CMSE 201
Computational Modeling and Data Analysis I

Course Description

A useful definition of *computational science* is "the use of computers to analyze and solve scientific problems." Over the course of this semester, we will explore various aspects of computational science and will acquire a variety of practical, fundamental computational skills. In addition, we will explore application-driven modeling of various systems, with applications to the physical, life, and social sciences, and also to engineering and mathematics. While we will learn some computer programming over this semester, the goal is utilitarian – this is a course in applied computing, rather than a course intended for beginning computer science majors!

By the end of this course, you will be able to:

1. Gain insight into physical, biological, and social systems through the use of computational algorithms and tools.
2. Write programs to solve common problems in a variety of disciplines.
3. Identify salient features of a system that can be codified into a model.
4. Manipulate, analyze, and visualize datasets and use this data to evaluate models.
5. Have an understanding of basic numerical methods (e.g., numerical integration, differential equations, Monte Carlo) and be able to use them to solve problems.
6. Be able to take results from a scientific computing problem and present it both verbally and in writing.

We will work toward the goals expressed above throughout this course using a range of activities – primarily by writing software both individually and in small groups, but also through discussion, presentations, and other types of exercises.

Topics covered

The primary topics covered in this course include:

- Creation of models (making mathematical representations of systems).
- The basics of functional programming in Python (i.e., variables and types, functions, simple data structures, strings, lists, tuples)
- Plotting and data visualization
- File and dataset manipulation

- Basic numerical techniques, possibly including statistics, linear regression, difference equations, Monte Carlo, agent-based modeling, numerical integration

Please note that **creating models to describe and understand systems** (whether they are in the physical, life, or social sciences, or in engineering) is the driving principle of this course – everything else we teach you is in service to this goal!

Required reading materials

This class has no required book or course pack. From time to time we will direct you toward outside online resources, but the main materials will be video lectures, instructor course notes, and software.

Required materials for class

Although this course will be meeting virtually this semester, the "in-class" programming assignments are a critical part of the learning process in this course. To that end, you will need to ensure that you have the following:

- A computer with a reliable internet connection and functional webcam, microphone, and speakers.
- The ability to run the Zoom video conferencing software, which you can download here: https://msu.zoom.us/support/download

If you do not have a sufficiently reliable internet connection to log into Zoom during the designated class times to participate in the virtual class sessions, you should notify your instructor immediately to determine how you can best participate in the course and successfully complete the required activities.

You are also expected to have a Slack account (https://slack.com/) and sign up for the CMSE Courses Slack workspace (https://cmse-courses.slack.com/). Details for doing so are outlined in later sections.

The details regarding the software needed for this course are provided in the "**Software Setup Guide**" which will be provided to you by your instructor.

Course activities

Class participation: Active class participation (led both by the instructor and by students) is critical to the success of this course. As such, you are expected to attend

class every week via Zoom and to actively participate in the in-class discussions and programming activities.

Pre-class assignments: We will assign short assignments that are due prior to class. The purpose of these assignments is to introduce new material and give you some practice with it so that we can focus on experimentation and implementation during class. These assignments will typically consist of one or more short videos or reading assignments and related questions or problems, and will be due at 11:59 p.m. the night before class via the course's Desire2Learn page. ***Completing these assignments will be critical for your success in this course***.

"In-class" programming assignments: Virtual class sessions will be held via Zoom twice a week, and will be broken up into group-based presentations, discussions, and programming activities that will allow you to immediately implement (and get instant feedback on) what you have just learned. In-class programming activities will be turned in at the end of the class session via the course's Desire2Learn page. Please note that **part of the in-class Zoom sessions will be recorded** so that students who are unable to make it to class for unexpected reasons will be able to catch up on important classroom-wide discussions that they may have missed. Recordings will only include the instructor's screen and identity in as much as is possible, but if you are uncomfortable with being included in the recording any fashion, please let your instructor know.

Homework: You will have periodic programming assignments (due roughly every other week) that will provide a more in-depth exploration of the materials covered in class. These will be pursued individually (or possibly in pairs), and will be turned in by the given deadline via the course's Desire2Learn page. In general, homework assignments will cover roughly two weeks worth of material and will be due roughly 3 business days after the last bit of material has been discussed in class. Since these assignments are only due every other week, you can expect that they will require two week's worth of out-of-class effort, so you are encouraged to start your assignments as early as possible.

Homework assignments that are submitted late will be accepted **for up to two days beyond the due date** (i.e., 48 hours past the original deadline). **If the assignment is submitted within 24 hours of the original deadline, there is a 10% penalty**. This applies even if the assignment is 1 minute late. Similarly, **if it is submitted in the 24-48 hour window, a 20% deduction is applied**. Again, **after the 48th hour, the assignment will no longer be accepted**.

Exams: Rather than limiting the exams to one or two high-stakes assessments, this class will have six quizzes over the course of the semester to provide multiple opportunities for you to demonstrate your mastery of the course content. The quizzes will involve active coding and will be designed to test the computational modeling and data science skills that you will learn in the course. These quizzes will take place roughly every other week starting in the third week of the semester. You may be asked to share your screen via Zoom while you complete your quizzes. Your lowest quiz score will be dropped at the end of the semester and you will not be allowed to make up missed quizzes unless there are extenuating circumstances that require it. **There will be no traditional final exam for this course, but the last quiz will likely take place during the scheduled final exam time**.

