

Introduction to $\text{T}_{\text{E}}\text{X}/\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$
UIUC Department of Mathematics
Graduate Student Orientation
Fall 2007

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8/20/2007

1 What is $\text{T}_{\text{E}}\text{X}$?

$\text{T}_{\text{E}}\text{X}$ is a program for high quality technical typesetting, created in the early 1980s by Stanford Computer Science Professor Don Knuth. It has become the de facto standard for typesetting documents in mathematics and related fields. Virtually all research level books and journals in mathematics now are produced in $\text{T}_{\text{E}}\text{X}$ (usually using author-generated files), all recent theses in this department have been prepared in $\text{T}_{\text{E}}\text{X}$, and it is common to see $\text{T}_{\text{E}}\text{X}$ snippets in email correspondence among mathematicians and postings to mathematical newsgroups and mailing lists. Aside from its use in research level publication, $\text{T}_{\text{E}}\text{X}$ is also useful in a classroom setting, e.g., to produce exams, quizzes, homework solutions, lecture notes, and other class handouts.

2 What is $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$?

$\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ is a superset of $\text{T}_{\text{E}}\text{X}$, created in the mid 1980s by Leslie Lamport. As an extension of $\text{T}_{\text{E}}\text{X}$, $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ can do everything that $\text{T}_{\text{E}}\text{X}$ does, but it also provides a comprehensive set of high level macros to facilitate typesetting of structured documents and automate such things as section and equation numbering, or matching citations to references in the bibliography. $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ is

one of a number of T_EX “dialects” that have been created over the years, but it is the only that has stood the test of time and now dominates the market¹. Virtually all T_EX produced these days is in the L^AT_EX flavor. **Henceforth, when referring to T_EX, I always mean the L^AT_EX incarnation².**

3 How do I get started with T_EX?

As participant in the UIUC Math Department’s REU program, you have (or will be set up with) an account on the UIUC Math Department’s Unix network, and access to the Sun and Linux workstations in the computer labs (130 and 110 Altgeld) and offices. I would strongly recommend using these machines rather than a home computer or laptop, since these machines have everything you need already installed—a current and comprehensive T_EX installation, editors (vi/vim, and emacs), and other useful utilities.

If you have no prior experience with T_EX, here is what I’d recommend to get started.

1. **Make sure you have some basic knowledge of Unix commands.** Since you will be doing your work in a Unix environment, you should be familiar with the basic Unix commands for moving around the file system, changing directories, listing files, etc.
2. **Make sure you are reasonably proficient with one of the standard Unix text editors, vi/vim or emacs.** Which one you choose is a matter of personal preferences. It’s hard to switch back and forth between the two, so if you are already familiar and comfortable with one of these, stick with it. Personally, I use vi (or rather vim, an enhanced version of vi), but that’s simply because I grew up with vi. For

¹The only other T_EX dialect that, for a period of time, was widely used, is $\mathcal{A}\mathcal{M}\mathcal{S}\text{T}_{\text{E}}\text{X}$, created by the American Mathematical Society (AMS). However, with L^AT_EX emerging as the dominant T_EX flavor during the past decade, $\mathcal{A}\mathcal{M}\mathcal{S}\text{T}_{\text{E}}\text{X}$ has become nearly obsolete, and its use is discouraged, even by the AMS, which had been the driving force behind $\mathcal{A}\mathcal{M}\mathcal{S}\text{T}_{\text{E}}\text{X}$. For its own publications, the AMS strongly recommends using L^AT_EX, in conjunction with special “packages” created by the AMS.

²More specifically, L^AT_EX 2_ε, the current version of L^AT_EX, created in the early 1990s. The previous version, L^AT_EX 2.09, is essentially obsolete, though one still occasionally sees papers prepared in that older format. Our T_EX installation is current, and typing `latex` will automatically give you the newer (L^AT_EX 2_ε) version. If for some reason, you really want the old version, you can get it by using the command `latex209` instead.

beginners, emacs is probably the better choice because it comes with extensive help pages and tutorials and has a shorter learning curve. Emacs has a “tex mode” that facilitates writing \TeX code, e.g., by coloring or highlighting key words or macros, and by doing some basic syntax checking. Vim—but not the original vi program—has a similar feature, though it is harder to set up.

