

L^AT_EX 2_ε – a deepening



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GRUPE D'ÉTUDES ET DE RECHERCHE
EN ANALYSE DES DÉCISIONS

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1.1 The power of L^AT_EX

- ▶ How I use it
- ▶ Examples
 - ▶ T_EXample.net
 - ▶ Community — StackExchange
- ▶ How will you use it?
 - ▶ Overleaf Template: <https://fr.overleaf.com/>
 - ▶ GERAD Template: <https://www.gerad.ca/en/publications/papers/cahiers-procedure>
 - ▶ Symbols: <http://detexify.kirelabs.org/classify.html>

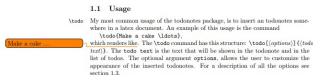
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1.1 The power of L^AT_EX (cont.)

► Interesting packages

–`\usepackage[]{\todonotes}` : Allows you to insert “to do lists” and/or write comments to your collaborators. The command: `\todo{Make a cake \ldots}`.



–`\usepackage[nameinlink]{cleveref}` : Enhances the cross-referencing features of L^AT_EX, to automatically determine cross-reference naming of the “label” based environment.

–`\usepackage{latexdiff}` : This is a Perl script for editing the differences between two L^AT_EX files. More information on [Overleaf](#).

~~Draft~~-~~Revision~~ Title

Pratik Patel ~~and Another Author~~

February 9, 2013

This is an example of a ~~draft-revision~~ article. These are some types of changes to ~~expect~~be expected. Here is how it deals with equations:

$$p = \int_{\dots} (x^2 + 32) dx \quad (1)$$

When you do not include your collaborator's name in the document, they might get upset with you. But inclusion of their name in the final version will settle all scores.

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1.1 The power of L^AT_EX[~](cont.)

► Interesting packages (cont.)

–`\usepackage[xcolor=<options>]{changes}` : Allows you to view changes made to text (additions, deletions or replacements) while adding color options and referencing the authors who made the changes. You can also highlight and comment the text. The following commands will get you started. See the associated documentation by clicking on the hyperlink : `\added[id=<id>, comment=<comment>]{<new text>}`, `\deleted[id=<id>, comment=<comment>]{<old text>}`, `\replaced[id=<id>, comment=<comment>]{<new text>}{<old text>}`.

Examples

```
This is \added{new} text.
This is \added[id=EK]{new} text too.
This is more \added[id=EK, comment={has to be in it}]{new} text.
This is the last \added[comment=anonymous]{new} text.
```

Result

This is new text. This is new^{EK} text too. This is more new text. This is the last new text.

[EK 3] has to be in it

[1] anonymous

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1.1 The power of L^AT_EX[~](cont.)

► Interesting packages (cont.)

–`\usepackage{listings}` : This package lets you write source code for L^AT_EX. You can format standalone files and code in an environment similar to `verbatim` and you can print code extracts using a command similar to `\verb`.

So if a user of the `listings` package wants to use these preferences, she/he can say for example when using Python

```
\input{listings-python.prf}
```

at the end of her/his `listings.cfg` configuration file as long as the file `listings-python.prf` resides in the T_EX search path. Of course that file can be changed according to the user's preferences.

At the moment there are five such preferences files:

1. `listings-acm.prf`
2. `listings-bash.prf`
3. `listings-fortran.prf`
4. `listings-lua.prf`
5. `listings-python.prf`

All contributors are invited to supply more personal preferences.

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1.2 The workshop

Objectives

- ▶ The goal of this workshop is to deepen the scope of L^AT_EX's capabilities for writing documents (assignment, internship report, letter, article, thesis, resume, ...). At the end of this workshop, students will be able to recognize the best practices and commands to improve their document and will be able to deepen their knowledge of the possibilities offered by L^AT_EX. Students will also learn tips on how to be more efficient and use the full potential of L^AT_EX.

Déroulement

- ▶ This workshop will explore the various environments for writing equations (alignment, grouping, long equations, numbering). We will also see the different ways to insert delimiters, distinguish the extensions for composing algorithms and their proper commands (pseudocode, algorithmic, algorithmicx and algorithm2e). Tables will be more complex and will answer well defined problems (text too long, automatic column width, table on several pages, text on several columns/rows, table too wide, note under the table, use of color, web converters for Excel tables, ...). We will also see how to create a bibliography file and insert references.
- ▶ Finally, the references cited in the "References" section will be used for the purpose of demonstrating their usefulness.

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2. Mathematics with L^AT_EX and A_MS-L^AT_EX

- ▶ `\usepackage{amsmath,amssymb,amsfonts}`
- ▶ in text mode: between `\(...\)` or `$...$`
- ▶ in display mode: between `\[...\]`
- ▶ in display mode, numbered:

```
\begin{equation}
c^{2}=a^{2}+b^{2}
\label{eq:c2}
\end{equation}
```

$$c^2 = a^2 + b^2 \tag{1}$$

- ▶ suppress numbering using the star form (`AMS-LATEX`) (impossible to reference)
- ▶ makes a reference to the equation number: (`\ref{etiquette}`), or best practice `\eqref{etiquette}` with `AMS-LATEX` (*which automatically sets the parentheses around the equation number.*)

Note: in the following examples, the mathematics doesn't mean anything. I'm just showing you how to present it.

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- ▶ commande `\tag{...}` (AMS-L^AT_EX)

$$\begin{aligned} a + b &= c \\ a^a + b^a &\leq c^a, \\ a^1 + b^2 &= c^3. \end{aligned} \tag{AMS} \tag{2}$$

```
begin{align}
a+b      &=c          \tag{AMS}   \label{eq:ams}\\
a^a+b^a &\leq c^a,      \label{eq:2}\\
a^1+b^2 &= c^3.     \nonumber
\end{align}
```

- ▶ equations numbers → right margin → by default
- ▶ equations numbers → left margin → class option
`\documentclass[leqno]{article}`
- ▶ equations are normally centered – to make them start on the left part of the page → class option `\documentclass[fleqn]{article}`

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- ▶ Normal text in a mathematical environment: `\textrm{ ... }`.
- ▶ $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX → `\text{...}`
which has the advantage of putting the text in the equation in the same font as the rest of the document.
- ▶ To insert text between the lines in a series of equations, while preserving alignment of the equations → `\intertext{}` of the packages $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX. `\shortintertext{}` creates less vertical space between equations but you need to upload `mathtools`

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- L^AT_EX

equation	equation*	one line, one equation
eqnarray	eqnarray*	one or many equations with two alignments

- A_MS-L^AT_EX

multline	multline*	one equation on many lines without alignment
gather	gather*	many equations without alignment
align	align*	many equations with alignments
split		a simple alignment in an equation on many lines
gathered		a “mini page” with equations without alignment
aligned		a “mini page” with equations with alignment

► The star form eliminates numbering, and references are impossible.

