Typesetting with T_EX

Scientific typesetting made easy

T_EX (rhymes with "blecchhh!") is a technical typesetting system created by Donald Knuth of Stanford University. It is currently used by most physicists, mathematicians, and computer scientists, and many astronomers.

T_EX is capable of correctly typesetting complicated mathematical expresions, with proper alignment of all elements:

$$\nabla \cdot \vec{D} = \frac{\rho}{\epsilon} \qquad (1a)$$
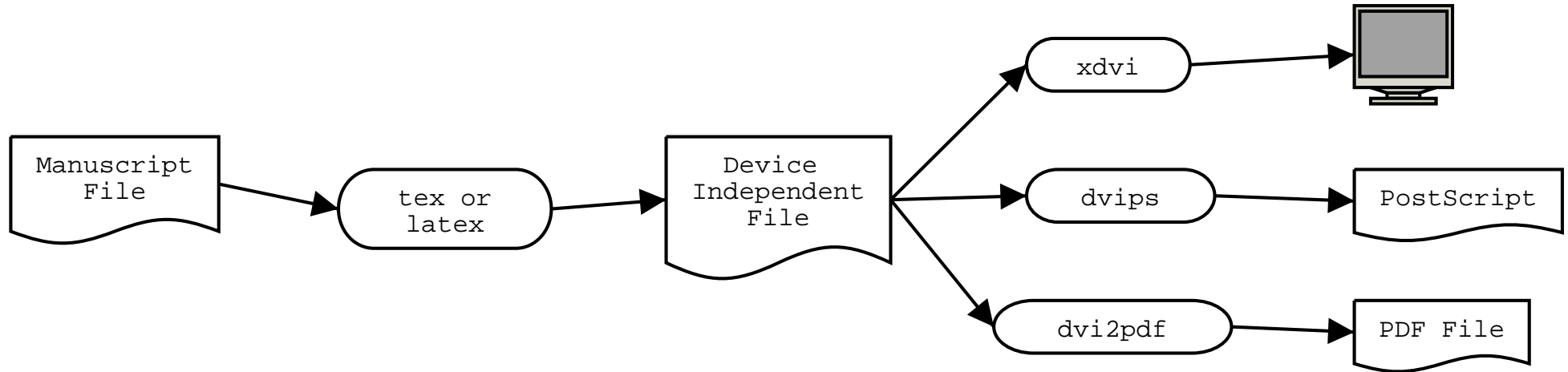
$$\nabla \cdot \vec{B} = 0 \qquad (1b)$$

$$\nabla \times \vec{E} = -\frac{1}{c}\frac{\partial \vec{B}}{\partial t} \qquad (1c)$$

$$\nabla \times \vec{H} = \frac{\partial \vec{D}}{\partial t} + \vec{J} \qquad (1d)$$

This is no mere "processing" of words.

The TeX Process

1. Text, equations, formatting instructions, etc.. are all entered into a "manuscript" file, `myfile.tex`.

2. This is run through `tex` or `latex` (the TeX "engine" and macros) to produce a Device Independent file, `myfile.dvi`

3. The DVI file is processed through an output filter. You can view it on the screen (with `xdvi`), convert it to a PostScript file `myfile.ps` (with `dvips`) or convert it to a PDF file `myfile.pdf` (with `dvi2pdf` or `dvips→ps2pdf`)

Typesetting: The Finer Points

Typesetting is more complex than word processing, but for regular text (no equations) typesetting is easy if you keep a few subtle points in mind:

- A new paragraph is signaled in TeX by a *blank line*. The entire paragraph is typeset at one time, with optimal line breaks chosen to make the entire paragraph look good.

- *Quotation marks* are more complicated: You should use left and right single quotes twice to get left and right quotation marks.

- Use a single dash for a short hyphen, "-", a double dash for a regular hyphen, "–", and a triple dash for a long hyphen "—".

- *Diacritical marks* are created with special control characters. For example, typeset the words "façade" and "coördinates" with `fa\c cade` and `co\"ordinates`.

Examples are shown in the file `story.tex`.

Symbols, Subscripts, Superscripts

Mathematics text is typeset differently. Variables are typeset in italics, with different spacing. Mathematics in the body of a text must therefore be enclosed in "math quotes", which are dollar signs, `$`.

Math symbols are indicated by a "control word" name, which begins with a backslash, (eg. `$\alpha$` and `$\Omega$` produce α and Ω).

Subscripts are indicated with an underscore `_`, while superscripts are indicated with a circumflex `^`. Grouping is indicated with curly brackets `{` and `}`.

