Université d'Ottawa
Faculté de génie

École de science informatique
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University of Ottawa
Faculty of Engineering

School of Electrical Engineering
and Computer Science

Tentative Syllabus ELG5255

Applied Machine Learning

Fall 2020

Instructor:

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Course Schedule:

LEC 10 Sep. 2020-3 Dec.2020 Thursday, 2:30-5:20

Location and the mode of online lectures: The online lectures will follow a hybrid mode. Microsoft Teams Link will be provided prior to each lecture when a lecture is going to be live. When a lecture is live, for students who join from different time zones, key aspects of the lectures will be recorded by the professor. To respect everyone's privacy, only the parts covered by the professor will be recorded. Lecture notes as well as student presentations (slides) will also be posted to Brightspace. Depending on the content to be covered, some of the lectures will be asynchronous (not live) but they will be announced ahead of time.

Class attendance is mandatory. As per academic regulations, students who do not attend 80% of the class will not be allowed to write the final examinations. Attendance will be evaluated based on the delivered graded material and in-class presentations.

All components of the course must be fulfilled; otherwise students may receive an INC as a final mark (equivalent to an F).

Calendar Style Description:

Supervised learning; Bayesian decision theory; parametric methods; multivariate analysis; multilayer perceptrons; clustering; hidden Markov models; ensemble learning; kernel machines; graphical models; and statistical testing.

Description

This course aims at teaching the theory and applications of machine learning by using techniques that utilize statistics, neural computation and information theory. More specifically theory of machine learning will include supervised learning, Bayesian estimation, clustering and unsupervised learning, multivariate, parametric and non-parametric methods, kernel machines, hidden markov models, multilayer perceptron networks and deep neural networks, ensemble learning and reinforcement learning. The applied content of the course will teach designing and testing machine intelligence techniques on real-world problems. Students will be introduced the guidelines for machine learning

experiments, methods for cross-validation and resampling, classifier performance analysis and tools for comparing classification algorithms and analysis of variance to compare multiple algorithms.

Prerequisite:

No official prerequisites are required. However, students are expected to have sufficient knowledge in Probability and Statistics for Engineers

Academic Integrity is expected from all students participating in this course and academic fraud will not be tolerated. All students should be familiar with the University of Ottawa Academic Integrity WEB site at http://web5.uottawa.ca/mcs-smc/academicintegrity/home.php Students must familiarize themselves with the codes for academic integrity. Plagiarism and/or any type of academic misconduct will not be tolerated. Please note that every submitted component must be students' original work including figures and tables used in the reports.

Course Objectives

By the end of the course, students:

- how to use theory and application of machine learning to real life problems
- how to address high dimensionality challenges when working on big data sets
- how/when to apply supervised learning methods
- how/when to apply clustering methods
- how to design machine learning experiments for performance testing
- how to use methods and tools for resampling, methodology comparison and cross validation

Topics aimed by this course:

- Introduction to Machine Intelligence and Supervised Learning
- Supervised Learning
- Bayesian Decision Theory
- Parametric and multivariate methods
- Dimensionality reduction, clustering
- Multilayer perceptrons
- Local models
- Kernel Machines
- Hidden Markov Models, Graphical models
- Graphical models, ensemble learning
- Machine learning experiment design and analysis

Text

- *E. Alpaydin, "Introduction to Machine Learning," MIT Press, 2015, 3rd ed, ISBN 8120350782*
- *R. F. Mello, M. A. Ponti; "Machine Learning: A Practical Approach on the Statistical Learning Theory" Springer, ISBN 3319949888*
- *M. Kubat, "An Introduction to Machine Learning," Springer, August 2017, ISBN: 9783319639130*
- *In addition to textbooks, contemporary reading is an integral part of this course*
  - *IEEE Transactions on Artificial Intelligence*
  - *Elsevier Engineering Applications of Artificial Intelligence*
  - *ACM Computing Surveys*
  - *IEEE Transactions on Big Data*
  - *IEEE Transactions on Parallel and Distributed Systems*
  - *IEEE Transactions on Services Computing*
  - *IEEE Transactions on Computers*
  - *IEEE Access*
  - *ACM Transactions on Computer Systems*
  - *Elsevier Pattern Recognition Letters*

- *…and many more….*

Term Project: The project will have three phases: 1) Proposal and presentation of the state of the art (in writing and brief 10 minute presentation), 2) Presentation of project outcomes, 3) Final report. Students will be grouped in groups of three; however their individual performance will be evaluated in all phases. In all reports, all members have to clearly indicate the contributions of each team member, and the reports have to be signed by all project members

Quizzes: 5 online quizzes will be given on Brightspace; each will contribute to 5% of your final grade. No make up quizzes will be given. No exceptions will be made for missed quizzes. For each quiz component, considering the students in different time zones, two quiz sessions will be prepared. Group-A will start at the beginning of the class time slot (i.e., 2:30pm EST/EDT) whereas the one for Group-B will start at 9pm EST/EDT. For each Quiz (say *Quiz-i*), students will be allowed to take *Quiz-i* for either of the groups but once *Quiz-i* in one group has been attempted to be taken, the student will not be allowed to take the quiz for the other group. However, a student can take *Quiz-i* in one group and *Quiz-j* in another group.
Further explanations to be given on September 10th if needed.

Midterm: Midterm consists of design and analysis questions. The online midterm will take place during the class time. The same practice will be followed as the quizzes. Target date: 15 October.

Final: Final exam will be given during the last class. The same procedures will be followed as the midterm.

Note: Rules and regulations will be posted on the course web site, as well as how to deal with late copies.

Grading

	Weight	Due
Term project- Phase I (Proposal + Presentation of the state of the art)	3%	1 October
Online quizzes	5%+5% + 5% + 5% +5%= 25%	Can be given at beginning time of any class, i.e., 2:30pm Thursday (except 15 October and 3 December) for Group A or 9pm EST/EDT for Group B. Quiz-i for group A does not have to be on the same day as Quiz-i for Group-B.
Midterm Examination	25%	15 October
Term project- Phase II (Presentation+ Report)	14(report)%+ 8% (individual presentation)	(Project presentations continue 29 October to 26 November) More information will be given in the first class how the presentations will continue in parallel to the lectures.
Final	25%	3 December

Explanations for the projects will be given in the first class on 10 September.