Introduction to LaTeX
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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. [**?**].

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

The default font is Computer Modern. It includes *italics* or *italics*, **boldface** or **boldface**, *slanted* or *slanted*, and `monospaced` or `monospaced` (typewriter) 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 usually a good idea to number equations, but we can have a equation without a number by writing

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

or

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

Note the different ways of writing a ratio.

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.[1]

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

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

```
\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

$$\langle x \rangle = 3. \tag{3}$$

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 (4).

We also can align several equations:

$$\begin{aligned} a &= b \qquad (5)\\ c &= d, \qquad (6) \end{aligned}$$

or number them as subequations:

$$\begin{aligned} a &= b \qquad (7a)\\ c &= d. \qquad (7b) \end{aligned}$$

We can also have different cases:

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

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 until you get the knack. 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 1 is an eps file with the bounding box already defined. Figure 2 has been scaled by 50%. It sometimes can be difficult to place the figures in the desired places.

Figure 1: Show me a sine.

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

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:

```
public void computeArea()
{
   this.area = this.length*this.length;
   System.out.println("Area = " + this.area);
}
```

The command `\verbatiminput{programs/Square.java}`\will allow 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.

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

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:

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

TEX is simple if we keep everything in proportion:

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

Finally we can skip some space by using a command 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?

References

[1] Helmut Kopka and Patrick W. Daly, *A Guide to LaTeX: Document Preparation for Beginners and Advanced Users*, third edition, Addison-Wesley (1999).