

LaTeX for beginners

An introduction to T_EX and L^AT_EX

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

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Summary

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Math in standard L^AT_EX(I)

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

- TeX defines “mathmode” in two version and four styles:
 - *In-line* mode, with \dots , or $\langle \dots \rangle$, or environment `math`.
 - *Display* mode, with $\left[\dots \right]$ or environment `displaymath`.
 - `\displaystyle`, `\textstyle`, `\scriptstyle` and `\scriptscriptstyle`, mostly related to size of symbols.
- In mathmode, each letter is supposed to be single variable, so that `abs` gives abs and not abS .
- T_EX ignores the types spaces and 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:

Math in standard L^AT_EX(II)

Basic math constructions

- Indices and exponents:

$\$2^3=8\$$ \rightarrow $2^3 = 8$	$\$\delta_{ij}=\pm 1\$$ $\rightarrow \delta_{ij} = \pm 1$
$\$a^3^2\$$ \rightarrow Error	$\$a^{\{(3^2)\}}=a^{\{9\}}\$$ $\rightarrow a^{(3^2)} = a^9$
$\$C_2^4=6\$$ \rightarrow $C_2^4 = 6$	$\$\mathrm{H_3O^+}\$$ $\rightarrow \text{H}_3\text{O}^+$

- Primes :

$\$x'=1\$$ $\rightarrow x' = 1$	$\$(x^2)'=2x\$$ $\rightarrow (x^2)' = 2x$
$\$x''=0\$$ $\rightarrow x'' = 0$	$\$\{(x^3)'\}=3x^2\$$ $\rightarrow (x^3)' = 3x^2$

- Fractions and roots :

$\$\frac{a}{b}\$$ $\rightarrow \frac{a}{b}$	$\$\sqrt{4}=2\$$ $\rightarrow \sqrt{4} = 2$
$\$[\frac{a}{b}]\$$ $\rightarrow \frac{a}{b}$	$\$\sqrt[3]{27}=3\$$ $\rightarrow \sqrt[3]{27} = 3$

Math in standard L^AT_EX(III) : Integrals, sums and limitsThe Euler-Mascheroni constant γ

- In `\textstyle` (in-line math)

is produced by the command :

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

inserted in `\cdots` or `\(\cdots\)`

- A better result in `\displaystyle` :

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

is produced by the same code in `displaymath` environment or `\[\cdots\]`

Math in standard L^AT_EX(IV) Fonts

Regular math is in “*mathematical italic*” (`\lmmi` for `latinmodern`)

Styles and families work like in text, but with `\math<style>`:

`\mathrm`, `\mathtt`, `\mathsf`, `\mathbf`, `\mathit`

Symbols are not embolden by `\mathbf`:

`\mathbf{\sum\int\beta}` $\rightarrow \sum \int \beta$ `\sum\int\beta`

Use instead package `\bm` and `\bm{\sum\int\beta}` $\rightarrow \sum \int \beta$

Other styles (with packages)

- `\mathcal{ABCDEFGH}` $\rightarrow \mathcal{A}\mathcal{C}\mathcal{D}\mathcal{E}\mathcal{F}\mathcal{G}\mathcal{H}$ (uppercase only, `latex`)
- `\mathbbm{ABCNR12abc}` $\rightarrow \mathbb{A}\mathbb{B}\mathbb{C}\mathbb{N}\mathbb{R}12abc$ (`\bm`)
- `\upalpha\upbeta\upmu\cdots` $\rightarrow \alpha\beta\mu\cdots$ (`\upgreek`)
- `\mathfrak{ABCNR12abc}` $\rightarrow \mathfrak{A}\mathfrak{B}\mathfrak{C}\mathfrak{N}\mathfrak{R}12abc$ (`\amsfonts`)
- `\mathscr{ABCD}` $\rightarrow \mathcal{A}\mathcal{B}\mathcal{C}\mathcal{D}$ (uppercase only, `\mathrsfs`)
- etc.

