COMP8220

Machine Learning

Session 2, Special circumstance 2020

Department of Computing

Contents

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and ot her small group learning activities on campus for the second half-year, while keeping an online ver sion available for those students unable to return or those who choose to continue their studies onli ne.

To check the availability of face-to-face and onlin e activities for your unit, please go to timetable vi ewer. To check detailed information on unit asses sments visit your unit's iLearn space or consult yo ur unit convenor.

General Information

Unit convenor and teaching staff
Convenor
A/Prof Mark Dras
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by appointment

Lecturer
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Lecturer, Tutor
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Credit points
10

Prerequisites
ITEC657 or COMP6200

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 Submission

No extensions will be granted without an approved application for Special Consideration. There will be a deduction of 20% of the total available marks made from the total awarded mark for each 24 hour period or part thereof that the submission is late. For example, 25 hours late in submission for an assignment worth 10 marks – 40% penalty or 4 marks deducted from the total. No submission will be accepted after solutions have been posted.

Assessment Tasks

Name	Weighting	Hurdle	Due
Practical Exercises	30%	No	throughout the semester
Major Project	40%	No	week 8 (interim); week 13 (final)
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 8 (interim); week 13 (final)**
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]: 3 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.

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[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

Delivery and Resources

Classes

- **Classes**: Each week there will be two hours of lecture and one hour of practical sessions.
- **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. There's a free downloadable pdf available.

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.

Unit Schedule

Week	Topic	Readings (from Géron)
1-2	Machine Learning: Introduction and Review	Ch 1-4
3-4	"Conventional" Machine Learning • Key machine learning methods • Key techniques: Ensemble Learning, Random Forests, and Dimensionality Reduction	Ch 5-8
5-6	Enrichment Topics • Handling Text Data • Outlier and Anomaly Detection	supplementary notes
7-8	Introduction to Artificial Neural Networks: • ANN basics • Multi-Layer Perceptrons • The Tensorflow and Keras frameworks	Ch 10-11
9-10	Deep Neural Networks • The structure of deep NNs • Convolutional NNs • Practical issues in training NNs	Ch 11-14, supplementary notes

Week	Topic	Readings (from Géron)
11-12	NNs for sequences, and advanced topics: • Recurrent NNs • Autoencoders • Reinforcement Learning	Ch 15 and onwards
13	Review	

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). 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
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

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

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/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

Student Support

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

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- 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

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

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.