Structured documents

Tools for writing science

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Structured documents

You probably know that using a good *data structure* can dramatically improve an algorithm

And you use *structured programs*

The same applies to structuring our documents

Maybe you have used LaTeX, or Markdown

Maybe you know HTML

Separation of concerns

Separate style from structure

Describe the role of text, not the “looks”

The key idea is to describe *what things are*, not *how they look*

This part is based on the ideas discussed in “LaTeX: A Document Preparation System” by Leslie Lamport (1986).

It is like a house

Structure makes the house solid and comfortable

If you only do decoration, the house looks nice but it is not solid

Structure of the walls come first

Painting the walls in a nice color is secondary

Structural elements

- Sections, subsections, paragraphs
- Figures and Tables
- Lists
- References
- Equations
- Metadata
  - Title
  - Authors
  - Affiliations
  - Dates: submission, acceptance

Microsoft Word

The first tool we learn today is a WYSIWYG word processor

In word processors like Word®,
What You See Is What You Get

This is sometimes called **WYSIWYG**

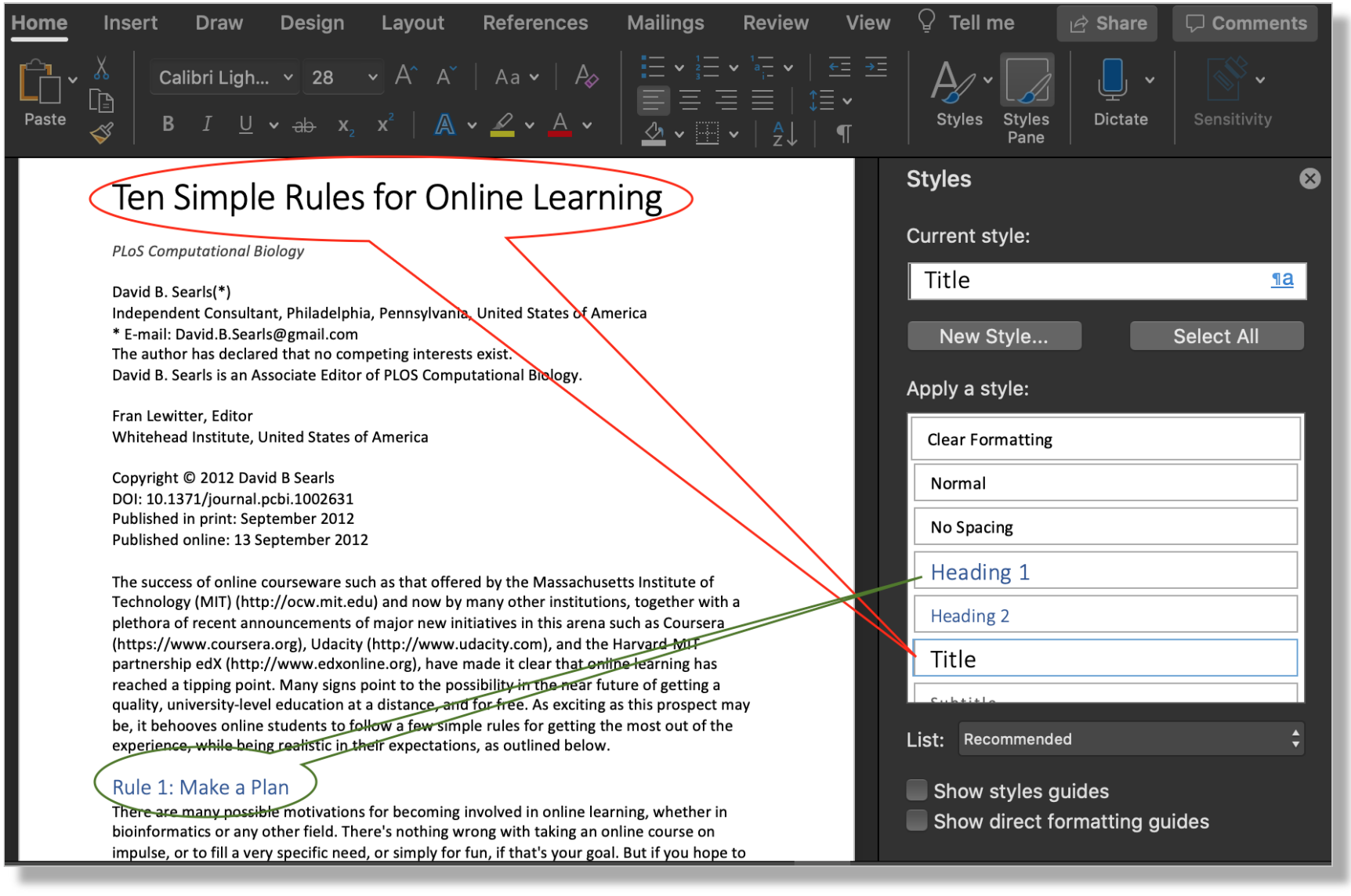
It is easy to change fonts, sizes, colors and other visual attributes, without paying attention to *structure*

