A brief history of LaTeX

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To Marcos, because he was right and

We all should learn $\LaTeX$

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Chapter 1

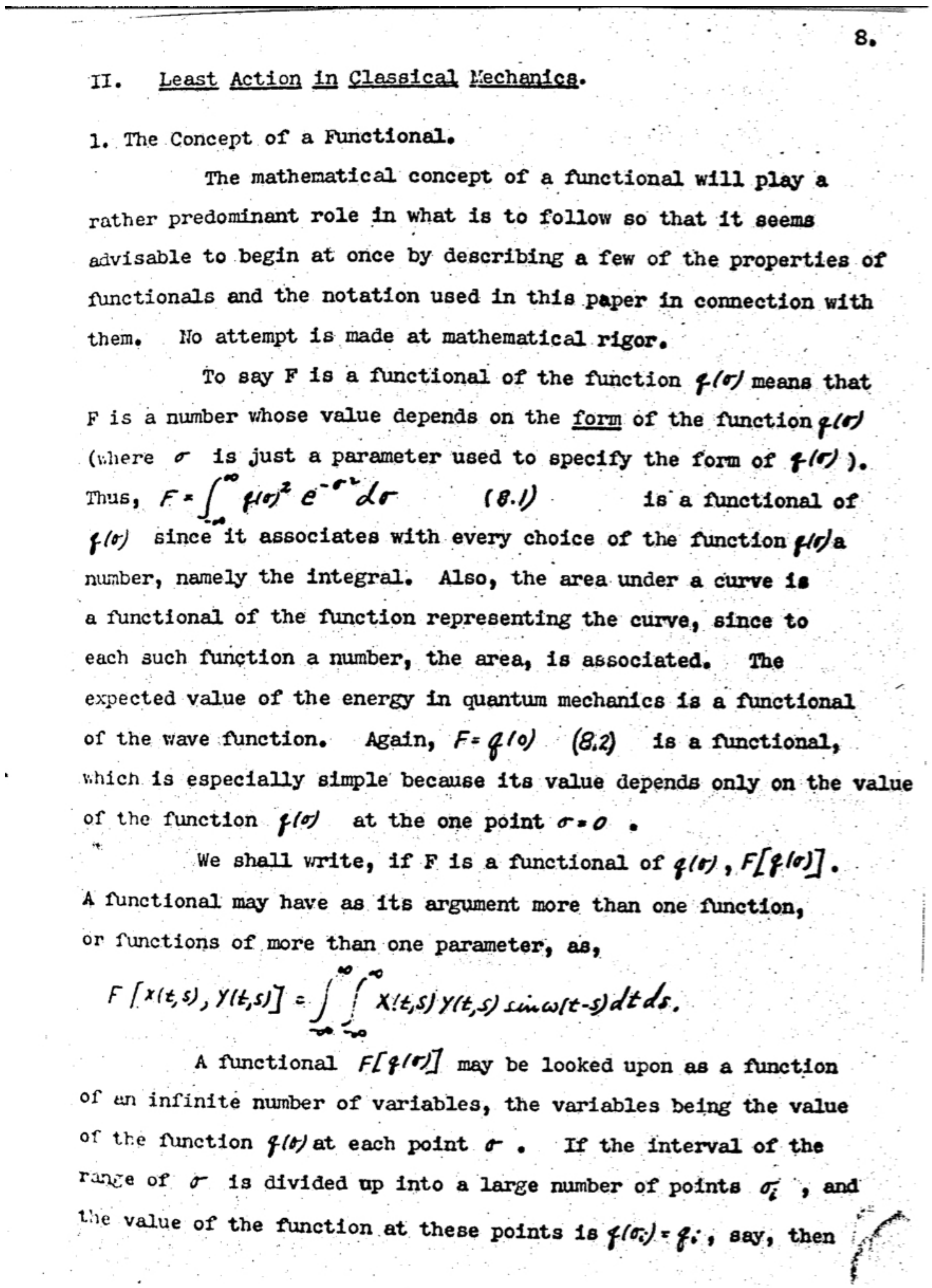
Introduction

The main question I receive (and used to make) when talking about LaTeX is: why should I go through the trouble of learning how to write in LaTeX if easier alternatives exist that produce a final document with a similar quality? The underlying problem in the question is that the complexity of the final document is never defined and the term similar quality is way too vague and highly dependent on the content of the final document. Most of the time the person asking the question has in mind a document similar to a letter to aunt Ulrike or just an email. And yes, it makes no sense to waste time learning LaTeX if this is all you need.