3. **Work through the “Introduction to LaTeX” course, <http://www.math.uiuc.edu/~hildebr/tex/course>.** This is a course I had created in 2001 for the participants at a Summer REU Program. It is essentially a self-study course and in principal is self-contained, but it would help to have a reference like “Math into LaTeX” by George Gratzer (see below) handy when working through that course.
4. **Work through Chapter I (“Short Course”) of the book “Math into LaTeX” by George Gratzer.** This chapter provides a more comprehensive introduction to \LaTeX and is an ideal follow-up to the three hour “crash course” mentioned above. The chapter (though not the most recent edition) is available online for free at <http://www.ctan.org/tex-archive/info/mil/mil.pdf>. However, I’d recommend purchasing your own copy of this book at this point, as you will need this book sooner or later anyway. Gratzer’s book is, by far, the best and most appropriate introductory text on \LaTeX because of its focus on **mathematical** typesetting. It is also quite complete and useful as a general reference on \LaTeX , and for most people Gratzer’s book is the only one they need.
5. **Practice your \TeX skills.** Once you have acquired basic \TeX knowledge, it’s time to practice your skills and gain more experience. A good way to do so is by gradually incorporating \TeX into your teaching and class work, and using \TeX for exams, class handouts, and homework solutions. While doing this, keep a copy of Gratzer’s book at hand and consult it whenever you are in doubt about how to do some specific typesetting task. Also check out my “LaTeX Tips” pages (online at <http://www.math.uiuc.edu/~hildebr/tex/>, printouts available in 130 Altgeld) for further tips and pointers. These tips pages are intended to complement standard books and reference works by focusing on items not well covered in books and on common mistakes.

[<http://www.math.uiuc.edu/~hildebr/texintro.pdf>]

Make sure you do things “by the book”. At this stage you have enough T_EX knowledge that you could handle most typesetting tasks on your own, without further consulting books and references, and it is tempting to do just that. This, however, would be a mistake. If you come across something you have never encountered before, do not try to find a “solution” on your own, but instead check Gratzer’s book to see if the situation is covered there. Any fixes you might come up with on your own are likely inferior to the “book solutions”, and while they may not cause immediate problems when compiling the code, they will probably result in poorly looking output. Moreover, by continuing to do things your own way, you will acquire bad coding habits that are hard to shed and which, aside from leading to inferior looking T_EX output, will end up costing you time from using inefficient and wasteful coding techniques.

Thus, whenever you come across something you have never seen or handled before (say, a summation involving a multiline summation condition), check Gratzer’s book to see if it is covered there, rather than trying to invent a solution on your own.

4 Resources

Here is a brief list of resources available to local students and faculty:

- **Introduction to LaTeX**, <http://www.math.uiuc.edu/~hildebr/tex/course>. The online version of the LaTeX “crash course” mentioned above.
- **Books**. The computer lab in 130 AH has copies of some T_EX books, including Gratzer’s “Math into LaTeX”, that you can consult if needed. Please do not take these books out of the room.
- **T_EX Tips and Resources**, <http://www.math.uiuc.edu/~hildebr/tex>. This page contains links to the LaTeX Tips pages mentioned above, UIUC thesis style files, and links to general resources. Of particular interest is the very comprehensive “TeX FAQ” by the UK T_EX Users Group.

[<http://www.math.uiuc.edu/~hildebr/texintro.pdf>]

- **Help.** You can send send \TeX questions to “texhelp”, or just stop by at my office in 241 Illini Hall (I’m in most of the time). The texhelp address is just an alias for me (hildebr), so email sent to texhelp will end up in my mailbox. I’m happy to answer questions, and I enjoy the challenge of solving a hard \TeX problem, but I am doing this on my own time, so please be sure to first check the tips pages and the Gratzner book to see if your question isn’t answered there. Also, such help limited to local users. Finally, I cannot help with problems you may have installing or running \TeX on your own computer.³ As mentioned above, I would recommend to do your \TeX work on the departmental Unix machines (or by logging into your account via ssh). This is what I have been doing for years, I am happy with what is available on the departmental network, I have never felt a need for having a separate \TeX installation on a personal machine, and I have no experience with such installations.