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► eqnarray – L^AT_EX and A_MS-L^AT_EX

Equations on several lines, three alignments or “columns”, the first aligned to the right, the second in the center, and the third to the left.

As with tabulars, the “&” allows you to change columns.

$$a + b = c, \tag{3}$$

$$a^a + b^a \leq c^a, \tag{4}$$

$$a^1 + b^2 + c^3 + d^4 = e^5.$$

```
\begin{eqnarray}
a+b & & = & & c, & \label{eq:3} \\
a^a+b^a & & \leq & & c^a, & \label{eq:4} \\
a^1+b^2+c^3+d^4 & & = & & e^5. & \nonumber
\end{eqnarray}
```

✓ *Less and less used, because of lack of flexibility.*

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► align – $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX (suite)

Equations on several lines, requiring several groups of alignments.

$$L_1 = R_1 \qquad L_2 = R_2 \qquad (7)$$

$$L_3 + L_4 = R_3 + R_4 \qquad L_5 + L_6 = R_5 + R_6 \qquad (8)$$

```
\begin{align}
L_1      &=& R_1      & & L_2      &=& R_2      & \label{eq:7} \\
L_3+L_4 &=& R_3+R_4 & & L_5+L_6 &=& R_5+R_6 & \label{eq:8} \\
\end{align}
```

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An other example:

$$a + b = c \qquad \forall x \in X \qquad (9)$$

$$a^1 + b^2 = c^3 \qquad \forall y_1 \in Y \dots \qquad (10)$$

```
\begin{align}
a+b      &= c      &\forall x \in X      & \label{eq:9} \\
a^1+b^2  &= c^3    &\forall y_1 \in Y \dots & \label{eq:10} \\
\end{align}
```

Or even better:

$$a + b = c \qquad \forall x \in X \qquad (11)$$

$$a^1 + b^2 = c^3 \qquad \forall y_1 \in Y \dots \qquad (12)$$

```
\begin{align}
a+b      &= c      &&\forall x \in X      & \label{eq:align11} \\
a^1+b^2  &= c^3    &&\forall y_1 \in Y \dots & \label{eq:align12} \\
\end{align}
```

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► **gather** – $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX

Environment used for several equations that don't require any particular alignment. Each line is centered.

$$(a + b)^2 = a^2 + 2ab + b^2 \quad (13)$$

$$(a + b) \times (a - b) = a^2 - b^2 \quad (14)$$

```
\begin{gather}
(a+b)^2 = a^2 + 2ab + b^2\\
(a+b) \times (a-b) = a^2 - b^2
\end{gather}
```

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▶ **multline** – $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX

Useful for equations that don't fit on a single line (a single number). The first line is aligned to the left, the last line is aligned to the right, and the lines in between are centered. The star shape form eliminates numeration.

$$\begin{aligned} de(t) = & [A(r(t)) + L(r(t))C_y(r(t))] e(t) dt \\ & + K(r(t))D_y(r(t))w(t)dt + Y(r(t))e(t)dt, \\ & + L(r(t))B_y(r(t))w(t)dt + W(r(t))e(t)dt \quad (15) \end{aligned}$$

```
\begin{multline}
d e(t) = \left[ A(r(t)) + L(r(t)) C_y(r(t)) \right] e(t) dt \\
+ K(r(t)) D_y(r(t)) w(t) dt + Y(r(t)) e(t) dt, \\
+ L(r(t)) B_y(r(t)) w(t) dt + W(r(t)) e(t) dt
\end{multline}
```

- ▶ The command `\shoveleft` placed at the beginning of the line, brings this line on the left side under the first line.

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► **split** – *A_MS-L^AT_EX*

Allows alignment in a multi-line equation (a single number). It cannot be used alone; it must be used within another mathematical environment, such as `equation`, `align`, `gather`, ... It is ideal for long equations.

$$\begin{aligned}
 (a + b) &= 2x - 5y \\
 &= (a + b)(a^2 + b^2) \\
 &= a^2b + 3ab^2 + b^3 \\
 &= c^2
 \end{aligned}
 \tag{16}$$

```

\begin{equation}
\begin{split}
(a+b) &= 2x-5y\\
&= (a+b)(a^2+b^2)\\
&= a^2b+3ab^2+b^3\\
&= c^2
\end{split}
\end{equation}

```

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► aligned and gathered – $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX

These environments, like `split`, can't be used on their own and can't produce an equation number.

They act like the `minipage` environment.

$$\begin{aligned}
 x^2 + y^2 &= 1 \\
 x &= \sqrt{1 - y^2} \\
 \text{and also } y &= \sqrt{1 - x^2}
 \end{aligned}
 \qquad
 \begin{aligned}
 (a + b)^2 &= a^2 + 2ab + b^2 \\
 (a + b) \times (a - b) &= a^2 - b^2
 \end{aligned}
 \qquad
 (17)$$

```

\begin{equation}
\begin{aligned}
x^2 + y^2 &= 1 \\
x &= \sqrt{1-y^2} \\
\text{and also } y &= \sqrt{1-x^2}
\end{aligned}
\end{equation}

```

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► Equation delimiters

L^AT_EX can determine the size of the delimiters with commands `\left` and `\right`.

$$1 + \left(\frac{1}{1-x^3} \right)^3 \quad 1 + \left(\frac{1}{1-x^3} \right)^3$$

```
\begin{equation*}
1 + \left( \frac{1}{1-x^3} \right)^3 \quad \quad
1 + \left( \frac{1}{1-x^3} \right)^3
\end{equation*}
```

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► Equation delimiters (cont.)

