Refining a Process

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Abstract

Unlike word processing, the changes involved in using TEX have not concerned the program, but have instead involved the type of user, equipment, and environment, all of which have evolved through the years and into the 90s. This paper profiles the various changes and offers suggestions for future structure and encouragement in the use of TEX.

Introduction

Before one can truly understand TEX one must understand its original purpose and intended user, for these have impacted TEX's current use and future applications in ways perhaps not anticipated by Professor Knuth and his colleagues in the beginning. Over the last decade, TEX has held its ground through numerous equipment and environment changes within both the scientific community and the computer industry. The direction and the problems surrounding the use of TEX enter the conversations of computer experts and novice TEX users alike. By shedding some light on TEX's history and by sharing insight and hindsight, the current and future use of TEX can be brought into focus, along with what its proficient users consider to be its positive aspects and what novice or non-users consider to be its negative aspects.

History

Purpose and application. As technology advanced into the computer age with its advanced mathematical capability, mathematicians became the forefathers of computer scientists. This group developed computers and numerous computer languages. By the late 70s, computers had advanced typesetting technology so quickly that within one generation we had gone from typewriting to TEX!

For many years, the documentation of advanced technology was made available to the scientific community by an expensive and timely typesetting method that allowed little or no interaction with the originator of the documentation. More and more experimentation was being done on computer by the scientists themselves, but the documentation was still dependent on the old, traditional typesetting procedures. There was an obvious need for a computer typesetting system that would enable its user to produce quality documentation.

This need was quite obvious to Dr. Knuth, as he started writing the many volumes of *The Art of Computing*. By the second volume, he had resolved to do the typesetting himself. With support from the National Science Foundation, Office of Naval Research, the IBM Corporation, the System Development Foundation, the American Mathematical Society, and Stanford University, he developed a program for typesetting his documentation, which he called TEX. While refining TEX, Dr. Knuth developed METAFONT, the Computer Modern fonts to be used with TEX. Being a perfectionist, Dr. Knuth was not satisfied with the construction of the first Computer Modern fonts and called them Almost Computer Modern! The first version of TEX was written in SAIL, not a widely used language since it only ran on DEC-20 computers. It was rewritten in Pascal and then in WEB to permit greater portability of the Pascal code. Others created a program to convert the WEB code into C code.

TEX was designed as a typesetting system to create beautiful mathematical and scientific documents. TEX received instant acceptance by the scientific community. Documenting technology was no longer at the mercy of previous typesetting methods. TEX enabled its original users to produce their own work and the results were as aesthetically pleasing as those achieved by the earlier costly and timely procedures. Finally, they had at their disposal a language that they could manipulate directly.

Users. The first users of TEX were the initial programmers, a team put together by Dr. Knuth. As this team grew and expanded, it came to be a

group of very specialized, unique users. A story about this group may give a better picture: At the first organized meeting of TEX users, discussion centered around whether they should be an organized *democracy* or a loose *anarchy;* they chose the latter!

TEX enabled the typesetting of one's own documentation without encountering hassles with printers or publishers. TEX users became authors *and* editors of their own documentation. This was a one-*wizard* show: The user was keyboarder, typesetter, technical typist, technical editor, and proof reader; and if a new macro was needed, the same wizard wrote it. From fonts to drivers, the problems were handled; easily said, easily done—or close to it. (See Figure 1.) Computer scientists and mathematicians learned TEX with ease and excitement. (So as not to exclude other areas of expertise and interest, it should be noted that other divisions in academia, such as the English and history departments at various universities, soon tried their hand successfully at TEX.)

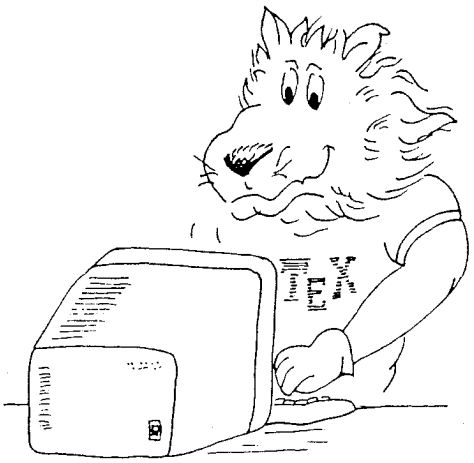

Figure 1: A One-Wizard Show

In the Preface to *TEX and* METAFONT, *New Directions in Typesetting* [1979], Dr. Knuth reversed a quote by Leonardo da Vinci, "Let everyone who is not a mathematician read my works." However, considering TEX's original users, the original quote by da Vinci, "Let no one who is not a mathematician read my works," should have been left alone. The original quote describes TEX and its wizards much more accurately. An even more accurate description of the wizard might be: "The trouble with having done something right the first time is that the wizard does not appreciate how difficult it is for anyone else."

As TEX's popularity grew, so did the number of its users; and it established new typesetting standards for scientific and mathematical publications and documentation. The first users were the TEX pioneers, who were specialists in their fields. However, as with any new technology, the use and users changed with time and organization.

Present

The TEX program is in the public domain. Dr. Knuth spent thousands of hours to make sure that "... the system would produce essentially identical results on all computers" [1990]. There are 1536 institutions and 3298 individual users of TEX.† TEX is used for all major European languages, and for others that are written either horizontally or vertically [Beebe 1990]; in more than 51 countries, the majority typeset English.† There are many publications that demonstrate and document TEX's various and diverse applications and users.

