

# Of the Computer Scientist, by the Computer Scientist, for the Computer Scientist

MICHAEL DOOB

Department of Mathematics  
University of Manitoba  
Winnipeg, Manitoba  
R3T 2N2 Canada  
mdoob@uofmcc.bitnet  
mdoob@ccu.umanitoba.ca

## ABSTRACT

Having been in existence for almost ten years, is  $\text{\TeX}$  being used by the writer of mathematics who may have little or no interest in the beautiful programming properties of  $\text{\TeX}$  and only wants a tool to write papers? What about the use of  $\text{\TeX}$  in other disciplines? Is the structure of the (mark-up) language too complicated for the casual user? What can be done to help new users adjust to the extra demands of  $\text{\TeX}$ ?

This presentation is meant to motivate some discussion along these lines. In particular, the lack of appropriate learning aids is addressed. Some of the needs will be presented using the author's recently written introduction to plain  $\text{\TeX}$  (Doob 1989). In particular, the question of appropriate instructional levels and methods will be discussed.

### 1. What's the Problem?

We users of  $\text{\TeX}$  have no doubt of the beauty of our resulting documents. This feeling of beauty is allowed by the fine control available to the writer of the  $\text{\TeX}$  input file; this control enables different writers to produce documents to their own very exacting standards. The combination of the precision of  $\text{\TeX}$  viewed as a computer program and the æsthetic appeal of the resulting document is certainly a powerful attraction and part of the excitement of using  $\text{\TeX}$ . It may come as something of a shock when  $\text{\TeX}$  is met with less than total enthusiasm by others. The claim of this paper<sup>1</sup> is that a major cause of this lack of enthusiasm is the large amount of material that must be absorbed before  $\text{\TeX}$  may be used for even relatively simple jobs, and that there are insufficient tools available to ease the new user through this difficult period. If we look at the recent changes in the  $\text{\TeX}$  world, we can see why this has become increasingly significant.

One of the interesting  $\text{\TeX}$  developments during the past few years has been increasing variety of users. Only five years ago it was necessary for users of  $\text{\TeX}$  to install it themselves. This involved sending for a computer tape and having, to some extent, systems-level knowledge of a mainframe operating system. Users also had to write the device drivers necessary since they were readily available in prototype only. Until just a few years ago, the primary users of  $\text{\TeX}$  were principally computer scientists, their students, and a few other computer literate (or at least computer enthusiastic) users. *TUGboat*, the journal of the  $\text{\TeX}$  Users Group (TUG), consisted almost entirely of technical articles devoted to  $\text{\TeX}$  implementation. The use of  $\text{\TeX}$  by mathematicians was exceptional. Occasionally a mathematical preprint would be prepared using  $\text{\TeX}$ , but not much more;  $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\text{\TeX}$  was still very young. By contrast,  $\text{\TeX}$  is now commonly seen in the mathematical community. Several publications

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of the American Mathematical Society are published using  $\text{\TeX}$ . *Mathematical Reviews*, also published using  $\text{\TeX}$ , now accepts reviews from mathematicians via electronic mail in  $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\text{\TeX}$  format, and these reviews in turn are now available as a database on compact disc (see Latterner and Woolf (1989) in this issue).

We have also seen  $\text{\TeX}$  used for non-mathematical purposes. The published *Proceedings* for the 1987 and 1988 Annual Meetings<sup>2</sup> contained articles showing  $\text{\TeX}$  being used to typeset linguistics material (Thiele 1988), for in-house use by TV Guide (Barnhart and Ness 1988) and eventual typesetting of their weekly *TV Guide*, and even to keep a database of canine histories (Harris 1988).

Given that  $\text{\TeX}$  is being used by newer and more varied groups, are there any significant problems? A further claim of this paper is that there is at least one important problem that needs to be solved; namely, the existing level of user documentation is so limited in scope that it is seriously impeding the migration of  $\text{\TeX}$  from areas that are highly computer-oriented to even closely related areas. And what is the solution? Since TUG has been so active in promoting the distribution of  $\text{\TeX}$ , at organizing both elementary and advanced classes at the annual meeting and elsewhere, and at communicating newer developments in  $\text{\TeX}$ , and at announcing the existence of new products, it (or, rather, its members) is the natural source of the solution.

