib database, from formats defined in .bst styles files.

- Since 2006 appeared package `biblatex` another tool using LaTeX to format the references (no longer .bst), and replacing the old bibtex by the new program biber.

Principles for automatic bibliography

There are hence two ways to automate the formatting of bibliography:

BibTeX : the traditional and still most used.
Format defined by an auxiliary .bst file. Uses the `bibtex` or `bibtex8`
or `bibtexu` external program to apply the format

Pro: simple, fast, widespread.
Contra: not Unicode aware, difficult to customize.

BibLaTeX : the modern flavor, still less used, but increasing rapidly.
Format is defined in pure LaTeX, with `biblatex` package and `.bbx`,
`.cbx`, `.dbx`, `.def`, `.cfg` options files. Uses the `biber` program.

Pro: Fully Unicode, easier (??) customization, more elaborate
citing styles, many more documents types and fields
entries.
Contra: Slow, more elaborate/difficult to master, not really stable.

We will first present the traditional BIBTEX route.

Using BIBTEX : the work-flow

1. Select a style by the command `\bibliographystyle{⟨stylefile⟩}`, where ⟨stylefile⟩`.bst` is a style file (described below).

2. Select database(s) by `\bibliography{⟨baseone⟩,⟨basetwo⟩...}` where ⟨base*⟩`.bib` are the bibliographic database files (described below).

3. Run (pdf)latex : citations defined by `\cite{⟨key⟩}` are written in the .aux file, as well as the specified ⟨stylefile⟩ and ⟨bibfile⟩s.

4. Run bibtex (or any variant): **it processes the .aux file**, finds the cited references in the .bib files, uses the .bst file to format (& optionally sort) them. The result is written in the .bbl file which contains the `thebibliography` environment, as you could have done by hand.

5. This.bbl file is loaded at the next compile time, to insert the bibliography in the document.

6. The references to the bibliography (i.e. citations) are resolved at a further (pdf)latex run. Hence the minimum work-flow is :

$$latex \longrightarrow bibtex \longrightarrow latex \longrightarrow latex$$

7. Non-cited documents in .bib files are ignored, unless using `\nocite{⟨key⟩}` or the *evil* `\nocite{*}`.

The compilation tool-chain
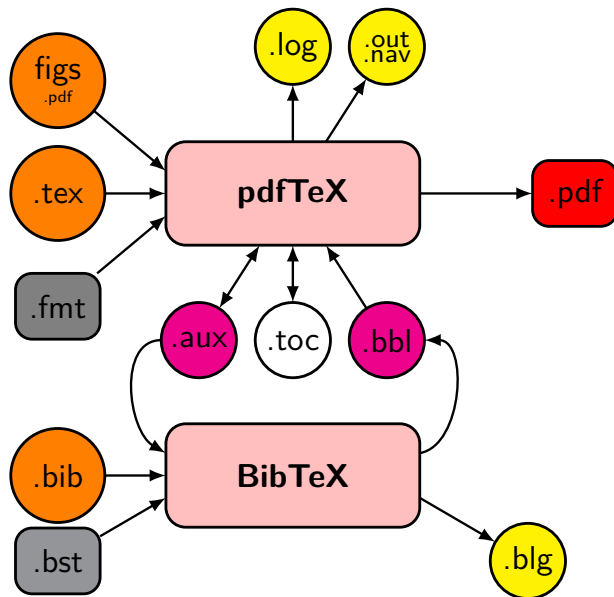
BIBTEX database files I

- By default, BIBTEX recognize the following type of documents:

  article   manual   conference   inproceedings[a]
  book   booklet   proceedings   unpublished   phdthesis
  misc   techreport   incollection[1] inbook[1]   mastersthesis

- Each type has a list of M-andatory or O-ptional fields.

- Exemple for an `@article` **entry**:

```
@ARTICLE{einstein1905a,                         % M (key)
  author = {Albert Einstein},                   % M
  title  = {{Z}ur {E}lektrodynamik bewegter {K}{\"o}rper}, % M
  journal = {Annalen der Physik},               % M
  year   = {1905},                              % M
  volume = {322}                                % O
  pages  = {891--921},                          % O
  number = {10},                                % O
  doi    = {10.1002/andp.19053221004},          % O
  note = {...}                                  % O
}
```

[1] : the `inxxxx` refer to another document in the same bibliography (cross-references).
They are more difficult to handle and usually require one more compilation.

