

Machine Learning

10-701/15-781, Spring 2011

Carnegie Mellon University

Tom Mitchell



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Date	Lecture	Topics	Readings and useful links	Handouts
Jan 11	Intro to ML Decision Trees Slides video	<ul style="list-style-type: none"> Machine learning examples Well defined machine learning problem Decision tree learning 	Mitchell: Ch 3 Bishop: Ch 14.4 The Discipline of Machine Learning	
Jan 13	Decision Tree learning Review of Probability Annotated slides video	<ul style="list-style-type: none"> The big picture Overfitting Random variables, probabilities 	Andrew Moore's Basic Probability Tutorial Bishop: Ch. 1 thru 1.2.3 Bishop: Ch 2 thru 2.2	HW1 out Jan 14
Jan 18	Probability and Estimation Annotated slides video	<ul style="list-style-type: none"> Bayes rule MLE MAP 	Andrew Moore's Basic Probability Tutorial Bishop: Ch. 1 thru 1.2.3 Bishop: Ch 2 thru 2.2	
Jan 20	Naive Bayes Annotated slides video	<ul style="list-style-type: none"> Conditional independence Multinomial Naive Bayes 	Mitchell: Naive Bayes and Logistic Regression	
Jan 25	Gaussian Naive	<ul style="list-style-type: none"> Gaussian Bayes classifiers 	Mitchell: Naive	HW1 due

	Bayes Slides Annotated Slides video	<ul style="list-style-type: none"> • Document classification • Brain image classification • Form of decision surfaces 	Bayes and Logistic Regression	HW2 out
Jan 27	Logistic Regression Slides Annotated slides video	<ul style="list-style-type: none"> • Naive Bayes - the big picture • Logistic Regression: Maximizing conditional likelihood • Gradient ascent as a general learning/optimization method 	Mitchell: Naive Bayes and Logistic Regression Ng & Jordan: On Discriminative and Generative Classifiers , NIPS, 2001.	
Feb 1	Linear Regression Slides Annotated slides video	<ul style="list-style-type: none"> • Generative/Discriminative models • minimizing squared error and maximizing data likelihood • bias-variance decomposition • regularization 		
Feb 3	Practical Issues	<ul style="list-style-type: none"> • Feature selection • Overfitting • Bias-Variance tradeoff 		
Feb 8	Graphical models 1 Annotated slides video	<ul style="list-style-type: none"> • Bayes nets • representing joint distributions with conditional independence assumptions 	Bishop: Ch 8, through 8.2	HW3 out
Feb 15	Graphical models 2 slides video	<ul style="list-style-type: none"> • D-separation and Conditional Independence • Inference • Learning from fully observed data • Learning from partially observed data 		
Feb 17	Graphical models 3 annotated slides video	<ul style="list-style-type: none"> • EM 	EM and HMM tutorial J. Bilmes	
Feb 22	Graphical models 4 annotated slides video	<ul style="list-style-type: none"> • Mixture of Gaussians clustering • Learning Bayes Net structure - Chow Liu 	Intro. to Graphical Models , K. Murphy Graphical Models tutorial , M. Jordan	HW3 due HW4 out
Feb 24	Computational Learning Theory	<ul style="list-style-type: none"> • PAC Learning 	Mitchell: Ch. 7	

	annotated slides video			
Mar 1	Midterm Review PAC learning slides midterm review slides video			HW4 due
Mar 3	Midterm Exam	<ul style="list-style-type: none"> • in class • open notes, open book, no internet 		Midterm Solution
Mar 15	Computational Learning Theory annotated slides video	<ul style="list-style-type: none"> • Mistake bounds • Weighted Majority Algorithm 	Mitchell: Ch. 7	
Mar 17	Semi-Supervised Learning slides: CoTraining NELL video	<ul style="list-style-type: none"> • CoTraining / Multi-view Learning • Never ending learning (NELL) 	<ul style="list-style-type: none"> • Cotraining: Blum & Mitchell • NELL: Carlson et al., 2010 	
Mar 22	Hidden Markov Models annotated slides	<ul style="list-style-type: none"> • Markov models • HMM's and Bayes Nets • Other probabilistic time series models 	Bishop Ch. 13	
Mar 24	Neural Networks slides video	<ul style="list-style-type: none"> • Non-linear regression • Backpropagation and Gradient descent • Learning hidden layer representations 	Mitchell Ch. 4 Bishop Ch. 5	Project proposals due
Mar 29	Learning Representations I slides video	<ul style="list-style-type: none"> • Artificial neural networks • PCA 	Bishop Ch. 12 through 12.1 A Tutorial on PCA , J. Schless SVD and PCA , Wall et al.	
Mar 31	Learning Representations II slides video	<ul style="list-style-type: none"> • Deep belief networks • ICA • CCA 	Deep Belief Nets paper , Hinton & Salakhutdinov CCA Tutorial , M. Borga	
Apr 5	Learning Representations III slides video	<ul style="list-style-type: none"> • Fisher Linear Discriminant • Latent Dirichlet Allocation • Intro to Kernel Functions 	Bishop Ch. 6.1 (required) Bishop Ch. 6.2, 6.3 (optional)	

Apr 7	Kernel Methods and SVM's slides video	<ul style="list-style-type: none"> • Regression: Primal and Dual forms • Kernels and Kernel Regression • SVMs 	Bishop Ch. 6.1 Bishop Ch. 7, through 7.1.2	
Apr 12	SVM's II slides video	<ul style="list-style-type: none"> • Maximizing the margin • Noise and soft margin SVM's • PAC learning and SVM's • Hinge loss, log loss, 0-1 loss 	Bishop Ch. 7, through 7.1.2	Project midway report due
Apr 14		No CMU classes today		
Apr 19	Active Learning slides video	Guest lecture: Dr. Burr Settles <ul style="list-style-type: none"> • Uncertainty sampling • Query by committee 	Settles: Active learning survey	
Apr 21	ML in Computational Biology slides video	Guest lecture: Prof. Ziv Bar-Joseph		
Apr 26	Reinforcement Learning I slides video	<ul style="list-style-type: none"> • Markov Decision Processes • Value Iteration • Q learning 	Kaelbling et al.: Reinforcement Learning: A Survey	
Apr 28	Reinforcement Learning 2 RL slides Final study guide video	<ul style="list-style-type: none"> • Q learning in non-deterministic domains • RL as model for learning in animals • Final exam review 		
May 6 (Friday)	Final Exam	<ul style="list-style-type: none"> • 1-4pm • Location: Gates Hillman 4401 • open notes, open book, no internet 	Final study guide	