| COURSE OUTLINE | | |
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| **TERM: SPRING 2023** | **COURSE NO: COMP 215** | |
| **INSTRUCTOR:** | **COURSE TITLE: INTRODUCTION TO COMPUTATIONAL SCIENCE** | |
| **OFFICE: LOCAL:**<br>**E-MAIL:** @capilanou.ca | **SECTION NO(S):** | **CREDITS: 4.0** |
| **OFFICE HOURS:** | | |
| **COURSE WEBSITE:** | | |

Capilano University acknowledges with respect the Lil'wat, Musqueam, Squamish, Sechelt, and Tsleil-Waututh people on whose territories our campuses are located.

**COURSE FORMAT**

1.5 hours of class time, 3 hours lab time, plus an additional 1.5 hours delivered through on-line or other activities for a 15-week semester, which includes two weeks for final exams.

**COURSE PREREQUISITES**

COMP 115 (A-) or COMP 135(A-); OR COMP 115(C+) and one of the following: MATH 116 (C-), MATH 108 (C-), or MATH 124 (C-)

**CALENDAR DESCRIPTION**

Computational Science is considered the "third pillar" of scientific inquiry, alongside theory and physical experimentation. It combines modelling, simulation, scientific visualization, computer programming, data structures and algorithms to offer insights into a wide range of problems. Students are introduced to the concepts, principles, approaches, technologies, and practices of computational science. Students learn to construct computational models in a high-level programming language, like Python, and develop practical simulation and computational experimentation skills. The course focuses on the application of these techniques in a wide range of domains across the physical and social sciences; and includes an introduction to complexity science, systems thinking, and dynamic systems.

**COURSE NOTE**

COMP 215 is an approved Science and Technology course for Cap Core requirements.
COMP 215 is an approved Science course.
COMP 215 is an approved Quantitative/Analytical course for baccalaureate degrees.

**REQUIRED TEXTS AND/OR RESOURCES**

Downey, A. Think Complexity 2e. Green Tea Press, 2018. (http://greenteapress.com/wp/think-complexity-2e/)
Please use the Interactive Edition: https://runestone.academy/ns/books/published/complex/index.html (course code: Comp215-Spr2022)

## COURSE STUDENT LEARNING OUTCOMES

**On successful completion of this course, students will be able to do the following:**

- apply computational tools and techniques to solve problems and gain a deeper understanding of the concepts and theory learned in science courses;
- utilize code notebooks (e.g., Jupyter) and version control (e.g., git) to manage the code, data, and documentation for a scientific analysis;
- employ a variety of Python libraries commonly used for scientific computing and data visualization (e.g., networkx, numpy, scipy, matplotlib, etc.);
- develop an appropriate data model for a problem using sequences, maps, graphs, and classes;
- construct solutions to 1D and 2D computational problems using vector and matrix operations;
- analyze the Big-O space and time complexity of an algorithm;
- apply Object-Oriented Programming (OOP) and Functional programming styles to define the data structures and algorithms required to solve a specific problem efficiently;
- effectively use simulation techniques, including spatial and stochastic simulation, to gain insights into hypotheses, theory, and physical systems;
- evaluate the ways in which computation is being or might be applied to scientific problems, and contribute meaningfully to discussions about its potential efficacy, ethics, and bias;
- apply computational techniques in their future course work, research, and careers.

**Students who complete this Science and Technology course will be able to do the following:**

- Apply numerical and computational strategies to solve problems;
- Assess the cultural, economic, and political effects of technology;
- Evaluate scientific information (e.g., distinguish primary and secondary sources, assess credibility and validity of information);
- Demonstrate how a problem, concept, or process can be modelled numerically, graphically, or algorithmically;
- Participate in scientific inquiry and communicate the elements of the process, including making careful and systematic observations, developing and testing a hypothesis, analyzing evidence, and interpreting results.

## COURSE CONTENT

| # of Weeks (Approx.) | Topics |
|---|---|
| 1 | Introduction to computational science, models, and complexity |
| 1 | Structured Data: records, tuples, dictionaries, objects |
| 1 | Classes and object-oriented programming |
| 2 | Graph, Trees, Networks |
| 2 | Cellular automata and spatial simulation |
| 1 | Physical Modelling (e.g., diffusion, percolation) |
| 2 | Stability, phase transitions, self-organizing criticality |

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| 2 | Agent-based models |
| 1 | Review and Testing |
| (2) | Final Exam Period (Weeks 14 – 15) |

**EVALUATION PROFILE**

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| Assignments + Quizzes | 25% |
| Projects | 30% |
| Term Test | 15% |
| Final Exam (comprehensive) | 25% |
| Performance Evaluation | 5% |
| TOTAL | 100% |

- Projects are completed in small groups and are peer-reviewed. Students receive a grade for both their project work and for their evaluation of their peer's work.
- The default ***performance evaluation*** component in the evaluation profile is pro-rated to the grade earned on the remainder of the profile. In exceptional circumstances, a student's improved performance in the later part of the term may justify an elevated grade.
  The instructor has sole discretion, in such cases, to alter the performance evaluation toelevate the student's grade to better reflect their performance at the end of term.

**GRADING PROFILE**

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| A+ = 90-100 | B+ = 77-79 | C+ = 67-69 | D = 50-59 |
| A = 85-89 | B = 73-76 | C = 63-66 | F = 0-49 |
| A- = 80-84 | B- = 70-72 | C- = 60-62 | |

**Incomplete Grades**
Grades of Incomplete "I" are assigned only in exceptional circumstances when a student requests extra time to complete their coursework. Such agreements are made only at the request of the student, who is responsible to determine from the instructor the outstanding requirements of the course.