BIBTEX database files II

- Example for `@book` **entry**:

```
@BOOK{einstein_meaning_2004,              % M (key)
  author = {Einstein, Albert},            % M
  title  = {The {M}eaning of {R}elativity}, % M
  year   = {2004},                        % M
  publisher= {Princeton University Press}, % M
  address = {Princeton},                  % O
  edition = {5Rev e.},                    % O
  isbn   = {978-0-691-12027-0}            % O
  month  = dec,                           % O
  note   = {...}                          % O
}
```

- For other types, see:

  `https://en.wikibooks.org/wiki/LaTeX/Bibliography_Management#Standard_templat`

- For tools to ease the `.bib` creation and management see:

  `https://en.wikipedia.org/wiki/BibTeX#Uses`.

BIBTEX style files

- The default .bst style files are stored in ⟨TEXMF⟩/bibtex/bst, but others can be stored anywhere LATEX can find them, especially in your working directory.

- The citations and references style reflect some aesthetical or semantic choices from publishers, scientific communities or countries. In Sciences, most journal provide their own style file. There is not a unique choice, but an exuberant multiplicity: there are hundreds of .bst files on CTAN!

- The styles can be categorized between "numeric" and "author" citation styles. Roughly speaking, the former is preferred in Sciences, and the latter in Humanities.

- They can list the references by citation order (said "unsorted"), or "sorted" alphabetic by first author or date. Pairs other than "Sorted"+"author", and "unsorted"+"numeric" are not really meaningful.

- The standard BIBTEX comes with the following styles:

abbrv	acm	alpha	apalike
ieeetr	plain	siam	unsrt

  but none of them is really satisfactory.

Some examples

Style plain.bst

[1] A. Einstein. Die Grundlage der allgemeinen Relativitätstheorie. *Annalen der Physik*, 354(7):769–822, 1916.

[2] A. Einstein, B. Podolsky, and N. Rosen. Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Phys. Rev.*, 47(10):777–780, 1935.

[3] Albert Einstein. *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field*. Princeton University Press, 5 rev e. edition, 2004.

[4] Albert Einstein and Nathan Rosen. The particle problem in the general theory of relativity. *Physical Review*, 48(1):73, 1935.

[5] Albert Einstein and Nathan Rosen. Two-body problem in general relativity theory. *Physical Review*, 49(5):404, 1936.

Citation d'un article [1]   Citation d'un livre [2]

Style unsrt.bst

[1] A. Einstein, B. Podolsky, and N. Rosen. Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Phys. Rev.*, 47(10):777–780, 1935.

[2] Albert Einstein. *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field*. Princeton University Press, 5 rev e. edition, 2004.

[3] Albert Einstein and Nathan Rosen. The particle problem in the general theory of relativity. *Physical Review*, 48(1):73, 1935.

[4] Albert Einstein and Nathan Rosen. Two-body problem in general relativity theory. *Physical Review*, 49(5):404, 1936.

[5] A. Einstein. Die Grundlage der allgemeinen Relativitätstheorie. *Annalen der Physik*, 354(7):769–822, 1916.

Citation d'un article [1]   Citation d'un livre [2]

Style alpha.bst

[Ein16] A. Einstein. Die Grundlage der allgemeinen Relativitätstheorie. *Annalen der Physik*, 354(7):769–822, 1916.

[Ein04] Albert Einstein. *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field*. Princeton University Press, 5 rev e. edition, 2004.

[EPR35] A. Einstein, B. Podolsky, and N. Rosen. Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Phys. Rev.*, 47(10):777–780, 1935.

[ER35] Albert Einstein and Nathan Rosen. The particle problem in the general theory of relativity. *Physical Review*, 48(1):73, 1935.

[ER36] Albert Einstein and Nathan Rosen. Two-body problem in general relativity theory. *Physical Review*, 49(5):404, 1936.

Citation d'un article [1]   Citation d'un livre [2]

Style siam.bst

[1] A. EINSTEIN, *Die Grundlage der allgemeinen Relativitätstheorie*, Annalen der Physik, 354 (1916), pp. 769–822.

[2] A. EINSTEIN, *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field*, Princeton University Press, 5 rev e. ed., 2004.

[3] A. EINSTEIN, B. PODOLSKY, AND N. ROSEN, *Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?*, Phys. Rev., 47 (1935), pp. 777–780.

[4] A. EINSTEIN AND N. ROSEN, *The particle problem in the general theory of relativity*, Physical Review, 48 (1935), p. 73.

