ABOUT TEX

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Why TEX?

Perhaps every mathematician is aware by now of the existence of TEX, a system for mathematical word processing and typesetting designed by the respected mathematician D. Knuth. This system has attracted some dissension among mathematicians, but it is rapidly becoming the standard system for preparing mathematical papers and documents because it is recognised even by its critics as the system which produces the best available output.

The word TEX is a shibboleth for the initiated of the art of mathematical word processing: TEX is pronounced "tech" with the ch imitating that found in loch. As Knuth explains this is because TEX represents the Greek root $\tau\epsilon\chi$.

The reason TEX produces such satisfactory output is that Knuth has put quite an enormous amount of effort into encapsulating within TEX the wisdom accumulated by professional typesetters over the centuries. In this sense TEX is almost an expert system; it makes decisions of its own — how far above the line a superscript should be, how small it should be, whether the limits of integration should be beside the integral sign on above and below, etc. It incorporates this kind of knowledge in respect of ordinary text also — spacing between letters or words, sensible places to hyphenate English words where necessary, for example. It does allow you to override the decisions it makes if you really want to, but the reason the finished product is so excellent is largely because this kind of detail is built into the system.

It is clear (to us) that the era of books or conference proceedings which have been reproduced directly from typewritten copy is nearly over. Soon papers typed on a golf-ball typewriter will be as unacceptable as a typescript with handwritten symbols is today. Just as twenty years ago mathematics departments adopted the golf-ball typewriter and coped with the consequential need to train secretaries in their use, they must now inevitably find the resources needed to implement TEX.

As some of you may know TEX runs on both PC's and mainframes and as it is a very powerful piece of software one would be forgiven for expecting it to be very expensive to buy. Happily this is not so: on mainframes the TEX

programme is in the public domain which means its cost is nominal being about $50 from the AMS. On PC's there are packages available which run TEX and these are a little more expensive. For example a commonly used one is called PCTEX and costs $248. This price should come down though in the future. The main reason for TEX not costing thousands of dollars is that Don Knuth has very generously given the programme to the public domain. Not only this, he also donates all his royalties from the manuals he has written for TEX to the AMS TEX users group: Tugboat.

It is AMS policy to support TEX and Maths Reviews is completely typeset in TEX as may be seen by looking for the appropriate small print on the inside cover. Thus although TEX is not perfect—it is still considerably easier to fill in a form using a typewriter than to try and use TEX—it does seem to be much better than any alternatives [1] and this is particularly true for text containing lots of mathematical symbols.

We think most mathematicians roughly understand the capabilities of a golf-ball typewriter and this influences their expectations of the result when something is typed on such a typewriter. With TEX, we think it will also be necessary for mathematicians to have some appreciation of what can be done, what is easy, what is difficult and what should not be asked of it. Some changes of attitude are required; documents prepared using TEX have more or less the same constraints as one is used to in a journal. Somehow we acquire (to a greater or lesser extent) an appreciation of good practice in preparing an article for submission to a journal. Long formulae should be displayed rather than embedded in the text; underlining is almost never used in printed material — bold face or italic type is used instead; symbols x, y, $f(x)$, etc are set in italic type but sin, sup, inf, etc. are not.

This rather superficial change of attitude by the mathematicians content to leave the details to someone else is not often considered. A lot of weight is frequently placed on the difficulty of learning how to use TEX. It is true that TEX involves creating first an abstract representation of the intended output document. In this sense TEX is a kind of programming language, but this feature of it makes it attractive to many mathematicians. As against that, simple documents are simple. A text document with no formulae is just typed in as it is with the understanding that TEX will decide how much to put on each line and that one begins a new paragraph by leaving a blank line. As one would expect, it takes little more know-how to centre a line or to put

[1] This view is broadly similar to those expressed by Abikoff [1] and Palais [2].

something in larger or bold-face type. To start a formula (the equivalent of changing to the symbol golf-ball) you type $ (or perhaps $$ for a displayed formula) and you end the formula with a matching $. Inside a formula a simple subscript such as x_i is indicated by an underscore `x_i`, a superscript or exponent as in x^2 by a carat `x^2`, the greek letter α by `\alpha`, and so on. As one would expect, compound subscripts are marginally harder, matrices are a little harder again, etc. Once typed into the computer — and this can be done with almost any text editor and on almost any computer (not necessarily one that can run the TEX program itself) — one runs the result through the TEX program and the end product can be printed (or viewed on the computer screen if you have appropriate equipment).

We admit all this takes a little getting used to and it helps a lot to have someone down the hall who doesn't mind answering questions that begin "How do you do ...?". We don't think it is an insurmountable difficulty for anyone to learn, but some effort is required.

Soon perhaps we will all be preparing our own papers, exams and handouts in TEX on the micro in the office. There is a growing school of thought among those who can type reasonably fast that it is quicker to type in the TEX input than to write out a draft which is sufficiently tidy for a secretary to read. In the shorter term however, it is inevitable that secretarial work becomes computerised and, for the secretaries in the mathematics department TEX is the right system to have.

We present below our own experiences with TEX. We know that TEX has also been adopted at other institutions in Ireland. Interesting developments are taking place at UCD, where Wayne Sullivan is writing a TEX previewer and a Laserwriter driver, both of which promise to be much faster than those currently available. Those interested in getting a preliminary version of his previewer should contact WSULIVAN@UCD.IRLEARN (HEANET) (WSULIVAN@IRLEARN.BITNET).

References

[1] Abikoff, William, TEX, Mathematical Intelligencer 8 No. 3 (1986) 54 –76; 9 No. 1 (1987) 66 – 68.

[2] Palais, Richard S. (editor), Mathematical Text Processing, Notices of the Amer. Math. Soc. **33** Nos. 1 – 5 (1986), **34** Nos. 1 – 4 (1987).

