

publication to a standard refereeing process. But what format should such papers have? Since people will want to be able to print copies of particular papers, formatting in \TeX becomes a leading possibility. Such papers could then be passed through a standard \TeX ing process and printed, or they could be read after processing through a \TeX screen previewer. However, there was additional discussion about how one could create electronic archives consisting of large data bases of electronic papers. Would \TeX help in the archiving and accessing processes?

It has been very interesting to read a book about desktop publishing in which \TeX is the leading contender, rather than being out of sight among the packages that allow you to produce fancy newsletters. But the growth of desktop publishing software packages has been so rapid that it is clear that \TeX must make good use of the new emerging technologies if it is to maintain its leading position among astronomers and other scientific users. Despite its faults of presentation, the book is recommended.

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Typesetting on PCs

\TeX -386 implementations for IBM PCs: Comparative timings

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Timing tests were performed on several implementations of \TeX for IBM PCs (and compatibles). All currently available 386-specific implementations were tested. Additionally the latest available versions of $\text{em}\text{\TeX}$ for other processor classes were tested. Since the last published benchmarks used $\text{sb}\text{\TeX}$ in the 8086 version as the standard the latest version of this implementation was also included for reference purposes. $\text{PCT}\text{\TeX}$ as the most widely used commercial implementation of \TeX for PCs was used in its 8086 flavor for the same reason.

These were the tested versions:

$\text{SB}\text{\TeX}$ 3.8
 $\text{em}\text{\TeX}$ 3.0 [3a]
 $\text{em}\text{\TeX}286$ 3.0 [3a]
 $\text{bigem}\text{\TeX}$ 3.0 [3a]
 $\text{bigem}\text{\TeX}286$ 3.0 [3a]
 $\text{PCT}\text{\TeX}$ 3.14
 $\text{em}\text{\TeX}386$ (beta8)
 $\text{\TeX}as$ 1.0
 $\text{PCT}\text{\TeX}386$ 3.14
 $\text{BigPCT}\text{\TeX}386$ 3.14

The files used for testing were the same as in the previously published series of benchmarks:

- Text1 is *The \TeX book*.^{*} It is 494 pages long.
- Text2 is a mathematical paper which needs \LaTeX and $\text{P}\text{\CT}\text{\TeX}$, so it really uses lots of memory. The document is 11 pages long.
- Text3 is a book of solutions for a college mathematics textbook. It consists almost completely of formulas and there is almost no text. It is among the most complicated \TeX files I have ever seen. It uses \LaTeX and additionally the msxm and msym fonts from (old) $\text{\AA}\text{\MS}\text{\TeX}$. The document is 40 pages long.
- Text4 is the demo file for $\text{Music}\text{\TeX}$, which is a rather large macro package for typesetting music. The document is 2 pages long.
- Text5 is Michael Wichura's original paper from *TUGboat* 9, no. 2, describing $\text{P}\text{\CT}\text{\TeX}$. It makes extensive use of $\text{P}\text{\CT}\text{\TeX}$ macros and also uses rather large data sets for the graphics. Additionally it uses the *TUGboat* macro files (in a stripped down version). The document is 10 (narrower than a page) columns long.
- Text6 is Barbara Beeton's review and the Boston Computer Society mathematical text processor benchmark from *TUGboat* 6, no. 3. It (naturally) contains complicated formulas and uses the *TUGboat* style. The document is 4 pages long.

Table 1 shows the times associated with the tests.

The following special events occurred during the benchmark:

- (1) capacity exceeded, program stopped.
- (2) Michael Wichura's $\text{P}\text{\CT}\text{\TeX}$ article could only be run in one column mode with non-386 versions of \TeX having standard \TeX memory.

^{*} The file for *The \TeX book* used with permission of the American Mathematical Society.

If we take em \TeX 386 as the base for a comparison of performance, we get relative indices of performance as shown in Table 2 (a low value indicates fast performance).

All these benchmark runs were performed on a 50MHz 486 DX2 machine with MSDOS 5.0 installed. All programs were run with QEMM-386 installed giving 600KB free main memory and either 7Mb of extended memory or 7Mb of simulated expanded memory.

