THE UNIVERSITY OF WINNIPEG

APPLIED COMPUTER SCIENCE

Course Number: GACS-7401-001
Course Name: Current Topics in Computing (Complex Adaptive Systems)
Course Webpage: https://nexus.uwinnipeg.ca/d2l/home/75034

Instructor Information

Instructor: Sergio G. Camorlinga
E-mail: s.camorlinga@uwinnipeg.ca
Office Hours: Thursdays 4:00 - 5:00 pm 3D29

Class meeting time: Tuesdays/Thursdays 2:30 pm - 3:45 pm 3D03

Important Dates

1. First Class: January 6, 2026
2. Reading Week (no classes): February 15-21, 2026
3. Midterm Exam: February 24, 2026
4. Final Withdrawal Date w/o academic penalty*: March 13, 2026
5. Last Class: April 2, 2026
6. University closures: Louis Riel Day February 16, 2026
   Good Friday April 3, 2026

*A minimum of 20% of the work on which the final grade is based will be evaluated and available to the student before the voluntary withdrawal date.

Course Objectives / Learning Outcomes

This course is an introduction to selected topics in the field of Complex Adaptive Systems (CAS) and its application to health and social systems. CAS are systems with many members, which are interacting, adapting and learning among themselves and the environment where they exist in a variety of ways. Because of these activities, novel properties for the system can emerge. Samples of CAS are everywhere and diverse, for instance our brains, immune systems, insect colonies, ecosystems, communities, geopolitical organizations, social systems, internet, etc. We will go over fundamental topics of complexity, cellular automata, dynamical systems, network models, genetic algorithms, immune systems, and artificial life. Then we will apply these ideas to health and social systems. We will utilize computational tools (Python & NetLogo models) to measure, simulate and analyze complexity in a variety of CAS. Theory and simulations will provide us some level of understanding for CAS and a methodology to better manage CAS and their interrelationships.

Evaluation Criteria

- Assignments: 30%
    - There will be 3 assignments worth 10% each.
        - May include theory, programming and/or analysis exercises
    - Due at the beginning of class on due dates.
    - No late assignment will be accepted, or under special circumstances accepted with 20% off for each late day.
    - Assignments should be submitted in pdf format by due date and medium (e.g. Nexus, email, printed, etc.) as specified in the assignment description. If several files being submitted, then everything should be only in <u>one zip file</u>. Handwritten assignments will not be accepted.
    - Multiple submissions are not permitted. Students may submit a partially completed assignment though.
    - If submitting assignments, students are responsible to review their assignments before submission to make sure the correct files are attached to the submission.

- Paper Presentations: 20%
    - There will be 2 paper presentations per student
    - Each presentation is worth 10% each
    - PowerPoint slides should be used for the presentation
    - PowerPoint slides should be submitted one day before presentation day by email.
    - Attendance and participation are required for all.
    - No attendance to a presentation without justification will deduct 2% per no show-up attendance

- Final Project: 45%
    - Instructions to be provided later during the term

- Attendance & Class Participation: 5%
    - Class participation on paper presentation discussions is required

Test / Exam Requirements

- Exams will be delivered in person.
- Photo ID is required for the final exam.
- The use of computers, calculators, phones, or other electronic devices is not permitted during exams.
- Final exam is closed-book.

Students should contact the instructor as soon as possible if extenuating circumstances require missing a lab, assignment, test or examination. A medical certificate from a practicing physician may be required before any adjustments are considered.

Students with documented disabilities, temporary or chronic medical conditions, requiring academic accommodations for tests/exams (e.g., private space) or during lectures/laboratories (e.g., note-takers) are encouraged to contact Accessibility Services (AS) at 204-786-9771 or accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a student's disability or medical condition remains confidential.
https://www.uwinnipeg.ca/accessibility-services

Students may choose not to attend classes or write examinations on holy days of their religion, but they must notify their instructors at least two weeks in advance. Instructors will then provide opportunity for students to make up work examinations without penalty. A list of religious holidays can be found in the 2025-26 Undergraduate Academic Calendar online at
http://uwinnipeg.ca/academics/calendar/docs/important-notes.pdf

Final Letter Grade Assignment

Historically, numerical percentages have been converted to letter grades using the following scale. However, instructors can deviate from these values based on pedagogical nuances of a particular class, and final grades are subject to approval by the Department Review Committee.

