LaTeXcourse

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LaTeX history

- The creator of TeX: Donald Knuth
  https://www-cs-faculty.stanford.edu/~knuth/
- The wizard of LaTeX(a macro language build over TeX) : Leslie Lamport http://www.lamport.org/ (By the way I learned and used LaTeXthe first time after reading the Lamport's book back in 1987 https://core.ac.uk/download/pdf/25171471.pdf
- The developer of XeTeX and XeLaTeX(another higher level languages build over TeX): Jonathan Kew
  https://www.tug.org/interviews/kew.htmlă
- To keep flexibility, TeXphilosophy distinguishes programming a text from their final human or machine ready format (this makes them different from wysiwyg approaches: as Scientific Workplace of MIcrosoft Word).

"Oficial" pages

- TEXusers group: www.tug.org (where you can download LATEXand have links to most
- LATEXproject https://www.latex-project.org/
- XETEXin TUG: https://tug.org/xetex/
- TEXrepository http://tug.ctan.org
- TEXcatalogue http://texcatalogue.ctan.org

TEXapproach to text editing

- TEXand derivatives are a programmers approach to text editing (see https://www.tug.org/whatis.html): flexible, powerful, non-proprietary, cheapă(i.e, no pecuniary costs) and demanding low levels of memory and computer power (it was developed in later 1970's)
- It separates text editing (in fact programming) from their final human or machine ready format . Text editing consists in creating a `tex` file and compiling means extracting from it a `pdf` (or `dvi` or even `html` file).

TEXtribes

We can chose to use it at different levels:

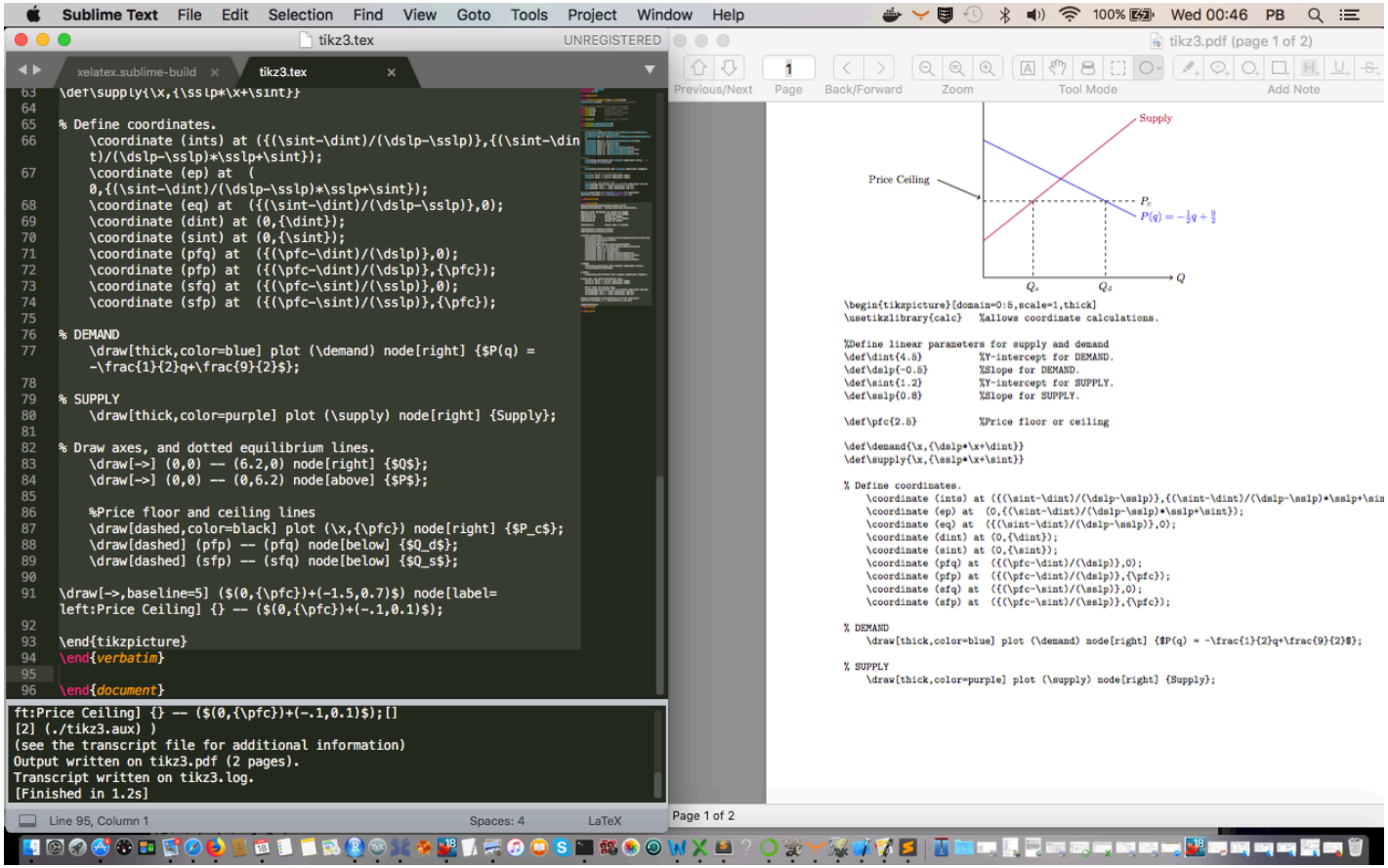
- purists will use a text editor like Vim and would run it in the terminal
- programmers will use a text editor like GNU Emacs or Sublime text (where they will also run C, python, etc, and would configure it and would run it from the editor
- lazy programmers will use an editor like Texshop (OsX) or Miktex (MSWindows) and would run it from the editor
- lazy people would use LyX which is a kind of wysiwyg (but still has the flavor of LATEX
- people I would not qualify use Scientific workplace (a commercial wysiwyg version of LATEXwith all the shortcomings and few of the advantages).
- For collaborative work there is a nice (commercial) alternative Sharelatex
- You can run LATEXfiles within Rstudio by using knitr

