MECH 580 A01 – Special Topics: Applied Machine Learning for Engineers

Term – Spring 2022 (202201)

Instructor	Office Hours
Dr. Homayoun Najjaran	Days: Tuesdays
Phone:	Time: Thursdays 10:00am-11:00am
E-mail: najjaran@uvic.ca	Location: Zoom

LECTURE DATE(S)

Section: A01/CRN: 24187	Days: Mondays & Thursdays	Time: 11:30am-1:00pm	Location: Online

ONLINE LEARNING, TEACHING, AND TOOLS

This course will be taught entirely online, making use primarily of BrightSpaces and Zoom.

Lectures:
The course material will be posted as MATLAB LiveScript files in BrightSpaces. I will introduce the topics discussed in each lesson in the beginning of the online lectures delivered in Zoom. These introductions will be also available as pre-recorded videos in BrightSpaces. You must review the videos before attending the Zoom lectures. Following the introductions, the students are called to present and discuss their implementations in the remaining part of the lecture hours. Participation in the online Zoom lectures is mandatory.

Office Hours
Office hours will be in Zoom.

Tools required:
- Desktop or Laptop Computer with webcam/microphone/speakers or headsets for online lecture & tutorials
- Scanner (desktop or phone-based)
- Printer (useful but not mandatory)
- Software installed on your computer:
  - o MATLAB (mandatory)
  - o Web browser to be able to access/run Zoom, BrightSpaces, etc.
  - o Pdf viewer
  - o Excel, Word, etc might be useful as well
- Please make yourself familiar with Zoom, which we will use for live interaction in tutorial, office hours, etc:* https://www.uvic.ca/systems/services/avmultimedia/zoomvideoconferencing/index.php

TA Name	E-mail	Office
Dr. Kashish Gupta	kashishg@uvic.ca	

Required Text	Optional Text
Title: Practical Deep Learning Examples with MATLAB	*Practical MATLAB Deep Learning*
Author: N/A	Michael Paluszek, Stephanie Thomas
Publisher/Year: The MathWorks Inc., 2019	Princeton Satellite Systems, Apress 2020
Reference Materials: Additional references for each lesson are provided in the MATLAB LiveScript files.	

COURSE OBJECTIVES: This course provides the necessary knowledge and practical experience for data-driven modeling and analysis for problem solving using the MATLAB machine learning toolboxes. It is designed to teach the student the design of a data-driven model training and analysis pipeline where the use of MATLAB provides a unified platform for data preparation, modeling, postprocessing and visualization. As a complementary and applied level course in machine learning the students will be exposed to different academic and industrial problems solved by a variety of machine learning methods. It encompasses the techniques that enable modeling, analysis and implementation of such processes based on publicly available datasets and simulations.

- Students will augment their knowledge of neural network machine learning methods using MATLAB comprehensive documentation on the topics,
- Students will practice the use of MATLAB toolboxes in numerous examples of applied science and engineering problems,
- Students will be engaged in this project-based course to gain hands-on experience with the use MATLAB tools, datasets and simulations for machine learning-based solutions,
- Students will learn to formulate and solve real-world data-driven problems and implement their solutions using MATLAB.

LEARNING OUTCOMES: Emphasizing the use of MATLAB toolboxes, this course will enable students to:

- Learn the concepts of machine learning including neural networks-based learning and optimization.
- Apply data handling methods including preprocessing, postprocessing, outlier detection and removal.
- Apply statistical methods for data processing, distribution analysis applicable to machine learning models.
- Learn how to effectively visualize input-output data, feature information, and training progress of machine learning models.
- Develop insight into analysis and representation of machine learning architecture and hyperparameters.
- Develop metrics and charts to assess the performance of machine learning models both during and after training.
- Gain a practical experience with formulating multiple aspects of applied science and engineering problems into a machine learning problem solving framework

Weight & Date(s) of Assessments:	Weight	Date
Implementation problems	40%	Weekly
In-class presentations	20%	During the lectures (each student will present at least twice during the term)
Final Project	40%	End of the term

ASSIGNMENTS

The assignments are due weekly in the form of MATLAB implementations in the LiveScript files of each Lesson introduced the prior week. **Implementations are to be completed individually and submitted electronically in MATLAB LiveScript .mlx files** via the MECH 580 Course Space site.

COURSE LECTURE NOTES

The course material is prepared and will be distributed in MATLAB LiveScript (.mlx) files. The course includes five lessons on machine learning topics. Each lesson includes a brief review of the corresponding topic, reference to additional reading material, and MATLAB examples. In the end of each lesson, there is a section of students' MATLAB implementations. The students must have access to a computer with adequate computational power, and have MATLAB, Simulink, as well as machine learning related toolboxes of MATLAB installed in their computers. Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

Course Schedule

Module	Contents	Date/Week
AppML.mlx	– Introduction – Organization of the course	Week 1 *1 lecture*
L1AppML.mlx	**Neural Network Models** – Multi-layer Perceptrons (MLP) – Deep Learning (DPL) – Convolutional Neural Networks (CNN) – Recurrent Neural Networks (RNN)	Week 2-3 *4 lectures*
L2AppML.mlx	**Supervised Learning** – Regression – Classification	Week 4-5 *4 lectures*
L3AppML.mlx	**Unsupervised Learning** – Clustering – Autoencoders	Week 6-7 *4 lectures*
L4AppML.mlx	**Reinforcement Learning** – Decision-making problem – Control problem	Week 8-9 *4 lectures*
L5AppML.mlx	**Hybrid Learning** – Semi-supervised learning – Active learning – Generative Adversarial Networks (GAN) – Neuro-fuzzy learning	Week 10-11 *5 lectures*
Presentations	**Students' Final Projects**	Week 12 *2 lectures*

General Information

Note to Students: Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Assistant to the Chair to set up an appointment.

