


Course Outline

School:	Business
Department:	Marketing & Entrepreneurship
Course Title:	Machine Learning and AI
Course Code:	BA 713
Course Hours/Credits:	42
Prerequisites:	N/A
Co-requisites:	N/A
Eligible for Prior Learning, Assessment and Recognition:	Yes
Originated by:	Ulya Sabeel
Creation Date:	Summer 2021
Revised by:	Ulya Sabeel, David Parent
Revision Date:	Winter 2022
Current Semester:	Winter 2022
Approved by:	

Chairperson/Dean

Students are expected to review and understand all areas of the course outline.

Retain this course outline for future transfer credit applications. A fee may be charged for additional copies.

This course outline is available in alternative formats upon request.

Acknowledgement of Traditional Lands

Centennial is proud to be a part of a rich history of education in this province and in this city. We acknowledge that we are on the treaty lands and territory of the Mississaugas of the Credit First Nation and pay tribute to their legacy and the legacy of all First Peoples of Canada, as we strengthen ties with the communities we serve and build the future through learning and through our graduates. Today the traditional meeting place of Toronto is still home to many Indigenous People from across Turtle Island and we are grateful to have the opportunity to work in the communities that have grown in the treaty lands of the Mississaugas. We acknowledge that we are all treaty people and accept our responsibility to honor all our relations.

Course Description

With the latest technological developments and the rapid growth in Big Data, insights and predictions can now easily be derived by diving into the data. AI and Deep Learning are two such powerful techniques in this endeavor.

In this course, the students will be familiarized with the underlying concepts of AI and Deep learning, and applications of these techniques to solve different problems. The students will learn to design and implement a Deep learning model step-by-step. The topics include an introduction to AI and Deep Learning, concepts of Shallow Learning, introduction to data preprocessing, feature selection, and hyperparameter optimization, design, and implementation of several deep learning models with their performance evaluation, and ethical concerns around AI.

Program Outcomes

Successful completion of this and other courses in the program culminates in the achievement of the Vocational Learning Outcomes (program outcomes) set by the Ministry of Colleges and Universities in the Program Standard. The VLOs express the learning a student must reliably demonstrate before graduation. To ensure a meaningful learning experience and to better understand how this course and program prepare graduates for success, students are encouraged to review the Program Standard by visiting <http://www.tcu.gov.on.ca/pepg/audiences/colleges/progstan/>. For apprenticeship-based programs, visit <http://www.collegeoftrades.ca/training-standards>.

Course Learning Outcomes

The student will reliably demonstrate the ability to:

1. Explain and analyze the basic concepts in Artificial Intelligence (AI) and Deep Learning (DL) and their applications using real-life examples.
2. Demonstrate the ability to prepare data, identify important features and normalization techniques for model training and analysis.
3. Design and implement intelligent problem-solving AI systems using Python, Keras and Tensorflow.
4. Demonstrate the ability to evaluate and assess models using multiple performance metrics.
5. Evaluate and identify AI biases, explain DL limitations and its future scope.

Essential Employability Skills (EES)

The student will reliably demonstrate the ability to*:

5. Use a variety of thinking skills to anticipate and solve problems.

6. Locate, select, organize, and document information using appropriate technology and information systems.
7. Analyze, evaluate, and apply relevant information from a variety of sources.

**There are 11 Essential Employability Skills outcomes as per the Ministry Program Standard. Of these 11 outcomes, the following will be assessed in this course.*

Global Citizenship and Equity (GC&E) Outcomes

The student will reliably demonstrate the ability to*:

4. Analyze the use of the world's resources to achieve sustainability and equitable distribution at the personal, professional, and global level.

**There are 6 institutional Global Citizenship & Equity outcomes. Of these 6 outcomes, the following will be assessed in this course.*

Text and other Instructional/Learning Materials

Text Book(s):

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurelien Geron, first edition Published by O'Reilly Media, Inc. 2017, ISBN: 978-1-491-96229-9
2. Deep Learning with Python by François Chollet, published by Manning Publications Co., 2018, ISBN: 978-1-61729-443-3

Online Resource(s):

1. <https://www.anaconda.com/>
2. <https://www.tensorflow.org/>
3. <https://www.tensorflow.org/tutorials/index.html>
4. <https://scikit-learn.org/stable/>
5. <https://keras.io/>
6. <https://pandas.pydata.org/>
7. <https://www.deeplearningbook.org/>

Material(s) required for completing this course:

Python, Anaconda and Jupyter Notebook installed on a personal computer.

