THE UNIVERSITY OF WINNIPEG

APPLIED COMPUTER SCIENCE

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

Instructor Information

Instructor: Dr. Simon Liao
Office: 3D31
Class Meeting Time: Tuesdays & Thursdays 14:30-15:45
Class Room: 3D03
Office Hour: Thursdays 16:00-17:00, or by email appointment
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Course Web Page: http://ion.uwinnipeg.ca/~sliao/Courses/PR.html

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 8, 2019
Reading Week (no classes) February 17 – 23, 2019
The University of Winnipeg will be closed on February 18th and April 19th.
Final Withdrawal Date w/o academic penalty: March 15, 2019
(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.)
Project Presentation Day: April 23, 2019

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 2018-19 Undergraduate Academic Calendar.

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. All presentations will be given on February 26, 2019 (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 image processing. The project includes choosing a particular problem in image processing (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 23, 2019.

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**, in the 2018-2019 UW Course Calendar available at: http://www.uwinnipeg.ca/index/calendar-calendar.

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.

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. Algorithm-Independent Machine Learning

   Lack of inherent superiority of any classifier
   Bias and variance
   Resampling for classifier design
   Estimating and Comparing classifiers
   Combining classifiers

7. Unsupervised Learning and Clustering

   Mixture densities and identifiability
   Maximum-likelihood estimates
   Unsupervised Bayesian learning
   Clustering

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