As a small step towards the solution, I have written a self-study manual called *A Gentle Introduction to  $\text{\TeX}$*  (Doob 1989), which is freely available. I found the writing of this manual, the subsequent teaching from it, and reactions to it quite interesting and to some extent surprising. Some of these experiences will be interspersed within the following sections. Some of the suggestions may seem self-evident and superfluous; having looked at a number of manuals, however, I would say that they are still worth putting down on paper. There is a lot of work to be done if  $\text{\TeX}$  is to be widely used; I hope that this will be a start.

## 2. From Where Are We Coming?

At the 1987 meeting of TUG in Seattle, a group of members interested in  $\text{\TeX}$  training met for the first time. At that time it was (naïvely) thought that a generic introduction to  $\text{\TeX}$  might be created by taking the main sections from existing manuals and glueing them together. I volunteered to gather things and to put together a first attempt at a general manual.

As the manuals arrived, it became clear that, while all had some good points, it was simply impossible to put them together. Many of them were highly site-dependent; others were obviously re-cycled lecture notes; some had clearly been put together in haste. In short, what existed was a series of learning aids that were designed for and could only be used in conjunction with a (human) tutor.

And then there is *The  $\text{\TeX}$ book*. The amount of information in that book continues to amaze me; its organization is wonderful for the experienced user. But no book can be all things to all people. The very enthusiastic can learn all they need to know from *The  $\text{\TeX}$ book*. For the less enthusiastic or less skilled, it is a rather unpleasant experience to try to do so. It is not a good starting point for most  $\text{\TeX}$  users (as, I'm sure, it was never intended to be).

The problem has been further exacerbated by the methods TUG has used to teach  $\text{\TeX}$ . By far the greatest technique has been what might be called the "university approach." A lecturer gives a course over one or two days, perhaps with a little lab time, and the student madly takes notes. In some undefined future spare time, the student is supposed to go over the notes and then know how to use  $\text{\TeX}$ . Of course, this is not a good way to learn something like  $\text{\TeX}$  where concomitant practice is such an important part of the learning process. And so I wrote the aforementioned self-study manual in which students could both practice and learn at their own pace.

At present, the great American  $\text{\TeX}$  manual is still waiting to be written. Of course, there may be just such a manual sitting on a file server somewhere in the far reaches of the electronic net. If this is the case we need to give it more exposure. In any event, the creation of appropriate manuals that may be widely used is surely an important concern of TUG.

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<sup>2</sup> The *Proceedings* for the TUG meetings of 1987 and 1988, although published separately, both carry a 1988 publication date. The *Proceedings* from the 1987 conference appear in the series  *$\text{\TeX}$ niques 5*, edited by Dean Guenther; the 1988 conference papers were published in  *$\text{\TeX}$ niques 7*, edited by myself —Ed.

### 3. Who Wants It?

There would be little point in creating a new manual unless there were a need for it. It is, then, reasonable to ask if there is really any demand for such a manual, and if so, how great is it. Earlier this year, unknown to me, a one-sentence statement indicating that I had written a self-study guide appeared in the American Mathematical Society *Notices* (Barwise 1989); it also gave my electronic mail address. It was something of a surprise to me when, with no warning, dozens of requests for the manual cascaded into my mailbox<sup>3</sup>. It would seem that there are many mathematicians who would like to use  $\text{\TeX}$  but for some reason cannot do so with the available materials. If there is this unmet demand among the mathematicians, it is safe to say that there is a similar need among other physical scientists and also among the social scientists.

