

L^AT_EX Course at ICT School

Let's add some mathematics

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Course overview

1. Basics and tips for your first \LaTeX document
2. Let's add some mathematics
3. Illuminate your work with color and illustrations

Course overview

1. Basics and tips for your first \LaTeX document
2. Let's add some mathematics
3. **Illuminate your work with color and illustrations**

What's next?

Lists

Big documents and collaborative work

Colors

Importing graphics

Drawing graphics

Floats

Section 1

Lists

Mainly three types of list

There are three types of list.

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- ▶ Itemization

```
\begin{itemize} ... \end{itemize}
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- ▶ Enumeration

```
\begin{enumerate} ... \end{enumerate}
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- ▶ Itemization

```
\begin{itemize} ... \end{itemize}
```

- ▶ Enumeration

```
\begin{enumerate} ... \end{enumerate}
```

- ▶ Description

```
\begin{description} ... \end{description}
```

Mainly three types of list

There are three types of list and a generic construction for new ones.

- ▶ Itemization

```
\begin{itemize} ... \end{itemize}
```

- ▶ Enumeration

```
\begin{enumerate} ... \end{enumerate}
```

- ▶ Description

```
\begin{description} ... \end{description}
```

- ▶ Generic

```
\begin{list}{...}{...} ... \end{list}
```

A common syntax

```
\begin{environment}
  \item[opt] item 1,
  \item      item 2,
  ...
  \item      last item.
\end{environment}
```

A common syntax

```
\begin{environment}  
  \item[opt] item 1,  
  \item      item 2,  
  ...  
  \item      last item.  
\end{environment}
```

itemize
enumerate
description

A common syntax

```
\begin{environment}  
  \item[opt] item 1,  
  \item      item 2,  
  ...  
  \item      last item.  
\end{environment}
```

No text before `\item` is allowed.

Commands are allowed.

Paragraphs are allowed inside an item.

Itemization

Items may be nested.

```
\begin{itemize}
  \item First level,
    \begin{itemize}
      \item second level,
      ...
    \end{itemize}
\end{itemize}
```

- First level,
 - second level,
 - * third level,
 - fourth level.

Itemization

Items may be nested, up to four levels.

! LaTeX Error: Too deeply nested.

```
\begin{itemize}
  \item First level,
    \begin{itemize}
      \item second level,
      ...
    \end{itemize}
\end{itemize}
```

- First level,
 - second level,
 - * third level,
 - fourth level.

Itemization

The symbols can be changed **individually**.

```
\begin{itemize}
  \item[>] First level,
  \item still first lvl.
\end{itemize}
```

- > First level,
- still first lvl.
- Another list.

```
\begin{itemize}
  \item Another list.
\end{itemize}
```


Itemization

The symbols can be changed individually, **locally**.

```
\begin{itemize}
  \renewcommand\labelitemi{>}
  \item First level,
  \item still first lvl.
\end{itemize}
```

- > First level,
- > still first lvl.
- Another list.

```
\begin{itemize}
  \item Another list.
\end{itemize}
```

Itemization

The symbols can be changed individually, locally or **globally**.

```
\renewcommand\labelitemi{>}
```

```
\begin{itemize}
```

```
  \item First level,
```

```
  \item still first lvl.
```

```
\end{itemize}
```

> First level,

> still first lvl.

> Another list.

```
\begin{itemize}
```

```
  \item Another list.
```

```
\end{itemize}
```

Enumeration

```
\begin{enumerate}
  \item First level,
    \begin{enumerate}
      \item second level,
      ...
    \end{enumerate}
\end{enumerate}
```

1. First level,
 - (a) second level,
 - i. third level,
 - A. fourth level.

Enumeration

You can change the numeration style.

```
\usepackage{enumerate}

\begin{enumerate}[a{}]]
  \item First level,
    \begin{enumerate}[\S 1.]
      \item second level,
      ...
    \end{enumerate}
\end{enumerate}
```

- a] First level,
 - §1. second level,
 - i. third level,
 - A. fourth level.

Enumeration

You can change the numeration style.

```
\usepackage{enumerate}

\begin{enumerate}[a{}]]
  \item First level,
    \begin{enumerate}[\S 1.]
      \item second level,
      ...
    \end{enumerate}
\end{enumerate}
```

- a] First level,
 - §1. second level,
 - i. third level,
 - A. fourth level.

Enumeration

You can change the numeration style.

```
\usepackage{enumerate}

\begin{enumerate}[a{}]
  \item First level,
    \begin{enumerate}[\S 1.]
      \item second level,
      ...
    \end{enumerate}
\end{enumerate}
```

- a] First level,
 - §1. second level,
 - i. third level,
 - A. fourth level.

