Course Outline

Instructor
- Prof. Ahmed Ashraf
  E3–504B EITC
  (204) 474–8179
  Ahmed.Ashraf@umanitoba.ca

Office Hours
- By appointment.

Teaching Assistant
- Mahboobeh Norouzi
  norouzim@myumanitoba.ca

Contact Hours
- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:
- MATH 3132 Engineering Mathematical Analysis 3

Course Website:
https://umanitoba.ca/umlearn

ECE 4450 – Applied Computational Intelligence

Course Objectives
This course applies computationally intelligent algorithms to solve difficult computer engineering and
computer science problems. This course consists of the following components: standard lecture delivery,
hands-on, and project based. The theory of several computationally intelligent algorithms will be presented
in class. Along with receiving the theory in class, students are required to demonstrate their understanding
by implementing the algorithms in software to solve given difficult engineering problems, which have
shown to be intractable with the application of conventional algorithms.

Course Content
The following topics will be covered:
- Introduction
- Nearest neighbour classification
- Decision Trees
- Ensemble Methods
- Linear regression
- Linear Classification
- Support Vector Machines
- Boosting
- Neural Networks
- Principal Component Analysis
- Probabilistic Models
- Clustering Methods
- Gaussian Mixture Models
- Expectation Maximization
- Matrix Factorization
- Reinforcement Learning

Laboratories
The following topics may be covered in the labs:
- Application of Linear Regression.
- Application of Logistic Regression.
- Analysis of the Backpropagation algorithm in ANNs.
- Investigation of the SVM algorithm in classification problems.
- Investigation and novel addition to the simulate annealing and genetic algorithms for classification
  problems.

Textbooks
https://web.stanford.edu/~hastie/Papers/ESLII.pdf


Reference

Machine-Learning-2006.pdf

Academic Integrity
Students are expected to conduct themselves in accordance with the highest ethical standards of the
Profession of Engineering and evince academic integrity in all their pursuits and activities at the university.
As such, in accordance with the General Academic Regulations on Academic Integrity, students are
reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects,
or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty
or university). A student found guilty of contributing to cheating by another student is also subject to
serious academic penalty.
Learning Outcomes
1. Ability to choose the appropriate machine learning algorithm to solve a computational intelligent demanding problem.
2. Develop Matlab programs to implement computationally intelligent algorithms.
3. Identify, define, and describe the components of the computationally intelligent algorithms studied in this course.
4. Create and design novel methods to implement parts of given algorithms.

Expected Competency Levels

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<th>Outcome</th>
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<th>IN</th>
<th>DE</th>
<th>ET</th>
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Evaluation
The final course grade is determined by the student’s performance on assignments, in laboratories, and on examinations. Students must complete a subset of the laboratories in order to be eligible to receive a passing grade.

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<th>Value (%)</th>
<th>Method of Feedback</th>
<th>Learning Outcomes Evaluated</th>
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<td>Term Test</td>
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* Method of Feedback: F - Formative (written comments and/or oral discussion), S - summative (numerical grade)

CEAB Graduate Attributes Assessed
DE.3 – Uses tools to complete engineering activities.
ET.1 – Develops/implements possible solutions to an open-ended design problem, leading to an appropriate recommendation.

Retention of Student Work
Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University’s Intellectual Property Policy and the protection of privacy provisions of The Freedom of Information and Protection of Privacy Act (Manitoba). Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

Requirements and Regulations
- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade.
- Students who falter should familiarize themselves with the University’s General Academic Regulations, as well as Section 3 of the Faculty of Engineering Academic Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Information