Some reasons to use LaTeX

- Learning curve: it has a relatively steep learning curve
- Long run gains: you can save lots of work in the future by connecting LaTeXto other programs (bibliographic organizers, R, python, html etc)
- Organization: you can organize your work in a modular and incremental way
- Literate programming: it is the way to perform reproducible (i.e., usefull) research
- Editing quality: you have to become aware and have some knowledge on issues relating to the quality of editing
- Ecology: you are entering in a very sophisticated and helpful community
- Signaling: this can be my prejudice, but the average level of quality of papers written in LaTeXis much higher than those written in MSword.
- Control: it really does what you understand and ask it to do.

LaTeX for programmers

Sublime text and Skim



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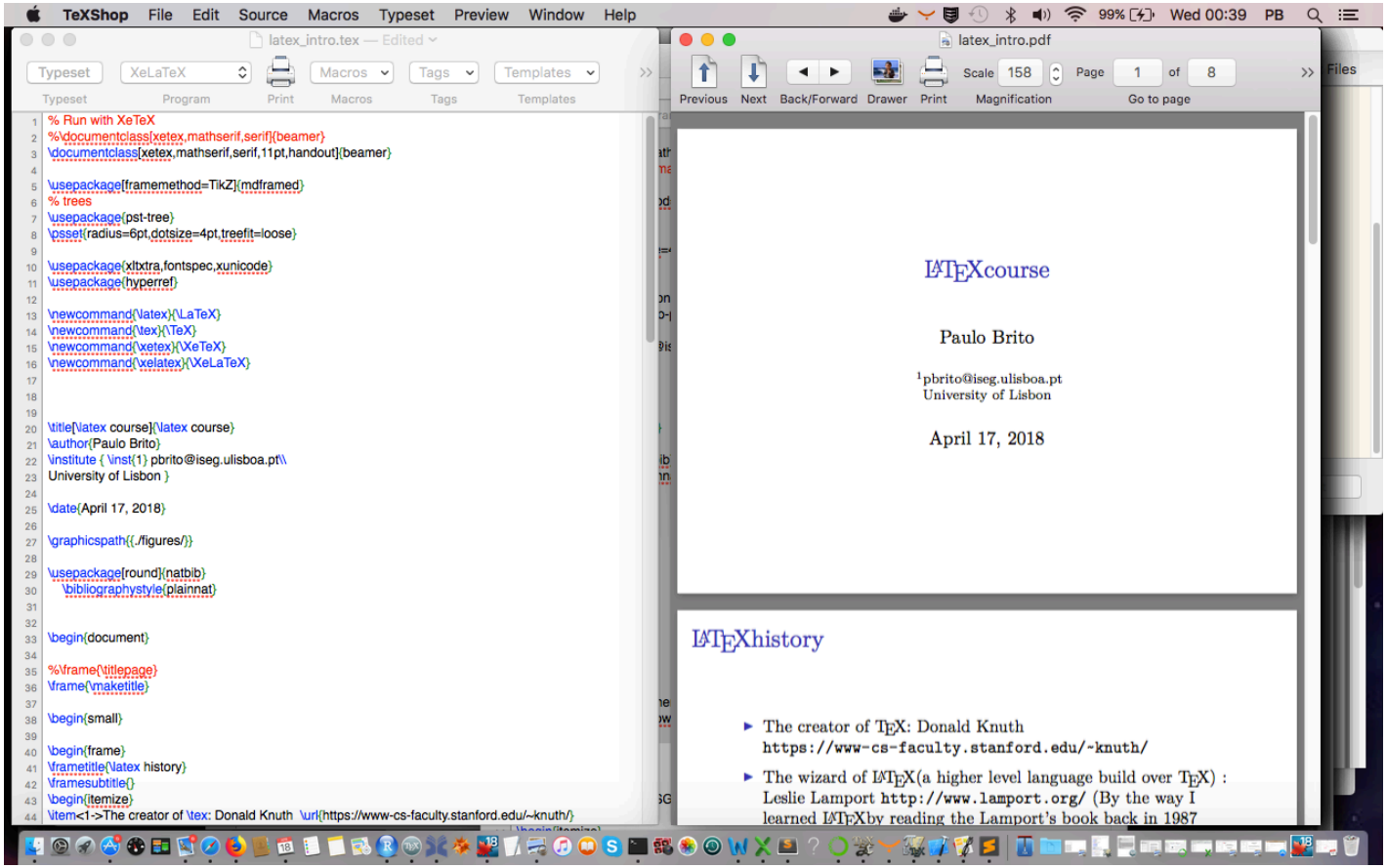
LaTeXfor lazy programmers

Texshop



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First LaTeXdocument

LaTeXscript

```
% Paulo Brito: 18.4.2018
% My first latex script
% compile with xelatex (or latex)
\documentclass{article}
\begin{document}
My first latex document: Hello World !
\end{document}
```

First LaTeXscript

After compilation: one time

My first latex document: Hello World !

Second LaTeXdocument: title

LaTeXscript

```
% Paulo Brito: 18.4.2018
% My second latex script: adding a  title
% compile with xelatex (or latex)
\documentclass{article}
\author{A. U. Thor \\
\texttt{author@iseg.ulisboa.pt}}
\title{Hello}
\date{18.4.2018}
\begin{document}
\maketitle
My first signed latex document: Hello World !
\end{document}
```

Second LaTeXscript

After compilation: one time

Hello

A. U. Thor
author@iseg.ulisboa.pt

18.4.2018

My first signed latex document: Hello World !