³If you really want to do that, here are some pointers. If you are running Linux (which I’d strongly recommend), you are in luck since all common Linux distributions include a full version of \TeX , aside from lots of other goodies, such as editors, compilers. (Note that for some distributions you need to check an appropriate box during the install process, or specify a “full” install.) On a MacIntosh running Mac OS X, I’d recommend TeXShop or iTeXMac; see <http://www.rna.nl/tex.html> for an excellent overview of setting up \TeX on a MacIntosh. Finally, for Windows, the best option is Miktex, <http://www.miktex.org>.

5 Examples of $\text{T}_{\text{E}}\text{X}$ documents

- A Math Contest
- Contest Solutions
- An Exam
- Exam Solutions
- Lecture Notes
- A journal article
- Transparencies for a Talk
- Chapter 1 of the TeX tutorial of the Indian TeX Users Group (slides).

6 Odds and Ends

6.1 Don Knuth Trivia

- World-renowned computer scientist.
- Author of masterpiece “The Art of Computer Programming” (1968–???, 3 volumes published so far, 4 additional volumes planned). (Volume 1 contains lots of interesting mathematics; highly recommended for that part alone.)
- Official title: “Professor of the Art of Computer Programming” at Stanford University CS Department.
- Retired from teaching, so he can concentrate on his writing and research activities.
- Creator of the TeX typesetting system and the METAFONT font design system.
- Versions of TeX program increment as 3, 3.1, 3.14, ..., with the latest version being 3.14159. Versions of the metafont program increment as 2, 2.7, 2.71, ... , with 2.7182 as the most recent version.
- Offers \$2.56 for any errors—technical, historical, or typographical, in his books or software.
- Stopped using email on January 1, 1990.
- Website <http://www-cs-faculty.stanford.edu/~knuth>.

6.2 Some Quotes

I hope to die before I have to use Microsoft Word.

–D.E. Knuth

I can't go to a restaurant and order food because I keep looking at the fonts on the menu. Five minutes later I realize that it's also talking about food.

–D.E. Knuth

I have been a happy man ever since January 1, 1990, when I no longer had an email address. I'd used email since about 1975, and it seems to me that 15 years of email is plenty for one lifetime.

–D. E. Knuth

It's is easy to use - if you're one of the 2 percent of the population who thinks logically and can read an instruction manual. The other 98 percent of the population would find it very hard to use.

–Leslie Lamport (in response to the question: Is LaTeX hard to use?)

For most of us using latex, our mathematical abilities far outstrip our typographical sensibilities! So our dissertations should excel in the first area, and we should avoid fiddling with the latter.

–Lucian Wischik

6.3 Some $\text{T}_{\text{E}}\text{X}$ error messages

Don Knuth, the creator of $\text{T}_{\text{E}}\text{X}$, is well-known for his sense of humor. This is reflected in many of the error messages displayed by the $\text{T}_{\text{E}}\text{X}$ program when it encounters an error in the compile phase. Here is a sample of error messages:

I have just deleted some text, as you asked.

You can now delete more, or insert, or whatever.

Sorry, I don't know how to help in this situation.

Your sneaky output routine has problematic { 's and/or } 's.

Maybe you should try asking a human?

I'll just pretend that you didn't ask for it.

Sorry, I already gave what help I could...

An error might have occurred before I noticed any problems.

This isn't an error message; I'm just \showing something.

One of your faux pas seems to have wounded me deeply...

A funny symbol that I can't read has just been input.

Continue, and I'll forget that it ever happened.

My plan is to forget the whole thing and hope for the best.

I'm forgetting what you said and using zero instead.

I can't handle that very well; good luck.

Sorry, but I'm not programmed to handle this case;

I've inserted something that you may have forgotten.

With luck, this will get me unwedged.

Things are pretty mixed up, but I think the worst is over.

Such booboos are generally harmless, so keep going.

Sorry, Pandora. (You sneaky devil.)

Try to go on, since this might almost work.

Pretend that you're Hercule Poirot: Examine all clues,