Semester Project(s): This class will have project(s) that will involve synthesizing the computational modeling, data analysis, and data visualization techniques that you learned over the course of the term and presenting it (them) in writing and in an oral presentation (in the form of a recorded video or Zoom presentation). Project proposals will be due at roughly the halfway point of the course. Project presentations will take place during the last two to three class periods of the course. More details on these projects will be available near the middle of the semester.

Course meeting times and location

Although the course is being offered virtually this semester rather than in person, you are still expended to attend all scheduled class sessions via Zoom. If you are in a time zone that makes this challenging, please notify your instructor immediately. The sections for this course meet at the following times:

- Section 001 (Dr. Silvestri) meets on Mondays & Wednesdays from 12:40-2:30pm
- Section 002 (Dr. Bazavov) meets on Mondays & Wednesdays from 10:20am-12:10pm
- Section 003 (Dr. Rapinchuk) meets on Tuesdays & Thursdays from 12:40-2:30pm
- Section 004 (Dr. Perea) meets on Tuesdays & Thursdays from 3:00-4:50pm
- Section 006 (Dr. Chen) meets on Mondays & Wednesdays from 4:10-6:00pm
- Section 007 (Dr. Finzell) meets on Mondays & Wednesdays from 8:00-9:50am
- Section 008 (Dr. Silvia) meets on Fridays from 10:20am-12:10pm & 3:00-4:50pm

Other important information

Course Website and Calendar: This course has a website where important information regarding the course will be posted (e.g. syllabus, schedule, office hours calendar, etc): http://cmse.msu.edu/CMSE201

In addition, this course also uses a Desire2Learn (D2L) page for course assignment management, which can be found at http://d2l.msu.edu. Duplicate copies of important course documents will be placed on D2L as well. **All assignments will be acquired from and handed in via Desire2Learn**. If you cannot access the course D2L page, notify your instructor immediately.

Email: At times, we will send out important course information via email. This email is sent to your MSU email address (the one that ends in "@msu.edu"). You are responsible for all information sent out to your University email account, and for checking this account on a regular (daily) basis.

Class discussion: We will be using the team communication software tool Slack to facilitate class discussions. See the Software Setup Guide provided on the course website and by your instructor for information on how to install and use Slack.

Class attendance: This class is heavily based on material presented and worked on during class, and it is critical that you attend and participate fully every week! Therefore, class attendance is absolutely required. Since unexpected situations may arise, all students will be permitted to miss **three** class periods without penalty. After the first three, **an unexcused absence will result in zero points for the day, which includes the in-class programming assignment points.** *Arriving late or leaving early without prior arrangement with the instructor of your session may be counted as an unexcused absence.* Note that if you have a legitimate reason to miss class (such as job, graduate school, or medical school interviews) you must arrange this ahead of time to be excused from class. Six or more unexcused absences will result in the reduction of your grade by one step (e.g., from 4.0 to 3.5), with additional absences reducing your grade further at the discretion of the course instructor. As we continue to face complications created by the COVID-19 pandemic, **if you have to miss class due to illness or self-isolation (as per the CDC recommended guidelines), your instructor will work to provide the necessary accommodations to ensure that your performance in class is not significantly impacted.** However, should you find that your overall success in all of your courses *is* significantly impacted by any illness, please refer to the University policy on medical leave and withdrawal.

Inclusive classroom behavior: Respectful and responsible behavior is expected at all times, which includes not interrupting other students, refraining from non-course-related use of electronic devices or additional software during class sessions, and not using offensive or demeaning language in our discussions. Flagrant or repeated violations of this expectation may result in ejection from the classroom, grade-related penalties, and/or involvement of the university Ombudsperson. In particular, behaviors that could be considered discriminatory or harassing, or unwanted sexual attention, will not be tolerated and will be immediately reported to the appropriate MSU office (which may include the MSU Police Department).

In addition, MSU welcomes a full spectrum of experiences, viewpoints, and intellectual approaches because they enrich the conversation, even as they challenge us to think differently and grow. However, we believe that expressions and actions that demean individuals or groups comprise the environment for intellectual growth and undermine the social fabric on which the community is based. These demeaning behaviors are not welcome in this classroom.

Academic Honesty: Intellectual integrity is the foundation of the scientific enterprise. In all instances, you must do your own work and give proper credit to all sources that you use in your papers and oral presentations – **any instance of submitting another person's work, ideas, or wording as your own counts as plagiarism**. This includes failing to cite any direct quotations or computer code in the assignments you submit for this course. The MSU College of Natural Science adheres to the policies of academic honesty as specified in the General Student Regulations 1.0, Protection of Scholarship and Grades, and in the all-University statement on Integrity of Scholarship and Grades, which are included in Spartan Life: Student Handbook and Resource Guide. Students who plagiarize risk receiving a 0.0 in the course. In addition, University policy requires that any cheating offense, regardless of the magnitude of the infraction or punishment decided upon by the professor, be reported immediately to the dean of the student's college.

