Syllabus for
Advanced Machine Learning (MLearn 310)
Machine Learning Certificate Program (5207/5208)

Downtown Seattle / Online
Thursdays, Apr 7 – Jun 9, 2016: 6-9pm

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Course Description:
This course builds upon the Introduction to Machine Learning (ML) course by covering recent and advanced methods in machine learning. It will emphasize approaches with current practical relevance, and discuss several more advanced machine learning topics, such as recommendation systems, natural language processing, and deep learning (to name a few). The main objective of the course is to introduce the students to more complex machine-learning-related problems commonly found in real-life applications that require specialized algorithms to model them, and where basic techniques would result in sub-optimal solutions.

Course Learning Objectives:
- Gain familiarity with advance machine learning techniques
- Explore state-of-the-art ML algorithms
- Ability to formalize and model a real world task as a machine learning problem
- Given a well-stated machine learning problem, being able to identify an appropriate and efficient technique to solve it

Course Format:
The course will consist of both lecture and demonstration. Students will need access to a computer to complete weekly assignments. Please bring your computer to class.

Course Materials:
This class will focus on making sure students are familiar with basic machine learning theory, while providing hands-on experience with advanced machine learning methods.

We will review several chapters of Kevin Murphy's book, "Machine Learning: A Probabilistic Perspective." If possible, please try to get a copy of the fourth printing of this book, as known typos have been corrected. The fourth printing has the string "10 9 8 7 6 5 4" at the bottom of the copyright page.

Technical Requirements:
The tools we will use in this class include python, scikit-learn, Apache Spark, NLTK, vowpal wabbit, xgboost, theano, and keras.

Program Webpage:
https://canvas.uw.edu/courses/1044489

Course Topics by Date:

- **Apr 7:**
  - **Chapter 1: Introduction**
  - **Python and scikit-learn**
    - **Interfaces**
    - **Model selection**

- **Apr 14**
  - **Chapter 2: Probability**
  - **Spectral clustering**
    - **Spectral representation**
    - **Clustering**

- **Apr 21**
  - **Chapter 3: Generative models for discrete data**
  - **Recommendation systems**
    - **Collaborative filtering**
    - **Content filtering**

- **Apr 28**
  - **Chapter 4: Gaussian models**
  - **Natural language processing**
    - **Bag of words**
    - **Topic modeling**

- **May 5**
  - **Chapter 5: Bayesian statistics**
  - **Imbalanced classification**
    - **Weights**
    - **Sampling**

- **May 12**
  - **Chapter 6: Frequentist statistics**
  - **Graphical models**
    - **Bayesian networks**
    - **Conditional random fields**

- **May 19**
  - **Chapter 7: Linear regression**
  - **Semi-supervised learning**
    - **Self-training**
    - **Co-training**
    - **Label propagation**

- **May 26**
  - **Chapter 8: Logistic regression**
  - **Active learning**
    - **Exploration**
    - **Exploitation**

- **Jun 2**
  - **Chapter 16: Adaptive basis function models**
  - **Online learning**
    - **Online gradient descent**
    - **Bandits**

- **Jun 9**
  - **Chapter 28: Deep learning**
  - **Introduction to deep learning**
    - **Multi-layer perceptron**
    - **Representation learning**

Student Assessment:
There will be a brief take-home quiz each week covering the week's material (50% of the grade). There will be hands-on assignments each week as well (50% of the grade).

Policies and Values:
You must attend at least 8 of the 10 sessions to be given credit for the course. You must satisfactorily complete at least 80% of the assigned work in order to receive credit for the course. We value both academic and personal integrity, as well as respect for others and the free exchange of ideas.