Evaluation Scheme

- ⇒ Quizzes: 2 quizzes
- ⇒ Lab Assignments: 2 projects
- ⇒ Mid-Term Test: Mid-term test
- ⇒ Final Test: Final test

Evaluation Name	CLO(s)	EES Outcome(s)	GCE Outcome(s)	Weight/100
Quizzes	1, 2, 3, 5	5, 7		30
Lab Assignments	1, 2, 3, 4, 5	5, 6, 7	4	25
Mid-Term Test	1, 2, 4, 5	5, 7		20
Final Test	1, 2, 4, 5	5, 7		25
Total				100%

If students are unable to write a test they should immediately contact their professor or program Chair for advice. In exceptional and well documented circumstances (e.g. unforeseen family problems, serious illness, or death of a close family member), students may be able to write a make-up test.

All submitted work may be reviewed for authenticity and originality utilizing Turnitin®. Students who do not wish to have their work submitted to Turnitin® must, by the end of the second week of class, communicate this in writing to the instructor and make mutually agreeable alternate arrangements.

When writing tests, students must be able to produce official Centennial College photo identification or they may be refused the right to take the test or test results will be void.

Tests or assignments conducted remotely may require the use of online proctoring technology where the student's identification is verified and their activity is monitored and/or recorded, both audibly and visually through remote access to the student's computer and web camera. Students must communicate in writing to the instructor as soon as possible and prior to the test or assignment due date if they require an alternate assessment format to explore mutually agreeable alternatives.

Student Accommodation

The Centre for Accessible Learning and Counselling Services (CALCS) (<http://centennialcollege.ca/calcs>) provides programs and services which empower students in meeting their wellness goals, accommodation, and disability-related needs. Our team of professional psychotherapists, social workers, educators, and staff offer brief, solution-focused psychotherapy, accommodation planning, health and wellness education, group counselling, psycho-educational workshops, adaptive technology, and peer support. Walk in for your first intake session at one of our service locations (Ashtonbee Room L1-04, Morningside Room 190, Progress Room C1-03, The Story Arts Centre Room 285, Downsview Room 105) or contact us at calcs@centennialcollege.ca, 416-289-5000 ext. 3850 to learn more about accessing CALCS services.

Use of Dictionaries

- Dictionary use is not permitted in test or examination settings.

Program or School Policies

N/A

Course Policies

N/A

College Policies

Students should familiarize themselves with all College Policies that cover academic matters and student conduct.

All students and employees have the right to study and work in an environment that is free from discrimination and harassment and promotes respect and equity. Centennial policies ensure all incidents of harassment, discrimination, bullying and violence will be addressed and responded to accordingly.

Academic Honesty

Academic honesty is integral to the learning process and a necessary ingredient of academic integrity. Forms of academic dishonesty include cheating, plagiarism, and impersonation, among others. Breaches of academic honesty may result in a failing grade on the assignment or course, suspension, or expulsion from the college. Students are bound to the College's AC100-11 Academic Honesty and Plagiarism policy.

To learn more, please visit the libraries information page about Academic Integrity

<https://libraryguides.centennialcollege.ca/academicintegrity> and review Centennial College's Academic Honesty Module:

https://myappform.centennialcollege.ca/centennial/articulate/Centennial_College_Academic_Integrity_Module_%202/story.html

Use of Lecture/Course Materials

Materials used in Centennial College courses are subject to Intellectual Property and Copyright protection, and as such cannot be used and posted for public dissemination without prior permission from the original creator or copyright holder (e.g., student/professor/the College/or third-party source). This includes class/lecture recordings, course materials, and third-party copyright-protected materials (such as images, book chapters and articles). Copyright protections are automatic once an original work is created and applies whether or not a copyright statement appears on the material. Students and employees are bound by College policies, including AC100-22 Intellectual Property, and SL100-02 Student Code of Conduct, and any student or employee found to be using or posting course materials or recordings for public dissemination without permission and/or inappropriately is in breach of these policies and may be sanctioned.

For more information on these and other policies, please visit www.centennialcollege.ca/about-centennial/college-overview/college-policies.

Students enrolled in a joint or collaborative program are subject to the partner institution's academic policies.

PLAR Process

This course is eligible for Prior Learning Assessment and Recognition (PLAR). PLAR is a process by which course credit may be granted for past learning acquired through work or other life experiences. The PLAR process involves completing an assessment (portfolio, test, assignment, etc.) that reliably demonstrates achievement of the course learning outcomes. Contact the academic school to obtain information on the PLAR process and the required assessment.

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Topical Outline (subject to change):

