ENGG*4430 Neuro-Fuzzy and Soft Computing Systems
Winter 2019

UNIVERSITY of GUELPH
School of Engineering

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Name: Simon Yang, Ph.D., P.Eng.
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1.2 Teaching Assistant

Name: Vithursan Thangarasa
Email: vthangar@uoguelph.ca
Office hours: TBA

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2 LEARNING RESOURCES

2.1 Course Website

Course material, news and announcements will be regularly posted to the ENGG*4430 CourseLink.

2.2 Recommended Resources

No specific textbooks will be assigned. Follow lecture notes and use the following references:

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

2.3 Additional Resources

Lecture Information: Students should take the notes during lectures.

Assignments: The assignments will be posted on the web page before the assignments start.

Miscellaneous Information: Other information related to this course are also posted on the web page.

2.4 Communication & Email Policy

Please use lectures as your main opportunity to ask questions about the course. Major announcements will be sent by emails and be posted to the course website. As per university regulations, all students are required to check their "uoguelph.ca" e-mail account regularly: e-mail is the official route of communication between the University and its students.

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3 ASSESSMENT

3.1 Dates and Distribution

Quizzes: 5%

Quiz 1:	Monday, Jan. 28, in class
Quiz 2:	Wednesday, Feb. 6, in class (replacement for Feb. 11)
Quiz 3:	Monday, Mar. 4, in class
Quiz 4:	Monday, Mar. 25, in class

Assignments: 5%

Assignment 1:	Monday, Jan. 28
Assignment 2:	Wednesday, Feb. 6
Assignment 3:	Monday, Mar. 4
Assignment 4:	Monday, Mar. 25

Project: 45%

Interim Report (10%):	Monday, Feb. 25, in class
Presentation (10%):	Monday, Apr. 1, in class
Final Report (25%):	Monday, Apr. 1, in class

Midterm Test: 20%

Monday, Feb. 25, 7:00-9:00 pm, in class

Final Exam: 25%

Thursday, Apr. 18, 7-9 pm

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Missed midterm tests: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam. There will be no makeup midterm tests.

Project Reports: Late submissions of project interim report and final report will not be accepted.

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4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 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
Corequisite(s) ENGG*4280

4.2 Course Aims

This course is an introductory course in neuro-fuzzy and soft computing systems, which is a basic course in most electrical and computer engineering programs. The main goals of the course are (1) to teach students the fundamental concepts in neuro-fuzzy and soft computing systems, and (2) to illustrate clearly how the neuro-fuzzy algorithms would provide intelligent solutions to various problems.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. 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;
2. Develop computational neural network models for some simple biological systems;
3. Develop fuzzy models for engineering systems, particularly for control systems;
4. Combine neural networks and fuzzy systems to design neuro-fuzzy control and inference systems;

5. Appreciate the pros and cons of intelligent control systems and compare their performance to that of classical control systems.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2, 3, 4, 5	Quizzes, Assignments, Exams
2. Problem Analysis	2, 3, 4	Assignments, Exams, Project
3. Investigation	2, 3, 4, 5	Project
4. Design	2, 3, 4, 5	Project
5. Use of Engineering Tools	2, 3, 4	Assignments, Project
6. Communication	-	-
7. Individual and Teamwork	-	Project
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

4.5 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on the course web site but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and project.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

4.7 Relationships with other Courses

Previous Courses:

ENGG*1500: Solving systems of linear equations, matrix algebra, complex numbers

MATH*1200 & MATH*1210: Limits, differentiation, integration, series expansion

MATH*2270: Differential equations

ENGG*2400: Foundations of engineering system analysis

ENGG*2450: Foundations of electric circuits, circuit analysis, ideal operational amplifiers

ENGG*3390: Foundations of signal processing

ENGG*3410: Foundations of control systems

ENGG*3700: Foundations of optimization for Engineers

Follow-on Courses:

ENGG*6570: Advanced topics on neuro-fuzzy systems and soft computing systems, genetic algorithms

ENGG*6580: Advanced control systems; nonlinear control; intelligent control

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5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Monday	7:00 – 9:50 pm	MACN 118

5.2 Lecture Schedule

Weeks	Lecture Topics	References	Learning Objectives
1	General Introduction to Intelligent Systems	Chapter 1	1,2,3,4,5
2-3	Basic Concepts and Models of ANN	Chapter 1	1,2,3,5
4-6	Biological Neural Networks	Chapter 2	1,2,5
7-8	Recurrent NN and Unsupervised Learning	Chapter 3	1,2,5
9-10	Fuzzy Logic and Fuzzy Sets	Chapter 4	1,3,5
11-12	Neuro-fuzzy Systems	Chapter 4	1,4,5

5.3 Other Important Dates

Monday, January 7: First day of class
Monday, February 18 – Friday, February 22: Winter Break
Friday, March 8: Drop day – 40th class

Friday, April 5: Last day of class

6 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

6.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

7 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

8 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs: http://www.uoguelph.ca/registrar/calendars/index.cfm?index