CMSC 828K/498G: Artificial Life and Evolutionary Computation
Syllabus - Spring 2014

Time and Place: Tuesdays and Thursdays, 12:30 – 1:45 pm, CSI 3120

Instructor: James Reggia, AVW 3233, 301-405-2686, reggia@cs.umd.edu
Office Hours: Th. 1:45 – 3 pm, or by appointment

Half-Time TA: Beth McNany, AVW 3212, 301-405-2713, beth@cs.umd.edu

Class web page: http://www.cs.umd.edu/class/spring2014/cmsc828k
Gives exam dates, homework assignments and their due dates, lecture slides, reading assignments, and links to other useful information.

A GRACE account and file space has been created for all registered students.

Prerequisites:
498G: CMSC 330 (Languages) and CMSC 351 (Algorithms), or permission of instructor
828K: graduate status in computer science, math, engineering, or permission of instructor

Objective: The primary objective of this course is to examine nature-inspired computational methods in artificial life, evolutionary computing, and related fields, with an emphasis on understanding the basic computational principles involved.

Content:

Conceptual Framework
- definitions, terminology, introduction to different paradigms, core concepts such as self-organization and emergence, history, overview

Complex Adaptive Systems
- Cellular Automata: basics, properties, environments, self-replicating machines, adaptation, applications
- Multi-Agent Artificial Life Worlds: flocking, swarm intelligence, ant colony optimization
- Developmental Systems: L-systems, morphogenesis, self-assembly, pattern formation
- Neural Nets: dynamics, learning, neurocontrollers, coupled oscillators, rhythmic behavior, attractor networks, self-organizing maps, memory models, neurocognitive systems,
- Immunological Computation: principles, artificial immune systems, applications

Evolutionary Computation
- Genetic Algorithms: biology, method, variants, schema theorem, applications
- Genetic Programming: evolving computer programs, tree/linear/graph based genomes
- Evolution Strategies: method, variations, optimization
- Evolutionary Programming: method, variations, applications
- Issues: preferred operators, co-evolution, speciation, creative evolutionary systems, network representations and genetic operations, spatially-distributed populations

Evolution and Adaptation of Intelligent Agents
- 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: cooperative/competitive behavior, communication

Advanced/Research Topics in Nature-Inspired Computation (as time permits)
- reinforcement learning in multi-agent systems, imitation learning, biologically-inspired robotics, multi-SOM systems, DNA/molecular computing, artificial consciousness, models of
attention, language and language acquisition, optical/photonic computing, quantum computing, nanotechnology, physarum machines, binding problem, simulated annealing, biologically-plausible supervised learning, machine creativity, etc.

**Grading:** Grading will be based on homework assignments, quizzes, and class participation (collectively 10%), a semester project (20%), and two exams (35% each) given during the semester.

**Textbooks:**
   ISBN 1-58488-643-9
   ISBN 3-540-40184-9
3. readings from relevant conferences/journals (pdf’s provided)

**Disabilities:** Any student eligible for and requesting reasonable academic accommodations due to a disability needs to provide the instructor with a letter of accommodation from the Office of Disability Support Services (DSS) within the first two weeks of the semester.

**Class Absence Policy:** The campus has an established policy governing class absences. This policy requires instructors to provide the following information. For this class, the “major scheduled grading events” are the exams and the semester project. A maximum of one self-signed medical excuse for other grading events will be accepted.

**Academic Integrity:** All homework assignments are to be done individually and independently; all submitted work must be your own. All students are expected to be familiar with and to uphold the Code of Academic Integrity administered by the Student Honor Council at UMCP (please see http://www.shc.umd.edu).