750723, Genetic Algorithms and Neural Networks

3 hours per week, 3 credit hours, prerequisite: **none**

Teaching Method: 37 hours Lectures (2-3 hours per week) + 8 hours Seminars (1 per 2 weeks)

Aims: By studying this module, students will gain an understanding of two of the principal components

of 'soft' artificial intelligence, namely Genetic Algorithms (GA) and Artificial Neural Networks (ANN).

Artificial neural networks attempt to capture the essential processing mechanism, which underlies the human

brain, by manipulating a network of interconnected nodes, each with fairly simple processing capabilities. ANN

has been used successfully for many classification applications, such as pattern recognition, and cluster analysis.

GA uses the principle of natural selection to 'evolve' artificially a population of candidate solutions through

simulated reproduction and mutation. GA has been used successfully for engineering optimization tasks and for

computational problems. This module will provide students with an appreciation of theoretical issues and

practical applications of variety of ANN architectures, including basic back-propagation, self-organizing maps

and radial basis function networks, and knowledge of the GA, including data representation, genetic operators

and properties of GA. Both GA and ANN will be studied in practical laboratory sessions. For the designing,

training and simulating of the ANN. MATLAB NN GA Toolbox will be used.

Learning Outcomes:

On completion of this module, the student should be able to:

• Evaluate and implement a variety of ANN architectures.

• Evaluate and implement the basic GA.

• Analyze and use 'soft-computing' problem-solving techniques.

• Design, train, critically evaluate and implement ANN for solving 'real-world' problems (use of MATLAB and UCI repository data bases).

Textbooks and Supporting Materials:

1- P. Picton, Neural Networks, Palgrave, 2000.

2- I. Nabney, NETLAB Algorithms for Pattern Recognition, Springer, 2002.

3- A. Zilouchian and M. Jamshidi, Intelligent Control Systems Using Soft Computing Methodologies, CRC Press, 2001.

4- Z. Michalewicz, Genetic Algorithms and Data Structures = Evolution Programs, Springer-Verlag, 1999.

5- M. Mitchell, An Introduction to GA, MIT Press, 1996.

6- A. Engelbrecht, Computational Intelligence, John Wiley and Sons, 2002.

7- S. Hykin, Neural Networks, Prentice-Hall 1999.

*** Plus some research papers on the topics**

Synopsis*:*

1- Introduction to AI - Search Methods.

2- ANN - Single-Layer Perceptions; ADALINE; Perception Learning.

3- Multi-Layer Feed Forward NN - Supervised Learning; Back propagation.

4- Unsupervised and Competitive Learning - Kohonen's Self Organising Maps (SOM); Radial Basis Function Networks.

5- Introduction to Genetic Algorithms - GA Terminology and Operators (crossover, mutation, inversion)

6- Theory of GA - Schema properties; Implicit Parallelism; GA - Evolutionary Computing.

7- Selection, Replacement and Reproduction Strategies ('roulette wheel', elitism) - Fitness proportional

selection; Premature convergence; Representation.

8- GA - advantages, disadvantages and applications; GA and NN.

Assessment: Two 1-hour midterm exams (15% each); Seminars (10%); 2-hours Final Exam (40%); Assignments (20%) (this will include designing, training, critical evaluation and

implementation of ANN for solving real-world problem (with the use of MATLAB

NN GA Toolbox eg. UCI repository data bases))