COMP 4107
Neural Networks

Winter, 2022

Instructor: Rosa Azami — E-mail: rosaazami@cunet.carleton.ca
Class place: Online (Zoom links in Brightspace) — Class Hours: M/W 4:05 pm - 5:25 pm
Office Hours: TBA — Discord: TBA

Teaching Assistants: — TA hour: TBA

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Course Description

This course gives an overview of theory and applications of Neural Networks to problems in machine learning. Topics include explanation of the representation, transformation and compression of data, biological models and the Perceptron. Modern neural network architectures, including feed forward, recurrent, convolutional and generative adversarial are introduced.

The course mostly focuses on supervised learning – training the network to produce a specified behavior when one has lots of labeled examples of that behavior. The remaining part of the course focuses on unsupervised learning – the algorithm isn't given any examples of the correct behavior, and the goal is instead to discover interesting regularities in the data.

Includes: Experiential Learning Activity

Prerequisites/Corequisites

Prerequisite(s): COMP 3106 and (MATH 1104 or MATH 1107).

Course Delivery Method

Online Blended Section: Online in-term assessments will be during the scheduled class-time (eg. tests and exams). Lectures will be recorded and posted for students to watch.

Most lectures will be live-streamed during class time. Unless otherwise announced in the brightspace, the instructor will be available during the live streaming and would answer the questions and provide extra explanations if needed.

It is recommended to attend every class. Optional recordings will be posted afterwards, but you may miss out on important in-class activities and discussions. Pop-up quizzes may appear during the online lectures (While class attendance is not mandatory, participating in quizzes would be calculated such that it can only improve student grades). You are not required to be on camera during lectures, however you must have a working microphone to interact with each other.

Resources

- Course materials will be available on brightspace. You may have some optional readings that would be posted on brightspace.
- Text books (Not Mandatory):
  - Ian Goodfellow, Vashya Bengio and Aaron Courville, Deep Learning. Online at: deeplearningbook.org
  - Aurélien Géron, Hands-on Machine Learning with Scikit-Learn and TensorFlow
  - Eli Stevens, Luca Antiga and Thomas Viehmann, Deep Learning with PyTorch

Software

The programming assignments will all be done in Python using the NumPy scientific computing library, but prior knowledge of Python is not required. We recommend IPython rather than the default Python console. You will work with Pytorch or TensorFlow to benefit from ML libraries.

Topics Covered

We will try to cover the following topics:

- Review of linear algebra
- Simple statistics and measures used for machine learning
- Linear Regression
- Linear Classification
- Perceptron and multilayer perception

- Backpropagation
- Optimization
- Generalization
- Convolutional Networks
- Image Classification
- Recurrent Neural Nets
- Learning Long Term Dependencies
- ResNets and Attention
- GANs

If time allows we may cover topics on Mixture Modeling, Boltzmann Machines, Autoencoders and Adversarial Learning.

Course Objectives

The principal objective for this course is to have students understand the principles underlying neural networks and how they can be used for the creation of intelligent systems. This course allows assumes no background in machine learning. Upon completion, a student will be able to:

- Select a neural network architecture appropriate to a supervised or unsupervised learning task
- Design a feature set appropriate to the machine learning task chosen
- Use a neural network training algorithm to develop an intelligent system for the chosen domain
- Implement the neural network design using the TensorFlow/Pytorch framework
- Use simple statistics and a testing methodology to assess the effectiveness of the system developed
- Visualize and analyze the performance of a neural network design using TensorFlow/Pytorch tools

Assignments will be application-centered and test a student's understanding of the material presented during the lectures.

Evaluation

Grading scheme:

- **20%** Written homeworks (approximately every two weeks)
- **30%** Programming (3-4 projects)
- **20%** Midterm (after reading week)
- **30%** Final exam

Note: In order to pass the course, the student **"must pass term work"**.

Late assignments policy

Homework deadlines are usually strict. For programming projects, you can have 3 days for late submissions in total (not for each project!). You can use this time at once or throughout the semester. An individual can not ask for extra time unless the instructor extends a deadline for a specific assignment.

CS Undergraduate Academic Advisor

The undergraduate advisor for the School of Computer Science is available in Room 5302C HP, by telephone at 520-2600, ext. 4364 or by email at undergraduate advisor@scs.carleton.ca. The advisor can assist with information about prerequisites and preclusions, course substitutions/equivalencies, understanding your academic audit and the remaining requirements for graduation. The undergraduate advisor will also refer students to appropriate resources such as the Science Student Success Centre, Learning Support Services and the Writing Tutorial Services.

Centre for Student Academic Support (CSAS)

The Centre for Student Academic Support (CSAS) is a centralized collection of learning support services designed to help students achieve their goals and improve their learning both inside and outside the classroom. CSAS offers academic assistance with course content, academic writing and skills development. Visit CSAS on the 4th floor of MacOdrum Library or online at: https://carleton.ca/csas/.

University Policies

Student Academic Integrity Policy

Every student should be familiar with the Carleton University student academic integrity policy. A student found in violation of academic integrity standards may be awarded penalties which range from a reprimand to receiving a grade of F in the course or even being expelled from the program or University. Some examples of offences are: plagiarism and unauthorized co-operation or collaboration. Information on this policy may be found in the Undergraduate Calendar.

Plagiarism

As defined by Senate, "plagiarism is presenting, whether intentional or not, the ideas, expression of ideas or work of others as one's own". Such reported offences will be reviewed by the office of the Dean of Science. The Dean of Science now has the following **minimum penalties**:

- First offence, first-year students (< 4.0 cr): Final grade reduction of one full grade (e.g., A- becomes a B-, if that results in an F, so be it)

- First offence (everyone else): F in the course
- Second offence: One-year suspension from program
- Third offence: Expulsion from the University

Note: these are minimum penalties. More-severe penalties will be applied in cases of egregious offences (e.g., a first-year student accessing CULearn/Brightspace from their phone during an exam will be given an F in the course; bribing a faculty member for a better grade would be grounds for suspension, etc.)

If you are unsure of the expectations regarding academic integrity (how to use and cite references, how much collaboration with lab- or classmates is appropriate), ASK your instructor. Sharing assignment or quiz specifications or posting them online (to sites like Chegg, CourseHero, OneClass, etc.) is considered academic misconduct. You are never permitted to post, share, or upload course materials without explicit permission from your instructor. Academic integrity offences are reported to the office of the Dean of Science. Penalties for such offences can be found on the ODS webpage: https://science.carleton.ca/academic-integrity/.

Unauthorized Co-operation or Collaboration

Senate policy states that "to ensure fairness and equity in assessment of term work, students shall not co-operate or collaborate in the completion of an academic assignment, in whole or in part, when the instructor has indicated that the assignment is to be completed on an individual basis". Please refer to the course outline statement or the instructor concerning this issue.

Requests for Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

Pregnancy obligation

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf

Religious obligation

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf

Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. https://carleton.ca/pmc/

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and is survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/

Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

For more information on academic accommodation, please contact the departmental administrator or visit: students.carleton.ca/course-outline

Brightspace – FGPA Access to Brightspace

University of Ottawa Joint Program graduate students (only) can request access by filling out the form.