

56:235 Computational Intelligence

<http://css.engineering.uiowa.edu/~comp/>
Spring 2009

Objectives: Introducing concepts, models, algorithms, and tools for development of intelligent systems. Example topics include data mining, expert systems, neural networks, particle swarm optimization, ant colony algorithms, artificial immune system, and their applications in engineering, medicine, and service industry. Learning research methodologies and preparing research papers and reports.

Course Webpage (<http://css.engineering.uiowa.edu/~comp/>): For your convenience, the website includes the course material offered previously. All classroom presentation entries will be gradually replaced with the new content starting with the top of the *Course Materials* page. The new material will be posted at the time of the classroom coverage. Other entries will be replaced in a similar way.

Textbook: Eberhart, E. and Y. Shi., *Computational Intelligence: Concepts and Implementations*, Morgan Kaufmann, San Diego, CA, 2007.

References: Engelbrecht, A.P., *Computational Intelligence: An Introduction*, John Wiley, New York, 2003.
Kantardzic, M., *Data Mining: Concepts Models, and Algorithms*, IEEE Press and John Wiley, New York, 2003.
Negnevitsky, M., *Artificial Intelligence: A Guide to Intelligent Systems*, Addison Wesley, New York, 2002.
Fogel, D.B. and C.J. Robinson (Eds), *Computational Intelligence: The Experts Speak*, John Wiley, New York, 2003.

Useful URLs: Data mining
http://www.pcc.qub.ac.uk/tec/courses/datamining/stu_notes/dm_book_1.html
<http://www.cs.ubc.ca/spider/poole/ci/lectures/lectures.html>
<http://www.cs.bris.ac.uk/~kovacs/lcs/search.html>
<http://www.icaen.uiowa.edu/~ankusiak/KDC/main.htm>
Neural networks
<http://www.cs.stir.ac.uk/~lss/NNIntro/InvSlides.html>
Expert systems
<http://www.ghg.net/clips/CLIPS.html>
Fuzzy logic
<http://www.austinlinks.com/Fuzzy/>
Computational intelligence
<http://www.cogs.susx.ac.uk/users/inmanh/easy/alife03/>
Artificial life
<http://www.ottawagenomecenter.ca/research/bioinformatics/mandrade/al-pres/index.html>
<http://www.cogs.susx.ac.uk/users/inmanh/easy/alife03/>
Swarm intelligence
<http://www.sce.carleton.ca/netmanage/tony/swarm.html>
<http://dsp.jpl.nasa.gov/members/payman/swarm/>

Instructor: Andrew Kusiak, Professor
2139 Seamans Center
Office hours: 1:30 pm - 3:00 pm, T Th
andrew-kusiak@uiowa.edu
<http://www.icaen.uiowa.edu/~ankusiak>

Tel: 319 - 335 5934
Fax: 319 - 335 5669

Class Time: 10:55 AM - 12:10 PM, TTh

Classroom: 3231 Seamans Center

Course Contents: Topic

1. Introduction
2. Data mining
3. Decision tree algorithms
4. Association rules
5. Rough set theory
6. Bayesian methods
7. Expert systems
8. Neural networks
9. Clustering
10. Fuzzy reasoning
11. Artificial life systems
12. Evolutionary computation
13. Particle swarm optimization
14. Ant colony optimization
15. Artificial immune systems

Final Exam (Time and date are provided at <http://www.registrar.uiowa.edu/exams/single.aspx>)

Course grading scheme

Homeworks	20%
Project	40%
Midterm Exam	20%
Final Exam	20%

Check your grade at ICON <http://icon.uiowa.edu/index.shtml>

A number of homeworks will be assigned in this class. Most homeworks will involve reading a recent journal paper on a computational intelligence topic and reporting the key ideas learned from the paper in class.

Project grading scheme

- 25% Project presentation
- 65% Project content
- 10% Attendance of all project presentations

Exams: One midterm and one final will be given

Dates to Remember:

Classroom presentations of project proposals:

- February 24, T

Classroom presentations of project results:

- April 21, T and April 23, Th

Project reports due:

- April 21, T

Midterm:

- Week of March 9

All homeworks, exams, and project materials are to be dropped in the ICON box.

SEMESTER PROJECT

THE SEMESTER PROJECT MAY TAKE ONE THE FOLLOWING THREE FORMS:

A. Application Project (Teams of two students are allowed)

You need to describe the problem considered for your project and propose a solution approach. Ideally, the project should be based on an existing application. The solution approach could be based on an existing freeware that could be found on the web.

Hint: To identify software (freeware) tool to be used for solving the selected problem (application) you may follow the following steps:

- ✓ Search the www.
- ✓ Identify a computational intelligence tool (e.g., data mining software, expert system shell) that is suitable for the selected problem.
- ✓ Get familiar with the tool.
- ✓ Prepare user's manual.
- ✓ Prepare Power Point presentation.
- ✓ Demonstrate the application of the tool for your problem in class.
- ✓ Prepare project report according to the format presented in this syllabus.

B. Research Paper (Teaming is not encouraged)

You may choose a specific problem, develop a model, and solve with a computational intelligence approach. This type of project should survey the existing literature, identify and summarize a research problem, present existing methods for solving the problem, formulate a new solution approach, and report computational results.

C. Software Development Project (Teams of two students are allowed)

The student(s) will be responsible for the development of software for some of the algorithms discussed in class. The code should be written in a modern language, e.g., C, C++, Visual Basic, ASP and a user-friendly interface should be developed. Web implementation of the software is encouraged.

PROJECT REPORT FORMAT

The project report should be prepared on a word processor and should contain figures and tables that are necessary to make the report complete. Be concise in your writing and consult technical writing references as needed.

The term project report should be prepared in the following format:

A. Application Project

1. Introduction
2. Problem definition
3. Project goals
4. Model formulation
5. Solution approach
6. Computational study
7. Conclusions

B. Research Paper

1. Abstract (approximately 100 words)
2. Statement of the problem
3. Literature review
4. Existing models and solution approaches
5. Proposed model and/or solution approach

6. Examples
7. Conclusions

C. Software Development Project

1. Introduction
2. Algorithm description
3. User's manual
4. Example problems (2)
5. Computer code description

The developed software should run on the College of Engineering network.

REFERENCES ON TECHNICAL WRITING

- [1] Hacker, D., *A Writer's Reference*, Bedford/St. Martin's, 1999.
- [2] Markel, M., *Technical Communication*, Bedford/St. Martin's, 2001.

Semester Project Guidelines

Time estimate

It is expected that each student should spend not less than 60 hours on the project.

Project presentation

Each project proposal and project results are to be presented in class.

Project report

Each team (student) should submit the following:

- ❑ Project report file and your class presentation Power Point slides. For software development projects, submit also the source code, executable, and specify the computer hardware and software needed to run your program. Compress the folder with all files and drop off in the ICON box.