UNSW Course Outline

ZEIT8601 Applied Machine Learning - 2024

Published on the 27 Jun 2024

General Course Information

Course Code : ZEIT8601
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Systems and Computing
Delivery Mode : Online
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course will expose cyber security, decision analytics, space, project management, and systems engineering students to the experience of when and how to apply machine learning to solve different real-life problems. The students will master concepts such as learning from data,

feature selection, regression, classification, clustering, and modes of learning such as supervised vs. unsupervised learning and biases in machine learning. They will also be exposed to the similarities and differences when applying machine learning to different modalities, such as time series data, image processing, and text analytics. This course will be a hands-on course with a low to moderate technical level that suits students who are interested in applying machine learning. The students will be able to design AI solutions that utilise existing machine learning algorithms to solve real-life problems, and then evaluate the performance of these systems and analyse the potential of recommending these systems to the decision makers.

Course Aims

This course aims to teach students how to apply and evaluate machine learning algorithms and give them the skills required to apply tools of existing algorithmic variants to solve specific problems. Algorithms for supervised and unsupervised learning will be covered, including feature-based, text, and image data. Statistical methods for analysing the performance of algorithms will also be taught, as well as techniques for communicating results to stakeholders.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Recognise the different classes of machine learning and be able to select and apply the appropriate algorithm by using existing tools
CLO2 : Understand how data defines a problem and the choice of the algorithm used to solve the problem
CLO3 : Apply statistical techniques to evaluate or compare the performance of an algorithm for solving a problem
CLO4 : Be able to assemble findings from the evaluation of machine learning in a form appropriate to communicate to stakeholders

Course Learning Outcomes	Assessment Item
CLO1 : Recognise the different classes of machine learning and be able to select and apply the appropriate algorithm by using existing tools	• Online Test • Foundational Machine Learning Project • Advanced Machine Learning Project
CLO2 : Understand how data defines a problem and the choice of the algorithm used to solve the problem	• Online Test • Foundational Machine Learning Project • Advanced Machine Learning Project
CLO3 : Apply statistical techniques to evaluate or compare the performance of an algorithm for solving a problem	• Advanced Machine Learning Project
CLO4 : Be able to assemble findings from the evaluation of machine learning in a form appropriate to communicate to stakeholders	• Foundational Machine Learning Project • Advanced Machine Learning Project

Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate

Learning and Teaching in this course

The lecture notes are organized into modules to support a structured and scheduled study plan.

All course materials will be gradually released on the course's Moodle website. Lecture notes will be available on Moodle by the beginning of the week they are intended to be covered.

To get the most out of the course, students are encouraged to progressively read the lecture notes, textbooks, and any recommended readings. Additionally, completing the weekly hands-on activities will be essential for reinforcing the material and gaining practical experience, and being

able to complete the assignments.

There will be 1 hour of Q&A sessions every week that will be scheduled via Blackboard Collaborate. Attendance is not mandatory, but watching the recording is important to ensure unified understanding and information communication to all students.

The course Moodle site will include a Q&A forum. Students are encouraged to interact through the forum, and the lecturer will use it to answer questions throughout the course.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Online Test Assessment Format: Individual	10%	Start Date: 22/07/2024 12:00 AM Due Date: 22/07/2024 11:59 PM
Foundational Machine Learning Project Assessment Format: Individual Short Extension: Yes (2 days)	40%	Due Date: 23/08/2024 11:55 PM
Advanced Machine Learning Project Assessment Format: Individual Short Extension: Yes (2 days)	50%	Due Date: 22/10/2024 11:55 PM

Assessment Details

Online Test

Assessment Overview

Online test that covers the core concepts covered till the exam date

Course Learning Outcomes

- CLO1 : Recognise the different classes of machine learning and be able to select and apply the appropriate algorithm by using existing tools
- CLO2 : Understand how data defines a problem and the choice of the algorithm used to solve the problem

Detailed Assessment Description

More information will be provided later on the Moodle page

Foundational Machine Learning Project

Assessment Overview

The assessment includes completing a data exploration and visualisation task and developing

an ML model for a supervised ML task using tabular data. The student will submit their implementation, which will be accompanied by a report that summarises the findings.

Course Learning Outcomes

- CLO1 : Recognise the different classes of machine learning and be able to select and apply the appropriate algorithm by using existing tools
- CLO2 : Understand how data defines a problem and the choice of the algorithm used to solve the problem
- CLO4 : Be able to assemble findings from the evaluation of machine learning in a form appropriate to communicate to stakeholders

Detailed Assessment Description

More information will be provided later on the Moodle page

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Advanced Machine Learning Project

Assessment Overview

The student will need to handle different modalities using advanced ML models in this assessment. The deliverables will include the implementation of the model, a recorded presentation, and a report that assembles the findings.

