



COMP8220

Machine Learning

Session 2, In person-scheduled-weekday, North Ryde 2023

School of Computing

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General Information

Unit convenor and teaching staff

Convenor and Lecturer

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Lecturer

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Credit points

10

Prerequisites

ITEC657 or COMP6200 or COMP8325

Corequisites

Co-badged status

Unit description

This unit begins with conventional machine learning techniques for constructing classifiers and regression models, including widely applicable standard techniques such as Naive Bayes, decision trees, logistic regression and support vector machines (SVMs); in this part, given required prior knowledge of machine learning, we focus on more advanced aspects. We then look in detail at deep learning and other state-of-the-art approaches. We discuss in detail the advantages and disadvantages of each method, in terms of computational requirements, ease of use, and performance, and we study the practical application of these methods in a number of use cases.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Derive algorithms to solve machine learning problems based on an understanding of how machine learning and data science problems are mathematically formulated and analysed.

ULO2: Create machine learning solutions to data science problems by identifying and applying appropriate algorithms and implementations.

ULO3: Analyse real-world data science problems, identify which methods are appropriate, organise the data appropriately, apply one or more methods, and evaluate the quality of the solution.

ULO4: Evaluate one or more approaches to advanced topics in machine learning and data science and report the findings in oral and written form.

General Assessment Information

Late Assessment Submission Penalty

From 1 July 2022, Students enrolled in Session based units with written assessments will have the following late penalty applied. Please see <https://students.mq.edu.au/study/assessment-exams/assessments> for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. Submission time for all written assessments is set at **11:55 pm**. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for [Special Consideration](#).

Assessments where Late Submissions will be accepted

In this unit, late submissions will be accepted as follows:

- Practical Exercises where the submission is a written report, notebook, etc – YES, Standard Late Penalty applies
- Practical Exercises where the submission is in the form of an online quiz - NO, unless Special Consideration is granted
- Major Project – YES, Standard Late Penalty applies
- Exam - NO, unless Special Consideration is granted

Assessment Tasks

Name	Weighting	Hurdle	Due
Practical Exercises	30%	No	throughout the semester
Major Project	40%	No	week 12

Name	Weighting	Hurdle	Due
Exam	30%	No	exam period

Practical Exercises

Assessment Type ¹: Problem set Indicative Time on Task ²: 30 hours Due: **throughout the semester** Weighting: **30%**

These will consist of practical exercises set throughout the semester.

On successful completion you will be able to:

- Derive algorithms to solve machine learning problems based on an understanding of how machine learning and data science problems are mathematically formulated and analysed.
- Create machine learning solutions to data science problems by identifying and applying appropriate algorithms and implementations.

Major Project

Assessment Type ¹: Project Indicative Time on Task ²: 30 hours Due: **week 13** Weighting: **40%**

The student will apply knowledge of conventional machine learning and deep learning to design and implement a solution to a (classification or other) task on a defined dataset. The deliverables will be the implementation and a report describing this implementation.

On successful completion you will be able to:

- Derive algorithms to solve machine learning problems based on an understanding of how machine learning and data science problems are mathematically formulated and analysed.
- Create machine learning solutions to data science problems by identifying and applying appropriate algorithms and implementations.
- Analyse real-world data science problems, identify which methods are appropriate, organise the data appropriately, apply one or more methods, and evaluate the quality of the solution.
- Evaluate one or more approaches to advanced topics in machine learning and data science and report the findings in oral and written form.

Exam

Assessment Type ¹: Examination Indicative Time on Task ²: 2 hours Due: **exam period**

Weighting: **30%**

The examination will require students to understand, apply, analyse and evaluate material drawn from the unit topics.

On successful completion you will be able to:

- Derive algorithms to solve machine learning problems based on an understanding of how machine learning and data science problems are mathematically formulated and analysed.
- Create machine learning solutions to data science problems by identifying and applying appropriate algorithms and implementations.
- Analyse real-world data science problems, identify which methods are appropriate, organise the data appropriately, apply one or more methods, and evaluate the quality of the solution.
- Evaluate one or more approaches to advanced topics in machine learning and data science and report the findings in oral and written form.

¹ If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the [Writing Centre](#) for academic skills support.

² Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Assessment Tasks

Name	Weighting	Hurdle	Due
Exam	30%	No	Exam period
Major Project	40%	No	Week 12
Practical Exercises	30%	No	throughout the semester

Exam

Assessment Type ¹: Examination

Indicative Time on Task ²: 2 hours

Due: **Exam period**

Weighting: **30%**

The examination will require students to understand, apply, analyse and evaluate material drawn from the unit topics.

On successful completion you will be able to:

- Derive algorithms to solve machine learning problems based on an understanding of how machine learning and data science problems are mathematically formulated and analysed.
- Create machine learning solutions to data science problems by identifying and applying appropriate algorithms and implementations.
- Analyse real-world data science problems, identify which methods are appropriate, organise the data appropriately, apply one or more methods, and evaluate the quality of the solution.
- Evaluate one or more approaches to advanced topics in machine learning and data science and report the findings in oral and written form.

Major Project

Assessment Type ¹: Project

Indicative Time on Task ²: 30 hours

Due: **Week 12**

Weighting: **40%**

The student will apply knowledge of conventional machine learning and deep learning to design and implement a solution to a (classification or other) task on a defined dataset. The deliverables will be the implementation and a report describing this implementation.

On successful completion you will be able to:

- Derive algorithms to solve machine learning problems based on an understanding of how machine learning and data science problems are mathematically formulated and

analysed.

