Introduction to TEX and LATEX*

Boris Veytsman

February 2009

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1. Goals of This Course

"Piled Higher and Deeper" by Jorge Cham, www.phdcomics.com

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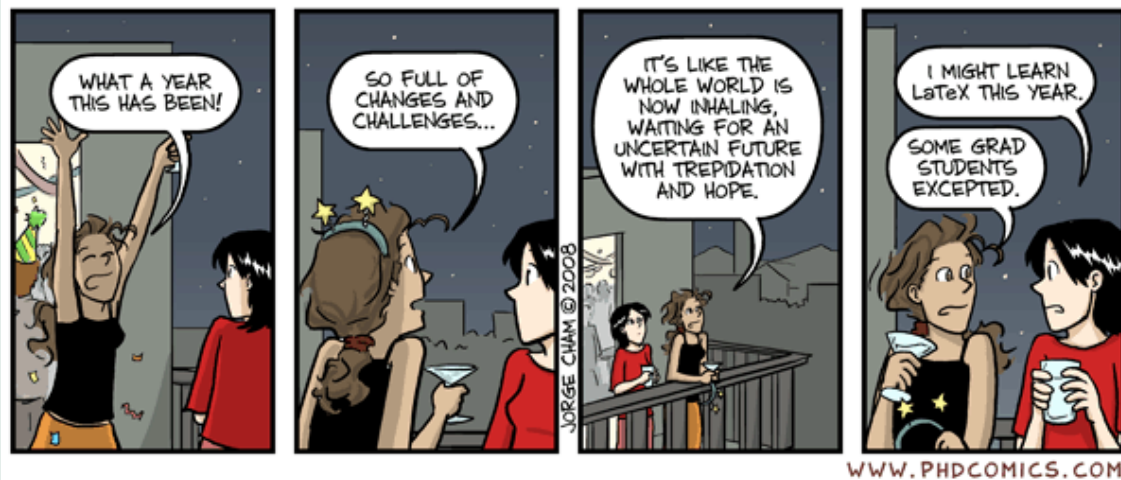
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1.   Goals of This Course
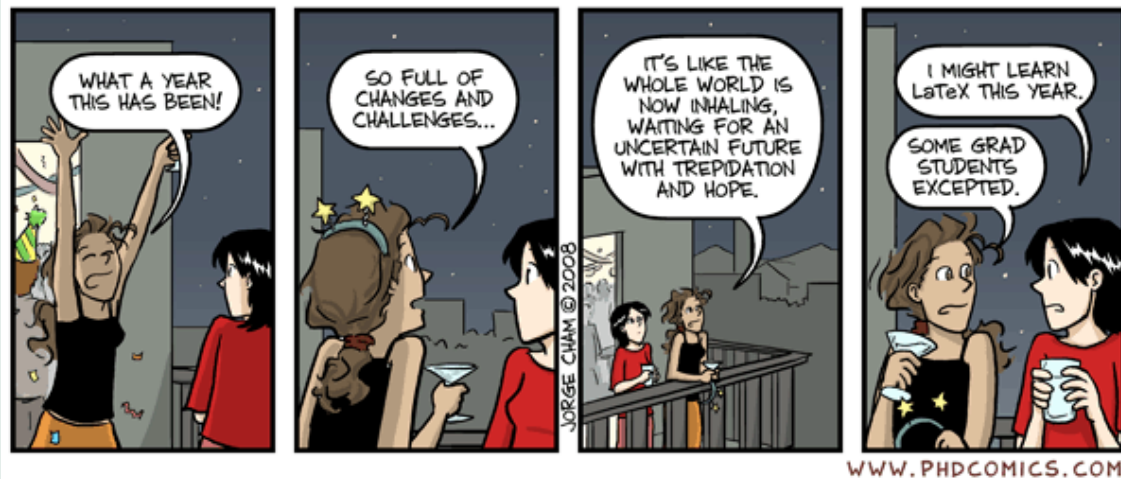
"Piled Higher and Deeper" by Jorge Cham, www.phdcomics.com

Since the audience is diverse, I want to provide basic information for the beginners—*and* some food for thought for the old hands.

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2. What is Different in T_EX?

You might know WYSIWYG documents: What You See Is What You Get. Is T_EX WYSIWYG?

