ECE/SYS 6410 INTELLIGENT CONTROL SYSTEMS (ICS)
WI 2018

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Catalog Description	ECE /SYS 6410 (formerly ECE/SYS 645) - Intelligent Control Systems (4 credits) Definition and paradigm for intelligent control; self-learning and supervised learning; hierarchical decision architecture; fuzzy logic, neural network, heuristics, genetic algorithm, optimum strategy and related topics; examples of intelligent and autonomous systems; computer simulation and visualization of applications. Previously SYS 735. Credit cannot be received for more than one of ECE 645, SYS 645 and SYS 735. Prerequisite(s): Student must meet prerequisite (at least one course from the core and theory group of courses) and have permission of instructor.
Course topics	Overview of Intelligent Systems: • Artificial intelligence (AI) • Computational intelligence soft computing • Cybernetics • Cyber-Physical Systems • Machine Learning • Deep Learning • Intelligent control systems (ICS) Artificial Neural Networks (ANN): • Bio-inspired neural model, • Feed forward NN, activation functions, recurrent NN, • Supervised learning: back propagation, Adaline, • Unsupervised learning: Reinforced learning • Competitive learning NN, Kohonen self-organizing network • Recurrent neural networks: • Applications Fuzzy Logic: • Fuzzy inference system: Mamdani style,, Sugeno style • Supervised learning: Adaptive neuro-fuzzy inference system (ANFIS) • Unsupervised learning • Applications Genetic Algorithm

	• Bio-inspired evolution model • Evolution algorithm • Genetic algorithm • Genetic programming • Applications Heuristics Search • Uninformed search: Breath first, depth first • Unformed search: A*, modified A* (D*, D-Lite) • Applications • Other methods. Applications & Matlab/Simulink Implementation of Concepts • Vision-based target locking system • Navigation of mobile robots • Supervisory decisions • Computer model, simulation, analysis, design, visualization, experiment
Course objective	At the end of the course, students should be able to understand the concepts and principles for intelligent control systems, read technical articles on the subjects, apply the techniques, verify via computer simulations, and use them in real world systems.
Course philosophy	Leaning new concepts and theories in this class should be exciting and entertaining. Hands-on simulation experiments and projects provides insights, reveals the strength and weakness of the techniques. Abstract concepts should crystallize into working concepts, and vice versa. Explore subjects on your own, with groups and instructors.
Prerequisite	Math background (calculus, linear algebra, vectors, matrices) SYS520 in systems & signal theory (math modeling, signal & system properties) Background in programming &simulation using Matlab/Simulink Background in classical and/or modern, analog and/or digital control and estimation systems.
Simulation programs, labs & projects	Matlab/Simulink-based assignments and simulation labs/projects are to be carried out using computers at OU facilities or own computers.
Text book	Neuro-Fuzzy and Soft Computing, J.-S.R.Jang, C.-T. Sun & E. Mizutani, Prentice-Hall 1997
Reference books	Neural Networks: A Comprehensive Foundation, 2nd Edition. Simon Haykin, Prentice Hall, 1998. Other books, journal and conference articles, and magazines.
Library	A wealth of knowledge can be found in the e-Journal Collections at OU Kresge Library http://library.oakland.edu/articles/ejournal.htm, and other websites. Students are encouraged to use this resource.
Grading	

	Homework assignments (~7) 30% Computer simulation assignments (~5) 40% Quizzes 10% Mid-term exam 10% Final Exam 10% ***100%***
Course delivery	**Course Materials** • ECE645 and SYS645 is an online course. We will use Moodle as a tool for delivery. • Course materials will be posted on **http://moodle.oakland.edu** under the designated course ECE645 & SYS645. • Please visit the Online Orientation tutorial for using MOODLE at http://www2.oakland.edu/elis/SO_index.cfm • Students would download, read and study the materials, which would be followed by homework and simulation assignments, and exams. • Students can work asynchronously on learning the materials at their own convenience, time & place. **Submission of Assignments & Exams** • Students would submit their assignments and exams online using Moodle. • Submitted solution to assignments must conform to the following where appropriate o Typed whenever possible using MSWord + equation editor (e.g., Mathtype) o Generated by Auto Report Generation feature from Matlab o Scanned and grouped as a single file. (Single pages must be grouped into a file.) • The files submitted must have identifiable filenames in the following format: AssignmentNumber _YourName. E.g., HW1_KaCCheok, Lab1_KaCCheok • Due dates will be observed. Penalty (-10% per week) will be assessed for late submissions. • Students are encouraged to discuss class materials among themselves, but submitted work must demonstrate individual work and comprehension of the materials. • Assignment solutions that appear to be identical copies will be questioned, so please submit own version (work) of solution. **Online Sessions** • There will be **online sessions each week** scheduled for - Tuesday 5:30-7:00 pm via **WebEx** feature on **Moodle** - Thursday 5:30-7:00 pm via **WebEx** feature on **Moodle** • During the online sessions I will go over the lecture notes and assignments to clarify and highlight key points on the topic being covered. • Students could ask questions during sessions • Students are encouraged to attend the sessions, but it is not compulsory to do so. • Students who missed the session schedule can logon later and playback recording of previous online sessions. **Interaction** • Students may post questions using regular email or the Forums feature on Moodle. • There will be once-a-week synchronous sessions on Tues 5:30-7:00 pm in the form of on-campus meeting or online chat session. Schedule to be announced, on moodle. • The synchronous sessions will be mainly for questions and answers, clarification and highlight on the subject matters. • Students may make appointments to meet with the professor for further discussion on class topics.

	On-Campus Meeting (may or may not be required) • A rule for online course stipulates that we are only allowed to meet at most three times during the semester in a class room setting on campus. • There may or may not be such on-campus meetings. If there is one, the schedule for on-campus classroom meeting will be announced via email and posted on Moodle.

About the course

Intelligent Control Systems will be taught through a series of lectures accompanied by computer simulations. Essential principles for each topic will be explained, followed by assignments; the assignment goals will verified by computer simulation and validated by experiments. The course requires each student to procure his/her own microcontroller and the necessary electronics toolkit and components. Matlab/Simulink/Simscape are used as a tool for simulation as well as for interfacing with the microcontroller. At the end of the course, students will gain understanding of computer-based control systems and various aspects for putting such a system together.

About learning

- Knowledge = Understanding + Experience + Instinct
- Learning = Explore + Discover
- How do we learn? Individual versus group?
- Only 1-10% burden on the instructor (external exposure) (say 1-10 hr);
- 10-99% burden is on YOU (own exploration + discovery) (10-100 hrs)!
- A teacher is a pointer to the truth that each student must discover for himself.
- A teacher shows you how to explore
- Learning is a constant process of discovery!
- Learn all you can. Keep the good ones. Discard the bad ones.
- Use only that which works, and take it from any place you can find it.
- What am I learning? How is it useful?
- Knowing is not enough, we must apply it.
- Willing is not enough, we must do it.