It is important to note that **plagiarism in the context of this course includes, but is not limited to, directly copying another student's solutions to assignments that are expected to be completed individually (pre-class assignments, homework problems, and exams); copying materials from online sources, textbooks, or other reference materials *without citing those references in your source code or documentation*, or having somebody else do your individual assignments (pre-class assignments, homework problems, and exams) on your behalf, this includes online tutoring services that provide exact solutions.** Any work that is

done in collaboration with other students should state this explicitly, and their names as well as yours should be listed clearly. When collaborating with other students, you should still be coding/writing your own solutions to the assignments and should limit your collaboration to conceptual discussions about how one might go about solving the problems, **not sharing exact solutions**.

More broadly, we ask that students adhere to the Spartan Code of Honor academic pledge, as written by the Associated Students of Michigan State University (ASMSU):

“As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do.”

Learning accommodations: If you have a university-documented learning difficulty or require other accommodations, please provide me with your VISA as soon as possible and speak with me about how I can assist you in your learning. If you do not have a VISA but have been documented with a learning difficulty or other problems for which you may still require accommodation, please contact MSU’s Resource Center for People with Disabilities (355-9642) in order to acquire current documentation.

Confidentiality and Mandatory Reporting: College students often experience issues that may interfere with academic success such as academic stress, sleep problems, juggling responsibilities, life events, relationship concerns, or feelings of anxiety, hopelessness, or depression. Our goal is to help create a safe learning environment and to support you through these situations and experiences. All instructors also have a mandatory reporting responsibility related to our roles as a University employees. We hope that you feel able to share information related to your life experiences in classroom discussions, in written work, and in one-on-one meetings. We will seek to keep information you share private to the greatest extent possible. However, under Title IX, we are required to share information regarding sexual misconduct, relationship violence, or information about criminal activity on MSU’s campus with the University including the Office of Institutional Equity (OIE).

Students may speak to someone confidentially by contacting MSU Counseling and Psychiatric Service (CAPS) (caps.msu.edu, 517-355-8270), MSU’s 24-hour Sexual Assault Crisis Line (endrape.msu.edu, 517-372-6666), or Olin Health Center (olin.msu.edu, 517-884-6546).

MSU Community Compact for COVID-19: During the Fall 2020 semester a set of requirements have been put in place to maximize the health and safety of all members of the MSU community. Details of the MSU Community Compact are here.

Instructor contact information

Course Instructors:

Luciano Silvestri (Section 001)
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Alexei Bazavov (Section 002)
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Min Chen (Section 006)
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Tom Finzell (Section 007)
Postdoctoral Research Associate, Dept of Computational Mathematics, Science & Engineering
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Devin Silvia (Section 008)
Teaching Specialist and Undergraduate Director, Dept of Computational Mathematics, Science & Engineering
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The teaching assistant and learning assistants who will be assisting with your section will be announced in class.

In the event of instructor illness, another CMSE instructor will fill in as quickly as possible to minimize disruption to the course. The substitute instructor will adhere to this syllabus as closely as possible.

Instructor office hours and locations

Office hours will start on September 9, 2020. **For the Fall 2020 semester, all office hour sessions will be virtual and held via Zoom**. The times and corresponding Zoom meeting URLs can be found here: https://cmse.msu.edu/cmse201-office-hours/

All sections are synchronized as much as is possible and will teach the same topics at roughly the same time - as a result, you can go to any office hours that fit into your schedule. Any course personnel can help you with questions pertaining to the course material, including in-class and homework assignments. Technical questions, including issues with Python and/or Jupyter, should be first directed to your professor, but specific issues with JupyterHub (jupyterhub.egr.msu.edu) can be sent to jupyterhub@egr.msu.edu. If you have issues relating to class administration, including missed classes, illness, VISA issues, or school-sponsored activities please contact the instructor for your section.

Grading information

There are a variety of course activities, with the percentage of the total grade listed below. More detailed descriptions of each activity can be found elsewhere in the syllabus.

Activity	**Grade (% of total)**
Participation, attendance, in-class assignments	10
Pre-class assignments	10
Exams (six quizzes, lowest is dropped)	30
Homework assignments	25
Semester project(s)	25

Grading scale

4.0	≥ 90%
3.5	≥ 85%
3.0	≥ 80%
2.5	≥ 75%
2.0	≥ 70%
1.5	≥ 65%
1.0	≥ 60%
0.0	< 60%

Note: final grades will not be curved - your grade is based on your own effort and progress, not on competition with your classmates.

Honors option: You can complete an honors option for this course. The honors option requires that you complete an additional project on a topic that is different than the project you are already required to complete. You must receive an honors option project grade of 80% or higher and must achieve an overall grade of 3.5 in the course. **If you are interested in pursuing the honors option you should meet with your course instructor within the first two weeks of the course to indicate your interest and develop a project plan. Project proposals must be submitted and approved before the middle of the semester (Wednesday, October 21, 2020).**