

ELEC9741

Electrical Engineering Data Science

Term 2, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Prof. Victor Solo	v.solo@unsw.edu.au			
Dr. Vidhyasaharan Sethu	v.sethu@unsw.edu.au			

School Contact Information

Consultations: Lecturer consultation times will be advised during the first lecture. ALL email enquiries should be made from your student email address with ELEC9741 in the subject line; otherwise, they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Student Support Enquiries

[For enrolment and progression enquiries please contact Student Services](#)

Web

[Electrical Engineering Homepage](#)

[Engineering Student Support Services](#)

[Engineering Industrial Training](#)

[UNSW Study Abroad and Exchange](#) (for inbound students)

[UNSW Future Students](#)

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

Email

[Engineering Student Support Services](#) – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

Course Details

Units of Credit 6

Summary of the Course

It is safe to say big data has become mainstream. Industry is forging ahead in the use of data mining to uncover patterns and information from massive datasets and reap the associated rewards. However, the challenges are not simply an increase in the size of datasets, but that of understanding the nature of the data being collected, the processes that underpin this data and the structure inherent in the data. In order to incorporate these aspects in the practice of data analyses, it is critical to bring techniques for signal analyses, filtering and dynamic modelling to bear on the problems and develop appropriate frameworks within which predictive systems can be engineered. These techniques from the fields of signal processing and control systems are traditionally learnt by Electrical Engineers and this course will give you a fairly unique perspective into the principles of Data Science from this perspective. In addition, in this course you will be able to apply your knowledge of signal processing, control, modelling, mathematics and computing to the practice of data modelling and machine learning.

Course Aims

Provide an introduction to Data Science principles and practice from a Control and a Signal Processing point of view.

Course Learning Outcomes

1. Suitably visualise data, applying fundamental principles of data visualisation to practice
2. Model data, including time-series data, by appropriately employing system identification techniques
3. Implement optimal linear filter models to analyse and process data
4. Design and implement suitable signal processing based feature extraction front-ends to machine learning systems
5. Demonstrate an understanding of linear and non-linear machine learning models and the algorithms underpinning their use
6. Deduce the behaviour of previously unseen prediction systems and hypothesise about their merits

Teaching Strategies

Lectures:

To give the basic material in written form, and to highlight the importance of different sections, and help with the formation of schema.

Assignments & Project:

To give practice in problem solving, and to assess your progress.

Examination:

Final test of competency.

Assessment

To pass, students must obtain a pass level in each part of the course

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Homework 1	15%	24/06/2022 04:00 PM	1, 2
2. Take Home Exam	35%	08/07/2022 04:00 PM	1, 2, 3
3. Homework 2	15%	Week 9	1, 4, 6
4. Take Home Exam	35%	Week 12	1, 5, 6

Assessment 1: Homework 1

Start date: 15/06/2022 12:00 PM

Due date: 24/06/2022 04:00 PM

Approximately 2 weeks, given at just past midpoint of first half of course

Assessment 2: Take Home Exam

Start date: 29/06/2022 10:00 PM

Due date: 08/07/2022 04:00 PM

Take home exam for first half of the course, given at end of first half.

Assessment 3: Homework 2

Start date: Week 7

Due date: Week 9

Approximately 2 weeks, given at just past midpoint of second half of course

Assessment 4: Take Home Exam

Start date: Week 10

Due date: Week 12

Take home exam for second half of the course, given at the end of the course (includes an oral presentation).

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

Part I Topics

Weekly Topic

1a Introduction to Data Science.

1b Matrix Methods Review:

emphasizing e.g. eigen-analysis.

2 Information Visualization: Principles & Practice.

3 Introduction to System Identification.

4 Stochastic Processes and Spectra in System Identification.

5 Kalman Filter, Wiener Filter.

Part II Topics

Weekly Topic

6a Introduction to Machine Learning.

6b Feature Representations:

e.g. speech and image features

7 Linear Methods for Regression and Classification.

8 Generative Models and Support Vector Machines.

9 Deep Learning.

10 Hardware and Software Considerations:

e.g. databases, toolboxes, GPUs, etc.

[View class timetable](#)

Timetable

Date	Type	Content
Week 1: 30 May - 3 June	Lecture	WED: Introduction to Data Science.
	Lecture	FRI: Matrix Methods Review (emphasizing e.g. eigen-analysis.)
Week 2: 6 June - 10 June	Lecture	Information Visualization: Principles & Practice.
Week 3: 13 June - 17 June	Lecture	Introduction to System Identification.
Week 4: 20 June - 24 June	Lecture	Stochastic Processes and Spectra in System Identification.
	Assessment	Homework 1
Week 5: 27 June - 1 July	Lecture	Kalman Filter, Wiener Filter.
Week 6: 4 July - 8 July	Lecture	WED: Introduction to Machine Learning.
	Lecture	FRI: Feature Representations (e.g. speech and image features).
	Assessment	Take Home Exam
Week 7: 11 July - 15 July	Lecture	Linear Methods for Regression and Classification.
Week 8: 18 July - 22 July	Lecture	Generative Models and Support Vector Machines.
Week 9: 25 July - 29 July	Lecture	Deep Learning.
	Assessment	Homework 2
Week 10: 1 August - 5 August	Lecture	Hardware and Software Considerations (e.g. databases, toolboxes, GPUs, etc.).
	Assessment	Second take-home exam released this week. Due in week 12.

Resources

Recommended Resources

Part 1

Software: Matlab & R

Textbook: None

Reference: R. Shumway & D. Stoffer (2011), Time Series Analysis and its Applications. 3rd. ed. Springer.

Part 2

Software: Matlab & Python

Textbook: None

Reference: (i) T. Hastie, R. Tibshirani, J. Friedman The Elements of Statistical Learning, 2nd ed. Springer (2009); (ii) R.O. Duda, D.G. Stork, P.E.Hart (2001), Pattern Classification 2nd.ed., J. Wiley.

Academic Honesty and Plagiarism

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see <https://student.unsw.edu.au/plagiarism>. To find out if you understand plagiarism correctly, try this short quiz: <https://student.unsw.edu.au/plagiarism-quiz>.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Academic Information

COVID19 - Important Health Related Notice

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by [NSW health](#) or government authorities. Current alerts and a list of hotspots can be found [here](#). **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the [Nucleus: Student Hub](#). If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for [special consideration](#) through the [Special Consideration portal](#). To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this [form](#).

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the [Safe Return to Campus](#) guide for students for more information on safe practices.

Dates to note

Important Dates available at: <https://student.unsw.edu.au/dates>

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see <https://student.unsw.edu.au/policy>), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both formal classes and *independent, self-directed study*. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the “fit to sit/submit” rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see <https://student.unsw.edu.au/special-consideration>.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:

<https://student.unsw.edu.au/guide>

<https://www.engineering.unsw.edu.au/electrical-engineering/resources>

Disclaimer

This Course Outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies:

Image Credit

Synergies in Sound 2016

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.