Course Syllabus

AEM/CS/IS 2770 EXCURSIONS IN COMPUTATIONAL SUSTAINABILITY

Location: Caldwell Hall 100
Time: Tuesdays and Thursdays 1:25 PM - 2:40 PM EDT

Instructor: Prof. Carla Gomes **(**gomes@cs.cornell.edu)
Office Hours: **Canceled 04/26** After or before class (email me to check availability) or Friday 1pm-2pm (in person 353 Gates Hall)

TA Office Hours:
Unless otherwise noted, all office hours are hybrid (in-person + Zoom) using this Zoom link

Links to an external site..
**** Office hours canceled 04/30 - 05/03 ****

- Tue 10-11am - Utku + Mary (Rhodes 400)
- Wed 12-1pm - Yiding + Jillian (Comstock B106)
- Thu 12-1pm - Laura G, Laura W, Evan (Warren 175)
- Thu 3-4pm - Utku + Yiding (Comstock B104)
- Fri 2-3pm - Mary + Leina (Ives 219)

Questions?
In general, please post questions on Ed Discussion

Links to an external site.. However, if needed please contact one of the head TAs: Laura Greenstreet (leg86@cornell.edu) or Yiding Ma (ym269@cornell.edu) by email.

Course Description:

Example of detailed syllabus, Spring 2023 (subject to change)
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Balancing environmental, economic, and societal needs for a sustainable future encompasses problems of unprecedented size and complexity. Computing and information science can play an important role in addressing such critical sustainability challenges faced by present and future generations. *An important objective of the course is to show how the often-ill-defined notion of sustainability can be made operational through computational and mathematical models, and how those models can improve policies to alter or modify unsustainable human behavior.*

In the context of these sustainability topics, the course will introduce students to *mathematical and computational modeling techniques, algorithms, and statistical methods.*

Pre-requisites:

The course satisfies the quantitative requirement for some majors, it emphasizes the usage of mathematical modeling and algorithms to address sustainability challenges. As such, students should *expect to work with computational and mathematical models and should be familiar with basic knowledge of probabilities and calculus. If you are unsure if you have the mathematical background for the course you should complete Homework 0.* Students are not expected to be familiar with computational languages and are not expected to write computer programs. The topics can vary a bit each year but at a high level the focus will be on sustainability and computational approaches to solve sustainability problems.

Homework 0 - the goal of this assignment is to help you evaluate if you have the mathematical background for the class. It is fine if you need to review material to answer these questions, but you should be comfortable enough to build on this material during the course. **This assignment does not need to be submitted and <u>the solution is available here</u>.**

High-level Outline

<u>1 - Introduction to Sustainability and Computational Sustainability</u>

This module introduces students to sustainability concepts, notions and metrics, emphasizing differences across different scientific fields, and to the role of computing and information science in addressing sustainability challenges. The course focuses on <u>the Sustainable Development Goals</u>

<u>Links to an external site.</u> a broad set of goals "adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity."

<u>Computational Sustainability</u>

<u>Links to an external site.</u>

<u>2 - Introduction computational modeling concepts</u>

Basic introduction to computational and mathematical modeling and techniques, concepts, algorithms, and computational complexity that will be used throughout the course.

<u>3 - Inventory of Natural Resources: Data and machine and statistical learning</u>

Examples of machine and statistical learning models and methods, big data techniques, and citizen science for assessing inventory of natural resources such as predictive models for species distributions (e.g., eBird), and models for forecasting electricity demands and solar and wind energy availability (e.g., regression models, decision trees, random forests, and ensemble models)

4 - Decision making for managing Resources: Optimization models

This section will have focus on optimization techniques such as network models, linear and mixed integer programming, and dynamic programming. Application examples include land use, wildlife corridors, nutrition, pollution, and energy.

5 - Shared resources: The Tragedy of the Commons

The students will be introduced to concepts concerning shared resources and *The Tragedy of the Commons*, and the seminal paper by Hardin.

Lectures:

Lecture attendance is important especially given that there is no textbook. Lecture notes will be posted on Canvas.

Homework assignments:

Homework is very important. It is the best way for you to learn the material. You are encouraged to discuss the problems with your classmates, but all work handed in **should be original, written by you in your own words**. Any violation of this will be treated as a breach of academic integrity. Assignments will be submitted on Gradescope.

Late homework policy: students are allowed a total of **ten days** for late homework. In general, a maximum of three late days may be used per assignment, though we may specify fewer if we need to make solutions available sooner, such as before a prelim. These ten should take care of all necessary emergencies: no other extensions will be granted, so you should use your ten day allowance wisely. Weekends count as one day. **If you use more than 10 slip days, 20% will be deducted for each additional late day used.**

Video project:

The video project includes:

- Short Project Report
- **3-minute** video presentation (**if you go over the 3 minutes you will be penalized**).

The detailed guidelines for the video project will be provided later in class.

Examples of previous projects:

- - Linear Programming for diet optimization

- Links to an external site.

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- Links to an external site.   Amazon and AI
- Links to an external site.
- Optimization for sustainable agriculture
- Links to an external site.
- Terraforming the Sahara Links to an external site.

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- Links to an external site.
- Smart Grid
- Links to an external site.
- UN REDD Program
- Links to an external site.
- Links to an external site.UN REDD Programme in Action

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- - Links to an external site.

Blog:

The main goal of the course blog is to engage students and create a collective resource that discusses topics related to the course. The blog will be readable by anyone enrolled in the course. Students are expected to contribute at least one posting to the class blog. The posts should be about a topic that is relevant to the course, say a recent news article, an on-line discussion or essay, an organization doing novel work in this area, or any other web site or material relevant to the course material. More information on the mechanics of the blog postings will be provided in a blog post linked from the Canvas course home page.

Grading Scheme:

- Homework assignments - 20%
- Blog – 5%

- Mini-project – 5%
- Exams - 70%
    - Prelim1 – 20%.
    - Prelim 2 – 20%
    - Final - 30% (optional)

If you choose not to take the final its weight will be split between the two prelims.
Class participation is an important component for borderline cases.

Tentative Dates:

- Homework assignments due roughly weekly on Thursdays at 11:59pm (6-8 total assignments)
- First homework due Feb 1st (Posted by January 25th)
- Tentative due dates for the homework assignments: Feb 1st, Feb 8, Feb 15, Feb 22, March 14th, March 21st , March 28th and April 11th
- Blog due April 15th
- Group video project:
    - Project due April 25th
    - Presentations in class April 30th and May 2nd
- Exams:
    - Prelim1 – March 12th
    - Prelim 2 – April 18th
- Final (optional) TBD

Academic Integrity:

There is a thin line between cooperation and collaboration, allowed and stimulated in this class, and plagiarism. When you turn in your work, you are signing it with your name. This certifies that you are the author of the submitted work and I assume that it is an expression of your original ideas. Even if you have discussed your work with others, you should not have copied it or let others copy your work.

Concerns:

It is very important that you let the instructor, or the TA know your concerns about any aspect of the class as soon as they arise. Please send email or call the instructor or a head TA, or talk to any of them in person (e.g., after class, or during my office hours).

Students with Disabilities:

If you have a disability that requires special testing accommodations or other classroom modifications, please notify the instructors or head TAs by no later than the second week of classes.

Course Summary:

Date	Details	Due
Thu Feb 1, 2024	Quiz [Background Survey](#)	due by 11:59pm
Mon Apr 15, 2024	Discussion Topic [Blog](#)	due by 11:59pm
Thu Apr 25, 2024	Assignment [Mini Project](#)	due by 11:59pm
	Assignment [Scaled Prelim I Grade](#)	