

- Text1 is *The T_EXbook*.^{*} It is 494 pages long.
- Text2 is a mathematical paper which needs L^AT_EX and P_lCT_EX, 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 T_EX files I have ever seen. It uses L^AT_EX and additionally the msxm and msym fonts from (old) A_AS-T_EX. The document is 40 pages long.
- Text4 is the demo file for MusicT_EX, 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 P_lCT_EX. It makes extensive use of P_lCT_EX 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.

* The file for *The T_EXbook* used with permission of the American Mathematical Society.

- 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) hash table size exceeded, program stopped.
- (2) capacity exceeded, program stopped.
- (3) Text1, Text4, Text5, and Text6 under PCT_EX had to be run with additional command line parameters, /f=26000 /m=65000 in our case.

PubliCT_EX (in normal run) used the hard disk for virtual memory

If we take SBT_EX 3.0 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 programs were run on a 25MHz 386 machine with MSDOS 3.3 installed. All programs were run with QEMM-386 installed giving 960K of simulated expanded memory and 600KB free main memory.

Table 1. Test times

	Text1	Text2	Text3	Text4	Text5	Text6
PCT _E X	12:11 (3)	1:28	3:39	1:07 (3)	2:15 (3)	1:11 (3)
PublicT _E X	27:32	2:28	6:17	1:48	7:59	3:20
SBT _E X	14:28	1:26	3:27	1:01	2:14	1:11
SBT _E X 3.0	13:35	1:21	3:14	1:01	2:04	1:04
μT _E X	15:51	(1)	(2)	1:19	3:23	1:25
emT _E X	16:31	(1)	3:28	0:58	2:03	1:04
emT _E X286	11:32	(1)	3:17	0:56	2:00	1:01
bigemT _E X	30:51	2:21	7:18	2:01	3:32	1:55
bigemT _E X286	29:38	2:17	7:10	1:59	3:31	1:55
emT _E X 3.0	15:05	1:14	3:11	0:56	1:48	1:03
emT _E X286 3.0	14:44	1:12	3:02	0:51	1:46	0:59

Table 2. Relative performance

	Text1	Text2	Text3	Text4	Text5	Text6
PCT _E X	0.90	1.09	1.13	1.10	1.09	1.11
PublicT _E X	2.03	1.83	1.94	1.77	3.86	3.12
SBT _E X	1.07	1.06	1.07	1.00	1.08	1.11
SBT _E X 3.0	1.00	1.00	1.00	1.00	1.00	1.00
μT _E X	1.17			1.30	1.64	1.33
emT _E X	1.22		1.07	0.95	0.99	1.00
emT _E X286	0.85		1.02	0.92	0.97	0.95
bigemT _E X	2.27	1.74	2.26	1.98	1.71	1.80
bigemT _E X286	2.18	1.69	2.22	1.95	1.70	1.80
emT _E X 3.0	1.11	0.91	0.98	0.92	0.87	0.98
emT _E X286 3.0	1.08	0.89	0.94	0.84	0.85	0.92

Additionally, a real “stress” test was performed with all these implementations of \TeX . Text5 was “hardened”: `\Lasertrue` (a switch from `TUGboat.sty`) was added (doing real two-column setting in \TeX), which usually has the consequence of needing much more \TeX main memory. Additionally (in the third degree) all `\eject` commands introduced to use \TeX 's memory cautiously were removed from Text5.

Only `bigemTeX` and `bigemTeX286` survived this test. The running times were:

- `bigemTeX` 3:34
- `bigemTeX286` 3:33

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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Tutorials

Long-winded Endnotes and Exercises with Hints or Solutions

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This is the third in a series of tutorials written for readers interested in exploring some of the subtler areas of \TeX . We illustrate the concepts described by considering tools that may prove useful to authors interested in using plain \TeX during creation of manuscripts of books or articles. The first and second installments appeared in *TUGboat* 10, no. 3, pp. 390–394, and volume 11, no. 1, pp. 62–68.

In this episode, we consider discursive endnotes and exercises for which hints or solutions are given. We are interested in endnotes and exercises that may be longer than one paragraph and that may cite one another. (We treat the endnote case as a special case of the exercise case.) As in the earlier pieces in this series, one of the main ideas is to get \TeX to attend to the numbering of items and to provide marginal notes in working drafts in order to facilitate cross references. Some of the central ideas here have been introduced in the earlier pieces (for example, using \TeX to write things into files), but this time we will be forced to devote special attention to some subtleties not considered in the earlier cases.

Source code for *The \TeX book* (part of the general \TeX distribution; it is described in Appendix E of *The \TeX book*, pages 412–425) reveals that a central idea of Knuth's about exercises and their solutions is that these should not be separated from one another in the text file (*ibid.*, page 422), no matter how far apart they will eventually appear in the finished book (or books, if solutions or answers are to appear in separate units—for example, in a supplementary volume for teachers).

If we keep the exercises and their solutions together in the source file, it will be possible to rearrange their order, add more, or delete some, and let \TeX do the renumbering without tampering with the coordination between the exercises and the solutions. Think of this as analogous to the way footnotes are treated in \TeX : the text of each footnote is imbedded in the source file at the point at which it is cited. This is also the way complicated endnotes ought to be handled, for exactly the same reasons. And, while we're at it, there's no difficulty in arranging for solutions and exercises to appear next to each other even in draft versions of the printed text until the dust settles and preparation of pages in final form is ready to begin. In addition, some authors may find it helpful to see the text of endnotes in draft versions of the printed text at the places they are called. Code that will make this possible is described below.

In some books, the fifth edition of Harold Davenport's *The higher arithmetic* (Cambridge University Press, 1982) is one, separate sections or appendixes are provided to contain hints for the exercises and their answers. No problem.

Exercises and endnotes, some preliminaries. Eventually we will consider definitions for macros such as