A+	90+ – 100%	B+	75 – 79%	C	60 – 64%
A	85 – 90 %	B	70 – 74%	D	50 – 59%
A-	80 – 84%	C+	65 – 69%	F	below 50%

NOTE: Final grades require departmental/program approval and may be subject to change.

Required Text Book / Reading List

We will use the following books as guides, supplemented with readings and other books throughout the course.

- Natural Complexity, a Modeling Handbook
  Charbonneau, Paul
  Princeton University Press, 2017 Edition
  ISBN 978-0-691-17684-0 (paper) / 978-0-691-17035-0 (pbk.)

- Introduction to the Modeling and Analysis of Complex Systems
  Hiroki, Sayama
  Open Suny Textbooks, 2015 Edition
  ISBN 978-1-942341-08-6 (paper) / 978-1-942341-09-3 (ebook)

- Complexity: A Guided Tour
  Mitchell, Melanie
  Oxford University Press, 2009 Edition
  ISBN 978-0-19-512441-5

- Complex Adaptive Systems: An Introduction to Computational Models of Social Life
  Miller John H. & Page Scott E.
  Princeton University Press, 2007 Edition
  ISBN 978-0-691-13096-5 (acid-free paper) / 978-0-691-12702-6 (pbk: acid-free paper)

- Class Notes will be available on Nexus

Prerequisite Information

(This information can be found in the UW Graduate Academic Calendar)
- Consent of the Graduate Studies Committee Chair or Instructor

Regulations, Policies, and Academic Integrity

Students are encouraged to familiarize themselves with the Academic Regulations and Policies found in the University Academic Calendar at:
https://uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf
Particular attention should be given to subsections 8 (Student Discipline), 9 (Senate Appeals) and 10 (Grade Appeals).

Avoiding Academic Misconduct: Academic dishonesty is a very serious offense and will be dealt in accordance with the University's policies.

Detailed information can be found at the following:

- Academic Misconduct Policy and Procedures:
  https://www.uwinnipeg.ca/policies/docs/policies/academic-misconduct-policy.pdf and
  https://www.uwinnipeg.ca/policies/docs/procedures/academic-misconduct-procedures.pdf
- About Academic Integrity and Misconduct, Resources and FAQs:
  https://library.uwinnipeg.ca/use-the-library/help-with-research/academic-integrity.html

Uploading essays and other assignments to essay vendor or trader sites (filesharing sites that are known providers of essays for use by others who submit them to instructors as their own work) involves "aiding and abetting" plagiarism. Students who do this can be charged with Academic Misconduct.

Academic Integrity and AI Text-generating Tools: Students must follow principles of academic integrity (e.g., honesty, respect, fairness, and responsibility) in their use of material obtained through AI text-generating tools (e.g., ChatGPT, Bing, Notion AI). Suspected misuse of AI may result in a report to the Senate Academic Standards and Misconduct Committee. If AI tools are used, students must cite them. According to the MLA (https://style.mla.org/citing-generative-ai/), "you should

    a. cite a generative AI tool whenever you paraphrase, quote, or incorporate into your own work any content (whether text, image, data, or other) that was created by it
    b. acknowledge all functional uses of the tool (like editing your prose or translating words) in a note, your text, or another suitable location
    c. take care to vet the secondary sources it cites."

