An Introduction to Type-setting projects in LaTeX 2ε with the UoYCSProject class

Jeremy Jacob

The University of York, Department of Computer Science

2013 October 22

What is LaTeX?

LaTeX 2ε is a *document description language* built on top of...

TeX , a type-setting engine designed by Donald Knuth.

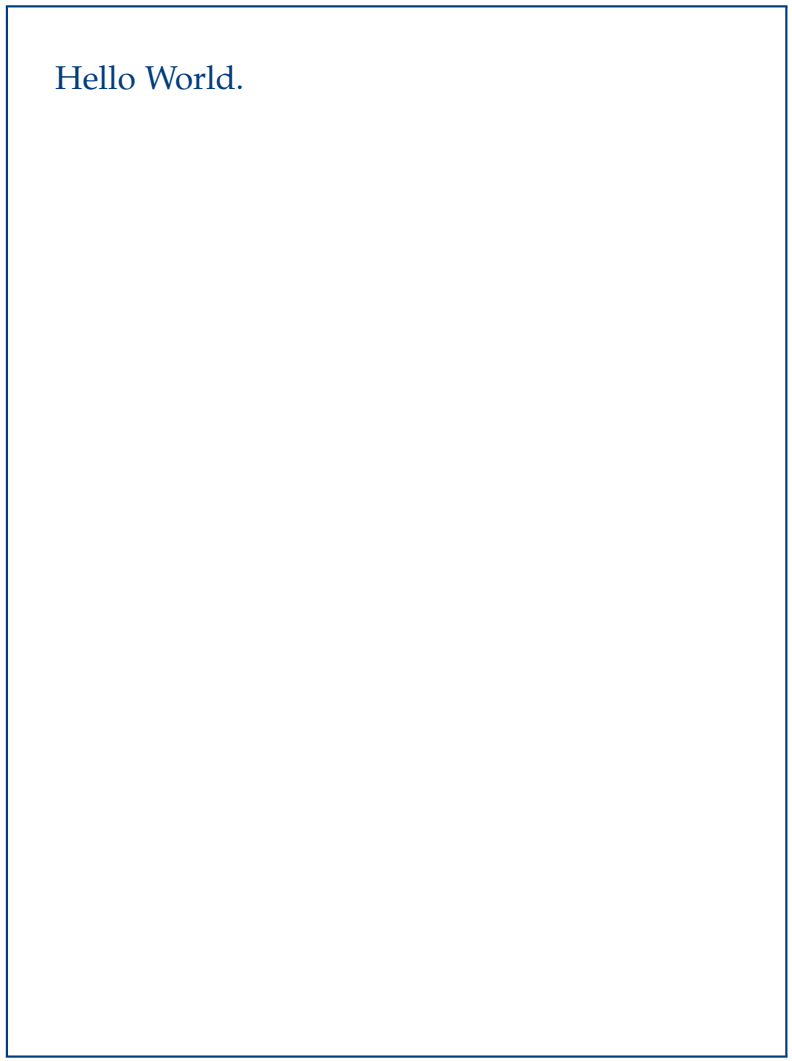
Cf. `HTML` and `SGML`/`XML` applications plus a rendering engine.

A minimal document

Source

```
\documentclass{minimal}
\begin{document}
Hello World.
\end{document}
```

Output



Why use LaTeX 2ε?

- The sophisticated type-setting algorithm of TeX, and the enhanced algorithm of *pdfe(la)tex*. ▸ the TeX showcase.
- The huge number of pre-defined packages for doing common things. ▸ the TeX catalogue
- The ability to define your own special purpose structures.
- Stable basis.
- Good for large, academic documents.

References

There are many good references for TEX and friends.

See "*A guide to type-setting project reports in LATEX with the UoYCSproject class*". ▸ Guide

Marc van Dongen produced a video to advertise his book, while gently introducing LATEX: ▸ Video.

UoYCSProject

a class for project reports

There are many pre-defined document classes:

Base	minimal, article, report, book, letter, slides.
KOMA-Script	scrartcl, scrreprt, scrbook, scrlttr2.
Memorandum	memorandum.
Others	. . . , beamer, . . . , UoYCSproject ▸ UoYCSproject, . . .