Note that you must close each opening delimiter (`\left`) with a closing delimiter (`\right`) on each line, or use an invisible delimiter (`\right.`).

$$(a + b)^3 = \left[(a + b)(a + b)^2 + \sum_{n+1}^n (a + b)(a^2 + 2ab_b^2) \right] = a^3 a^2 b + 3ab^2 + b^3$$

```
\begin{equation*}
\begin{split}
(a+b)^3 =\quad & \left[(a+b) (a+b)^2 \right.\! \! \! \backslash
& \left. \sum_{n+1}^n (a+b)(a^2+2ab_b^2)\right]\! \! \! \backslash \\
& =\quad & a^3_3a^2b+3ab^2+b^3\! \! \! \backslash \\
\end{split}
\end{equation*}
```

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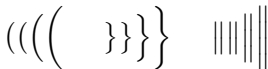
References

► Equation delimiters (cont.)

In this case it is necessary to indicate the size of the delimiters.

$$(a + b)^3 = \left[(a + b)(a + b)^2 + \sum_{n=1}^n (a + b)(a^2 + 2ab_b^2) \right] \\ = a^3 a^2 b + 3ab^2 + b^3$$

```
\begin{equation*}
\begin{split}
((a+b)^3 =\quad & \& \bigg[(a+b) (a+b)^2 \\\
& \& \sum^n_{n=1}+(a+b) (a^2+2ab_b^2)\bigg] \\\
= \quad & \& a^3_3a^2b+3ab^2+b^3 \\\
\end{split}
\end{equation*}
```



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

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► cases – $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX

$$|x| = \begin{cases} -x & \text{si } x < 0 \\ 0 & \text{si } x = 0 \\ x & \text{si } x > 0. \end{cases} \quad (19)$$

$$|x| = \begin{cases} -x & \text{si } x < 0 \\ 0 & \text{si } x = 0 \\ x & \text{si } x > 0. \end{cases} \quad (20)$$

```
\begin{equation}
|x| = \begin{cases}
-x & \text{si } \$x<0\$\\
0 & \text{si } \$x=0\$\\
x & \text{si } \$x>0.\$
\end{cases} \label{eqcases}
\end{equation}
```

```
\begin{equation}
|x| = \left\{ \begin{array}{l}
-x & \text{si } \$x<0\$\\
0 & \text{si } \$x=0\$\\
x & \text{si } \$x>0.\$
\end{array} \right. \label{eqcases2}
\end{equation}
```

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► **matrix** – $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX

In the `matrix` environment you don't need to specify the number of columns; the default values allows up to 10 centralized columns.

If you need more than 10 columns, you need to adjust the counter `MaxMatrixCols` in the preamble, with the command `\setcounter{MaxMatrixCols}{20}`.

$$\begin{matrix} 0 & 1 & (0 & -i) \\ 1 & 0 & (i & 0) \end{matrix}$$

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \quad \left\{ \begin{matrix} 1 & 0 \\ 0 & -1 \end{matrix} \right\}$$

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} \quad \left\| \begin{matrix} i & 0 \\ 0 & -i \end{matrix} \right\|$$

```
\begin{matrix} 0 & 1 & \backslash 1 & 0 \end{matrix}
\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}
\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}
\begin{Bmatrix} 1 & 0 \\ 0 & -1 \end{Bmatrix}
\begin{vmatrix} a & b \\ c & d \end{vmatrix}
\begin{Vmatrix} i & 0 \\ 0 & -i \end{Vmatrix}
```

✓ You could also use the `matrix` environment with delimiters.

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► **matrix** – $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX (cont.)

There is also the environment

`begin{smallmatrix} ... \end{smallmatrix}` environment for smaller matrices (to be placed in text, for example).

$$\begin{pmatrix} a + b + c & uv \\ a + b & c + d \end{pmatrix}$$

$$\begin{pmatrix} a+b+c & uv \\ a+b & c+d \end{pmatrix}$$

```

 $\begin{pmatrix}
  a + b + c & uv \\
  a + b & c + d
\end{pmatrix}$ 

```

```

 $\big(
\begin{smallmatrix}
  a + b + c & uv \\
  a + b & c + d
\end{smallmatrix}
\big)$ 
```

- Note that we need to write the delimiters.

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3. Algorithms

L^AT_EX has several packages for composing algorithms in the form of “pseudocode”. These provide stylistic improvements over a uniform style, so that constructs such as loops or conditions are visually separated. The pseudocode is generally placed in an “algorithm” environment.

- ▶ To compose real code written in a programming language, use the extension `listings`.
- ▶ Complete documentation on the various extensions is available on the website www.ctan.org.

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3.1 packages

- ▶ `\usepackage{algorithm}`: Floating environment for an algorithm. Works with `algorithmic` and `algorithmicx`.
- ▶ `\usepackage{algorithmic}`: First development environment for writing an algorithm.
- ▶ `\usepackage{algorithmicx}`: Second development environment for writing an algorithm.
- ▶ `\usepackage{algorithm2e}`: Third development environment for writing an algorithm. This is a floating environment in itself. It will not work if `\usepackage{algorithm}` is also in the preamble.
- ▶ `\usepackage{pseudocode}`: Simple environment for writing an algorithm.
- ▶ `\usepackage{algpseudocode}`: Layout extension for `algorithmicx`.