Style is not Structure

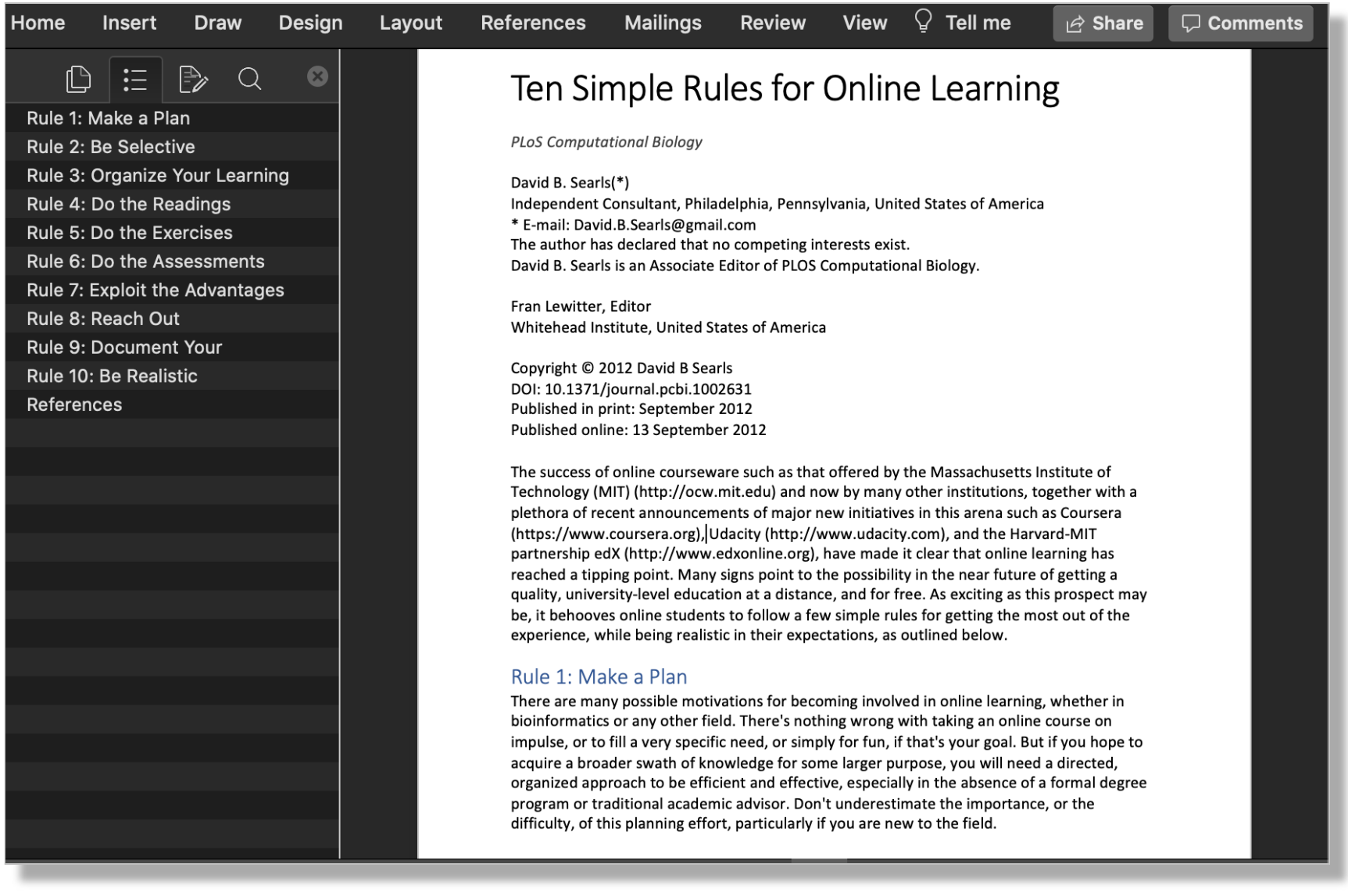
You can follow the same philosophy:

- Separate style from structure
- Focus on content

Structured Word documents



Now the document has structure



Historical note

Mechanical typewriters were invented in 1874

They had only one font

We still use the same keyboard

Using UPPERCASE and underline for emphasis

PRELIMINARY DISCUSSION OF THE LOGICAL DESIGN OF

AN ELECTRONIC COMPUTING INSTRUMENT

1.0 Principal Components of the Machine

1.1. Inasmuch as the completed device will be a general-purpose computing machine it should contain certain main organs relating to arithmetic, memory-storage, control and connection with the human operator.

Early computers had only *text*, no graphics

Giving style to plain text

Since there was only one type of letter, people used some symbols as “magic”

For example `\` or `@`

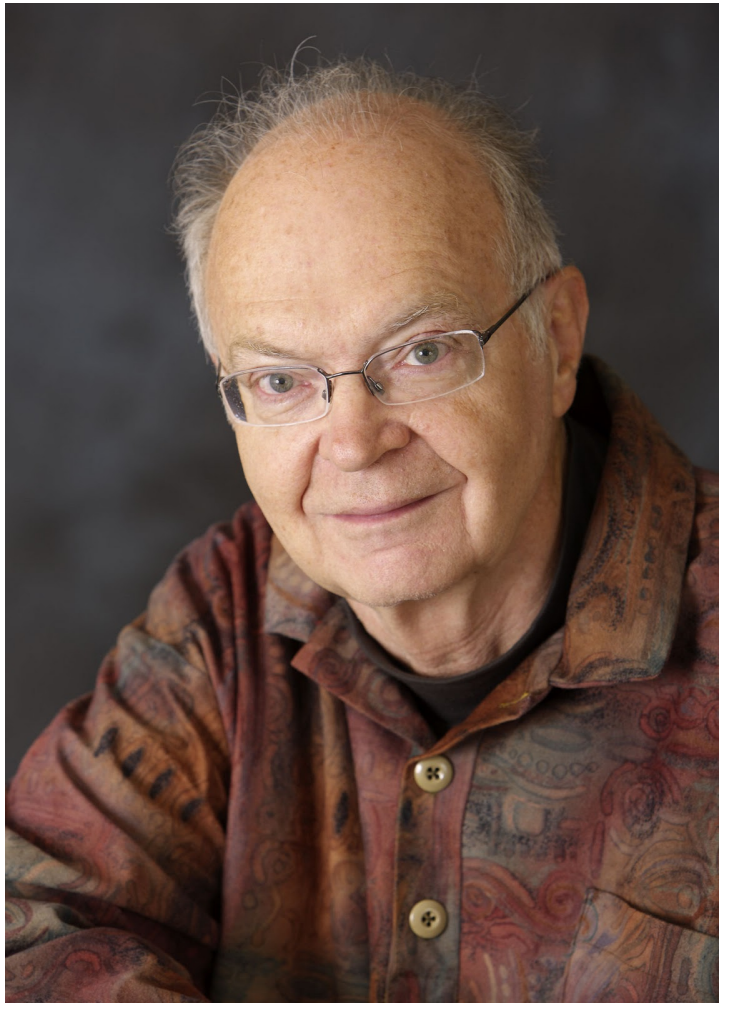
If you write a “magic” symbol, you tell the computer that the next symbol shows a change of format