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2. What is Different in T_EX?

You might know WYSIWYG documents: What You See Is What You Get. Is T_EX WYSIWYG?

Here is how I wrote the previous page

```
\section{Goals of This Course}
\label{sec:goals}


\begin{center}
\includegraphics[width=15cm]{phd123108s.png}\\
''Piled Higher and Deeper'' by Jorge Cham,
\href{http://www.phdcomics.com}{www.phdcomics.com}
\end{center}

\pause

Since the audience is diverse, I want to provide basic information
for the beginners---\emph{and} some food for thought for the old hands.
```

It is definitely *not* what you get!

Why is it so? What are the objectives of this strange design?

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3. A Short History of TEX & LATEX

Donald Knuth[1] got an impulse to develop TEX, when he saw bad typesetting of his *The Art of Computer Programming* (end of 1970s).

How were the old mathematical books typeset? Is it possible to do this with computers?

This lead to a research in the history of typography, fonts and typesetting.

TEX tries to imitate the classical typography practice—on the new technological level.

The quality of TEX algorithms is unsurpassed. It is the way to obtain best-looking pages—including pages with many equations.

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[1]Pencil portrait by The Lutheran High School Association of Greater Milwaukee, see http://www-cs-faculty.stanford.edu/~uno/graphics.html

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3.1. The Classical Typography Process

Author

The author produced a manuscript—just written (or typed) text:

```
Chapter 1
The Old Sea-dog at the Admiral Benbow

Squire Trelawney, Dr. Livesey, and the rest of these
gentlemen having asked me to write down the whole
particulars about Treasure Island, from the beginning
to the end, keeping nothing back but the bearings of the
island, and that only because there is still treasure not
yet lifted, I take up my pen in the year of grace 17... and
go back to the time when my father kept the Admiral Benbow
inn and the brown old seaman with the sabre cut first took
up his lodging under our roof.
```

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```

Book Designer

The book designer produced the design: the book must be set in Modern Sans Serif 10pt, chapter heads must be 12pt, etc.

Technical Editor

Technical editor would *mark up* the manuscript:

Chapter 1 — *12pt bold*

The Old Sea-dog at the Admiral Benbow — *bold*

Squire Trelawney, ~~Dr. Livesey,~~ and the rest of
these gentlemen having asked me to write down the
whole particulars about Treasure Island, from the
beginning to the end, keeping nothing back but the
bearings of the island, and that only because there
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when my father kept the Admiral Benbow inn and the
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sm. caps

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Compositor

Compositor would *typeset* the manuscript, selecting line breaks, hyphenation, page breaks to have a beautiful manuscript:

Chapter 1

The Old Sea-dog at the Admiral Benbow

SQUIRE TRELAWNEY, Dr. Livesey, and the rest of these gentlemen having asked me to write down the whole particulars about Treasure Island, from the beginning to the end, keeping nothing back but the bearings of the island, and that only because there is still treasure not yet lifted, I take up my pen in the year of grace 17... and go back to the time when my father kept the Admiral Benbow inn and the brown old seaman with the sabre cut first took up his lodging under our roof.

The result is definitely *not* WYSIWYG: the layout is *professional!*

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3.2. The Idea of T_EX

The idea of Knuth was to automate the work of *compositor.* The author would produce manuscript with *commands* (like the markup of the technical editor on page 6), and the computer would typeset it. The author's manuscript would look like this:

```
{\twelvebf Chapter 1}

{\bf The Old Sea-dog at the Admiral Benbow}

{\sc Squire Trelawney}, Dr. Livesey, and the rest of these
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about Treasure Island, from the beginning to the end, keeping
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```

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seaman with the sabre cut first took up his lodging under our
roof.
```

The sequences \twelvebf, \bf, \sc, \dots are *commands.* A TEX manuscript is text interspersed with commands. Commands are basically technical editor's markup.

