Revised: Jan 18, 2010

56:230 Innovation Science and Studies

http://css.engineering.uiowa.edu/~ie230/

Spring 2010

Objectives: Innovation typology and sources; Classical innovation models; Measuring innovation; Innovation discovery from data; Computational intelligence in innovation; Innovation life-cycle. Introducing concepts, models, algorithms, and tools for development of innovation systems. Comutational intelligence topics include data mining, expert sytems, neural networks, particle swarm optimization, ant colony algorithms, artificial immune systems, sand their applications in innovation. Learning reseach methodologies and preparing research papers and reports.

Textbook: R. Eberhart and Y. Shi, *Computational Intelligence: Concepts to Implementations*, Morgan Kaufmann (Elsevier), San Francisco, CA, 2007.

References:

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.

Cios, K., W. Pedrycz, and Swiniarski, R., *Data Mining: Methods for Knowledge Discovery*, Kluwer 1998.

Eiben, A.E. and J.E. Smith, *Introduction to Evolutionary Computing*, Springer, Heilderberg, Germany, 2003.

Koza J. R. *et al.*, *Genetic Programming IV*, Kluwer, Norwell, MA, 2003.

Websites:

http://www.thinksmart.com/library/bookclub.html
Innovation Network

http://www.red3d.com/cwr/evolve.html
Evolutionary Computation and its application to art and design

http://www.cs.umd.edu/users/seanl/gp/
Evolutionary Computation

http://www.genetic-programming.com/
Genetic Programming

http://alphard.ethz.ch/gerber/approx/default.html
Genetic Programming Applet

Journals: Visit the Lichtenberger Engineering Library webpage http://www.lib.uiowa.edu/eng/
Open E-journals http://infolink.lib.uiowa.edu/sfx_local/a-z/default?perform=search
and search on keywords such as: Innovation, Computational intelligence, Evolutionary Computation
Search also:

- IEEE Explore http://ieeexplore.ieee.org
- Elsevier Science Direct http://www.sciencedirect.com/science
- Informaworld http://journalsonline.tandf.co.uk
- Springerlink http://www.springerlink.com/home/main.mpx

Instructor: Andrew Kusiak
2139 Seamans Center
andrew-kusiak@uiowa.edu
http://www.icaen.uiowa.edu/~ankusiak

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

Instructor Office Hours:
1:30 PM – 3:00 PM, TTh
2139 Seamans Center

Class Time: 10:55 AM – 12:10 PM, TTh
Classroom: 3231 SC

Course Contents:

1. Introduction
2. Innovation principles
3. Innovation case studies
4. Computational innovation
5. Machine learning and evolutionary computation
6. Genetic programming and biology
7. Genetic programming formalisms
8. Fundamentals of genetic programming
9. Statistics in genetic programming
10. Applications of genetic programming
11. Genetic programming software
12. Evolutionary optimization
13. Evolutionary neural networks
14. Case studies

Course grading scheme

Homework assignments	20%
Mini project	10%
Semester Project	30%
Midterm Exam	20%
Final Exam	20%

Check your grade at the ICON website http://icon.uiowa.edu/index.shtml

Homeworks: Regular homework assignments are due by 10:55AM on the day indicated on the assignment. Some homeworks that may be due in more than one week. It is preferred that you upload all homeworks to ICON. If needed, a hard copy can be dropped in the classroom or at the instructor's office (2139 SC).
Each student is to submit her/his own work.

Exams: Two exams (midterm and final) will be given.
The final exam date is provided at http://www.registrar.uiowa.edu/exams/single.aspx

SEMESTER PROJECT

There are three components to the semester project:

1. Project Proposal — DUE: Th, March 11
   Submit the proposal to ICON
2. Project Report — DUE: T, May 4
   Submit the project report and your Power Point presentation to ICON
   (Look under "Project report" for submission details)
3. Project Presentations — In class: May 4, and May 6

⇒ *The project content used in this class cannot be used for credit in other courses*

Project grading scheme

- 30% project presentation
- 60% project content
- 10% attendance of discussion meetings and project presentations

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., a specific text mining algorithm, a geometric programming algorithm) 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 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 semester 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 50 hours on the project.

Project presentation

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

Project report

Each team (student) should upload the following items to ICON:

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. Before uploading to ICON, compress the folder with all files and name it with your name and course number, e.g., Smith_56_230_Project.

University Information

This course is given by the College of Engineering. This means that class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Engineering. Students wishing to add or drop this course after the official deadline must receive the approval of the Dean of the College of Engineering. Details of the University policy of cross enrollments may be found at http://www.uiowa.edu/~provost/deos/crossenroll.doc