



# THE UNIVERSITY OF WINNIPEG

## APPLIED COMPUTER SCIENCE

### GACS-7206-001 Advanced Machine Learning

#### **Instructor Information**

**Instructor:** Dr. Sheela Ramanna  
**E-mail:** s.ramanna@uwinnipeg.ca

**Class Meeting Time:** T, Th 10:00 - 11:15am  
**Lecture Room No:** 3D03

**Office Hours:** T,Th: 2:15-3:15pm (in person)  
Friday (Remote): By appointment  
ZOOM coordinates will be communicated via email.

#### **Important Dates**

1. First Class: Jan. 7
2. Final Withdrawal Date w/o academic penalty: March 14  
(A minimum of 20% of the work on which the final grade is based will be evaluated and available to the student before the voluntary withdrawal date)
3. Reading Week: Feb 16-22 (No classes)
4. Last Class: April 3
5. Final Project Presentations Date: TBD
6. The university will be closed on February 17 (Louis Riel Day), April 18 (Good Friday)

**Lectures on Feb. 11 and Feb. 13 will be recorded. There are no in-person classes and office hours in the week of February 10-14.**

#### **Course Objectives**

This course covers well-known machine learning and deep learning algorithms. Topics include *supervised learning* (generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines); *unsupervised learning* (clustering, dimensionality reduction); *learning theory* (bias/variance tradeoffs, optimization). The second focus of this course is on Natural Language Processing (NLP) and deep neural models for language processing tasks. Large Language Models (LLMs) will be discussed. Applications of machine learning and deep learning are introduced via case studies. The course is also meant to give experience to students in preparing a peer reviewed paper as a part of a class project. Familiarity with Python is recommended.

*Note: A permitted or necessary change in mode of delivery may require adjustments to important aspects of course outlines, like class schedule and the number, nature, and weighting of assignments and/or exams.*

## Tentative List of Topics

- **Supervised Learning**
  - Classifiers: Tree-based, Rule-Based, Bayesian, K-Nearest Neighbour, Logistic Regression, Support Vector Machines, Neural Networks
- **Unsupervised Learning**
  - Clustering Methods: Partitional, Hierarchical, Density-based, Probabilistic
- **Numeric Prediction** (regression)
- **Ensemble Methods**
- **Other topics**
  - Sampling, Metrics, Data Fairness, Bias, Responsible AI
- **Deep Neural Language Models** (CNN, RNN, LSTM, Encoder/Decoder and Transformers)
  - **Large Language Models (LLMs)** – strengths and weaknesses
- **Case Studies** with neural language models (sentiment analysis and text summarization)

## Evaluation Criteria

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|--|-----|
| ➤ Assignments (2)<br><b>A1 (20%), A2 (15%)</b> | 35% |
| ➤ Participation                                | 5%  |
| ➤ Project Proposal Report                      | 10% |
| ➤ Final Project (35%) + Presentation (15%)     | 50% |

### **Assignments:**

Assignment 1 is meant to give hands-on experience in coding well-known ML algorithms as well as writing **detailed analysis of the implemented algorithms**. Assignment 2 will involve reading a well-known **ground-breaking paper in ML or DL** and presenting the assigned paper in class as well as writing a report on the paper.

**Participation:** Each student must submit a **participation report** at the end of the term. Participation activities include: attending some department seminars, participating in class presentations and discussions (e.g., Q/A). **Each student is required to attend ALL presentation of their peers.** Instructions on the completing a participation report will be given in class.

**Reports:** All assignments and reports **must be written in LaTeX**. Instructions on the specific tools as well as sample templates will be given in class.

### **Final Project**

- Preparing a project proposal (max. 5 pages)
- Reading a few high-quality peer-reviewed papers related to the proposal topic
- Implementing a solution
- Preparing a project report (max 20 pages)

The Final Project will be evaluated based on, i) innovative solution, ii) working software, iii) technical soundness and completeness, and iv) quality of the project report. The report must be

prepared using a standard template which will be provided in class.

### **Late Submission Policy:**

You are allowed to submit assignments late by up to 2 days. Each day will result in a penalty of 10% of your grade.

Students with documented disabilities, temporary or chronic medical conditions, requiring academic accommodations for tests/exams (e.g., private space) or during lectures/laboratories (e.g., note-takers) are encouraged to contact Accessibility Services (AS) at 204-786-9771 or [accessibilityservices@uwinnipeg.ca](mailto:accessibilityservices@uwinnipeg.ca) to discuss appropriate options. All information about a student's disability or medical condition remains confidential.

<https://www.uwinnipeg.ca/accessibility-services>.

Students may choose not to attend classes or write examinations on holy days of their religion, but they must notify their instructors at least two weeks in advance. Instructors will then provide opportunity for students to make up work examinations without penalty. A list of religious holidays can be found in the Undergraduate Academic Calendar online at

<http://uwinnipeg.ca/academics/calendar/docs/important-notes.pdf>

### **Final Letter Grade Assignment**

Historically, numerical percentages have been converted to letter grades using the following scale. However, instructors can deviate from these values based on pedagogical nuances of a particular class, and final grades are subject to approval by the department.