This is called **Markup Language**

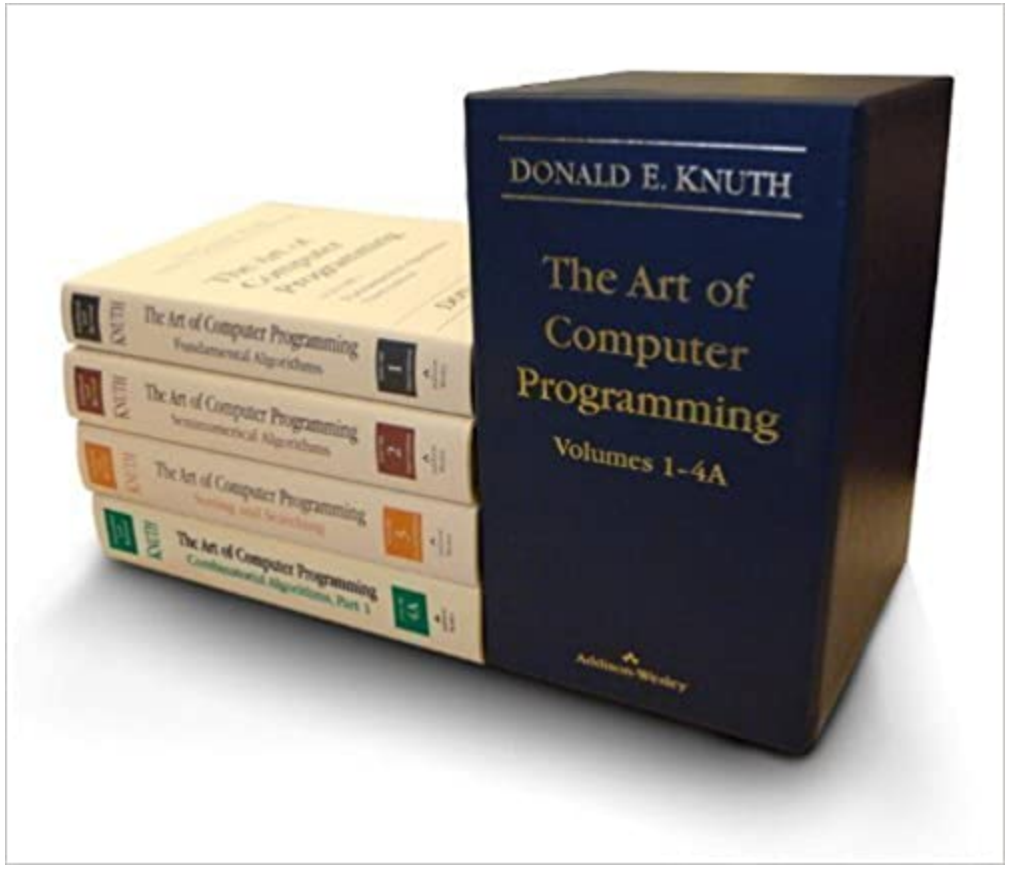
TeX

An important system to prepare documents in the computer was invented in the 70's by Donald Knuth, who is probably the most important computer scientist of the last 70 years.