When using 386 machines most people do not run just plain MSDOS. Additionally in most cases multitasking environments are used. Since all 386

specific \TeX implementations are using some sort of DOS extender it is important to know which version of \TeX will be compatible with which multitasking environment. Experience has taught us that one must be very careful when using multitasking environments. Therefore some additional tests were performed. All tested implementations of \TeX were run under DesqView 386 and under Windows 3.1 in standard and in enhanced mode. To reduce the number of runs only text3 (being a very complicated \TeX document) was used for this test.

Table 3 gives an overview of timings and of compatibility problems.

Table 1. Test times

	Text1	Text2	Text3	Text4	Text5	Text6
SB \TeX	2:39	(1)	0:33	0:10	0:18 (2)	0:08
em \TeX	2:50	(1)	0:35	0:10	0:18 (2)	0:09
em \TeX 286	2:43	(1)	0:34	0:10	0:18 (2)	0:09
bigem \TeX	6:20	0:27	1:35	0:24	0:40	0:21
bigem \TeX 286	6:00	0:26	1:31	0:23	0:39	0:21
PCT \TeX	3:11	0:15	0:42	0:12	0:23	0:11
em \TeX 386	1:41	0:09	0:22	0:08	0:13	0:07
\TeX as	1:49	0:15	0:30	0:12	0:20	0:11
PCT \TeX 386	1:44	0:10	0:22	0:08	0:15	0:07
BigPCT \TeX 386	1:48	0:10	0:23	0:08	0:16	0:07

Table 2. Relative performance

	Text1	Text2	Text3	Text4	Text5	Text6
SB \TeX	1.57		1.50	1.25	1.38	1.14
em \TeX	1.68		1.59	1.25	1.38	1.29
em \TeX 286	1.61		1.55	1.25	1.38	1.29
bigem \TeX	3.76	3.00	4.32	3.00	3.08	3.00
bigem \TeX 286	3.56	2.89	4.14	2.87	3.00	3.00
PCT \TeX	1.89	1.67	1.91	1.50	1.77	1.57
em \TeX 386	1.00	1.00	1.00	1.00	1.00	1.00
\TeX as	1.08	1.67	1.36	1.50	1.54	1.57
PCT \TeX 386	1.03	1.11	1.00	1.00	1.15	1.00
BigPCT \TeX 386	1.07	1.11	1.05	1.00	1.23	1.00

Table 3. Test times and compatibility with Windows and DesqView

	DesqView 386	Windows standard	Windows enhanced
SB \TeX	(3)	(3)	0:33
em \TeX	0:36	0:34	0:35
em \TeX 286	0:34	0:34	0:33
bigem \TeX	6:37	5:40	2:29
bigem \TeX 286	6:24	5:30	2:20
PCT \TeX	0:56	1:22	0:54
em \TeX 386	0:23	3:38	(5)
\TeX as	0:33	(4)	0:32
PCT \TeX 386	0:25	(6)	0:24
BigPCT \TeX 386	0:26	(6)	0:25

The following problems occurred during the tests:

- (3) Program started, but not enough memory to compile document.
- (4) Loader failed (DOS4GW)
- (5) DPMI not supported
- (6) Insufficient physical memory available

This table clearly shows that none of the available implementations of $\text{T}_{\text{E}}\text{X}$ for 386 PCs under DOS can run in both variants of Windows: $\text{emT}_{\text{E}}\text{X}$ cannot run in enhanced mode, and $\text{PCT}_{\text{E}}\text{X}386$ and $\text{T}_{\text{E}}\text{Xas}$ cannot run in standard mode. Since Windows only functions as a full multitasker for DOS tasks in enhanced mode, running a 386- $\text{T}_{\text{E}}\text{X}$ for this configuration can be accomplished only with $\text{PCT}_{\text{E}}\text{X}$ and $\text{T}_{\text{E}}\text{Xas}$. When using DesqView all three 386- $\text{T}_{\text{E}}\text{X}$ implementations will work, but only standard mode Windows will be available, because DesqView and Windows enhanced mode cannot be run concurrently.

Other implementors are invited to provide copies of their implementations to be run through the same tests, the results to be reported in a future issue of *TUGboat*. I am willing to accept hints and suggestions from the implementors about how to make the tests run as efficiently as possible. I am also willing to send out any files which cause problems and rerun the tests after the problems have been solved.

This test would not be what it is without valuable advice and some test files from Barbara Beeton.

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