Enumeration

You can change the numeration style.

```
\usepackage{enumerate}

\begin{enumerate}[a{}]]
  \item First level,
    \begin{enumerate}[\S 1.]
      \item second level,
      ...
    \end{enumerate}
\end{enumerate}
```

- a] First level,
 - §1. second level,
 - i. third level,
 - A. fourth level.

Description

```
\begin{description}
  \item[Something] needs to be defined...
  \item[And] is meant for the greater good.
  \item[A very long item] I want to type.
\end{description}
```

Something needs to be defined, even if it will imply a long sentence
that may continue on the second line.

And is meant for the greater good.

A very long item I want to type.

Section 2

Big documents and collaborative work

A few tips not to get lost

- ▶ Use a suitable document class (book, report, memoir).
- ▶ Divide your code into multiple source files.
- ▶ Comment a lot.
- ▶ Use a Makefile or a Batch file.
- ▶ Keep track of changes with versioning system.
- ▶ Keep a minimal file to test material before inclusion.
- ▶ Choose a good quality font (garamond, libertine, etc.).
- ▶ Adjust margins and font size to get around 60 characters per line.
- ▶ Print a table of contents, an index and a bibliography.
- ▶ Use references (eventually hyperref).

Using `\input` and `\include`

`\input{filename}`

Includes the material from the file as it is. Good for big equations, big tables or some graphics.

`\include{filename}`

Inserts a page break before and after the inclusion. Good for parts or chapters. Cannot be nested.

Ideas to structure your working directory

- ▶ One directory for each big part
- ▶ No numbering for the part (you might want to reorder later)
- ▶ One directory for biggest equations
- ▶ One folder for images
- ▶ One for biggest tables (if needed)

Ideas to structure your working directory

- ▶ Concerning_flowers
 - ▶ flowers.tex
 - ▶ preamble.tex
 - ▶ min.tex
 - ▶ About_roses
 - ▶ roses.tex
 - ▶ Sections
 - ▶ horticulture.tex
 - ▶ white.tex
 - ▶ red.tex
- ▶ About_magnolia
- ▶ Equations
- ▶ Images

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 - ▶ red.tex
 - ▶ Equations
 - ▶ Images
 - ▶ About_magnolia

Template for flowers.tex I

```
\documentclass[a4paper,draft,...]{report}
\input{preamble.tex}
```

```
\includeonly{About_magnolia/magnolia}
```

```
\title{...}
```

```
\author{...}
```

```
\begin{document}
```

```
  \frontmatter
```

```
    \maketitle
```

```
    \input{abstract}
```

```
    \input{thanks}
```

```
    ...
```

Template for flowers.tex II

```
\mainmatter
  \include{About_roses/roses}
  \include{About_magnolia/magnolia}

\appendix

\backmatter
  \tableofcontents
  \printindex
  \listoffigures
  ...
\end{document}
```


The minimal file

```
\documentclass[a4paper,final]{report}
\input{preamble.tex}

\begin{document}
  \input{...}
\end{document}
```

Changing margins for readability

```
\usepackage[top=..., left=..., ...]{geometry}
```

And to preview the result:

```
\usepackage{layouts}
```

```
\currentpage\pagedesign
```

Section 3

Colors

The problem of colors

- ▶ Not anticipated by Donald KNUTH.
- ▶ DVI file format does not allow colors.
- ▶ But \TeX `\special` command allows transmission of information to the printer driver (`dvips`, `ps2pdf`, `pdftex`, ...)

Two extensions

color

- ▶ driver dependent
- ▶ RGB, CMYK and gray
- ▶ only 8 predefined colors
- ▶ two different ways to define named colors, not compatible with all drivers

xcolor

- ▶ driver independent
- ▶ RGB, CMYK, gray, HTML, HSB
- ▶ 19 predefined colors and 3 loadable sets of up to 752 predefined colors
- ▶ a standard way to define named colors and to mix them

Guess what? We'll use xcolor.

```
\usepackage{xcolor}
```

```
\bfseries
```

```
\textcolor{red}{This}  
is red.
```

This is red.

Guess what? We'll use xcolor.

```
\usepackage{xcolor}
```

```
\bfseries
```

```
{\color{red} This}
```

```
is red.
```

This is red.

Guess what? We'll use xcolor.

```
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```
\bfseries
```

```
\textcolor{red}{This}
```

```
is red.
```

This is red.

