UNIVERSITY OF TORONTO
SCHOOL OF CONTINUING STUDIES

COURSE OUTLINE

COURSE CODE: 3253-073

COURSE TITLE: Machine Learning

INSTRUCTOR: Saeid Abolfazli (PhD)
Email address: Saeid.abolfazli@utoronto.ca

Preferred method of communication and expected communication timelines

DAY/TIME: saeid.abolfazli@utoronto.ca

Jan 18, 2024 **to** Apr 04, 2024

WEBINAR SCHEDULE:
Thu, 6:00 PM – 9:00 In-Class Lecture -
St. George Campus Ontario Institute for Studies in Education (OISE) Building 252 Bloor Street W. , Toronto Room: 4422

REQUIRED TEXT(S): Hands On Machine Learning with Scikit-Learn and Tensorflow Concepts, Oreilly, 2nd or 3rd edition, Aurelien Geron, 978-1-491-96229-9

RECOMMENDED TEXT(S) AND OTHER RESOURCES: TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurélien Géron. *O'Reilly Media (2017)*

PREREQUISITE(S)/ RECOMMENDATIONS:

3250 Foundations of Data Science and 3251 Statistics for Data Science, **OR**
Previous knowledge and experience in Python programming and Statistical techniques, **OR**
A passing grade on a self-assessment test/quiz for equivalent skills.

Recommended:
Laptop Computer with the following Specifications:
System Type: 64-bit operating system, X 64-based processor; Windows 7, 8 or 10; Mac OS/X or Linux running on similar hardware. Processor: Intel ® i5-3230M CPU @ 2.6 GHz or better; Installed Memory (RAM): 8 GB or more.

Software needed for this course is free and mostly open source. You will receive instructions for download/install/use in class

Academic Requirements: A degree in Engineering, Mathematics, or Computer Science is recommended, but not required. Basic knowledge of programming and programming languages is also recommended.

CERTIFICATE(S): This course is applicable to the following SCS Certificates

Artificial Intelligence: Required Courses
Data Science: Required Courses

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COURSE DESCRIPTION:

This course will equip you with the fundamental machine learning (ML) and artificial intelligence (AI) algorithms and techniques for mining and analyzing data and extracting insights for data-driven decision making. You will learn how to formulate a ML/AI problem, prepare data, build and optimize predictive models using a wide range of algorithms and evaluate the performance of those models. Throughout the course you will use Scikit-learn and TensorFlow hands-on to build applications that learn from data

LEARNING OUTCOMES:

- Formulate machine learning and AI problems
- Learn techniques to pre-process data for modeling
- Train generalized predictive classification and regression models
- Identify clusters in data such as market segments
- Evaluate and combine models for best performance

ASSOCIATIONS: This course is not recognized by an Association.
https://learn.utoronto.ca/programs-and-courses/association-partnerships

QUERCUS and ONLINE RESOURCES

Quercus is a learning management engine, and is the University of Toronto's main online teaching and learning environment. It is web-based software which gives you and your instructor a shared learning space online to receive and exchange course content as well as to communicate using a range of tools. More information about online learning in Quercus can be found here:
https://help.learn.utoronto.ca/hc/en-us/sections/115000462414-Online-learning-in-Quercus

COURSE FORMAT:

The following provides a high-level description of the main course delivery formats provided by the School. Please note that your instructor will provide you with a detailed overview of the course venue, learning materials, learning activities and group interaction at the start of your course. If you have any questions about this course, please contact the School at 416-978-2400 or email learn@utoronto.ca to discuss the course delivery format for the course you're interested in.

Course Format	Definition
Classroom + Online Resources	● Location of Instruction: All classes held on campus with instructor-led lectures and class discussions. ● Course Administration and Learning Materials: Course materials are provided in paper-based format (text, readings) and/or as digital online resources through the Blackboard Learning Management System. ● Communication & Interactivity: Interactions between learners and instructor and between learners directly are conducted primarily in class. Some learning activities, ad hoc or project-based interaction may be conducted on the Blackboard Learning Management System. E-mail is typically used for ad hoc or project-based interaction outside of class. Occasionally other social media and communication applications may be used for interaction outside class.

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https://help.learn.utoronto.ca/hc/en-us/sections/115000462414-Online-learning-in-Quercus

COURSE PLAN:

MODULES	DATE	TOPIC/LESSONS/WEBINARS	READINGS, ASSIGNMENTS, ACTIVITIES, ETC.
1-Introduction to Machine Learning	2024-01-18	● Course Logistics ● Types of Machine Learning ● Machine Learning Main Challenges	● Chap 1 ● Complete coding practices if any
2- End to End Machine Learning Project	2024-01-25	● Getting data, visualizing it and sharing insights ● Prepare data for training: preprocess it, divide into train/test/validation ● Select a model, train, tune hyperparameters ● Deploy, monitor and maintain	● Chap 2 ● Complete coding practices if any
3- Classification	2024-02-01	● Train a Binary Classifier ● Performance measures	● Chap 3

