COMP 5206

Evolutionary Computing and Artificial Life

Fall 2016

Lectures:

COMP 5206 (4125 HP)
Wed. and Wed. 11:05 am-12:55 pm

Instructor:

Tony White
arpwhite at(@) scs.carleton.ca
HP 5354, 520-2600 x2208

Office Hours: Wed. 1:00-3:00pm

Teaching Assistants:

The TA(s) for this course will be in **HP 1170** during stated office hours.

Name	Office Hours
No TA	

Announcements:

- Please use COMP 5206 in the subject line of any email.
- **Final exam** is scheduled for **9th December at 11:00 am**. It is a 1.5 hour in-class exam. It will take place in **4125 HP**.

Course Description:

Introduction to the theory and application of naturally-occurring systems for the creation of computer algorithms. Topics from Evolutionary Computing, Swarm Intelligence, Neural Networks and Artificial Life will be studied.

Topics Covered:

1. Introduction to biologically-inspired computing
2. Genetic Algorithms
3. Genetic Programming
4. Gene Expression Programming

5. Principles of Swarm Intelligence
6. Modelling using NetLogo
7. Ant Colony Optimization
8. Particle Swarm Optimization
9. Task Allocation and Division of Labour
10. Neural Networks
11. Artificial Immune Systems
12. L-systems
13. Cellular Automata
14. Membrane Computing
15. Complex Systems analysis tools

Prerequisites:

none

Course Objectives:

Short Description

The principal objective for this course is to have students understand the principles underlying naturally occurring systems and how they can be used for the creation of computer algorithms.

Long Description

The principal course objective is to have a student solve problems using algorithms inspired by the study and analysis of naturally-occurring systems. The motivation for this objective is that naturally-occurring systems solve complex problems in a robust, scalable, fault tolerant manner using decentralized, self-organizing processes.

During the course a student can expect to analyze several naturally-occurring systems which include: ant colonies, flocks of birds and evolutionary systems. Tools and techniques used in the analysis of complex systems will also be presented.

In order to achieve the above, numerous open source software packages will be introduced. These may include: JGAP, NetLogo, JAMA.

Assignments will be application-centered and test a student's understanding of the material presented during the lectures.

Textbooks (not mandatory):

- Leandro Nune de Castro, "Fundamentals of Natural Computing: Basic Concepts, Algorithms and Applications"
- Dario Floreano and Claudio Mattiussi, "Bio-inspired Artificial Intelligence: Theories, Methods and Technologies"
- Eric Bonabeau, Marco Dorigo and Guy Theraulaz, "Swarm Intelligence: From Natural to Artificial Systems"
- Melanie Mitchell, "An Introduction to Genetic Algorithms"

- R. Poli, Bill Langdon, Nicholas McPhee (with contributions by John Koza) "A Field Guide to Genetic Programming" (FREE)
- T. White, "Expert Assessment of Stigmergy" (FREE)

  For a computational complexity view of bioinspired computation (free book+slides):

- F. Neumann, C. Witt, "Bioinspired Computation in Combinatorial Optimization -- Algorithms and Their Computational Complexity" (FREE)

  Great book on biological models: focus is explanation of phenomena, not engineering applications

- Scott Camazine, Jean-Louis Deneubourg, Nigel R. Franks, James Sneyd, Guy Theraulaz and Eric Bonabeau, "Self-Organization in Biological Systems"

- Content is also provided through web links associated with each lecture prefixed by the tag **READING:**

Software:

Students will be required to use Eclipse, JGAP and NetLogo during this course.

Assignment Submission:

There will be 4 equally-weighted assignments in this course which will be available on the course web page and through cuLearn. All assignments are counted towards the final grade.

Marking Scheme:

Assignments (4x10%)	40%
Final (in-class)	20%
Project	40%

Course Web Page:

As well as being announced in class, all important information, such as course news, assignments, TA hours, instructor office hours, will be available on the course web page. It is the student's responsibility to check this web page for new information *regularly*.

Collaboration Policy

Collaborating outside of your team on assignments is strictly disallowed. Your team must complete the work. If you need help, please see a TA or your instructor. Posting assignment solutions on discussion boards before the due date and time is also prohibited.

SCS Computer Accounts

Any student taking an SCS course qualifies to have an SCS account. SCS accounts can be created at the following URL: http://www.scs.carleton.ca/newacct. SCS students can access one of the designated labs for your course. The labs are operational 7 days a week 24 hours per day, please be advised that the building will be closed overnight, Mon. - Fri. 23:00 - 8:00 and on weekends from 17:00 - 8:00. Technical support is available in room HP5161 Monday to Friday from 9:00 until 17:00. All SCS account related information is accessible at the following URL: http://www.scs.carleton.ca/nethelp.

Graduate Academic Advisor

The Graduate Advisor for the School of Computer Science is available in Room 5302 HP, by telephone at 520-2600, ext. 8751 or by email at graduate_advisor@scs.carleton.ca. The graduate advisor can assist with information about prerequisites and preclusions, course substitutions/equivalencies, understanding your academic audit and the remaining requirements for graduation. The undergraduate advisor will also refer students to appropriate resources such as the Science Student Success Centre, Learning Support Services and the Writing Tutorial Services.

University Policies

Student Academic Integrity Policy

Every student should be familiar with the Carleton University student academic integrity policy. A student found in violation of academic integrity standards may be awarded penalties which range from a reprimand to receiving a grade of F in the course or even being expelled from the program or University. Some examples of offences are: plagiarism and unauthorized co-operation or collaboration. Information on this policy may be found in the Undergraduate Calendar.

Plagiarism

As defined by Senate, "plagiarism is presenting, whether intentional or not, the ideas, expression of ideas or work of others as one's own". Such reported offences will be reviewed by the office of the Dean of Science.

Unauthorized Co-operation or Collaboration

Senate policy states that "to ensure fairness and equity in assessment of term work, students shall not co-operate or collaborate in the completion of an academic assignment, in whole or in part, when the instructor has indicated that the assignment is to be completed on an individual basis". Please refer to the course outline statement or the instructor concerning this issue.

Academic Accommodations for Students with Disabilities

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to

send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Medical Certificate

The following is a link to the official medical certificate accepted by Carleton University for the deferral of final examinations or assignments in courses. To access the form, please go to http://www.carleton.ca/registrar/forms