

# L<sup>A</sup>T<sub>E</sub>X: from dummy to T<sub>E</sub>Xnician

## Overview and basis

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ISP 2019,  
*lesson 1*

# What we will know?

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Introduction: on approaches to  $\text{\LaTeX}$

“Hello, world”: first steps in  $\text{\LaTeX}$

Mastering the base

# Acknowledgments

---

We acknowledge

**Vlad Yurchenko** for being the co-author of the first version of this presentation in 2015

**Dmitry Barashev** for useful comments, that was included in the presentation

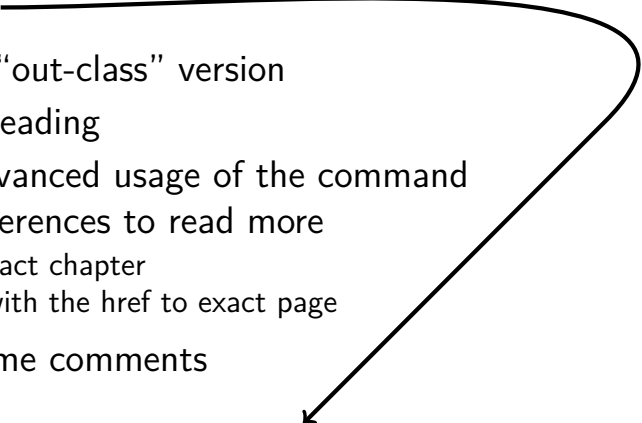
**Alexey Dmitriev** for useful comments, that was included in the presentation

**Peter Borisovets** for being a tester of the presentation

# Agreements

I

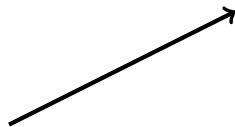
## Footnotes

- ▶ Only in the “out-class” version
  - ▶ For second reading
  - ▶ Containe advanced usage of the command
  - ▶ Containe references to read more
    - ▶ to the exact chapter
    - ▶ (often) with the href to exact page
  - ▶ Containe some comments
- 

*Like this*



## Addition information – “magic”



- ▶ To have the full picture
- ▶ Not to analyze or to puzzle out in class

# What we will know?

---

Introduction: on approaches to  $\text{\LaTeX}$

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# Pros and Cons

# Cons

---

- when you want to put something in **attributary position**
- when you want to do something “**against the rules**”
- when you want to work with **visual-based** things (tables, pictures)
- when you want to do something really **simple**
- when you want to do something “**quick and dirty**”



# Cons

Science research about L<sup>A</sup>T<sub>E</sub>X

---

“We show that LaTeX users were **slower** than Word users <...> and produced **more typesetting**, <...>. LaTeX users, however, more often report **enjoying using** their respective software.”

# Pros

---

- + When you have lots of equations
- + When you have a complex, but typical document
- + When you carry about device-independant view and edit
- + When you don't want not care about the beauty, but want it
- + When you are care about the beauty wery much
- + When you love text files

$\text{\LaTeX}$  is only for use  
in academic area

# Common belief

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L<sup>A</sup>T<sub>E</sub>X is common use  
in academic area

**WRONG**

# The power of $\text{\LaTeX}$ in it's templates and flexibility!

---

Look at examples at:

- ▶ <https://www.latextemplates.com/>
- ▶ <https://tex.stackexchange.com/questions/158668/nice-scientific-pictures-show-off>
- ▶ <https://tex.stackexchange.com/questions/1319/showcase-of-beautiful-typography-done-in-tex-friends>
- ▶ ...

# Conclusion

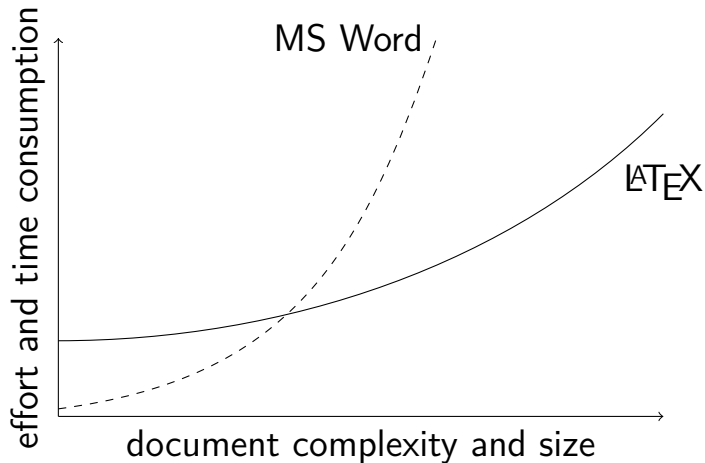
---

Now, in 2019, using  $\text{\LaTeX}$  to write scientific articles with no math inside is more matter of joy, not productivity: MS Office took over lots of  $\text{\LaTeX}$ 's ideas.

But  $\text{\LaTeX}$  becoming better too! because of packages, online tools and developing  $\text{\LaTeX}$ 3.

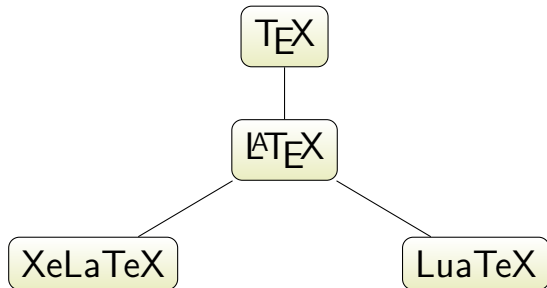
And for something as complex as this presentation you'll spend way too more time, trying to reproduce it with MS Office.

