ML 445/545 Machine Learning

Computer Science

	Description
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Credits	4/3

Course Description

Provides a broad introduction to techniques for building computer systems that learn from experience; conceptual grounding and practical experience with several learning systems; and grounding for advanced study in statistical learning methods, and for work with adaptive technologies used in speech and image processing, robotic planning and control, diagnostic systems, complex system modeling, and iterative optimization. Students gain practical experience implementing and evaluating systems applied to pattern recognition, prediction, and optimization problems.

Course Outcomes/Learning Objectives

Upon the successful completion of this class, students will be able to:

- Describe the main components of a machine learning system and the major classes of approaches to machine learning.
- Describe the overall algorithms and special techniques for several machine learning methods, including support vector machines, Bayesian learning, and unsupervised learning, as well as methods for dimensionality reduction.
- Explain the relative advantages and disadvantages of each of these methods, and list several potential areas of application for these methods.
- Design training sets and testing sets for machine learning tasks.
- Use several public domain machine learning tools.
- Design and run experiments that test the effectiveness of each of the methods listed above and write up the results of such experiments.

Course Prerequisites

We will use Python to create, train, and test ML models. We will provide a brief intro to Python and the libraries that we will use in the course but students are expected to be already familiar with a programming language to quickly pick up and code in Python.

Required Materials

The course does not have a required textbook. For reference to the math and programming concepts of the course, students can refer to the follow books:

- Hastie, Tibshirani, Friedman, "Elements of Statistical Learning".
- Raschka, "Python Machine Learning".

Students are expected to have access to a desktop or laptop computer to complete the required coursework. The computers in departmental labs are sufficient for this purpose for those students who do not have access to individual equipment.

All course material such as slides and code are available through Canvas.

Outline of Course Content

Some of the major topics discussed are as follows:

- Supervised Classification and Regression
- Evaluating Classifiers
- Computational Learning Theory
- Support Vector Machines
- Clustering
- Mixture Models
- Expectation Maximization
- Principal Component Analysis

Technology

Recording Technology Notice

We will use technology for virtual meetings and recordings in this course. Our use of such technology is governed by FERPA, the Acceptable Use Policy and PSU's Student Code of Conduct. A record of all meetings and recordings is kept and stored by PSU, in accordance with the Acceptable Use Policy and FERPA. I will not share recordings of your class activities outside of course participants, which include your fellow students, TAs/GAs/Mentors, and any guest

faculty or community-based learning partners that we may engage with. **You may not share recordings outside this course. Doing so may result in disciplinary action.**

Turnitin

Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of Turnitin.com page service is subject to the Usage Policy and Privacy Pledge posted on the Turnitin.com site.

Major Assignments

Assignments: There will be four homework assignments. These assignments will be based on the lecture material and may include coding assignments based on Python.

Exam: There will be a single exam.

Participation: Some weeks will include discussion assignments. There are two deadlines associated with a discussion assignment. By the first deadline, students are expected to independently answer a discussion question. By the second deadline, students are expected to reply to someone else's answer in their group. Discussion assignments are meant to encourage students to engage in classroom discussions and learn from each other, i.e., it is completely fine if your answers are incorrect every week.

Grading Criteria

This class is letter graded only. The weight for different class activities are:

Assignments: 40%

Exam: 30%

Participation: 30%

Flexibility Statement

The instructor reserves the right to modify course content and/or substitute assignments and learning activities in response to institutional, weather, or class situations.

Course Calendar / Schedule

The weekly activities can be summarized as follows:

- Week 1: Course Overview and Simple Linear Regression
- Week 2: Multi-Variable Linear-Regression
- Week 3: Model Order Selection and Cross Validation
- Week 4: LASSO Regularization
- Week 5: Logistic Regression
- Week 6: Non-Linear Optimization
- Week 7: Support Vector Machines
- Week 8: Neural Networks
- Week 9: Dimensionality Reduction and PCA
- Week 10: Clustering

PSU Policies and Resources

Academic Integrity

Academic integrity is a vital part of the educational experience at PSU. The Student Code of Conduct is the university's policy on academic dishonesty. A confirmed violation of that code in this course may result in failure of the course.

