THE UNIVERSITY OF WINNIPEG

APPLIED COMPUTER SCIENCE

Graduate Course No.: GACS-7203-001
Graduate Course Title: Pattern Recognition

Instructor Information

Instructor: Camilo Valderrama
Office: 3D06A
Class Meeting Time: Tuesdays & Thursdays 13:00-14:15
Classroom: 3D03
Office Hour: Thursdays 14:30-15:30
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When it is necessary to cancel a class due to exceptional circumstances, the instructor will make every effort to inform students via uwinnipeg.ca e-mail, as well as the Department Assistant and Chair/Dean so that class cancellation forms can be posted outside classrooms.

Students are reminded that they have a responsibility to regularly check their uwinnipeg.ca e-mail addresses to ensure timely receipt of correspondence from the university and/or their course instructors.

Important Dates

First Class: September 3, 2024
Final Withdrawal Date w/o academic penalty: November 13, 2024
(A minimum of 20% of the work on which the final grade is based will be evaluated and available to all students before the voluntary withdrawal date.)
Reading Week (no classes) October 14 – 18, 2024
Last Class: November 28, 2024
The University of Winnipeg will be closed on September 30th (Truth and Reconciliation Day), October 14th (Thanksgiving), and November 11th (Remembrance Day).
Project Presentation Day: December 13, 2024

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 here: https://www.uwinnipeg.ca/academics/calendar/docs/importantnotes.pdf .

Course Objectives/Learning Outcomes

This course will give students a detailed overview of classification techniques, known as "pattern recognition". This is a diverse and interesting area, with applications in science, industry, and finance. This course covers a range of methods and techniques for extracting patterns from datasets, including Bayesian theory, unsupervised models, and neural networks.

Evaluation Criteria

1. Assignments (36%)
   - Number of Assignments: 3 (12%+12%+12%)

2. Paper presentation (14%)
   - Students will be asked to read a scientific journal, and to give a 10-minute presentation on the topic.

3. Final Project (50%)

The final exam will be replaced by a project. The purpose of the project is to make students familiar with at least one of applications of pattern recognition. The project includes choosing a particular problem in pattern recognition (theory or application), searching and reading related papers on this topic, implementing the solution, and writing a 15-20 pages report.
The final project is composed of the following subcomponents:

- Project Presentation (15%): This document outlines the project's context, objectives, and proposed methodology. It serves as the foundational plan for your project.
- Attendance and Participation (5%): Students need to attend all the final project presentation and participate during the question session.
- Final Project Report (20%): A **two-column six-page paper** following the IEEE format is required. The report should include the following information:
    1. **Title**: clearly state the title of your research project to provide a concise overview of the topic.
    2. **Abstract:** Provide a brief summary of your research, including the problem, methodology, key findings, and contributions (**250 words**)
    3. **Introduction**
        - **Problem Statement**: Present a well-defined problem statement that outlines the research challenge your project aims to address. Clearly articulate the significance and relevance of this problem
        - **Distinguishing Contributions from Related Works**: Identify the current gap in the research (the GAP) that your project will address. Discuss how your project contributes to filling this gap and highlight the potential contributions your work makes to the field.
    4. **Methods**
        - **Methodology**: Describe the methodology employed in your research, detailing the tools, techniques, and approaches used to

investigate and solve the problem. This section should provide a clear roadmap for readers to understand your research process, including the experimental parameters and evaluation metrics you used to assess your approach.

5. **Results**
    - **The performance evaluation**: Present your results using text, tables, and figures. Provide only the raw results; interpretation should be reserved for the discussion section.
6. **Discussion**
    - **Main findings implications:** Explain how the achieved results contribute to the state-of-the-art. Discuss how your results relate to previous studies—whether they support or contradict prior research
    - **Strength and Limitations**: Acknowledge and discuss the strengths and limitations of your research. The limitations could involve constraints in methodology, data, or other factors that may impact the generalizability or robustness of your findings.

- **NOTE**: The six pages also include the figures, tables, and references.
- **Additionally, submit any code produced for the project.**
- Presentation (15%). Final presentation of the project on **December 13, 2024**
- Attendance and participation of final project presentations (5%)

NOTE: Late work for any work delivery will receive a 20% penalty daily.

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 Graduate Studies Committee.

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%		

Services for Students

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 786-9771 or email accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a student's disability or medical condition remains confidential.
http://www.uwinnipeg.ca/accessibility.

All students, faculty and staff have the right to participate, learn and work in an environment that is free of harassment and discrimination. The UW Respectful Working and Learning Environment Policy may be found online at www.uwinnipeg.ca/respect.

The University of Winnipeg promotes a scent-free environment. Please be respectful of the needs of classmates and the instructor by avoiding the use of scented products while attending lectures. Exposure to perfumes and other scented products (such as lotion) can trigger serious health reactions in persons with asthma, allergies, migraines or chemical sensitivities.

Required Text Book

• ***Pattern Classification*** by R.O. Duda, P.E. Hart, and D.G. Stork (ISBN-13: 978-0471056690)

Prerequisite Information

This course assumes that students have a working knowledge of probability theory, linear algebra, optimization methods, basic estimation techniques, and other statistical topics on the level of introductory courses in statistics. Strong programming skill is needed as well.

Consent of the Department Graduate Program Committee Chair and Instructor is required.

Regulations, Policies, and Academic Integrity

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).

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

Detailed information can be found at the following:

- Academic Misconduct Policy and Procedures: https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-policy.pdf and https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-procedures.pdf
- About Academic Integrity and Misconduct, Resources and FAQs: https://library.uwinnipeg.ca/use-the-library/help-with-research/academic-integrity.html

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). If an instructor prohibits the use of AI tools in a course, students may face an allegation of academic misconduct if using them to do assignments. If AI tools are permitted, 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

If students are not sure whether or not they can use AI tools, they should ask their professors.

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/institutional-analysis/docs/policies/acceptable-use-of-information-technology-policy.pdf
- Non-Academic Misconduct Policy and Procedures: https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-policy.pdf and https://www.uwinnipeg.ca/institutional-analysis/docs/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/basics/copyright-policy.html

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.

Topics to be covered(tentative)

1. Overview of Learning and Pattern Recognition

2. Bayesian Decision Theory

   Continuous features
   Bayes rule and Bayes risk
   Classifiers, discriminant functions, and decision surfaces
   The normal density
   Discriminant functions for the normal density

3. Maximum-Likelihood and Bayesian Parameter Estimation

   Maximum-Likelihood estimation
   Bayesian estimation
   Bayesian parameter estimation

4. Unsupervised Methods

   Dimensionality Reduction and Feature Selection
   Principal Component Analysis
   Fisher's Linear Discriminant Analysis
   Clustering

5. Neuronal Networks

   Regularization, stochastic gradient descent (SGD), learning rates
   MLP, CNN history and architectures
   Training Neural Networks, activation functions, data processing, weight initialization, hyperparameter tuning, data augmentation

Note that all topics listed may not be covered and can be offered in a different time order.