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3.3.   Macro Expansion

One of them most important features of Knuth's TᴇX—macro expansion. Instead of writing

```
{\twelvebf Chapter 1}
{\bf The Old Sea-dog at the Admiral Benbow}
...
{\twelvebf Chapter 2}
{\bf  Black Dog Appears and Disappears}
...
{\twelvebf Chapter 3}
{\bf The Black Spot}
...
```

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we can define a command \chapter with one argument and write just

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\chapter{Old Sea-dog at the Admiral Benbow}
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\chapter{Black Dog Appears and Disappears}
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\chapter{The Black Spot}
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we can define a command \chapter with one argument and write just

```
\chapter{Old Sea-dog at the Admiral Benbow}
...
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...
\chapter{The Black Spot}
```

The command \chapter should calculate chapter number, put the word "Chapter" and the chapter title in the proper fonts, make the proper whitespace, etc.

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3.4. Visual and Logical Format

There is a big difference between the commands

{\twelvebf Chapter 1}
{\bf The Old Sea-dog at the Admiral Benbow}

and

\chapter{The Old Sea-dog at the Admiral Benbow}

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There is a big difference between the commands

```
{\twelvebf Chapter 1}
{\bf The Old Sea-dog at the Admiral Benbow}
```

and

```
\chapter{The Old Sea-dog at the Admiral Benbow}
```

The first one says *how the text should look*. The second one says *what does it mean*.

We can *redefine* \chapter, so this command produces

Chapter I

THE OLD SEA-DOG AT THE ADMIRAL BENBOW

We did an important thing: we separated the meaning from the appearance. This is the difference between *visual markup* and *logical markup*.

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Knuth's TEX provides mostly visual markup, but it has means (macro expansion!) to create a logical markup system.

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3.5. Why Do We Want Logical Markup?

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3.5. Why Do We Want Logical Markup?

Professionalism

Everybody must do his or her own work. Authors know how to write. Designers know how to make beautiful pages.

Authors should think about *meaning*, not about looking (besides, 99% of them have no idea of good design!)

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Style Changes

If the publisher wants to change fonts, headings, etc.—one can just change definition of commands!

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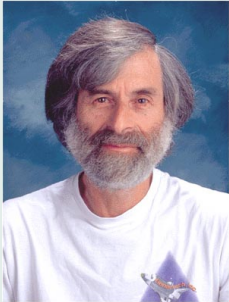
Style Changes

If the publisher wants to change fonts, headings, etc.—one can just change definition of commands!

Machine-Readable

We can process logical markup by a computer and make different outputs!

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3.6.   The Principles Of LATEX

There were several systems of logical markup with TEX. One of the most known is LATEX, created by Leslie Lamport[2]. The development is now done by the LATEX3 team. It provides a logical markup, automating numbering and references, bibliography and index handling, and hundreds of additional packages.

The main ideas of LATEX: (more or less) uniform logical markup of the manuscripts, *and* visual markup in *style files.*

Unlike Knuthian TEX, in LATEX authors are just authors, designers write style files, and computer does the work of a technical editor and a compositor.

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[2]The image used is released by the author to the public domain, see http://en.wikipedia.org/wiki/Image:Leslie_Lamport.jpg

Example: consider two simple files:

```
\documentclass[12pt]{article}

\begin{document}
\title{On Something Or Other}
\author{A. U. Thor}
\date{May 12, 2120}
\maketitle

\section{Introduction}

This is an introduction to the paper.

\end{document}
```

```
\documentclass[12pt]{amsart}

\begin{document}
\title{On Something Or Other}
\author{A. U. Thor}
\date{May 12, 2120}
\maketitle

\section{Introduction}

This is an introduction to the paper.

\end{document}
```

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On Something Or Other

A. U. Thor

May 12, 2120

1 Introduction

This is an introduction to the paper.

1

ON SOMETHING OR OTHER

A. U. THOR

1. INTRODUCTION

This is an introduction to the paper.

Date: May 12, 2120.