		• Multiclass classification • Error Analysis • Multilabel classification	• Complete coding practices if any • There will be multi-choice review questions during webinar
4- Clustering & Unsupervised Learning	2024-02-08	• Define Unsupervised Learning • Clustering: ideas and objective • Clustering algorithms: k-means, agglomerative, DBSCAN • Performance measures	• Chap 9 • http://scikit-learn.org/stable/modules/clustering.html • Complete coding practices if any • There will be multi-choice review questions during webinar
5- Training Models & Feature Selection	2024-02-15	• Linear Regression • Gradient Descent • Polynomial regression • Learning Curves • Regularized Models	• Chap 4 • Complete coding practices if any • There will be multi-choice review questions during webinar
6- Support Vector Machines	2024-02-22	• Linear SVM Classification • Non-linear SVM Classification • SVM Regression	• Chap 5 • Complete coding practices if any • There will be multi-choice review questions during webinar
7- Decision Trees, Ensemble Learning & Learning Forests	2024-02-29	• Training and Visualizing a Decision Tree • Making Predictions • Estimating probabilities • Computational Complexity • Voting Classifiers • Bagging and Pasting • Random Subspaces • Random Forest • Boosting and stacking	• Chap 6 and 7 • Complete coding practices if any • There will be multi-choice review questions during webinar
8- Dimensionality Reductions	2024-03-07	• The Curse of Dimensionality • PCA, Kernel PCA, LLE	• Chap 8 • Complete coding practices if any • There will be multi-choice review questions during webinar
9- Training Deep Neural Networks	2024-03-14	• Train Deep Neural Nets • Fine Tuning Hyper Parameters • Training with High and Low Level TF API	• Chap 10, 11,12 • Complete coding practices if any

		● Vanishing and Exploiting Gradient ● Reusing Pretrained Layers	● There will be multi-choice review questions during webinar
10- Introduction to Tensor Flows & Neural Networks	2024-03-21	● Introduction to TF ● Graph and Session ● Linear Regression with TF ● Saving models ● Scopes and Modularity ● Biological Inspirations ● Back Propagation ● Training a Neural Network	● Chap 12, 13 ● Complete coding practices if any ● There will be multi-choice review questions during webinar
11- Distributing TensorFlow	2024-03-28	● Distributed Training ● Convolution Neural Network ● CNN Architectures ● Recurrent Neural Networks	● Chap 14, 15 ● Complete coding practices if any ● There will be multi-choice review questions during webinar
12- Term Project Presentations	2024-04-04	● Learners present project to their classmates	● Hands on projects ● Send PPT and code before the class

GRADING AND EVALUATION:

Project	20%
Assignment	70%
Participation	10%

A note about Participation Marks:

Participation marks are for attendance and, more importantly, constructive contributions to class discussion on a regular basis.

Learners can expect to receive feedback and marks, if applicable, before the course end date, for all their submitted assignment(s) and test(s) other than the final exam, project or course paper. However, it is the sole responsibility of learners to make sure that they do get these marks from their Instructor and have all related questions answered before the course ends.

MISSED TEST/ASSIGNMENT GUIDELINES

If you miss a test or assignment please work directly with your instructor to make alternate arrangements. There may be penalties for missed or late assignments and tests.

SCS GRADING SCALE:

A 80% to 100% Excellent

B 70% to 79% Good

C 60% to 69% Adequate

D 50% to 59% Marginal

FX Less than 50%

INC Incomplete

DNW Did not write

FINAL GRADE:

To view your final grade, please login to "My Access – Student Login" at: https://learn.utoronto.ca/login. Please note that your final grade will not be posted on Quercus.

More information regarding Academic Policies and Guidelines is located here: https://help.learn.utoronto.ca/hc/en-us/sections/207314307-Academic-Policies-and-Guidelines

CODE OF STUDENT CONDUCT AND CODE OF BEHAVIOUR ON ACADEMIC MATTERS:

All School of Continuing Studies learners are required to comply with the University of Toronto Academic Policies including, but not limited to the Code of Student Conduct and the Code of Behaviour on Academic Matters.

Information regarding University of Toronto Academic Policies can be reviewed here: https://help.learn.utoronto.ca/hc/en-us/articles/235279047-Academic-Policies-and-Student-Code-of-Conduct

ACADEMIC HONESTY:

Course work that is not appropriately cited may be in violation of the Code of Behaviour on Academic Matters (see above).

For guidelines about plagiarism and properly citing your sources, please visit:

https://help.learn.utoronto.ca/hc/en-us/articles/115006427548-Academic-Honesty

AUDIO/VIDEO RECORDINGS:

You are not permitted to record lectures without the written consent of your instructor(s).

ACADEMIC ACCOMMODATIONS:

If you require accommodation for a disability, please contact Enrolment and Learner Services at 416-978-2400, email scs.accessibility@utoronto.ca or fill out the form at the following link to arrange this service.
https://learn.utoronto.ca/help/forms-and-applications/accommodation-request-form