Third LaTeXdocument: sectioning

LaTeXscript

```
% Paulo Brito: 18.4.2018
\documentclass{article}
\author{A. U. Thor \\
\texttt{author@iseg.ulisboa.pt}}
\title{Hello}
\date{18.4.2018}
\begin{document}
\maketitle
% = = = = = = = = = = TEXT BODY = = = = =
\section{Introduction} \label{sec:intro}

This paper deals addresses the origins of the word Hello. There are two theories:
one says it comes from hell (hell-oh) and the other says it comes from honey (mell-oh).
Section \ref{sec:literature} reviews the literature on the topic. In section \ref{sec:model}
we present a model.

\section{Literature review} \label{sec:literature}

There are two strands in the literature

\section{The model} \label{sec:model}

From the literature review in Section \ref{sec:literature} we propose
a new theory on hello.

\end{document}
```

Third LaTeXscript

After compilation: two times

Hello

A. U. Thor
author@iseg.ulisboa.pt

18.4.2018

1 Introduction

This paper deals addresses the origins of the word Hello. There are two theories: one says it comes from hell (hell-oh) and the other says it comes from honey (mell-oh). Section 2 reviews the literature on the topic. In section 3 .

2 Literature review

There are two strands in the literature

3 The model

From the literature review in Section 2 we propose a new theory on hello.

Fourth LaTeXdocument: bibliographies

1. Build a bibtex file with name `biblio.bib`

```
@Book{ljungqvist&sargent2012,
  Title = {Recursive {M}acroeconomic {T}heory},
  Author = {Ljungqvist, Lars and Sargent, Thomas J.},
  Publisher = {{MIT} Press},
  Year = {2012},
 Address  = {Cambridge and London},
  Edition  = {Third edition},
}
@Article{prescott&mehra1980,
  Title  = {Recursive competitive equilibrium: the case of homogeneous households},
  Author  = {Edward C. Prescott and Rajnish Mehra},
  Journal  = {Econometrica},
  Year  = {1980},
  Month  = {Sep.},
  Number  = {6},
  Pages  = {1365-1379},
  Volume  = {48},
}
@TechReport{sargent&golosov&all2017,
  author  = {Thomas Sargent and Mikhail Golosov and David Evans and Anmol Bhandari},
  title  = {{Optimal Fiscal-Monetary Policy with Redistribution}},
  institution = {Society for Economic Dynamics},
  year  = {2017},
  type  = {2017 Meeting Papers},
  number  = {1245},
  url  = {https://ideas.repec.org/p/red/sed017/1245.html},
}
```

Fourth LaTeXdocument: bibliographies

2. Use it in the LaTeXscript

```
% Paulo Brito: 18.4.2018
% My fourth  latex script: bibliographies
% compile with xelatex (or latex) then bibtex and then xelatex (twice)

\documentclass{article}
%
\usepackage[round]{natbib}  %
\bibliographystyle{apalike}   % style
\setcitestyle{authoryear,open={(},close={)}}
%
\author{A. U. Thor \\
\texttt{author@iseg.ulisboa.pt}}
\title{Hello}
\date{18.4.2018}
\begin{document}
\maketitle
% = = = = = = = = = = TEXT BODY =====

The main papers in this literature are: books  \cite{ljungqvist&sargent2012},
papers \cite{prescott&mehra1980} and  working papers \cite{sargent&golosov&all2017}

\bibliography{biblio}

\end{document}
```

Fourth LaTeXscript

Compilation: latex, bibtex, latex, latex

Hello

A. U. Thor
author@iseg.ulisboa.pt

18.4.2018

The main papers in this literature are: books Ljungqvist and Sargent (2012), papers Prescott and Mehra (1980) and working papers Sargent et al. (2017)

References

Ljungqvist, L. and Sargent, T. J. (2012). *Recursive Macroeconomic Theory*. MIT Press, Cambridge and London, third edition edition.

Prescott, E. C. and Mehra, R. (1980). Recursive competitive equilibrium: the case of homogeneous households. *Econometrica*, 48(6):1365–1379.

Sargent, T., Golosov, M., Evans, D., and Bhandari, A. (2017). Optimal Fiscal-Monetary Policy with Redistribution. 2017 Meeting Papers 1245, Society for Economic Dynamics.