Course Learning Outcomes

- CLO1 : Recognise the different classes of machine learning and be able to select and apply the appropriate algorithm by using existing tools
- CLO2 : Understand how data defines a problem and the choice of the algorithm used to solve the problem
- CLO3 : Apply statistical techniques to evaluate or compare the performance of an algorithm for solving a problem
- CLO4 : Be able to assemble findings from the evaluation of machine learning in a form appropriate to communicate to stakeholders

Detailed Assessment Description

More information will be provided later on the Moodle page

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

General Assessment Information

Late Submission of Assessment

- Unless prior arrangement is made with the lecturer or a formal application for special consideration is submitted, a penalty of 5% of the total available mark for the assessment will apply for each day that an assessment item is late up to a maximum of 5 days (120 hours) after which an assessment can no longer be submitted and a grade of 0 will be applied.
- Penalties for late submission apply from the original submission date, unless that date is formally varied by agreement. If a late submission is allowed, the extra time granted should be viewed solely as a grace period. To be clear, should the delayed date not be met, the penalty applies from the original date of submission, not from the end of the grace period.
- All requests for special consideration must be formally submitted via MyUNSW prior to the assessment due date.

Referencing

In this course, students are required to reference following the APA 6 / Chicago NB referencing style. Information about referencing is available at: Support for Referencing Assignments | UNSW Current Students

Grading Basis

Standard

Requirements to pass course

- All marks obtained for assessment items during the session are provisional. The final mark as published by the university following the assessment review group meeting is the only official mark.
- The overall passing mark is set at 50% by the university and this must not be varied.
- To pass the course, students must undertake the three assessments.
- As per school policy, the final marks in this course may be moderated. Your marks on assignments with feedback will be posted on Moodle.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Module	Introduction to Machine Learning Concepts • Overview of Machine Learning • Machine Learning Life Cycle • Introduction to Supervised Machine Learning Problems:
Week 2 : 22 July - 26 July	Module	Cont. Introduction to Machine Learning Concepts • Introduction to unsupervised learning Problems • Other Paradigms in Machine Learning
	Activity	Self-paced hands-on experience • Building your first workflows for data visualisation.
Week 3 : 29 July - 2 August	Module	Data Exploration and Visualization • Understanding Data Types and Sources • Exploratory Data Analysis (EDA) • Data Characteristics and Quality Assessment
	Activity	Self-paced hands-on experience • Hands-on exercises on extracting data characteristics (data distributions, correlations, and outliers) and creating various types of plots and visualisations to explore datasets.
Week 4 : 5 August - 9 August	Module	Data Preparation and Preprocessing • Data Cleaning and Preprocessing • Feature Engineering • Dimensionality Reduction • Data Transformation Techniques
	Activity	Self-paced hands-on experience • Data cleaning and handling missing values. • Utilising dimensionality reduction techniques.
Week 5 : 12 August - 16 August	Module	Introduction to Supervised ML Models • Decision Trees • Naïve Bayes • Support Vector Machine • Ensemble Learning
	Activity	Self-paced hands-on experience • Building and visualising decision trees to understand data splits and classifications. • Implementing Naive Bayes classifiers to handle different types of data. • Configuring SVM for classification tasks. • Analysing the performance improvements of ensemble models over single models.
Week 6 : 19 August - 23 August	Module	Introduction to Unsupervised ML • K-Means Clustering • C-Fuzzy Means Clustering: • Association Rules: • Recommender Systems
	Activity	Self-paced hands-on experience • Experiment with different 'K' values using the elbow method node to determine the optimal number of clusters. • Visualise clustering results using the scatter plot node. • Use the Apriori algorithm to identify frequent itemsets from transactional data.
Week 7 : 9 September - 13 September	Module	Neural Networks • Introduction to Neural Networks • Activation Functions • Loss Functions • Backpropagation • Introduction to Autoencoders
	Activity	Self-paced hands-on experience • Building and configuring a neural network. • Visualizing the network structure and tuning parameters