Math in standard L^AT_EX (V): operators and relations

“Binary operators”, “Binary relations” and “unary operators”. E.g.:

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

<code>\pm</code>	\pm	<code>\cap</code>	\cap	<code>\diamond</code>	\diamond	<code>\times</code>	\times
<code>\mp</code>	\mp	<code>\cup</code>	\cup	<code>\ast</code>	\ast	<code>\div</code>	\div
<code>\bullet</code>	\bullet	<code>\cdot</code>	\cdot	<code>\setminus</code>	\setminus	<code>\otimes</code>	\otimes

etc.

Bin rel, automatically surrounded by small space (3 mu):

<code>\equiv</code>	\equiv	<code>\approx</code>	\approx	<code>\sim</code>	\sim
<code>\leq</code>	\leq	<code>\ll</code>	\ll	<code>\simeq</code>	\simeq
<code>\geq</code>	\geq	<code>\gg</code>	\gg	<code>\propto</code>	\propto

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

<code>\arccos</code>	\arccos	<code>\cos</code>	\cos	<code>\exp</code>	\exp	<code>\lim</code>	\lim	<code>\min</code>	\min
<code>\arcsin</code>	\arcsin	<code>\cosh</code>	\cosh	<code>\deg</code>	\deg	<code>\gcd</code>	\gcd	<code>\ln</code>	\ln
<code>\cot</code>	\cot	<code>\det</code>	\det	<code>\log</code>	\log	<code>\sec</code>	\sec	<code>\tan</code>	\tan

Math in standard L^AT_EX (VI): symbols, arrows, delimiters

L^AT_EX also has various kind of symbols. Some examples :

Symbols (variable-sized) automatically surrounded by space:

`\sum` Σ `\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)` $\left(\left(\left(\left((\)\right)\right)\right)\right)$
 but the correct spacing would require:
`\Biggl(\biggl(\Bigl(\bigl((\)\bigr)\Bigr)\biggr)\Biggr)`

Math in standard L^AT_EX(VII): Greek letters

<code>\alpha</code>	α	<code>\imath</code>	\imath	<code>\rho</code>	ρ	<code>\varepsilon</code>	ε
<code>\beta</code>	β	<code>\kappa</code>	κ	<code>\sigma</code>	σ	<code>\vartheta</code>	ϑ
<code>\gamma</code>	γ	<code>\lambda</code>	λ	<code>\tau</code>	τ	<code>\varkappa</code>	\varkappa
<code>\delta</code>	δ	<code>\mu</code>	μ	<code>\upsilon</code>	υ	<code>\varpi</code>	ϖ
<code>\epsilon</code>	ϵ	<code>\nu</code>	ν	<code>\phi</code>	ϕ	<code>\varsigma</code>	ς
<code>\zeta</code>	ζ	<code>\xi</code>	ξ	<code>\chi</code>	χ	<code>\varrho</code>	ϱ
<code>\eta</code>	η	<code>o</code>	o	<code>\psi</code>	ψ	<code>\varphi</code>	φ
<code>\theta</code>	θ	<code>\pi</code>	π	<code>\omega</code>	ω		
<code>\Gamma</code>	Γ	<code>\Lambda</code>	Λ	<code>\Sigma</code>	Σ	<code>\Psi</code>	Ψ
<code>\Delta</code>	Δ	<code>\Xi</code>	Ξ	<code>\Upsilon</code>	Υ	<code>\Omega</code>	Ω
<code>\Theta</code>	Θ	<code>\Pi</code>	Π	<code>\Phi</code>	Φ		
<code>\varGamma</code>	\varGamma	<code>\varLambda</code>	\varLambda	<code>\varSigma</code>	\varSigma	<code>\varPsi</code>	\varPsi
<code>\varDelta</code>	\varDelta	<code>\varXi</code>	\varXi	<code>\varUpsilon</code>	\varUpsilon	<code>\varOmega</code>	\varOmega
<code>\varTheta</code>	\varTheta	<code>\varPi</code>	\varPi	<code>\varPhi</code>	\varPhi		

