Technical Torture Test

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1 Introduction

In 1985-86 the *Notices of the American Mathematical Society* ran a series, authored by Richard Palais[1], on using a computer to produce technical text. As part of that series, they reprinted *Technical Wordprocessors for the IBM PC and Compatibles: A report by the PC Technical Group of the IBM PC Users Group of the Boston Computer Society.*[2] It said, "TEX systems are in a class by themselves. The TEX user has power and flexibility unmatched by any conventional word processor."

In 1986, I was fresh from struggling with the text of my Ph.D. thesis, and so I read the entire series with interest. It convinced me that a TEX system is the way to go. Much of it involves tests of products that no longer exist and so it would not make sense to reproduce the entire report. But the committee's selection of benchmarks remains wonderful: they covers a wide range of tasks in the production of technical material, and provide a fair test for systems that a person might consider. And, they show that – especially in quality of output – there is still no competitor for TEX.

2 Methodology

Below, each page contains one benchmark. I have done each in the way that a moderately knowlegeable TEX user would, using only those facilities discussed in *LATEX: a Document Preparation System*, and in *The LATEX Companion* and *The LATEX Graphics Companion.* I have stayed away from any low-level programming or wizardry. I believe that this shows what a reasonable person can accomplish, with reasonable effort, with a TEX system.

Note. I have corrected several small typos in the original benchmarks.

3 To do . . .

This document is not yet complete. In particular, because I don't know any Chemistry, someone else should do the chemical diagrams.

[1]Mathematical Text Processing, *Notices of the Amer. Math. Soc*, vol. 33, no. 1, Jan. 1986, p. 3–7.

[2]Authors: Avram Tetewsky, Jack Pearson. TEX reviewers: A.G.W Cameron, Jack Pearson. Reprinted in *Notices of the Amer. Math. Soc*, vol. 33, no. 1, Jan. 1986, p. 8–37.

Benchmark 1: L. Tsang and J. A. Kong, *Journal of Applied Physics*, **51**(7), July 1980, page 3471, equation 110.

$$W^{3\beta}_{m_1n_1n_2}(p_1,p_2) = U^{3\beta}_{m_1n_1}(p_1,p_2) + \int_0^\infty \frac{dp_3p_3^2}{8\pi^3} \sum_n \sum_m \sum_{\alpha_2} \sum_{\beta_2} \sum_{n'} \sum_{n''} (-1)^m$$

$$\times \left(\frac{U^{33}_{m_1n_1}(p_1,p_2)}{p_3^2 - k^2} \right) z_{3m_1n_1} h_n(p_3,p_2) \cdot a^{\alpha_{23}}_{mn(m_1-m)n'n_2} a^{\beta_2\beta}_{-mn(-m_1+m)n''n_2} W^{\alpha_2\beta_2}_{(m_1-m)n'n''}(p_3,p_2) \quad (110)$$

Benchmark 2: Athanasios Papoulis, *Probability, Random Variables, and Stochastic Processes*, second edition, McGraw-Hill, 1984, page 17.

Unions and Intersections The *sum* or *union* of two sets $\mathcal{A}$ and $\mathcal{B}$ is a set whose elements are all elements of $\mathcal{A}$ or $\mathcal{B}$ or of both (Fig. 2-3). This set will be written in the form

$$\mathcal{A} + \mathcal{B} \qquad \text{or} \qquad \mathcal{A} \cup \mathcal{B}.$$

The above operation is commutative and associative:

$$\mathcal{A} + \mathcal{B} = \mathcal{B} + \mathcal{A} \qquad (\mathcal{A} + \mathcal{B}) + \mathcal{C} = \mathcal{A} + (\mathcal{B} + \mathcal{C}).$$