# Illustration



# What we have

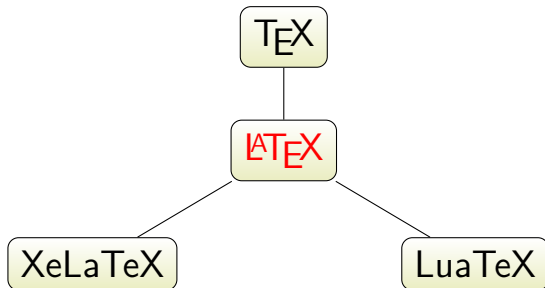
---





# Definitions

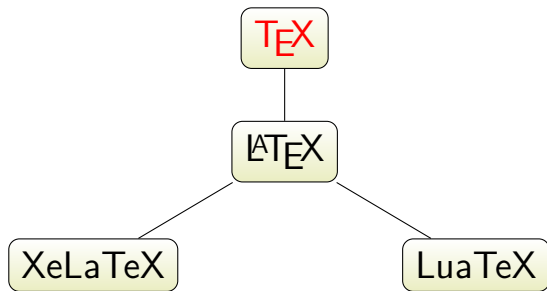
---



**LaTeX** — is the most popular set of macro-extensions (or macro package) of the computer typesetting system **TeX**, which facilitates a typesetting of complex documents.

# Definitions

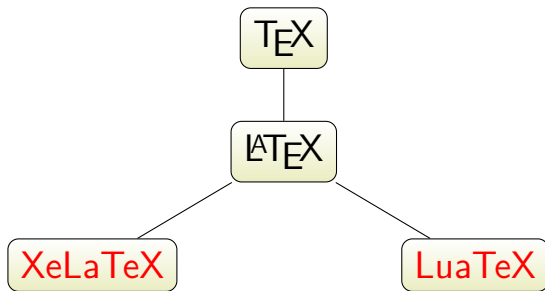
---



**TeX** — is a typesetting system designed and mostly written by Donald Knuth — the “father of modern Computer Science”. TeX was designed with two main goals in mind: to allow anybody to produce high-quality books using minimal effort and to provide a system that would give exactly the same results on all computers, at any point in time

# Definitions

---



**XeLaTeX** — XeTeX is a  $\text{T}_{\text{E}}\text{X}$  typesetting engine using Unicode and supporting modern font technologies such as OpenType, Graphite and Apple Advanced Typography

**LuaTeX** — LuaTeX is a  $\text{T}_{\text{E}}\text{X}$ -based computer typesetting system which started as a version of pdfTeX with a Lua scripting engine embedded



- ▶ Knuth “The T<sub>E</sub>XBook” (en, ru)
- ▶ L’vovsky “Nabor i verstka v sisteme L<sup>A</sup>T<sub>E</sub>X” (ru)
- ▶ Lamport. “L<sup>A</sup>T<sub>E</sub>X. A Document Preparation System, User’s Guide and Reference Manual” (en)
- ▶ Gratzer “Math into L<sup>A</sup>T<sub>E</sub>X” (en)
- ▶ Oetiker “The Not So Short Introduction to L<sup>A</sup>T<sub>E</sub>X” (en, ru)
- ▶ <https://www.overleaf.com/learn>
- ▶ <https://www.latex-project.org/help/>
- ▶ <https://texfaq.org/>

# Resources

## Interesting links

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questions about  $\text{\TeX}$  <https://tex.stackexchange.com>

knowing a command of the symbol <http://detexify.kirelabs.org/classify.html>

beauty of TikZ <http://www.texample.net/tikz/examples/>

beauty of pictures <https://tex.stackexchange.com/questions/158668/nice-scientific-pictures-show-off>

beauty of typesetting <https://tex.stackexchange.com/questions/1319/showcase-of-beautiful-typography-done-in-tex-friends>

# where to get

---

## 1. Online

- ▶ <http://papeeria.com>
- ▶ <https://overleaf.com>

## 2. Offline

- ▶  $\text{\LaTeX}$  <https://www.latex-project.org/get/>
- ▶ package manager `tlmgr`

# What we will know?

---

Introduction: on approaches to  $\text{\LaTeX}$

“Hello, world”: first steps in  $\text{\LaTeX}$

Mastering the base

# WYSiWYG vs not-WYSiWYG approaches

---

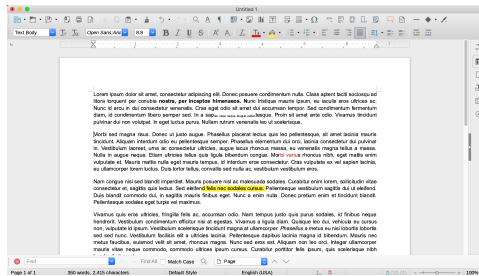
**WYSiWYG** – *What You See is  
What You Get* approach



# WYSiWYG vs not-WYSiWYG approaches

**WYSiWYG** – *What You See is What You Get* approach

## Microsoft Word



# not-WYSiWYG

## HTML and CSS

```
<html>
  <head>
    <meta charset="utf-8">
  </head>
  <style>h1{color:red;}</style>
  <body>
    <h1>Header</h1>
    <i>Hello</i>,<br/> world!  <!--
      comment -->
  </body>
</html>
```

1  
2  
3  
4  
5  
6  
7  
8  
9  
10

**Header**

*Hello,*  
world!

```
...
  <style>h1{color:green;}</style>
...
```

1  
2  
3

**Header**

CSS was most probable created influenced by T<sub>E</sub>X

# not-WYSiWYG

## L<sup>A</sup>T<sub>E</sub>X

```
\documentclass[a4paper,11pt]{article} 1
\usepackage{xcolor} 2
\usepackage{titlesec} 3
\usepackage{fontspec} 4
5
\titleformat*{\section}{\LARGE\ 6
    bfseries\color{red}}
\begin{document} 7
    \section{Header} 8
    \textit{Hello},\ \ world! \% 9
        comment
\end{document} 10
```

