Computer Science and Engineering
Ferguson Hall – 0115
472-2402

Course Specification

CSCE-479
Neural Networks and Genetic Algorithms

Catalogue Description:
479. Neural Networks and Genetic Algorithms (3 cr). This introduction to the concepts, design and application of connection-based computing begins by simulating neural networks. The focus will be on competing alternative network architectures, including sparse distributed memories, Hopfield networks, and the multilayered feed-forward systems. The construction and improvement of algorithms used for training of neural networks will be addressed to reduce training time and improve generalization. Algorithms for training and synthesizing effective networks are implemented in high level language programs running on conventional computers. There will be an emphasis on methods for synthesizing and simplifying network architectures for improved generalization. Application areas treated include: pattern recognition, computer vision, robotics medical diagnosis, weather and economic forecasting.

Textbook(s) and/or Other Required Materials:
S. Haykin, Neural Networks: A Comprehensive Foundation, 2nd Ed., Prentice Hall, 1999.
D. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Reading. MA Addision Wesley.

Prerequisites by Topic:

1. **Mastery** of competence in programming for one high level computer language, mathematical maturity competence to the level of introductory calculus.
2. **Familiarity** with basic algebra, data structures, program organization, pseudo-code, objectives of intelligent systems.
3. **Exposure** to Programming Languages, Alternative styles of program construction Recursion, World wide web and personal computer based level of smart programs.

Course Objectives:

1. **Mastery** Understanding of the paradigm shift from procedural algorithmic problem solution to connectionist, subsymbolic approaches, supervised and self-organizing neural network model architectures, implementation of one form of neural network and also of the basic model of fixed-length, chromosome-based genetic algorithms and operator definitions.
2. **Familiarity** with alternative architectures for neural networks and evolutionary systems.
   Familiarity with alternative supervised and self-organization algorithms for neural networks and evolutionary systems.
   Familiarity with practical methods for formulating complex problems for solution by connectionist or evolutionary paradigms.

Familiarity with data from real world problems and under controlled conditions synthesizing it for solving toy problems and validating neural networks of full scale problems.

March 22, 1999

Topics Covered:
Arithmetic and Logic Level.
Historical background: adalines, madalines, sparse distributed memories, Hebbian learning and the delta rule, backpropagation learning for the PDP model, adaptive resonance theory for networks, counter propagation, self-organizing maps, cognitron and neocognitron
Supervised and unsupervised training: principles and parameters, data and training pattern structure and sequencing, principles of operation.
Organization of problem solving systems variety of neural network models,achitectures and training and self organizing methods.
Evolutionary Problem Solving Paradigms: fundamental theorem of genetic algorithms, Introduction to evolutionary computing with the basic genetic algorithm and genetic programming.
Schema Theorem and Genetic Operators: crossover, mutation and reversal or inversion, Fitness and selection pressure, Sequential and Parallel implementations.
Artificial life and application areas for genetic algorithms and programming.

Relationship of Course to Program Objectives:
Ignore for Fall 1998. Details will be firmed up during Spring 1998 Semester.

Contribution of Course to Meeting the Professional Component:
Ignore for Fall 1998. Details will be firmed up during Spring 1998 Semester.

Class/Laboratory Schedule:
Lecture: 45 hours = 3 hours/week for 15 weeks

Prepared by:
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