

COURSE SYLLABUS

CMPT 820: Topics in Learning and Intelligent Systems

Catalogue Description:

This course explores advanced techniques for management and analysis of data in unstructured application environments. Techniques covered may be chosen from the following: Bayesian modelling, data conditioning, machine learning (Bayesian inference, neural networks, decision trees, classifiers), user interface agents, and other similar techniques in the AI research literature as appropriate.

Prerequisite(s): Graduate degree in Computer Science
Class Time & Location: Lecture Tuesday, Thursday 1:00-2:30 Thorvaldson 205A
 Tutorial Wednesday 12:30-1:20, Spinks 311
Website: moodle.cs.usask.ca

Instructor Information

Instructor: Kevin Stanley
Contact: Email: kevin.stanley@usask.ca
 Phone: 306-966-6747
Office Hours: Location: Thorvaldson 281.5
 Hours: Friday 2:00-4:00

Course Objectives

Students will be given the opportunity to achieve the following:

- Reinforce an existing understanding of statistics
- Understand traditional statistical techniques and their relationship to Machine Learning algorithms
- Understand the statistical basis for machine learning algorithms
- Examine Bayesian learning algorithms from a fundamental mathematical and algorithmic perspective
- Appropriate apply each algorithm for dataset analysis including
 - Appropriate data conditioning
 - Run time performance estimation
 - Common failure modes and their detection
 - Scope of application of the algorithm results
- Distinguish between structured and unstructured learning and how they are applied in practice
- Describe and implement a variety of Machine Learning algorithms, and their application
- Knowledge of existing software tools including MATLAB, R, Weka and Netica

Student Evaluation

Grading Scheme

Assignments	28%
Project	72%
Total	100%

Students will be expected to prepare five assignments primarily dealing with the fundamentals. The majority of the grade will be assigned to the final project and paper. Students will be expected to obtain real data such as transaction logs from digital services or games, DNA sequences, population health data, or other tabular databases, and perform a suitable Machine Learning analysis on the data. Student teams will submit a proposal on the questions and hypothesis they wish to study and the approach they wish to employ, which will be graded for feasibility, depth, and originality. At the end of the course, the students will be expected to produce both an 8000 word paper and a 20 minute presentation on the results they obtained. Paper and presentation will be graded on quality of presentation, quality of analysis and depth of demonstrated understanding of the course topics.

Assignments are tentatively scheduled for the following dates: 9/17, 9/24, 10/8, 10/29

Project deliverables are tentatively scheduled for the following dates: 9/10, 10/1, 10/22, 11/5, 11/19, 11/26, 12/4.

Criteria that must be met to Pass

Student must demonstrate minimum acceptable performance on the project to pass the course.

Attendance Expectation

Students are expected to attend demonstration sessions associated with project deliverables, as scheduled with the professor

Note: All students must be properly registered in order to attend lectures and receive credit for this course.

Textbook Information

Required Text

Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, Cambridge MA, 2012, ISBN 978-0-262-01802-9

Tentative Lecture Schedule

1. Data and Analysis
2. Bayesian Statistics
3. Linear Regression
4. Bayes Nets
5. Classification
6. Clustering
7. Latent Linear Models
8. Hidden Markov Models
9. Kalman and Particle Filtering
10. Markov Chain Monte Carlo
11. Neural Networks
12. Deep Learning

Course Overview

Students will be provided with access to three Machine Learning programming environments: MATLAB, R and Weka. Students will be responsible for learning most of the technical particulars of each of these tools outside of

instructional time. One lecture each on the use of these tools will be provided at the midpoint of the semester. While instructors will provide examples in each of these (and potentially other) environments, the class is intended to discuss the underlying mathematical and algorithmic structures of the Machine Learning algorithms, and not their interpretations in a particular software package.

Policies

Late/Missed Assignments

In general, late assignments are not accepted, except with legitimate excuses (e.g. illness, bereavement)

Missed Examinations

1. "Students who have missed an exam or assignment must contact their instructor as soon as possible. Arrangements to make up the exam may be arranged with the instructor. Missed exams throughout the year are left up to the discretion of the instructor if a student may make up the exam or write at a different time. If a student knows prior to the exam that she/he will not be able to attend, they should let the instructor know before the exam."
2. "Final exams - a student who is absent from a final examination through no fault of his or her own, for medical or other valid reasons, may apply to the College of Arts and Science Dean's office. The application must be made within three days of the missed examination along with supporting documentary evidence. Deferred exams are written during the February mid-term break for Term 1 courses and in early June for Term 2 and full year courses." (2007/08. <http://www.arts.usask.ca/students/transition/tips.php>)

Incomplete Course Work and Final Grades

"When a student has not completed the required course work, which includes any assignment or examination including the final examination, by the time of submission of the final grades, they may be granted an extension to permit completion of an assignment, or granted a deferred examination in the case of absence from a final examination. Extensions for the completion of assignments must be approved by the Department Head, or Dean in non-departmentalized Colleges, and may exceed thirty days only in unusual circumstances. The student must apply to the instructor for such an extension and furnish satisfactory reasons for the deficiency. Deferred final examinations are granted as per College policy.

In the interim, the instructor will submit a computed percentile grade for the course which factors in the incomplete course work as a zero, along with a grade comment of INF (Incomplete Failure) if a failing grade. In the case where the instructor has indicated in the course outline that failure to complete the required course work will result in failure in the course, and the student has a computed passing percentile grade, a final grade of 49% will be submitted along with a grade comment of INF (Incomplete Failure).

If an extension is granted and the required assignment is submitted within the allotted time, or if a deferred examination is granted and written in the case of absence from the final examination, the instructor will submit a revised computed final percentage grade. The grade change will replace the previous grade and any grade comment of INF (Incomplete Failure) will be removed.

For provisions governing examinations and grading, students are referred to the University Council Regulations on Examinations section of the Calendar. (2011 University of Saskatchewan Calendar/Academic Courses Policy)

Academic Honesty

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or

participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct (<http://www.usask.ca/secretariat/student-conduct-appeals/StudentAcademicMisconduct.pdf>) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (<http://www.usask.ca/secretariat/student-conduct-appeals/StudentNon-AcademicMisconduct.pdf>) For more information on what academic integrity means for students see the Student Conduct & Appeals section of the University Secretary Website at: <http://www.usask.ca/secretariat/student-conduct-appeals/forms/IntegrityDefined.pdf>

Examinations with Disability Services for Students (DSS)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Disability Services for Students (DSS) if they have not already done so. Students who suspect they may have disabilities should contact DSS for advice and referrals. In order to access DSS programs and supports, students must follow DSS policy and procedures. For more information, check <http://www.students.usask.ca/disability/>, or contact DSS at 966-7273 or dss@usask.ca.

Students registered with DSS may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through DSS by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by DSS.