### 1 Header

*Hello,*  
world!

```
... 1
\titleformat*{\section}{\LARGE\ 2
    bfseries\color{green}}
... 3
```

### 1 Header

# Commands

---

`\command[o1, o2]{n1, n2=value}[o3]{n3}`  
(o = optional argument, n = necessary argument)

# Commands

---

`\command[o1, o2]{n1, n2=value}[o3]{n3}`

(o = optional argument, n = necessary argument)

Command symbols `\$ \# \{ \} \^{\} \& \_ \sim{\} \backslash`

Command words `\sin \LaTeX \rightarrow \quad`

Environments

`\begin{frame}\end{frame} \begin{equation}\end{equation}`

# Document structure

## overview

---

```
\documentclass[a4paper,11pt]{article} % document class -- the large-scale settings 1
% start of ``preamble'' 2
%% add style files 3
    \usepackage{fontspec} 4
    \usepackage{fancyhdr} 5
    \usepackage{xcolor} 6
%% tune settings 7
    \pagestyle{fancy} 8
%% create variables etc 9
    \definecolor{lvocolor}{RGB}{0, 253, 250} 10
% end of ``preamble'' 11
\begin{document} %% from here to the end -- the document itself 12
    \section{Header} 13
    \textit{Hello},\\ world! 14
\end{document} 15
```

# Document structure

class files

---

Class of the document is responsible for the large-scale settings

```
{beamer} %presentation, poster
{report}
{book}
{standalone} %for one picture/equation
{extarticle} %if you want 14pt font size
\documentclass[10pt, onecolumn, a4paper]{article}
    [12pt] %fontsize
        [twocolumns] %number of columns in document
            [a5paper] %paper size
```

# Document structure

style files

---

Style files are responsible for settings and providing new commands

```
\usepackage[optional]{necessary}{packagename}
```



# What we will know?

---

Introduction: on approaches to  $\text{\LaTeX}$

“Hello, world”: first steps in  $\text{\LaTeX}$

Mastering the base

# What we will know?

---

## Mastering the base

Text

Inputs

Math

# Writing *Text*

---

```
In most cases , the  
text is just a  
text . You write it  
and write and  
write . The system  
creates line  
breaks by itself .
```

1

In most cases, the text is just a text. You write it and write and write. The system creates line breaks by itself.

# Spaces

Multiple spaces are  
ignored. 1

One new line is like  
space. 2

If you write a % after  
the line% 3

the next character  
will be the letter,  
not space, 4

All spaces before  
the begin of the line  
are ignored 5

Multiple spaces are ignored. One new line is like space. If you write a % after the line the next character will be the letter, not space, All spaces before the begin of the line are ignored

# Paragraph

---

Two new lines --- new  
paragraph.

as well as \par \$\backslash\$par command.

More than 2 lines ---  
only as two.

1

2

3

4

5

6

7

8

Two new lines — new  
paragraph.

as well as

\par command.

More than 2 lines — only  
as two.

# Indents

---

By default, there is an indent. 1

\par\noindent You can start without it. \indent or force to make it. 2

By default, there is an indent.

You can start without it. or force to make it.

# More spaces

---

Use ~ for non  
brocken space and ~~~  
more spaces. Or \ \ \  
like this

---

Use \\ for new line.  
And more then one  
~\\~\\~\\ new line

Use    for non brocken  
space and    more spaces.  
Or    like this

---

Use  
for new line. And more  
then one

new line

# Spaces and commands

---

source

result

---

`\TeX□book`

TeXbook

---

`\TeX{}□book`

TeX book

---

`\TeX\□book`

TeX book

---



# Fonts

shape (form)

---

Upright shape

`\textup{text}`

`{\upshape text}`

*Italic shape*

`\textit{text}`

`{\itshape text}`

*Slanted shape*

`\textsl{text}`

`{\slshape text}`

SMALL CAPS SHAPE

`\TEXTSC{TEXT}`

`{\SCSHAPE TEXT}`

# Fonts

saturation (series)

---

Medium series  
**Boldface series**

`\textmd{text}`  
`\textbf{text}`

`{\mdseries text}`  
`{\bfseries text}`

# Fonts

garniture (family)

---

Roman family

`\textrm{text}`

`{\rmfamily text}`

Sans serif family

`\textsf{text}`

`{\sffamily text}`

Typewriter family

`\texttt{text}`

`{\ttfamily text}`

# Fonts

## size

---

`{\Huge text}`

▶ `{\huge text}`

▶ `{\LARGE text}`

▶ `{\Large text}`

▶ `{\large text}`

▶ `{\normalsize text}`

▶ `{\small text}`

▶ `{\footnotesize text}`

▶ `{\scriptsize text}`

▶ `{\tiny text}`

# To Default

---

`\Huge text \ttfamily text \itshape text \normalfont\  
normalsize text`

text text *text* text

# to Default: “GROUPS”

---

- ▶ Lots of  $\text{\LaTeX}$  commands are “local”
- ▶ Local commands lose their effect outside the group
- ▶ “group” is
  - ▶ `{group}`
  - ▶ `\begin{group} group \end{group}`
  - ▶ `$group$`
  - ▶ `\begin{env}group \end{env}`
- ▶ often something inside `{group}` means “indivisible”, “atomic”, “single” for  $\text{\TeX}$  commands.

