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# THE BOOK

# L<sup>A</sup>T<sub>E</sub>X TEMPLATES

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# Preface

The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

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# Chapter 1

## The first chapter

### 1.1 The first section

LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents.

The unnumbered list

- item one
- item two
- item three

The numbered list

1. item one
2. item two
3. item three

#### 1.1.1 A sub section

LaTeX is not a word processor! Instead, LaTeX encourages authors not to worry too much about the appearance of their documents but to concentrate on getting the right content. For example consider this document:

$$\sin^2 \theta + \cos^2 \theta = 1. \tag{1.1}$$





## 1.2 The second section

LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents.

### 1.2.1 A sub section

LaTeX is not a word processor! Instead, LaTeX encourages authors not to worry too much about the appearance of their documents but to concentrate on getting the right content. LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents.

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**Definition 1.1.** *This is a definition environment.*

**Lemma 1.1.** *This is a lemma environment.*

**Theorem 1.1.** *This is a theorem environment.*

**Proposition 1.1.** *This is a proposition environment.*

**Lemma 1.2.** *This is a lemma environment*

(i) *item A*

(ii) *item B*

$$\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n = e. \quad (1.11)$$

**Theorem 1.2** (Mass–energy). *This is a theorem environment.*

*Proof.* This is a proof environment. □

**Remarks 1.1.** *This is a remark environment.*

**Example 1.1.** *This is example environment.*

The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

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### 1.3 The third section

LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents.

Here we state our main result as 1.3.

**Theorem 1.3** (*LDL<sup>T</sup> Factorization [2]*). *If  $A \in \mathbb{R}^{n \times n}$  is symmetric and the principal submatrix  $A(1 : k, 1 : k)$  is nonsingular for  $k = 1 : n - 1$ , then there exists a unit lower triangular matrix  $L$  and a diagonal matrix*

$$D = \text{diag}(d_1, \dots, d_n),$$

*such that  $A = LDL^T$ . The factorization is unique.*

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**Theorem 1.4** (Mean Value Theorem). *Suppose  $f$  is a function that is continuous on the closed interval  $[a, b]$ . and differentiable on the open interval  $(a, b)$ . Then there exists a number  $c$  such that  $a < c < b$  and*

$$f'(c) = \frac{f(b) - f(a)}{b - a}.$$

*In other words,*

$$f(b) - f(a) = f'(c)(b - a).$$

**Remarks 1.2.** *Observe that 1.3, 1.4 correctly mix references to multiple labels.*

**Corollary 1.1.** *Let  $f(x)$  be continuous and differentiable everywhere. If  $f(x)$  has at least two roots, then  $f'(x)$  must have at least one root.*

*Proof.* Let  $a$  and  $b$  be two distinct roots of  $f$ . By 1.4, there exists a number  $c$  such that

$$f'(c) = \frac{f(b) - f(a)}{b - a} = \frac{0 - 0}{b - a} = 0.$$

□

Note that it may require two L<sup>A</sup>T<sub>E</sub>X compilations for the proof marks to show.

Display matrices can be rendered using environments from **amsmath**:

$$S = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \quad \text{and} \quad C = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}. \quad (1.12)$$

Equation 1.12 shows some example matrices.

We calculate the Fréchet derivative of  $F$  as follows:

$$\begin{aligned} F'(U, V)(H, K) &= \langle R(U, V), H\Sigma V^T + U\Sigma K^T - P(H\Sigma V^T + U\Sigma K^T) \rangle \\ &= \langle R(U, V), H\Sigma V^T + U\Sigma K^T \rangle \end{aligned} \quad (1.13a)$$

$$= \langle R(U, V)V\Sigma^T, H \rangle + \langle \Sigma^T U^T R(U, V), K^T \rangle. \quad (1.13b)$$

1.13a is the first line, and 1.13b is the last line.

## 1.4 Algorithm

Our analysis leads to the algorithm in 1.

