EVOLUTIONARY COMPUTATION & ARTIFICIAL LIFE
CMSC 828/498R - Fall 2005

Time and Place: TuTh 11:00 am - 12:15 pm; CSI Rm 1121

Instructor: James Reggia, AVW Bldg., Rm. 3233, 405-2686, reggia@cs.umd.edu
Office Hours: Thurs. 12:15 - 1:30 pm or by appointment

Teaching Asst: Nick Frangiadakis (half-time), AVW Bldg., Rm. 4132, 405-2722, ntg@cs.umd.edu
Office Hours: Mons. 1:00 - 2:00 pm or by appointment

Prerequisites:

498R: CMSC 250 (Discrete Math) & CMSC 330 (Languages), or permission of instructor
898R/689C: CMSC 421 (Introduction to AI) & grad status, or permission of instructor

Objectives: This course examines evolutionary and other types of biologically-inspired computing ("artificial life"), with an emphasis on understanding the basic computational principles involved.

Content:

Conceptual Framework:

- definitions, terminology, introduction to different paradigms, history, overview

Complex Adaptive Systems

- Cellular Automata: basics, properties, environments, self-replication, adaptation, applications
- Multi-Agent Artificial Life Worlds: ant colonies, collective/swarm intelligence, flocking
- Developmental Systems: L-systems, morphogenesis, self-assembly, pattern formation
- Neural Nets: dynamics, learning, coupled oscillators, rhythmic behavior, self-organizing maps
- Immunological Computation: principles, artificial immune systems, applications

Evolutionary Computation

- Genetic Algorithms: biology, method, variants, schema theorem, applications, etc.
- Evolution Strategies: method, variations, optimization, etc.
- Evolutionary Programming: method, variations, applications, etc.
- Issues: preferred operators, co-evolution, speciation, etc.

Evolution and Adaptation of Intelligent Agents

- Evolving Computer Programs: genetic programming, variants
- Evolving Rule-Based Systems: classifier systems, GABIL, cellular automata, L-systems
- Evolving Neural Networks: weights, architectures, recurrent networks, cellular coding, etc.
- Evolving Multi-Agent Systems: TIERRA, cooperative/competitive behavior, communication

Topics in Nature-Inspired Computation: (as time permits)
reinforcement learning in multi-agent systems, biologically-inspired robotics, DNA/molecular computing, nanotechnology, simulated annealing, etc.

Class web page: http://www.cs.umd.edu/class/fall2005/cmsc828r/

Grading: midterm (35%), assignments (15%), final exam (50%);
students in 498R are graded independently of those in 898R.

Texts:

1. E Bonabeau et al, *Swarm Intelligence*, Oxford Univ. Press, ISBN 0-19-513159-2 (pbk), 1999
2. M Mitchell, *Introduction to Genetic Algorithms*, ISBN 0-262-63185-7 (pbk), MIT Press, 1996
3. W. Banzhaf et al., *Genetic Programming*, Morgan Kauffman ISBN 1-55860-510-X, 1998
4. papers from relevant conferences/journals