# Other languages

## accents



`\' {o}` → ò

`\" {o}` → ö

`\k {a}` → ą

`\. {o}` → ȝ

`\u {o}` → ŏ

`\l {}` → ł

`\' {o}` → ó

`\H {o}` → Ȯ

`\= {o}` → ō

`\d {u}` → Ȯ

`\v {s}` → š

`\i {}` → ĩ

`\^ {o}` → ô

`\c {o}` → o

`\b {o}` → Ȯ

`\r {a}` → å

`\j {}` → ĵ

# Other languages

complete solution: russian



## XeLaTeX

```
\usepackage{fontspec} 1
\usepackage{polyglossia} 2
\setdefaultlanguage{ 3
    russian}
\setmainfont[Mapping=tex 4
    -text]{CMU Serif}
```

## pdfLaTeX

```
\usepackage[T2A]{fontenc} 1
}
\usepackage[utf8x]{ 2
    inputenc}
\usepackage[main=russian 3
    ,english]{babel}
```



# Enumerate

<code>\begin{enumerate}</code>	1	
<code>\item first</code>	2	1. first
<code>\begin{enumerate}</code>	3	
<code>\item First</code>	4	(a) First
<code>\end{enumerate}</code>	5	
<code>\item second</code>	6	2. second
<code>\end{enumerate}</code>	7	

<code>\begin{itemize}</code>	1	
<code>\item first</code>	2	• first
<code>\begin{itemize}</code>	3	
<code>\item First</code>	4	– First
<code>\end{itemize}</code>	5	
<code>\item second</code>	6	• second
<code>\end{itemize}</code>	7	

# What we will know?

---

## Mastering the base

Text

**Inputs**

Math

# Input some elements

---

- ▶ Code
- ▶ Figures (pictures)
- ▶ Tabela
- ▶ T<sub>E</sub>X files



\usepackage		
verbatim	listings	minted
inline		
\verb!code!	\lstinline code	\mintinline{LaTeX}{Code}
environment (\begin{env} code \end{env})		
{verbatim}	{lstlisting}	{minted}
file		
\verbatiminput	\lstinputlisting	\inputminted





```
\usepackage{verbatim}      1  
\verbatiminput{code.py}    2
```

```
import time  
  
def f(x):  
    pass  
  
if __name__ == "__main__":  
    # execute only if  
    # run as a script  
    f("oo")
```



```
\usepackage{listings}      1
\lstinputlisting{code.py}  2
}
```

```
import time

def f(x):
    pass

if __name__ == "__main__":
    # execute only if
    # run as a script
    f("oo")
```

# Listings (also)



```
\usepackage{listings}
\usepackage{color}

\lstset
{
    language=Python,
    breaklines=true,
    % basicstyle=\tt\scriptsize,
    keywordstyle=\color{blue},
    identifierstyle=\color{magenta},
    commentstyle=\color{green},
    numbers=left
}
\lstinputlisting{code.py}
```

```
1
2
3 1 import time
4 2
5 3 def f(x):
6 4     pass
7 5
8 6 if __name__ == "__main__":
9 7     # execute only if
10 8     # run as a script
11 9     f("oo")
12
13
14
```



```
\usepackage{minted}  
\inputminted{python}{code.py}
```

1  
2

```
import time  
  
def f(x):  
    pass  
  
if __name__ == "__main__":  
    # execute only if  
    # run as a script  
    f("oo")
```





- verbatim** is the default package when you need just to add code
- minted** is the verbatim on steroids — it will color your code in proper style, but it works through a python library
- listings** is a package, that you must tune by yourself, but it is the most “tunable” package

# Tips about the code packages



- ▶ you must use `[fragile]` option in presentation slides (beamer) in the slides with code
- ▶ use `\cprotect` package and command if you want to bring code to the command
- ▶ you can include only part of the code and provide a path to your src folder
- ▶ you can find lots about the code usage in the source of this presentation

# Include graphics

---

```
\usepackage{graphicx}  
\graphicspath{{../../images/}} %  
    optional  
\includegraphics{papeeria}
```

1  
2  
3



PVAPEERIA

# Include graphics

params

---

```
\includegraphics[width=\textwidth,height=0.5\textheight,keepaspectratio]{papeeria}
```

the width of the picture

means “for whole width of the text”

the height of the picture

half of the whole page height

the ratio will remain the same

file name. You can ommit

the extension



Figure 1: Papeeria caption

```
\usepackage{graphicx}          1
\graphicspath{{../.. /images/}} % 2
    optional
\usepackage{lipsum}            3
\lipsum[1]                     4
\begin{figure}[tbp]            5
    \begin{center}              6
        \includegraphics[scale=0.2]{ 7
            papeeria}
    \end{center}                8
    \caption{Papeeria caption}  9
\end{figure}                   10
\lipsum[1]                     11
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Figure 1: Papeeria caption

```
\usepackage{graphicx} 1
\graphicspath{{../.. /images/}} % 2
    optional
\usepackage{lipsum} 3
\lipsum[1] 4
\begin{figure}[tbp] 5
    \begin{center} 6
        \includegraphics[scale=0.2]{ 7
            papeeria}
    \end{center} 8
    \caption{Papeeria caption} 9
\end{figure} 10
\lipsum[1] 11
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Figure appeared not where it was declared!

# Tips

---

- ▶ `\caption` generate caption to the figure
- ▶  $\text{\LaTeX}$  doesn't care of what is inside the `figure`. You are responsible of the content.
- ▶ You can kindly ask  $\text{\LaTeX}$  to put the illustration where you want:
  - t top
  - b bottom
  - p separate page
  - h in place

# Wrapping graphics



```
\usepackage{graphicx}
\usepackage{wrapfig}
\begin{wrapfigure}{l}{0.3\linewidth}
  \includegraphics[width=\
    linewidth]{papeeria}
  \caption{Papeeria}
\end{wrapfigure}
\lipsum[1]
```

1  
2  
3  
4  
5  
6  
7



Figure 1: Papeeria

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.



