COMP 4107B – Winter 2025

Neural Networks

Course Information

Classroom: In-person (room location is posted on Carleton Central)
Lectures: Mondays & Wednesdays, 10:00am – 11:30am
Course Website: https://brightspace.carleton.ca/d2l/home/283361

Instructor

Matthew Holden (he/him/his)
Contact: matthew.holden@carleton.ca
Office Hours: Mondays & Wednesdays 11:30am – 12:30pm (or by appointment)
Office Location: Herzberg Laboratories 5435

Teaching Assistants

TBD

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.

Prerequisites

COMP 3105 and (MATH 1104 or MATH 1107)

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

Learning Objectives

By the end of this course, students should be able to:

- Understand the different architectures of neural networks
- Select appropriate neural networks to solve different types of problems
- Implement and train neural networks using a software library for deep learning
- Analyze the performance of neural networks

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.

Learning Materials and Other Resources

Recommended textbook:
Ian Goodfellow, Yoshua Bengio & Aaron Courville. Deep Learning. MIT Press (2016).
Available online: https://www.deeplearningbook.org/
Approximate cost: Free

Optional Textbooks:
Aurelien Geron. Hands-On Machine Learning with Scikit-Learn, Keras & Tensorflow (3rd edition). O'Reilly (2022).
Available eBook or hard copy: https://www.oreilly.com/library/view/hands-on-machine-learning/9781098125967/
Approximate cost: $97

Francois Chollet. Deep Learning with Python (2nd edition). Manning Publications (2021).
Available eBook or hard copy: https://www.manning.com/books/deep-learning-with-python-second-edition
Approximate cost: $80

Any editions of the textbook are allowed, but the most recent versions are recommended for compatibility with the latest versions of Tensorflow and Keras.

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 Wooclap, Carleton University's web-based student response system. See here for details: https://www.wooclap.com/.

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.

Component	*Weight*
Assignments (5)	33%
Quizzes (5)	33%
Project	34%

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.

For each assignment, you may be submitting one or more files that contain source code. These files must follow the specified format. Incorrectly formatted assignments 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.

Tentative assignment due dates:
Assignment #1: 2025-01-29
Assignment #2: 2025-02-14
Assignment #3: 2025-03-07
Assignment #4: 2025-03-21
Assignment #5: 2025-04-04

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.

Tentative quiz dates:
Quiz #1: 2025-01-27
Quiz #2: 2025-02-12
Quiz #3: 2025-03-05
Quiz #4: 2025-03-19
Quiz #5: 2025-04-02

The lowest assignment grade or the lowest quiz grade (not both) will be excluded from the total grade computation. That is, either (1) the best four out of five assignments and five out of five quizzes will count toward your total grade or (2) five out of five assignments and 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.

Tentative project due dates:
Project proposal: 2025-02-24
Project report: 2025-04-08
Project demonstration: 2025-04-02 to 2025-04-08 (to be arranged individually)

Late and Missed Work Policies

Late Work
For each assignment, the project proposal, and the project report, students may request a 48-hour extension with no questions asked. A link to request a 48-hour extension will be provided on Brightspace. Submissions within this 48-hour extension period will be accepted without penalty. Late submissions beyond this will not be accepted.

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. It is your responsibility to ensure you have submitted the correct materials.

Missed Work
Students requesting academic consideration for short-term (5 days or shorter) extenuating circumstances must contact the course instructor as soon as possible and complete the Academic Consideration for Coursework Form (https://carleton.ca/registrar/academic-consideration-coursework-form/).

Students requesting academic consideration for long-term (longer than 5 days) extenuating circumstances must contact the course instructor as soon as possible and complete the Long-

Term Academic Consideration Form with supporting documentation (https://payments.carleton.ca/registrar/long-term-academic-considerations-for-coursework/).

Typical accommodation for missed quizzes will involve a modified grading scheme; typical accommodation for missed assignments or project components will involve modified due dates. In all cases, accommodation will be at the discretion of the course instructor.

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/.

Academic Accommodations and Regulations

For information about Carleton's academic year, including registration and withdrawal dates, see Carleton's Academic Year website (https://calendar.carleton.ca/academicyear/).

Academic Accommodation

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (https://students.carleton.ca/course-outline/).

Chat GPT/Generative AI Usage

Unless explicitly stated otherwise, the use of any AI system to complete coursework must be appropriately cited. This includes the use of chatbots (e.g., ChatGPT, Google Bard, Bing Chart), research assistants (e.g., Elicit), and image generators (e.g., Stable Diffusion, Dall-E), etc. Failure to reference such systems or tools is considered academic misconduct.

Academic Integrity

Students are expected to uphold the values of academic Integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that compromise these values include but

are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using artificial intelligence tools such as ChatGPT without appropriate reference.

If you are unsure of the expectations regarding academic integrity (e.g. how to use and cite references, to what degree collaboration with labmates or classmates is permitted), then you must 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 not 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. Information, process and penalties for such offences can be found on the ODS webpage: https://science.carleton.ca/students/academic-integrity/.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in Carleton University's Academic Integrity Policy (https://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy-2021.pdf). Students are expected to familiarize themselves with and abide by Carleton University's Academic Integrity Policy. A list of standard sanctions in the Faculty of Science and additional details about processes can be found here: https://science.carleton.ca/academic-integrity/.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the Rights and Responsibilities Policy (https://carleton.ca/studentaffairs/student-rights-and-responsibilities/#sect1.1) for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.