Donald Knuth won the Turing Award in 1974



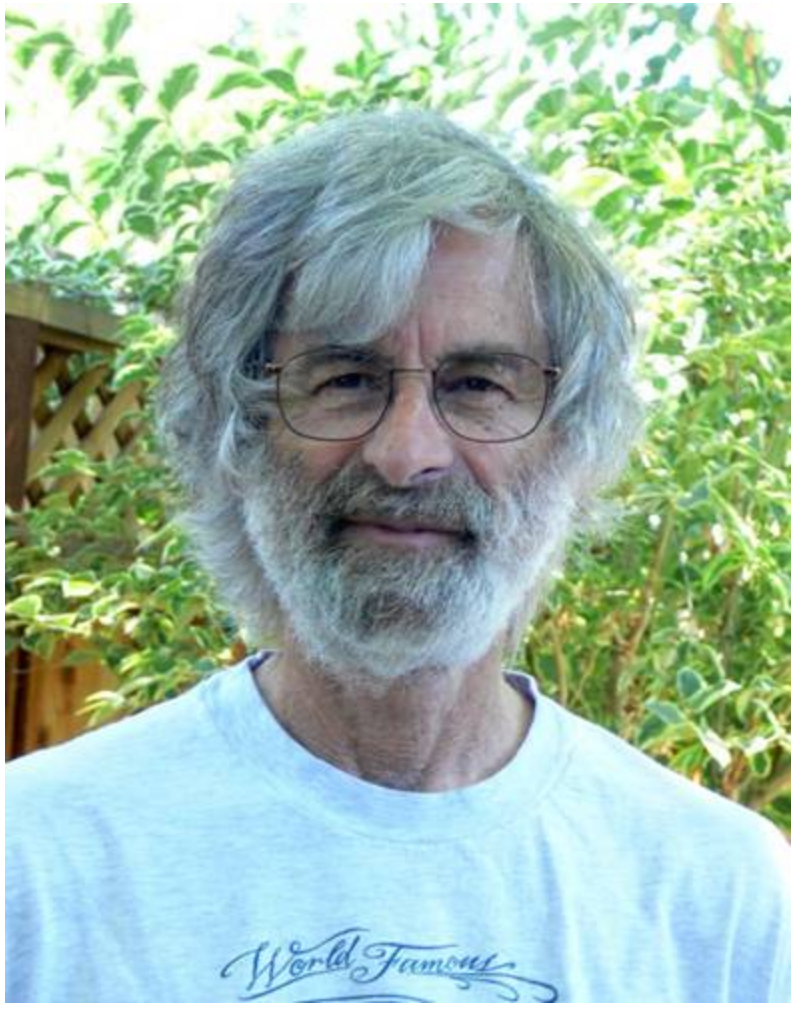
Knuth invented TeX to write this



LaTeX

TeX has styles but not structure. In the 80's Leslie Lamport created LaTeX as an extension of TeX

Leslie Lamport won the Turing Award in 2013



Example: writing in LaTeX

A LaTeX document looks like this

```
\documentclass[a4paper]{article}
\title{Ten Simple Rules for Online Learning}
\author{David B. Searls}
\date{13 September 2012}
\begin{document}
\section{Rule 1: Make a Plan}
There are many possible motivations for becoming involved in online learning…
\end{document}
```

LaTeX files are text files. They will never be obsolete.

Changing the `documentclass` will change the document *look*

Advantages of LaTeX

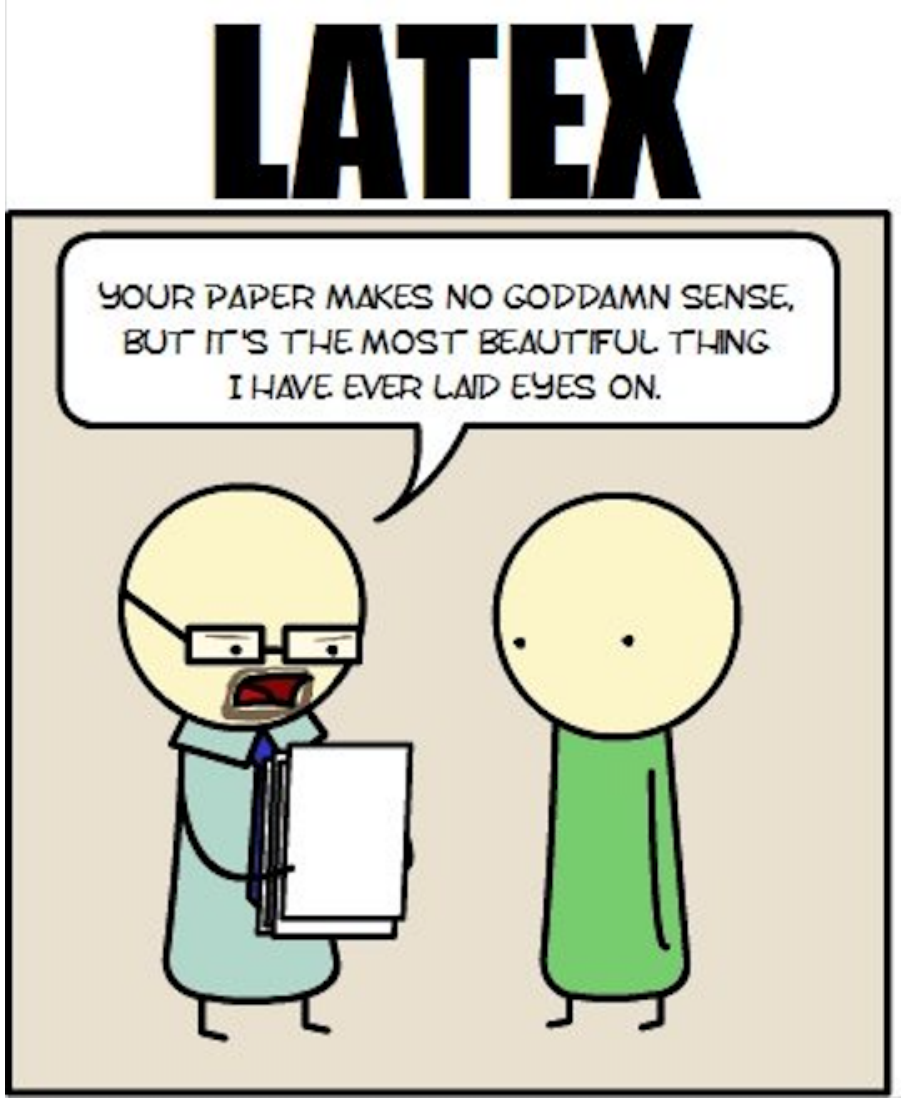
- It is free
- it *forces* you to think logically and organize your ideas
- Write first, compile later
- Do not waste time playing with fonts
- Good journals accept LaTeX submissions
  (they also accept Microsoft Word format)

