

## 1 Introduction

T<sub>E</sub>X looks more difficult than it is. It is almost as easy as  $\pi$ . See how easy it is to make special symbols such as  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\sin x$ ,  $\hbar$ ,  $\lambda$ ,  $\dots$ . We also can make subscripts  $A_x$ ,  $A_{xy}$  and superscripts,  $e^x$ ,  $e^{x^2}$ , and  $e^{a^b}$ . We will use L<sup>A</sup>T<sub>E</sub>X, which is based on T<sub>E</sub>X 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.

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

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.

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

Equation (2) expresses the energy of a configuration of spins in the Ising model.<sup>1</sup>

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

$$\langle x \rangle = 3. \quad (3)$$

Examples of more complicated equations:

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

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:

$$a = b \quad (5)$$

$$c = d, \quad (6)$$

or number them as subequations:

$$a = b \quad (7a)$$

$$c = d. \quad (7b)$$

We can also have different cases:

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

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<sup>1</sup>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	$d$	$q$	$T_{\text{mf}}/T_c$
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 ?? has been scaled by 60%.

## 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;
```

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

$$\frac{dy}{dx} = \lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x} \quad (11)$$

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

$$f(x) \xrightarrow{x \rightarrow x_0} y \quad (13)$$

Order of magnitude:

$$\log_{10} f \simeq n \quad (14)$$

$$f(x) \sim 10^n \quad (15)$$

Approximate equality:

$$f(x) \simeq g(x) \quad (16)$$

L<sup>A</sup>T<sub>E</sub>X is simple if we keep everything in proportion:

$$f(x) \propto x^3. \quad (17)$$

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 L<sup>A</sup>T<sub>E</sub>X, they want to use some of its advanced features. So we now show how to place two figures side by side.

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 L<sup>A</sup>T<sub>E</sub>X: Document Preparation for Beginners and Advanced Users*, fourth edition, Addison-Wesley (2004).
- [2] Some useful links are given at .

Updated 5 December 2006.