Fifth LaTeXdocument: page formatting

LaTeXscript

```
% Paulo Brito: 18.4.2018
% My fifth scrip: page formatting
\documentclass{article}

\usepackage[total={6.7in,8.5in},top=1.2in, left=1in, includefoot]{geometry}
\renewcommand{\baselinestretch}{1.5} % <------- choose the line-spacing

\title{Hello}
\author{A. U. Thor}
\date{18.4.2018}

\begin{document}
\maketitle

Those two types of  evidence are not contradictory.  They mean that there are countervailing forces
 acting in the short-to-medium run concurring to  the reduction of inequality. First, globalllzation and t
 flow of capital and ideas between countries  may  generate convergence forces. Particularly between
 successive "Industrial Revolutions" , after an initial outbreak of inequality, there are homogeinizing
 forces at work  through international flows of capital and ideas. Second, when the social fabric
 becomes fragile after heavy shocks generated by natural disasters or  diseases,  or man-made
 disasters, as wars and revolutions, it usually follows a period of reduction of inequality.
\end{document}
```

Sixth LaTeXscript

Compilation: latex once

Hello

A. U. Thor

18.4.2018

Those two types of evidence are not contradictory. They mean that there are countervailing forces acting in the short-to-medium run concurring to the reduction of inequality. First, globalllzation and the flow of capital and ideas between countries may generate convergence forces. Particularly between successive "Industrial Revolutions" , after an initial outbreak of inequality, there are homogeinizing forces at work through international flows of capital and ideas. Second, when the social fabric becomes fragile after heavy shocks generated by natural disasters or diseases, or man-made disasters, as wars and revolutions, it usually follows a period of reduction of inequality.

Sixth LaTeXdocument: listings

LaTeXscript

```
\documentclass{article}
\begin{document}
Bullet listings
\begin{itemize}
\item First point
\item Second point
\end{itemize}
Numbered listings
\begin{enumerate}
\item First point
\item Second point
\end{enumerate}
Listings with own itemization
\begin{itemize}
\item[One] First point
\item[Two] Second point
\end{itemize}
Llstings within listings
\begin{enumerate}
\item First point
\begin{enumerate}
\item First inside point
\item Second  inside point
\end{enumerate}
\item Second point
\begin{enumerate}
\item First inside item
\item Second  inside item
\end{enumerate}
\end{enumerate}
\end{document}
```

Sixth LaTeXscript

Compilation: latex once

Bullet listings

- First point
- Second point

Numbered listings

1. First point
2. Second point

Listings with own itemization

One First point

Two Second point

Llstings within listings

1. First point
   (a) First inside point
   (b) Second inside point
2. Second point
   (a) First inside item
   (b) Second inside item

Seventh LaTeXdocument: tables

LaTeXscript

```
\documentclass{article}
\begin{document}
Table \ref{tab:1} is a simple table
\begin{table}[hp]
\centering
\caption{A simple table}
\vspace{0.5cm}
\begin{tabular}{l|cc}
 & A  &  B  \\
 \hline
 X & 1 & 2 \\
 Y & 3 & 4
\end{tabular}
\label{tab:1}
\end{table}
Table \ref{tab:2} is a little more complicated: multicolumns
\begin{table}[hp]
\centering
\caption{A simple table}
\vspace{0.5cm}
\begin{tabular}{lc|cc|cc}
 & A  &  \multicolumn{2}{c|}{B} &   \multicolumn{2}{c}{C}  \\
 &   &  B1 & B2  & C1 & C2  \\
 \hline
 X & 1 & 2  & 3 & 4  & 5 \\
 Y & 6 & 7  &  8 & 9 & 10
\end{tabular}
\label{tab:2}
\end{table}
\end{document}
```