Why is there such a sudden demand? In the last few years, the  $\text{\TeX}$  world has completely changed. Up to 1985 the  $\text{\TeX}$  user needed to be a somewhat sophisticated computer user. But once  $\text{\TeX}$  migrated to the microcomputer and laser printer environment, it became trivial to run and print  $\text{\TeX}$  documents. Our teaching methods in TUG have not really adapted to this change.

It should be self-evident that different audiences need different manuals. So our need is not for just one manual but, in fact, for a series of manuals, each one to target a different potential group of users. Some manuals have tried to be both an introduction for the new user and a reference manual for the experienced user; the results are not usually satisfactory. In particular, it is necessary to know the computer experience, the sophistication, and the level of knowledge of your audience before starting out.

With the large number of sophisticated TUG members, it should be possible to create such manuals. To make it a little easier, I have included in the next section a dozen suggestions that might make the writing a little easier. Needless to say, this is not exhaustive, but it might make the way a bit smoother.

## 4. A Dirty Dozen

### 4.1 The Right Definition (for you)

As we mentioned before, the nature of any manual is influenced by the target group. When writing a  $\text{\TeX}$  training manual, the target group must be well defined before starting. This group will then determine things like topics covered, examples, exercises, and even writing style.

#### Suggestion 1: Know your user

Many of the manuals that I received were far too broad in the attempted scope. The pace and background must be different for manuals aimed at a typical mathematician as opposed to a computer scientist. The user with other backgrounds needs to be handled still differently. The amount of space to be devoted to each topic needs to be adjusted in each case. For example, in one case it might be preferable to cover the different types of mathematical typesetting in great detail while in another, it might be better to see how to generate appropriate footnotes and endnotes. In any case, the topics covered must be controlled and appropriate. The object is not to display all that the writer knows.

A good list of different topics has been given by Childs *et al* (1988) in their discussion of possible course syllabi, and further suggestions were given by Childs (1989).

#### Suggestion 2: Know all of the topics to be covered first

A huge manual is truly intimidating. Although most manuals were of reasonable size, there were signs that they grew (like Topsy) as they went along. If you want to write a work that is encyclopedic and is several hundred pages long, that's fine — just don't consider it an introductory manual. If you want to write a reference card which fits on two sides of a sheet of paper, that's fine too. An introductory manual probably should be well under 100 pages. Don't be surprised if you find it

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<sup>3</sup> Added in proof: the number of requests is now approaching 250.

difficult to stick to the exact number of pages; in fact you should probably plan for a 10% margin of error. But it is certainly necessary to have some kind of limit in mind.

**Suggestion 3: Decide on the document size first**

#### 4.2 Getting the User Going

There is a huge hump in the beginning of the learning curve for T<sub>E</sub>X. Priority must be given to easing the new user into the intricacies of T<sub>E</sub>X. In particular, the T<sub>E</sub>X source of the your manual should be available easily, and it should be straightforward to produce hard copy at a typical T<sub>E</sub>X installation. This probably means that the source should be in one file with no auxiliary files being used. This also implies that the index and table of contents will be written directly into the document. It's possible, of course, to write the table of contents at the end of the document in one pass, but the index is more troublesome. For my introductory manual, I put in the index and table of contents directly into the T<sub>E</sub>X source file, but left the hooks in the introductory macros so that the knowledgeable user could generate new ones easily. And it's better to avoid documents that require two passes of the T<sub>E</sub>X program to generate and read auxiliary files, since this tends to have site-dependent restrictions.

**Suggestion 4: Make it easy for the user to get a hard copy**

It is inevitable that some site-specific information will be needed. For the new user, it is hoped that this is kept to a minimum. In any case, if at all possible it should be in one place, either as a separate section or as an appendix. This allows for greater portability of the document; it also lets the reader know what is part of T<sub>E</sub>X and what is part of the site implementation of T<sub>E</sub>X. It's easy for the new user of T<sub>E</sub>X to confuse them.