Guess what? We'll use xcolor.

```
\usepackage{xcolor}
```

```
\bfseries
```

```
\textcolor{red!50}{This}  
is red.
```

This is red.

Guess what? We'll use xcolor.

```
\usepackage{xcolor}
```

```
\bfseries
```

```
\textcolor{red!50!blue}{This}  
is red.
```

This is red.

Guess what? We'll use xcolor.

```
\usepackage{xcolor}
```

```
\bfseries
```

```
\textcolor{red!50!blue!20}{This}  
is red.
```

This is red.

Guess what? We'll use xcolor.

```
\usepackage{xcolor}
```

```
\bfseries
```

```
\textcolor[rgb]{.9,.8,.9}{This}  
is red.
```

This is red.

Target model

```
\usepackage[hsb]{xcolor}
```

Prefer:

- ▶ RGB for screen and display,
- ▶ HSB for inkjet printing,
- ▶ CMYK for professional printing.

Defining colors

Always try to separate form and substance!

Defining colors

Always try to separate form and substance!

```
\colorlet{SectionColor}{red!50!blue}  
\definecolor{SubsectionColor}[HTML]{7F007F}  
\definecolor{TableColor}[rgb/hsb]{0,0,1/1,1,0,0}
```

More?

Take a look at

- ▶ table option and colortbl package,
- ▶ `\pagecolor`,
- ▶ `\blendcolors`,
- ▶ `\testcolor`,
- ▶ and many more...

Section 4

Importing graphics

Two packages


`graphics` is the standard package.

`graphicx` is the extended version, commands differ only in optional arguments.

Including an image

```
\includegraphics[key1=..., key2=...]{filename.ext}
```



The included image is seen  as a character.

Which file formats can be used?

Graphics inclusion relies totally on the output driver.

PostScript

latex+dvips

Only Encapsulated PostScript
(.eps).

Portable Document Format

pdf_latex

One of JPEG (.jpg), Portable
Network Graphic (.png),
Portable Document Format
(.pdf).

And if I want to include equations in my graphics
or references to other parts of the document?

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or references to other parts of the document?

- ▶ Use Inkscape which can export in PDF+ \LaTeX , this means that every text is interpreted by `pdf \LaTeX` , allowing expansion of any macro.

And if I want to include equations in my graphics
or references to other parts of the document?

- ▶ Use Inkscape which can export in PDF+ \LaTeX , this means that every text is interpreted by `pdf \LaTeX` , allowing expansion of any macro.
- ▶ Use gnuplot that can produce an EPS of data with parameters.

And if I want to include equations in my graphics
or references to other parts of the document?

- ▶ Use Inkscape which can export in PDF+ \LaTeX , this means that every text is interpreted by `pdflatex`, allowing expansion of any macro.
- ▶ Use gnuplot that can produce an EPS of data with parameters.
- ▶ Produce your graphics directly into \LaTeX .

Section 5

Drawing graphics

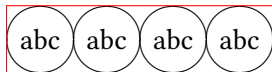
The native picture environment

```
\begin{picture}(100,25)  
  \put(12.5,12.5){\makebox(0,0){abc}}  
  \put(12.5,12.5){\oval(25,25)}  
\end{picture}
```



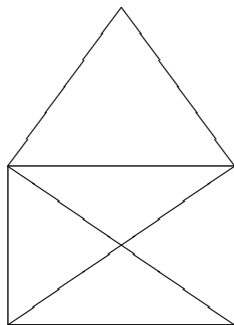
The native picture environment

```
\begin{picture}(100,25)  
  \multiput(12.5,12.5)(25,0){4}{\makebox(0,0){abc}}  
  \multiput(12.5,12.5)(25,0){4}{\oval(25,25)}  
\end{picture}
```



...an outdated method

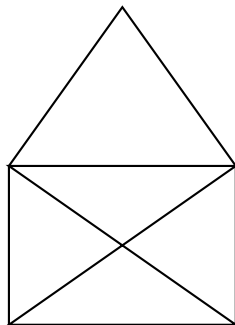
The `picture` environment is based on fonts, which leads to strange behaviour.
Only 25 slopes available.



Using PostScript capabilities

```
\usepackage{pstricks}

\begin{pspicture}(10,14)
  \psline(0,0)(0,7)(5,14)
          (10,7)(0,7)(10,0)
          (0,0)(10,7)(10,0)
\end{pspicture}
```



But...

The file needs to be compiled with `latex`, not `pdflatex`.



PSTricks collides with PNG or JPEG inclusion.