1
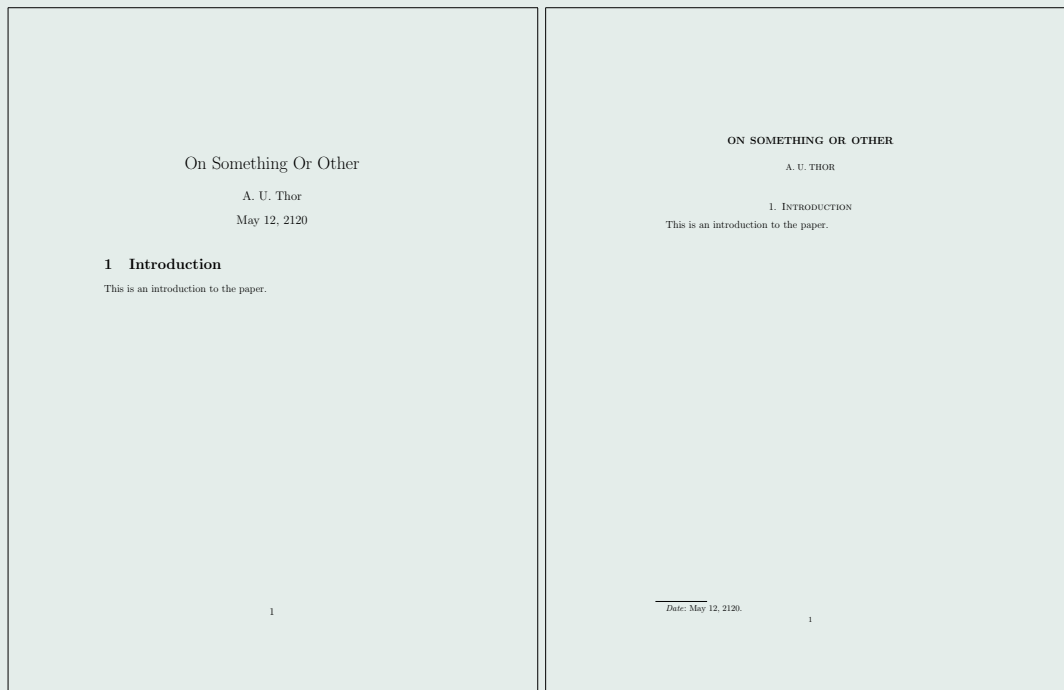
Observe the differences! (`article` is the default LATEX version, `amsart` is the version of the American Mathematical Society).

The author _or_ designer can easily change the manuscript style.

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4.   Why LaTeX & TeX?

Now we understand what is different in LaTeX & TeX: a `.tex` file is *not* a document. It is a *program* to produce a document!

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4. Why LᴬTᴇX & TᴇX?

Now we understand what is different in LᴬTᴇX & TᴇX: a `.tex` file is *not* a document. It is a *program* to produce a document!

4.1. Advantages of This Approach

A computer deals with all mundane tasks of writing: numbering, citations, references. You need just to express your thoughts.

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The results are versatile and unsurpassed: print documents (in any format), screen presentations, automatic generation, etc., etc.

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The language is stable: you can use the documents written decades ago!

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The results are versatile and unsurpassed: print documents (in any format), screen presentations, automatic generation, etc., etc.

The language is stable: you can use the documents written decades ago!

4.2. Bugs

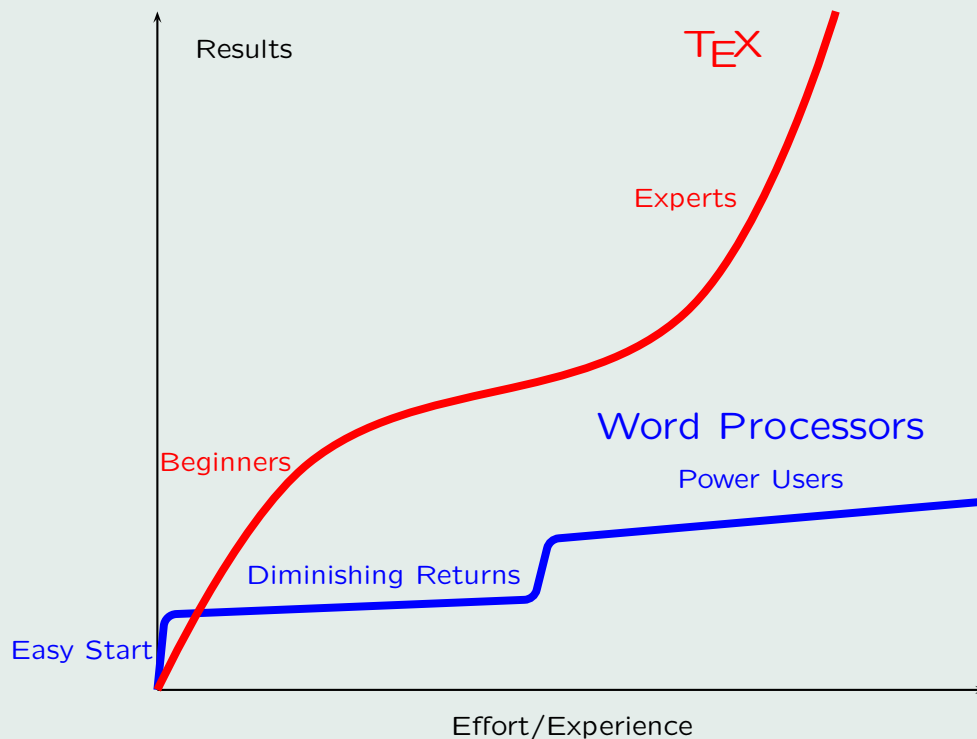Bad thing: programs have bugs. While TEX is[3] bug-free, *your* files are not.

