

CMSC 727: NEURAL COMPUTATION - FALL 2008

Instructor: James A. Reggia (AVW 3233; 301-405-2686; reggia@cs.umd.edu)

Office Hours: Thurs. 12:15 - 1:30 pm, or by appointment

Grader: Charles Martin (cmarti16@mail.umd.edu)

Time and Place: TuTh 11:00 - 12:15 p.m., CSIC 3118

Class web page: <http://www.cs.umd.edu/class/fall2008/cmssc727/>

Prerequisites: CMSC 421 or permission of instructor. Undergraduate calculus, linear algebra and elementary probability theory are assumed.

Objectives are i) to survey the most important neural modeling methods, ii) to illustrate their use for difficult computational tasks and for cognitive/brain modeling, iii) to provide hands-on experience training neural models, and iv) to introduce current active research areas.

Content:

1. Biological inspiration: neurons, synapses, neural networks, information processing mechanisms, learning, major brain regions, neurobiological basis of cognition.
2. Basic concepts: architectures, activation and learning rules, self-organization, adaptive systems, emergent behavior, competition and cooperation in networks, local vs. distributed representations, dynamical systems, historical perspective, applications.
3. Supervised learning: logical neurons, perceptrons and perceptron convergence theorem, LMS learning rule with linear models of associative memory, error backpropagation, radial basis functions, etc.
4. Unsupervised learning: Hebb's rule, linear associative memories, competitive learning, self-organizing feature maps, adaptive resonance theory, energy-minimizing attractor nets, simulated annealing, etc.
5. Related topics: reinforcement learning, evolutionary computation and neural networks, learning of activation rules, applications, software packages, echo state networks, neural network oscillations, hardware implementations, large-scale networks, spiking neurons, etc.

Workload (weight in grading): Midterm (35%), projects/homework (15%), final exam (50%). Final grade will be lowered one letter if projects/homework score is below 70% of total possible.

Texts:

1. Mehrotra K, et al: *Elements of Artificial Neural Networks*, MIT Press, 1997, ISBN 0-262-13328-8
2. H. Demuth and M. Beale: *Neural Network Toolbox User's Guide*, Mathworks, current version.
3. Additional readings from the literature.

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