

COMP 4107B – Winter 2023

Neural Networks

Course Information

Classroom: Room location is posted on the public class schedule

Lectures: Tuesdays & Thursdays, 8:30am – 10:00am

Course Website: <https://brightspace.carleton.ca/d2l/home/131308>

Instructor

Matthew Holden

Contact: matthew.holden@carleton.ca

Office Hours: Tuesdays & Thursdays 10:00am – 11:00am (or by appointment)

Office Location: Herzberg Laboratories 5435

Teaching Assistants

Mohammad Reza Zarei

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Office Hours Time: Mondays 10:30am - 12:30pm

Office Hours Location: HP 5336

Adam Bennett

Contact: adamebennett@cmail.carleton.ca

Office Hours Time: Wednesdays 10:00am - 12:00noon

Office Hours Location: HP 5336

Harman Kang

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Office Hours Time: Thursdays 3:00pm - 5:00pm

Office Hours Location: HP 5336

Course Calendar Description

An introduction to neural networks and deep learning. Theory and application of Neural Networks to problems in machine learning. Various network architectures will be discussed. Methods for improving optimization and generalization of neural networks. Neural networks for unsupervised learning.

Topics Covered

- Biological inspiration for neural networks
- Multilayer perceptrons
- Backpropagation
- Implementation in TensorFlow with the Keras API

- Convolutional neural networks
- Recurrent neural networks
- Generalization in neural networks (model capacity, dropout, regularization, weight decay)
- Reinforcement Learning
- Attention-based methods

Prerequisites

COMP 3105 and (MATH 1104 or MATH 1107)

***For Winter 2023 ONLY: acceptable COMP prerequisites are 3105 or 4105 (no longer offered) or 3106 or 4106 (no longer offered) or SYSC 4415. Must have one MATH prerequisite as per the 2022-23 Undergraduate Calendar.

Course Format

This course will be in-person. During class, we will have interactive activities such as: discussions, tutorials, demonstrations, examples, exercises, etc. In-person class attendance is very important as students will be responsible for all items discussed in class.

Communication

All announcements for the course will be made through Brightspace. You are responsible for regularly monitoring these announcements. In-person classes may also be used to elaborate on announcements.

Students are requested to ask questions or have discussions about the course or course material during the live classes, during instructor or TA office hours, or on Brightspace. This way, other students may benefit from the discussion. You may not, however, post solutions to the assessments during the live classes or Brightspace. Questions or discussion about your individual situation may be asked by email.

Required Textbook(s) and Other Resources

Recommended textbook:

Ian Goodfellow, Yoshua Bengio & Aaron Courville. Deep Learning. MIT Press (2016).

URL: <https://www.deeplearningbook.org/>

Optional Textbooks:

Aurelien Geron. Hands-On Machine Learning with Scikit-Learn, Keras & Tensorflow. O'Reilly (2022). ISBN-13: 978-1098125974

Francois Chollet. Deep Learning with Python. Manning Publications (2021). ISBN-13: 978-1617294433

The course may also use supplementary resources available publicly or through the Carleton Library. Information on accessing these resources will be provided in class or posted on Brightspace.

This course will use Poll Everywhere, Carleton University's tool for in-class polling. See here for details: <https://carleton.ca/edc/pollev/>.

Assessment Scheme

Students will be evaluated in this course according to the following scheme. Details, dates, and submission procedures for each component will be posted on Brightspace.

| <i>Component</i> | <i>Weight</i> |
|------------------|---------------|
| Assignments (5) | 35% |
| Quizzes (5) | 30% |
| Project | 35% |

Assignments

There will be five assignments. Assignments may be theory-based (requiring a written response or calculation), assignments may be implementation-based (requiring an implementation in code), or both theory-based and implementation-based. Implementations must be written in Python 3 and use the TensorFlow library (<https://www.tensorflow.org/>) with the Keras API (<https://keras.io/>). Assignments may be completed individually or in small groups of up to three students.

The lowest assignment grade will be excluded from the total grade. That is, the best four out of five assignments will count toward your total grade.

Quizzes

There will be five quizzes. Each quiz will be 40 minutes in length and take place in-person during regularly scheduled class time. Quizzes are open-book, and you may consult your notes and the textbook during quizzes. You may not use electronic devices (except non-programmable scientific calculators) during quizzes; you may not consult other people during quizzes. Quizzes must be completed individually.

The lowest quiz grade will be excluded from the total grade. That is, the best four out of five quizzes will count toward your total grade.

Project

Students will complete a project that solves a problem using a neural network. The project will comprise: (1) a project proposal outlining the problem, (2) a project report detailing the work completed, and (3) a live demonstration of the work. Projects may be completed individually or in small groups of up to three students.

Important Considerations

If you are unsure of the expectations regarding academic integrity (e.g. how to use and cite references, how much collaboration with classmates is appropriate), ask your instructor

beforehand. 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.

For each assignment and the project, you will be given a 48-hour grace period. Assignments or projects submitted within this 48-hour grace period will be accepted without penalty. Late submissions beyond this will not be accepted. This will be strictly enforced. "Last-minute" requests for extensions or exceptions to these rules will not be granted (except for accommodations provided by university policy). Technical problems do not exempt you from this requirement. Consequently, you are advised to: (1) periodically upload your progress (e.g. upload your progress at least daily) and (2) attempt to submit your final submission well in advance of the due date and time.

For each assignment, you may be submitting one or more files that contain source code. They must be provided in the specified format. Assignments that are in the incorrect format will be penalized and may receive a mark of zero. If any of the source code files you submit does not run, it may receive a mark of zero. Furthermore, you are expected to demonstrate good programming practices, and your code may be penalized if it is poorly written. You are also expected to do the necessary preparatory work (i.e. devising an algorithm) before you start coding. You may be asked to present either pseudocode or a flowchart before you will receive any assistance from the instructor or a teaching assistant.

Undergraduate Academic Advisors

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

SCS Computer Laboratory

Students taking a COMP course can access the SCS computer labs. The lab schedule and location can be found at: <https://carleton.ca/scs/tech-support/computer-laboratories/>. All SCS computer lab and technical support information can be found at: <https://carleton.ca/scs/tech-support/>. Technical support staff may be contacted in-person or virtually, see this page for details: <https://carleton.ca/scs/tech-support/contact-it-support/>.

University Policies

For information about Carleton's academic year, including registration and withdrawal dates, see [Carleton's Academic Calendar](#).

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 [Equity Services](#).

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 <https://carleton.ca/equity/focus/discrimination-harassment/religious-spiritual-observances/>.

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. For more details, visit the [Paul Menton Centre](#) website.

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 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: 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. For more details, see [the policy](#).

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. Examples of punishable offences include: plagiarism and unauthorized co-operation or collaboration. Information on this policy may be found [here](#).

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.

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.

COVID Information

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's symptom reporting protocols.

Masks. Carleton has paused the COVID-19 Mask policy, but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines. While proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.

Doctor's note or medical certificate. in effect for Winter 2023 term. In place of a doctor's note or medical certificate, students are advised to complete the [self-declaration form](#) available on the Registrar's Office website to request academic accommodation for missed course work including exams and assignments. Students should also discuss with the course instructor the required accommodations arising from the COVID-19 situation.