[5] ——, *Two-body problem in general relativity theory*, Physical Review, 49 (1936), p. 404.

Citation d'un article [1]   Citation d'un livre [2]

BIBTEX, a better unsorted style: `ieeetr`

The `ieeetr` style is a good[4] example of "unsorted numeric" style:

Style ieeetr.bst

[1] A. Einstein, B. Podolsky, and N. Rosen, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?," *Phys. Rev.*, vol. 47, no. 10, pp. 777–780, 1935.

[2] A. Einstein, *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field.* Princeton University Press, 5 rev e. ed., 2004.

[3] A. Einstein and N. Rosen, "The particle problem in the general theory of relativity," *Physical Review*, vol. 48, no. 1, p. 73, 1935.

[4] A. Einstein and N. Rosen, "Two-body problem in general relativity theory," *Physical Review*, vol. 49, no. 5, p. 404, 1936.

[5] A. Einstein, "Die Grundlage der allgemeinen Relativitätstheorie," *Annalen der Physik*, vol. 354, no. 7, pp. 769–822, 1916.

Citation d'un article [1]   Citation d'un livre [2]

---

[4] In Physics journals, Nature, Science, etc. the volume in bold (w/o Vol); year at the end in parentheses. In Chemistry or Biology, the year is usually just after author names...

BIBTEX, a better author-year style: `apalike`

The `apalike` style is a good example of "sorted by author-year":

Style apalike.bst

[Einstein, 1916] Einstein, A. (1916). Die Grundlage der allgemeinen Relativitätstheorie. *Annalen der Physik*, 354(7):769–822.

[Einstein, 2004] Einstein, A. (2004). *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field.* Princeton University Press, 5 rev e. edition.

[Einstein et al., 1935] Einstein, A., Podolsky, B., and Rosen, N. (1935). Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Phys. Rev.*, 47(10):777–780.

[Einstein and Rosen, 1935] Einstein, A. and Rosen, N. (1935). The particle problem in the general theory of relativity. *Physical Review*, 48(1):73.

[Einstein and Rosen, 1936] Einstein, A. and Rosen, N. (1936). Two-body problem in general relativity theory. *Physical Review*, 49(5):404.

Citation d'un article [1]   Citation d'un livre [2]

More on author-year: see natbib (below) and

http://homepage.stat.uiowa.edu/~rlenth/ALPHA/bibstylescompared.pdf

BIBTEX, a journal unsorted style: `osajnl`

OSA Journals provide a rather good style file for physics, but journal names are upright and doi is not shown (`osajnl2` package required) :

Style osajnl.bst with `osajnl2` package

1. A. Einstein, B. Podolsky, and N. Rosen, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?" Phys. Rev. **47**, 777–780 (1935).

2. A. Einstein, *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field* (Princeton University Press, 2004), 5th ed.

3. A. Einstein and N. Rosen, "The particle problem in the general theory of relativity," Physical Review **48**, 73 (1935).

4. A. Einstein and N. Rosen, "Two-body problem in general relativity theory," Physical Review **49**, 404 (1936).

5. A. Einstein, "Die Grundlage der allgemeinen Relativitätstheorie," Annalen der Physik **354**, 769–822 (1916).

BIBTEX better author-year with `natbib`

- The `natbib` package is mostly intended to **format the the citations**.
- It accommodates author-date and numeric styles, without editing the source.
- It works well with its own style `natbib.bst` and modified versions of some standard styles like plainnat.bst, unsortnat.bst, etc.
- It adds to `\bibitem` in an optional argument "*label*" like :

  ```
  \bibitem[Einstein et~al.(1935)Einstein, Podolsky,
                     and Rosen]{EPR1935}
  ```

- This "*label*" is used to provide (a lot of) variants to `\cite{}`, like `\citep`, `\citep*`, `\citet`, `\citet*`, `\citeauthor`, `\citeauthor*`, `\citeyear`, where the starred versions print the full author list, if available in "*label*", even in numeric style (option "numbers" of `natbib`). It also enables to separate the author's names from the number.
- Two optional text arguments (pre & post) can be added like
  `\citep[see][chap.~2]{EPR1935}` → [see 1, chap. 2]....

– `natbib` documentation available on: `https://ctan.org/pkg/natbib`,
– More examples: `https://www.sharelatex.com/learn/Natbib_citation_styles`.

