Introduction to LaTeX

December 5, 2006

1 Introduction

TeX looks more difficult than it is. It is almost as easy as π. See how easy it is to make special symbols such as α, β, γ, δ, $\sin x$, $\hbar$, λ, ... We also can make subscripts A_x, A_{xy} and superscripts, e^x, e^{x^2}, and e^{a^b}. We will use LaTeX, which is based on TeX and has many higher-level commands (macros) for formatting, making tables, etc. More information can be found in Ref. [1].

We just made a new paragraph. Extra lines and spaces make no difference. Note that all formulas are enclosed by $ and occur in *math mode*.

The default font is Computer Modern. It includes *italics*, **boldface**, *slanted*, and `monospaced` fonts.

2 Equations

Let us see how easy it is to write equations.

$$\Delta = \sum_{i=1}^{N} w_i (x_i - \bar{x})^2. \tag{1}$$

It is a good idea to number equations, but we can have a equation without a number by writing

$$P(x) = \frac{x-a}{b-a},$$

and

$$g = \frac{1}{2}\sqrt{2\pi}.$$

We can give an equation a label so that we can refer to it later.

$$E = -J \sum_{i=1}^{N} s_i s_{i+1}, \tag{2}$$

Equation (2) expresses the energy of a configuration of spins in the Ising model.[1]

We can define our own macros to save typing. For example, suppose that we introduce the macros:

```
\newcommand{\lb}{{\langle}}
\newcommand{\rb}{{\rangle}}
```

Then we can write the average value of x as

```
\begin{equation}
\lb x \rb = 3
\end{equation}
```

The result is

$$\lb x \rb = 3. \tag{3}$$

Examples of more complicated equations:

$$I = \int_{-\infty}^{\infty} f(x)\, dx. \tag{4}$$

We can do some fine tuning by adding small amounts of horizontal spacing:

```
\, small space        \! negative space
```

as is done in Eq. (4).

We also can align several equations:

$$a = b \tag{5}$$
$$c = d, \tag{6}$$

or number them as subequations:

$$a = b \tag{7a}$$
$$c = d. \tag{7b}$$

We can also have different cases:

$$m(T) = \begin{cases} 0 & T > T_c \\ \left(1 - [\sinh 2\beta J]^{-4}\right)^{1/8} & T < T_c \end{cases} \tag{8}$$

[1]It is necessary to process (typeset) a file twice to get the counters correct.

write matrices

$$\begin{aligned}\mathbf{T} &= \begin{pmatrix} T_{++} & T_{+-} \\ T_{-+} & T_{--} \end{pmatrix}, \\ &= \begin{pmatrix} e^{\beta(J+B)} & e^{-\beta J} \\ e^{-\beta J} & e^{\beta(J-B)} \end{pmatrix}. \end{aligned} \tag{9}$$

and

$$\sum_i \vec{A} \cdot \vec{B} = -P \int \mathbf{r} \cdot \hat{\mathbf{n}} \, dA = P \int \vec{\nabla} \cdot \mathbf{r} \, dV. \tag{10}$$

3 Tables

Tables are a little more difficult. TeX automatically calculates the width of the columns.

lattice	d	q	T_{mf}/T_c
square	2	4	1.763
triangular	2	6	1.648
diamond	3	4	1.479
simple cubic	3	6	1.330
bcc	3	8	1.260
fcc	3	12	1.225

Table 1: Comparison of the mean-field predictions for the critical temperature of the Ising model with exact results and the best known estimates for different spatial dimensions d and lattice symmetries.

4 Lists

Some example of formatted lists include the following:

1. bread
2. cheese

- Tom
- Dick

5 Figures

We can make figures bigger or smaller by scaling them. Figure 2 has been scaled by 60%.

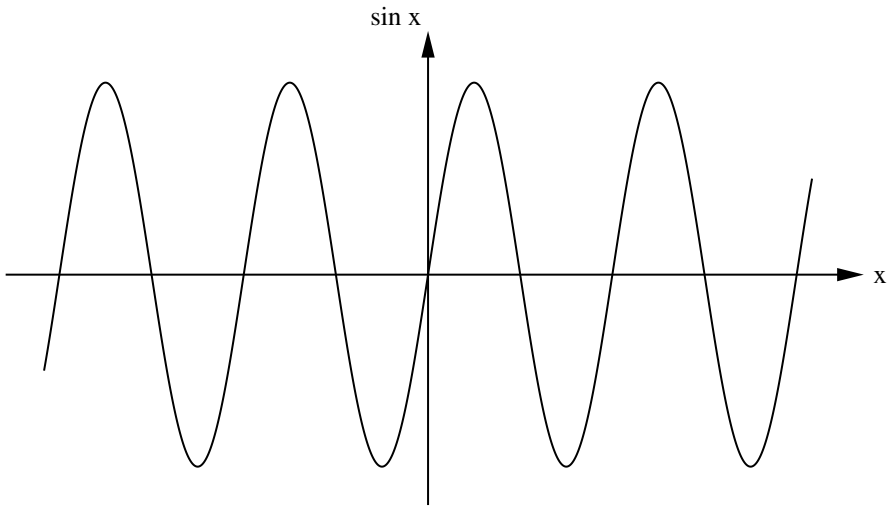


Figure 1: Show me a sine.