On the other hand, if the text you need to produce is highly complex then the answer is a sound YES. Yes, spend a few hours learning LaTeX and you will be grateful forever. If you need to create a document rich in sections, subsections, figures, tables, cross references and a big bibliography then, learn LaTeX. Furthermore, if the text contains complex mathematical symbols and equations then nothing out there is better and more user friendly than LaTeX, price included. Because LaTeX is completely free for everyone to use. There are more reasons to learn LaTeX but we will come back to this in Chapter 3.

Since a picture is worth a thousand words, take a look at Figure 1.1. This figure shows one of the pages in the PhD thesis of Richard Feynman and yes, in 1942 the equations were written by hand. Now, if you let LaTeX make its work the same page may look as page 3. Of course, just knowing LaTeX will not take you to win a Nobel Prize but it will allow you to convey your ideas in a more clear and efficient way. In addition, you will safe a lot of time because the workflow in LaTeX is extremely efficient.

This brief history of LaTeX was written to serve as the basis of a tutorial to learn LaTeX. Therefore, more care was taken to make sure that the main items used while writing a complex document were indeed employed here than in the strict historical accuracy of the facts stated in the following chapters. I apologize beforehand if a crude historical mistake was done and commit to amend it if notified. Without much to add, let's start.



8.

II. Least Action in Classical Mechanics.

1. The Concept of a Functional.

The mathematical concept of a functional will play a rather predominant role in what is to follow so that it seems advisable to begin at once by describing a few of the properties of functionals and the notation used in this paper in connection with them. No attempt is made at mathematical rigor.

To say F is a functional of the function $q(\sigma)$ means that F is a number whose value depends on the form of the function $q(\sigma)$ (where σ is just a parameter used to specify the form of $q(\sigma)$). Thus, $F = \int_{-\infty}^{\infty} q(\sigma)^2 e^{-\sigma^2} d\sigma$ (8.1) is a functional of $q(\sigma)$ since it associates with every choice of the function $q(\sigma)$ a number, namely the integral. Also, the area under a curve is a functional of the function representing the curve, since to each such function a number, the area, is associated. The expected value of the energy in quantum mechanics is a functional of the wave function. Again, $F = q(0)$ (8.2) is a functional, which is especially simple because its value depends only on the value of the function $q(\sigma)$ at the one point $\sigma = 0$.

We shall write, if F is a functional of $q(\sigma)$, $F[q(\sigma)]$. A functional may have as its argument more than one function, or functions of more than one parameter, as,

$$F[x(t,s), y(t,s)] = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} x(t,s)\, y(t,s) \sin\omega(t-s)\, dt\, ds.$$

A functional $F[q(\sigma)]$ may be looked upon as a function of an infinite number of variables, the variables being the value of the function $q(\sigma)$ at each point σ. If the interval of the range of σ is divided up into a large number of points σ_i, and the value of the function at these points is $q(\sigma_i) = q_i$, say, then

Figure 1.1: A page from the PhD thesis of Richard Feynman. Note how in 1942 equations had to be written by hand.

II. Least Action in Classical Mechanics

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Chapter 2

The Art of Typesetting

To write is the process of using predefined graphical symbols to convey an idea. Using this broad definition it is possible to trace the history of writing to the first steps of mankind, when we started drawing in caves. The full development of languages and the increasing complexity of human societies had an immense influence in the birth of the first writing systems. The oldest evidence of writing was discovered in 1961 in Romania (*1*). The objects found near Alba Iulia were dated to 5300 BC predating by almost 2000 years the accepted first writing system.

Writing as we know it today was invented independently at least two times along human history. The first time was in Sumer around 3100 BC and the second in Mesoamerica around 300 BC (*2*). For certain scholars the birth of the Chinese writing system around 1200 BC represents the third time that writing was invented. During this early stage of human writing the preferred mediums to contain the written symbols were stones or clay tablets.