# Tables: Floating and wrapping

---

```
\begin{table}table\end{table}
```

```
\begin{wraptable}table\end{wraptable}
```

# Tables

## tabbing



```
\begin{tabbing}1
A line \= that sets the \=distance2
    between \= cells\kill
cell 1 \> cell 2 \> can overlap the3
    next cell\> 4\\
you \> hi! \> overlap without errors4
    \\
\end{tabbing}5
```

cell 1 cell 2  
you hi!

can overlap the next cell  
overlap without errors

# Tables

## tabbing



```
\begin{tabbing}                                1
A line \= that sets the \=distance              2
    between \= cells\kill
cell 1 \> cell 2 \> can overlap the              3
    next cell\> 4\\
you \> hi! \> overlap without errors            4
    \\
\end{tabbing}                                  5
```

cell 1   cell 2   can overlap the next cell  
you   hi!   overlap without errors

- ▶ omit `\kill` to show the first line
- ▶ You can also reinsert tabular position inside the tabbing.

# Tables

tabular

---

```
\begin{tabular}{|c|cc|}  
\hline  
o & x & o\\ \hline  
x & o & x\\  
o & x & o\\ \hline  
\end{tabular}
```

1  
2  
3  
4  
5  
6

	O	X	O
	X	O	X
	O	X	O

# Tables

tabular

- ▶ Line: `o & x & o\\ \\hline`
  - ▶ `&` — moves to the next cell
  - ▶ `\\` — moves to the next line
  - ▶ `\hline` — provide a horizontal line between cells. You can omit it.
- ▶ preambula `{||c|c|c|}`
  - ▶ number of letters — number of columns
  - ▶ `|` stand for vertical line
  - ▶ available letters:
    - `l` pressed to the left
    - `r` pressed to the right
    - `c` centered
  - `p{<size>}` place for a paragraph with some `<size>` width

} it is common, remember!

# Tabular: what else?

WYSiWYG

---



It is hard to make a table without WYSIWYG. Use this  
<https://www.tablesgenerator.com/>

# Tabular: what else?

color



```
\usepackage[table]{xcolor}          1
\rowcolors{2}{gray!25}{white}        2
\begin{tabular}{cc}                  3
  \rowcolor{gray!50}                 4
  Table head & Table head\\          5
  Some values & Some values\\        6
  Some values & Some values\\        7
  Some values & Some values\\        8
  Some values & Some values\\        9
\end{tabular}                        10
```

Table head	Table head
Some values	Some values
Some values	Some values
Some values	Some values
Some values	Some values

# Tabular: what else?

more complex cells



```
\begin{tabular}{||c|cc|}
o & x & o\\\cline{2-3}
x & o & x\\
\multicolumn{2}{||l|}{o x }&o \\
\end{tabular}
```

1  
2  
3  
4  
5

O	X	O
X	O	X
O	X	O

- ▶ `\cline` is as `\hline` for several columns
- ▶ `\multicolumn` is a multi column



# Tabular: what else?

## Preamble



```
\begin{tabular}{lr@{--}l@{\quad}1  
    Lunch \quad r@{--}l}  
Monday & 8^{30}$ & 15 & 11 & 12 \\  
Tuesday & 12 & 19 & 15 & 16 \\  
Wednesday & 10 & 17 & 12^{30}$ &  
    13^{15}$ \\  
Thursday & 9 & 17 & 12 & 13 \\  
Friday & 11 & 16 & & \\  
\end{tabular}7
```

Monday	8 <sup>30</sup> –15	Lunch	11–12
Tuesday	12–19	Lunch	15–16
Wednesday	10–17	Lunch	12 <sup>30</sup> –13 <sup>15</sup>
Thursday	9–17	Lunch	12–13
Friday	11–16	Lunch	–

The word “lunch” isn’t inside cells!

# Including a $\text{\LaTeX}$ file

---

`\input{filename}`

# What we will know?

---

## Mastering the base

Text

Inputs

Math

# Going → Math

## Math environments

Displayed formula

```
$$x=y$$
```

inline  $x=y$  formula

numbered formula

```
\begin{equation}
```

```
x=y
```

```
\end{equation}
```

1  
2  
3  
4  
5  
6  
7

Displayed formula

$$x = y$$

inline  $x = y$  formula

numbered formula

$$x = y$$

(1)

# Going $\rightarrow$ Math

---

“Because mathematics is supposedly expensive.”  
©D. Knuth “the T<sub>E</sub>XBook”

# Indexes

upper ind	$\text{\$}\textcolor{violet}{x}^2\text{\$}$	$x^2$
lower ind	$\text{\$}\textcolor{violet}{x}_2\text{\$}$	$x_2$
lower and upper ind	$\text{\$}\textcolor{violet}{x}^4_2\text{\$}$	$x_2^4$
more letters in ind	$\text{\$}\textcolor{violet}{x}_{\textcolor{violet}{i}j}\text{\$}$	$x_{ij}$
empty block	$\text{\$}\{\}^3_2\textcolor{violet}{He}\text{\$}$	${}^3_2\textcolor{violet}{He}$
index in index	$\text{\$}\textcolor{violet}{x}^{\{4^2\}}\text{\$}$	$x^{4^2}$

