COMP 5206
Evolutionary Computing and Artificial Life
Fall 2019

Lectures:

COMP 5206 (413 Southam Hall)
Fri. 2:05pm-4:55pm

Instructor:

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

Office Hours: TBD

Teaching Assistants:

The TA(s) for this course will be in HP 4125 during stated office hours.

<table>
<thead>
<tr>
<th>Name</th>
<th>Office Hours</th>
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<td>No TA</td>
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Announcements:

- Please use COMP 5206 in the subject line of any email.
- Potential projects may be found here.

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. Modelling using NetLogo
3. Principles of Swarm Intelligence
4. Ant Colony Optimization
5. Particle Swarm Optimization
6. Task Allocation and Division of Labour
7. Genetic Algorithms
8. Genetic Programming
9. Gene Expression Programming
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):

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:

Lectures:

Assignments:

All assignments are weighted equally.

Software:

Students may 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:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Assignments</td>
<td>4x12.5%</td>
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<tr>
<td>Project</td>
<td>50%</td>
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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 Administrator for the School of Computer Science is available in Room 5302 HP, by telephone at 520-2600, ext. 8751 or by email at grad@scs.carleton.ca. The Graduate Administrator can assist with information about prerequisites and preclusions, course substitutions/equivalencies, understanding your academic audit and the remaining requirements for graduation. The Graduate 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 Graduate 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.

Requests for Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

Pregnancy obligation

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

Religious obligation

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. [carleton.ca/pmc](carleton.ca/pmc)

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and is survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: [carleton.ca/sexual-violence-support](carleton.ca/sexual-violence-support)

Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the
national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. [carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf](carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf)

For more information on academic accommodation, please contact the departmental administrator or visit: [students.carleton.ca/course-outline](students.carleton.ca/course-outline)

**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 undergraduate courses. To access the form, please go to [www.carleton.ca/registrar/forms](www.carleton.ca/registrar/forms)