Syllabus and Course Schedule

Time and Location: Monday, Wednesday 9:30-10:50am, NVIDIA Auditorium

Class Videos: Current quarter's class videos are available here for SCPD students and here for non-SCPD students.

Event	Date	Description	Materials and Assignments
Introduction (1 class)			
Lecture 1	9/25	1. Basic concepts	**Class Notes** • Supervised Learning, Discriminative Algorithms [ps] [pdf]
A0	9/25	**Problem Set 0** [pdf]. Submission instructions.	
Supervised learning (5 classes)			
Lecture 2	9/27	1. Supervised learning setup. LMS.	
Section	9/29	Discussion Section: Linear Algebra	**Discussion Section**: Linear Algebra [Notes]
Lecture 3	10/2	2. Logistic regression. Perceptron. Exponential family.	
Lecture 4	10/4		
A1	10/4	**Problem Set 1** [pdf]. Out 10/4. Due 10/18. Submission instructions.	
Section	10/6	Discussion Section: Probability	**Discussion Section**: Probability[Notes][Slides]
Lecture 5	10/9	3. Generative learning algorithms. Gaussian discriminant analysis. Naive Bayes.	**Class Notes** • Generative Algorithms [ps] [pdf]
Lecture 6	10/11	4. Support vector machines.	**Class Notes** • Support Vector Machines [ps] [pdf]
Section	10/13	Discussion Section: Vectorization	**Discussion Section**: Vectorization[Slides][kNN][Logistic Regression][Softmax Regression][images][labels]
Practice ML advice (2 classes)			
Lecture 7	10/16	1. Bias/variance tradeoff 2. Model selection and feature selection	**Class Notes** • Bias/variance tradeoff and error analysis[pdf] • Learning Theory [ps] [pdf] • Regularization and Model Selection [ps] [pdf] • Online Learning and the Perceptron Algorithm. (optional reading) [ps] [pdf] • Advice on applying machine learning[pdf]
Lecture 8	10/18	3. Evaluating and debugging learning algorithms 4. Practical advice on structuring an ML project	

Event	Date	Description	Materials and Assignments
A2	10/18	**Problem Set 2** [pdf]. Out 10/18. Due 11/1. Submission instructions.	
Section	10/20	Discussion Section: Convex Optimization	**Discussion Section**: Convex Optimization • Convex Optimization Overview, Part I [ps] [pdf] • Convex Optimization Overview, Part II [ps] [pdf]
Project	10/20	Project proposal due at **11:59pm**.	
Deep Learning (2 classes)			
Lecture 9	10/23	1. NN architecture 2. Forward/Back propagation	**Class Notes** • Deep learning [pdf] • Backpropagation [pdf]
Lecture 10	10/25	3. Vectorization 4. Other optimization tricks.	
Section	10/27	Discussion Section: Evaluation Metrics	**Discussion Section**: Evaluation Metrics [Slides]
Unsupervised learning (5 classes)			
Lecture 11	10/30	1. Clustering. K-means. 2. EM. Mixture of Gaussians. 3. Factor analysis. 4. PCA (Principal components analysis). 5. ICA (Independent components analysis).	**Class Notes** • Unsupervised Learning, k-means clustering. [ps] [pdf] • Mixture of Gaussians [ps] [pdf] • The EM Algorithm [ps] [pdf] • Factor Analysis [ps] [pdf] • Principal Components Analysis [ps] [pdf] • Independent Components Analysis [ps] [pdf] **Problem Set 3** Out 11/1. Due 11/15.
Lecture 12	11/1		
Lecture 13	11/6		
Lecture 14	11/8		
Lecture 15	11/13		
Section	11/3	Discussion Section: Midterm-Review	**Discussion Section**: Midterm-Review
A3	11/1	**Problem Set 3** [pdf]. Out 11/1. Due 11/15. Submission instructions.	
Midterm	11/8	The midterm is **open-book/open-notes/open laptop (no internet)**. It will take place on **Wednesday, November 8, 2017 from 6-9 PM**. The course staff will announce exam venue and material covered closer to the midterm date.	
Section	11/17	Discussion Section: Deep Learning Methods	**Discussion Section**: Deep Learning Methods
Project	11/20	Project milestones due 11/20 at **11:59pm**.	
Reinforcement learning and control (4 classes)			
Lecture 16	11/15	1. MDPs. Bellman equations. 2. Value iteration and policy iteration. 3. Linear quadratic regulation (LQR). LQG. 4. Q-learning. Value function approximation.	**Class Notes** • Reinforcement Learning and Control [ps] [pdf] • LQR, DDP and LQG [pdf] **Problem Set 4** Out 11/15. Due 12/6.
Lecture 17	11/27		
Lecture 18	11/29		
A4	11/15	**Problem Set 4** [pdf]. Out 11/15. Due 12/6. Submission instructions.	
Section	12/1	Discussion Section: Deep Learning Platform	**Discussion Section**: Deep Learning Platform
Lecture 19	12/4	Generative Adversarial Networks (GANs)	**Class Notes**

Event	Date	Description	Materials and Assignments
			• Generative Adversarial Networks (GANs)[pdf]
Lecture 20	12/6	Adversarial machine learning	**Class Notes** • Adversarial examples in ML[pdf]
Project	12/11	**Project poster PDF** and project recording (some teams) due at 11:59 pm Submission instructions.	
Project	12/12	Poster presentations from 8:30-11:30am. Venue and details to be announced.	
Project	12/15	Final writeup due at **11:59pm** (no late days).	

Supplementary Notes

1. Binary classification with +/-1 labels [pdf]
2. Boosting algorithms and weak learning [pdf]
3. Functional after implementing stump_booster.m in PS2. [here]
4. The representer theorem [pdf]
5. Hoeffding's inequality [pdf]

Section Notes

1. Linear Algebra Review and Reference [pdf]
2. Probability Theory Review [pdf]
3. Files for the Matlab tutorial: [pdf] [sigmoid.m] [logistic_grad_ascent.m] [matlab_session.m]
4. Convex Optimization Overview, Part I [ps] [pdf]
5. Convex Optimization Overview, Part II [ps] [pdf]
6. Hidden Markov Models [ps] [pdf]
7. The Multivariate Gaussian Distribution [pdf]
8. More on Gaussian Distribution [pdf]
9. Gaussian Processes [pdf]

Other Resources

1. Advice on applying machine learning: Slides from Andrew's lecture on getting machine learning algorithms to work in practice can be found here.
2. Previous projects: A list of last year's final projects can be found here.
3. Matlab resources: Here are a couple of Matlab tutorials that you might find helpful: http://www.math.ucsd.edu/~bdriver/21d-s99/matlab-primer.html and http://www.math.mtu.edu/~msgocken/intro/node1.html. For emacs users only: If you plan to run Matlab in emacs, here are matlab.el, and a helpful .emac's file.
4. Octave resources: For a free alternative to Matlab, check out GNU Octave. The official documentation is available here. Some useful tutorials on Octave include http://en.wikibooks.org/wiki/Octave_Programming_Tutorial and http://www-mdp.eng.cam.ac.uk/web/CD/engapps/octave/octavetut.pdf .
5. Data: Here is the UCI Machine learning repository, which contains a large collection of standard datasets for testing learning algorithms. If you want to see examples of recent work in machine learning, start by taking a look at the conferences NIPS(all old NIPS papers are online) and ICML. Some other related conferences include UAI, AAAI, IJCAI.
6. Viewing PostScript and PDF files: Depending on the computer you are using, you may be able to download a PostScript viewer or PDF viewer for it if you don't already have one.