- To get "$Y_l^m(\theta_1, \phi')$" you type:

  ```
  $Y_l^m(\theta_1,\phi^\prime)$
  ```

- To get "$G_{\mu\nu} = g_{\mu\nu} R + \frac{1}{4} R_{\mu\nu}$" type:

  ```
  $G_{\mu\nu} = g_{\mu\nu} R + {1 \over 4} R_{\mu\nu}$
  ```

Displayed Equations

Long equations, or important equations, are set off from the text as "displayed" equations. To get a displayed equation you double the math quotes. To get this:

$$
\langle \psi_1 | \psi_2 \rangle = \int_{-\infty}^{\infty} \frac{Y_l^m(\theta_1, \phi_1) \, Y_l^m(\theta_2, \phi_2)}{\sqrt{2\pi}} \, d\Omega
$$

you would type this:

```
$$
\langle \psi_1\vert \psi_2 \rangle =
        \int_{-\infty}^\infty {
    Y_l^m(\theta_1,\phi_1) Y_l^m(\theta_2,\phi_2)
    \over \sqrt{2\pi} } \, d\Omega
$$
```

Maxwell's Equations

$$\nabla \cdot \vec{D} = \frac{\rho}{\epsilon}$$

$$\nabla \cdot \vec{B} = 0$$

$$\nabla \times \vec{E} = -\frac{1}{c}\frac{\partial \vec{B}}{\partial t}$$

$$\nabla \times \vec{H} = \frac{\partial \vec{D}}{\partial t} + \vec{J}$$

Maxwell's equations, nicely aligned, are produced by typing:

```
$$
\eqalign{
   \nabla \cdot \vec D     &=   {\rho \over \epsilon}      \cr
   \nabla \cdot \vec B     &=   0                          \cr
   \nabla \times \vec E    &=
             - {1 \over c} {\partial \vec B \over \partial t} \cr
   \nabla \times \vec H    &= \phantom{-}
     {\partial \vec D \over \partial t} + \vec J \cr}
$$
```

Macro Definitions

T_EX is extendable by defining new control words as "macros". For example:

```
\def\Sph#1{Y_l^m(\theta_{#1},\phi_{#1})}
```

The argument `#1` is replaced with whatever argument you give to the macro. So you can produce

$$\langle \psi_1 | \psi_2 \rangle = \int_{-\infty}^{\infty} Y_l^m(\theta_1, \phi_1) Y_l^m(\theta_2, \phi_2)\, d\Omega$$

by typing:

```
$$
\langle \psi_1\vert \psi_2 \rangle =
        \int_{-\infty}^\infty \Sph{1} \Sph{2} \, d\Omega
$$
```

Large collections of pre-defined macros are called "formats". REVT_EX and T_EXsis are examples of special formats for physicists.

EPS Figures

Drawings and figures can be included in the document if they are in an "Encapsulated" PostScript file (ie, an `.eps` file).

- In Plain TeX you need to use the macro file `epsf.tex`, like so:

  ```
  \input epsf.tex
      ⋮
  \line{\epsfxsize=\hsize\epsfbox{TeX-Process.eps}}
  ```

- In LaTeX you use the "`graphix`" style package, like so:

  ```
  \usepackage{graphicx}
      ⋮
  \includegraphics[width=\columnwidth]{LAT96Fig2}
  ```

(There is a bit more to it if you also want captions, figure numbers, etc..., but not much. See the file `modlab.tex` for examples.)

Citations and References

A utility program called BIBTEX makes it easy to manage citations and references:

1. You collect one or more bibliography files (eg. `mylist.bib`) containing a list of fields (title, author, journal, etc..) for each work that you might wish to cite. Each item is identified by a unique 'key'. For example:

```
@book{Bevington1969,
          title = {Data Reduction and Error Analysis
                    for the Physical Sciences},
          author = {Philip R. Bevington},
          edition = {First},
          publisher = {McGraw Hill},
          year = {1969}
   }
```

2. In your text, when you wish to cite a work, you simply say `\cite{key}`. Each new work gets a new citation number.

3. At the end of the manuscript file you put

   `\bibliography{mylist}`

   This names the bibliography file (ie, `mylist.bib`) and it is also where the list of references will appear.

4. When you run TeX, the citations are added to an auxiliary file, `myfile.aux`. You then run the BIBTeX program, which collects the citations, selects the references from the bibliography file, and outputs the list of references as `myfile.bbl`.

5. When you run TeX again the list of references (in `myfile.bbl`) is inserted at the end of your document (where you put the `\bibliography`).

You only need to run BIBTeX again if you add, delete, or re-arrange references.

T_EX Distributions

- On Windows PC's you want to get MikT_EX, which collects together both the T_EX engine and all available macros, a DVI displayer, and `dvips`. Go to `www.miktex.org` to get it

  A good front-end is WinEDT.

- On MacOSX get T_EXShop for the front end, and `II2.dmg` for the T_EX engine and macros. [Better instructions on the web sometime soon.]

- On Linux T_EX has been packaged by Thomas Escher as teT_EX. This is the T_EX engine and macros, output filters (`xdvi`, `dvips`, etc.) and other tools.

  Use your favorite editor (`emacs`, `vi`, `nedit`) as the "front-end". These all come with Red Hat Linux.

  There is also a front-end system called Lyx.

T_EX for Physicists

- For LaT_EX there is a "class" of macros called REVT_EX which is used by the American Institute of Physics to typeset their journals (eg. *Physical Review*, *Physical Review Letters*, and *Reviews of Modern Physics*). Authors are encouraged to submit computer manuscripts using REVT_EX.

- For Plain T_EX the equivalent is T_EXsis (see `www.texsis.org`)

- For the Vassar Journal of Modern Physics there is a style file called `vjmp.sty`.