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3.2 pseudocode

```
\begin{pseudocode}[ovalbox]{SquareAndMultiply}(x,b,n)
  \PROCEDURE{ShiftRight}{b}
    \RETURN{b / 2}
  \ENDPROCEDURE
  \COMMENT{ Compute  $x^b \pmod{n}$  }
  z \GETS 1 \
  \WHILE b > 0 \DO
    \BEGIN
      z \GETS z^2 \pmod{n} \
      \IF b \mbox{ is odd} \THEN
        z \GETS z \cdot x \pmod{n} \
      b \GETS \CALL{ShiftRight}{b}
    \END \
  \RETURN{z}
\end{pseudocode}
```

Algorithm 0.1: SQUAREANDMULTIPLY(x, b, n)

```
procedure SHIFTRIGHT( $b$ )
  return ( $b/2$ )

comment: Compute  $x^b \pmod{n}$ 
 $z \leftarrow 1$ 
while  $b > 0$ 
  do  $\begin{cases} z \leftarrow z^2 \pmod{n} \\ \text{if } b \text{ is odd} \\ \text{then } z \leftarrow z \cdot x \pmod{n} \\ b \leftarrow \text{SHIFTRIGHT}(b) \end{cases}$ 
return ( $z$ )
```

- ▶ creation of a simple algorithm where pre-defined commands are limited (braces, fixed font size, etc.). A few possible modifications, such as numbering and adding boxes
- ▶ creates space to add a title
- ▶ numerotation registers automatically without being in the environment `algorithm`
- ▶ `\usepackage{pseudocode}` and `\usepackage{fancybox}`
- ▶ simple vocabulary

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pseudocode—list of useful commands

command	output
<code>\LOCAL{list of variables}</code>	local list of variables
<code>\GLOBAL{list of variables}</code>	global list of variables
<code>\EXTERNAL{list of procedures}</code>	external list of procedures
<code>\RETURN{list of values}</code>	return (list of values)
<code>\OUTPUT{list of values}</code>	output (list of values)
<code>\EXIT</code>	exit
<code>\AND</code>	and
<code>\OR</code>	or
<code>\NOT</code>	not
<code>\TRUE</code>	true
<code>\FALSE</code>	false
<code>\GETS</code>	←

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3.3 algorithmic

```

\renewcommand{\algorithmiccomment}[1]{// #1}

\renewcommand{\algorithmicrequire}{\textbf{Input:}}
\renewcommand{\algorithmicensure}{\textbf{Output:}}

\algsetup{linenose=\tiny}

\begin{algorithmic}[1]
  \REQUIRE $b$
  \ENSURE {ShiftRight $b$}
  \RETURN  $b / 2$ 
\end{algorithmic}

\begin{algorithmic}[3]
  \REQUIRE {$x$, $b$, $n$}
  \ENSURE {$x^b \pmod{n}$}
  \STATE $z$ \gets 1$
  \WHILE{$b > 0$}
    \STATE $z$ \gets  $z^2 \pmod{n}$ 
    \IF{$b$ is odd}
      \STATE $z$ \gets  $z \cdot x \pmod{n}$ 
    \ENDIF
    \STATE $b$ \gets \text{ShiftRight}(b)$
    \COMMENT{Call the ShiftRight function}
  \ENDWHILE
  \RETURN $z$
\end{algorithmic}

```

```

Input:  $b$ 
Output: ShiftRight  $b$ 
1: return  $b / 2$ 

Input:  $x, b, n$ 
Output:  $x^b \pmod{n}$ 
 $z \leftarrow 1$ 
while  $b > 0$  do
3:    $z \leftarrow z^2 \pmod{n}$ 
   if  $b$  is odd then
      $z \leftarrow z \cdot x \pmod{n}$ 
6:   end if
    $b \leftarrow \text{ShiftRight}(b)$  // Call the ShiftRight function
end while
9: return  $z$ 

```

- ▶ `\begin{algorithmic}[lines]`
- ▶ multiple preset commands
- ▶ flexibility to change command values (`\renewcommand{}`). Cannot change commands specific to `algorithmic`
- ▶ flexibility to change parameter values (`\algsetup{}`)
- ▶ `\usepackage{algorithm}` and `\usepackage{algorithmic}`
- ▶ simple vocabulary

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algorithmic—list of useful commands

```
\STATE <text>
\IF{<condition>} \STATE {<text>} \ELSE \STATE{<text>} \ENDIF
\IF{<condition>} \STATE {<text>} \ELSIF{<condition>} \STATE{<text>} \ENDIF
\FOR{<condition>} \STATE {<text>} \ENDFOR
\FOR{<condition> \TO <condition> } \STATE {<text>} \ENDFOR
\FORALL{<condition>} \STATE{<text>} \ENDFOR
\WHILE{<condition>} \STATE{<text>} \ENDWHILE
\REPEAT \STATE{<text>} \UNTIL{<condition>}
\LOOP \STATE{<text>} \ENDLOOP
\REQUIRE <text>
\ENSURE <text>
\RETURN <text>
\PRINT <text>
\COMMENT{<text>}
\AND, \OR, \XOR, \NOT, \TO, \TRUE, \FALSE
```

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3.4 algorithmicx

```

\renewcommand{\algorithmiccomment}[1]{// #1}
\begin{algorithmic}
\Procedure{ShiftRight}{b}
  \State \Return b / 2
\EndProcedure
\Procedure{SquareAndMultiply}{x, b, n}
  \Comment{Compute  $x^b \pmod{n}$ }
  \State  $z$  \gets 1
  \While{ $b > 0$ }
    \State  $z$  \gets  $z^2 \pmod{n}$ 
    \If{ $b$  is odd}
      \State  $z$  \gets  $z \cdot x \pmod{n}$ 
    \EndIf
    \State  $b$  \gets  $\text{Call}\{\text{ShiftRight}\}\{b\}$ 
  \EndWhile
  \State \Return  $z$ 
\EndProcedure
\end{algorithmic}

```

```

procedure SHIFTRIGHT(b)
  return b / 2
end procedure
procedure SQUAREANDMULTIPLY(x, b, n) // Compute
 $x^b \pmod{n}$ 
   $z \leftarrow 1$ 
  while  $b > 0$  do
     $z \leftarrow z^2 \pmod{n}$ 
    if  $b$  is odd then
       $z \leftarrow z \cdot x \pmod{n}$ 
    end if
     $b \leftarrow \text{SHIFTRIGHT}(b)$ 
  end while
  return  $z$ 
end procedure

```

- ▶ multiple preset commands
- ▶ greater flexibility to change command values (`\renewcommand{\}`) and can define new commands
- ▶ flexibility to change parameter values
- ▶ `\usepackage{algorithm}` is necessary to create a floating environment
- ▶ `\usepackage{algorithmicx}` is not necessary but the layout extension is necessary. The most commonly used is `\usepackage{algpseudocode}`
- ▶ simple vocabulary

