Hsuan-Tien Lin

I am fortunate to be among the very first NTU EECS professors to offer two Mandarin-teaching MOOCs (massive open online courses) on NTU@Coursera. The two MOOCs are Machine Learning Foundations and Machine Learning Techniques and are based on the textbook *Learning from Data: A Short Course* that I co-authored. The book is consistently among the best sellers in Machine Learning on Amazon.

You can find the slides of the two MOOCs below. The slides are available as is with no explicit or implied warranties. The slides themselves are shared by CC-BY-NC 3.0, but the copyright of all materials (figures in particular) remain with the original copyright holder (in almost all cases the authors of the *Learning from Data: A Short Course* book).

Machine Learning Foundations (all handout slides)

When can machines learn?		
Lecture 1	the learning problem: 0. Course Introduction 1. What is Machine Learning 2. Applications of Machine Learning 3. Components of Machine Learning 4. Machine Learning and Other Fields	handout slides; presentation slides; go to MOOC; watch on youtube
Lecture 2	learning to answer yes/no: 1. Perceptron Hypothesis Set 2. Perceptron Learning Algorithm (PLA) 3. Guarantee of PLA 4. Non-Separable Data	handout slides; presentation slides; go to MOOC; preview on youtube
Lecture 3	types of learning: 1. Learning with Different Output Space 2. Learning with Different Data Label 3. Learning with Different Protocol 4. Learning with Different Input Space	handout slides; presentation slides; go to MOOC; preview on youtube
Lecture 4	feasibility of learning: 1. Learning is Impossible? 2. Probability to the Rescue 3. Connection to Learning 4. Connection to Real Learning	handout slides; presentation slides; go to MOOC; preview on youtube
Why can machines learn?		
	training versus testing:	

Lecture 5	1. Recap and Preview 2. Effective Number of Lines 3. Effective Number of Hypotheses 4. Break Point	handout slides; presentation slides; go to MOOC
Lecture 6	theory of generalization: 1. Restriction of Break Point 2. Bounding Function: Basic Cases 3. Bounding Function: Inductive Cases 4. A Pictorial Proof	handout slides; presentation slides; go to MOOC
Lecture 7	the VC dimension: 1. Definition of VC Dimension 2. VC Dimension of Perceptrons 3. Physical Intuition of VC Dimension 4. Interpreting VC Dimension	handout slides; presentation slides; go to MOOC
Lecture 8	noise and error: 1. Noise and Probabilistic Target 2. Error Measure 3. Algorithmic Error Measure 4. Weighted Classification	handout slides; presentation slides; go to MOOC
How can machines learn?		
Lecture 9	linear regression: 1. Linear Regression Problem 2. Linear Regression Algorithm 3. Generalization Issue 4. Linear Regression for Binary Classification	handout slides; presentation slides; go to MOOC
Lecture 10	logistic regression: 1. Logistic Regression Problem 2. Logistic Regression Error 3. Gradient of Logistic Regression Error 4. Gradient Descent	handout slides; presentation slides; go to MOOC
Lecture 11	linear models for classification: 1. Linear Models for Binary Classification 2. Stochastic Gradient Descent 3. Multiclass via Logistic Regression 4. Multiclass via Binary Classification	handout slides; presentation slides; go to MOOC
Lecture 12	nonlinear transformation: 1. Quadratic Hypotheses 2. Nonlinear Transform 3. Price of Nonlinear Transform 4. Structured Hypothesis Sets	handout slides; presentation slides; go to MOOC

How can machines learn better?		
Lecture 13	hazard of overfitting: 1. What is Overfitting? 2. The Role of Noise and Data Size 3. Deterministic Noise 4. Dealing with Overfitting	handout slides; presentation slides; go to MOOC
Lecture 14	regularization: 1. Regularized Hypothesis Set 2. Weight Decay Regularization 3. Regularization and VC Theory 4. General Regularizers	handout slides; presentation slides; go to MOOC
Lecture 15	validation: 1. Model Selection Problem 2. Validation 3. Leave-One-Out Cross Validation 4. V-Fold Cross Validation	handout slides; presentation slides; go to MOOC
Lecture 16	three learning principles: 1. Occam's Razor 2. Sampling Bias 3. Data Snooping 4. Power of Three	handout slides; presentation slides; go to MOOC