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

Math in standard L^AT_EX(VIII): more symbols

<code>\ldots</code>	...	<code>\cdots</code>	...	<code>\vdots</code>	:	<code>\ddots</code>	⋮
<code>\aleph</code>	ℵ	<code>\prime</code>	/	<code>\forall</code>	∀	<code>\infty</code>	∞
<code>\hbar</code>	ℏ	<code>\emptyset</code>	∅	<code>\exists</code>	∃	<code>\Box</code>	□ ^b
<code>\imath</code>	ı	<code>\nabla</code>	∇	<code>\neg</code>	¬	<code>\Diamond</code>	◇ ^b
<code>\jmath</code>	ȝ	<code>\surd</code>	√	<code>\flat</code>	♭	<code>\triangle</code>	△
<code>\ell</code>	ℓ	<code>\top</code>	⊤	<code>\natural</code>	♮	<code>\clubsuit</code>	♣
<code>\wp</code>	℘	<code>\bot</code>	⊥	<code>\sharp</code>	♯	<code>\diamondsuit</code>	◇
<code>\Re</code>	ℜ	<code>\ </code>		<code>\backslash</code>	\	<code>\heartsuit</code>	♥
<code>\Im</code>	ℑ	<code>\angle</code>	∠	<code>\partial</code>	∂	<code>\spadesuit</code>	♠
<code>\mho</code>	℧ ^b	.	.				

Math in standard L^AT_EX(XI) : Decorations

Math mode accents

\hat{a} \acute{a} \bar{a} \dot{a}
 \breve{a} \check{a} \grave{a} \vec{a}
 \ddot{a} \tilde{a}

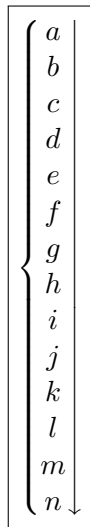
Other constructions

\widetilde{abc} \widehat{abc}
 \overleftarrow{abc} \overrightarrow{abc}
 \overline{abc} \underline{abc}
 \overbrace{abc}^d \underbrace{efg}_h

Extensible delimiters The `\Bigg``\bigg``\Big``\big` delimiters are sometimes too 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 `.` for no visible delimiter.



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 - Using BibLaTeX
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Basic L^AT_EX mechanism

- L^AT_EX defines the environment `thebibliography`, a list where `\item` is replaced by `\bibitem{key}`, where `key` is the (unique) identifier.

Example:

```
\begin{thebibliography}{10}
\bibitem{einstein05}
  A. \textsc{Einstein};
  "Zur Elektrodynamik bewegter Körper";
  Annalen der Physik, \textbf{322}, p. 891--921 (1905);
  URL: \url{http://dx.doi.org/10.1002/andp.19053221004}.
\bibitem{...}
\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}` command like `\cite[eq.~3]{einstein05}`, giving 1, eq. 3].

Work-flow for handmade bibliography

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

- Formatted bibliography is inserted in the output file, and citation and bibitem keys are written in the `.aux` file.
- At the next compile time, L^AT_EX resolves the link between citations and bibliography, as the usual way for latex references.
Hence the minimal work-flow is : `latex latex`
- Writing by hand the `\bibitem` 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 BIB_TE_X in 1985, with the purpose to separate the reference data (stored in a `.bib` database) from the format defined in `.bst` files.

Principles for automatic bibliography

There are presently 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`) program.

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, much more documents types and much more 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 Define a style by the command `\bibliographystyle{stylefile}`, where `stylefile.bst` is a style file (described below).
- 2 Define database(s) by `\bibliography{baseone,basetwo...}` where `base*.bib` are bibliographic database files (described below).
- 3 Run `(pdf)latex` : citation defined by `\cite{key}` are written in the `.aux` file, as well as the specified `stylefile` and `bibfiles`.
- 4 Run `bibtex` (or any variant) : it processes the `.aux` file and produces the `.bbl` file, containing the `thebibliography` environment. This file is loaded by `(pdf)latex` at the next compile time, to insert the bibliography in the document.
- 5 The references to the bibliography (i.e. citations) are resolved at a further compilation. Hence the minimum work-flow is :

`latex bibtex latex latex`

- 6 Non-cited documents are ignored, but there is `\nocite{key}` or even the *evil* `\nocite{*}`.

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 ^a	inbook ^a	mastersthesis

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

- Exemple for article:

```

1 @ARTICLE{einstein1905-a,           % M (key)
2   author   = {Albert Einstein},    % M
3   title    = {{Zur Elektrodynamik bewegter K\"{o}rper}}, % M
4   journal  = {Annalen der Physik}, % M
5   year     = {1905},               % M
6   volume   = {322}                 % O
7   pages    = {891--921},           % O
8   number   = {10},                 % O
9   doi      = {10.1002/andp.19053221004}, % O
10  note     = {...}, abstract = {...} % O
11 }
```

^a : 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

- For `book`:

```

1 @BOOK{einstein_meaning_2004,                % M (key)
2   author   = {Einstein, Albert},             % M
3   title    = {The {Meaning} of {Relativity}}, % M
4   year     = {2004},                         % M
5   publisher = {Princeton University Press},  % M
6   address  = {Princeton},                   % O
7   edition  = {5Rev e.},                     % O
8   isbn     = {978-0-691-12027-0}            % O
9   language = {Anglais},                     % O
10  month    = dec,                           % O
11  note     = {...}, abstract = {...}         % O
12 }
```

- For other types, see https://en.wikibooks.org/wiki/LaTeX/Bibliography_Management#Standard_templates
- For tools to ease the `.bib` creation and management see <https://en.wikipedia.org/wiki/BibTeX#Uses>.

BibTeX style files

- The `.bst` style files must be stored in `/texmf/bibtex/bst/`
- The citation 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 latter is preferred in Humanities, and the former in Sciences.
- They can list the references by citation order (unsorted), or sorted by date, or alphabetic by first author.
- The standard BibTeX comes with the following styles :
`abbrv` `acm` `alpha` `apalike`
`ieeetr` `plain` `siam` `unsrt`
but none of them is really satisfactory.
- An example of various styles is shown on the next slides.

Some examples I

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]

Some examples II

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]

Some examples III

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]

Some examples IIV

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 good² 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]

²In 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` is a good example of “sorted 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:

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 citation.
- It also accommodates author-date form, but also numeric style, without editing the source.
- It works with its own style `natbib.bst` and with modified versions of some standard styles like `plainnat.bst`, `unsrnat.bst` etc.
- It features (lot of) variants of `\cite` using the optional argument `label` in `\bibitem[label]{key}`. Most important examples:
`\bibitem[Jones et al. (1990) Jones and Williams]{jon90}`:
 - `\citep{jon90}` → (Jones et al., 1990),
 - `\citet{jon90}` → Jones et al., (1990)
 - starred versions print the full author list, if available in `label`.
 - two optional text arguments (pre & post) can be added like
`\citep[see][chap. ~2]{jon90}` → (see Jones et al., 1990, chap. 2)
- In numeric mode, `\citep{key}` gives the (bracketed) number alone, while `\citet{key}` gives both label and number.

– `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 `\citete{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>.

BibTeX: custom .bst styles I/II

- The `.bst` files are executables code written in a somehow complicated language, mostly because it is a “postfix” language, also known as “Reverse Polish Notation”. Hence its modification “by hand”, though possible, is very cumbersome.
- By chance there is in T_EX distributions a TeX program called `makebst.tex` (in `texmf/tex/latex/custom-bib`) that enables the creation of a custom style (after answering more than 150 questions), et particularly to apply some “national” specificities, including translation but not only.
- Provided during the course are 8 custom `natbib`-enabled `.bst` files named `th**nat??-!!!`, where `**` is the language `fr` or `en`, `??` the sorting (either `ay`, `ayus`, or `us`), and `!!!` (either `doi` or `href` denoting how the hyperlinks towards the documents are used. This is more specifically illustrated on the next slide.

BibTeX: custom .bst styles II/II

- **th****-doi**: the doi are shown in shorts form :

- [1] A. EINSTEIN, B. PODOLSKY & N. ROSEN; «Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?»; Phys. Rev. **47**, p. 777–780 (1935). doi :10.1103/PhysRev.47.777.
- [2] A. EINSTEIN; *The Meaning of Relativity – Including the Relativistic Theory of the Non-Symmetric Field*; 5^e édition (Princeton University Press) (2004); ISBN 978-0-691-12027-0.
- [3] A. EINSTEIN & N. ROSEN; «The particle problem in the general theory of relativity»; Physical Review **48**, p. 73 (1935). doi :10.1103/PhysRev.48.73.

- **th****-href**: The hyperlinks are on reference itself.

- [1] A. EINSTEIN, B. PODOLSKY & N. ROSEN; «Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?»; Phys. Rev. **47**, p. 777–780 (1935).
- [2] A. EINSTEIN; *The Meaning of Relativity – Including the Relativistic Theory of the Non-Symmetric Field*; 5^e édition (Princeton University Press) (2004); ISBN 978-0-691-12027-0.
- [3] A. EINSTEIN & N. ROSEN; «The particle problem in the general theory of relativity»; Physical Review **48**, p. 73 (1935).

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 \bibliographystyle{<prim>}{styleprimary}
7 \bibliographystyle{<sec>}{stylesecondary}
8 \bibliography{<prim>}{primary}
9 \bibliography{<sec>}{secondary}
10 \bibliography{general}
11 \begin{document}
12 % body: use \cite{} or \cite{<prim>}{} or \cite{<sec>}{}
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 :

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