**Late Assignments**
Assignments are due at the beginning of the class on the due date listed. Late assignments are penalized 10% if submitted late on the due date, then 20% for each successive day until a solution is posted, and will not be accepted thereafter.
If you anticipate handing in an assignment late, please consult with your instructor beforehand.

**Missed Exams/Quizzes/Labs etc.**
A score of zero is normally given for missed work. Make-up exams or quizzes may be permitted, at the discretion of the instructor, and generally only in cases of medical emergency or severe personal crisis. In some cases, it may not be possible to accommodate a missed exam or quiz. Please consult with your instructor, ideally before the missed activity.

**Attendance**
Students are expected to attend and fully participate in all classes, labs, and associated activities. Students are responsible for all information given during lectures, labs, and tutorials, including exam dates and assignment deadlines, even if they were unable to attend for any reason.

**English Usage**
Students are expected to proofread all written work for any grammatical, spelling and stylistic errors. Instructors may deduct marks for incorrect grammar and spelling in written assignments.

**Electronic Devices**
Students may use electronic devices during class solely for class-related activities, such as note-taking, coding, and "just in time" research to contribute to class discussions.

**On-line Communication**
Outside of the classroom, instructors will (if necessary) communicate with students using either their official Capilano University email or eLearn; please check both regularly. Official communication between Capilano University and students is delivered to students' Capilano University email addresses only.

**UNIVERSITY OPERATIONAL DETAILS**

**Tools for Success**
Many services are available to support student success for Capilano University students. A central navigation point for all services can be found at: https://www.capilanou.ca/student-life/

**Capilano University Security: download the CapU Mobile Safety App**

**Policy Statement (S2009-06)**
Capilano University has policies on Academic Appeals (including appeal of final grade), Student Conduct, Academic Integrity, Academic Probation and other educational issues. These and other policies are available on the University website.

**Academic Integrity (S2017-05)**
Any instance of academic dishonesty or breach of the standards of academic integrity is serious and students will be held accountable for their actions, whether acting alone or in a group. See policy and procedures S2017-05 Academic Integrity for more information: https://www.capilanou.ca/about-capu/governance/policies/

Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances, are prohibited and will be handled in accordance with the Student Academic Integrity Procedures.

**Academic dishonesty** is any act that breaches one or more of the principles of academic integrity. Acts of academic dishonesty may include but are not limited to the following types:

**Cheating**: Using or providing unauthorized aids, assistance or materials while preparing or completing assessments, or when completing practical work (in clinical, practicum, or lab settings), including but not limited to the following:

- Copying or attempting to copy the work of another during an assessment;
- Communicating work to another student during an examination;
- Using unauthorized aids, notes, or electronic devices or means during an examination;

- Unauthorized possession of an assessment or answer key; and/or,
- Submitting of a substantially similar assessment by two or more students, except in thecase where such submission is specifically authorized by the instructor.

**Fraud**: Creation or use of falsified documents.

**Misuse or misrepresentation of sources**: Presenting source material in such a way as to distort its original purpose or implication(s); misattributing words, ideas, etc. to someone other than the original source; misrepresenting or manipulating research findings or data; and/or suppressing aspects of findings or data in order to present conclusions in a light other than the research, taken as a whole, would support.

**Plagiarism**: Presenting or submitting, as one's own work, the research, words, ideas, artistic imagery, arguments, calculations, illustrations, or diagrams of another person or persons without explicit or accurate citation or credit.

**Self-Plagiarism**: Submitting one's own work for credit in more than one course without the permission of the instructors, or re-submitting work, in whole or in part, for which credit has already been granted without permission of the instructors.

**Prohibited Conduct**: The following are examples of other conduct specifically prohibited:

- Taking unauthorized possession of the work of another student (for example, interceptingand removing such work from a photocopier or printer, or collecting the graded work of another student from a stack of papers);
- Falsifying one's own and/or other students' attendance in a course;
- Impersonating or allowing the impersonation of an individual;
- Modifying a graded assessment then submitting it for re-grading; or,
- Assisting or attempting to assist another person to commit any breach of academicintegrity.

**Sexual Violence and Misconduct**

All Members of the University Community have the right to work, teach and study in an environment that is free from all forms of sexual violence and misconduct. Policy B401 defines sexual assault as follows:

Sexual assault is any form of sexual contact that occurs without ongoing and freely givenconsent, including the threat of sexual contact without consent. Sexual assault can be committed by a stranger, someone known to the survivor or an intimate partner.

Safety and security at the University are a priority and any form of sexual violence and misconduct will not be tolerated or condoned. The University expects all Students and Members of the University Community to abide by all laws and University policies, including B.401 Sexual Violence and Misconduct Policy and B.401.1 Sexual Violence and Misconduct Procedure (found on Policy page https://www.capilanou.ca/about-capu/governance/policies/

**Emergencies:**
Students are expected to familiarize themselves with the emergency policies whereappropriate and the emergency procedures posted on the wall of the classroom.

**DEPARTMENT OR PROGRAM OPERATIONAL DETAILS**

**Computer Access**
Students may bring and use their own computing devices, running any modern OS (i.e., Windows, OSX, or Linux). Every effort is made to ensure that required course software can be freely downloaded and installed on student computer. However, it is the responsibility of each student to ensure their computer meets the minimum requirements of required course software, and to perform the installation and configuration of such software themselves.
Computer labs at the University will have course-required software installed and configured – students may use lab computers to complete all their course work.
Drop-in access to the University computers is available during the hours posted outside each lab, subject to availability. Please respect an instructor's directions if asked to leave the lab due to a class booking.
University policies on student conduct and use of University computer systems, available on the University website, will be strictly enforced.