ICS 635 Machine Learning

15 week syllabus, two lectures per week. Lecture numbers indicated in bold font on the left.

1 Introductory Lecture: Introduction to machine learning.

2-3 Basic maths skills: review of important mathematical methods, such as differential equations, linear algebra, calculus of variations, probability theory - specifics depend on student needs.

4-7 Regression:

- Linear regression.
- Bayesian Inference.
- Maximum likelihood models.
- Occam factors.
- Selected applications to contemporary problems. Subject areas are listed below - specifics are adjusted to student interests.

8-12 Artificial neural networks:

- Back-propagation algorithm.
- Recurrent networks.
- Boltzmann machine.
- Selected applications to contemporary problems. Subject areas are listed below - specifics are adjusted to student interests.

12-17 Statistical Learning Theory:

- VC-dimension
- Structural risk minimization
- Kernel trick
- Support Vector Classification
- Cross-validation
- Support Vector Regression
- Selected applications to contemporary problems. Subject areas are listed below - specifics are adjusted to student interests.

18-25 Unsupervised learning:

- Principal component analysis.
- Cluster analysis: Concepts and issues.
- Decision trees
- Iterative re-allocation algorithms.
- EM-algorithm.
- Finding the number of clusters: stopping rules and stability arguments.
- Selected applications to contemporary problems. Subject areas are listed below - specifics are adjusted to student interests.

26-27 Time series analysis:

- Linear predictive coding.
- Adaptive filters.
- Hidden Markov Models.

28-29 Graphical Models:

- Bayesian Belief Networks.
- Causal Networks.
- Dynamic Bayesian Networks.
- Selected applications to contemporary problems. Subject areas are listed below - specifics are adjusted to student interests.

30 Reinforcement learning.

Application subject areas include: robotics, computer vision, speech recognition, time series analysis, renewable energies, mathematical finance, geology, astronomy, learning formal grammars, medical imaging, and bioinformatics. Students are encouraged to add subjects.