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### Algorithm 1 Build tree

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```

Define  $P := T := \{\{1\}, \dots, \{d\}\}$ 
while  $\#P > 1$  do
    Choose  $C' \in \mathcal{C}_p(P)$  with  $C' := \operatorname{argmin}_{C \in \mathcal{C}_p(P)} \varrho(C)$ 
    Find an optimal partition tree  $T_{C'}$ 
    Update  $P := (P \setminus C') \cup \{\bigcup_{t \in C'} t\}$ 
    Update  $T := T \cup \{\bigcup_{t \in \tau} t : \tau \in T_{C'} \setminus \mathcal{L}(T_{C'})\}$ 
end while
return  $T$ 

```

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# Chapter 2

## The second chapter

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### 2.1 Table Environment

Additional results are available in the supplement in Table 2.1.

Table 2.1: Numerical error

degree	step-size $h$	$L^2$ -errors	order	$H^1$ -errors	order	$L^\infty$ -errors	order
1	1/128	9.18E-06	2.02	7.70E-03	1.01	6.46E-07	2.02
	1/256	2.29E-06	2.01	1.92E-03	1.00	1.61E-07	2.01
	1/512	5.70E-07	2.00	9.56E-04	1.00	4.01E-08	2.00
2	1/128	1.39E-08	3.01	1.15E-05	2.01	3.48E-12	4.02
	1/256	1.73E-09	3.01	2.88E-06	2.01	3.27E-13	3.94
	1/512	2.17E-10	3.00	7.24E-06	2.00	6.66E-13	1.55
3	1/32	2.28E-09	4.05	6.92E-07	3.04	1.45E-15	8.21
	1/64	1.42E-10	4.03	8.65E-08	3.02	2.06E-14	3.85
	1/128	8.91E-12	4.01	1.08E-08	3.01	3.86E-14	0.91

Use the `tabularx` environment to generate Table 2.2.

Table 2.2: Table description

N	A	B	C	D	E
2	9.20E-05	9.90E-05	1.00E-06	8.00E-06	1.50E-05
4	9.80E-05	8.00E-05	7.00E-06	1.40E-05	1.60E-05
6	4.00E-06	8.10E-05	8.80E-05	2.00E-05	2.20E-05
8	8.50E-05	8.70E-05	1.90E-05	2.10E-05	3.00E-06