# Fractions and (square) root

---

`$\frac{x+z^2}{y-1}$`

$$\frac{x + z^2}{y - 1}$$

`$\sqrt{x}$`

$$\sqrt{x}$$

`$\sqrt[y]{x}$`

$$\sqrt[y]{x}$$

# Brackets

You can't write just

$$\frac{x}{y}$$

use `\left` and `\right`

$$\left(\frac{x}{y}\right)$$

or even like

$$\left.\frac{x}{y}\right|_a^b$$



# Brackets



Sometimes you need to manually set the bracket size. Then use something like this

`$$(\bigl( \Bigl( \biggl( \Biggl( $$`

(((((((

`$$]\biggr] \Bigr] \biggr] \Biggr] $$`

]]]]]]

# Text inside equations

Sometimes, you need to write a text *inside* an equation

$$\frac{x+1}{y} = z; \text{ if } x-1 < y, \text{ but not always!}$$

but the direct solution remove all spaces!

$$\frac{x+1}{y} = z; \text{ if } x-1 < y, \text{ but not always!}$$

Use `\hbox`:

`$$\frac{x+1}{y} = z; \hbox{if } x-1 < y$, but not always!}$$`

or `\text` from `amsmath` package.

# More symbols

---

<http://detexify.kirelabs.org/classify.html>



# More symbols

## Greek letters



`\alpha` → α

`\epsilon` → ε

`\kappa` → κ

`\xi` → ξ

`\sigma` → σ

`\psi` → ψ

`\beta` → β

`\zeta` → ζ

`\lambda` → λ

`\tau` → τ

`\pi` → π

`\omega` → ω

`\gamma` → γ

`\eta` → η

`\mu` → μ

`\nu` → ν

`\phi` → φ

`\delta` → δ

`\iota` → ι

`\nu` → ν

`\rho` → ρ

`\chi` → χ

`\varepsilon` → ε

`\varphi` → φ

`\vartheta` → θ

`\kappa` → κ

`\varrho` → ϱ

`\Gamma` → Γ

`\Sigma` → Σ

`\Psi` → Ψ

`\Delta` → Δ

`\Upsilon` → Υ

`\Omega` → Ω

`\Lambda` → Λ

`\Pi` → Π

`\Xi` → Ξ

`\Phi` → Φ

# More symbols

Other common used symbols



`\infty` →  $\infty$   
`\backslash` →  $\backslash$   
`\Im` →  $\Im$   
`\to` →  $\rightarrow$

`\nabla` →  $\nabla$   
`\aleph` →  $\aleph$   
`\cdot` →  $\cdot$   
`\times` →  $\times$

`\forall` →  $\forall$   
`\hbar` →  $\hbar$   
`\cdots` →  $\cdots$

`\partial` →  $\partial$   
`\Re` →  $\Re$   
`\ldots` →  $\ldots$

`\imath` →  $\imath$

`\jmath` →  $\jmath$

are useful for accents.

# More symbols

## Accents



$\backslash\text{hat}\{a\} \rightarrow \hat{a}$   
 $\backslash\text{acute}\{a\} \rightarrow \acute{a}$   
 $\backslash\text{ddot}\{a\} \rightarrow \ddot{a}$

$\backslash\text{check}\{a\} \rightarrow \check{a}$   
 $\backslash\text{grave}\{a\} \rightarrow \grave{a}$   
 $\backslash\text{breve}\{a\} \rightarrow \breve{a}$

$\backslash\text{tilde}\{a\} \rightarrow \tilde{a}$   
 $\backslash\text{dot}\{a\} \rightarrow \dot{a}$   
 $\backslash\text{vec}\{a\} \rightarrow \vec{a}$

# More symbols

## Accents



$\backslash\text{hat}\{a\} \rightarrow \hat{a}$	$\backslash\text{check}\{a\} \rightarrow \check{a}$	$\backslash\text{tilde}\{a\} \rightarrow \tilde{a}$
$\backslash\text{acute}\{a\} \rightarrow \acute{a}$	$\backslash\text{grave}\{a\} \rightarrow \grave{a}$	$\backslash\text{dot}\{a\} \rightarrow \dot{a}$
$\backslash\text{ddot}\{a\} \rightarrow \ddot{a}$	$\backslash\text{breve}\{a\} \rightarrow \breve{a}$	$\backslash\text{vec}\{a\} \rightarrow \vec{a}$

$\backslash\text{check}\{a\} \rightarrow \check{a} \quad \rightarrow \quad \backslash\text{skew5}\backslash\text{check}\{a\} \rightarrow \check{a}$

# More symbols

## Math fonts



<code>\mathrm{letters, etc}</code>	ABCabc, 123, $\hat{a}$ , $\mathfrak{b}$ , $\epsilon$ ,
<code>\mathbf{letters, etc}</code>	<b>ABCabc, 123, <math>\hat{a}</math>, <math>\mathfrak{b}</math>, <math>\epsilon</math>,</b>
<code>\mathsf{letters, etc}</code>	ABCabc, 123, $\hat{a}$ , $\mathfrak{b}$ , $\epsilon$ ,
<code>\mathtt{letters, etc}</code>	ABCabc, 123, $\hat{a}$ , $\mathfrak{b}$ , $\epsilon$ ,
<code>\mathit{letters, etc}</code>	<i>ABCabc, 123, <math>\hat{a}</math>, <math>\mathfrak{b}</math>, <math>\epsilon</math>,</i>
<code>\mathnormal{letters, etc}</code>	<i>ABCabc, 123, <math>\hat{a}</math>, <math>\tilde{b}</math>, <math>\tilde{c}</math>, <math>\Psi\Omega</math></i>
<code>\mathcal{capital letters}</code>	<i>ABC</i>
<code>\mathds{capital letters}</code>	ABCRN