Week	Topics	Readings/Materials	Weekly Learning Outcome(s)	Instructional Strategies	Evaluation Name and Weight	Evaluation Date
1	Python, Anaconda and Jupyter Notebook installed on a personal computer.	Lecture Notes Textbook 1-Chapter 1 Textbook 2-Chapter 1	Introduction session with the instructor and/or fellow peers. Review the course outline and expectations. Explain the difference between AI and Machine Learning. Explain AI background, categories, and Challenges. Describe all the necessary steps for a ML workflow.	Icebreaker Course Review Lecture Hands-on exercises Discussion Board		
2	Understanding individual components of a ML pipeline End-to-End ML Project	Lecture Notes Textbook 1-Chapter 2, 3, and 8 Textbook 2-Chapter 4	Implement a basic ML model. Apply multiple data pre-processing, feature selection, and dimension reduction techniques to identify the best features for a ML model. Apply multiple standardization/ normalization techniques to train data and analyze the results. Employ hyperparameter optimization for model tuning. Analyze the ML model results by using multiple performance metrics.	Lecture Discussion Board Hands-on exercises		
3	Basics and Review of Logistic Regression Overview of Shallow Neural Networks	Lecture Notes Textbook 1-Chapter 4,10 Textbook 2-Chapter 3	Explain the idea behind Logistic Regression. Explore the log loss function used for Logistic Regression. Understand the concept of regularization for Logistic Regression. Demonstrate the working of Shallow Neural Networks. Design and implement Shallow Neural Networks to solve business problems.	Lecture Discussion Board Hands-on exercises		
4	Introduction to Deep Learning (DL) Why DL?	Lecture Notes Textbook 1-Chapter 9,10,11	Explain the concept of a Deep Neural Network (DNN) and its working. Establish the differences between Shallow ML techniques and Deep Learning.	Lecture Discussion Board	Quiz-1 due (15%)	

Week	Topics	Readings/Materials	Weekly Learning Outcome(s)	Instructional Strategies	Evaluation Name and Weight	Evaluation Date
	Introduction to Keras, Tensorflow	Textbook 2-Chapter 3	Explain different activation functions for DNN and their differences. Illustrate the working of DL frameworks such as Keras and Tensorflow.	Hands-on exercises		
5	Building a Deep Neural Network step by step with case studies Introduction to TensorBoard	Lecture Notes Textbook 1-Chapter 10,11 Textbook 2-Chapter 3	Design and implement a Deep Neural Network (DNN) in Keras and Tensorflow to solve business problems. Analyze and visualize DNN results using TensorBoard.	Lecture Discussion Board Hands-on exercises		
6	Deep Learning for Computer Vision Introduction to Convolutional Neural Network (CNN)	Lecture Notes Textbook 1-Chapter 13 Textbook 2-Chapter 5	Explain the applications of Deep Learning in Computer Vision. Design and implement a CNN model for solving Business Problems.	Lecture Discussion Board Hands-on exercises	Lab Assignment-1 due (12.5%)	
7	Introduction To Recurrent Neural Networks (RNN) Case study time series forecasting Test Review	Lecture Notes Textbook 1-Chapter 14 Textbook 2-Chapter 6	Demonstrate the inner working of a RNN model. Explain the applications of a RNN model. Design and implement a RNN model for time series forecasting problems.	Lecture Discussion Board Hands-on exercises		
8	Mid-Term Test	N/A	Test #1 Topics: AI and ML concepts, Logistic Regression, Shallow Neural Network, Deep Neural Network, Convolutional Neural Network	Test	Knowledge Test #1 due (20%)	
9	Introduction to Deep Autoencoders (DAE) Anomaly detection case study	Lecture Notes Textbook 1-Chapter 15	Demonstrate the inner working of a DAE model. Explain the applications of a DAE model. Design and implement a DAE model for anomaly detection in business applications.	Lecture Discussion Board Hands-on exercises		
10	Introduction to Deep Generative Modeling Generative Adversarial Networks	Lecture Notes Textbook 2- Chapter 8	Explain the applications of Deep Generative learning. Analyze the different types of Generative models.	Lecture Discussion Board Hands-on exercises	Quiz-2 due (15%)	

Week	Topics	Readings/Materials	Weekly Learning Outcome(s)	Instructional Strategies	Evaluation Name and Weight	Evaluation Date
	and its variants		Design and implement a Deep generative model.			
11	Introduction to Deep Reinforcement Learning	Lecture Notes Textbook 1- Chapter 16	Explain the applications of Deep Reinforcement Learning in a dynamic environment. Analyze the foundations and components of a Deep Reinforcement learning algorithm. Describe the differences between Value Learning and Policy Learning.	Lecture Discussion Board Hands-on exercises		
12	AI bias and fairness Types Identify Evaluate	Lecture Notes	Understand the concepts of AI Bias and Fairness. Explain the taxonomy of Biases in AI. Evaluate and Identify AI biases. Examine and provide strategies for reducing AI Bias.	Lecture Discussion Board Hands-on exercises	Lab Assignment-2 due (12.5%)	
13	Key concepts review DL Limitations Future of DL	Lecture Notes Textbook 2- Chapter 9	Review the key concepts in AI and Deep Learning. Explain the limitations and future of Deep Learning. Analyze real-world Deep Learning problems.	Lecture Hands-on exercises Discussion Board		
14	Final Test	N/A	Test #2 Topics: Recurrent Neural Network, Deep Autoencoder, Deep Generative Modeling, Deep reinforcement Learning, AI bias and Fairness	Test	Final Knowledge Test due (25%)	