

LaTeX for Technical Writing

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Abstract

The main goal of the paper is to introduce the reader to an alternative typesetting system - LaTeX. The system is widely used in academy for publishing papers, reports, theses, dissertations and books. Its primary and notorious advantage over other word processing systems is the ease of handling mathematical writing.

Keywords: LaTeX, typesetting, word processing

Introduction

LaTeX can be viewed as a programming language – a language that allows you to program documents. As any programming language one has to learn the basics to be able to produce reasonable output.

In this regard Microsoft Word may seem like an attractive alternative. All you have to do to typeset a document is to install the software on your personal computer, open a blank document and start typing. As you progress, the graphical user interface allows you to control various aspects of your document – most frequently, font style and size, paragraph indentations, line spacing, margins, etc. Any changes that are made by you become immediately apparent. There are many reasons why Microsoft Word is a popular choice for creating documents. However, it is not the only choice, and it is definitely not the best choice where technical writing is concerned.

History of LaTeX

Donald Knuth is an American computer scientist and a mathematician, currently a Professor Emeritus at Stanford University. The author of numerous scientific works, and a recipient of many prestigious awards, he is called “the father” of the analysis of algorithms. In addition to making fundamental contributions to many branches of computer science, he is the creator of LaTeX.

In 1978, D. Knuth started a project to create a new typesetting system. Initially the project led to the development of TeX (pronounced “tech”). By 1986 he published a series of five books, *Computers and Typesetting*, describing TeX and Metafont systems for digital typography. The first book in the series concentrated on TeX (Knuth, 1984).

TeX allowed for extremely fine-grained control of the document layout. The downside of such flexibility was that the language was too complex. By mid-80’s another American computer scientist, Leslie Lam-

port, created a kind of library: a set of programs, called macros, that allowed the user to avoid many complexities of TeX. This led to creation of LaTeX (pronounced “lay-tech”) – an extension of TeX used by many academicians today. His manual on LaTeX (Lamport, 1986) was published by Addison-Wesley among other LaTeX related products and services.

Why LaTeX?

LaTeX is a popular choice among authors of technical papers. Publications, such as articles, reports, books, dissertations, that are heavy with formulas, figures and tables, are typeset using this language.

Do you recall how documents used to be submitted to publishers some twenty-thirty years ago? An author would often create a handwritten manuscript, he or she would then hire a professional typist to produce several hardcopies of the final version. While the plain text was typed, any formulas in the text were hand-written.

We have come a long way since then. Personal computers are so common, that authors do their own typesetting. Academic papers are submitted to publishers on-line or via e-mail. And while some publishers may still accept hard copies of manuscripts initially, they do require that after the paper is accepted for publication a digital copy of the work is to be submitted to the publisher as well.

Each journal has its own specific formatting style. A paper submitted to a conference, and to be published in a conference proceedings book, has to be typeset in compliance with a particular format. The burden of creating a document consistent with the publisher’s styling requirements is passed onto the author.

Similarly, a university has specific styling and formatting guidelines for graduate students preparing a thesis or a dissertation. A student preparing this major and most likely massive scientific work is facing two

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main challenges. First and most obvious, he or she needs to conduct research, collect materials, read papers, etc. At the end all relevant information is to be organized in a clear and coherent manner and presented in a form of a dissertation. A student initially concerned with the content of his work now faces a challenge of typesetting a large document, consistent with the styling and formatting requirements of his school. He or she has to choose a word processor, and this choice definitely affects the amount of time and frustration put into producing work ready for publishing.

Here is, for example, what we read on The University of Georgia graduate school website:

"Choosing a word processor or typesetting package:

You can use any word processor, text-editor, or typesetting package you want to write your document. As long as you can set page numbers, set margins, and print from it, you can generate an appropriately-formatted PDF from it. However, please be aware that there are serious problems with WordPerfect's ability to convert accurately into a PDF file. We are not partisans of any specific word processing program. We share our experience with you in order to make the preparation and submission of your thesis/dissertation as easy as possible. "

This guideline is then followed by a pro-con list for Microsoft Word, Word Perfect, and LaTeX/TeX.