- Create machine learning solutions to data science problems by identifying and applying appropriate algorithms and implementations.
- Analyse real-world data science problems, identify which methods are appropriate, organise the data appropriately, apply one or more methods, and evaluate the quality of the solution.
- Evaluate one or more approaches to advanced topics in machine learning and data science and report the findings in oral and written form.

Practical Exercises

Assessment Type ¹: Problem set

Indicative Time on Task ²: 30 hours

Due: **throughout the semester**

Weighting: **30%**

These will consist of practical exercises set throughout the semester.

On successful completion you will be able to:

- Derive algorithms to solve machine learning problems based on an understanding of how machine learning and data science problems are mathematically formulated and analysed.
- Create machine learning solutions to data science problems by identifying and applying appropriate algorithms and implementations.

¹ If you need help with your assignment, please contact:

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² Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Classes

- **Classes:** There will be a two hour lecture each week, and additionally a small class that

will focus on working through practical tasks.

- **Textbook:** The main textbook for the unit is Aurélien Géron (2019) "[Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow](#)" (2nd edition; September 2019). This is available through the MQ library (MQ has an arrangement with publisher O'Reilly: you can register at O'Reilly using your MQ email, and get access to the book there). The book comes with source code that is available from <https://github.com/ageron/handson-ml2>. A supplementary source of material for a deeper understanding of the theoretical material is Trevor Hastie, Robert Tibshirani and Jerome Friedman (2009; corrected 12th printing Jan 2017) "The Elements of Statistical Learning: Data Mining, Inference, and Prediction." A freely downloadable pdf is available at the [first author's webpage](#).

Background Material

- The unit requires a sound background in programming, and particularly Python. If you feel you need a refresher on Python (or an introduction from scratch, as long as you're a quick and independent learner), there's a popular tutorial at <http://learnpython.org/>. This goes all the way from basic programming to the mathematical and data science libraries used by Python, like numpy and pandas. There's also the resources at the Python website at python.org, like the [Beginner's Guide](#).
- For a refresher on linear algebra as it is relevant to machine learning, Jason Brownlee (2018) "Basics of Linear Algebra for Machine Learning" has useful material that's linked to Python data structures. (The book used to have a freely available pdf, but this seems to have disappeared. It is published by [Machine Learning Mastery](#).)

Unit Webpage and Technology Used and Required

- [iLearn](#) is going to be used as a main web server for the unit.
- The programming language for the unit will be Python. The "conventional" machine learning section will use Python's scikit-learn, and the deep learning section will use TensorFlow and Keras.
- For the most part, programming will be done via Jupyter notebooks. We'll typically be running these notebooks on [Google Colab](#).

Methods of Communication

We will communicate with you via your university email and through announcements on iLearn. Queries to convenors can either be placed on the iLearn discussion board or sent to the unit convenor via the contact email on iLearn.

COVID Information

For the latest information on the University's response to COVID-19, please refer to the Coronavirus infection page on the Macquarie website: <https://www.mq.edu.au/about/coronavirus-faqs>. Remember to check this page regularly in case the information and requirements change during semester. If there are any changes to this unit in relation to COVID, these will be communicated via iLearn..

Unit Schedule

Week	Topic	Readings (from Géron)
1	What is Machine Learning?	Ch 1
2	Workflow of a Machine Learning Project	Ch 2
3	Support Vector Machines and Decision Trees	Ch 3 - 6
4	Ensemble Learning, Random Forests, and Dimensionality Reduction	Ch 7 - 8
5	Handling Text Data	supplementary notes
6 - 7	Introduction to Artificial Neural Networks: <ul style="list-style-type: none"> • ANN basics • Multi-Layer Perceptrons • The Tensorflow and Keras frameworks 	Ch 10 - 11
8 - 9	Deep Neural Networks <ul style="list-style-type: none"> • The structure of deep NNs • Convolutional NNs • Practical issues in training NNs 	Ch 11 - 14, supplementary notes
10	NNs for sequences, and advanced topics: <ul style="list-style-type: none"> • Recurrent NNs • Autoencoders 	Ch 15 and onwards, supplementary notes
11	Transformers	Supplementary notes
12	Machine Learning and security/privacy	Supplementary notes
13	Unit review	

Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://policies.mq.edu.au\)](https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)

- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Assessment Procedure](#)
- [Complaints Resolution Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#)

Students seeking more policy resources can visit [Student Policies](https://students.mq.edu.au/support/study/policies) (<https://students.mq.edu.au/support/study/policies>). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit [Policy Central](https://policies.mq.edu.au) (<https://policies.mq.edu.au>) and use the [search tool](#).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/admin/other-resources/student-conduct>

Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe [academic integrity](#) – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free [online writing and maths support](#), [academic skills development](#) and [wellbeing consultations](#).

Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

The Writing Centre

[The Writing Centre](#) provides resources to develop your English language proficiency, academic writing, and communication skills.

- [Workshops](#)
- [Chat with a WriteWISE peer writing leader](#)
- [Access StudyWISE](#)

- [Upload an assignment to Studiosity](#)
- [Complete the Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

Student Services and Support

Macquarie University offers a range of [Student Support Services](#) including:

- [IT Support](#)
- [Accessibility and disability support](#) with study
- Mental health [support](#)
- [Safety support](#) to respond to bullying, harassment, sexual harassment and sexual assault
- [Social support including information about finances, tenancy and legal issues](#)
- [Student Advocacy](#) provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via [AskMQ](#), or contact [Service Connect](#).

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.