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# Teaching LaTeX: Why and How?

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Abstract We discuss some of the problems related to the process of learning of LaTeX and the opportunity of a LaTeX course. We also propose a syllabus for such a course and briefly mention some of the LaTeX books which, in our opinion, are suitable to be adopted as course material.

## 1 Is teaching LaTeX really necessary?

Let's face it: LaTeX courses are very rare. Only now and then one can find a university offering an introduction to the basics. Some probable reasons for the scarcity of organized LaTeX learning are, in the opinion of many LaTeX users:

- LaTeX is very easy to learn, after all;
- there are plenty of excellent (and free) introductions on the internet.

In spite of the validity of these claims, from our experience as editors of this journal and in discussions with colleagues, it seems to us that:

- Many users of LaTeX learned the basic elements of writing a document only and stopped there, having yet to explore LaTeX's richer features.
- Many mathematical users don't employ equation-like or theorem-like environments. Other users don't use some of the *real* advantages of LaTeX, such as automatic numbering, reference citations, figure references, etc. Often an article document appears without the title, author, sectioning, and other usual commands, thereby missing most of the fun.
- The great majority of users rarely use fonts other than the default Computer Modern Fonts.

- Very few people use the many customization options available in LaTeX. As a consequence, even users with a fair knowledge of LaTeX produce documents which all look alike. As a result we are left to read a huge number of journals and books (some of them produced by well-known international publishers) which all look the same. It is no longer possible to tell, looking at a document's typography, who produced it.
- It is sad to see at many mathematics conferences, for instance, how few presentations use (in a proper way) the capabilities of LaTeX. Actually, most of the presentations are either just pages from an article, or they are prepared using Power Point (which is a shame for a mathematician).

We are of the opinion that if the LaTeX community doesn't get more involved in making LaTeX more accessible to a wider audience, for instance through teaching, the best part of it will remain only an esoteric game for the few initiated. An additional barrier to more widespread use is that although there are plenty of books on LaTeX only a few can effectively be used as textbooks in a teaching environment.

## 2 The goals of a LaTeX course

In our opinion, after taking a LaTeX course, the student (a mathematician or computer scientist, for instance) should be able to do at least the following:

- format an article or book in a correct and structured manner, and using fonts other than the default ones;
- be familiar with the tools for producing bibliography and indexes (such as BibTeX or Makeindex);
- include graphics files in the document; and
- use LaTeX to produce professional-looking PDF documents.

In addition, mathematicians should be able to

- build complex mathematical structures;
- produce specialized graphical material such as commutative diagrams and graphs.

Computer science students and others who have technical skills should be able to format specialized figures and diagrams, such as the description of an algorithms or the production of simple drawings using LaTeX tools.

# 3 A LaTeX course outline

Creating a course syllabus is not an easy job. This is true for any course, and especially for a LaTeX course where there are few existing course outlines to draw from. There are many things to consider: you have to take into account the background of the students, the goals of the course, the teaching facilities available, and so on. We provide here one example of such a syllabus, for teaching students in mathematics or computer science. The amount of material that can be covered depends, of course, on the time available and the level of the students' interest. This course outline can be adapted for students in other disciplines as well.

## 3.1 Introductory notions. Handling errors.

Years ago, before the era of the personal computers and notebooks, TeX distributions were usually installed by the system engineers and were available for everyone. Nowadays, however, each user would like to have TeX installed on his own computer. Since there are many different personal computer versions available, some of them command-line and some graphical interface, one of the first problems a course designer faces is which one or ones to use for the course.

As we all know, the LaTeX source files are plain text files, therefore any text editor is sufficient enough to prepare them. It is, however, wise to choose an integrated editor, specialized for LaTeX, and give students some basic ideas on its use. It is always a good idea to choose a free editor, if available (such as TeXnic Center under Windows, or Kile under Linux), but this is not necessarily the rule, especially if the students are willing to make a small investment in a better editor.

With the system installed and with some familiarity of the basic use of the LaTeX system, the students are now prepared to begin learning the basics of LaTeX. Clearly, we should start with the simplest LaTeX files, including only the basic commands. Later, additional commands and structures can be introduced.

It is also useful to describe the main types of errors that can occur. When using LaTeX for the first several times the student is likely to make more errors

than anything else. It is a good idea to get the students used to reading the LOG file. It is fairly common for LaTeX users to ignore the log file. However, it contains a lot of useful information and can point out why the output you get is not exactly what you expected it to be.

We might also introduce here the sectioning commands for articles and books, as well as the bibliography environment. By doing so the student is equipped to format a simple article. Later, the student can return and add richer commands to the basic set. It is probably best to avoid a teaching method that tries to present too much detail at once.

## 3.2 Formatting text and mathematics

In this part of the course the goal is to learn the basic formatting methods for both text and mathematics. We should describe first the "modes" of LaTeX: paragraph mode, left-to-right (LR) mode, and math mode, and explain how LaTeX behaves in each mode. At this stage we can describe the basic commands for formatting text, such as special characters, using fonts, and a description of ways to change their characteristics, such as spacing and justifying text. For formatting mathematics, describe how to enter and leave math mode, for both inline math, display math, and the use of math symbols in text.

Also, it is a good idea to introduce the `babel` package, enabling the use of text in other languages.

## 3.3 Often-used LaTeX environments

In this part of the course, the intention is to familiarize the student with the most often used environments:

- theorem-like environments (with the extensions provided by the packages `amsthm` and `theorem` from the `tools` group);
- environments of equation type (for the moment, only `equation` and the starred version, provided by `amsmath`). We shall avoid the (by now obsolete) `eqnarray`).
- environments for producing tabular material (including the packages `tabularx` and `longtable`). If the course is addressed to computer scientists, then it is

a good idea to mention, also, the `tabbing` environments, on which the packages for typesetting algorithms are usually based.