Text, commands and environments

A LaTeX 2ε source is a mix of:

text Some text.,

commands **LaTeXe**, **ensuremath**{**frac**{2}{3}}, and

environments

```
\begin{verse}
  Much have I travell'd in the realms of gold,\\
  And many goodly states and kingdoms seen;\\
  Round many western islands have I been\\
  Which bards in fealty to Apollo hold.\\
  Oft of one wide expanse had I been told\\
  That deep-browed Homer ruled as his demesne;\\
  Yet did I never breathe its pure serene\\
  Till I heard Chapman speak out loud and bold:\\
  Then felt I like some watcher of the skies\\
  When a new planet swims into his ken;\\
  Or like stout Cortez when with eagle eyes\\
  He star'd at the Pacific --- and all his men\\
  Look'd at each other with a wild surmise ---\\
  Silent, upon a peak in Darien.
\end{verse}
```

Examples typeset

Much have I travell'd in the realms of gold,
And many goodly states and kingdoms seen;
Round many western islands have I been
Which bards in fealty to Apollo hold.
Oft of one wide expanse had I been told
That deep-browed Homer ruled as his demesne;
Yet did I never breathe its pure serene
Till I heard Chapman speak out loud and bold:
Then felt I like some watcher of the skies
When a new planet swims into his ken;
Or like stout Cortez when with eagle eyes
He star'd at the Pacific — and all his men
Look'd at each other with a wild surmise —
Silent, upon a peak in Darien.

LaTeX 2ε

$$\frac{2}{3}$$

The anatomy of a LaTeX source

```
\documentclass[class options]{class name}
preamble (definitions and declarations)
\begin{document} % this is a comment.
body
\end{document}
```

The anatomy of a UoYCSproject preamble

```
\documentclass{UoYCSproject}
% Order of declarations does not matter.
\author{Anne Student-Name}
\title{A Solution to the Problem of $\mathit{P}=\mathit{NP}$}
\date{30 February 2000}
\supervisor{Prof. Z. Soporific}
\MEng
\wordcount{2,345}\excludes{Appendix~\ref{sec:code}}
\dedication{To My Cat, Jeoffery}
\abstract{The well-known problem of $P=NP$ is explained,
  together with its significance and a brief history of
  attempts to solve it. An ingenious solution is presented.}
\begin{document}
...
\end{document}
```

A full list of declarations is given in ▸ Guide, Figure 7.1, P 46.

Extra definitions and package loading

- You can load extra packages and make your own definitions.
- These go in a file with the same name as your main file, but extension ‘ldf’. This is different to the way all other classes work.
  (I have implemented UoYCSproject in this way to ensure that packages are loaded in the correct order.)
- Useful packages include: listings , graphics, graphicx, pgf/ tikz , amsmath.

The anatomy of the body

Front matter	Title pages, abstract, contents, &c.
Main matter	The text, divided into (parts,) chapters (, sections, subsections, subsubsections, paragraphs and subparagraphs).
Back matter	Bibliography, appendices &c.

Front matter

```
\maketitle % Compulsory: title pages, table of contents
\listoffigures % Optional: the list of figures
\listoftables % Optional: the list of tables
... % Optional, package dependent lists,
... % e.g. \lstlistoflistings
```

Main matter

```
\part{title}                % Optional
\chapter{title}             % Compulsory
\section{title}             % Optional
\subsection{title}          % Optional
\subsubsection{title}       % Optional
\paragraph{title}           % Optional
\subparagraph{title}        % Optional
Text.  Text.
```

Back matter

```
\bibliography{file1,file2} % Construct bibliography
\appendix % remaining chapters are appendices
\chapter{title}          % One per appendix
\section{title}          % Optional
\subsection{title}       % Optional
\subsubsection{title}    % Optional
\paragraph{title}        % Optional
\subparagraph{title}     % Optional
Text.  Text.
```

Text elements

Characters Can control series, family, shape, colour and size of each text character. See ▸ Guide, §6.3.3.