Centre for Accessible Learning (CAL) https://www.uvic.ca/services/cal/

Accommodation of Religious Observance (AC1210) Read it here

Discrimination and Harassment Policy (GV0205) Read it here

Sexualized Violence Prevention and Response at UVic:
UVic takes sexualized violence seriously, and has raised the bar for what is considered acceptable behaviour. We encourage students to learn more about how the university defines sexualized violence and its overall approach by visiting https://www.uvic.ca/sexualizedviolence/. If you or someone you know has been impacted by sexualized violence and needs information, advice, and/or support please contact the sexualized violence resource office in Equity and Human Rights (EQHR). Whether or not you have been directly impacted, if you want to take part in the important prevention work taking place on campus, you can also reach out:
Where: Sexualized violence resource office in EQHR; Sedgewick C119
Phone: 250.721.8021
Email: svpcoordinator@uvic.ca
Web: https://www.uvic.ca/sexualizedviolence/

Office of the Ombudsperson:
The Office of the Ombudsperson is an independent and impartial resource to assist with the fair resolution of student issues. A confidential consultation can help you understand your rights and responsibilities. The Ombudsperson can also clarify information, help navigate procedures, assist with problem-solving, facilitate communication, provide feedback on an appeal, investigate and make recommendations.
Phone: 250-721-8357
Email: ombuddy@uvic.ca
Web: https://uvicombudsperson.ca/

Electronic devices in labs and lectures: No unauthorized audio or video recording of lectures is permitted.

Electronic devices in midterms and exams: Calculators are only permitted for examinations and tests if explicitly authorized and the type of calculator permitted may be restricted. No other electronic devices (e.g. cell phones, pagers, PDA, etc.) may be used during examinations or tests unless explicitly authorized.

Faculty of Engineering, University of Victoria Standards for Professional Behavior
It is the responsibility of all members of the Faculty of Engineering, students, staff, and faculty, to adhere to and promote standards of professional behavior that support an effective learning environment that prepares graduates for careers as professionals...
You are advised to read the Faculty of Engineering document *Standards for Professional Behavior* which contains important information regarding conduct in courses, labs, and in the general use of facilities.

Graduate Students' Society

The Graduate Students' Society (GSS) serves all students registered in a Graduate degree program. For information on GSS activities, events and services navigate to https://gss.uvic.ca/

Grading System

The University of Victoria follows a percentage grading system in which the instructor will submit grades in percentages. The University will use the following Senate approved standardized grading scale to assign letter grades. Both the percentage mark and the letter grade will be recorded on the academic record and transcripts. Read the policy here

Course Experience Survey (CES)

We value your feedback on this course. Towards the end of term you will have the opportunity to complete a confidential course experience survey (CES) regarding your learning experience. The survey is vital to providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. When it is time for you to complete the survey, you will receive an email inviting you to do so. If you do not receive an email invitation, you can go directly to the http://ces.uvic.ca

You will need to use your UVic NetLink ID to access the survey, which can be done on your laptop, tablet or mobile device. I will remind you closer to the time, but please be thinking about this important activity, especially the following three questions, during the course.

- What strengths did your instructor demonstrate that helped you learn in this course?
- Please provide specific suggestions as to how the instructor could have helped you learn more effectively.
- Please provide specific suggestions as to how this course could be improved.

Attendance

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time...
An Instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations. Students who do not attend classes must not assume that they have been dropped from the course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course. Read the policy here.

Academic Integrity

Academic integrity is intellectual honesty and responsibility for academic work that you submit individual or group work. It involves commitment to the values of honesty, trust, and responsibility. It is expected that students will respect these ethical values in all activities related to learning, teaching, research, and service. Therefore, plagiarism and other acts against academic integrity are serious academic offences.

> **The responsibility of the institution** Instructors and academic units have the responsibility to ensure that standards of academic honesty are met. By doing so, the institution recognizes students for their hard work and assures them that other students do not have an unfair advantage through cheating on essays, exams, and projects.

The responsibility of the student Plagiarism sometimes occurs due to a misunderstanding regarding the rules of academic integrity, but it is the responsibility of the student to know them. If you are unsure about the standards for citations or for referencing your sources, ask your instructor. Depending on the severity of the case, penalties include a warning, a failing grade, a record on the student's transcript, or a suspension.

It is your responsibility to understand the University's policy on Academic Integrity

Equality

This course aims to provide equal opportunities and access for all students to enjoy the benefits and privileges of the class and its curriculum and to meet the syllabus requirements. Reasonable and appropriate accommodation will be made available to students with documented disabilities (physical, mental, learning) in order to give them the opportunity to successfully meet the essential requirements of the course. The accommodation will not alter academic standards or learning outcomes, although the student may be allowed to demonstrate knowledge and skills in a different way. It is not necessary for you to reveal your disability and/or confidential medical information to the course instructor. If you believe that you may require accommodation, the course instructor can provide you with information about confidential resources on campus that can assist you in arranging for appropriate accommodation. Alternatively, you may want to contact the Centre for Accessible Learning (formerly the Resource Centre for Students with a Disability) located in the Campus Services Building.

The University of Victoria is committed to promoting, providing, and protecting a positive, and supportive and safe learning and working environment for all its members.