Current applications. Current applications are numerous. Aside from extremely specific applications, often demonstrated and published in the *TUGboat*, the primary application is still to typeset scientific and technical documentation and to solve difficult formatting problems.

The academic environment revolves around publications. Institutions are frequently evaluated in terms of their publications. The funding of many organizations depends heavily on presentations and documentation. As a result, an increasing number of journal and other publishers use TEX and/or accept submissions in TEX. Many government and government subcontractors use TEX exclusively to typeset technical documentation and publications [McCaskill 1988].

Users. The users of these various applications fall into two categories: (1) the do-it-yourself wizards, and (2) the multilevel document-preparation-system team members. (This second group must include at least one person who will be responsible for TEX

† This information was obtained from TEX Users Group, May 1991.

instruction and system language support [Gibson 1990].)

The first group is similar to the TEX pioneer; however, the use of TEX in a one-person operation is no longer necessarily by choice, but is influenced by time constraints, level of expertise, and funding.

The structure of the second group can be as simple as two people, perhaps one author and one typesetter, or as complicated as eight individuals, each of whom does only one of the eight various tasks involved in document preparation. The number of personnel doing these tasks vary and responsibilities overlap in some organizations, depending once again on time constraints, level of expertise, and funding. The roles that must be filled are: author (for text), technical editor, design editor, illustrator (for graphics), typesetter, keyboarder, proofreader, and printer/photocopier. (See Figure 2.)

Figure 2: Multilevel Complexity

The ability to work together toward a common goal is fundamental to the refinement of any process. If an organization has two or more people involved in the various steps of document preparation, each member's understanding and knowledge of TEX and of document preparation may differ widely, but all must work well, together as well as independently.

Observation — filling in the gaps. It is not difficult to outline TEX's current applications and users. In fact, one sentence summarizes this observation: TEX's most efficient and effective use is to support technical documentation departments at educational institutions, research organizations, government agencies, and publishing companies.

How the typical TEX user moved from being an individual user to being a member of a highly specialized team of technical users and support personnel was less subtle and organization-dependent. Various factors impacted these changes: time constraints, computer expertise, and funding. Historically, organizations and institutions that implemented TEX as soon as it became available on their computer systems later experienced structural changes. However, TEX still addressed the majority of their typesetting problems, was in the public domain, and produced beautiful documents in a reasonable length of time.

At TEX's advent, word processing software was not as user friendly as it is today, and TEX could be used to solve nearly every typesetting problem. However, TEX use was not limited to wizards. What could be so difficult about using a computer language to typeset everything? The answer became apparent when avid TEX supporters and users wanted (or needed) to rely on clerical staff to typeset technical documentation. TEX's high learning curve became apparent and the need for TEXnical support became quite obvious: The underpaid, overworked, stressed-out, clerical support staff emitted cries of frustration, while the technically-oriented document personnel emitted cries of gratitude. The positive and negative aspects of TEX appeared all at once, all involving accessible (at various user levels) information, technical support, and structured organizational levels (or the lack thereof). At this point, WYSIWYG word processing systems for use by non-technical clerical staff came of age, and TEX was reclaimed by those who needed it *and* could use it effectively and efficiently.

Various organizations have flip-flopped from word processing packages to TEX or from TEX to word processing packages [Hoover 1989]. Conscientious institutions utilize both systems according to their typesetting requirements. Time constraints, computer expertise, and funding are now factors that organizations can analyze to determine the best possible cost-effective document-preparation system for meeting their needs. Organizations that previously relied solely on TEX can now restructure. By placing their capable TEXnical personnel where they will be of greatest benefit to the entire system, that is, in a technical documentation department,

and using word processors for non-technical uses, they can better use their often-limited resources.

Future

TEXnically speaking. The future of TEX depends on its ability to meet the varying and continuously growing needs for the typesetting of technical documentation. This is not for a novice, like myself, to speculate on what technical innovations need to be addressed; excellent observations have already been presented by Nelson Beebe [1990] and Frank Mittelbach [1990].

Today's market is flooded with word processing software that address most typesetting and formatting requirements but that cannot typeset difficult technical, scientific, and mathematical documentation. As word processing software continues to address the needs of the commercial industry, TEX must also adapt and integrate and, beyond this, again set new standards and goals.

Non-TEXnically speaking. There are several areas of promotion and successful marketing and development strategies that TEX users and supporters have failed to use; the leaders of TEX need to address these. They include: encouraging more-accessible written information to close the gaps between user levels, such as dictionaries containing computer- and TEX-user terms; providing multi-level computer-dependent and TEX-related encouragement and publications; advertising already-established publishing practices; giving more than lip service to suggestions; and making sure that distributed information is received, is understood, and is applicable. The basic idea must be to establish TEX's uses and users, and to support them.

Conclusion

For hundreds of years, society advanced technologically through the sharing of scientific knowledge. This century has seen many technological advancements become commercial interests, to the point that commercial interests too often dictate the progress of technology. It has been difficult for TEX to hold to the ideal of shared knowledge in the face of commercial exploitation, but it is this ideal that has made TEX valuable to computer science and to the documentation of scientific information. In short, TEX is a brilliantly written, designed, and executed program that was far ahead of its time. If it had been developed later, TEX could perhaps have been more easily adapted and perhaps the original goals would have been different. However, it is the continuing ability of TEX users to use this hindsight to their advantage, along with their willingness to solve and share technical and non-technical problems and solutions, that makes the use of TEX such a refined process. Whatever the future holds for TEX, there is no doubt that it has already passed the test of time.

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