An introduction to LaTeX
Sample Article

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Contents

Abstract

This is a simple introduction to **LaTeX**. This class is separated into 3 sections. Each section is presented in detail. Examples are given for all commands. Every student is expected to be able to write this document by the end of the seminar.

1 First section: Preliminaries

In the *first section* we shall give details regarding the installation of LaTeX. We will also cover basic text formatting.

Step 1 Show how to install LaTeX.

Step 2 Cover all the basic principles of text formating.

2 Second section: Mathematics

2.1 Calculus

Definition 2.1.1. In first-year calculus courses, we defined intervals such as (a, b) and (a, ∞). Such an interval is a *neighborhood* of u if u is in the interval. Students should not be confused by ∞. It is a symbol, not a number.

Definition 2.1.2. [6] A function $f(t)$ is *differentiable* at a point a if the limit

$$\lim_{h \to 0} \frac{f(a+h) - f(a)}{h} \tag{2.1.1}$$

exists. Then, the limit (2.1.1) is denoted by $f'(a)$ and is called the *derivative* of f at point a.

Example 2.1.1. Let $f(t) = t^2$. Then

$$\begin{aligned} f'(t) &= lim_{h\to 0}\frac{f(t+h)-f(t)}{h} \\ &= lim_{h\to 0}\frac{(t+h)^2-t^2}{h} \\ &= lim_{h\to 0}\frac{2ht+h^2}{h} \\ &= lim_{h\to 0}(2t+h) \\ &= 2t \end{aligned}$$

Below is a table of the basic properties of the Laplace Transform.

Property	f(t)	F(s)
Definition	f(t)	$\int_0^\infty f(t)e^{-st}dt$
Inverse	$\frac{1}{2\pi i}\int_{c-i\infty}^{c+i\infty} F(s)e^{-st}ds$	F(s)
Linearity	$c_1f_1(t) + c_2f_2(t)$	$c_1F_1(s) + c_2F_2(s)$

2.2 Algebra

Theorem 2.2.1. There are infinitely many prime numbers.

Proof. Start by assuming that the set of all primes is finite. The result will contradict this assumption. □

Theorem 2.2.2. [5] Let A be an $n \times n$ matrix. Then, A is invertible iff $\det A \neq 0$. In this case

$$\det(A^{-1}) = \frac{1}{\det A}$$

Definition 2.2.1. [5] Let A be an $n \times n$ matrix

$$A = \begin{pmatrix} a_{11} & \dots & a_{1n} \\ \vdots & \vdots & \vdots \\ a_{n1} & \dots & a_{nn} \end{pmatrix} \tag{2.2.1}$$

Its *characteristic polynomial* is defined as

$$p(\lambda) = det(\lambda I - A) \tag{2.2.2}$$

Theorem 2.2.3. [5] Every matrix A satisfies its characteristic polynomial (2.2.2), i.e. $p(A) = 0$

Theorem 2.2.3 is known as the Cayley-Hamilton Theorem and is one of the most important theorems in matrix algebra.

Lemma 2.2.1. [5] The power of a 3×3 matrix as shown below is given by

$$\begin{bmatrix} x & 1 & 0 \\ 0 & x & 1 \\ 0 & 0 & x \end{bmatrix}^n = \begin{bmatrix} x^n & \binom{n}{1}x^{n-1} & \binom{n}{2}x^{n-2} \\ 0 & x^n & \binom{n}{1}x^{n-1} \\ 0 & 0 & x^n \end{bmatrix} \tag{2.2.3}$$

A great book summarising matrix facts is The Matrix Cookbook

A matrix T(s) whose elements are polynomials is called a polynomial matrix. Let q be the highest degree among the degrees of the polynomial entries of T(s). Then we can write T(s) as

$$T(s) = T_q s^q + T_{q-1}s^{q-1} + \dots + T_1 s + T_0 \tag{2.2.4}$$

The number q is often called the *lag* of the matrix.

Example 2.2.1. Let T(s) be

$$T(s) = \begin{pmatrix} s^2+1 & 3 \\ s & s^2+2s \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} s^2 + \begin{pmatrix} 0 & 0 \\ 1 & 2 \end{pmatrix} s + \begin{pmatrix} 1 & 3 \\ 0 & 0 \end{pmatrix}$$

Obviously T(s) is in the form of (2.2.4), with

$$T_2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \quad T_1 = \begin{pmatrix} 0 & 0 \\ 1 & 2 \end{pmatrix} \quad T_0 = \begin{pmatrix} 1 & 3 \\ 0 & 0 \end{pmatrix}$$

3 Third section: Debugging, Bibliography, Greek text

In the *last section*, we will spend time discussing code errors.

Then we will give two methods for creating the bibliography:

1. Inside the text using \begin{thebibliography}.
2. Using Bibtex.

Lastly, we will see how we can type text in greek characters.

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