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3.5 algorithm2e

```

\begin{algorithm}[H]
  \KwData{ $x$ ,  $b$ ,  $n$ }
  \KwResult{ $x^b \pmod{n}$ }
   $z$  \gets 1;
  \While{ $b > 0$ }{
     $z$  \gets  $z^2 \pmod{n}$ ;
    \If{ $b$  is odd}{
       $z$  \gets  $z \cdot x \pmod{n}$ ;
    }
    \tcc{Shift to right}
     $b$  \gets  $b / 2$ ;
  }
  \KwRet  $z$ 
\end{algorithm}

```

```

Data:  $x, b, n$ 
Result:  $x^b \pmod{n}$ 
 $z \leftarrow 1$ ;
while  $b > 0$  do
  |    $z \leftarrow z^2 \pmod{n}$ ;
  |   if  $b$  is odd then
  |     |  $z \leftarrow z \cdot x \pmod{n}$ ;
  |   end
  |   /* Shift to right
  |    $b \leftarrow b/2$ ;
  |
end
return  $z$ 

```

- ▶ multiple predefined commands, including several for managing comments
- ▶ lines of commands must finish with “;”
- ▶ maximum flexibility to define commandes
- ▶ title and labels must be located just before the `\end{algorithm}`
- ▶ `\usepackage{algorithm2e}`
- ▶ specific and less natural vocabulary

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4.1 Tabular

```
\begin{tabular}{description of the table}
description of the table
\end{tabular}
```

- ▶ description of the table:

l	column with text aligned to the left
r	column with text aligned to the right
c	column with text centered
p{ <i>largeur</i> }	column with right-justified text on several lines
	vertical lines of the table

- ▶ in the table:

&	jumps to the next column
\\	jumps to the next line
\hline	insert an horizontal line
\cline{x-y}	insert an horizontal line between column x and column y

- ▶ Which tabular packages do which tasks and which packages conflict?

<https://tex.stackexchange.com/questions/12672/which-tabular-packages-do-which-tasks-and-which-packages-conflict>

- ▶ Comprehensive list of tools that simplify the generation of LaTeX tables

<https://tex.stackexchange.com/questions/49414/comprehensive-list-of-tools-that-simplify-the-generation-of-latex-tables?noredirect=1&lq=1>

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4.3 Longtable

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Example of a multi-column centralized title with multicolumn
Example of a note under the table with multicolumn

The numbers	
7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal

NOTE: These numbers are the outcome of chance.
These numbers are the outcome of chance.

```

\begin{tabular}{|r|l|}
\hline
\multicolumn{2}{|c|}{\bfseries The numbers}\hline
\hline
7C0 & hexadecimal \\
3700 & octal \\
11111000000 & binary \\
\hline
1984 & decimal \\
\hline
\end{tabular}

```

- ▶ No package to include
- ▶ Command : `\multicolumn{nb_columns}{alignment}{content}`

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Table 1: Title of the table

	Calls	
	$M \leq -0.2$	$-0.2 < M \leq 0$
Average IV(%)	17.90	15.23
Standard deviation IV(%)	7.19	5.46
Number of contracts	274,252	774,321
	$\tau \leq 30$	$30 < \tau \leq 90$
Average IV(%)	24.68	23.93
Standard deviation IV(%)	13.08	11.27
Number of contracts	277,521	1,008,508

```

\begin{table}[h]
\caption{Title of the table}\label{tab:1}
\setlength{\tabcolsep}{3pt}
\begin{threeparttable}
\begin{tabular}{l*{2}{c}}
\toprule
& \multicolumn{2}{c}{Calls} \\
\cmidrule{1r}{2-3}
&  $M \leq -0.2$  &  $-0.2 < M \leq 0$  \\
Average IV(%) & 17.90 & 15.23 \\
Standard deviation IV(%) & 7.19 & 5.46 \\
Number of contracts & 274,252 & 774,321 \\
\bottomrule
&  $\tau \leq 30$  &  $30 < \tau \leq 90$  \\
Average IV(%) & 24.68 & 23.93 \\
Standard deviation IV(%) & 13.08 & 11.27 \\
Number of contracts & 277,521 & 1,008,508 \\
\bottomrule
\end{tabular}
\end{threeparttable}
\begin{tablenotes}[flushleft]
\item[a] This is a very long table note This is a very long table note
This is a very long table note This is a very long table note This
is a very long table note This is a very long table note
\item[b] This is another table note
\end{tablenotes}
\end{table}

```

^a This is a very long table note This is a very long table note
This is a very long table note This is a very long table note This
is a very long table note This is a very long table note
^b This is another table note

► Package `\usepackage[option]{threeparttable}`

Overly long long text			
a	b	c	d
000	001	002	003
000a	001a	002a	003a
000b	001b	002b	003b

```
\begin{tabular}{lccr}
\hline
& \multicolumn{2}{c}{Overly long long text} & \\
\cline{2-3}
\multicolumn{1}{c}{\bfseries a}
& {\bfseries b} & {\bfseries c}
& \multicolumn{1}{c}{\bfseries d}\\
\hline
000 & 001 & 002 & 003\\
000a & 001a & 002a & 003a\\
000b & 001b & 002b & 003b\\
\hline
\end{tabular}
```

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Overly long long title			
a	b	c	d
000	001	002	003
000a	001a	002a	003a
000b	001b	002b	003b

```
\begin{tabular}{lccr}
\hline
& \multicolumn{2}{c}{0verly long}& \\
& \multicolumn{2}{c}{long title}& \\
\cline{2-3}
\multicolumn{1}{c}{\bfseries a}
& {\bfseries b} & {\bfseries c}
& \multicolumn{1}{c}{\bfseries d}\\
\hline
000 & 001 & 002 & 003\\
000a & 001a & 002a & 003a\\
000b & 001b & 002b & 003b\\
\hline
\end{tabular}
```

Overly long long text			
a	b	c	d
000	001	002	003
000a	001a	002a	003a
000b	001b	002b	003b

```
\begin{tabular}{lccr}
\hline
& \multicolumn{2}{c}{C{.34\linewidth}}
{0verly long long text}& \\
...
\hline
\end{tabular}
```

