Adaptive Signal Processing
Chung-Ang University
Spring 2014

Course Instructor:
Monson H. Hayes

Office Hours: To be announced

Textbook: None. Class notes and papers will be handed out.

Prerequisite:
Each student is expected to have had a course in digital signal processing, a course in basic probability theory, and familiarity with the basics of linear algebra. A basic review of probability theory and linear algebra will be given at the start of the course.

Course Objective:

To develop the basic theory of machine learning and adaptive filtering, including Kalman filters, particle filters, neural networks, the perception algorithm, radial basis functions, support vector machines, and kernel methods.

Course Requirements:

Weekly Homework with Matlab projects.
One Midterm and one Final Exam.

Lecture Schedule:
On the following sheet is a tentative lecture schedule showing the topics that will be covered. Depending upon student interest and background, this schedule may change as the term progresses, and will be updated weekly.

Topical Outline
(Subject to Change and Reordering)

1. Introduction to Learning
2. Review and background
    - Probability and Random Processes
    - Linear Algebra
3. The Linear Model and Hoeffdings Inequality
4. Error and Noise
5. Training versus Testing
6. The Theory of Generalization
7. The VC Dimension and the Bias-Variance Tradeoff
8. Optimum Filtering
    - The normal equations and the Wiener filter
    - Linear prediction
9. The discrete Kalman filter
10. Particle Filters
11. Gradient-based adaptive filters
    - Steepest descent
    - The LMS algorithm
12. Recursive Least Squares (RLS)
13. Adaptive IIR filters
14. Neural networks
    - The perceptron, multilayer perceptron
    - Backpropagation algorithm
15. Overfitting, Regularization, and Validation
16. Support Vector Machines and Kernel Methods
17. Radial Basis Functions