COURSE OUTLINE **SCS 3546 - Deep Learning**

INSTRUCTORS:

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DATE/TIME:

Tuesdays May 7, 2019 – July 23, 2019
6 PM – 9 PM
Location: Health Sciences Building Room 108,
155 College Street
Toronto

REQUIRED TEXT(S):

1. **[HML]** Hands-On Machine Learning with Scikit-Learn & TensorFlow, by Aurélien Géron

RECOMMENDED TEXT(S):

1. **[DL]** Deep Learning, by Goodfellow, Bengio & Courville (available free online at http://www.deeplearningbook.org/)
2. **[IT]** Information Theory, Inference and Learning Algorithms, by David MacKay (available free online at https://www.ece.uvic.ca/~agullive/Mackay.pdf)

COURSE DESCRIPTION:

Extend your knowledge and understanding of Machine Learning to Deep Learning Networks. In this course we will cover the theory and practice of modern neural nets through a series of increasingly challenging exercises. You will build your own AI's that can learn to classify images, perform rudimentary language translation and generate synthetic images or sounds.

PREREQUISITE(S):

SCS 3253 Machine Learning

RECOMMENDATIONS:

COMPUTER REQUIREMENTS:
Laptop Computer with the following Specifications:
System Type: 64 bit operating system, X64-based processor; Windows 7/8/10, Mac OS X or Linux; Processor: Intel ® i5-3230M CPU @ 2.6 GHz or better; Installed Memory (RAM): 8 GB or more

CERTIFICATE(S):

Certificate in Artificial Intelligence

LEARNING OUTCOMES: By the end of this course, learners will be able to:

- Use Keras to create and run deep neural nets
- Build your own deep neural nets for a variety of purposes
- Understand the trade-offs between different network architectures
- Design deep learning network architectures appropriate to the problem
- Optimize the network's performance

COURSE PLAN

Week	Module Topics	Readings/Assignments/ Activities Prior to Class
1 – Intro to Course & Review	• Course logistics • Applications of Deep Learning and Moral Issues • Review of key concepts from SCS 3253	• (Advanced: Read DL Chaps. 1-5)
2 – Model Tuning	• Regularization • Optimization	• HML Chap. 10 p. 272-276 • (Advanced: Read DL Chap 7 & 11) • Assignment 1 Deep Learning using Keras
3 – Convolutional Networks	• Convolution • Stacking • Padding • Pooling • CNN Architectures	• Read HML Chap. 13 • (Advanced: Also read DL Chap. 9)
4 – Deep Computer Vision	• Visual Feature Extraction • Transfer Learning • Classification and Localization • Region Detection	• See Resources section of Module 4 Jupyter notebook for readings • Assignment 1 due • Assignment 2 Convolutional Neural Nets and Transfer Learning
5 – Recurrent Neural Nets	• Recurrent Neural Nets • Recursive Neural Nets • Long Short-Term Memory	• Read HML Chap. 14 • (Advanced: Also read DL Chap. 10)
6 – Natural Language Processing	• Natural Language Processing • Google Translate	• (Advanced: Read DL Chap. 12.3) • Assignment 2 due • Assignment 3 Recurrent Neural Nets

7 – Deep Models for Text	• Deep models for text	• See Resources section of Module 7 Jupyter notebook for readings
8 – Representational Learning & Variational Methods	• Deep learning models for learning distributions	• Read about Google DeepDream: https://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html • Assignment 3 due
9 – Deep Generative Models	• Models for generating new examples from a learned distribution	• DL Chap. 20 • Assignment 4 Generative models
10 – Speech and Music Recognition & Synthesis	• Speech recognition • Speech synthesis • Music recognition • Music analysis • Music and instrument synthesis	• Read about Magenta: https://magenta.tensorflow.org/ • Assignment 4 due
11 – Term Project Presentations	• Term project presentations	• Term project due
12 – Term Project Presentations	• Term project presentations	

DELIVERY 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.

DELIVERY FORMAT	DESCRIPTION
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.

GRADING AND EVALUATION:

Assignments	60%
Term Project	30%
Class Participation	10%

There will be 4 assignments during the term worth 15 marks each for a total of 60. The assignments will primarily be programming tasks in Python to complete models for various applications of deep neural nets. The project will be to develop your special-purpose net using techniques you learn during the term.

Learners can expect to receive feedback and marks, if applicable, before the course end date, for all their submitted assignment(s) and term 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.

If you are unable to write the final exam for whatever reason (e.g. medical, work conflicts, family emergencies) you can write an Alternate Examination at the next exam sitting. The Alternate Examination Application form can be downloaded from our website: http://learn.utoronto.ca/how-to-register/forms-applications. Please complete the form, and along with the fee of $150.00, submit it to the Registration Office.

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%	Inadequate/Incomplete

FINAL GRADE:

To view your final grade, please log into the "My Access – Student Login" located on our website, www.learn.utoronto.ca/login. Please note that your final grade will not be posted on Blackboard.

Once your exam has been written or the course has finished, if you have any questions concerning your grades or final mark, please contact the School directly at scs.business@utoronto.ca or 416-978-2412

CERTIFICATE:

To receive your certificate upon completion of all requirements, please complete the Certificate Request Form

available at http://learn.utoronto.ca/how-to-register/certificate-request-form

ACADEMIC CONSULTATION: Most issues and questions can be addressed during class or by e-mail. Unless urgent information is required, the instructor will respond to your e-mail questions during the next class. If confidentiality is required, a learner and the instructor can arrange a mutually convenient time to address questions – either before or after class, or by telephone.

NOTE(S): In the event that we have to cancel your class at the last moment due to weather, the illness of the instructor, etc., please ensure that you have provided a daytime phone number or email in your student profile, so that we are able to notify you immediately.

CODE OF CONDUCT: All School of Continuing Studies learners are required to comply with the University of Toronto Code of Student Conduct available at http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppjul012002.pdf Learners are also required to comply with the Code of Behaviour on Academic Matters, available at http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppjun011995.pdf

ACADEMIC HONESTY: If you are using the ideas of others in your written work please see information regarding:

Guidelines for properly citing your sources:
'Writing at the University of Toronto' website at http://www.writing.utoronto.ca/advice/using-sources/documentation

Plagiarism:
http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize

AUDIO/VIDEO RECORDINGS: You are not permitted to record lectures without the written consent of your instructor(s).

ACCOMMODATION FOR

A DISABILITY: If you require accommodation for a disability, please contact Student Services at 416-978-2400 or email learn@utoronto.ca to arrange this service.