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Course Outline
MATH/STAT 469/563: Machine Learning

Instructor(s)

Lecturer Xuekui Zhang, Associate Professor, Canada Research Chair, & MSFHR BC Scholar

Research Area [Statistical genomics, Bioinformatics, Bayesian Statistics, Machine Learning.]

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General Course Information

Number of Units 1.5

Pre-requisites STAT 353 + STAT260 + STAT261, or permission of the instructor

Class meets Every Mon & Thur 1-2:20 pm David Strong Building C128 (Jan 06 – Apr 04, 2025)

Course Introduction

Machine learning is a sub-field of both Computer Science and Statistical Science. The machines are a collection of statistical models with unknown parameters, and learning is the process of estimating the best values of model parameters from data. Statistical models give the computer system the ability to "learn" with data.

Data Scientist is currently rated as "the best job" by many media. Machine Learning is the top one skill of a data scientist (per LinkedIn https://www.linkedin.com/title/data-scientist). Given the needs of the job market and its wide application in many other research areas, I have developed this course to share with you my knowledge about machine learning.

This course is based on three sources, (1) the textbook, (2) what I learned from a Machine Learning course at UBC (CS540), and (3) my recent research or other related topics I am interested in.

To be successful in this course, I expect you to have sufficient statistical knowledge and programming skills in the R language (https://cran.r-project.org). Like CS540 offered at UBC, my machine learning course usually requires students to spend much more time than standard UVic courses.

If you need more info to decide whether or not this course is suitable for you, I suggest you quickly read a few chapters of the textbook to get the flavor.

This course is a terminal course, i.e. not a pre-requisite for any other courses.

Office Hours and Assistance

Office hours of instructor: tentatively 2:30-3:30 pm on each Monday (DTB A523 or A514)

Intended Course Learning Objectives

- Be able to apply machine learning algorithms to analyze real data and solve real-world problems (e.g. Kaggle competition problems)
- Develop other skills of working as a data scientist, e.g. preparing slides presentation and writing reports to present your results, and working in a team -- dividing problems into smaller portions and collaborating with your teammates.

Course Materials and Online Resources

Textbook

James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. *An introduction to statistical learning with Applications in R*. New York: Springer, 2013.

Reference

Trevor Hastie, Robert Tibshirani, Jerome Friedman. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer Series in Statistics, 2009

Murphy, Kevin P. *Machine learning, second edition: a probabilistic perspective.* MIT Press, 2021.

Murphy, Kevin P. *Machine learning: a probabilistic perspective.* MIT Press, 2012.

Christopher Bishop. *Pattern Recognition and Machine Learning.* Springer, 2006

Tentative Topics to Be Covered

- Introduction
- Linear Models for Regression and Classification
- Nonlinear Models for Regression and Classification
- Model comparison
- Ensemble learning
- Mixture Models and EM algorithms
- Clustering
- Dimension reduction and PCA
- Optimization

Evaluation and Grading

Your final percentage grade will be computed according to the following scheme.

Four Assignments Tentative due dates: 02/10, 02/24, 03/10,03/24	Midterm course project + Oral presentation Tentative exam date: 02/27	Final course project + PowerPoint slides presentation (no oral presentation) Tentative deadline: Apr 04, 2025
30%	30% + 10%	30%

You will be required to hand in all assigned problems by the deadline. To be fair to students who hand in the assignments on time, late assignments will receive a 10 percent penalty. If the solution is already posted, late assignments will not be accepted.

I will mark assignments and projects based on presentation AND content. If you work together as a team, I expect the collaborations to be fair in that everyone in a team puts real effort into doing the work. The size of the team should be no more than 3 persons. “Having less than 3 members” cannot be a reason to get bonus marks.

Missing work Regardless of the reason, there will be **neither make-up midterm course project nor Oral presentation**. If you miss a midterm or assignment due to illness, accident, or family affliction, you should notify me as soon as possible, and provide a written request to be excused. In such cases, your percentage allocation for a missed assignment will be divided evenly among those you did write; for a missed test, the percentage allocation will be added to your final exam and homework assignments, with the final exam worth no more than 60 percent. If you miss a midterm and the absence is not excused, zero marks will be awarded.

Academic concessions for term work are limited to work of value, totalling at most 50% of the course grade. Retroactive withdrawals are available to students who can provide their Associate Dean with documentation showing that an accident, illness, or affliction has prevented them from making a serious attempt at the course.

Accessibility Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL) as soon as possible. The CAL staff are available by appointment to assess specific needs, provide referrals, and arrange appropriate accommodations http://uvic.ca/cal. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

Grading Percentage scores will be converted to letter grades according to the university-wide standard table.

Undergraduate: http://web.uvic.ca/calendar/undergrad/info/regulations/grading.html
Graduate: http://web.uvic.ca/calendar/grad/academic-regulations/grading.html)

Supplemental Examinations. The Department of Mathematics and Statistics does not award ‘E’ grades or offer Supplemental Examinations in any of its courses.