

# ECE 324: Introduction to Machine Intelligence – Fall 2020

## Basic Course Information

Welcome! We live in times in which computers have become essential in almost every human endeavour, in music, design, healthcare, business and entertainment. The goal of this course is to provide an introduction to practical machine learning methods that are part of exciting recent advances that help computers contribute to these areas.

The course will also give you an opportunity to improve your software skills and practices, and practice important communication skills in a project proposal, report and presentations. The key learning vehicles of the course are the programming assignments, and the course project.

The topics to be covered are: representation of data, classification, supervised learning, loss functions, activation functions, neural network optimization, learning rate, regularization, underfitting, overfitting, deep neural networks, convolutional neural networks, natural language processing and recurrent neural networks. We will also discuss and consider some of the ethical considerations that arise in this corner of AI.

The assignments will make use of the Python language and the PyTorch deep learning framework.

## Instructor

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## Teaching Assistants

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## Grading

The grade in the course will be based on five assignments, a term test, and the course project, which is done in groups. The term test will cover all material up to a point that will be specified in class. The project will include a proposal document and presentation, final and individual reports, final in-class presentation and an individual interview.

| Item            | Weight |
|-----------------|--------|
| Assignments (5) | 25%    |
| Midterm Test    | 30%    |
| Project         | 45%    |

The midterm test will be held on Friday November 27th, from 9am-11am. Aids available for use will be specified closer to the test.

## Course Web Sites

The web site for this course can be found on Quercus, accessible from `q.utoronto.ca`. All class announcements, and handouts - including assignments, will be accessible there. We will also use Piazza.com to serve as the course discussion board where you can ask questions about course content, assignments and project. If you were not automatically signed up to the class Piazza page by the instructor, go to the sign up page here: <https://piazza.com/utoronto.ca/fall2020/ece324/home>,

## Course Schedule

| Type     | Day      | Time    | Room   |
|----------|----------|---------|--------|
| Lecture  | Tuesday  | 9am-10  | Online |
| Tutorial | Tuesday  | 10am-11 | Online |
| Lecture  | Thursday | 11am-12 | Online |
| Lecture  | Friday   | 10am-11 | Online |

## Assignments

A key part of the learning in this course is in the hands-on programming assignments.

There are five assignments in this course; the schedule is given in Table 1. Assignments are due at 9pm on the due date given in the Table. There is a penalty-free grace period of one hour past the time deadline. Work that is submitted between 1 hour and 24 hours past the deadline will receive a 20% grade deduction (that is 20% of the total achievable grade). No subsequent (past 24 hours) late work will be accepted.

These assignments will likely take a substantial amount of your time.

| Number       | Title   | Date Assigned | Date Due     | Grade Portion |
|--------------|---|---------------|--------------|---------------|
| 1            | Review of Python                                | September 10  | September 17 | 1%            |
| 2            | Single Neuron Classifier from Scratch & PyTorch | September 17  | October 1    | 6%            |
| 3            | MLP for Income Prediction                       | September 24  | October 13   | 6%            |
| 4            | CNN for Image Recognition                       | October 8     | October 22   | 6%            |
| 5            | NLP and CNN/RNN for Sentence Classification     | October 22    | November 5   | 6%            |
| <b>Total</b> |   |               |              | <b>25%</b>    |

Table 1: Assignment Schedule and Grade Portion

## Project

The project in this course will be a major software project that makes use of the course material to do Machine Learning engineering of your own choosing. The project in this course will be done in groups of two (or possibly three, depending on course enrolment), and will account for 45% of your final grade. There are several phases and specific deadlines of the project, with several interim deliverables. Please see the associated document titled "Project Structure, Timeline and Grading."

| Item                               | Portion of Full Grade |
|------------------------------------|-----------------------|
| Proposal Document and Presentation | 5%                    |
| In-Class Final Presentation        | 10%                   |
| Final Report                       | 15%                   |
| Individual Report                  | 5%                    |
| Individual Interview               | 10%                   |
| Total                              | 45%                   |

## Software Frameworks, Acceleration and Getting Started Tutorials

We will be using Python 3.8 and PyTorch as the main software environment. Assignment 1 and 2 provide instructions on the software frameworks and how to access them.

There will be a survey to fill out at the beginning of the course so that we can understand what all students have as computers, and internet access. It would be advisable that all students have good quality computers and internet access.

## Suggested Textbook

**Deep Learning with PyTorch**, Authors: Eli Stevens, Luca Antiga, Thomas Viehmann. <https://www.manning.com/books/deep-learning-with-pytorch?query=Deep%20Learning%20with%20PyTorch>

## Other References

1. **Deep Learning, A Practitioner's Approach** by Patterson & Gibson (O'Reilly) - this text doesn't use the same language we're using, but the front material is closer to how I will present neural networks. <https://www.oreilly.com/library/view/deep-learning/9781491924570/> also available from Amazon.
2. **Programming PyTorch for Deep Learning** by Ian Pointer - <https://learning.oreilly.com/library/view/programming-pytorch-for/9781492045342/> this is a very gentle introduction to the topics covered in the class, but doesn't go into depth.
3. **Deep Learning** by Goodfellow, Bengio and Courville - free at <http://www.deeplearningbook.org>, but can also be purchased in hardcover. I do not cover the material in the way this book presents it, but it is a useful reference for various aspects of the mathematics of deep learning.
4. **Machine Learning Yearning** by Andrew Ng - this is an online book that is free, located at <https://www.deeplearning.ai/machine-learning-yearning/>. I also highly recommend that you sign up for Andrew Ng's weekly newsletter, 'The Batch' at the same website.
5. **Data Science from Scratch, First Principles with Python** by Joel Grus - this book covers much broader territory than this course, and it does it from the bottom up; it is relevant to the first few weeks of the course, but is also considered as a key long-term reference for the field. <https://joelgrus.com/2019/05/13/data-science-from-scratch-second-edition/>

In addition, there are many online resources that can teach aspects of the course, including the PyTorch tutorials located here: <https://pytorch.org/tutorials/>.

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## **Academic Integrity**

In developing solutions to assignments, you are free to discuss your approach to the solution with fellow students. This is fine as long as the final solution is yours alone. You should not post any of your assignment questions in a private or public online discussion forum or web site in order to solicit solutions from others. Note that, under the University of Toronto code of conduct, a person who supplies an assignment to be copied will be penalized in the same way as the one who makes the copy. We will use software to detect copying that is quite sophisticated and so is difficult to defeat.

## **Accessibility Needs**

The University of Toronto is committed to accessibility. If you require accommodations or have any accessibility concerns, please visit <http://www.studentlife.utoronto.ca/as> as soon as possible.