**Suggestion 5: Isolate site-specific instructions**

#### 4.3 How and What To Include?

Now for the real nitty-gritty. In planning an introductory T<sub>E</sub>X manual, it is often helpful to use the analogy of the structure of a foreign language text. A first-year text of this sort has rather limited goals. There is just enough information given to start using the language. It is certainly not expected that the student will write sonnets after the first few weeks of study. An introductory T<sub>E</sub>X manual must also have limited goals. As with a foreign language text, sections need to cover a relatively small amount of material, with successive sections being cumulative. Similarly, when material from different sections is used for a new idea, this should be explicitly pointed out.

**Suggestion 6: Make evident the interdependency of different sections**

The first steps to learning T<sub>E</sub>X are rather difficult. Parks (1988) and McCaskill (1988) have both noted that it may take extended periods of time before a real facility is attained. No one would expect a person to learn a foreign language without reviewing each lesson carefully. Normally this is done with exercises, translations, and tables.

**Suggestion 7: Have lots of exercises and examples**

It is useful to have exercises which review material from the immediately previous section, as well as new concepts. Later exercises in one section can reinforce the earlier exercises in the same section. The point of the exercise should be clear to the student.

It is, of course, necessary to give lots of examples. When doing so, it is useful to have a `\verbatim` or `\literal` macro that will allow you to use exactly the same code for the example and the listing that generated the example. In a surprisingly large number of cases, examples were given where the supposed T<sub>E</sub>X input source was wrong. This is, of course, disastrous.

In a foreign language text there are often tables of the following sort:

Present tense of the verb *to be*:

|            | Singular     | Plural   |
|------------|--------------|----------|
| 1st person | I am         | We are   |
| 2nd person | You are      | You are  |
| 3rd person | He/she/it is | They are |

Such tables give an overview of the material covered and are often useful for T<sub>E</sub>X manuals, too. They also serve as a useful quick reference once the reader has mastered the material.

Here is an example of a similar table from the beginning of my manual. It follows a discussion of characters that have special purposes in the T<sub>E</sub>X input file.

#### Characters requiring special input

| Character | Purpose                          | Input for literal output |
|-----------|----------------------------------|--------------------------|
| \         | Special symbols and instructions | <code>\backslash</code>  |
| {         | Open group                       | <code>{</code>           |
| }         | Close group                      | <code>}</code>           |
| %         | Comments                         | <code>%</code>           |
| &         | Tabs and table alignments        | <code>&amp;</code>       |
| ~         | Unbreakable space                | <code>~</code>           |
| \$        | Starting or ending math text     | <code>\$</code>          |
| ^         | Math superscripts                | <code>^</code>           |
| _         | Math subscripts                  | <code>_</code>           |
| #         | Defining replacement symbols     | <code>#</code>           |

#### Suggestion 8: Use tables to recapitulate sections

As mentioned before, it is important that a manual have definite limits to its scope. It's quite useful to let the reader to know where to get further information when desiring to go beyond that scope. Not surprisingly, *The T<sub>E</sub>Xbook* is often the most useful reference. Here is a macro that I used to point the reader towards further information:

```

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
\newdimen\theight
\def \TeXref#1{%
    \vadjust{\setbox0=\hbox{\sevenrm\quad\quad\TeX book: #1}}%
    \theight=\ht0
    \advance\theight by \dp0    \advance\theight by \lineskip
    \kern -\theight \vbox to \theight{\rightline{\rlap{\box0}}}%
    \vss}%
}
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

```

Then `\TeXref{1--9}` will cause a reference to appear in the right margin (now look to the right). The macro is obviously easy to adapt to different references.