Having said enough about the need of typesetting software in academy, and the importance of making the right decision, let us move onto some differences among the available choices today. Where technical writing is concerned the two main competitors are Microsoft Word and LaTeX.

Microsoft Word is a word processing software. Widely used, it has a simple layout, and many convenient features, such as spelling and grammar checking, bullet and numbering options, text alignment, etc.

Many users of MS Word, however, complain that it is not reliable, as it has bugs and can crash. Others are unhappy with its cost. Even such likable options as spelling and grammar checking, bulleting and numbering, can be controversial (The grad factor, 2013).

Our main concern however is technical writing. How does Microsoft Word handle mathematical expressions?

Simple equations can be created using an equation builder. The graphical user interface gives the author many commonly needed options: symbols, super- and sub-scripting, functions, etc. These equations look professionally formatted, seem like a natural part of the document, and are easily edited in case of a mistake. However, like with any graphical user interface, the choices are limited, and the process is quite slow.

An alternative to using the built-in equation editor is to create formulas separately, convert them into pictures, and insert them into the text file. Here is, for

example, a quote from last year's guidelines for authors, IBSU JTST:

Equations must be picture in png format, 100 dpi, transparent background, inline and compressed, equation text font is Sans Serif, 10pt,. Use LaTeX equation editor. We recommend/suggest you to use online LaTeX equation editor in <http://www.codecogs.com/LaTeX/eqneditor.php>

Notice that the recommendation suggests LaTeX as an equation editor. The editor allows the user to typeset equations and formulas using commands of LaTeX. Where flexibility and complexity of mathematical expressions are concerned there is no better tool. However, in this particular case, we have a problem, since the rest of the document is typeset in MS Word.

Equations converted into pictures do not look as an organic part of the document – the font sizes are often mismatched, symbols look blurry, and the effort that goes into creating a picture for every single formula is frustrating. Imagine now that a mistake is made in such a picture, there is no simple way to correct such a mistake, as one does in plain text. The author has to start from scratch – create the corrected formula, convert it into a picture, and replace the original.

Why use LaTeX for equations and use Microsoft Word for plain text? Is it really such a challenge to learn LaTeX?

Let us consider some pros and cons of LaTeX. The list of cons for LaTeX users is very short, and thus we begin with cons.

The most common complaint about LaTeX is that it has a pretty steep learning curve. To address the issue, let us mention a common opinion of users of both LaTeX and MS Word: "once you know how to use LaTeX, it is easier to use than Word. Also, with LaTeX you only go through the learning curve once. With MS Word, you go through the learning curve every time Microsoft decides to "freshen things up"" (StackExchange, 2013).

The pro list usually contains the following highlights:

- Free and powerful alternative to MSWord and WordPerfect, etc.,
- Stable, no crashing, no viruses
- Beautiful-looking documents, high level of control and consistency, superior typography- TeX produces some of the finest typeset material short of hiring a professional to set your paper,
- Superior cross referencing and bibliography management,
- If you are using complex mathematical equations and/or special symbols, you are pretty much obliged to use this package,
- Document structuring,
- Content and formatting are separated.

Allow me to walk you through some of the above mentioned points, beginning with the last. An author working on an article is mostly concerned with the content of the paper. In a perfect world, he or she should

not waste their intelligence and valuable time on adjusting fonts, setting margins, and making sure that all section headings are of the same size and style (The grad factor, 2013). When using LaTeX, this is exactly the luxury one can afford. One can worry about formatting after the paper is finished.

Format and style of a LaTeX document can be controlled in two ways – locally and globally. If the author chooses to do so, he may format the paper as his heart desires, by specifying certain parameters either for the entire document (globally) or for parts of the document (locally).

When the author has to comply with specific formatting requirements, which is often the case when publishing, his or her work is usually very simple. The publishing agency provides the author with a styling file. Once this file is included into the paper (simply inserting the name of a file in a heading of a paper), the style of the paper becomes globally consistent with the requirements of the publisher.