TEX at TCD

It is probably accurate to say that Timothy Murphy in TCD was the first Irish person on the TEX scene and he set up experimental TEX outputting programs (referred to as printer 'drivers') at TCD at a very early date. Despite this, due to lack of enthusiasm on the part of the TCD computer laboratory and lack of resources under the control of the school of mathematics, it was only recently that a satisfactory system for TEX has become available to users in the mathematics departments. For some years there was a lone Toshiba printer attached to the grossly overloaded DEC20 mainframe which was capable of printing TEX output. The whole system was slow and painful to use and it was necessary to go to the computer laboratory and physically adjust the printer for TEX each time one used it.

For almost a year we have had an Apple Laserwriter attached to an Ergo microcomputer (that's an IBM-PC clone with a 20MB hard disc, 640K of memory, a Hercules graphics screen and TEX software from PCTEX). This is linked to the departmental minicomputer system (via software known as 'Kermit') so that TEX input files can be typed in on any of a number of terminals in the department. The system is quite satisfactory although it is still necessary to use the Ergo for finally printing (or even error-checking) the input. We dream of a high speed network in the department with various processors attached which would allow (among other things, of course) anyone at any terminal to check a TEX input file for errors and send it off to be printed. The PC linked directly to the printer might then only be used for confidential documents and examination papers.

More than half the academic staff in the school of mathematics have experience of using TEX personally and the facility is quite heavily used. Regrettably the one secretary we had who was competent at producing mathematical papers in TEX has left but we hope to remedy this soon.

How fast is TEX on our present set up? This is not too easy to answer accurately. I took a short paper with a fairly high density of mathematical formulae — integrals, partial derivatives, subscripts, *etc.* It took about a minute to run through the TEX program (this step might need to be repeated if errors crop up). Printing it out in 12 point type size (over 3.5 pages) took about 7 minutes. The average time per page would be shorter for a longer document (under a minute per page). Some of the time is occupied by the computer translating the DVI (device independent) output produced by the TEX program into a different format (about 2.5 minutes in the example) and

some by initial overhead so that it took over 5 minutes for the first page to appear. Thereafter the printer prints at about 2 pages per minute. The print quality is high and the printer is not noisy.

There is also a screen preview facility which allows one to see the general layout and to understand errors that have shown up in running the TEX program. This is not quite instantaneous but is much faster than printing as a way of looking through for things that are not coming out as you wanted. It has the drawback that it takes a while to start up (perhaps 30 seconds), it only allows you to see a portion of the page at a time and it takes a few seconds to move the 'window' around the page or to the next page. This program requires better graphics (Hercules or EGA) than the minimum CGA standard. The rest of the software runs happily without good graphics. Preview is reputed to be noticably faster on a PC-AT.

On the subject of macro packages for TEX, we have tended towards LATEX rather than the plain or AMS packages. For example we have LATEX style files and blank documents for letters, memos and exam papers which we are beginning to use. I should say that some of us do use plain TEX and all three packages are available. *RMT*

TEX at Maynooth

We have had TEX running and printing at Maynooth since the summer of 1983. There are now many TEX users here and they are by no means all members of the mathematics departments. For example they may be found among the historians, linguists and sociologists; also the computer laboratory use TEX to produce its monthly newsletter while the library uses it for special high quality notices. One can infer from the above remarks that, for non-mathematical prose, TEX is rather easy to use. In addition considerable resources are needed here to meet the demand created by all these TEX users.

In fact the most critical resources for TEX users tend to be the printers. The two mainframes here (a vax and a microvax) support four printers for TEX printing. Two of these are medium resolution Toshiba dot matrix printers. The other two are high resolution DEC LN03 laser printers. All four printers are permanently switched on and offer queueing facilities: thus a TEX job can be submitted to any of these devices from any terminal, then the job either starts immediately if the relevant queue is empty, or awaits its turn if the printer is already in use. The Toshiba printers are rather slow taking three minutes or so to print an average A4 page. However they are fine for drafting and for when one is not in a hurry. The laser printers are extremely fast printing at a rate of six or seven A4 pages a minute even for the most heavily symbol-laden mathematical text. A word of caution: not all laser printers reach these speeds, particularly if, as is *not* the case for the LN03's, they use the page description language called Postcript. The siting of printers around the campus is an important topic and one of obvious interest to mathematicians.

The mathematics departments have in their corridor a room in which one of the Toshiba devices referred to above is located. Also in this room we have an IBM PC clone known as a Prompt to which we have connected an Apple Laserwriter. This latter arrangement frees us from being dependent on the mainframes whose queues can become rather long and slow when these mainframes are heavily loaded. The PC can double as a terminal to the mainframes so that we may use Kermit to send files back and forth between the two sorts of machine. The Apple Laserwriter is not quite as fast as the LN03 particularly for mathematical text using many symbols per square cm. I have referred in passing above to one of the reasons for this. Nevertheless PC-based TEX systems are likely to become ever more popular in the future. This is because the large fall in price of both PC's and laser printers of recent years makes their purchase an option for indivdual departments. As well as this such a system operates independently of a potentialy heavily loaded mainframe but can be connected to it using Kermit if it suits one. Many mathematicians now boast PC's either at home or in their offices and this allows them both to make full use of all the college resources and to take their work away with them on a diskette.

Lastly electronic mail, both national and international, is here to stay and a TEX file is an obvious medium in which to send a mathematical article. The author has actually published an article in a conference proceedings abroad which was submitted electronically at the request of the conference organisers — they had some industrial action in their postal service at the time of the conference. In the case of journals, the requirement of a uniform appearance, and the need not to penalise would-be authors whose institutions do not provide the relevant mathematical word processing facilities, makes routine electronic submission look a little further in the future. *CN*