We note that, if $\mathcal{B} \subset \mathcal{A}$ then $\mathcal{A} + \mathcal{B} = \mathcal{A}$. From this it follows that

$$\mathcal{A} + \mathcal{A} = \mathcal{A} \qquad \mathcal{A} + \emptyset = \mathcal{A} \qquad \mathcal{J} + \mathcal{A} = \mathcal{J}.$$

The *product* or *intersection* of two sets $\mathcal{A}$ and $\mathcal{B}$ is a set consisting of all elements that are common to the two sets $\mathcal{A}$ and $\mathcal{B}$ (Fig. 2-3). This set is written in the form

$$\mathcal{A}\mathcal{B} \qquad \text{or} \qquad \mathcal{A} \cap \mathcal{B}.$$

Benchmark 3: Richard P. Feynman, *The Feynman Lectures on Physics*, Addison-Wesley Publishing Co., 1965, Vol. 3, page 20-12, Table 20-1.

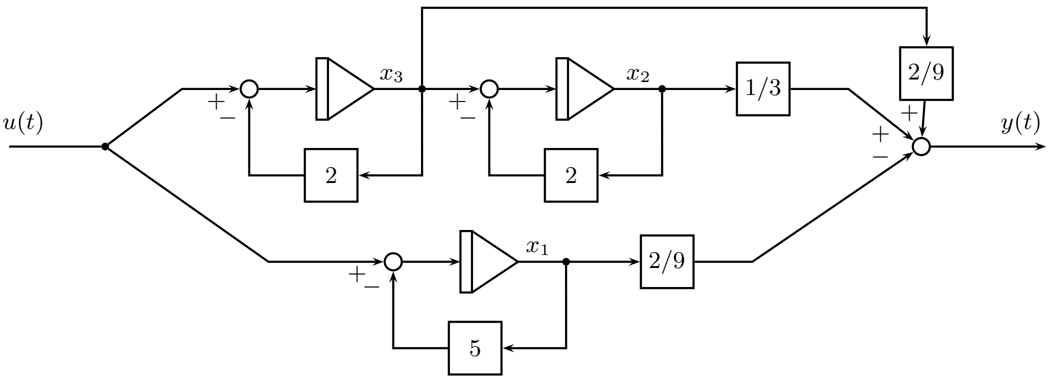
Table 1: **20-1**

Physical Quantity	Operator	Coordinate Form
Energy	$\hat{H}$	$\hat{\mathcal{H}} = -\dfrac{\hbar^2}{2m}\nabla^2 + V(r)$
Position	$\hat{x}$	x
	$\hat{y}$	y
	$\hat{z}$	z
Momentum	$\hat{p}_x$	$\hat{\mathcal{P}}_x = \dfrac{\hbar}{i}\dfrac{\partial}{\partial x}$
	$\hat{p}_y$	$\hat{\mathcal{P}}_y = \dfrac{\hbar}{i}\dfrac{\partial}{\partial y}$
	$\hat{p}_z$	$\hat{\mathcal{P}}_z = \dfrac{\hbar}{i}\dfrac{\partial}{\partial z}$

In this list, we have introduced the symbol $\mathcal{P}_x$ for the algebraic operator $(\hbar/i)\partial/\partial x$:

$$\mathcal{P}_x = \frac{\hbar}{i}\frac{\partial}{\partial x}.$$

Benchmark 4: William L. Brigan, *Modern Control Theory*, QPI Quantum Press Inc., Prentice Hall, 1984, page 240, Figure 9.11.



From Fig. 9.11,

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}-5 & 0 & 0\\ 0 & -2 & 1\\ 0 & 0 & -2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}1\\ 0\\ 1\end{bmatrix} u \qquad \text{and} \qquad y = \begin{bmatrix}-2/9 & 1/3 & 2/9\end{bmatrix} x$$

Benchmark 5: Marsden, J.E., *Elementary Classical Analysis*, W.H. Freeman and Co., 1974, page 234, proof of Theorem 2.