Seventh LaTeXscript

Compilation: latex twice

Table 1 is a simple table

Table 1: A simple table

	A	B
X	1	2
Y	3	4

Table 2 is a little more complicated: multicolumns

Table 2: A simple table

	A	B		C	
		B1	B2	C1	C2
X	1	2	3	4	5
Y	6	7	8	9	10

Eighth LaTeXdocument: imported figures

LaTeXscript

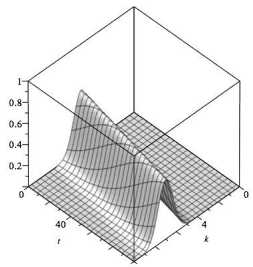
```
% Figures  produced with mathematica or maple
\documentclass{article}
 \usepackage{graphicx}
 \usepackage{caption,subcaption}
\begin{document}
Figure \ref{fig:1} represents a three-dimensional projection
\begin{figure}[hp]
\centering
\caption{Three-dimensional diagram}
\includegraphics[scale=0.4]{fig1.jpg}
\subcaption*{See equation .. with parameters}
\label{fig:1}
\end{figure}
Figure \ref{fig:2} represents two  three-dimensional projection
\begin{figure}[hp]
\caption{A figure}
\begin{subfigure}[b]{.60\linewidth}
\centering
\includegraphics[scale=0.3]{fig1.jpg}
\caption{A subfigure}
\label{fig:2a}
\end{subfigure}%
\begin{subfigure}[b]{.25 \linewidth}
\centering
\includegraphics[scale=0.3]{fig2.jpg}
\caption{Another subfigure}
\label{fig:2b}
\end{subfigure}
\label{fig:2}
\end{figure}
\end{document}
```

Eighth LaTeXscript

Compilation: latex twice

Figure 1 represents a three-dimensional projection Figure 2 represents two

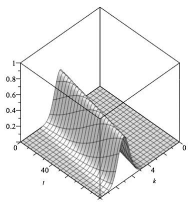
Figure 1: Three-dimensional diagram



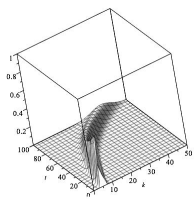
See equation .. with parameters

three-dimensional projection

Figure 2: A figure



(a) A subfigure



(b) Another subfigure

Ninth LaTeXdocument: pstricks

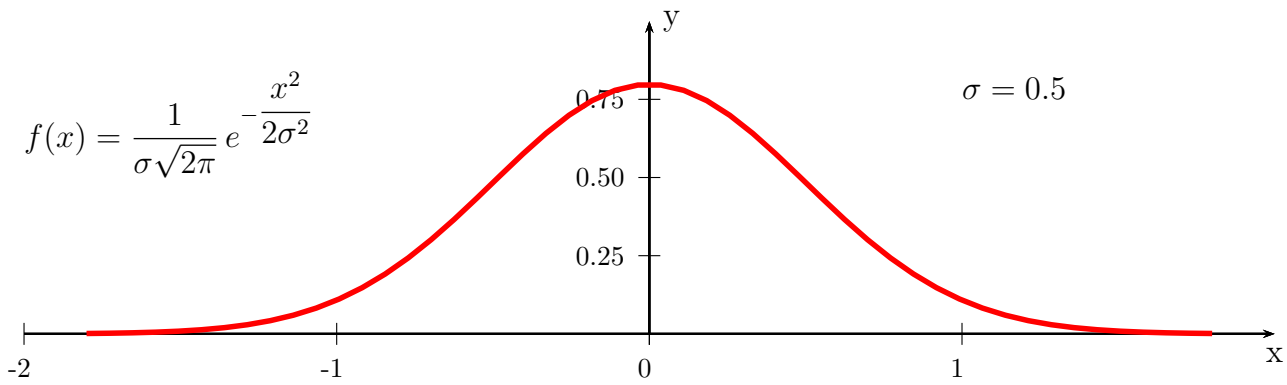
LaTeXscript

```
\documentclass[12pt,a4paper]{article}
\usepackage{pst-plot}
\usepackage{pstricks-add}
\usepackage{amsmath}
%
\def\pshlabel#1{\footnotesize#1}\def\psvlabel#1{\footnotesize#1}
%
\begin{document}
\begin{figure}[hp]
\centering
\caption{A pstricks figure}
\vspace{0.5cm}
\psset{yunit=4cm,xunit=4}
\begin{pspicture}(-2,0)(2,1)
%  \psgrid[griddots=10,gridlabels=0pt, subgriddiv=0]
  \psaxes[Dy=0.25]{->}(0,0)(-2,0)(2,1)
  \uput[-90](2,0){x}\uput[0](0,1){y}
  \rput[lb](1,0.75){$\sigma =0.5$}
  \rput[lb](-2,0.5){$f(x)=\dfrac{1}{\sigma\sqrt{2\pi}}\,e^{-\dfrac{x^2}{2\sigma{}^2}}$}
  \psplot[linecolor=red, linewidth=2pt]{-1.8}{1.8}{%
    /sigma 0.5 def
    /e 2.718282 def
    /C 1 sigma div 6.2831 sqrt div def
    e x dup mul 2 div sigma dup mul div neg exp C mul}
\end{pspicture}
\end{figure}
\end{document}
```