BIBTEX, `natbib` samples: `authoryear`

Natbib with option=`authoryear,round` and style=`plainnat`

Citation of a book :
`\citep[voir][§~12]{einstein_meaning_2004}` → (voir   Einstein, 2004, § 12)

Citation of an article
  `\citep*{einstein_can_1935}` → (Einstein, Podolsky, and Rosen, 1935)
  or `\citet{einstein_can_1935}` → Einstein et al. (1935)

A. Einstein, B. Podolsky, and N. Rosen. Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Phys. Rev.*, 47 (10):777–780, May 1935. doi: 10.1103/PhysRev.47.777. URL https://link.aps.org/doi/10.1103/PhysRev.47.777.

Albert Einstein. *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field 5e.* Princeton University Press, Princeton, 5rev e. edition, December 2004. ISBN 978-0-691-12027-0.

BIBTEX, `natbib` samples: `numbers`

Natbib with option=numbers,square and style=unsrtnat

Citation of a book :
`\citep[voir][§~12]{einstein_meaning_2004}` → [voir 1, § 12]
Citation of an article
  `\citep*{einstein_can_1935}` → [2]
  or `\citet{einstein_can_1935}` → Einstein et al. [2]

[1] Albert Einstein. *The Meaning of Relativity – Including the Relativistic Theory of the Non–Symmetric Field 5e.* Princeton University Press, Princeton, 5rev e. edition, December 2004. ISBN 978-0-691-12027-0.

[2] A. Einstein, B. Podolsky, and N. Rosen. Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? *Phys. Rev.*, 47(10):777–780, May 1935. doi: 10.1103/PhysRev.47.777. URL https://link.aps.org/doi/10.1103/PhysRev.47.777.

Multiples Bibliographies with BIBTEX I/II

- The bibliography can be split by using the packages `splitbib`, `chapterbib`, or, better, `multibib`.

- Generally speaking, for a PhD in Sciences, it would be a very bad idea.

- For Humanities, one should separate sources according status.

- Using files named general.bib, primary.bib, secondary.bib, do:

```
1  \documentclass[...]{...}
2  \usepackage{multibib}
3  \newcites{prim,sec}{{Sources primaires},{Sources secondaires}}
4  \begin{document}
5  \bibliographystyle{stylegeneral}
6  \bibliographystyleprim{styleprimary}
7  \bibliographystylesec{stylesecondary}
8  \bibliographyprim{\code{primary}}
9  \bibliographysec{secondary}
10 \bibliography{general}
11 \begin{document}
12 body: use \cite{} or \citeprim{} or \citesec{}
13 \end{document}
```

Multiples Bibliographies with BIBTEX II/II

The code above works, but for the proper definition of sectioning, table of contents, headers and bookmarks, it must be enhanced as follows.

- If you are in `book` style or another having chapters, add in preamble:

```
\usepackage{etoolbox}
\patchcmd{\thebibliography}{\chapter*}{\section*}{}{}
```

- Before the insertion of the bibliography (line 8 on previous slide) add:

```
\chapter*{\bibname}
\phantomsection
\addcontentsline{toc}{chapter}{\bibname}
```

- Before the insertion of each bib section `\bibliography`xxxx add:

```
\phantomsection
\markboth{\bibname}{Sources xxxx}
\addcontentsline{toc}{section}{Sources xxxx}
```

Encoding problems and solutions for BIBTEX

- The program `bibtex` is only 7-bits encoding (ASCII) aware, and the recommended solution is coding the accents with the old-fashioned style like `M{\'e}canique` → Mécanique, (see the mandatory `{ }`).
- When using an 8-bits input encoding like latin1, ansinew, applemac, etc. you could switch to bibtex8, keeping your encoding.
- Unfortunately, the BIBTEX records exported from the web use UTF-8:
    - A conversion can be done by using the icode and recode utilities[5].
    - The `inputenc` package provides us with `\inputencoding{⟨enc⟩}`, where $+$⟨enc⟩ is a 8-bit encoding, to be perpended to bibliography.
- A whole UTF-8 work-flow would be preferable, and is possible by using `biblatex+biber`.
- Another solution is using the bibtexu program. It may produces a lot of (harmless) errors. They that can be filtered out by using sed utility[5], with the command :

```
bibtexu myfile | sed "s/6there is a error:
U_ZERO_ERROR//ig"
```

