

# Introduction to Neural Networks

## 1. Course Information

Introduction to Neural Networks  
Applied Mathematics 9624B/4264B  
Winter 2021

### Times

Monday 11:30-1:30 PM (lecture), Thursday 12:30-2:30 PM (programming lab)  
Online synchronous delivery

## 2. Instructor Information

- **Instructors:** Assistant Professors Lyle Muller and Marieke Mur
- **Office:** Western Interdisciplinary Research Building, #4168 (Muller) and #4148 (Mur)
- **E-mail (preferred):** [lmuller2@uwo.ca](mailto:lmuller2@uwo.ca), [mmur@uwo.ca](mailto:mmur@uwo.ca)

## 3. Course Description

### Description

This one-semester graduate course will provide you with an introduction to neural networks. You will learn the fundamentals of neural computation and explore how networks of neurons support brain information processing. You will be familiarized with mathematical models, programming, and machine learning techniques. You will gain an in-depth knowledge of neural computations through weekly programming assignments.

### Learning outcomes

The course is designed to achieve three primary objectives:

1. You will learn what computations are performed by networks of neurons
2. You will learn to link neural computations to cognitive function
3. You will learn to model neural computations in a high-level language (Python)

## Topic outline and schedule

Refer to the course calendar for specific meeting dates and times. Activity and assignment details will be explained in detail within each week's corresponding learning module. If you have any questions, please contact your instructor.

## Fundamental Topics

1. Mathematical models for neural and cognitive processes
2. Single-neuron models
3. Dynamics of neural networks
4. Simple models for memory
5. Simple models for sensory processing
6. Deep convolutional neural networks
7. Recurrent neural networks

## Advanced topics

- Random graph theory
- Dimensionality reduction techniques
- Attractor network models

## Prerequisites

This course is open to graduate students and senior undergraduates. There are no formal prerequisites for the course. However, you are expected to have elementary knowledge of linear algebra (vectors, matrices, matrix multiplication) and programming (functions, variables, loops).

We provide an [online self assessment](#) that you can take prior to the start of the course to help you determine your level of background knowledge on the elementary topics listed above. If you do not have the background knowledge on these topics but are willing to learn, we can provide authorization to enroll in the course on a case-by-case basis. For those who would like to gain programming experience prior to the course, please consider taking Psychology 9040a: Scientific Computing (Fall 2020).

## 4. Course Materials

We will use the following required textbooks: *Theoretical Neuroscience* by Dayan and Abbott and [Deep Learning](#) by Goodfellow, Bengio, and Courville. We will additionally assign recommended readings from primary literature when relevant for the coursework. We will also provide links to online resources for learning to program in Python. Readings and links will be posted on the [course website](#). Students are responsible for checking the course website on a regular basis for news and updates.

## 5. Methods of Evaluation

The overall course grade will be calculated as listed below:

Assignments (8)	50%
Midterm project	25%
Final project	25%

The course will be graded according to weekly programming assignments, a midterm project (week 6, week of February 15), and a final project (week 13, week of March 29). Assignments need to be completed independently. The final project will be performed in small groups. The project involves implementing a model of a neural system and presenting the results in class.

## 6. Accommodation and Accessibility

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a self-reporting of absence or via the Dean's Office/Academic Counselling unit of your Home Faculty. If you are a Social Science student, the Academic Counselling Office of the Faculty of Social Science is located in SSC 2105, and can be contacted at [ssaco@uwo.ca](mailto:ssaco@uwo.ca). If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at [scibmsac@uwo.ca](mailto:scibmsac@uwo.ca). For further information, please consult the university's [policy on academic consideration for student absences](#).

## 7. Academic Policies

The website for Registrarial Services is <http://www.registrar.uwo.ca>. In accordance with [policy](#), the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that email received from the University at his/her official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf). We will clearly indicate the level of acceptable collaboration on assignments and projects.

All assignments and papers may be checked for textual similarity for detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service for papers is subject to the licensing agreement currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>). Programming assignments may be checked for similarity using MOSS (Measure of Software Similarity).

## 8. Support Services

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at 661-2147 if you have any questions regarding accommodations.

The policy on Accommodation for Students with Disabilities can be found here:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/Academic%20Accommodation\\_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf)

The policy on Accommodation for Religious Holidays can be found here:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_religious.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

Learning-skills counsellors at the Student Development Centre (<http://www.sdc.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western ([http://www.health.uwo.ca/mental\\_health](http://www.health.uwo.ca/mental_health)) for a complete list of options about how to obtain help. Additional student-run support services are offered by the USC, <http://westernusc.ca/services>.

## 9. Statements Concerning Online Etiquette

In courses involving online interactions, the Psychology and Applied Mathematics Departments expect students to honour the following rules of etiquette:

- Please “arrive” to class on time
- Please use your computer and/or laptop if possible (as opposed to a cell phone or tablet)
- Please ensure that you are in a private location to protect the confidentiality of discussions in the event that a class discussion deals with sensitive or personal material
- To minimize background noise, kindly mute your microphone for the entire class until you are invited to speak, unless directed otherwise
- In classes larger than 30 participants please turn off your video camera for the entire class unless you are invited to speak
- In classes of 30 students or fewer, where video chat procedures are being used, please be prepared to turn your video camera off at the instructor’s request if the internet connection becomes unstable
- Unless invited by your instructor, do not share your screen in the meeting

The course instructor will act as moderator for the class and will deal with any questions from participants. To participate please consider the following:

- If you wish to speak, use the “raise hand” function and wait for the instructor to acknowledge you before beginning your comment or question.
- Please remember to unmute your microphone and turn on your video camera before speaking.
- Self-identify when speaking.
- Please remember to mute your mic and turn off your video camera after speaking (unless directed otherwise).

General considerations of “netiquette”:

- Keep in mind the different cultural and linguistic backgrounds of the students in the course.
- Be courteous toward the instructor, your colleagues, and authors whose work you are discussing.
- Be respectful of the diversity of viewpoints that you will encounter in the class and in your readings. The exchange of diverse ideas and opinions is part of the scholarly environment. “Flaming” is never appropriate.
- Be professional and scholarly in all online postings. Use proper grammar and spelling. Cite the ideas of others appropriately.

Note that disruptive behaviour of any type during online classes, including inappropriate use of the chat function, is unacceptable. Students found guilty of Zoom-bombing a class or of other serious online offenses may be subject to disciplinary measures under the Code of Student Conduct.