Syllabus WWI15B4

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1 introduction May 8

- about us, administrative etc.
- history, motivation
- applications, CRISP-DM
- what is learning? why machine learning?
- technical notation (vector, matrix algebra)
- types of learning (supervised vs. unsupervised)
- classification, regression, clustering

2 statistical learning May 16, May 29

2.1 multiple linear regression

- model assumptions, estimation and prediction
- error term composition, model flexibility
- iris flower dataset
- advantages of statistical parametric methods

2.2 algorithms

- ridge regression, lasso
- logit regression
- nearest neighbor

2.3 model evaluation

- empirical vs. true error
- bias variance tradeoff
- overfitting vs. underfitting
- cross-validation, bootstrapping
- evaluation metrics: ROC, confusion matrix

3 concept learning theory and understanding of the hypothesis space May 24

- inductive learning hypothesis
- hypothesis space
- most simple learning concept: hypothesis space search (general-to-specific, specific-to-general-search, version space / candidate elimination algorithm)
- VC dimension and its implications
- structural risk minimization (SRM)

4 classification June 6, June 12

4.1 decision tree

- concept of information, entropy
- induction algorithms (CART, C4.5)
- extensions: bagging, boosting, random forests

4.2 neural networks

- logistic regression
- relation between logistic regression and NN
- activation functions, regularization etc.
- backpropagation
- convolutional neural networks
- some advices for practical applications
- NNs in the field

4.3 svm

- maximum margin classifier
- soft vs. hard margin
- kernel trick
- evaluation and relation to SRM

5 clustering June 20

- PCA / dimensionality reduction
- applications
- agglomerative, hierarchical, partitioning
- distance metrics
- k-means, k-medoids, fuzzy k-means
- expectation maximization
- application: outlier detection

6 outlook July 3

- advantages: human forecasting
- human brain vs. AI
- future of machine learning: transfer learning, reinforcement learning, technological singularity
- critical perspective on machine learning
- time for questions and discussions