# More symbols

## Limiters



## Brackets

`(` → `(`                      `)` → `)`

`[` → `[`                      `]` → `]`

`\{` → `{`                      `\}` → `}`

`\lfloor` → `⌊`                      `\rfloor` → `⌋`

`\langle` → `⟨`

`\rangle` → `⟩`

`\lbrack` → `[`

`\rbrack` → `]`

`\lbrace` → `{`

`\rbrace` → `}`

`\lceil` → `⌈`

`\rceil` → `⌉`

## Other

`/` → `/`

`\backslash` → `\`

`|` → `|`

`\vert` → `|`

`\|` → `||`

`\Vert` → `||`

`\updownarrow` → `↕`

`\Updownarrow` → `↕`

`\uparrow` → `↑`

`\Uparrow` → `↑`

`\downarrow` → `↓`

`\Downarrow` → `↓`

# More symbols

Limiters with `\Big` prefix



`\vert` →  $|$   
`\lgroup` →  $($   
`\bracevert` →  $|$

`\Vert` →  $||$   
`\rgroup` →  $)$

`\arrowvert` →  $|$   
`\lmoustache` →  $\int$

`\Arrowvert` →  $||$   
`\rmoustache` →  $\int$

# More symbols

## Operators



$$\begin{array}{lcl} \backslash\text{prod} & \rightarrow & \prod \\ \backslash\text{iint} & \rightarrow & \iint \end{array}$$

$$\begin{array}{lcl} \backslash\text{sum} & \rightarrow & \sum \\ \backslash\text{oint} & \rightarrow & \oint \end{array}$$

$$\begin{array}{lcl} \backslash\text{int} & \rightarrow & \int \\ \backslash\text{idotsint} & \rightarrow & \int \cdots \int \end{array}$$

# More symbols

## Operators

---

Mathematical tradition: write not  $\sin(x)$ , but  $\sin(x)$ .

use `\sin`

sometimes more effect is displayed:

`$$\min_{x \rightarrow 0} f$$`

$\min_{x \rightarrow 0} f$

# Multiline equations

```
$$  
\begin{array}{ccl}  
x^2&+y^2&= 7\\  
&+z&= 10.\\  
\end{array}  
$$
```

1  
2  
3  
4  
5  
6

$$\begin{array}{rcl} x^2 & +y^2 & = 7 \\ & +z & = 10. \end{array}$$

notice `{ccl}`, `&`, `\\`

`array` is a `tabular` for math mode!

# Also array



```
$$  
\left(\begin{array}{ccc}  
a_{11}-\lambda & a_{12}&a_{13}\\a_{21}& a_{22}-\lambda & a_{23}\\a_{31}& a_{32}&a_{33}-\lambda  
\end{array}\right)  
$$
```

1  
2  
3  
4  
5  
6  
7

$$\begin{pmatrix} a_{11} - \lambda & a_{12} & a_{13} \\ a_{21} & a_{22} - \lambda & a_{23} \\ a_{31} & a_{32} & a_{33} - \lambda \end{pmatrix}$$

```
$$  
M: \left\  
\begin{array}{ccl}  
x^2+y^2&=&7\\x+y &=&3.\\ \end{array}  
\right.  
$$
```

1  
2  
3  
4  
5  
6  
7  
8

$$M : \begin{cases} x^2 + y^2 & = & 7 \\ x + y & = & 3. \end{cases}$$

# Multiline equations

---

it is better to use

```
\usepackage{amsmath}
```

# Formula in multiple line



```
\usepackage{amsmath}  
\begin{multline}  
1 + 2 + 3 + 4 + \\  
54 + 43 + 43  
\end{multline}
```

1  
2  
3  
4  
5

$$\begin{aligned} 1 + 2 + 3 + 4 + \\ 54 + 43 + 43 \end{aligned} \quad (1)$$



# Multiple formulas



```
\usepackage{amsmath}
\begin{gather}
x = y + 2 \\
y = z - 5 \notag \\
z = x + y
\end{gather}
```

1  
2  
3  
4  
5  
6

$$x = y + 2 \quad (1)$$

$$y = z - 5$$

$$z = x + y \quad (2)$$

notice `\notag` !

# Multiple formulas and lines: alignment



```
\usepackage{amsmath}
\begin{align}
7\times 9&=63 \quad \& \quad 63:9&=7\\
9\times 10&=90 \quad \& \quad 90:10&=9
\end{align}
```

1  
2  
3  
4  
5

$$\begin{array}{rcl} 7 \times 9 = 63 & 63 : 9 = 7 & (1) \\ 9 \times 10 = 90 & 90 : 10 = 9 & (2) \end{array}$$

```
\usepackage{amsmath}
\begin{equation}
\begin{split}
1999&=1000+900+{\}\\\
&+90+9
\end{split}
\end{equation}
```

1  
2  
3  
4  
5  
6  
7

$$\begin{array}{rcl} 1999 = 1000 + 900 + & & (1) \\ & + 90 + 9 & \end{array}$$

ampersand  $\&$  is stands for indent (as in tables)

# Text inside equations



```
\usepackage{amsmath}
\begin{align*}
3\cdot 5+7\cdot 5&=(3+7)
\cdot 5 \ \&\&(\text{clear})\\
&=50\&\&(\text{obviously}),\\
\text{then}\\
15+35 \ \&=50
\end{align*}
```

```
1
2       $3 \cdot 5 + 7 \cdot 5 = (3 + 7) \cdot 5$    (clear)
3
4       $= 50$    (obviously),
5
6      then
7
8       $15 + 35 = 50$ 
```