Ninth LaTeXscript

Compilation: latex once

Figure 1: A pstricks figure



Tenth LaTeXdocument: tikz

LaTeXscript

```
\begin{frame}[fragile,label=notleM2bis]
\frametitle{Nineth  \latex document: pstricks}
\framesubtitle{\latex script}
\begin{block}{}
\begin{verbatim}
% run with XeLaTeX
\documentclass{article}
\usepackage{tikz}
\usetikzlibrary{calc}

\begin{document}

\begin{figure}
\centering
\caption{An exponential function}
\vspace{0.5cm}
\begin{tikzpicture}[xscale=0.01,yscale=0.05]
\draw[thick,->] (0,0) -- (500,0) node[right]{$t$};
\draw[thick,->] (0,0) -- (0,100) node[above]{$y(t)$};
\draw[blue,smooth,variable=\x,domain=0:460] plot (\x,{exp(0.01*\x)});
\end{tikzpicture}
\label{fig:1}
\end{figure}
Figure \ref{fig:1} represents function $y = e^{0.01 t}$.
\end{document}
```

Tenth LaTeXscript

Compilation: latex twice

Figure 1: An exponential function

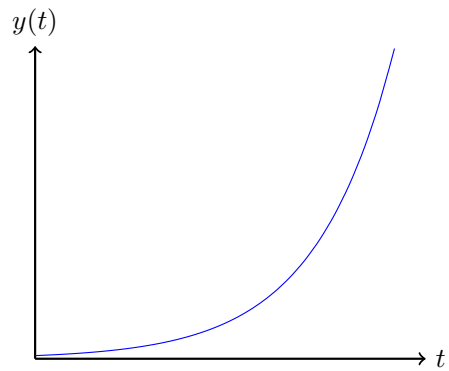


Figure 1 represents function $y = e^{0.01t}$.

Eleventh LaTeXdocument: LaTeXmath

LaTeXscript

```
\documentclass{article}
\begin{document}
Let $t \in T \subseteq   R_{+}$ and $x: T \rightarrow R$ be a continuous
\[
\dot{x} = f(x)
\]ă
If we want to number equation we would make
\begin{equation}
\dot{x} = f(x) \label{eq:ode1}
\end{equation}
If we want to refer to equation (\ref{eq:ode1}).
A system of equation un-numbered
\begin{eqnarray*}
a_{11} y_1 + a_{12} y_2 & = & b_1 \\
a_{21} y_1 + a_{22} y_2 & = & b_2
\end{eqnarray*}
A numbered system
\begin{eqnarray}
a_{11} y_1 + a_{12} y_2 & = & b_1 \\
a_{21} y_1 + a_{22} y_2 & = & b_2
\end{eqnarray}
A matrix
\[
A =  \left( \begin{array}{cc}ă a_{11}  & a_{12}  \\ a_{21}  & a_{22} \end{array} \right)
\]ă
Some symbols  $y(t) = \int_{0}^{\infty} k(x,y) y(x) dx$  $U[C] = \sum_{t=0}^{\infty} \beta^{t} u(C(t))$

Greek letters: $\alpha$, $\beta$, $\gamma$, $\delta$. Capitals: $\Delta$, $\Gamma$
\end{document}
```