Week 8 : 16 September - 20 September	Module	Model Evaluation and Validation • Criteria for Choosing the Right Model • Understanding Models Assumptions and Limitations • Feature Selection • Evaluation Metrics • Validation Techniques • Statistical Techniques in Model Evaluation
	Activity	Self-paced hands-on experience • Create workflows to apply feature selection methods and compare model performances using different evaluation metrics. • Use statistical tests to compare models. • Visualize test results
Week 9 : 23 September - 27 September	Module	Time Series Analysis with Machine Learning • Introduction to Time Series Data • Preprocessing Time Series Data • Time Series Forecasting Models • Using ML models for Time series classification
	Activity	Self-paced hands-on experience • Preprocess time series data • Visualization of time series data and decomposition. • Classification of time series data
Week 10 : 30 September - 4 October	Module	Foundations of Deep Learning • Deep Neural Networks • Convolutional Neural Networks (CNNs): • Recurrent Neural Networks (RNNs) and LSTMs
	Activity	Self-paced hands-on experience • Building and training a CNN • Building and training RNN and LSTM
Week 11 : 7 October - 11 October	Module	• Unsupervised and Semi-Supervised Learning in Deep Learning: • Deep Autoencoders and Generative Adversarial Networks (GANs): • Self-supervised Learning: • Transfer Learning: • Deep Reinforcement Learning
	Activity	Self-paced hands-on experience • Create a basic GAN model • Training a GAN on a dataset and evaluating generated samples.
Week 12 : 14 October - 18 October	Module	Natural Language Processing (NLP) • Introduction to NLP • Classic ML for NLP • Modern NLP and Transformers
	Activity	Self-paced hands-on experience Text Preprocessing. Prompt Engineering for ChatGPT: • Develop prompts to effectively communicate with and guide the responses of ChatGPT for specific tasks. • Experiment with ChatGPT to understand the nuances of prompt design and response quality.
Week 13 : 21 October - 25 October	Module	Ethics and Society: The Impact and Responsibility of Machine Learning • Ethics and Machine Learning • Social Impact of Machine Learning • Privacy and Security in Machine Learning • Responsible AI Development
	Activity	Self-paced hands-on experience • Analyse datasets for potential biases. • Visualize data distributions to analyse societal inequalities.

Attendance Requirements

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

Course Resources

Prescribed Resources

The prescribed books below are ordered based on their suitability to non-technical audiences. The first book is the easiest to read and would suit all students regardless of their background, and provides a general idea about the different topics. The second book provides a moderate level of knowledge that suits readers who are interested in having a better understanding of the different topics and seeing some detailed examples. The third textbook is more advanced and suits students with strong math backgrounds who are interested in understanding the math behind the algorithms.

As the course audience is from different backgrounds, it is up to them to select the level of reading that suits their background and needs. The minimum weekly reading is detailed under the course weekly plan.

1. The Hundred-Page Machine Learning Book, by Andriy Burkov, 2019, ISBN: 978-1777005474.
2. Fundamentals of Machine Learning for Predictive Data Analytics, second edition: Algorithms, Worked Examples, and Case Studies (2nd edition), by John D. Kelleher et al.,2021, ISBN: 978-0262044691.
3. Applied Machine Learning, by M Gopal, 2019, ISBN: 978-1260456844

Course Evaluation and Development

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the "On-going Student Feedback" link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: *Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy*

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Heba El-Fiqi		Building 15 Room 204	+61 2 5114 5332	Tuesday 1-2 pm	Yes	Yes
Lecturer	Mo Hossny		Building 36 Room 103	02 5114 5363	Tuesday 4pm to 5pm	Yes	No

Other Useful Information

School-specific Information

The Leaning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:
• Google Chrome 50+
• Safari 10+
Internet Explorer is not recommended. Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:
• Windows 10,
• Mac OSX Sierra,
• iPad IOS10

Further details:
Moodle System Requirements
Moodle Log In

If you need further assistance with Moodle:

For enrolment and login issues please contact:

IT Service Centre

Email: itservicecentre@unsw.edu.au

Phone: (02) 9385-1333

International: +61 2 9385 1333

For all other Moodle issues please contact:

External TELT Support

Email: externalteltsupport@unsw.edu.au

Phone: (02) 9385-3331

International: +61 2 938 53331

Opening hours:

Monday – Friday 7:30am – 9:30 pm

Saturday & Sunday 8:30 am – 4:30pm

Study at UNSW Canberra

Study at UNSW Canberra has lots of useful information regarding:

• Where to get help

• Administrative matters

• Getting your passwords set up

• How to log on to Moodle

• Accessing the Library and other areas.

UNSW Canberra Student Hub

For News and Notices, Student Services and Support, Campus Comminity, Quick Links, Important Dates and Upcoming Events

School Contact Information

Deputy Head of School (Education): Dr Erandi Hene Kankanamge

E: e.henekankanamge@adfa.edu.au

T: 02 5114 5157

Syscom Admin Support: syscom@unsw.edu.au

T: 02 5114 5284

Syscom Admin Office: Building 15, Level 1, Room 101 (open 10am to 4pm, Mon to Fri)