CMPE449 Intelligent Systems Engineering

Neural Networks, Fuzzy Systems, and Genetic Optimization

The University policy about course outlines can be found in Section 23.4(2) of the University Calendar (http://www.registrar.ualberta.ca/calendar/Regulations-and-Information/Academic-Regulation/23.4.html).

About the instructor

Name:	Petr Musilek
Office location:	ECERF W6-033 (6th floor access: 8:30-12:00, 13:00-16:30)
Office hours:	M 14:00-15:00, H 11:00-12:00, or individual consultation scheduled by e-mail
Email:	Petr.Musilek@ualberta.ca (please put CMPE449 in the subject line)
Website:	Linked from http://www.ece.ualberta.ca/~musilek (more details provided below)

Course days, times, and locations

Lectures:	LEC A1, MWF 11:00-11:50, ETL E1 008 (reg. code 36054)
Labs:	Lab D1: T 14:00–15:20, ETL E5-005 (reg. code 40566)
Last lecture:	December 7, 2011 (Wednesday)
Midterm exam:	October (TBD)
Final exam:	December 20, 2011 (T) 9:00-11:00, ETL E1-008
No classes:	October 10 (M - Thanksgiving Day), November 11 (F – Remembrance Day)

Calendar Description

*3 (fi 6) (3-0-0). Neural networks as adaptive systems. Main architectures and learning paradigms. Supervised, reinforcement, and unsupervised learning. Fuzzy sets. Membership functions, operations, fuzzy relations, approximate reasoning. Rule based systems, fuzzy control, pattern classification. Evolutionary computing. Genetic algorithms as mechanisms of global optimization. Neurofuzzy systems and genetic optimization of neural and fuzzy systems. Selected applications. Note: May not be taken for credit if credit has already been obtained in either EE 563 or 564.

Textbook and references

[1] Fakhreddine O. Karray and Clarence De Silva, *Soft Computing and Intelligent Systems Design - Theory, Tools and Applications*, Pearson/Addison Wesley, 2004, ISBN 0 321 11617 8.

[2] Extensive set of handouts available on course website for download and print

Topics Covered in this Course

In this course, we will study five main areas:

1. Intelligent systems: (1 week approx.) Introduction to intelligent systems, artificial and computational intelligence, types of problems to be solved, biological inspiration for intelligent systems.
2. Neural Networks: (4 week approx.) Neurons (biological and artificial), topologies of neural networks, learning in neural networks (types of learning), supervised networks (single-neuron structures, layered networks, MLP), selforganization (Self-organizing maps, Learning vector quantization), associative and dynamic neural networks.
3. Fuzzy Systems: (4 weeks approx.) Fuzzy sets (operations, membership functions), fuzzy relations, fuzzy reasoning (inference, algorithms, implication), fuzzy rule-based computing, fuzzy control (structure of fuzzy controllers, fuzzification, defuzzification, types of fuzzy controllers).
4. Evolutionary Computing: (3 weeks approx.) Evolution in natural and artificial systems, search and optimization, problem representation, Genetic algorithms (selection, genetic operations), other evolutionary methods (Learning classifier systems, Artificial immune systems).
5. Hybrid Systems: (2 weeks approx.) Combining neural networks, fuzzy systems, and evolutionary computing

Learning objectives

The major objectives of the course can be summarized by the following list of skills students will acquire:
- *Identify* different methods of computational intelligence (CI)
- *Outline* procedures for solving problems with CI
- *Describe* the building blocks of several CI methods
- *Explain* the operation of several CI systems studied in this course
- *Distinguish* between different types of learning an knowledge representation
- *Interpret* results provided by techniques studied in this course
- *Apply* selected CI methods to analyze data, build models and control simple systems
- *Design* CI systems suitable for solving various engineering problems

Course Website

Website for CMPE449 is provided by University of Alberta moodle server.

This live website contains a plan of lectures, as well as important course material (handouts, assignments, extras) that will be updated as the term progresses. Marks obtained for individual assignments and exams will be also posted at the website. In addition, the website should serve as a forum for students to discuss course related topics and to ask question. The site will be monitored daily during week days.

Evaluation Scheme:

	Percentage	Component
1	15%	Assignments (10)
2	25%	Laboratories (5)
3	20%	Midterm Exam
4	40%	Final Exam

Grading

As of September 2003, the University of Alberta uses a (4-point) letter-grading scheme. Grades are assigned under this system and are guided by the Faculty of Engineering's suggested distribution, which is subject to modification from time to time. The Faculty's suggested GPA range for 300-level courses is 2.8 to 3.4 with a median grade of B+.

Plagiarism

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour at

http://www.uofaweb.ualberta.ca/GFCPOLICYMANUAL/content.cfm?ID_page=37633

and avoid any behaviour, which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

Lecture Recording

Recording is permitted only with the prior written consent of the professor or if recording is part of an approved accommodation plan.