CMPT 726 - G100 Machine Learning

Calendar Objective/Description:
Machine Learning is the study of computer algorithms that improve automatically through experience. Provides students who conduct research in machine learning, or use it in their research, with a grounding in both the theoretical justification for, and practical application of, machine learning algorithms. Covers techniques in supervised and unsupervised learning, the graphical model formalism, and algorithms for combining models. Students who have taken CMPT 882 (Machine Learning) in 2007 or earlier may not take CMPT 726 for further credit.

Instructor's Objectives:
Machine Learning is the study of computer algorithms that improve automatically through experience. Machine learning algorithms play an important role in industrial applications and commercial data analysis. The goal of this course is to present students with both the theoretical justification for, and practical application of, machine learning algorithms. Students in the course will gain hands-on experience with major machine learning tools and their applications to real-world data sets. This course will cover techniques in supervised and unsupervised learning, neural networks / deep learning, the graphical model formalism, and algorithms for combining models. This course is intended for graduate students who are interested in machine learning or who conduct research in fields which use machine learning, such as computer vision, natural language processing, data mining, bioinformatics, and robotics. No previous knowledge of pattern recognition or machine learning concepts is assumed, but students are expected to have, or obtain, background knowledge in mathematics and statistics.

Prerequisites:
None

Topics:
- Graphical models: directed and undirected graphs
- Inference algorithms: junction tree, belief propagation, variational inference, Markov Chain Monte Carlo, Gibbs sampling
- Temporal models and algorithms: hidden Markov Models, Kalman filtering, particle filtering
- Classification: nearest neighbour, support vector machines, decision trees, naive Bayes, Fisher's linear discriminant
- Regression: linear regression, logistic regression, regularization
- Unsupervised learning: spectral clustering, kmeans
- Expectation-maximization
- Kernel density estimation
- Boosting
- Deep learning

Grading:
The course grade will be based on homework assignments, a project, and exams.

Required Books:
Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2006, 9780387310732
**Reference Books:**

- *The Elements of Statistical Learning*, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, Springer-Verlag, 2009, 9780387848570
- *Pattern Classification (2nd ed.*), Richard O. Duda, Peter E. Hart, and David G. Stork, Wiley Interscience, 2000, 9780471056690

**Academic Honesty Statement:**

Academic honesty plays a key role in our efforts to maintain a high standard of academic excellence and integrity. Students are advised that ALL acts of intellectual dishonesty will be handled in accordance with the SFU Academic Honesty and Student Conduct Policies (http://www.sfu.ca/policies/gazette/student.html).