CSI 5130 Computational Intelligence, Winter 2018

General Information

Instructor: Guangzhi Qu
Office Location: 538 Engineering Center
Office Hours: M-TH 9:15-11:55am or by appointment
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(use the course forum unless you prefer an 'old' style: please put CSI 5130 in the subject line)
Teaching Assistant: Zijun Han (zhan@oakland.edu)

Lectures: T/TH 5:30-7:17pm
Class room: EC 555

Course Information

Prerequisites

- (APM 263 OR equivalent) AND
- (CSE 507 OR equivalent)
- Probability [though not listed from catalog, but it is very relevant]
- In all case if you do not have the standard prerequisites ***you will be responsible*** for covering any necessary background on your own.

Course Description (Catalog)

This course covers fundamental notions of modern artificial intelligence and fuzzy logic. Topics include: problem solving (informed search methods); knowledge and reasoning (inference in first-order logic); planning/acting; reasoning under uncertainty (probabilistic reasoning systems, decision making) and fuzzy inferences (Mamdani, Sugeno, and Tsukamoto); parameter identification and learning from observations (neural and belief networks, Genetic algorithms). The course will also discuss recent applications of artificial intelligence (such as Chess, Othello, robot navigation), and fuzzy logic (fuzzy controllers).

Course Objectives

Upon completion of the course, students will be able to:

- Be able to solve a problem through search (e.g. A*, game playing).
- Be able to solve linear regression models (least-squares) for a system identification

- Understand the basic concepts and approaches about machine learning.

- Be able to make decision with uncertainty.
- Know when he or she should apply derivative-based optimization to determine local optima.
- Solve combinatorial problems using derivative-free optimization (Simulated Annealing, Genetic Algorithm)
- Solve problems when the environment is subject to change (Neural Nets and Adaptive models)
- Understand the difference between a fuzzy, a deterministic and a probabilistic system

Text [Recommended]

Artificial Intelligence: A Modern Approach, 3rd edition. Stuart J. Russell and Peter Norvig. Prentice Hall, Englewook Cliffs, N.J., 2010

Machine Learning: An Algorithmic Perspective, 2nd edition. Stephen Marsland. CRC Press, Taylor & Francis Group, 2014

Course Website: All course information (lecture notes, projects, announcements, questions, etc.) will be posted in Moodle (https://moodle.oakland.edu/). Students are responsible for checking Moodle on a regular basis.

Topics Covered

- Introduction on AI history and today
- Problem solving as Search
    - Uninformed search: breadth-first search, depth-first search, uniform-cost search, iterative-deepening search, etc.
    - Informed search: A* algorithm
    - More search: Hill-climbing, simulated annealing, genetic algorithm
    - Game playing
        - Minmax, alpha-beta pruning
    - Constraint Satisfaction Problems
- Machine Learning (inductive inference)
    - Intro to ML
    - Clustering: k-means, hac, etc.
    - Classification:
        - k-Nearest-Neighbor
        - Support Vector Machine
        - Decision Trees
    - Reasoning and Uncertainty
    - Bayesian Networks Markov Model, Markov Process, etc.
    - Neural Networks, deep learning
- AI applications
    - Vision, natural language processing, etc.

Homework Assignments (50%): in the form of both written and programming parts. Each homework is based on certain applications and will also enhance your understanding of theoretical concepts.

Exams (40%): There will be a midterm exam and a final exam that test your knowledge and problem-solving skills on all preceding lectures, homework assignments, and in classroom discussions. You cannot use any external aids except one double-sided A4 page of "cheat-sheet" with no limit on the font size. If you have a major conflict (e.g., an academic conference, medical emergency), submit a request to take it at another (EARILIER) time.

- The midterm is scheduled on Feb 27th
- Final exam is scheduled on April 19th

Project (10%): The project will ask you to use the tools (modeling + algorithms) from class to build something interesting of your choice. Projects should be done in groups of up to three. The project will be something that you work on throughout the course and we have set up some milestones to help you along the way:

- Project proposal (maximum 2 pages) (Due: in classroom: Feb 13th)
- Project progress report (submit online: March 20th)
- Project final presentation and final report (last day of class: April 12th -17th)

Grading: The final grade will be based upon the following weights:

- Homework Assignments 50%
- Exams 40%
- Term project and paper 10%

- Grading Scale:

90% - - 100%	3.6-4.0
80% - - 89%	3.0-3.5
70% - - 79%	2.0-2.9
60% - - 69%	1.0-1.9
<60%	0.0

Note: The total grades shown in Moodle do not necessary reflect the proportions above. So, do your own calculation for grades using the proportions.

Course Regulations:

- **Late Policies:** This course covers a lot of material and late assignments will seriously impact your overall experience of learning. Assignments are due at 11:55pm (EST) on the due date. After that the assignments will not be graded (NO EXCEPTION). Please try to start earlier, finish and submit your assignments on time.

- **Cooperation and Cheating:** Feel free to discuss homework and projects with other students of the class, teaching assistant and instructor. However, DO NOT look at or copy another student's solution to a homework or project. I am not concerned with how you come to understand the problem and how to solve it, but once you have the background necessary to solve it, you must provide your own solution. Exchanging homework or project solutions is cheating and will be reported to the University, and you will receive an automatic grade of **0** on the course. All students must be aware of the contents of Academic Conduct Regulations (http://www2.oakland.edu/deanofstudents/handbook/acr.cfm).
- **Please TURN OFF ALL** electronic devices during the lecturing time.
- **No MAKEUP for the exams.** All exams will cover topics from lectures, homework assignments and in classroom discussions.

Program Outcomes: Program outcomes are a set of skills that assure the achievement of the program educational objectives and are necessary for professional engineering practice. Before graduating, SECS students will demonstrate their skills in the following key areas:

a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;
c. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.
d. An ability to function effectively on teams to accomplish a common goal.
e. An understanding of professional, ethical, legal, security, and social issues and responsibilities.
f. An ability to communicate effectively with a range of audiences.
g. An ability to analyze the local and global impact of computing on individuals, organizations and society.
h. Recognition of the need for, and an ability to engage in, continuing professional development.
i. An ability to use current techniques, skills, and tools necessary for computing practice.
j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
k. An ability to apply design and development principles in the construction of software systems of varying complexity.