Non-academic misconduct: Students are expected to conduct themselves in a respectful manner on campus and in the learning environment, irrespective of the platform being used. Behaviour, communication, or acts that are inconsistent with a number of UW policies could be considered "non-academic" misconduct. More detailed information can be found here:

- Respectful Working and Learning Environment Policy: https://www.uwinnipeg.ca/respect/respect-policy.html,
- Acceptable Use of Information Technology Policy: https://www.uwinnipeg.ca/policies/docs/policies/acceptable-use-of-information-technology-policy.pdf
- Non-Academic Misconduct Policy and Procedures: https://www.uwinnipeg.ca/policies/docs/policies/student-non-academic-misconduct-policy.pdf and https://www.uwinnipeg.ca/policies/docs/procedures/student-non-academic-misconduct-procedures.pdf

Copyright and Intellectual Property: Course materials are the property of the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides—irrespective of format. Students who upload these materials to filesharing sites, or in any other way share these materials with others outside the class without prior permission of the instructor/presenter, are in violation of copyright law and University policy. Students must also seek prior permission of the instructor/presenter before, for example, photographing, recording, or taking screenshots of slides, presentations, lectures, and notes on the board. Students found to be in violation of an instructor's intellectual property rights could face serious consequences pursuant to the Academic Misconduct or Non-Academic Misconduct Policy; such consequences could possibly involve legal sanction under the Copyright Policy: https://www.uwinnipeg.ca/policies/docs/policies/copyright-policy.pdf

Privacy

Students have rights in relation to the collection of personal data by the University of Winnipeg.
- Student Privacy: https://www.uwinnipeg.ca/privacy/admissions-privacy-notice.html
- Zoom Privacy: https://www.uwinnipeg.ca/privacy/zoom-privacy-notice.html
- Exam and Proctoring: https://www.uwinnipeg.ca/privacy/zoom-test-and-exam-proctoring.html

Class Cancellation, Correspondence with Students, and Withdrawing from Course

When it is necessary to cancel a class due to exceptional circumstances, the course instructor will make every effort to inform students via UWinnipeg email and Nexus.

Students are reminded that they have a responsibility to regularly check their UWinnipeg e-mail addresses to ensure timely receipt of correspondence from the University and/or the course instructor*.*

Please let the course instructor know if you plan on withdrawing from the course. Note that withdrawing before the VW date does not necessarily result in a fee refund.

Student Wellness

The University of Winnipeg affirms the importance of student mental health and our commitment to providing accessible, culturally appropriate, and effective services for students. Students who are seeking mental health supports are encouraged to reach out to the Wellness Centre at studentwellness@uwinnipeg.ca or 204-258-3809. For community-based mental health resources and supports, students are encouraged to dial 2-1-1. This program of United Way is available 24/7 in 150 languages. Other resources and contact information can be found at the following link: https://www.uwinnipeg.ca/student-wellness/contact-us.html.

Sexual Violence and Human Rights Advisor (SVHRA)

Students who have experienced Sexual Violence can access support from the SVHRA. The SVHRA receives disclosures and can support students with on and off-campus reporting. In collaboration with the Sexual Violence Response Team (SVRT), the SVHRA also provides fast-track referrals to Student Wellness, academic accommodations, security support, and other on and off campus supports. The SVHRA and SVRT operate within a confidential, survivor-centered, and trauma-informed framework. https://www.uwinnipeg.ca/respect/sexual-violence/

Disclosures may be made in-person, email, by text, by phone, or Zoom/Teams.

5Ri55, 5th Floor (Rice Centre)
204.230.6660 – *call or text (confidential line)*
svrt@uwinnipeg.ca

Topics to be covered (tentative)

I. CAS Introduction
- Modeling introduction
- Complexity, emergence, self-organization
- Dynamics, chaos and prediction, fractals
- Information, computation, and evolution

II. Fundamental Concepts
- Modeling
- Agent-based objects
- Genetic algorithms
- Cellular automata
- Network models
- Dimensionality and scaling

III. Selected CAS Topics
- Artificial life
- Computational immunology
- CAS in health systems
- CAS in social systems
- Open agenda for future works

Note that all topics listed may not be covered and may be offered in a slightly different time order. Computer models based on Python and NetLogo will be heavily used during the course

Additional Course Related Information

1. A permitted or necessary change in mode of delivery may require adjustments to important aspects of course outlines, like class schedule and the number, nature, and weighting of assignments and/or exams.

2. In order to ensure a safe and comfortable learning environment for everyone, we kindly ask that all students refrain from wearing or using scented products while attending class.