You need to understand some debugging!

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[3]Arguably

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5. Where to get help?

5.1. For Beginners

1. The standard reference book by Lamport[4] is a good start.

2. The indispensable online FAQ[5] will answer many questions.

3. The great introduction text "The Not So Short Introduction to LaTeX 2_ε"[6] is available online.

4. There is the Comprehensive List of LaTeX symbols[7] available online.

5. The good book about higher math in LaTeX by Graätzer[8]. The first part of this book is available online[9]

6. People from the Usenet group `c.t.t`[10] will answer many questions.

---

[4] Leslie Lamport, *LaTeX: a Document Preparation System*, 2 edition (Reading, Ma.: Addison-Wesley Publishing Company, 1994), illustrations by Duane Bibby.

[5] UK TeX Users Group, UK List of TeX Frequently Asked Questions, `http://www.tex.ac.uk/cgi-bin/texfaq2html`, 2008.

[6] Tobias Oetiker et al., The Not So Short Introduction to LaTeX 2_ε, Or LaTeX 2_ε in 141 Minutes, May 2008, `http://ctan.tug.org/tex-archive/info/lshort`.

[7] Scott Pakin, The Comprehensive LaTeX Symbol List, September 2008, `http://ctan.tug.org/tex-archive/info/symbols/comprehensive`.

[8] George Gräetzer, *More Math Math into LaTeX*, fourth edition (New York: Springer, 2007).

[9] `http://ctan.tug.org/tex-archive/info/Math_into_LaTeX-4/`

[10] `news://comp.text.tex`

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5.2.　For More Advanced Users

1. `texdoc` utility helps to browse system documentation.

2. The great LaTeX Companion[11] lists many tips and tricks.

3. For special tasks see Graphics Companion[12] and Web Companion[13].

4. The Knuth's text[14] helps in the advanced macro programming in TeX.

5. TeX-related stuff is available at Comprehensive TeX Archive Network[15]

6. Consider joining TeX Users Group[16], which provides excellent journals, DVD collections and conferences about TeX.

---

[11]Frank Mittelbach et al., *The LaTeX Companion* (Boston: Addison-Wesley Professional, 2004), series Addison-Wesley Series on Tools and Techniques for Computer Typesetting.

[12]Michel Goossens, Sebastian Rahtz and Frank Mittelbach, *The LaTeX Graphics Companion: Illustrating Documents With TeX and PostScript* (Reading, Ma.: Addison-Wesley, 1997), series Addison-Wesley Series on Tools and Techniques for Computer Typesetting.

[13]Michael Goossens et al., *The LaTeX Web Companion: Integrating TeX, HTML, and XML* (Reading, Ma.: Addison Wesley Longman, 1999), series Addison-Wesley Series on Tools and Techniques for Computer Typesetting.

[14]Donald Ervin Knuth, *The TeXbook* (Reading, Ma.: Addison-Wesley Publishing Company, 1994), series Computers & Typesetting A, illustrations by Duane Bibby.

[15]http://ctan.tug.org

[16]http://www.tug.org

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Lamport, Leslie. *LaTeX: a Document Preparation System*. 2 edition. Reading, Ma.: Addison-Wesley Publishing Company, 1994. Illustrations by Duane Bibby.

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Oetiker, Tobias et al. The Not So Short Introduction to LaTeX 2_ε, Or LaTeX 2_ε in 141 Minutes. May 2008. http://ctan.tug.org/tex-archive/info/lshort.

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