## Problem:

```
\usepackage{amsmath}
\begin{align*}
3\cdot 5+7\cdot 5&=(3+7)
\cdot 5 \ \&\&(\text{yes clear})\\
&=50\&\&(\text{obviously}),\\
\text{then}\\
15+35 \ \&=50
\end{align*}
```

```
1
2       $3 \cdot 5 + 7 \cdot 5 = (3 + 7) \cdot 5$    (yesclear)
3
4       $= 50$    (obviously),
5
6      then
7
8       $15 + 35 = 50$ 
```

# Text inside equations

solution



```
\usepackage{amsmath}
\begin{align*}
3\cdot 5+7\cdot 5&=(3+7)
\cdot 5 \quad \text{(yes clear)} \\
&=50 \quad \text{(obviously),} \\
\intertext{then}
15+35 \quad &=50
\end{align*}
```

1	$3 \cdot 5 + 7 \cdot 5 = (3 + 7) \cdot 5$	(yes clear)
2		
3	$= 50$	(obviously),
4		
5	then	
6		
7		
8	$15 + 35 = 50$	

`\text` and `\intertext`

# System of equations



```
\usepackage{amsmath}
$$
\left\{
\begin{aligned}
x^2+y^2&=7\\
x+y &= 3.
\end{aligned}
\right.

```

1  
2  
3  
4  
5  
6  
7  
8  
9

$$\begin{cases} x^2 + y^2 = 7 \\ x + y = 3. \end{cases}$$

```
\usepackage{amsmath}
$$
|x|=\begin{cases}
x,&\text{if } x>0; \\
0,&\text{if } x=0; \\
-x,&\text{if } x<0.
\end{cases}

```

1  
2  
3  
4  
5  
6  
7  
8

$$|x| = \begin{cases} x, & \text{if } x > 0; \\ 0, & \text{if } x = 0; \\ -x, & \text{if } x < 0. \end{cases}$$



```
\usepackage{amsmath}
$$
\begin{pmatrix}
a_{11}&a_{12}&\ldots&a_{1n}\\
a_{21}&a_{22}&\ldots&a_{2n}\\
\vdots&\vdots&\ddots&\vdots\\
a_{n1}&a_{n2}&\ldots&a_{nn}
\end{pmatrix}
$$
```

1  
2  
3  
4  
5  
6  
7  
8  
9

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix}$$

# One over another

operators

source

operator

`$$\int\limits_0^\pi$$`

$$\int_0^\pi$$

`$$\int\nolimits_0^\pi$$`

$$\int_0^\pi$$

# One over another



source

result

`\stackrel{\Leftrightarrow}{A}`

$\Leftrightarrow$   
 $A$

`A \stackrel{a'}{\rightarrow} D`

$A \xrightarrow{a'} D$

`\sum_{\substack{i \in [0;n] \\ j \in [0;m]}} a_{ij}`

$$\sum_{\substack{i \in [0;n] \\ j \in [0;m]}} a_{ij}$$



# One over another



source

result

`$\underbrace{a+\overbrace{b+c}+d}_{m}$`

$$a + \overbrace{b + c} + d$$

$m$

`$\lefteqn{\overbrace{\phantom{1+2+3}}}`

`1+\underbrace{2+3+4}$`

$$1 + \underbrace{2 + 3} + 4$$

# Domain-specific packages

Lots of them!

---

You can use

**Physics** <https://ctan.org/pkg/physics>

**Chemistry** <http://www.mychemistry.eu/known-packages/>, [https://ru.overleaf.com/learn/latex/Chemistry\\_formulae](https://ru.overleaf.com/learn/latex/Chemistry_formulae),  
<https://ctan.org/pkg/mhchem>

**Biology** <https://www.tug.org/pracjourn/2007-4/senthil/senthil.pdf>

# Briefly: $\text{\LaTeX}$ escaped symbols

symbol	textmode	mathmode
%	<code>\%</code>	<code>\%</code>
~	<code>\~ \textasciitilde</code>	<code>\sim</code>
&	<code>\&amp;</code>	<code>\&amp;</code>
\	<code>\textbackslash</code>	<code>\backslash</code>
{	<code>\{ \textbraceleft \lbrace</code>	<code>\{ \lbrace</code>
}	<code>\} \textbraceright \rbrace</code>	<code>\} \rbrace</code>
_	<code>\_</code>	<code>\_</code>
^	<code>\^ \textasciicircum</code>	<code>\^</code>
\$	<code>\\$</code>	<code>\\$</code>
#	<code>\#</code>	<code>\#</code>

# Briefly: $\text{\LaTeX}$ escaped symbols

---

%	comments
~	non-breaking space
&	table indent
\	command-start symbol
{	start of group
}	end of group
_	subscript
^	superscript
\$	math mode
#	for params in macros creation (will discuss at the last lecture)

# What we have learned today?

---

Introduction: on approaches to  $\text{\LaTeX}$

“Hello, world”: first steps in  $\text{\LaTeX}$

Mastering the base

- Text



- Inputs

- Math

# references I



---

color from the footnotes corresponds to references' color.

- ▶ kn: Knuth “The T<sub>E</sub>XBook”
- ▶ lv: L'vovsky “Nabor i verstka v sisteme L<sup>A</sup>T<sub>E</sub>X”
- ▶ lamport: Lamport. “L<sup>A</sup>T<sub>E</sub>X. A Document Preparation System, User's Guide and Reference Manual”
- ▶ man: “L<sup>A</sup>T<sub>E</sub>X2e: An unofficial reference manual” also at website <https://latexref.xyz/>
- ▶ : <https://tex.stackexchange.com/questions>
- ▶ : <https://en.wikibooks.org/wiki/LaTeX>

# references II

---

- ▶  : <https://www.overleaf.com/learn/latex>
- ▶  : <https://www.tug.org/utilities/plain/cseq.html>

# Distribution

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