10	8.60E-05	9.30E-05	2.50E-05	2.00E-06	9.00E-06
12	1.70E-05	2.40E-05	7.60E-05	8.30E-05	9.00E-05

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## 2.2 Figure Environment

Figure 2.1 shows some example results.

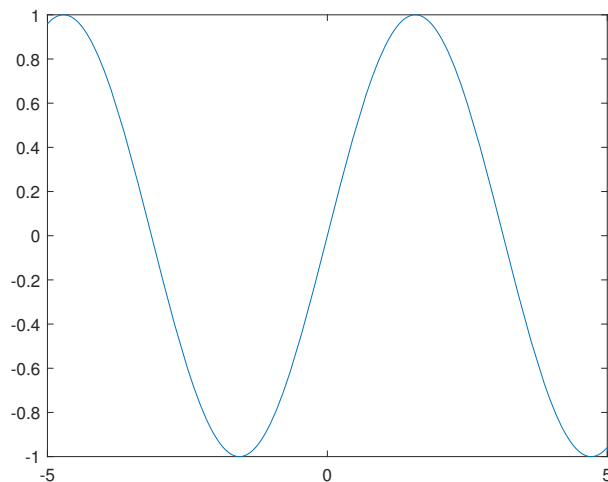


Figure 2.1: Example figure using external image files.

The two figures are placed side by side, sharing the one title, as shown in Figure 2.2.

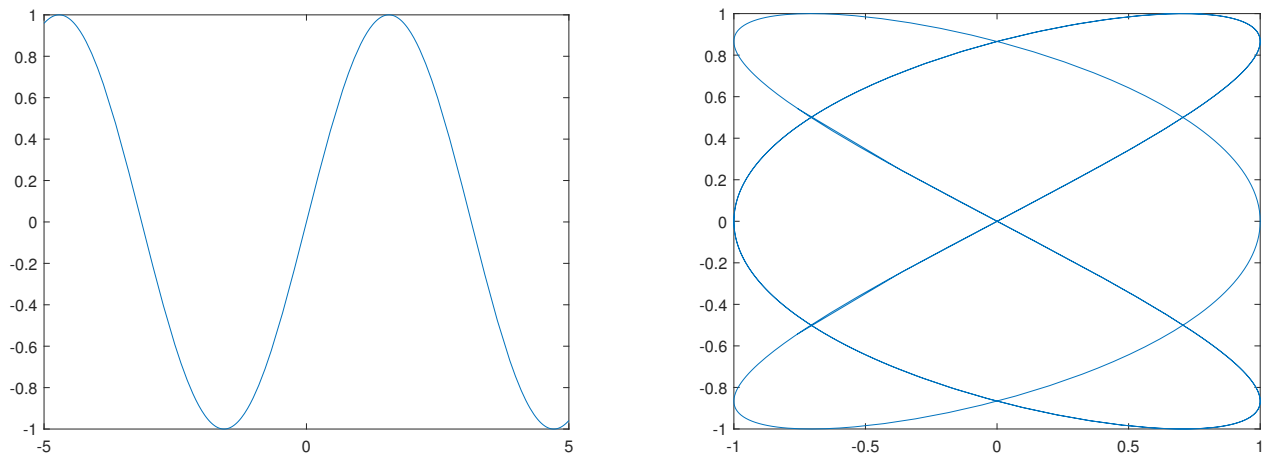


Figure 2.2: Left: Caption 1, Right: Caption 2.

Use `minipage` package to set images side-by-side, each with its own title, as shown in Figure 2.3 and Figure 2.4.

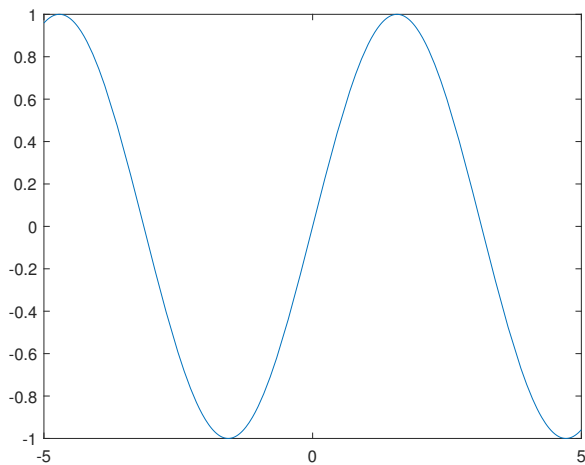


Figure 2.3: Caption A

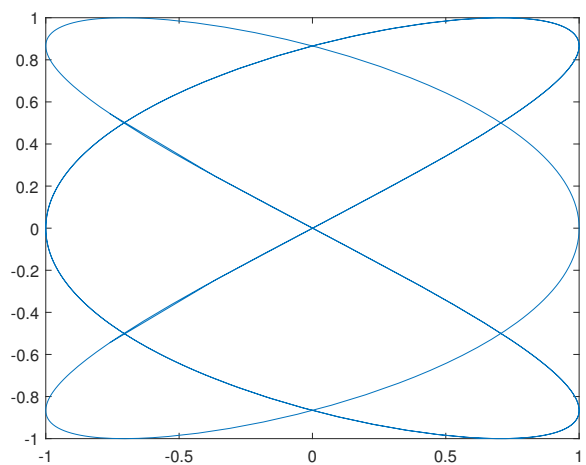


Figure 2.4: Caption B

## 2.3 Discussion of $Z = X \cup Y$

Some discussions here. Some discussions here. Some discussions here.

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# Appendix A

## This is the first appendix

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### A.1 A sub section

$$a^2 + b^2 = c^2. \tag{A.1}$$

**Lemma A.1.** *This is a lemma environment.*

This is Figure A.1.

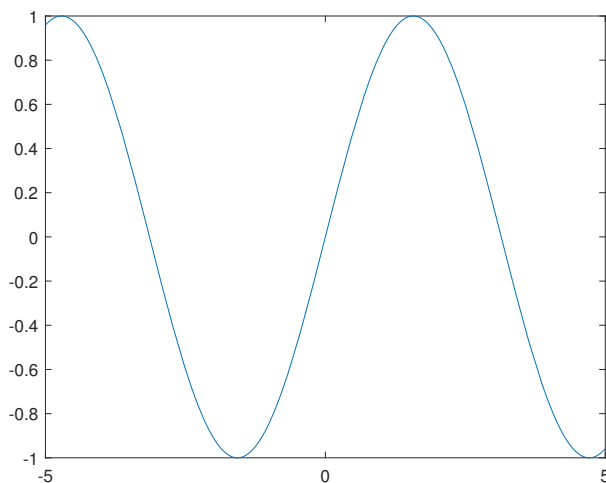


Figure A.1: Example figure using external image files.

Number	Age	Height	Weight
1	14	156	42
2	16	158	45
3	14	162	48
4	15	163	50
Mean	15	159.75	46.25

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# Appendix B

## This is the second appendix

### B.1 A sub section

The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.  
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### B.2 A sub section

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