University of Colorado at Colorado Springs

CS 5710: Syllabus

Evolutionary Computing

MW 4:30 - 5:45 p.m.

Objective: Develop an understanding of issues in the computing using evolutionary algorithms, in particular genetic algorithms. Study theoretical as well practical issues. Prepare oneself for independent research in the area. Learn how the knowledge of evolutionary computing can be used in application areas.

Instructor: Jugal Kalita (255-3432)
Email: jkalita@uccs.edu
Office: Engineering 178
Hours: MW 3:00-4:30 p.m. or by appointment

Text Book and Recommended Books

- *Sivanandan and Deepa: Introduction to Genetic Algorithms, Springer 2008 (SD)*. It is the only recently published textbook that I could find. It has a wide coverage of the materials we need to know. Frequently however, the accompanying explanations are weak. The book is available from Amazon.com for about $99. However, there is a way to buy the book inexpensively. If you are on campus, go to springer.com and search for the book. On the page for the book, click on “Read Online.” You should be able to read the book chapter by chapter for free if you are on campus, maybe also through VPN to UCCS. I would recommend that you buy a print copy available from the same page on springer.com for $24.95 by ordering it from within campus.


- *David E. Goldberg: Genetic Algorithms in Search, Optimization and Machine Learning, 1989* (G). It is a very nice introductory book by a pioneering individual who was instrumental in making genetic algorithms accepted widely by researchers and practitioners. The book is outdated and there is no subsequent edition. However, it is still valuable to anyone who wants to learn about genetic algorithms from a theoretical as well as practical point of view.

- I also want you to download a freely available book called *Field Guide to Genetic Programming* by Riccardo Poli, William B. Langdon, Nicholas F. McPhee, with contributions by John R.
Koza (PLMK). If you want a printed copy, you can buy it from lulu.com for $11.15. It is an excellent book covering basic, advanced and practical genetic programming. I don’t think we will cover a lot of genetic programming in the class, but your class projects can definitely use genetic programming.

Schedule of Topics

The following schedule is tentative. It is quite likely that we will cover only selected subsections/problems from the indicated chapters. This is especially so because the textbook by Sivanandan and Deepa go into many complex topics without proper explanation. In such cases, we will try to find the actual papers and read them.

I will give out handouts when appropriate. Please read the appropriate material given below before coming to class.

<table>
<thead>
<tr>
<th>Number of Classes</th>
<th>Topics</th>
<th>Chapters</th>
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<tr>
<td>2</td>
<td>Introduction</td>
<td></td>
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<tr>
<td>3</td>
<td>Introduction to Optimization</td>
<td>SD 2, HH1</td>
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<tr>
<td>3</td>
<td>The Basic (Binary) Genetic Algorithm</td>
<td>SD3, HH2</td>
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<tr>
<td>3</td>
<td>Advanced Genetic Algorithms</td>
<td>SD4, HH3</td>
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<td>3</td>
<td>Optimization using Genetic Algorithms</td>
<td>SD7</td>
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<td>3</td>
<td>Advanced Applications of GA</td>
<td>SD10, HH4, HH6 &amp; G6 &amp; G7</td>
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<td>3</td>
<td>Types of GA</td>
<td>SD 5, HH5 &amp; G5</td>
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<tr>
<td>2</td>
<td>Mathematical Foundations of GA</td>
<td>SD 3, G1 &amp; G2</td>
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<td>3</td>
<td>Genetic Programming</td>
<td>SD 6, PLMK 1-4</td>
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<tr>
<td>3</td>
<td>Particle Swarm &amp; Ant Colony Algorithms</td>
<td>SD 11, HH7</td>
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Grading Scheme

The grading scheme is not conventional for UCCS. I seek your cooperation in making it work. In other words, I need motivated students who are willing to be self-reliant. I have designed the grading scheme to allow for independent research, project implementation, and development of presentation skills. The grading scheme reflects that it is an advanced graduate class.

Grading for the class will be based on a class project, homework assignments and class participation. Each student will complete a substantial class project during the semester. Go to the UCCS library Web site and peruse recent issues of the journals *Evolutionary Computation* and *IEEE Transactions on Evolutionary Computation* in addition to reading the recommended books to get project ideas. Of course, I am available for consultation.

From time to time, you will be required to present your progress on the project to the class. Class participation will be evaluated in terms of physical presence in the class, reading the assigned
material and participating in discussions in a manner that reflects the knowledge acquired from reading. You may be asked to read material and present it to the class as well.

In particular, the action items are given below.

• **Homework Assignments:** 25% of the class grade will be based on two homework assignments.

• **Proposal:** A 2-3 page class project proposal is due at the end of the third week of classes. You will talk to the class for 9-10 minutes (75 minutes divided by the number of students) regarding what you want to accomplish in the class project. You must strictly comply with this time limit, but I don’t want you to finish too quickly either. The proposal write-up and talk are worth 10% of the class grade.

• **Mid-term Exam:** The mid-term exam will be worth 15% of the class grade. The mid-term exam will be comprised of a presentation, a write-up and a demo of your class project accomplishments so far. You will do a 9-10 minute presentation in the class. The write-up will be 4-5 pages. The write-up must be well-written and well-integrated with any material from the proposal that you may use. You will do the demo to me during my office hours. You must make visible progress by the mid-term date to get full credit. In other words, you should at least implement one or more preliminary algorithms and provide some results by the mid-term exam.

• **Final Exam:** The final exam will be held on the scheduled date. It is worth 45% of the class grade. The final exam will be comprised of a 20 minute presentation, a write-up and a demo of your class project. The write-up will be 8-10 pages long. The write-up must read like a paper ready to submit to IEEE Transactions on Evolutionary Computations. You will demo the final accomplishments for the project to me before the day of the final exam.

• 5% of the grade will be based on your regular attendance and participation in class discussion. This will mean leading the discussion in the class.

**Formats**

You *must* use IEEE journal author style for all your reports. It is a very compact and dense format. You can use LaTeX or Word-based templates that are downloadable to write your paper. Each report must have academic-type references from conferences and journals. Use Powerpoint or a similar tool for presentations. You will be penalized for not following the formats. The presentations should look professional. The final presentation will be like that in a computer science conference.

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1If your work is good enough by the end of the semester or if you are willing to work some more, possibly in the summer, we may be able to submit a paper for submission. In such a case, I will help you edit and submit the paper.

2On Google, search for “IEEE Guide for Transactions Authors” to find the style files.
Important Dates

Semester Project Proposal: 2/13/2012
Project Proposal Write-up due: 2/13/2012
Midterm Exam: 3/12/2012
Midterm Project Report: 3/12/2012
Midterm Demo: The week of 3/12/2012
Final Exam: 5/9/2012, 4:30 to 7:00 PM
Final Report: 5/9/2012
Final Demo: The week of 5/9/2012