Eleventh LaTeXscript

Compilation: latex twice

Let $t \in T \subseteq R_+$ and $x : T \to R$ be a continuous

$$\dot{x} = f(x)$$

If we want to number equation we would make

$$\dot{x} = f(x) \tag{1}$$

If we want to refer to equation (1). A system of equation un-numbered

$$\begin{aligned} a_{11}y_1 + a_{12}y_2 &= b_1 \\ a_{21}y_1 + a_{22}y_2 &= b_2 \end{aligned}$$

A numbered system

$$\begin{aligned} a_{11}y_1 + a_{12}y_2 &= b_1 && (2) \\ a_{21}y_1 + a_{22}y_2 &= b_2 && (3) \end{aligned}$$

A matrix

$$A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$$

Some symbols

$$y(t) = \int_0^\infty k(x, y)y(x)dx$$

$$U[C] = \sum_{t=0}^{\infty} \beta^t u(C(t))$$

Greek letters: α, β, γ, δ. Capitals: Δ, Γ

Twelveth LaTeXdocument: AMS math

LaTeXscript

```
\documentclass{article}

\usepackage{amstext}
\usepackage{amsfonts}
\usepackage{amsthm}
\usepackage{amsmath}
\usepackage{amssymb}

\begin{document}

New references: reference to equation \eqref{eq:1}
\begin{equation}
\dot{x} = f(x) \label{eq:1}
\end{equation}
Tagging : reference to equation \eqref{eq:2}
\begin{equation}
\dot{x} = f(x) \label{eq:2} \tag{\mathcal{E}}
\end{equation}
Easier definition of matrices
\[
A =  \begin{pmatrix}
a_{11}  & a_{12}  \\
a_{21}  & a_{22}
\end{pmatrix}
\]ã
Lots of new symbols: $\mathbb{R}$, $\mathcal{R}$ $\mathscr{R}$

\end{document}
```

Twelveth LaTeXscript

Compilation: latex twice

New references: reference to equation (**??**)

$$\dot{x} = f(x) \tag{1}$$

Tagging : reference to equation (**??**)

$$\dot{x} = f(x) \tag{E}$$

Easier definition of matrices

$$A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$$

Lots of new symbols: $\mathbb{R}$, $\mathcal{R}$ R

beginframe[fragile,label=notleM2bis]

```
\documentclass{article}
\usepackage{amsthm}
\usepackage{amstext}
\usepackage{amsfonts}
 \usepackage{amsthm}
 \usepackage{amsmath}
 \usepackage{amssymb}
\newtheorem{assumption}{Assumption}
\newtheorem{lemma}{Lemma}
\newtheorem{theorem}{Theorem}
\newtheorem{corollary}{Corollary}
\newtheorem{proposition}{Proposition}
\newtheorem{hypothesis}{Hypothesis}
\newtheorem{definition}{Definition}
\newtheorem{example}{Example}
\newtheorem{exercise}{Exercise}
\begin{document}
Reference to Assumption \ref{ass:1} to Proposition \ref{prop:1}
\begin{assumption} \label{ass:1}
Let  $f(x)$ such that $f: x \mapsto f(x) \in \mathbb{R}$ be continuously differentiable
\end{assumption}
\begin{proposition} \label{prop:1}
Consider function $f(x)$ as in assumption \ref{ass:1}. Then $\dot{x} = f(x)$ has a unique solution
\end{proposition}
\end{document}
```

Tirtheenth LaTeXscript

Compilation: xelatex twice

Reference to Assumtion 1 to Proposition 1

Assumption 1. *Let $f(x)$ such that $f : x \mapsto f(x) \in \mathbb{R}$ be continuously differentiable*

Proposition 1. *Consider function $f(x)$ as in assumption 1. Then $\dot{x} = f(x)$ has a unique solution*

Let X be given by definition 1

Definition 1. *Let X be the set of sports.*