Proof. Define the function $G\colon A \subset \boldsymbol{R}^n \times \boldsymbol{R}^m \to \boldsymbol{R}^n \times \boldsymbol{R}^m$ by $G(x, y) = (x, F(x, y))$. Since F is of class C^p and the identity matrix is of class C^∞, it follows that G is of class C^p. The matris of partial derivatives of G (Jacobean matrix) is

$$\begin{pmatrix} 1 & 0 & \dots & 0 & 0 & \dots & 0 \\ 0 & 1 & & & & & \\ \vdots & & \ddots & \vdots & \vdots & & \vdots \\ 0 & & \dots & 1 & 0 & \dots & 0 \\ \dfrac{\partial F_1}{\partial x_1} & & \dots & \dfrac{\partial F_1}{\partial x_n} & \dfrac{\partial F_1}{\partial y_1} & \dots & \dfrac{\partial F_1}{\partial y_m} \\ \vdots & & \ddots & \vdots & \vdots & & \vdots \\ \dfrac{\partial F_m}{\partial x_1} & & \dots & \dfrac{\partial F_m}{\partial x_n} & \dfrac{\partial F_m}{\partial y_1} & \dots & \dfrac{\partial F_m}{\partial y_m} \end{pmatrix}$$

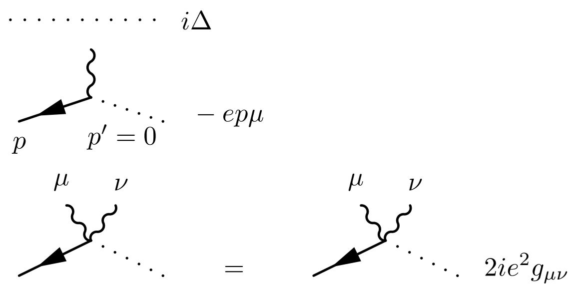
□

Benchmark 6: Henry, Allen F., *Nuclear Reactor Analysis*, MIT Press, Cambridge, Mass., 1982, page 495, subequations 4 and 5.

$$iB_r[\tilde{a}^n_{kl}] \equiv \frac{1}{2}(h_{n-1} + h_n) \int_0^R 2\pi r\, dr [\rho^{n_*}_k(r)] \frac{d}{dr} [\Psi^n_l(r)],$$

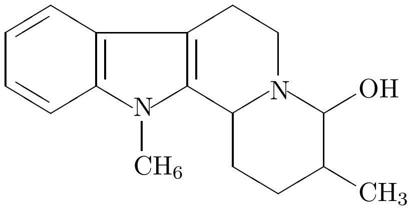
$$[D^n_{r,kl}]^{-1} \equiv \int_0^R 2\pi r\, dr \int_{z_n - \frac{1}{2}h_n - 1}^{z_n + \frac{1}{2}h_n} [\rho^{n^*}_k(r)][D^{-1}(r,z)][\rho^n_l(r)],$$

Benchmark 7: Guendelman and Radulovic, "Infrared Divergence in Three-Dimensional Gauge Theories" *Journal of the American Physical Society*, **30**, No 6, 15 Sept 1984, page 1347, Figure 13.



Benchmark 8: Hendrickson, Cram, and Hammond, *Organic Chemistry*, McGraw-Hill, 1970, page 1078, Figure 27-6, Ajmaline and Quinine.

Note: This benchmark is not finished. If you know how to do it; I'd appreciate the help, very much.



Ajmaline

Quinine

Benchmark 9: The following expressions.

$$f_{\underline{Z}}(\underline{Z}) \qquad f_{\underline{y}}(\underline{y}) \cdot e^{\alpha^{\beta}}$$

Benchmark 10: Place benchmark examples 1 through 9 in one file. See if pagination works and if the system has enough memory or stack to do the work.

In a sense, this document witnesses the success that this system has with this benchmark. A person who wants to try this test with more than one benchmark on a page can get the source to this document and adjust the preamble to eliminate the \newpage in the \newtest definition.