Course Overview

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COMP 4211: Machine Learning (Fall 2022)

https://course.cse.ust.hk/comp4211/

Course Design

- Machine learning is the science of making computer artifacts improve their performance by learning from data without requiring humans to program their behavior explicitly.
- This is an undergraduate-level introductory machine learning course designed for students with a solid computational and mathematical background.
- Students will learn the mathematical and computational principles underlying a variety of machine learning models and algorithms and will also gain hands-on experience by applying some of them to learn from data.

Background/Prerequisites Needed

- Computer science:
  - Object-oriented programming and data structures
  - Design and analysis of algorithms
- Mathematics:
  - Multivariable calculus
  - Linear algebra and matrix analysis
  - Probability and statistics
- Official course requirements:
  - Prerequisites: (COMP 2012 or COMP 2012H) and (ELEC 2600 or IEDA 2510 (prior to 2018-19) or IEDA 2520 or IEDA 2540 or ISOM 2500 or LIFS 3150 or MATH 2411 or MATH 2421 or MATH 2431)
  - Exclusions: COMP 4331, COMP 5212, ISOM 3360

Learning Outcomes

By the end of this course, students are expected to demonstrate competence in the following:

- Understanding of issues involved in learning from data and the major types of machine learning tasks;
- Ability to explain the principles underlying a variety of machine learning algorithms;
- Ability to apply a variety of machine learning algorithms to data;
- Ability to evaluate and compare the performance of different machine learning algorithms according to common performance criteria.

Major Topics

- Linear regression
- Logistic regression
- Feedforward neural networks
- Deep neural networks
- Convolutional neural networks
- Recurrent neural networks
- Principal component analysis
- Autoencoders
- Clustering
- Support vector machines
- Decision trees and random forests
- Reinforcement learning

Machine Learning Reference Books

- Ethem Alpaydin (2020). Introduction to Machine Learning. Fourth Edition. MIT Press. (HKUST Library call no: Q325.5 A46 2020; 3-day loan)
- Ian Goodfellow, Yoshua Bengio, and Aaron Courville (2016). Deep Learning. MIT Press. (HKUST Library call no: Q325.5 G66 2016) (also available online at `https://www.deeplearningbook.org/`)
- Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola (2022). Dive into Deep Learning.
  (latest version available online at `https://d2l.ai/d2l-en.pdf`)

Mathematics References

- A handy reference on matrices and multivariate distributions:
  The Matrix Cookbook (`https://archive.org/details/imm3274`)
- Online book:
  Mathematics for Machine Learning (`https://mml-book.github.io/`)

Assessment Tasks

- Quizzes (10%): iPRS
  (read student guide: `https://itsc.hkust.edu.hk/services/academic-teaching-support/teaching-tools/prs/iprs`)
- Programming assignments (25%):
  - Programming assignment 1: due week 4
  - Programming assignment 2: due week 7
- Problem set (10%): due week 10
- Project (20%): due week 12
- Final exam (35%): passing the exam is required for passing the course
- Students who attempt the bonus parts in PA1 and/or PA2 and receive reasonable scores are entitled to penalty-free late submission of the problem set and/or project by one day each.

Class Arrangements

- Lectures: face-to-face mode
- Tutorials: blended learning mode (read pre-tutorial materials before attending tutorials online via Zoom)
- Quizzes: iPRS in classroom
- Exam: physical exam held on campus

Software Tools

- Colab (`https://colab.research.google.com/`):
  - Supporting cloud-based Jupyter notebooks
- Python:
  - Quick reviews in LearnPython.org (`https://learnpython.org`) and DataCamp (`https://www.datacamp.com/courses-all`)
- Scikit-learn (`https://scikit-learn.org/`):
  - For PA1 and possibly also project
- TensorFlow/Keras (`https://www.tensorflow.org/`, `https://keras.io/`):
  - For PA2 and possibly also project

The HKUST Academic Honor Code

- Honesty and integrity are central to the academic work of HKUST. Students of the University must observe and uphold the highest standards of academic integrity and honesty in all the work they do throughout their program of study.
- As members of the University community, students have the responsibility to help maintain the academic reputation of HKUST in its academic endeavors.
- Sanctions will be imposed on students, if they are found to have violated the regulations governing academic integrity and honesty.

- **Also check:**
  - Academic Honor Code and Academic Integrity (`https://registry.hkust.edu.hk/resource-library/academic-honor-code-and-academic-integrity`)
  - Regulations for Student Conduct and Academic Integrity (`https://registry.hkust.edu.hk/resource-library/regulations-student-conduct-and-academic-integrity`)