Machine Learning Techniques (all handout slides)

embedding numerous features		
Lecture 1	linear support vector machine: 0. Course Introduction 1. Large-Margin Separating Hyperplane 2. Standard Large-Margin Problem 3. Support Vector Machine 4. Reasons behind Large-Margin Hyperplane	handout slides; presentation slides; go to MOOC
Lecture 2	dual support vector machine: 1. Motivation of Dual SVM 2. Lagrange Dual SVM 3. Solving Dual SVM 4. Messages behind Dual SVM	handout slides; presentation slides; go to MOOC
Lecture 3	kernel support vector machine: 1. Kernel Trick 2. Polynomial Kernel 3. Gaussian Kernel 4. Comparison of Kernels	handout slides; presentation slides; go to MOOC

Lecture 4	soft-margin support vector machine: 1. Motivation and Primal Problem 2. Dual Problem 3. Messages behind Soft-Margin SVM 4. Model Selection	handout slides; presentation slides; go to MOOC
Lecture 5	kernel logistic regression: 1. Soft-Margin SVM as Regularized Model 2. SVM versus Logistic Regression 3. SVM for Soft Binary Classification 4. Kernel Logistic Regression	handout slides; presentation slides; go to MOOC
Lecture 6	support vector regression: 1. Kernel Ridge Regression 2. Support Vector Regression Primal 3. Support Vector Regression Dual 4. Summary of Kernel Models	handout slides; presentation slides; go to MOOC
combining predictive features		
Lecture 7	blending and bagging: 1. Motivation of Aggregation 2. Uniform Blending 3. Linear and Any Blending 4. Bagging (Bootstrap Aggregation)	handout slides; presentation slides; go to MOOC
Lecture 8	adaptive boosting: 1. Motivation of Boosting 2. Diversity by Re-weighting 3. Adaptive Boosting Algorithm 4. Adaptive Boosting in Action	handout slides; presentation slides; go to MOOC
Lecture 9	decision tree: 1. Decision Tree Hypothesis 2. Decision Tree Algorithm 3. Decision Tree Heuristics in C&RT 4. Decision Tree in Action	handout slides; presentation slides; go to MOOC
Lecture 10	random forest: 1. Random Forest Algorithm 2. Out-Of-Bag Estimate 3. Feature Selection 4. Random Forest in Action	handout slides; presentation slides; go to MOOC
Lecture 11	gradient boosted decision tree: 1. Adaptive Boosted Decision Tree 2. Optimization View of AdaBoost 3. Gradient Boosting 4. Summary of Aggregation Models	handout slides; presentation slides; go to MOOC

distilling hidden features		
Lecture 12	neural network: 1. Motivation 2. Neural Network Hypothesis 3. Neural Network Learning 4. Optimization and Regularization	handout slides; presentation slides; go to MOOC
Lecture 13	deep learning: 1. Deep Neural Network 2. Autoencoder 3. Denoising Autoencoder 4. Principal Component Analysis	handout slides; presentation slides; go to MOOC
Lecture 14	radial basis function network: 1. RBF Network Hypothesis 2. RBF Network Learning 3. k-Means Algorithm 4. k-Means and RBF Network in Action	handout slides; presentation slides; go to MOOC
Lecture 15	matrix factorization: 1. Linear Network Hypothesis 2. Basic Matrix Factorization 3. Stochastic Gradient Descent 4. Summary of Extraction Models	handout slides; presentation slides; go to MOOC
happy learning!		
Lecture 16	finale: 1. Feature Exploitation Techniques 2. Error Optimization Techniques 3. Overfitting Elimination Techniques 4. Machine Learning in Practice	handout slides; presentation slides; go to MOOC

Last updated at CST 18:25, December 20, 2015

Please feel free to contact me: htlin@csie.ntu.edu.tw