---

[5] For Windows see `http://gnuwin32.sourceforge.net/packages.html`

Summary

Commands I/III

- A great interest of (La)TeX is the possibility to create new commands:
- Two methods to create a command `\mycmd` with two mandatory arguments (max number=9) :
  - TeX: `\def``\mycmd#1#2``{command-def-using-#1-and-#2}`
  - LaTeX: `\newcommand``\mycmd``[2]``{command-def-using-#1-and-#2}`
- `\def` creates or overwrites `\mycmd`, which is *local* (scopes limited to current group) and *short* (argument limited to one paragraph). This can be changed by using `\long` or `\global`, so that `\long``\global``\def``\mycmd``{...}` will define a global long macro.
- `\newcommand` first checks if the command already exist, and fail if it exists. Redefinition can be performed with `\renewcommand` (which fails if the command does not exist).
- `\(re)newcommand` creates *local long* macros. The stared version `\(re)newcommand*``\mycmd``[2]``{...}` creates a *short* macro. No build-in global version.

Commands II/III

- Examples:
  ```
  \newcommand\COII{\ensuremath{\mathsf{CO}_2}}
  \newcommand\fname[2]{\textsc{#2}, #1}
  \newcommand\JD{\fname{John}{Doe}}
  ```
  $\backslash$COII$\rightarrow$ CO$_2$

  $\backslash$fname$\{$John$\}\{$Doe$\}$ $\rightarrow$ DOE, John

  $\backslash$JD$\rightarrow$ DOE, John.

- Such formatting commands *(i)* reduce the number of keystrokes, *(ii)* ensure homogeneous formatting *(iii)* make easier to change the choice. E.g. Must chemical element be typeset in roman, such that :
  ```
  \renewcommand\COII{\ensuremath{\mathrm{CO}_2}
  ```
  $\backslash$COII $\rightarrow$ CO$_2$

- One optional argument can be introduced by a second `[...]` after the first one, which contains the default value of #1. Example :
  ```
  \newcommand\fcol[2][blue]{\fbox{\color{#1}\bfseries #2}}
  ```
  such that

  $\backslash$fcol$\{$foo$\}\rightarrow$ **foo**   but $\backslash$fcol$[$red$]\{$foo$\}\rightarrow$ **foo**.

- Interest of `\def` : *delimited arguments*. Example:
  ```
  \def\braket<#1|#2>{\langle #1\vert #2\rangle}
  ```
  so that `\braket<`χ`|`ψ`>` $\rightarrow \langle\chi|\psi\rangle$.

Commands III/III

- As already said, commands with a name containing one or more @ can not be directly used your LaTeX source `.tex`, but only in `.sty` (packages) and `.cls` files (classes).[6]
- Digits are not allowed.[7]
- Command definitions can be *cloned* in other command by using `\let`. Example : `\Re`→ $\Re$ and `\Im`→ $\Im$ but can be enhanced with:
  `\let\origRe=\Re \undef{\Re} \DeclareMathOperator{\Re}{\origRe e}`
  `\let\origIm=\Im \undef{\Im} \DeclareMathOperator{\Im}{\origIm m}`
  which gives `\Re(x)`→ $\Re\mathrm{e}(x)$ and `\Im(x)`→ $\Im\mathrm{m}(x)$.
- Some macro are `fragile` because when passed to another command or written in the `.aux` fil,e their deferred effect is lost. This can be fixed locally by using `\protect`\mycmd, or on the global scope with `\DeclareRobustCommand`\MyCmd`}{...}`

---

[6] A workaround: enclose the commands between `\makeatletter` & `\maketaother`
[7] A workaround: enclose their name between `\csname` & `\endcsname`.

Environments

- Environments can be (re)defined with the command :
  `\(re)newenvironment{⟨envname⟩}[⟨nargs⟩][⟨default⟩]{begdef}{enddef}`
  where ⟨envname⟩ is the name, ⟨nargs⟩ the number of arguments,
  ⟨default⟩ the default value of the first argument, making it optional, `begdef`
  is the code executed at `\begin{⟨envname⟩}` and `enddef` the code for
  `\end⟨envname⟩}`.

- Exemple (elementary) :
  `\newenvironment{myquote}{\begin{quote}\itshape\small }{\end{quote}}`

- Defining an environment on the basis of one or several other is generally the
  easiest way, but will fail with some kind of environments, like those that expects
  their body as a whole (e.g. tabular) or those containing verbatim text.

- The package `environ` helps to fix some of these issues, and enable more
  powerful environments.