Student Services

Disability Access Statement

If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations. The DRC is at 116 Smith Memorial Student Union, 1825 SW Broadway; 503-725-4150; drc@pdx.edu.

Basic Needs at Portland State

It can be challenging to do your best in class if you have trouble meeting basic needs like safe shelter, sleep, and nutrition. Resource centers across campus are here to provide assistance, referrals, and support. Please contact anyone on this list for assistance:

- **Basic Needs Hub:** basicneedshub@pdx.edu
- **Portland State Food Pantry:** psufp.com or pantry@pdx.edu
- **C.A.R.E. Program:** askdos@pdx.edu, (503) 725-4422
- **Student Health & Counseling:** askshac@pdx.edu, (503) 725-2800

Understanding Sexual Misconduct

PSU desires to create a safe campus. As part of that mission, PSU requires all students to take the Understanding Sexual Misconduct and Resources learning module. If you or someone you

know has been harassed or assaulted, you can find the appropriate resources on PSU's Sexual Misconduct Response website.

Title IX Reporting

Students frequently come to me for assistance in matters not related to the course material. Please be aware that PSU's policies require instructors to report any instance of sexual harassment, sexual and relationship violence and/or other forms of prohibited discrimination to university officials, who will keep the information private. If you would rather share information about these matters with a PSU staff member who does not have these reporting responsibilities and can keep the information confidential, please use these campus resources:

- Confidential Advocates: 503-894-7982 or schedule online (for matters regarding sexual harassment and sexual and relationship violence)
- Center for Student Health and Counseling: 1880 SW 6th Avenue #200; 503-725-2800

Discrimination and Bias Incidents

The Office of Equity and Compliance (OEC) addresses complaints of discrimination, discriminatory Harassment, and sexual harassment against employees (faculty and staff). If you or someone you know believes they have been discriminated against, you may file a complaint. Someone from the OEC will contact you to discuss how to best address your complaint.

The Bias Review Team (BRT) gathers information on bias incidents that happen on and around campus, and gives resources and support to individuals who experience them. You can report a bias incident you experienced or learned about. A member of the BRT will contact you if you indicate you would like to be contacted.

Religious Accommodations

If you would like to obtain religious accommodations, such as flexibility in attending evening courses or extension on assignments, please contact your instructors. If you need additional assistance, please contact the Office of the Dean of Student Life (DOSL) by emailing askdos@pdx.edu.

Cultural Resource Centers

Cultural Resource Centers (CRCs) create a student-centered inclusive environment that enriches the university experience. They honor diversity, explore social justice issues, celebrate cultural traditions, and foster student identities, success, and leadership. They provide opportunities for student leadership, employment, and volunteering; student resources such as computer labs, event, lounge, and study spaces; and extensive programming. All are welcome!

- Multicultural Student Center
- La Casa Latina Student Center
- Native American Student and Community Center
- Pan African Commons
- Pacific Islander, Asian, and Asian American Student Center
- Middle East, North Africa, South Asia Initiative

COVID-19 Response

The University has established rules and policies to make the return to the classroom as safe as possible. To learn about Portland State's activities to reduce the spread of COVID-19, visit PSU's COVID-19 Response page.

If you need advice on testing and/or quarantine, visit The Center for Student Health and Counseling (SHAC)'s COVID-19 FAQ page or call 503-725-2800.

Also, please notify me (i.e. your instructor), should you need to miss a class period for any of these reasons so that we can discuss strategies to support your learning during this time. If I become ill or need to quarantine during the term, either I or the department chair will notify you via PSU email about my absence and how course instruction will continue.

Failure to Comply with Any of these Rules

As the instructor of this course, the University has given me the authority to require your compliance with these policies. If you do not comply with these requirements, I may ask you to leave the classroom, or I may need to cancel the class session entirely.

In addition, failure to comply with these requirements may result in a referral to the Office of the Dean of Student Life to consider charges under PSU's Code of Conduct. A student found to have violated a university rule (or rules) through the due process of student conduct might face disciplinary and educational sanctions (or consequences). For a complete list of sanctions, see Section 14 of the Student Code of Conduct & Responsibility.

Guidance May Change

Please note that the University rules, policies, and guidance may change at any time at the direction of the CDC, State, or County requirements. Please review the University's main COVID-19 Response webpage and look for emails from the University on these topics.