A brief introduction to

TEX and the *MathTime* Professional Fonts

Michael Spivak, March 2009

When Don Knuth created TEX, he provided the mathematical community with a way of typesetting material that contained formulas within the text, as well as "displayed" formulas, set out separately between lines of text. Formulas like

$$\sum_{i=1}^{n} a_i = a_1 + \cdots + a_n$$

became easy to produce, with TEX automatically determining the proper spacing between letters and symbols, the proper adjustments for subscripts and superscripts, and the proper positioning of symbols in constructions, while also allowing the author to introduce any desired alterations to the programmed choices.

Of course, having such automatic, yet easily modified, control over the positioning of symbols is only useful when one has some letters and symbols to position—one also needs to have some typefaces to work with in order to typeset text and mathematics.

At the time that TEX was first produced, just before PostScript printers became affordable and PostScript fonts became cheap and widely available, having typefaces to work with was no small order. Fonts for computer typesetting were mainly provided by the manufacturers of expensive typesetting equipment, and specifically designed for that equipment. So Knuth also produced a set of typefaces to be used with TEX, named the *Computer Modern* fonts. In addition to an array of typefaces for text, like the Computer Modern Roman and Computer Modern *Text Italic* used here, there were specialized fonts for all the math symbols, arranged in special ways to allow them to work with TEX.

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As soon as PostScript fonts could be used with TEX, many people switched their text from *Computer Modern* typefaces to other standard fonts, like the *Times* fonts that we've started using in this paragraph. (The difference can best be seen by ***printing*** this document, rather than by viewing it on the screen.) Of course, the choice of typeface is basically an aesthetic one, so that much of what we say from now on merely reflects different people's tastes.

The best way to get an impression of a typeface is simply to look at an entire page on which it is used. The *Annals* for the previous few years, up until Volume 170 (July 2009) are printed in *Computer Modern*, so almost any page gives a good idea of the general impression that this typeface makes. The strokes on the *Computer Modern* letters are quite thin, so that the page might seem to lack heft (or might seem to be particular elegant, depending on your preferences, and possibly on whether you are near-sighted or not). This is particularly true of the italics, so that statements of Theorems don't stand out, but seem to recede into the background.

THEOREM 1. *If your italics are dainty, your theorems won't seem so bold, no matter how significant their content may be.* [Computer Modern]

THEOREM 2. *If your italics are robust, then you can fool people into thinking they are significant, even if they're pretty trivial.* [Times]

PostScript gives one an enormous choice of fonts for text, but corresponding math fonts aren't provided, and a math formula like $z^n = x^n + y^n$, set in *Computer Modern*, doesn't match very well with a text font like *Times*. In addition, to get right down to my personal prejudices, the shapes of many of the *Computer Modern* symbols, especially the Greek letters, on the first line below, don't correspond to the shapes that I am used to, and prefer, on the second line:

$\partial\ \alpha\ \beta\ \gamma\ \delta\ \epsilon\ \zeta\ \eta\ \theta\ \iota\ \kappa\ \lambda\ \mu\ \nu\ \xi\ \pi\ \rho\ \sigma\ \tau\ \upsilon\ \phi\ \chi\ \psi\ \omega\ \varepsilon\ \vartheta\ \varpi\ \varrho\ \varsigma\ \varphi$

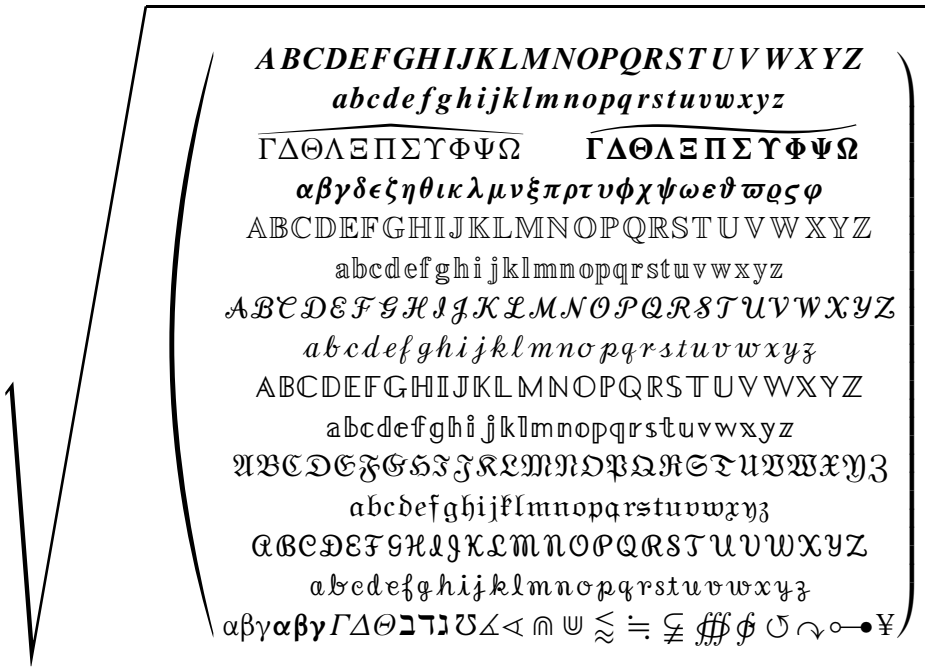
$\partial\ \alpha\ \beta\ \gamma\ \delta\ \epsilon\ \zeta\ \eta\ \theta\ \iota\ \kappa\ \lambda\ \mu\ \nu\ \xi\ \pi\ \rho\ \sigma\ \tau\ \upsilon\ \phi\ \chi\ \psi\ \omega\ \varepsilon\ \vartheta\ \varpi\ \varrho\ \varsigma\ \varphi$

So the original *MathTime* fonts were developed to be used along with *Times*, the most commonly used font, and fortunately turned out to work well with other classical fonts also. Later on *MathTime* turned professional (MTPro) when it was augmented with one of the most important, though subtle, classical features that Don Knuth provided in the design of his fonts. Notice the difference between

$$\alpha^{\beta^{\gamma\cdot\delta\cdot\phi}} \qquad \text{and} \qquad \alpha^{\beta^{\gamma\cdot\delta\cdot\phi}}.$$

The first, the sort of formula found in good old-fashioned typesetting, is easy to read. The second is not so easy to read, but it is alluringly easy to typeset in PostScript, because the β is simply a 70% reduction of β, and γ is likewise a reduction of γ, etc. In other words, the typefaces to be used in superscripts and second order superscripts should really be separate designs from the typeface for ordinary type, not just photo-reductions of it. The Design Size video at `http://pctex.com/MTPro2Videos.html` discusses this in greater detail.

In addition, although TEX can typeset virtually any formula, it does resort to some compromises. For example, instead of having very large parentheses, like the one on the left below from the MTPro fonts, it creates parentheses like the one on the right by adding tops and bottoms to straight segments. Similarly, the *Computer Modern* square root signs beyond a certain size no longer slope, and math "accents" are of limited width. In addition, basic TEX didn't provide some of the more specialized fonts, both extra symbols and additional alphabets, often used by mathematicians. So MTPro2 (the latest version of MTPro) has added these also, a small sample of which are shown below.



For many more examples and details see
`http://pctex.com/MTPro2Videos.html`