King Fahd University of Petroleum & Minerals
College of Computer Sciences and Engineering
Information and Computer Science Department

ICS 488: Soft Computing (3-0-3)

Syllabus – Summer Semester 2009-2010 (093)

Website: Blackboard (WebCT) & http://faculty.kfupm.edu.sa/ICS/alfy/files/teaching/093-ics488/index.htm

Class Time, Venue and Instructor Information:

Sec.	Time	Venue	Instructor	Office Hours
01	SUMTW 9:20-10:20am	24-106	**Dr. EL-SAYED EL-ALFY** Office: 22-108 Phone: 03-860-1930, E-mail: alfy@kfupm.edu.sa, http:faculty.kfupm.edu.sa/ics/alfy	MT: 11:20 -11:59 am SU: 12:20 – 01:00 am Or by appointment

Course Catalog Description

Introduction to Soft Computing, Fuzzy Sets Theory, Fuzzy Logic, Artificial Neural Networks, Probabilistic Reasoning, Genetic Algorithms, Neuro-Fuzzy Technology, Combination of Genetic Algorithms with Neural Networks, Combination of Genetic Algorithms and Fuzzy Logic, Applications of Soft Computing (three to four real life applications).

Pre-requisites: STAT 319 and Senior Standing

Course Objectives

- Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world problems.

Course Learning Outcomes

Upon completion of the course, you should be able to:
1. Identify and describe soft computing techniques and their roles in building intelligent machines
2. Recognize the feasibility of applying a soft computing methodology for a particular problem
3. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
4. Apply genetic algorithms to combinatorial optimization problems
5. Apply neural networks to pattern classification and regression problems
6. Effectively use existing software tools to solve real problems using a soft computing approach
7. Evaluate and compare solutions by various soft computing approaches for a given problem.

Required Material

- Soft Computing and Intelligent Systems Design, Theory, Tools and Applications, F. Karray and C. De Silva, Prentice Hall, 2004.
- Lecture Handouts

Other Recommended References

- Timothy J. Ross, Fuzzy Logic with Engineering Applications, 3rd Edition, Willey, 2010.
- J.-S. R. Jang, C.-T. Sun, & E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Prentice Hall, 1997.
- Andries P. Engelbrecht, Computational Intelligence: An Introduction, 2nd Edition, Wiley, 2007.

- Randy L. Haupt &   Practical genetic algorithms, John Wiley & Sons Inc, 2004.
- Edmund K. Burke and Graham Kendall, Search Methodologies: Introductory Tutorials in Optimization and Decision Support Techniques, Springer 2005.

Web Resources
- Matlab Technical Language with its Toolboxes: Fuzzy Logic, Neural Networks, and Genetic Algorithms. http://www.mathworks.com/products/matlab/
- Other web resources will be posted in the course website.

Assessment Plan

Assessment Tool	Weight
Project	15%
Quizzes	10 %
Homework Assignments	10%
Major Exam 1 (Date & Room: TBA)	15 %
Major Exam 2 (Date & Room: TBA)	20 %
Final Exam (semi-comprehensive) [Date: as announced by the registrar]	30 %

Course Description:
This course introduces the concepts and algorithms that are developed in the fields of soft computing. It looks at three computational methods which are finding growing interest at both industry and academia environments. These are: Fuzzy Logic, Artificial Neural Networks, and Genetic Algorithms.
- Fuzzy Sets and Fuzzy Logic are ways to represent and manipulate the types of uncertainty and vagueness that are usually present in human descriptions of the world. These tools can be used to build control systems that use the imprecise knowledge of human experts.
- Neural Networks, modeled after concepts from biological neural systems, use large numbers of simple interconnected computational units to perform tasks such as detecting patterns to noisy data and simulate massively parallel processing of interconnected elements.
- Genetic Algorithms are optimization techniques inspired by biological evolution to search for good solutions to complex problems. Each potential solution to the problem is assigned a quality, or ``fitness`` value. Probabilistic techniques are then used to find solutions with high ``fitness``.

These three problem-solving techniques are closely related, often being applied simultaneously to aspects of the same problem. The subject is provided with several examples and case studies to master the techniques and assess their relevance to solve real-world engineering problems.

Tentative Topics
- Introduction to soft computing and its role in building intelligent machines
- Fuzzy sets, logic operations, and relations; Fuzzy decision-making; Basics of fuzzy control;
- Neural networks: Basic concepts and major classes of neural networks, Single-layer perceptron, Multi-layer perceptron, Radial-basis function networks, Support vector machines, Polynomial and dynamic neural networks
- Introduction to evolutionary computation and genetic algorithms
- Introduction to probabilistic reasoning and Bayesian belief networks
- Hybrid systems: Combination of genetic algorithms with neural networks, Combination of genetic algorithms and fuzzy logic, Neuro-fuzzy inference systems
- Soft computing tools (e.g. Matlab, Weka and DTREG) and applications to pattern classification and clustering, function optimization, regression problems

Important Notes and Course Policies

- *Course Project***:** Students are urged to start working on the project early in the semester. They can suggest their own projects, but they have to discuss it with the instructor and get approval. A report will be delivered and the project will be presented at the end of the semester.

- *Course Website & Participation*: Students are required to periodically check the course website and download course material as needed. Several resources will be posted through the website as well. Keys to quizzes and exams are generally discussed during class as time permits but solutions will not be posted. WebCT will be used for communication and interaction, posting and submitting assignments, posting grades, posting sample exams, etc. It is expected that you get benefit of the discussion board by raising questions or answering questions put by others.

- *Attendance*: Regular attendance is a university requirement; hence attendance will be checked at the beginning of each class. Late arrivals will disrupt the class session. Hence, two late attendances (more than 10 minutes) will be considered as one absence. Missing more than 9 lectures will result in a DN grade without prior warning. To avoid being considered as absent, an official excuse must be shown no later than one week of returning to classes. Every unexcused absence leads to a loss of 0.5% of total grade.

- *No makeup of homework, quizzes or exams will be given.*

- *Re-grading policy*: If you have a complaint about any of your grades, discuss it with the instructor no later than a week of distributing the grades (except for the final). Only legitimate concerns on grading should be discussed.

- *WP/WF grade policy***:** To get a WP grade, you should get at least 40% in class work and an excellent attendance record prior to withdrawal.

- *Office Hours*: Students are encouraged to use the office hours to clarify any part of the material that is not clear; however the instructor will only provide hints if it is an assigned task but not solve it.

- *Academic honesty*: Students are expected to abide by all the university regulations on academic honesty. Cheating will be reported to the Department Chairman and will be severely penalized. Although collaboration and sharing knowledge is highly encouraged, copying others' work without proper citation, either in part or full, is considered plagiarism. Whenever in doubt, review the university guidelines or consult the instructor. Cheating in whatever form will result in F grade.

- *Courtesy*: Students are expected to be courteous toward the instructor and their classmates throughout the duration of this course. Talking while someone else is speaking will not be tolerated. Furthermore, all cell phones must be turned off during class and exams. In addition, students are expected to be in class on time. More importantly, you are not allowed to leave the class unless it is an urgent matter. To contact your instructor, please use email through WebCT whenever possible and avoid using phone calls or written notes. When necessary to send an email through the university email system, please indicate ICS488-093 in the "Subject" field of your email, e.g. ICS488-093: Question about hw1.

⊙⊙⊙ **Best of luck!!** ⊙⊙⊙