MATH1025/MATH2030:

Calculus and Matrix Methods

Introduction

This was prepared by Dr Steven Richardson, with some part slightly modified.

Unit Coordinator/Lecturer

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Unit Objectives[1]

1. Employ mathematical methods based on calculus and/or matrix theory to analyse mathematical models of real-world problems.
2. Understand and appreciate the power mathematics has in helping to find solutions of practical problems.
3. Communicate effectively with others.
4. Present results in a logical and coherent fashion.
5. Undertake continuous learning, aware that an understanding of fundamentals is necessary for effective application.

[1] Ref UWA Handbook 2008
http://units.handbooks.uwa.edu.au/units/math/math1025
http://units.handbooks.uwa.edu.au/units/math/math2030

Unit Content

This unit has five broad sections:

1. Matrices (including eigenvalues, eigenvectors and matrix applications)
2. Differential Calculus
3. Integral Calculus (including integration by parts and improper integrals)
4. Differential Equations (including systems of differential equations)
5. Multivariate Calculus (including partial derivatives and double integrals)

Prerequisites

- MATH1030 Calculus A or MATH1040 Calculus B
- Both TEE Calculus and TEE Applicable Mathematics

Incompatibility

- MATH1010 Calculus and Linear Algebra
- MATH1020 Calculus, Statistics and Probability
- MATH1025/MATH2030 Calculus and Matrix Methods

Learning Activities

- 4 Lectures per week (Monday, Tuesday, Thursday and Friday 8am in the Fox Lecture Hall). Lectures will be used to formally present the unit material.
- 1 Workshop per week (Wensday 8am in the Fox Lecture Hall). Workshops will be less formal, with content depending largely on student demand. As a default I will prepare practice problems for students to work on during the workshop session, however this may be replaced with a discussion of assignment questions and clarification of lecture material as required.

Assessment

1. End of Semester Examination worth 60%.
2. One mid-semester test worth 15% (April 8).
3. Three Assignments: totalling 15%.
4. 10 quizes: totalling 10% (every Thursday except for three weeks).

Unit Materials

- Some handouts and lecture slides.
- Further Reading: The content of this unit can be found in any introductory texts on Calculus, Matrices and Differential Equations. Examples are the three texts which have been nominated as references for this unit:

1. Greenwell, R. N., Ritchey, N.P. & Lial, M.L. (2003) *Calculus for the Life Sciences*. Addison Wesley, US.
2. Goode, S.W. & Annin, S.A. (2007) *Differential Equations and Linear Algebra (3rd ed.).* Pearson Prentice Hall, New Jersey, US.
3. Williamson, R. E., & Trotter H. F. (2004) *Multivariable Mathematics (4th ed.).* Pearson Prentice Hall, New Jersey, US.

What is required for success in this unit?

You are responsible for your own learning experience: My job is merely to facilitate your learning of the unit material. It is up to you to do the learning.
I recommend that:

- You attend all lectures and workshops, or at least keep up to date with reading the lecture slides to ensure that you can identify any difficulties you may be having quickly.
- You ensure that you understand how to do the assignment questions.
- If you are having difficulty with the unit material, **Get help early**. This will also provide me with feedback on what concepts I may need to elaborate on further in lectures.

Examples

Example 1. Matrices are used in almost every where of mathematics, industry and businesses. Here is an example in coding theory. Let

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$

Then G can be used to make a "good" code – a Hamming code.

Message	Encode G	Code word	Message	Encode G	Code word
0000	$\longrightarrow$	0000000	0110	$\longrightarrow$	0110010
0001	$\longrightarrow$	0001011	0101	$\longrightarrow$	0101110
0010	$\longrightarrow$	0010111	0011	$\longrightarrow$	0011100
0100	$\longrightarrow$	0100101	1110	$\longrightarrow$	1110100
1000	$\longrightarrow$	1000110	1101	$\longrightarrow$	1101000
1100	$\longrightarrow$	1100011	1011	$\longrightarrow$	1011010
1010	$\longrightarrow$	1010001	0111	$\longrightarrow$	0111001
1001	$\longrightarrow$	1001101	1111	$\longrightarrow$	1111111

This code can correct 3 errors, and detect 4. It is one of an infinity class of important codes discovered by Richard Hammaing 1948, which are the most widely used codes.