6 Literal text

It is desirable to print program code exactly as it is typed in a monospaced font. Use `\begin{verbatim}`and `\end{verbatim}`as in the following example:

```
double y0 = 10; // example of declaration and assignment statement
double v0 = 0;  // initial velocity
double t = 0;   // time
double dt = 0.01; // time step
double y = y0;
```

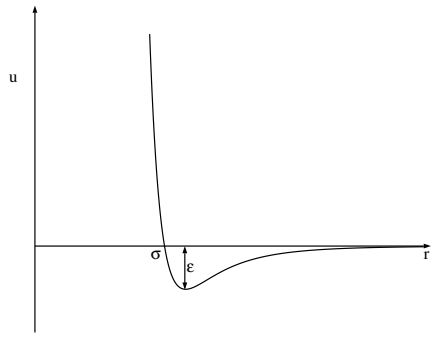


Figure 2: Plot of the Lennard-Jones potential $u(r)$. The potential is characterized by a length σ and an energy ϵ.

The command `\verbatiminput{programs/Square.java}\`allows you to list the file `Square.java` in the directory programs.

7 Special Symbols

7.1 Common Greek letters

These commands may be used only in math mode. Only the most common letters are included here.

$\alpha, \beta, \gamma, \Gamma, \delta, \Delta, \epsilon, \zeta, \eta, \theta, \Theta, \kappa, \lambda, \Lambda, \mu, \nu, \xi, \Xi, \pi, \Pi, \rho, \sigma, \tau, \phi, \Phi, \chi, \psi, \Psi, \omega, \Omega$

7.2 Special symbols

The derivative is defined as

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} \tag{11}$$

$$f(x) \to y \quad \text{as} \quad x \to x_0 \tag{12}$$

$$f(x) \underset{x \to x_0}{\longrightarrow} y \tag{13}$$

Order of magnitude:

$$\log_{10} f \simeq n \tag{14}$$

$$f(x) \sim 10^n \tag{15}$$

Approximate equality:

$$f(x) \simeq g(x) \tag{16}$$

LaTeX is simple if we keep everything in proportion:

$$f(x) \propto x^3. \tag{17}$$

Finally we can skip some space by using commands such as

`\bigskip` `\medskip` `\smallskip` `\vspace{1pc}`

The space can be negative.

8 Use of Color

We can change colors for emphasis, but who is going pay for the ink?

9 Subfigures

As soon as many students start becoming comfortable using LaTeX, they want to use some of its advanced features. So we now show how to place two figures side by side.

We first have to include the necessary package, `\usepackage{subfigure}`, which has to go in the preamble (before `\begin{document}`). It sometimes can be difficult to place a figure in the desired place.

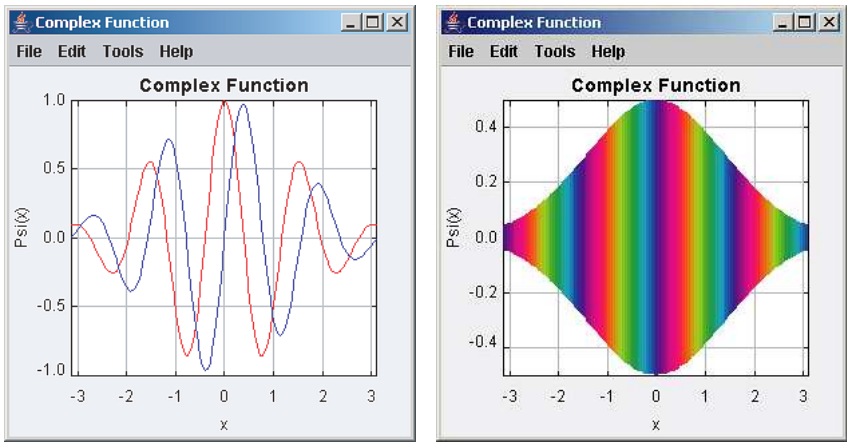
Your LaTeX document can be easily modified to make a poster or a screen presentation similar to (and better than) PowerPoint. Conversion to HTML is straightforward. Comments on this tutorial are appreciated.

References

[1] Helmut Kopka and Patrick W. Daly, *A Guide to LaTeX: Document Preparation for Beginners and Advanced Users*, fourth edition, Addison-Wesley (2004).

[2] Some useful links are given at `<http://sip.clarku.edu/tutorials/TeX/>`.

Updated 5 December 2006.



(a) Real and imaginary.

(b) Amplitude and phase.

Figure 3: Two representations of complex wave functions.