Tip for aligning columns differently with the array extension.
Commands to put in the preamble:

```
\newcolumntype{L}[1]{>\raggedright\arraybackslash}p{#1}}
\newcolumntype{C}[1]{>\centering\arraybackslash}p{#1}}
\newcolumntype{R}[1]{>\raggedleft\arraybackslash}p{#1}}
```

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Title on two columns				
a	b	c	d	e
000	001	002	003	004
000a	001a	002a	003a	004a
000ab	001ab	002ab	003ab	004ab

Normal text after the table. The table should not overlap into the right margin.

```

\begin{tabular}{lccrr}
\hline
& \multicolumn{2}{c}{Title on two columns} & & \\
\cline{2-3}
000 & 001 & 002 & 003 & 004 \\
000a & 001a & 002a & 003a & 004a \\
000ab & 001ab & 002ab & 003ab & 004ab \\
\hline
& \multicolumn{1}{c}{\bfseries d} \\
& \multicolumn{1}{c}{\bfseries e} \\
\hline
000 & 001 & 002 & 003 & 004 \\
000a & 001a & 002a & 003a & 004a \\
000ab & 001ab & 002ab & 003ab \\
& 004ab \\
\hline
\end{tabular}

```

```

\medskip
Normal text after the table. The table
should not overlap into the right margin.

```

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2. Basics

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Title on two columns				
a	b	c	d	e
000	001	002	003	004
000a	001a	002a	003a	004a
000ab	001ab	002ab	003ab	004ab

Normal text after the table. The table do not overlap anymore into the right margin.

```

{\setlength{\tabcolsep}{3pt}
\begin{tabular}{lccrr}
\hline
000 & 001 & 002 & 003 & 004 \\
000a & 001a & 002a & 003a & 004a \\
000ab & 001ab & 002ab & 003ab & 004ab \\
\hline
\end{tabular}
}

```

```

\medskip
Normal text after the table. The table
do not overlap anymore into the right
margin.

```

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Semester	Months	Days
Fall	October	31
	November	30
	Décember	31
Winter	January	31
	February	28
	March	31
	April	30

```

\begin{tabular}{llc}
\hline
Semester & Months & Days\\
\hline
& October & 31\\
Fall & November & 30 \\
& Décembre & 31\\
Winter & January & 31 \\
& February & 28 \\
& March & 31 \\
& April & 30\\
\hline
\end{tabular}

```

- ▶ Package multirow
- ▶ Command : `\multirow{nb_row}{length}{content}`

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Title 1			Title 2	
a	b	c	d	e
000	001	002	003	004
000a	001a	002a	003a	004a
000ab	001ab	002ab	003ab	004ab

```

\begin{tabular}{lccrr}
\toprule
& \multicolumn{2}{c}{Title 1}
& \multicolumn{2}{c}{Title 2} \\
\cmidrule(r){2-3} \cmidrule(r){4-5}
\multicolumn{1}{c}{\bfseries a}
& {\bfseries b} & {\bfseries c}
& \multicolumn{1}{c}{\bfseries d}
& \multicolumn{1}{c}{\bfseries e} \\
\midrule
000 & 001 & 002 & 003 & 004 \\
000a & 001a & 002a & 003a & 004a \\
000ab & 001ab & 002ab & 003ab
& 004ab \\
\bottomrule
\end{tabular}

```

- ▶ Package booktabs
- ▶ Commandes : `\toprule`, `\midrule`, `\cmidrule{x-y}` `\bottomrule`
 - ▶ Note the optional argument to the `\cmidrule` command in brackets indicating which side of the line is to be shortened, `\cmidrule(l,r,lr,l{5pt},r{10pt}){x-y}`

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4.2 Tabularx

Example using tabularx

One and two		Three	Four
One	The width of this column depends on the width of the table	Three	Column four also depends on the width of the table

Text on the width of the 4 columns

	The next line starts here		Note that the text is justified
--	---------------------------	--	---------------------------------

```
\begin{tabularx}{4.4cm}{|c|X|c|X|}
\hline
\multicolumn{2}{|c|}{One and two}
& Three & Four\\
\hline
One & The width of this column
depends on the width of the table
& Three & Column four also depends
on the width of the table\\
\hline
\multicolumn{4}{|l}{Text on the
width of the 4 columns}\\
\hline
& The next line starts here &
& Note that the text is justified\\
\hline
\end{tabularx}
```

- ▶ Package tabularx
- ▶ Note the addition of a table width argument
- ▶ Column width “X” automatically calculated by L^AT_EX
- ▶ Same thing as p{width} in a standard tabular, but we don’t have to calculate the column width; L^AT_EX distributes the empty space between the X

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4.3 Longtable

For tables longer than one page:

- ▶ Package `longtable`
- ▶ Command: `\begin{longtable}[c]{lcr} ... \end{longtable}`
- ▶ Note the addition of an argument in square brackets: the position of the table in the page – `c` for centered, `l` for the left margin and `r` for the right margin
- ▶ Replaces the environment `table` (which it automatically increments), can be numbered, reference possible, and appears in the list of tables
- ▶ Use the `\newpage` command to force a page break at the desired position within the table
- ▶ Note that the `\caption{...}` must be followed by `\\` to appear
- ▶ Compile L^AT_εX three times

✓ *Note that the table counter is automatically incremented, even if you don't add a caption to your `longtable` environment. Don't forget to correct the table counter before the next environment (`\setcounter{table}{4}`).*

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```
%tab3
\begin{longtable}[c]{*{4}{c}}
\caption{Exemple de longtable avec titre de colonnes se répétant
à chaque page}\label{tab3}\\
\toprule
Titre 1\`ere colonne & Titre 2e colonne & Titre 3e colonne & Titre 4e colonne\\
\midrule
%
\endfirsthead
%
\multicolumn{4}{l}{\emph{Table 3 \ldots\ suite}}\***[10pt]
\midrule
Titre 1ere colonne & Titre 2e colonne & Titre 3e colonne & Titre 4e colonne\\
\midrule
\endhead
\midrule \multicolumn{4}{r}{\emph{Suite \`a la page suivante \ldots}}
\endfoot
\endlastfoot
texte colonne 1 & texte colonne 2
& texte colonne 3 & texte colonne 4 \\
%
... reste du texte ... &... reste du texte ...
&... reste du texte ...&... reste du texte ... \\
%
... reste du texte ... &&& \\
... reste du texte ... &&& \\
... reste du texte ... &&& \\
... reste du texte ... &&& \\
\bottomrule
\end{longtable}
```

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4.4 Table created from an external file

- ▶ Requires the extensions `pgfplots`, `pgfplotstable` and `array`
- ▶ `pgfplotstable` is a code generator that generates a `\begin{tabular} ... \end{tabular}` with data extracted from an external file. Use to customize and standardize tables or automatically format numerical data
- ▶ If you use Excel, convert your data into a `.txt` file. Choose the save option: `Text(separator:tabulation)(* .txt)`
- ▶ Then use `pgfplots` to generate the layout and `pgfplotstable` to generate the table, both reading the data files