PGF/TikZ

- PGF** Portable Graphics Format, is a low level language for producing vector graphics.
- TikZ** TikZ ist *kein* Zeichenprogramm, it's a high level language based upon PGF.

PGF/TikZ

Advantages of this tandem are:

- ▶ “High level” means here “closer to human understanding”.
- ▶ System based on keys: easy to define new entities for the language (such as shapes, shadings, etc.).
- ▶ Compatible with `latex+dvips`, `pdflatex`, `context`, etc.
- ▶ Various coordinate systems, including 3D.
- ▶ Some softwares have extensions to export to TikZ (Inkscape, Blender, MATLAB, matplotlib, R).
- ▶ Named points to keep semantic visible.
- ▶ Allows to draw things over the text, for example, a blue arrow from there to there or a crossed ~~word~~.



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- ▶ Various coordinate systems, including 3D.
- ▶ Some software have extensions to export to TikZ (Inkscape, Blender, MATLAB, matplotlib, R).
- ▶ Needed points to keep semantic visible.
- ▶ Allows to draw things over the text, for example, a blue arrow from there to there or a crossed word.

A very complete documentation

The very basis

```
\begin{tikzpicture}
  \path (0,0) -- (1,0) (0,1) -- (1,1) ;
\end{tikzpicture}
```

The very basis

```
\begin{tikzpicture}
  \path (0,0) -- (1,0) (0,1) -- (1,1) ;
\end{tikzpicture}
```



The very basis

```
\begin{tikzpicture}  
  \path[draw] (0,0) -- (1,0) (0,1) -- (1,1) ;  
\end{tikzpicture}
```



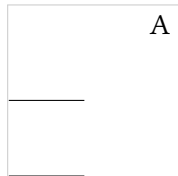
The very basis

```
\begin{tikzpicture}  
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;  
\end{tikzpicture}
```



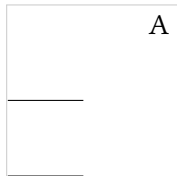
The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \path (2,2) node {A} ;
\end{tikzpicture}
```



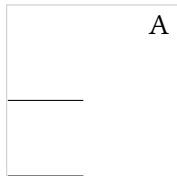
The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \path (2,2) node (a) {A} ;
\end{tikzpicture}
```



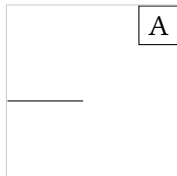
The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \node (a) at (2,2) {A} ;
\end{tikzpicture}
```



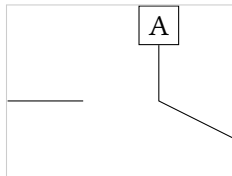
The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \node[draw] (a) at (2,2) {A} ;
\end{tikzpicture}
```



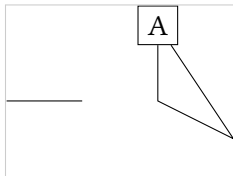
The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \node[draw] (a) at (2,2) {A} ;
  \path (2,1) coordinate (b)
        (3,.5) coordinate (c) ;
  \draw (a) -- (b) -- (c) ;
\end{tikzpicture}
```



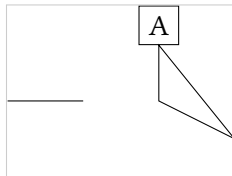
The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \node[draw] (a) at (2,2) {A} ;
  \path (2,1) coordinate (b)
        (3,.5) coordinate (c) ;
  \draw (a) -- (b) -- (c) -- (a) ;
\end{tikzpicture}
```



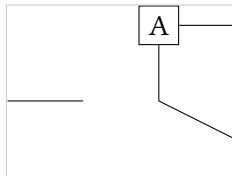
The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \node[draw] (a) at (2,2) {A} ;
  \path (2,1) coordinate (b)
        (3,.5) coordinate (c) ;
  \draw (a) -- (b) -- (c) -- cycle ;
\end{tikzpicture}
```



The very basis

```
\begin{tikzpicture}
  \draw (0,0) -- (1,0) (0,1) -- (1,1) ;
  \node[draw] (a) at (2,2) {A} ;
  \path (2,1) coordinate (b)
        (3,.5) coordinate (c) ;
  \draw (a) -- (b) -- (c) |- (a) ;
\end{tikzpicture}
```



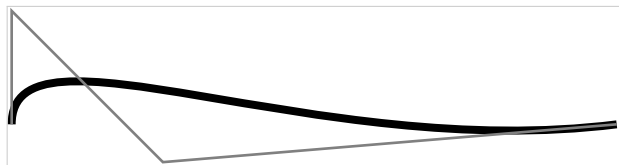
Path operations