```

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

```
1 \chapter*{\bibname}
2 \phantomsection
3 \addcontentsline{toc}{chapter}{\bibname}

```

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

```
1 \phantomsection
2 \markboth{\bibname}{Sources 'xxxx'}
3 \addcontentsline{toc}{section}{Sources 'xxxx'}

```

Minimal introduction to `biblatex`

- `biblatex` eliminates the complexity of the `.bst` file, the formatting being fully done by latex macros
- Hence `biblatex` is much more powerful, but IMO increases complexity.
- The `.bib` files keep the same spirit as for BibTeX, but the number of document types is above 30, and the number of possibles entries in `@article` is up to 38! The compatibility BibTeX \rightarrow BibLaTeX/biber is quite good, but the reverse doesn't make sense.
- The key idea: almost the whole content of the `.bib` file given back to \LaTeX to enable its post-processing by `biblatex`, according its standard, or custom rules. A quick look on CTAN returns more then 50 packages adding some more documents types and processing rules.
- When the `.aux` file is processed by `biber` one get a `.bcf` file, and the `.bbl` output is a large and not readable XML file.
- The next slide provides a “starter” code to use `biblatex`.

biblatex : basic code

- In this basic example two `.bib` files are loaded by the `\addbibresource{}` command doing the same thing as `\bibliography{}`, except to write the refs.
- The refs are printed by the final `\printbibliography`.
- The (author-year) style is defined by the provided options.

```
1 \documentclass[...]{...}
2 \usepackage...
3 \usepackage[backend=biber,style=authoryear-comp]{biblatex}
4 \ExecuteBibliographyOptions{sortcites,sorting=nyt,%name/year/title
5     maxnames=3,minnames=3,backref,date=year}
6 \addbibresource{fileone.bib}
7 \addbibresource{filetwo.bib}
8 \begin{document}
9 % content : use \autocite[] or \nocite{} or variants
10 \printbibliography
11 \end{document}
```