A major milestone in the evolution of writing was the invention of papyrus. Writing in papyrus is a lot easier and faster than carving symbols in stone or clay tables. There is evidence that papyrus was been used in ancient Egypt as far as 2550 BC (*3*). The next major step was the development of paper (as we know it today) in China around 105 AC (*4*). From China, paper made its way to Europe in the 13th century.

At this point in history mankind had fully developed languages and writing systems, paper and ink, but yet, not a fast and cheap way to print books in a massive scale. Up to the 12th century in Asia and the 15th century in Europe, books were created by writing each page by hand or using wood block printing. Needless to say, that to copy or write a full book by hand was (and still today is) a very slow process with a high error rate. Wood block printing was faster but it still required carving a wood table and to add complexity, letters must be carved as mirror-image letters. A major breakthrough took place in China when movable metal types were created. The oldest known book printed using metal movable types is a Korean Buddhist text from 1377 known as ***Jikji*** and conserved in the National Library of France. In the next century, Johannes Gutenberg created his own printing press leading to the famous printing of the Bible (*5*). From this point on, the number of books in circulation in Europe exploded as shown in Table 2.1.

The explosion in the output of books in Europe was the results of a combination of technological improvements in many areas like the manufacture of paper, the development of oil based ink and of course, the use of metal movable types. Metal movable types represented a huge improvement over any previous printing method because they allow the fast assemble of a page for printing. In addition, the individual types are reusable, long lasting and using the method created by Gutenberg very easy to cast.

Using movable types the text of a page is assembled by taking the individual types and placing them together in a composing stick. This process must be done from left to right and similar to woodcarving the types are mirror images of the letters. The assembled types form a surface with all letters having the same height to the paper (Figure 2.1). After assembly, the created text is placed in a press, inked and printed into paper.

Although the use of metal movable types represented a revolution in the printing industry, the fact that each page must be assembled by hand represents a severe limitation. Therefore, during the 19th century several attempts were made to create mechanical typesetting machines. The most successful systems include the Linotype machine and the Monotype System. With both machines a mechanical keyboard was used to create the line that was fed to a machine controlling the casting of the needed types. Since these methods require the casting of individual types using melted metal alloys they are known as hot metal typesetting systems.

Table 2.1: European output of books in the years 500 to 1800 (*6*). The figures include manufactured and printed books.

Century	Books ($x10^6$)
6^{th}	0.015
7^{th}	0.01
8^{th}	0.045
9^{th}	0.2
10^{th}	0.15
11^{th}	0.21
12^{th}	0.8
13^{th}	1.9
14^{th}	3
15^{th}	15
16^{th}	200
17^{th}	550
18^{th}	1000

The next step in the evolution of typesetting was the use of phototypesetting introduced in the 1950s. This method involves several steps but totally avoids the entire type casting process. Here, photosensitive paper or film is used to create a positive copy of the pages in the document that is later transferred to a plate using a photomechanical process. In addition, with phototypesetting, fonts and graphics may be printed at any size. However, the change from metal movable types to phototypesetting made necessary to entirely recreate the type styles for the new machines and we will come back to this in Chapter 3.

Finally, the advent of personal computers transferred the typesetting process from specialized centers to the public in general and so far this has been the last major evolution in the art of creating a book. Although I have focused in the technological milestones along the rich history of book creation it is impossible not to briefly mention other important aspects. One of them is all the details concerning the page and book layout. The principles guiding all the details involved (from how to distribute the text in the pages to the outside look of the book) are known as canons of page construction and were set during medieval times (*7*). Another fundamental aspect is the creation of different type styles. The creation of type styles (or font families as commonly known now) has been a continuous process which started when we begun writing and later evolving according to the technological challenges arising from the printing press, phototypesetting or computer based display and printing of text.

Figure 2.1: Assembling individual types. Note how the individual types are mirror-images of the letters and they must be placed from left to right.

For centuries the book creation process had a clear separation between two main steps, writing the content for the book and giving physical form to the book. Just reading these brief lines gives a good enough idea about why this was the case. The advent of personal computers and the new digital age have considerably blurred this separation since now anyone with the appropriate software and perseverance to write can create books with professional like appearances and publish them online. One of the major software allowing this is LaTeX.