```

\documentclass{article}

\usepackage{pgfplots}
\usepackage{pgfplotstable}
\usepackage{booktabs}
\usepackage{array}
\usepackage{colortbl}

\pgfplotstableset{% global configuration, for example in the preamble
every head row/.style={before row=\toprule,after row=\midrule},
every last row/.style={after row=\bottomrule},
fixed,precision=2,
}

\begin{document}

\pgfplotstabletypeset[
columns/freq/.style={column name=Frequency (Hz)},
columns/conc/.style={column name=Concrete},
columns/lino/.style={column name=Linoleum},
]{2020-02-01.txt}

\end{document}

```

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4.4 Table created from an external file (cont.)

- ▶ Will give

Frequency (Hz)	Concrete	Linoleum
125	0.01	0.02
250	0.01	0.03
500	0.02	0.03
1,000	0.02	0.03
2,000	0.02	0.03
4,000	0.02	0.02

- ▶ This example is taken from: <https://tex.stackexchange.com/questions/152027/plot-data-from-a-latex-table>
- ▶ Documentation `pgfplotstable` to personalize your tables <http://ctan.mirror.globo.tech/graphics/pgf/contrib/pgfplots/doc/pgfplotstable.pdf>
- ▶ Overleaf's example of a more general usage of `pgfplots` https://www.overleaf.com/learn/latex/Pgfplots_package

✓ *Note that columns are centered by default.*

✓ *Knowing the `kpgf` keys `pgfkeys` helps you code your desires!*

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4.5 Table created using a web converter (cont.)

► <https://www.tablesgenerator.com/>

► % Please add the following required packages to your document preamble:

```
% \usepackage{booktabs}
% \usepackage{graphicx}
% \usepackage{landscape}
\begin{landscape}
\begin{table}[]
\caption{}
\label{tab:my-table}
\resizebox{\textwidth}{!}{%
\begin{tabular}{@{}l|lllllllllllllllllllll@{}}
\toprule
conferencier_nom & conferencier_prenom & conferencier_institution & & conferencier_pays & titre
Attila & Öykü & Université du Québec à Montréal & Canada & Python Workshop Season 2 - pa
Attila & Öykü & Université du Québec à Montréal & Canada & Python Workshop Season 2 - pa
Attila & Öykü & Université du Québec à Montréal & Canada & Python Workshop Season 2 - pa
Attila & Öykü & Université du Québec à Montréal & Canada & Python Workshop Season 2 - pa
\end{tabular}%
}
\end{table}
\end{landscape}
```

✓ To make the table more attractive and flexible, use the formula `\begin{tabular}{*{n}{columns style}}`. In this example : `{*{29}{l}}`.

✓ from the online tool, select the `booktabs` style instead of the by default.

✓ Several options are available. For example, the position of the `\caption{}` and the `\label{tab:my-table}`. In the various options you can resize the table to the width of the text or column, rotate the table in landscape mode and add the `longtable` environment. But don't forget to add extensions in the document preamble.

✓ Beware of using `\resizebox{\textwidth}{!}{%}`.

✓ All that's left to do is to modify the columns titles.

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Creating a bibliography and inserting it into a document is summarized in the following steps:

1. Create the bibliographic database in BibTeX format and save it in a file with the extension `.bib`
2. Insert a quotation and/or bibliography in the L^AT_EX document (`fichier.tex`)
 - ▶ To insert a quotation in the text: `\cite{label}`
 - ▶ To add the bibliographic style used. This item must always be present, either in the preamble or before the bibliographic file:
`\bibliographystyle{style.bst}`
 - ▶ To add the bibliography at the exact place where it should appear:
`\bibliography{biblio1.bib;biblio2;chemin/biblio3}`
 - ▶ Compile the file three times

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5.1 BibTeX¹

BibTeX is reference management software for formatting lists of references:

- ▶ Manage and process citations and personal bibliographic databases;
- ▶ Insert references from one or more bibliographic databases;
- ▶ Cite references in the body of the text;
- ▶ Create a bibliography or list of references in documents;
- ▶ Manually or automatically import references from databases such as Compendex, Web of Science, Google Scholar, etc. ;
- ▶ Import from other bibliographic management software such as EndNote, Zotero and JabRef;
- ▶ Separate content (bibliographic references) from the format of the text (bibliographic style);
- ▶ Produce bibliographies according to different citation styles.

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¹This section is taken from the following site: <https://guides.biblio.polymtl.ca/bibtex>

- ▶ BibTeX offers a pre-defined set of syntaxes.
- ▶ The general form of an entry in a .bib file is:

```
@type_d'entree{cle_de_citation, champ_requis  
[, champ_optionnel]}
```

- ▶ The syntax of the entries:

```
@article, @book, @booklet, @electronic, @inbook, @incollection,  
@inproceedings, @proceedings, @manual, @mastersthesis, @patent,  
@periodical, @phdthesis, @standard, @techreport, @unpublished,  
et @misc
```

✓ Depending on the style of bibliography used, it is possible to references in the text with a number in square brackets [10] or, via natbib, the author's name with the date of publication of the book or article (Nash, 1950), etc. publication date of the book or article (Nash, 1950), etc. Of course, the author's name and the year have only been written once in the bibliography, to avoid errors.

✓ natbib reference sheet: <https://gking.harvard.edu/files/natnotes2.pdf>

✓ When you import BibTeX references, check them as you go to unify your .bib file

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5.2 .bib et .bbl

The `.bib` file format is used to describe bibliographical references. When used together with LaTeX and BibTeX, it generates a file with the `.bbl` extension, which is really just a `tex` file with a different extension containing your references **formatted according to the bibliography style chosen in your `.tex` file** through the `\bibliographystyle{}` command. LaTeX then automatically inserts the contents of the `bbl` file in the exact place you call the `\bibliography{}` command in your document.

Usually, when working with TeX documents, journal and conference editors don't want to go to the trouble of using BibTeX to compile your paper; they prefer to defer the responsibility of sending the bibliography correctly formatted to the paper author (you). So, they tell you to manually do what `pdflatex` and `bibtex` automate for you: to get the contents of the `bbl` file and put them where you would call the `\bibliography{}` command. This way, you only have to send them a single `tex` file, instead of the `tex` file along with the `bib` file.

<https://tex.stackexchange.com/questions/302916/difference-between-a-bib-and-bbl-file-for-latex>

```
\begin{thebibliography}{99}

\bibitem{AuDeLe07}
C.~Audet, J.E.~{Dennis,~Jr.}, and S.~{Le~Digabel}.
\newblock {{Parallel space decomposition of the MADS algorithm}}.
\newblock {SIAM Journal on Optimization}, 19(3):1150--1170, 2008.

\bibitem{AuHa2017}
C.~Audet and W.~Hare.
\newblock {{Derivative-Free and Blackbox Optimization}}.
\newblock Springer Series in Operations Research and Financial
Engineering. Springer International Publishing, 2017.

\end{thebibliography}
```

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- ▶ Double-spaced or single-spaced and half-spaced text:
 - ▶ `\baselineskip`
Line spacing is usually 2.5 pt higher than the font used. For example, for an 11 pt font, the line spacing is approximately 13.5 pt. For text with one and a half line spacing, we use a `baselineskip` of around 18 pt; for double-spaced text, about 24 pt. The command is placed after the `\begin{document}` and looks like that: `\baselineskip=13.5pt`. This command affects only the text.
 - ▶ `\usepackage{setspace}`
Robust, it affects the entire document. We use a “multiplier” of the normal line spacing. `begin{spacing}{1.2} ... \end{spacing}` gives 1.2 times the normal line spacing. You can also use the following commands:
`\singlespace`, `\onehalfspace` or `\doublespace`.
- ▶ Indent the first paragraph, use this command
`\setlength{\parindent}{15pt}` in the preamble. For a document where you don't want indentation, simply set it to 0pt.
- ▶ To insert a line that would otherwise have appeared on another page (to cheat a little), use `\enlargethispage{1\baselineskip}` in the page you want it.

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- ▶ Space between paragraphs, place the command `\setlength{\parskip}{12pt plus 1 pt minus 1 pt}` in the preamble. This gives L^AT_EX a little freedom for the layout.
- ▶ To remove the page number, use the command `\pagestyle{empty}`; for the current page only, use `\thispagestyle{empty}`.
- ▶ To force a page number, use the command `\setcounter{page}{17}`.
 - ▶ This is the same command for forcing the number of all counters (equation, enumerate, figure, table, algorithm, ...).
 - ▶ In the appendix section, you can change the type of numbering to mark the difference `\setcounter{table}{0} \renewcommand{\thetable}{A.\arabic{table}}`, `\setcounter{equation}{0} \renewcommand{\theequation}{A.\arabic{equation}}`,...
- ▶ To change the appearance of the page number, use the command `\pagenumbering{style}`, the style being
 - ▶ Alph : for uppercase alphabetical letters
 - ▶ alph : for lower-case alphabetical letters
 - ▶ Roman : for uppercase Roman numerals
 - ▶ roman : for lowercase Roman numerals
 - ▶ arabic : for Arabic numerals (by default).

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Frequently asked questions (cont.)

- ▶ How to draw with L^AT_EX?

Answer : with the extensions `pgf` and `tikz`

- ▶ TikZ & PGF –Manual for Version 2.10–CVS, Till Tantau, 2007, 880 pages. <http://math.et.info.free.fr/TikZ/bdd/TikZ-Impatient.pdf>
- ▶ A very minimal introduction to TikZ, Jacques Crémer, Toulouse School of Economics, March 11, 2017, 24 pages. <http://cremeronline.com/LaTeX/minimaltikz.pdf>
- ▶ TikZ pour l'impatient, Gérard Tisseau et Jacques Duma, 11 février 2017, 166 pages. <http://math.et.info.free.fr/TikZ/bdd/TikZ-Impatient.pdf>
- ▶ Introduction à TikZ, Luciano costa, Lucie Desfontaines, Karine Hébert et Frédéric Quesnels, GERAD, 2022, 89 pages. <https://www.gerad.ca/aide/latex/tikz/>

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References

- ▶ Goossens, M., Mittlebach, F., Samarin, A., *The L^AT_εX Companion*, second edition, Addison-Wesley Publishing Company, Reading, Massachusetts, 2004.
- ▶ L^Ampport, L., *A Document Preparation System*, Addison-Wesley, Reading, Massachusetts, second edition, 1994.
- ▶ Oetiker, T., Partl, H., Hyna, I., Schlegl, E., *Une courte (?) introduction à L^AT_εX 2_ε ou L^AT_εX 2_ε en 166 minutes*, traduit en français par S. Colin, M. Pégourié-Gonnard et M. Herrb, disponible à <http://ctan.cms.math.ca/tex-archive/info/lshort/french/lshort-fr.pdf>.

Online references

- ▶ Wikibooks: <http://en.wikibooks.org/wiki/LaTeX>
- ▶ CTAN website: <http://www.ctan.org>
- ▶ FAQ L^AT_εX: <http://www.tex.ac.uk>
- ▶ L^AT_εX project: <http://www.latex-project.org>
- ▶ Symbols: <http://detexify.kirelabs.org/classify.html>
- ▶ BibTeX, JabRef: <https://guides.biblio.polymtl.ca/bibtex>
- ▶ Q&A: <https://tex.stackexchange.com>
- ▶ Short Math guide for L^AT_εX: <http://tug.ctan.org/info/short-math-guide/short-math-guide.pdf>

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