Sentences Sentence␣one.␣␣Sentence␣two.

Paragraphs

```
Paragraph␣one.␣␣%␣␣blank␣line␣separates␣paragraphs

Paragraph␣two.
```

Special features

Context dependent emphasis	\emph{...\emph {...}...}
Cross references	Sectional units, floats, equations, &c.
Quotations	Short and long
Citations	
Lists	Bulleted, numbered and labelled
Tables	
Pictures	
Floats	Tables, Figures and others.

Citations and the bibliography

- Through the natbib package, set up for IEEE style.
- \citep{Joyce:FW} —cite parenthesised— generates [34], assuming Joyce:FW is the label of the 34th reference.
  Do not use this form as a noun.
- \ citet {Joyce:FW} —cite as text— generates Joyce [34], assuming also that the author's surname is 'Joyce'.
  You may use this form as a noun.
- Rule: your document should read naturally when all the citation markers (eg the '[34]', but not the 'Joyce') are removed.

Citations are kept in a database in a flat file and processed by a program called BibTEX before inclusion in output file. ▸ Example database

Mathematics

Very powerful facilities. May be enhanced by amsmath packages (best advice is to *always* load amsmath).

Inline Here is a formula: $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$; isn't it beautiful?

Displayed Here is a formula:

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2} \tag{1}$$

Isn't it beautiful?

Definitions

- A major reason for using LaTeX. Create special-purpose commands and environments for the structures in *your* document.
- To define a command called \UoY that prints 'The University of York':
  newcommand*{\UoY}{The University of York}
- To define a command that has two parameters:
  newcommand*{\C}[2]{_{#1}C^{#2}}
  begin{math}\C{x+2}{3y}**end**{math} type-sets as ${}_{x+2}C^{3y}$.

Case study: Cryptographic protocols

Syntax and form of messages

A *message* has three components: *sender*, *receiver* and *content*. So we write our document in terms of a command \msg that has 3 parameters:

```
\newcommand*{\msg}[3]{BODY}
```

Two possible definitions for BODY:

1. `#1\rightarrow#2:#3`
2. `#2\Leftarrow\left[#3\right]\Leftarrow#1`

The call `\msg{S}{R}{C^{A^{B}}}` produces

1. $S \rightarrow R : C^{A^B}$ or
2. $R \Leftarrow \left[C^{A^B} \right] \Leftarrow S$ respectively.

Case study: Cryptographic protocols

Syntax of message sequences

A protocol is a sequence of messages. So we write our document in terms of an environment that collects a sequence of messages.
We will write, for example:

```
\begin{protocol}
        \msg{A}{B}{X,Y,Z}
   \sep \msg{B}{C}{W,X}
   \sep \msg{C}{B}{W,X'}
\end{protocol}
```

Case study: Cryptographic protocols

Desired form of message sequences

Now we design the printed form.

1. The output should have numbered messages to which labels can be attached. Each message should be printed on a line of its own.
2. The definitions of \msg and \sep should be local to the environment.

Case study: Cryptographic protocols

Form of message sequences

```
\newcounter{msgnumber}
\newenvironment*{protocol}
{ % set up
   \setcounter{msgnumber}{0}%
   \newcommand*{\msg}[3]{%
      \refstepcounter{msgnumber}%
      \themsgnumber&##1&##2&##3}
   \newcommand*{\sep}{\\}
   \begin{math}\displaystyle%
      \begin{array}%
         {r@{.\quad}l@{\rightarrow}l@{\;:\;}l}}
{ % finalise
   \end{array}\end{math}}
```

Case study: Cryptographic protocols

The end product

Source

```
\begin{protocol}
        \msg{A}{B}{X,Y,Z}
  \sep  \msg{B}{C}{W,X}
  \sep  \msg{C}{B}{W,X'}
\end{protocol}
```

Output

1. $A \rightarrow B : X, Y, Z$
2. $B \rightarrow C : W, X$
3. $C \rightarrow B : W, X'$