Western University Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 9039: Machine Learning: From Theory to Applications
Outline 2017-18

Description: The objective of this course is to introduce students to Machine Learning techniques based on a unified, probabilistic approach. Regression, classification, clustering, neural networks, mixture models, ensemble methods, and structure prediction will be covered in this course. Students will get hands-on experience with machine learning from a series of practical engineering case-studies.

Instructor: Dr. Abdallah Shami, P.Eng
TEB 337, Abdallah.Shami@uwo.ca
Consultation Hours: TBA

Prerequisite(s): Knowledge of statistics, calculus, and linear algebra is required as well as strong programming skills.

Recommended References:

- Machine learning: a probabilistic perspective, Kevin P. Murphy, MIT press, 2012, ISBN: 9780262018029.
- Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, ISBN-10: 0387310738
- James, G., Witten, D., Hastie, T., & Tibshirani, R. An introduction to statistical learning with applications in R. New York: Springer, 2013.
- MacKay, David JC. Information theory, inference and learning algorithms. Cambridge university press, 2003.
- Class Notes

Major Topics:

- Introduction to Machine Learning
- Probability Theory Review
  - Basic Probability Concepts
  - Probability Density Functions
  - Estimations
- Optimization Overview
- Supervised Learning
  - Regression
  - Classification
- Unsupervised Learning
  - Clustering
- Machine Learning Process:
  - Feature selection
  - Algorithms Evaluation
    - Variance: Test set, cross-validation, bootstrap
    - Bias: Confounding, causal inference
  - Performance Measures

- Reinforcement Learning and Sequential Decision Making
- Machine Learning Use Cases:
    - Network Security
    - Network Function Virtualization
    - Cloud Computing (i.e., Resources Provisioning)
    - Smart Grid Systems

SPECIFIC LEARNING OBJECTIVES:
At the end of the course, the students will be able to:

- Have a good understanding of the fundamental issues and challenges of machine learning: data, features selection, model selection, and model complexity.
- Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
- Understand the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervised learning.
- Be able to design and implement various machine learning algorithms in a range of real-world engineering applications.

CONTACT HOURS:
3 lecture hours/week

EVALUATION:

Course Component	Weight
Homework Assignments	20%
Exam	30%
Project (Proposal, Presentation, Code, and Final Report)	50%

Homework Assignments: There will be ~ 4 assignments. All homework assignments have equal weights. Homework assignments will involve heavy programming. Python programming language will be used in this course.

Project & Homework Assignments Code: The students' project and assignments software will be released under Apache License Version 2.0. Apache License Version 2.0 details are available at https://www.apache.org/licenses/

Attendance: Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Late Submission Policy: Assignments should be submitted by **5:00 pm** on the specified due date. Late assignment submissions will be penalized 20% per day.

Cheating and Plagiarism: Students must write their essays and assignments in their own words.

Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com).