LaTeX files are *text files*

- Independent of any provider
- Use your favorite text editor (VScode?)
- Version control friendly (GitHub?)
- Can probably still be read 20 years from now

We cannot say the same about Microsoft Word

The real advantage: it looks correct



According to the author of LaTeX

The main mistake that people should stop making is

> *Worrying too much about formatting and not enough about content.*

"How (La)TeX changed the face of Mathematics". An E-interview with Leslie Lamport. http://lamport.azurewebsites.net/pubs/lamport-latex-interview.pdf

Bonus: Slides for presentations

After writing your paper, you will probably present it (or maybe before finishing it)

Using structured document makes it easy to *recycle* your material to presentation slides

In LaTeX you can do that using the `beamer` document class

Good ideas in LaTeX

- Chapters, sections, subsections
- Automatic creation of Table of Contents
- Automatic numbering of sections, figures, tables
- Cross referencing sections, figures, tables
- Floating figures
- Math formulas
- Bibliographic references

Writing Math Expressions

LaTeX is favored by people who writes mathematical formulas

```
$$(a+b)^n=\sum_{k=0}^n \frac{n!}{k!(n-k)!} a^k b^{n-k}$$
```

$$(a + b)^n = \sum_{k=0}^{n} \frac{n!}{k!(n - k)!} a^k b^{n-k}$$

You can use this syntax in Microsoft Word's Equation Editor

Learning how to write math is a good investment

Bibliographic References

There are *hundreds* of citation styles

Life is too short to sort references *manually*

LaTeX also provides a convenient way to handle references

References are stored in a separate text file, in BiBTeX format

Many tools can create BiBTeX files for you

- Zotero
- Mendeley

LaTeX disadvantages

- LaTeX is hard to learn
  - This discourages many people
  - Your collaborators may not use it
  - You need to have the Reference Manual at hand
- It is oriented to producing printed material
  - It produces PDF files or equivalents
  - Not suitable for Web or eBook
- Writing tables is hard

Web Pages

In the 90's most computers had good graphic capabilities and Internet access

Researchers at CERN invented the web, using "hyper-text"

(That is, text with links to other text)

Web pages are written in *Hyper Text Markup Language*

HTML

These are also *text files*. It looks like this:

```
<head>
<title>Ten Simple Rules for Online Learning</title>
</head>
<body>
<h1>Rule 1: Make a Plan</h1>
There are many possible motivations for becoming involved in online learning…
</body>
```

Good ideas from HTML

- Works well on the screen: adapts to screen size
- Links to other pages
- Structural elements
  - `<h1>...</h1>` marks Header level 1
  - There are also `<h2>` ... `<h6>`
- Comments: `<!-- this part is not shown -->`
- Structure separated from Style
  - Style is defined in CSS files

Disadvantages of HTML

- It does not work well for paper
- It is hard to write manually
- There are editors, but they often focus on style, not structure

Alternative: Markdown

It is a light markup system that can be easily converted into nice presentations

```
---
title: Ten Simple Rules for Online Learning
author: David B. Searls
date: 13 September 2012
...

# Rule 1: Make a Plan

There are many possible motivations for becoming involved in online learning…
```