The Ultimate LaTeX Guide

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1 Introduction

1.1 Basic Commands

- **Bold** *Italic* <u>Underline</u>

1.2 Math

- $\frac{1}{2}$ $\sqrt{2}$ x^2 x_i

- $x_i = \frac{1}{2}$

1.3 Tables

Column 1	Column 2	Column 3
1	2	3
4	5	6

1.4 Figures

Figure 1: This is a scary figure. I advise running.

2 Mathematics

2.1 Subscripts and Superscripts

- Create a subscript with the _ character: x_i
- Create a superscript with the $^\wedge$ character: x^2
- You can also combine them: x_i^2

2.2 Brackets and Parentheses

- Round brackets: (function arguments)

$$\left(\frac{1}{2}\right)$$

- Square brackets: (vectors)

$$\left[\frac{1}{2}\right]$$

- Curly brackets: (sets)

$$\left\{\frac{1}{2}\right\}$$

- Absolute value: (absolute values)

$$\left|\frac{1}{2}\right|$$

- Floor: (floor function, i.e. rounding down)

$$\left\lfloor\frac{1}{2}\right\rfloor$$

- Ceiling (ceiling function, i.e. rounding up)

$$\left\lceil\frac{1}{2}\right\rceil$$

- Angle brackets: (inner product)

$$\left\langle\frac{1}{2}\right\rangle$$

- Double angle brackets: (outer product)

$$\left\langle\left\langle\frac{1}{2}\right\rangle\right\rangle$$

2.3   Matrices

- Plain: a matrix with no brackets

$$\begin{matrix} 1 & 2 \\ 3 & 4 \end{matrix}$$

- Parentheses: a matrix with round brackets

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

- Square brackets: a matrix with square brackets

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

- Curly brackets: a matrix with curly brackets

$$\begin{Bmatrix} 1 & 2 \\ 3 & 4 \end{Bmatrix}$$

- Absolute value: a matrix with absolute value brackets

$$\begin{vmatrix} 1 & 2 \\ 3 & 4 \end{vmatrix}$$

- Double absolute value: a matrix with double absolute value brackets

$$\begin{Vmatrix} 1 & 2 \\ 3 & 4 \end{Vmatrix}$$

2.4   Fractions and Binomials

- Binomials:

$$\binom{n}{k}$$

- Fractions with numbers:

$$\frac{1}{2}$$

- Fractions with text:

$$\frac{numerator}{denominator}$$

- Function arguments:

$$f(x) = \frac{f(x+h) - f(x)}{h}$$

- Nested fractions:

$$\frac{1}{1 + \frac{1}{x}}$$

- Fractions with subscripts:

$$\frac{x_i}{x_{i+1}}$$

- Overflow example:

$$a_0 + \cfrac{1}{a_1 + \cfrac{1}{a_2 + \cfrac{1}{a_3 + \ddots}}}$$

2.5 Aligning Equations

- Aligning equations with the `align` environment:

$$a = b \tag{1}$$
$$c = d \tag{2}$$

- Use the asterisk to align equations without numbers:

$$a = b$$
$$c = d$$

- Two columns:

$$a = b \qquad\qquad c = d$$
$$e = f \qquad\qquad g = h$$

- Lopsided:

$$\frac{1}{2} = a$$
$$= c$$

- Displaying large equations:

$$p(x) = 3x^6 + 14x^5 y + 590x^4 y^2 + 19x^3 y^3$$
$$+ 14x^2 y^4 + 3xy^5 + y^6 + 3x^5 + 14x^4 y + 19x^3 y^2$$

- Grouping equations:

$$a = b$$
$$c = a + b$$

2.6   Operators

- Summation: to calculate the sum of a series

$$\sum_{i=1}^{n} x_i$$

  the sum of x_i from $i = 1$ to $i = n$

- Product: to calculate the product of a series

$$\prod_{i=1}^{n} x_i$$

  the product of x_i from $i = 1$ to $i = n$

- Union:

$$\bigcup_{i=1}^{n} x_i$$

- Intersection:

$$\bigcap_{i=1}^{n} x_i$$

- Integral:

$$\int_{a}^{b} x$$

- Double integral:

$$\iint_{a}^{b} x$$

- Triple integral:

$$\iiint_{a}^{b} x$$

- Contour integral:

$$\oint_{a}^{b} x$$

- Limit:

$$\lim_{x \to 0} x$$

- Logarithm:

$$\log_2 x$$

- Derivative:

$$\frac{d}{dx} x$$

- Partial derivative:

$$\frac{\partial}{\partial x} x$$

2.6.1   The Simpler Quadratic Formula

$$m \pm \sqrt{m^2 - c} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$m = -\frac{b}{2a}$$

$$b = -(x + y)$$

$$c = x \cdot y$$

$$x^2 + 4x + 3 = 0$$

$$m = -\frac{b}{2} = -2$$

$$d = \sqrt{m^2 - c} = \sqrt{4 - 3} = \sqrt{1}$$

$$x, y = m \pm d = -2 \pm \sqrt{1} = -1, -3$$

old

$$x^2 + 4x + 3 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-4 \pm \sqrt{16 - 4 \cdot 1 \cdot 3}}{2}$$

$$x = \frac{-4 \pm \sqrt{4}}{2}$$

$$x = \frac{-4 \pm 2}{2}$$

$$x = -1, -3$$

$$x^2 - 10x + 6 = 0$$

$$m = -\frac{b}{2} = 5$$

$$d = \sqrt{m^2 - c} = \sqrt{25 - 6} = \sqrt{19}$$

$$x, y = m \pm d = 5 \pm \sqrt{19} = 5 \pm 4.3589 = 9.3589, 0.6411$$

$$x^2 - 6x + 10 = 0$$

$$m = -\frac{b}{2} = 3$$

$$d = \sqrt{m^2 - c} = \sqrt{9 - 10} = \sqrt{-1}$$

$$x, y = m \pm d = 3 \pm \sqrt{-1} = 3 \pm i$$

$$3x^2 - 5x + 2 = 0$$

$$x^2 - \frac{5}{3}x + \frac{2}{3} = 0 \qquad\qquad 6$$

$$m = -\frac{b}{2} = \frac{5}{6}$$

$$d = \sqrt{m^2 - c} = \sqrt{\frac{25}{36} - \frac{2}{3}} = \sqrt{\frac{1}{36}} = \frac{1}{6}$$

$$x, y = m \pm d = \frac{5}{6} \pm \frac{1}{6} = 1, \frac{2}{3}$$