

AM9624B/AM4624B/PSYCH9221B Course Outline

1. Course Information

Introduction to Neural Networks

Applied Mathematics 9624B/4264B, Psychology 9221B

Winter 2025

List of Prerequisites

This course is open to graduate students and senior undergraduates. Prerequisites specific to undergraduate and graduate enrolment are listed below. In general, you are expected to have background knowledge in 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.

Undergraduate Enrollment Restrictions

Undergraduate enrollment in this course is restricted to senior students in Applied Mathematics, with Applied Mathematics 3813A/B and Applied Mathematics 3815A/B as prerequisites (or permission of the instructor).

Graduate Enrollment Restrictions

Graduate enrollment in this course is restricted to graduate students in Applied Mathematics, Psychology, and Neuroscience programs, as well as any student that has obtained special permission to enroll in this course from the course instructor as well as the Graduate Chair (or equivalent) from the student's home program.

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Lyle Muller	lmuller2@uwo.ca	WIRB 4168	x88790	TBD
Dr. Marieke Mur	mmur@uwo.ca	WIRB 4148	x85058	TBD

Students must use their Western (@uwo.ca) email addresses when contacting their instructors and use the relevant course number in the subject line.

3. Course Syllabus, Schedule, Delivery Mode

Course description

This one-semester graduate and undergraduate 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.

Course format

The course will be delivered in person.

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

Key sessional dates

Classes begin: September 5, 2024; January 6, 2025

Fall Reading Week: October 12 – 20
Spring Reading Week: February 15 – 23, 2025
Classes end: December 6, 2024; April 4, 2025
Exam period: December 9 – 22, 2024; April 7 – 30, 2025

4. Course Materials

- **Required textbook:** *Theoretical Neuroscience*, Dayan and Abbott. This textbook costs \$78 (Amazon) and is available through Western Libraries in print and digital versions. Students are welcome to purchase second-hand or earlier editions of this textbook.
- **Required textbook:** *Deep Learning*, Goodfellow, Bengio, and Courville. This textbook costs \$103 (Amazon) and is available through Western Libraries in print version and online in digital form (<https://www.deeplearningbook.org>). Students are welcome to purchase second-hand or earlier editions of this textbook.
- We will assign recommended readings from primary literature when relevant for the coursework. We will also provide links to online resources for Python programming.
- 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. This is the primary method by which information will be disseminated to all students in the class.

5. Methods of Evaluation

Grading Scheme and Assessment Dates

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 programming assignments, a midterm project, and a final project. 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.

Tentative due dates for assignments will be January 17, January 24, January 31, February 7, March 7, March 14, March 21, and March 28. The midterm will tentatively be due the week of February 10, and the final will tentatively be due the week ending with April 4. Projects will be presented and assessed in class. If a student cannot attend their assigned session, a make-up date will be coordinated with the instructors.

General information about missed coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](#).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage: https://registrar.uwo.ca/academics/academic_considerations. All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests normally must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

- Final project

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

Evaluation Scheme for Missed Assessments

If you need to miss an assessment and have been granted Academic Consideration to do so, we will apply the following evaluation scheme. When you miss an assignment, we will reweight the other assignments to calculate your course grade, using the same weight for each of the other assignments, adding up to a total of 50%. When you miss the midterm project, we will reweight the final project to 50% to calculate your course grade. When you miss the final project, we will provide a make-up opportunity.

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under [Special Examinations](#)), especially for those who miss multiple final exams within one examination period.

Essential Learning Requirements

Even when Academic Considerations are granted for missed coursework, the following are deemed essential to earn a passing grade.

- A minimum of 4 completed assignments

Coursework with Assessment Flexibility

By policy, instructors may deny Academic Consideration requests for the following assessments with built-in flexibility:

Flexible Completion

Assignments. This course has 8 assignments, and the 7 assignments with the highest marks are counted towards your final grade.

Deadline with a No-Late-Penalty Period

Assignments. Students are expected to submit each of the 8 assignments by the deadline listed. Should extenuating circumstances arise, students do not need to request Academic Consideration and they are permitted to submit their assignment up to 48 hours past the deadline without a late penalty. Should students submit their assignment beyond 48 hours past the deadline, the assignment will receive a zero mark.

6. Additional Statements

Religious Accommodation

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays:

<https://www.edi.uwo.ca>.

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf).

Academic Policies

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,

the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their 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:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf or https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf.

All required papers and code may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers and code 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 is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>). Code may be checked for similarity using MOSS (Measure of Software Similarity).

Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage or Social Science Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic-related matters: <https://www.uwo.ca/sci/counselling/> and <https://counselling.ssc.uwo.ca/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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 Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counsellors at Learning Development and Success (<https://learning.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.

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>.

Accessible Education at Western (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate and undergraduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective programs.

Students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW), a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their programs to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.