```
\tikz[line width=3pt] \draw (0,0) -- (8,0) |- (7,.3) ;
```



Path operations

```
\begin{tikzpicture}
  \draw[line width=3pt]
    (0,1) ..controls (0,2.5) and (4,.5).. (8,1) ;
  \draw[gray,line width=1pt]
    (0,1) -- (0,2.5) -- (2,.5) -- (8,1) ;
\end{tikzpicture}
```



Path operations

```
\tikz[line width=3pt]\draw (0,3) rectangle (8,4) ;
```



Path operations

```
\tikz[line width=3pt]\draw  
  (2,5) circle[radius=.5] --  
  (4,5) circle[radius=.2]  
  (6,5) circle[x radius=.2,y radius=.5] ;
```



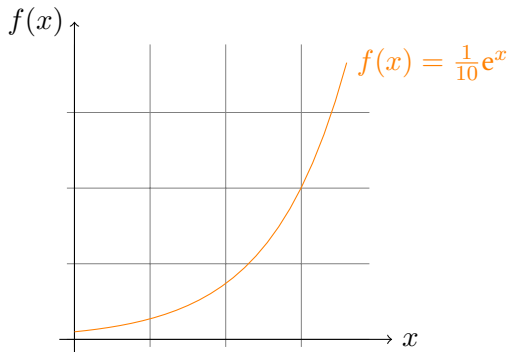
Study case I

```
\begin{tikzpicture}[domain=0:3.6]
  \draw[very thin,gray] (-.1,-.1) grid (3.9,3.9);

  \draw[->] (-.2,0) -- (4.2,0) node[right] {$x$} ;
  \draw[->] (0,-.2) -- (0,4.2) node[left] {$f(x)$} ;

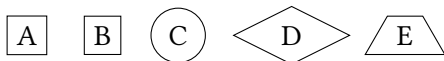
  \draw[color=orange] plot (\x,{0.1*exp(\x)})
    node[right] {$f(x) = \frac{1}{10} \mathrm{e}^x$} ;
\end{tikzpicture}
```

Study case II






Shapes

```
\begin{tikzpicture}[every node/.style={draw}]  
  \path  
    (0,0) node {A}  
    (1,0) node[rectangle] {B}  
    (2,0) node[circle] {C}  
    (3.5,0) node[diamond,shape aspect=2] {D}  
    (5,0) node[trapezium] {E} ;  
\end{tikzpicture}
```



Further informations

-  Michel Goossens, S.P.Q. Rahtz, and Frank Mittelbach. *The L^AT_EX Graphics Companion: Illustrating Documents with T_EX and PostScript*. Addison-Wesley Professional, 1997.
-  Till Tantau. *TikZ and PGF*. Oct. 25, 2010. URL: <http://www.ctan.org/tex-archive/graphics/pgf/base/doc/generic/pgf/pgfmanual.pdf>.
-  T_EX Community. *T_EXample.net. TikZ and PGF examples*. URL: <http://www.texample.net/tikz/examples/>.

Section 7

Floats

The problem with tables and graphics

- ▶ Graphics are seen as characters.
- ▶ Arrays are always left aligned.
- ▶ Both are often big and break the page setting.
- ▶ We cite them mostly more than once along a document.

The solution is in floats

```
\begin{figure}  
  \includegraphics  
    [width=2cm]  
    {kth.pdf}  
\end{figure}
```



The solution is in floats

```
\begin{figure}  
  \includegraphics  
    [width=2cm  
     {kth.pdf}  
  \caption{KTH logo.}  
\end{figure}
```



The solution is in floats

```
\begin{figure}  
  \caption{KTH logo.}  
  \includegraphics  
    [width=2cm  
     {kth.pdf}]  
\end{figure}
```

Figure 1: KTH logo.



The solution is in floats

```
\begin{figure}  
  \includegraphics  
    [width=2cm  
     {kth.pdf}  
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\begin{figure}  
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The solution is in floats

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\begin{figure}  
  \label{fig:kth}  
  \centering  
  \includegraphics  
    [width=2cm]  
    {kth.pdf}  
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\end{figure}
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Figure~\ref{fig:kth}
is KTH logo.



Figure 1: KTH logo.

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The solution is in floats

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  \centering  
  \includegraphics  
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```

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Figure 1: KTH logo.

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More?

- ▶ Accepts a placement option (h, t, b, p).
- ▶ A `table` environment for tabular and arrays.
- ▶ A `wrapfig` package to wrap figures with text.
- ▶ A `subfig` package to group multiple figures under a same reference and caption.

That's all folks!

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