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 14:30-15:45
Classroom: 3D03
Office Hour: Thursdays 16:00-17:00
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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: January 5, 2023
Final Withdrawal Date w/o academic penalty: March 14, 2023
(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) February 20 – 24, 2023
Last Class: April 4, 2023
The University of Winnipeg will be closed on February 20th (Louis Riel Day), and April 7th (Good Friday).
Project Presentation Day: April 20, 2023

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/important-notes.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 methods from linear classifiers of more flexible models to nonparametric techniques. Feature generation, selection, and extraction techniques will be examined. Both supervised and unsupervised learning methods will be discussed.

Evaluation Criteria

Assignments (42%)

- Number of Assignments: 3 (10%+10%+10%)

  All assignments are to be completed **individually**.

  The process of actively struggling with an assignment is one of the most important educational experiences you will have in this course.

- Students will be asked to read some material for selected problems, to write 5-7 pages typed review of the provided topic, to develop computer programs for simulating results, and to give a 20-minute presentation on the topic (12%).

- Late work will receive a 20% penalty daily.

Final Exam (48%)

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 project will be evaluated by its originality and novelty (20/48), technical soundness and completeness of the solution (20/48), and readability and organization of the typed report (8/48).

Presentation (10%)

The project will be represented in a 30-minute presentation on April 20, 2023.

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.

Misuse of Computer Facilities, Plagiarism, and Cheating

Academic dishonesty is a very serious offense and will be dealt in accordance with the University's discipline bylaw. Be sure that you have read and understood **Regulations & Policies #8**, available at
https://www.uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf

Avoiding Academic Misconduct: Uploading essays and other assignments to essay vendor or trader sites (file-sharing 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.

Avoiding Copyright Violation: Course materials are owned by the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides. Students who upload these materials to file-sharing 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 photographing or recording slides, presentations, lectures, and notes on the board.

Important notes
1. 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.
2. Students can find answers to frequently ask questions related to remote learning here:
   https://www.uwinnipeg.ca/covid-19/remote-learning-faq.html
3. **Regulations, Policies, and Academic Integrity.** Students are encouraged to familiarize themselves with the Regulations and Policies found in the University Academic Calendar at https://www.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 emphasize the importance of maintaining academic integrity and the potential consequences of engaging in plagiarism, cheating, and other forms of

academic misconduct. Even unintentional plagiarism, as described in the UW Library video tutorial "Avoiding Plagiarism" (https://www.youtube.com/watch?v=UvFdxRU9a8g), is a form of academic misconduct. Similarly, 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) is a form of misconduct, as it involves aiding and abetting plagiarism. Important information is outlined in the 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.
Clear expectations for assignments, tests, and exams should be set for students to avoid instances of misconduct. For instance, in the case of take-home exams, students should be advised on permitted resources, being able to collaborate (or not) with other students, etc.

4. **Respectful Learning Environment.** 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 nonacademic misconduct. See the Respectful Working and Learning Environment Policy (https://www.uwinnipeg.ca/respect/respect-policy.html) and Acceptable Use of Information Technology Policy (https://www.uwinnipeg.ca/institutional-analysis/docs/policies/acceptable-use-ofinformation-technology-policy.pdf). More detailed information is outlined in the Non-Academic Misconduct Policy and Procedures (https://www.uwinnipeg.ca/institutional-analysis/docs/student-nonacademic-misconduct-policy.pdf and https://www.uwinnipeg.ca/institutional-analysis/docs/studentnon-academic-misconduct-procedures.pdf). Instructors whose mode of delivery includes Zoom or a similar platform should clarify expectations for appropriate remote classroom behaviour or decorum (e.g., being on time, muting/unmuting, raising hand, reacting, etc.), and make appropriate allowances in order to respect the privacy of students (e.g., clarifying need to have video on/off).

5. **Privacy.** Students should be reminded of their rights in relation to the collecting of personal data by the University (https://www.uwinnipeg.ca/privacy/admissions-privacy-notice.html), especially if Zoom is being used for remote teaching

(https://www.uwinnipeg.ca/privacy/zoom-privacynotice.html) and testing/proctoring (https://www.uwinnipeg.ca/privacy/zoom-test-and-examproctoring.html).

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.   Non-Parametric Techniques

   Density estimation
   Parzen windows
   The Nearest-Neighbor rule

5.   Linear Discriminant Functions

   Linear discriminant functions and decision surfaces
   Generalized linear discriminant functions
   Minimizing the perceptron criterion function
   Relaxation procedures
   Minimum square-error procedures

6.   Non-metrics methods

   Decision Trees
   CART
   Number of Splits
   Pruning

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