A method for biblatex multiple bibliographies will be provided on demand.

biblatex: split bibliography for a single .bib file

To label the references by type, one inserts in the preamble the macro:

```
\newcommand{\multibib}[1]{
  \providebool{bibfirst} \forcsvlist{\listxadd\multibiblist}{#1}
  \DeclareListParser*{\forbibitem}{=}
  \expandafter\renewcommand{\do}[1]{ \booltrue{bibfirst}
    \forbibitem{
      \ifbool{bibfirst}{\boolfalse{bibfirst}\xdef\bibkeyword}%
        {\xdef\bibfile}}{##1}
    \addbibresource{\bibfile}
    \map{\perdatasource{\bibfile}
      \step[fieldset=keywords, fieldvalue=\bibkeyword,append]} }
  \DeclareSourcecmap{\maps[datatype=bibtex,overwrite=true]}{%
    \dolistloop{\multibiblist} }}
}
```

Then the two `\addbibresource{...}` are replaced by the command :

```
\multibib{'prim'=primary.bib,'secd'=secondary.bib}
```

Finally the bibliography is produced by :

```
\printbibheading
\printbibliography[keyword='prim', heading=subbibliography,title=Primaires]
\printbibliography[keyword='secd', heading=subbibliography,title=Secondaires]
```

Warning: `keywords` should be missing or finish with a coma like `{BibTeX,}`.

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, (with the mandatory `{ }` à).
- 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` utilities³.
 - The `inputenc` package provide us with `\inputencoding{<enc>}`, where `<enc>` is a 8-bit encoding, to be prepended to the bibliography.
- A whole UTF-8 work-flow would be preferable, and is possible by using `biblatex+biber`.
- A *imperfect* solution is using the *undocumented* `bibtexu`. It produces a lot of (harmless) errors, that can be filtered out by using `sed` utility³, with the command :

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

³For Windows see <http://gnuwin32.sourceforge.net/packages.html>

Summary

- 1 Do you need \LaTeX ?
- 2 TeX and friends
- 3 The basics
- 4 What is needed
- 5 Getting started
- 6 Basic text formatting
- 7 Layout and structure
- 8 Labeling & hyperref
- 9 Commands, declarations, lengths, counters
- 10 Babel
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- 12 Floats
- 13 Spacing and breaking
- 14 Basic mathematics in standard \LaTeX
- 15 Handling bibliography
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- 17 Creating commands and environments in standard \LaTeX

Boxes (I/III)

Typesetting text in T_EX consists in building lines as horizontal boxes filled by glyphs and stack them in the page which is a vertical box.

Dès Noël, où un zéphyr haï me vêt de glaçons würmiens, je dîne d'exquis rôtis de bœuf au **kir**, à l'ay d'âge mûr, &cætera. Et quelques *ligatures* fi, ff, ffi.

Dès Noël, où un zéphyr haï me vêt de glaçons würmiens, je dîne d'exquis rôtis de bœuf au **kir**, à l'ay d'âge mûr, &cætera. Et quelques *ligatures* fi, ff, ffi.

No need to enter in this process which is T_EX's job. We will introduce only the “basic” common user-level boxes of L^AT_EX.

Boxes (II/III)

- \TeX primitive boxes: `\hbox`, `\vbox`, `\vcenter`, `\vtop`.
- \LaTeX boxes behaves differently with their content, as they can be in horizontal mode (or LR mode) like in `\hbox`, or vertical mode (or paragraph mode) line in `\vbox`.
- Boxes with horizontal content (Never broken across lines):
 - `\mbox{<text>}` horizontal box with natural size of `<text>`.
 - `\makebox[<width>][<alignmt>]{<text>}` like `\mbox` but fixed width.
 - `\fbox{<text>}` and `\framebox[<width>][<alignmt>]{<text>}` : framed versions of `\mbox` and `\makebox` possibly adjust lengths `\fboxsep` & `\fboxrule` (default to 3.0pt & 0.4pt)
 - `\raisebox{<lift>}[<height>][<depth>]{<text>}` is like `\mbox` but raises it by the dimension `<lift>`.