#### Suggestion 9: Tell your reader where to find more information

Sometimes it is better to give an explanation that is not fully complete than to get lost in details that are not important. By mathematical analogy, consider two possible definitions of the real numbers: (1) real numbers are all possible decimals, and (2) real numbers are all possible greatest lower bounds

of sets of rational numbers. The first definition is (at best) rather loose and glosses over details such as non-uniqueness and repeating decimals; however, it does have the advantage of having a direct connection to familiar objects. The second definition is mathematically better than the first, but without the insight of the truncated decimals of the first definition, the second one has less intuitive understanding. When introducing a new topic, it is sometimes better to bend the truth a little (needless to say, it is hoped that the bending of the truth will be intentional). In particular, it is necessary to set a depth to which the material will be presented and then to consistently work to that level. As an example, in the manual I wrote, there is no mention of horizontal or vertical modes. Now it is obvious that a lack of knowledge about modes is *very* limiting. It is also clear that many error messages will be totally incomprehensible (so what's new?). Some topics, vrules and hrules for example, can only be discussed in a rough way, much as with the first definition of the real numbers. Nonetheless, in my (somewhat arbitrary) opinion, the neophyte T<sub>E</sub>X user can learn how to do lots of good documents without knowing about modes. Many decisions of this type were necessary for my manual; they require more time and thought than might be expected.

**Suggestion 10: Some judicious fibs are O.K.**

#### 4.4 A Few Final Comments

As has been mentioned earlier, it is important to have many exercises; as with learning a foreign language, it is necessary *to do* as well as *to read*. Give some thought as to whether or not the answers should appear directly after the exercises. It is evident to me that the typical reader wants them there; whether or not it is the best thing to do is a matter of debate. It really depends on whether the perspective of the manual is to be that of a teaching document or that of a reference document. There are at least two other possibilities: the answers can be put in an appendix, perhaps with a switch to determine whether or not they are actually printed, or they can be put into the T<sub>E</sub>X source code.

The T<sub>E</sub>X source code is also instructive. You may be assured that any macros that you write will be observed at some time by the readers of the manual. It is worth the trouble to comment your macros well.

**Suggestion 11: Make your T<sub>E</sub>X source code self-documenting**

The easiest way to distribute the T<sub>E</sub>X is via electronic mail. In principle, this should pose no problem; one of the strong points of T<sub>E</sub>X is that it uses only standard characters. My experience is that there are (EBCDIC-to-ASCII) problems. In one case, all the curly brackets disappeared (I leave it to the reader to imagine what this did to the output). It is prudent to give a sample set of characters as a comment at the beginning of your source file; sometimes it is possible to reverse the damage by simple global editing. I do something like the following:

```
%% Thanks for your interest in A Gentle Introduction to TeX. At the
%% moment it is in draft form, i.e., subject to correction, but it
%% is pretty close to the final copy. Any comments on this manual
%% would be appreciated: these may be typesetting, English, or
%% TeX criticisms.
%%
%%%           Michael Doob
%%           Department of Mathematics
%%           The University of Manitoba
%%           Winnipeg, Manitoba R3T 2N2
%%           Canada
%%           mdoob@uofmcc           (bitnet)
%%           mdoob@ccu.umanitoba.ca (internet)
%%
%% Here is a character listing to check to be sure that no
```

```

%% unwanted translations took place within the bowels of the net.
%% Upper case letters: ABCDEFGHIJKLMNOPQRSTUVWXYZ
%% Lower case letters: abcdefghijklmnopqrstuvwxyz
%% parentheses, brackets, braces: () [] {}
%% Exclaim, at, sharp, dollar, percent: ! @ # $ %
%% Caret, ampersand, star, underscore, hyphen: ^ & * _ -
%% vertical bar, backslash, tilde, backprime, plus: | \ ~ ' +
%% plus, equal, prime, quote, colon: + = ' " :
%% less than, greater than, slash, question, comma: < > / ? ,
%% period, semicolon: . ;
%%

```

**Suggestion 12: Make you source code available via electronic mail**

There are other manuals waiting to be written. We have already seen that there is a need for different elementary manuals. More advanced ones are non-existent. Most of the suggestions for elementary manuals also apply to advanced ones. Would someone, for example, like to write one on how to write output routines (that work)? How about introductory T<sub>E</sub>X wizardry? And maybe one on efficient T<sub>E</sub>X programming? How about METAFONT? I feel that I've done my part by writing an introductory manual — what about the rest of you TUG members?

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