Styling files are often provided by universities to their graduate students. The dissertation formatting requirements are coded in such a file by an experienced LaTeX user. The file controls about anything you can think of – fonts of the text, chapter and section headings, title pages, signature pages, page numbering, bibliography, table of contents, etc. Such global control of formatting issues not only minimizes the work that an author has to put into formatting, it minimizes the amount of formatting mistakes and the time that editors have to spend making sure that the work is in compliance with the formatting requirements.

Anyone who has ever compared documents prepared using LaTeX and MS word would agree that LaTeX documents look nicer (StackExchange, 2013). As vague as this description sounds, it translates into the fact that LaTeX is much better at kerning, hyphenation and justification (Dario Taraborelli, 2013). The algorithms for laying out text are more sophisticated and are extremely fine-grained: LaTeX uses a measurement unit known as a scaled point, a 100th of the wavelength of natural light (Andrew Roberts, 2013).

A few words on document structuring. Every chapter, or a section, or any block of thoughts, can be typeset in a separate file. It is very simple to organize these files into a structured document. If one works on a book or a dissertation this option is of great importance. Imagine searching for something or trying to edit a detail in a Word document containing hundreds of pages. With LaTeX document structuring these kind of tasks become much easier, and searching abilities of LaTeX are much more advanced.

The one pro LaTeX is famous for is how it handles mathematical expressions. The key difference between LaTeX and Microsoft Word in this regard is that there is no need to use a graphical interface: mathematical expressions are typeset just like any other part of the text. For inline expressions the user needs to place his mathematical string between two dollar signs, for example x^2 produces inline x^2 . Another option for mathematical expressions is a dis-

play mode: an expression is displayed on a separate line or lines for greater visibility. This mode is invoked when the expression is placed between two double-dollar signs, for example x^2 will lead to

$$x^2$$

clearly displayed between two paragraphs of the text. There are other commands that invoke display mode used for presenting more complex formulas, and we are not going to mention them here. The point of these examples is that whenever a mathematical expression is needed, a user does not have to pause his or her work in search of the appropriate tools in MS Word, he or she simply continues typing as if was regular text. For technical texts full of formulas, equations, expressions, matrices, etc. the time and effort put into typesetting is reduced so drastically that no user of LaTeX would ever go back to MS Word for typesetting technical documents.

How it works

LaTeX can be viewed as a programming language. To produce a LaTeX program you can use any text editor, even a notepad if you wanted to. It is more convenient however to use a LaTeX editor. There are numerous LaTeX editors, many of them available on-line for free, and these programs work on various platforms. Once the LaTeX file is prepared it is saved as a “.tex” file, and is converted to either a DVI (stands for device independent) or a PDF file for viewing. Obviously you do not need to finish the entire document before you view the results, but usually you view the output only once in a while. We already mentioned the content and format separation, and this is how it is achieved - you do not view the output until you finished some logical block of your document writing and are ready to see how it looks and spend time on formatting the results if you wish.

While mathematical typesetting is certainly a selling point of LaTeX, it is not the only area that it is strong in. You can get LaTeX to do just about anything you can think of! For example, LaTeX’s main users are within academia and research institutions, and they benefit hugely thanks to the “BibTeX” package that provides bibliography. Including graphics does not present any difficulties either: you prepare your image in any format you’d like – LaTeX supports most of the formats, for higher quality images it is preferable however to use PDF or EPS, and save the image file in the same directory as your “.tex” file is. The “graphicx” package allows you to control various aspects of the image from within the “.tex” file.

There are various packages which allow you to typeset music scores, chessboards and cross-words. CTAN is the main repository of these resources. Most are well documented and as you can imagine, with LaTeX being around for so long, the number of extensions is vast (Andrew Roberts, 2013). There are nu-

merous manuals for LaTeX users as well (Wikibooks, 2013).

Conclusion

It is not fair, perhaps, to compare LaTeX and MS Word: these two systems are suited for different jobs. For a short textual document, a flier, a form, or a list of instructions, pretty much any document needed in a typical office setting MS Word is certainly the software of choice. Our goal in this paper is to simply introduce LaTeX as an alternative to MS Word for publishing technical papers. Any author faced with a task of writing a technically challenging document will not find a richer and better quality system.

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