- text environments, like `quote`, `quotation`, `verse`, more useful to non-mathematicians, but, also, the `minipage` environment.

## 3.4 Mathematical formulae

This is a part of the course devote, almost entirely, to mathematicians (and, maybe, physicists). The intention is to speak about more complex formulae, including, for instance, systems of equations, matrices, large operators with indices and so on. Essential here is the `amsmath` package, providing a wealth of commands and environments for typesetting complex mathematics, as well as the font package `amsfonts`, containing a lot of symbols which are not available in standard LaTeX. While teaching the basics of math typesetting it is an appropriate time to give the students the list of symbols provided by standard LaTeX, as well as various symbols provided by other packages the students might be using.

## 3.5 LaTeX programming

This is something for more advanced users, but is, nevertheless, important. The students will be taught how to define new commands, new environments, lists, counters, length, boxes, and other techniques.

## 3.6 Bibliographies and indices

First, we shall review the basic commands for producing bibliographies, and then show how two use several programs for handling bibliography databases (BibTeX), and indexes (Makeindex and, possibly, xindy).

## 3.7 Producing and including graphics in a LaTeX file

We shall describe here several packages and programs for producing graphical material. There are many programs that produce graphics, of course, and almost any ot them can be used. Our intention, however, is to focus on programs providing (among others) LaTeX output. The intention is to familiarize the students

with the basics of PSTricks (for general graphics) and Xy-Pic (for commutative diagrams) and to initiate them in the use of programs such as LaTeXDraw, JsDraw or Xfig.

For the inclusion of graphics, of course, the natural choice is the package `graphicx` and its relatives from the `graphics` bundle (for instance, `color` for producing colored text or background).

## 3.8 Floating bodies

Floating bodies are, essentially, figures and tables. We shall describe both their basic function and the packages which allow better handling of (`subfigure`, `float`, `rotating`, ...).

## 3.9 Producing slides with LaTeX

There are several packages and classes for producing slides with LaTeX. Our first choice is `beamer` which is surprisingly easy to use and the results are spectacular. `beamer` has a wide assortment of frame styles, and can produce many special effects.

## 3.10 Postscript fonts

Postscript fonts are indispensable for producing professional-looking documents. We recommend some free (and some non-free) Postscript fonts which are available, both for text and mathematics. We also explain how to replace the default Computer Modern fonts with other fonts, by using the Postscript New Fonts Selection Scheme (PSNFSS).

## 3.11 LaTeX and other markup languages

The intention is to describe the package `hyperref` for producing PDF files, as well as the connections between LaTeX and MathML.

## 4 How to teach LaTeX?

There are few reports on LaTeX teaching available (see, for instance, the paper of Nicola Talbot, in this issue of the journal for some very useful tips) because, apart from very short introductions, LaTeX courses are rather rare.

The author is currently giving a course for undergraduate students in mathematics and computer science. Here are some of outcomes to date:

- As the main operating system in use in the university (and, more generally, in Romania) is Windows, the natural choice for the TeX distribution to use was MikTeX. The computer experts of the university were kind enough to install it on all the computers we used in the classroom.
- As someone pointed out, "LaTeX is not a spectator sport." It is crucial for the students to use it on their own personal computers. Therefore, we chose ProTeXt as the most complete and easy to install version. Because the installation kit is rather large, we provided CD versions for all the students.
- There are, basically, two excellent LaTeX-adapted editors for Windows: TeXnic Center and Winedt. We decided to use TeXnicCenter because because it is completely free and is included with ProTeXt, whereas Winedt is shareware. We would like to mention, nevertheless, that some of the commercial implementations of TeX also have free editors which are useful. An example is the "PCTeX Reader", which comes with the shareware version of PCTeX (and can be downloaded from the web page http://www.pctex.com). The free Reader version can edit and view TeX files, but you must have a licensed version in order to typeset files and perform other functions.
- We decided to use an interactive teaching method, where the students follow along with the instructor and immediately try all new material.
- As a teaching tool, we provided the PDF version of a document and the students attempted to "recreate" the LaTeX source.
- Besides the basic material, the rest of the subjects were strictly related to the students' interests, as the main aim of the course is to help students prepare their diploma theses with LaTeX. We discussed, therefore, some non-standard subjects such as algorithms.

- Obviously, there is not enough time in the classroom to discuss everything in detail. Therefore, detailed lecture notes were prepared and made available, along with many examples, on a web page. This might be expanded to provide advanced LaTeX courses as well if needed.
- The outline we have been discussing is meant for a course devoted to computer science and mathematics students. While some of the subjects, algorithms and MathML, for instance, are specialized, a large part of the course is general and can be taught to students of any discipline. The syllabus can be adapted for other course subjects as well, for instance, for physics we could include the package for drawing Feynman diagrams, or, for chemistry packages that format chemical formulae. A significant part of the course can be taught, as well, to students in literature, concentrating on formatting text, poetry, plays and the like; or even to musicians, because LaTeX has musical typography capabilities (see the Distractions column in this issue).

# 5 Documentation

In spite of the wealth of LaTeX books, there are few that are suitable for use as textbooks in a classroom setting. In our opinion, aside from classical book by Leslie Lamport (see [3]), the books most useful for teaching are those by George Grätzer ([1, 2]). Among the free resources available over the Internet, the closest to our idea of teaching LaTeX is, no doubt, the book by Peter Flynn, *Beginner's LaTeX*, available at many internet sites. This book, however, doesn't treat the "mathematical" part of LaTeX.

# 6 Acknowledgments

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