ADAPTIVE COMPUTATION AND MACHINE LEARNING (COMS4030A)

COURSE OUTLINE

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Semester I, 2022

1 Introduction and Course Description

Building systems that can adapt and learn from their environments has been a core area of research in the broader field of Artificial Intelligence and has thus attracted researchers from fields such as computer science, engineering, neuroscience, cognitive science and many other diverse fields. Machine learning has been a key enabler in building adaptive AI systems.

This course aims at providing a broad overview of machine learning principles such as supervised learning, unsupervised learning, reinforcement learning and adaptive learning. Applications of the above learning methods will be explored in fields such as object recognition, verbal and non verbal emotion recognition such as text/speech/facial expressions, etc.

2 Course aim

To provide a broad overview of the machine learning paradigms along with an in-depth review of specific learning algorithms in supervised, unsupervised, and reinforcement learning categories.

3 Course Learning Outcomes

By the end of the COMS4030A course, students should be able to:

- have a good understanding of fundamental concepts in machine learning and the challenges faced
- have an understanding of the strengths and weaknesses of popular machine learning algorithms along with their applicability in solving different problems
- be able to assess the use of different machine learning paradigms such as supervised, unsupervised and reinforcement learning;
- design and implement various machine learning algorithms for a range of applications

4 Course prerequisite

- Familiarity with Python programming
- Familiarity with basic linear algebra, calculus, Probability and statistics

5 Course breakdown

- Introduction to Machine Learning
- Supervised Learning
- Unsupervised Learning
- Semi-supervised Learning
- Computational Learning Theory
- Reinforcement Learning
- Introduction to Deep Learning

6 Prescribed Book

- Tom Mitchell, "Machine Learning" McGraw-Hill, 1997

7 References

- Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
- Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning", Springer, 2009
- Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016

8 Assessment Breakdown

A number of continuous assessments will be scheduled during the semester. A brief description of the type of assessments and their contribution towards the final mark is stated below. To pass the course, you **must** obtain at least 50% as your final year mark. Please refer to PG rules document for minimum requirements.

- **Class Test**: There will be **one** class test, weighted at a total of 20%.
- **Assignments**: There will be a two assignments weighted at a total of 20%. These assignments will contain theory questions (to be attempted in MSL labs) under invigilation and some take home questions that require some programming and insights gained by working on lab handouts.
- **Project**: There will be a group project weighted at 25%. A group may not have more than three members. In this project, you will be investigating practical aspects of machine learning to a problem that interests you. As part of this project, you will be required to do a presentation (no longer than 10 mins) and report your findings in a scientific paper format. Students who are willing to go an extra mile and submit these papers to conferences/journals will receive academic support beyond the course.
- **Final Examination**: Towards the end of the course a final exam will be conducted which will weigh 35% towards the final mark.

NOTE: All assessments will be held on-campus as per the directives from Faculty. Any changes to this format will be communicated well in advance.

The following table shows the dates and times associated with these assessment activities:

Event	**Date**	**Time**	**Venue**
Class Test	Friday, 8th April 2022	10:15 - 13:15	MSL
Assignments	18th March, 13th May 2022	10:15 - 13:15	MSL
Project	Friday, 3th June 2022	08:00 - 17:00	MSL

Note: Date and time for final written exam will be conveyed by Exams Office.

9 Course events

Event	**Day**	**Time**
Lecture/Lab	Friday	10:15 - 13:15
Consultations	Tuesday	12:15 - 14:15

Lectures will be a combination synchronous/asynchronous sessions. Links to all events will be posted on Wits learning management system Ulwazi. Tutors will be available during lab hours to assist you with the labs. All one-on-one consultation requests to be scheduled via Ulwazi and will be managed using google meet/MS teams.

10 Course policies

- Wits learning management system Ulwazi will be used for posting all the course related material and notices.
- Academic honesty should be upheld by all students. Any academic misconduct will be subjected to the academic misconduct procedures outlined by the university.

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[1]Any changes to the course outline will be communicated via the Wits learning management system Ulwazi. It is a student's responsibility to take note of the changes and act accordingly.