Chapter 3

The Age of LaTeX

Writing software can be divided into two broad categories. The first category includes the WYSIWYG (**w**hat **y**ou **s**ee **i**s **w**hat **y**ou **g**et) programs. This means that the text displayed in the screen is what you will get in the final document. The current archetype for this category is Microsoft Word. The second category includes software that divide the processes of writing a text and placing the text in a document, yes exactly like medieval typesetting but with all the power of modern computers. The best example I know of the second category is TeX.

3.1 The origins of TeX

Donald Knuth is the creator and main developer of TeX. The main motivation to create the program was the bad quality of the galley proof from the second volume of his book, The Art of Computer Programming. This sent Knuth into a ten-year trip during the 1980s culminating in the creation of TeX and Metafont.

TeX was developed in the 1980s as a typesetting system with the main goals of allowing anyone to produce high quality documents using minimal efforts and to provide a way to display the same document in the same way independently of the computer in use. Special care was placed in the handling and display of mathematical symbols which is why TeX is the preferred writing tool in technical sciences. If you did not skip Chapter 2 you already know a few things about TeX. The fact that TeX is a typesetting program tells that, in order to create a document using TeX you will have a plain text file containing everything you wrote and this plain text file will be converted into the final document by TeX.

3.2 Then, what is LaTeX?

To put it in a very simple way, LaTeX is an easier way to create the input needed by TeX. LaTeX was created by Leslie Lamport as a set of macros to speed up and make more user friendly the input files for TeX. Therefore, if you learn LaTeX you can use the entire power of TEX while working with files that you can easily read and manage.

3.3 Why bother learning LATEX?

The main advantages of using LATEX and TEX are:

- It is absolutely free and if you get carried away you can put your hands on the source code and create your own code (but you cannot name it TEX)
- A document created today will be perfectly usable in the future since there is no built-in obsolescence
- The input file is a plain text file occupying very little space in your computer's memory and disk and the output file can be almost anything you want
- Separates the writing process from the typesetting process allowing writers to concentrate in what they should do, to write
- Accurate typesetting capabilities meaning that you will not have to worry about float elements (e.g. tables and figures) randomly moving around pages
- Best quality for mathematics
- Perfect and easy handling of cross references, bibliography, index, chapter, sections, footnote, etc
- They have been around for a long time and have a very friendly community meaning that help to solve how to problems can be easily found
- I could keep going but I will just stop here with, the final document just looks perfect

Chapter 4

Final words

The main purpose of this document was to offer an overview of the philosophy behind the workflow in LaTeX. For the younger generation of LaTeX users it might be hard at first to write something without using a WYSIWYG software. However, if you manage to break the initial inertia you will find really liberating the fact that you can write without worrying about how the document will look at the end and you will find that you can really focus more on writing. You will even notice that once you master the basics of LaTeX you will write faster with LaTeX than with other programs, especially when tables and figures are involved. Nevertheless, unless you get really skillful using LaTeX, it will not totally substitute other writing software, especially for small documents. Another story would be long and complicated documents full of float elements (e.g. tables and figures), cross references, different page layouts and sections. For this case you will run to dust off your LaTeX binaries even if you suffer from deadly allergy to dust.

Thus, if you need to write a complex document or you just want to write without worrying about the final look of your document, take some time to learn the basics of LaTeX. It may be that the time spent learning will be more than compensated when you avoid worrying about flying figures or tables, track changes that ruin your document, introducing a new section that change everything before it, landscape pages with the wrong header positions and a long long etc.

Bibliography

1. H. Haarmann, *Geschichte der Schrift*, ed. by C. H. Beck, ISBN: 3-406-47998-7.
2. B. M. Fagan, *The Oxford Companion to Archaeology*, ed. by C. Beck (Oxford University Press, 1996), ISBN: 978-0-19-507618-9.
3. P. Tallet, *British Museum Studies in Ancient Egypt and Sudan* **18**, 147–68 (2012).
4. J. Needham, T. Tsuen-Hsuin, in *Science and Civilisation in China* (Cambridge University Press, 1985).
5. *The Morgan Gutenberg Bible Online* (http://www.themorgan.org/collection/Gutenberg-Bible).
6. E. Buringh, J. L. Van Zanden, *The Journal of Economic History* **69**, 409–445, ISSN: 00220507, 14716372 (2009).
7. J. Tschichold, *The Form of the Book* (Hartley & Marks, 1991), ISBN: 0-88179-116-4.