Boxes (III/III)

- Boxes with vertical content:
 - `\parbox[alignmt]{width}{text}` contains text which is broken in lines, and possibly several paragraphs; but no environments.
 - `\begin{minipage}[alignmt]{width}text\end{minipage}`: full emulation of page, `text` can contain (almost) anything of page content (except floats).
- Special “saved” boxes : `\sbox{bin}{text}` and `\savebox{bin}[width][alignment]{text}` are analogous to `\mbox` and `\makebox` respectively, but store the box in the `bin` declared in advance with `\newsavebox`. Its content is printed by `\usebox{bin}`.
- Environment `\begin{lrbox}{bin} text \end{lrbox}` is analogous to `\sbox{bin}{text}` but can be used to define new environments.
- A lot of “enhanced” boxes is provided by numerous packages. The most powerful of them is `tcolorbox`...

Page breaking

Once again, avoid to break the T_EX approach of decomposition of your text, limiting the occurrence of widows and orphans ... If really needed, you nevertheless can tweak the page breaking with commands :

- `penalty<number>` (the number between $-10\,000$ and $10\,000$ is the “badness” that T_EX tries to minimize). You can use `penalty ± 10000` to ensure/exclude a page break, but prefer `\break/\nobreak` (see <https://tex.stackexchange.com/questions/51263>).
- `\pagebreak[0-4]` / `\newpage` force the end of the page. The former extend the vertical spaces to fill the page, while the latter keep the page bottom empty.
- `\clearpage` like `\newpage` plus force to print the trailing floats.
- `\cleardoublepage` like `\clearpage` but open an odd page ..
- `\enlargethispage{length}` extend the `\textheight` by the length added. Limit `length` to `2\baselineskip`.
- `\smallbreak`, `\medbreak` and `\bigbreak` like `***skip` but remove preceding vertical space and define a good break position.

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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) :
 - T_EX: `\def\mycmd#1#2{command-def-using-#1-and-#2}`
 - L^AT_EX: `\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 starred version `\(re)newcommand*\mycmd[2]{...}` creates a *short* macro. No build-in global version.

Commands II/III

- Examples:

```
\newcommand\COII{\ensuremath{\mathsf{CO}}_2} \COII → CO2
\newcommand\fname[2]{\textsc{#2}, #1} \fname{John}{Doe} → DOE, John
\newcommand\JD{\fname{John}{Doe}} \JD → 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} \COII → CO2
```

- One optional argument can be introduced by a second [...] after the first one, which contains the default value of #1. Example :

```
\newcommand\fcoll[2][blue]{\fbox{\color{#1}\bfseries #2}} such that
```

`\fcoll{foo}` → foo but `\fcoll[red]{foo}` → foo.

- Interest of `\def` : *delimited arguments*. Example:

```
\def\braket<#1|#2>{\langle #1\rangle #2\rangle}
```

so that `\braket<\chi|\psi>` → $\langle \chi | \psi \rangle$.

Commands III/III

- As already said, commands with a name containing one or more @ can not be directly used your L^AT_EX source .tex, but only in .sty files.⁴
- Digits are not allowed.⁵
- Command definitions can be *cloned* in other command by using \let.

Example : \Re → ℝ and \Im → ℑ 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(x) and \Im(x) → ℑm(x).

- Some macro are **fragile** because when passed to another command or written in the .aux file their deferred effect is lost. This can be fixed locally by using \protect\mycmd, or on the global scope with \DeclareRobustCommand{\MyCmd}{...}

⁴A workaround: enclose the commands between \makeatletter & \makeatother

⁵A workaround: use \csname & \endcsname, or with etoolbox package, \csdef & \csuse

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** 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.