A+	90+ - 100%	B	70 - 74%	F	below 50%
A	85 - 90%	C+	65 - 69%		
A-	80 - 84%	C	60 - 64%		
B+	75 - 79%	D	50 - 59%		

### **Reading List\***

There is no specific textbook for this course. Course notes and links to free materials on the topics covered in class will be shared in class and will be made available via NEXUS.

**Prerequisite Information** (This information can be found in the UW Graduate calendar)  
Consent of the Department Graduate Program Committee Chair or Instructor.

### **Student Wellness**

The University of Winnipeg affirms the importance of student mental health and our commitment to providing accessible, culturally appropriate, and effective services for students. Students who are seeking mental health supports are encouraged to reach out to the Wellness Centre at [studentwellness@uwinnipeg.ca](mailto:studentwellness@uwinnipeg.ca) or 204.988.7611. For community-based mental health resources and supports, students are encouraged to dial 2-1-1. This program of United Way is available 24/7 in 150 languages.

## **Regulations, Policies, and Academic Integrity**

Academic dishonesty is a very serious offense and will be dealt in accordance with the University's policies.

*Avoiding Academic Misconduct:* Students are encouraged to familiarize themselves with the Academic Regulations and Policies found in the University Academic Calendar at:

<https://uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf>

Particular attention should be given to subsections 8 (Student Discipline), 9 (Senate Appeals) and 10 (Grade Appeals). Please note, in particular, the subsection of Student Discipline pertaining to plagiarism and other forms of cheating.

Detailed information can be found at the following:

- Academic Misconduct Policy and Procedures:  
<https://www.uwinnipeg.ca/policies/docs/policies/academic-misconduct-policy.pdf> and  
<https://www.uwinnipeg.ca/policies/docs/procedures/academic-misconduct-procedures.pdf>
- UW Library video tutorial “Avoiding Plagiarism”  
<https://www.youtube.com/watch?v=UvFdxRU9a8g>

Uploading essays and other assignments to essay vendor or trader sites (filesharing sites that are known providers of essays for use by others who submit them to instructors as their own work) involves “aiding and abetting” plagiarism. Students who do this can be charged with Academic Misconduct.

### ***Academic Integrity and AI Text-generating Tools:***

Students must follow principles of academic integrity (e.g., honesty, respect, fairness, and responsibility) in their use of material obtained through AI text-generating tools (e.g., ChatGPT, Bing, Notion AI). AI tools are permitted. However students must cite them. According to the MLA (<https://style.mla.org/citing-generative-ai/>), writers should

- cite a generative AI tool whenever you paraphrase, quote, or incorporate into your own work any content (whether text, image, data, or other) that was created by it
- acknowledge all functional uses of the tool (like editing your prose or translating words) in a note, your text, or another suitable location
- take care to vet the secondary sources it cites

**Non-academic misconduct:** Students are expected to conduct themselves in a respectful manner on campus and in the learning environment irrespective of platform being used. Behaviour, communication, or acts that are inconsistent with a number of UW policies could be considered “non-academic” misconduct. More detailed information can be found here:

- Respectful Working and Learning Environment Policy  
<https://www.uwinnipeg.ca/respect/respect-policy.html>,
- Acceptable Use of Information Technology Policy

<https://www.uwinnipeg.ca/policies/docs/policies/acceptable-use-of-information-technology-policy.pdf>

- Non-Academic Misconduct Policy and Procedures  
<https://www.uwinnipeg.ca/policies/docs/policies/student-non-academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/policies/docs/procedures/student-non-academic-misconduct-procedures.pdf>

**Copyright and Intellectual Property.** Course materials are the property of the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides—irrespective of format. Students who upload these materials to filesharing sites, or in any other way share these materials with others outside the class without prior permission of the instructor/presenter, are in violation of copyright law and University policy. Students must also seek prior permission of the instructor/presenter before, for example, photographing, recording, or taking screenshots of slides, presentations, lectures, and notes on the board. Students found to be in violation of an instructor’s intellectual property rights could face serious consequences pursuant to the Academic Misconduct or Non-Academic Misconduct Policy; such consequences could possibly involve legal sanction under the Copyright Policy

[https://copyright.uwinnipeg.ca/docs/copyright\\_policy\\_2017.pdf](https://copyright.uwinnipeg.ca/docs/copyright_policy_2017.pdf)

### **Privacy**

Students have rights in relation of the collecting of personal data the University of Winnipeg

- Student Privacy: <https://www.uwinnipeg.ca/privacy/admissions-privacy-notice.html>
- Zoom Privacy: <https://www.uwinnipeg.ca/privacy/zoom-privacy-notice.html>

### **Class Cancellation, Correspondence with Students and Withdrawing from Course**

When it is necessary to **cancel a class** due to exceptional circumstances, the course instructor will make every effort to inform students via **uwinnipeg email and Nexus**. Students are reminded that they have a responsibility to **regularly check their uwinnipeg e-mail addresses** to ensure timely receipt of correspondence from the University and/or the course instructor. Please let course instructor know if you plan on **withdrawing from the course**. Note that withdrawing before the VW date does not necessarily result in a fee refund.