Neuro-Fuzzy & Soft Comp Systems

*ENGG*4430 (Winter 2013)*

Instructor: *Ayman Elmesalami* (*Thornbrough, Room #1340*)
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Office Hours: Wednesday, 9:30 am or by appointments

Overview (*Calendar description*)

Introduction to Fuzzy systems; Fuzzy Sets; Fuzzy Rules and Fuzzy Reasoning; Fuzzy Inference Systems; Fuzzy Control; Introduction to Neural and Automata Networks; Neural Network Paradigms; Supervised Learning Neural Networks, Learning from Reinforcement, Unsupervised Learning and Other Neural Networks; Neurocontrol; System Identification; Controller Training, Robust Neurocontrol; Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling; Reinforcement Learning Control, Gradient-Free Optimization, Feedback Linearization and Sliding Control; Applications: Quality Assurance, Decision Aid Systems, Automatic Character Recognition, Inverse Kinematics Problems, Automobile MPG (Miles Per Gallon) Prediction, System Identification, Channel Equalization, Adaptive Noise Cancellation, Process Control.

Prerequisite(s): ENGG*3410

Co-requisite(s): ENGG*4280

Evaluation

Assignments	
• *Assignment #1*	13%
• *Assignment #2*	12%
Midterm	
• *February 28th*	20%
In-class activities *(discussion, quizzes and presentation)*	20%
Final Exam	
• *Check Registrar Schedule*	35%
Total	**100%**

- **Note (1)** late submissions for assignments are acceptable, but there will be a deduction of marks by 10% for one day late, 25% for two days late, and 50% for three days late. No marks will be given for submissions that are more than three days late. Penalties will only be waived for good reason, at the discretion of the instructor.
- **Note (2)** both ***Midterm*** and ***Final exam*** are *closed-book*.
- **Note (3)** more instructions about the student's presentations will be given in class.

Course Objectives:

Students who successfully complete this course will be able to:

- Have a general understanding of soft computing methodologies, including biological and artificial neural networks, fuzzy sets and fuzzy logic systems, and hybrid neuro-fuzzy systems;
- Develop computational neural network models for some simple biological systems;
- Develop fuzzy models for engineering systems, particularly for control systems;
- Combine neural networks and fuzzy systems to design neuro-fuzzy control and inference systems;
- Appreciate the pros and cons of intelligent control systems and compare their performance to that of classical control systems.

Textbook and References

No specific textbooks will be assigned, however the following are good references:

- Soft Computing & Intelligent Systems Design, by Karray & De Silva, Addison-Wesley, 2005.
- Neuro-fuzzy and Soft Computing, by Jang, Sun & Mizutani, Pretice Hall, 1997.
- An Introduction to Fuzzy Sets, by Pedrycz & Gomide, MIT Press, 1998.
- Evolutionary Computation, by Dumitrescu et al., CRC, 2000.

Topics (Tentative)***:***

- Introduction: Introduction to soft computing; introduction to biological and artificial neural network; introduction to fuzzy sets and fuzzy logic systems.
- Biological neural networks: generalization of single neuron; neural dynamics; additive and shunting neural networks; short term and long-term memory.
- Artificial neural networks and applications: artificial neural network models; learning in artificial neural networks; neural network applications in control systems.
- Fuzzy systems and applications: fuzzy sets; fuzzy reasoning; fuzzy inference systems; fuzzy control; applications of fuzzy systems.
- Neuro-fuzzy systems: neuro-fuzzy modeling; neuro-fuzzy control.

Comments:

Discussion with fellow students is always encouraged; however assignments answers should be your own. **Plagiarism is not tolerated at the University of Guelph**; awareness of the university and School of Engineering policy on plagiarism is your responsibility. Please do not hesitate to ask a question during lectures if something is unclear. The chances are that you are not the only one who thinks so!