MGT 451 Computational Models of Thought and Behavior

School of Business
Fall 2023

Instructor: Jordan Suchow
Canvas Course Address: https://sit.instructure.com/courses/67426/
Course Schedule: Tuesday and Thursdays, 2:00–3:15 p.m. with Friday recitations at noon
Contact Info: jws@stevens.edu
Office Hours: TBD
Prerequisite(s): CS 105, 110, 115, or previous experience with programming in Python. If you have not me this prerequisite before the course begins, you will be asked to participate in a 2-week crash course and attend recitation sections at the start of the semester.
Corequisite(s): None

COURSE DESCRIPTION

In this course, we review computational models of thought and behavior from across the behavioral and social sciences, including economics, psychology, evolutionary biology, network science, information systems, and sociology. The course begins by studying individual thought and behavior, from predicting the future to taking risks. The course proceeds to study group thought and behavior, from social influence to the design of voting mechanisms. Each class covers a new topic in the study of thought and behavior and introduces the range of empirical and theoretical computational approaches to studying that topic.

STUDENT LEARNING OUTCOMES

The course aims to provide students with broad exposure to computational modeling in the behavioral and social sciences. Having taken the course, students will have a toolbox of data structures and algorithms that they can use when reasoning about the thought and behaviors of individuals and groups.

After successful completion of this course …

- Students will be able to model a broad range of thoughts and behaviors
- Students will be able to model both individuals and groups
- Students will have an integrated view of the behavioral and social sciences
- Students will be certified in and capable of replicating behavioral and social-science experiments

COURSE FORMAT AND STRUCTURE

This course is on campus. There is a lecture two times per week and (optional) recitation once per week. To access the online portion of the course, please visit stevens.edu/canvas. For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

TENTATIVE COURSE SCHEDULE

COURSE SCHEDULE

The instructor reserves the right to make changes to the schedule.

1. **A whirlwind tour of thought and behavior, together and apart.**

   Tuesday, September 5

   Topics:
   - Overview of class
   - Small-group discussion to spark interest
   - Review this syllabus

   Readings:
   - This syllabus
   - "The Standard Equipment" by Steven Pinker
   - Marr's 3 levels
   - The Humane Representation of Thought

Part I: Computational models of individual thought and behavior.

2. **On predicting the future**

   Thursday, September 7

   Topics:
   - The Anthropic Principle
   - Marr's levels-of-analysis framework
   - Basics of Bayesian inference
   - "Optimal predictions in everyday life" by Griffiths & Tenenbaum.
   - The end-of-history illusion
   - The recency illusion
   - Retrofuturism

   Readings:
   - The Anthropic Principle by J. Richard Gott
   - Retrofuturism subreddit (https://www.reddit.com/r/RetroFuturism/top/?t=all)

Assignment #1: In this assignment, you will replicate the experiment detailed in the "Optimal predictions…" reading.

3. **On reasoning about what might have been**

   Tuesday, September 12

   Topics:
   - "When less is more" and counterfactual reasoning
   - Causal graphical models

4. **On summarizing one's experience**

   Thursday, September 14

   Topics:
   - Peak-end rule

5. **On choosing between now and later**

   Tuesday, September 19

   Topics:
   - Intertemporal choice
   - Hyperbolic vs. exponential discounting
   - Rational snacking

   Assignment #2: In this assignment, you will measure your own temporal discounting function and determine whether it is better described as a hyperbolic or exponential function.

6. **On seeking and avoiding risk**

   Thursday, September 21

   Topics:
   - Kahneman and Tversky and the history of behavioral economics
   - Risk aversion
   - The certainty effect
   - The Allais paradox
   - Ellsberg paradox
   - Expected Value Theory
   - Expected Utility Theory

   Assignment #3: In this assignment, you will implement Expected Value Theory and Expected Utility Theory using the Python language and demonstrate a choice anomaly.

7. **On gaining and losing**

Tuesday, September 26

Topics:

- Anchoring and adjustment
- Prospect Theory

8. **On being rational**

Thursday, September 28

Topics:

- The Law of Small Numbers
- Gambler's Fallacy
- Hot-hand effect

9. **On exploring and exploiting, Part I**

Tuesday, October 3

Topics:

- Multiarmed bandit problems
- The Upper Confidence Bound algorithm
- Epsilon-greedy strategies for solving multiarmed bandit problems
- Thompson sampling
- From multiarmed bandits to contextual bandits

10. **On exploring and exploiting, Part**

Thursday, October 5

Topics:

- Markov Processes
- Markov Decision Processes
- Partially Observable Markov Decision Processes

Assignment #4: In this assignment, you will implement a Partially Observable Markov Decision process using the Python programming language.

11. **On deciding under incomplete information**

Thursday, October 12

Topics:

- Drift diffusion models of choice
- System I and System II thinking
- The idea of time as a resource

12. **On having limits**

    Tuesday, October 17

    Topics:
    - Bounded rationality
    - The concept of attentional limits
    - Availability heuristics
    - Base-rate neglect
    - Conjunction fallacy
    - Resource rationality

    Assignment #5: In this assignment, you will test some of your own perceptual and attentional limits and consider various ways to quantify them.

13. **On knowing thyself**

    Thursday, October 19

    Topics:
    - Metacognition
    - Dunning-Kruger effect
    - Curse of knowledge

14. **On having preferences**

    Tuesday, October 24

    Topics:
    - Preferences
    - Implicit Associations
    - Multi-objective scalarization
    - Multi-objective optimization

    Assignment #6: In this assignment, you will take an online version of the Implicit Association Test.

15. **On wishing it were so**

    Thursday, October 26

    Topics:
    - Motivated reasoning
    - Survivorship bias
    - Selection biases

16. **"But I like it / Because it is bitter / And because it is my heart."**

    Tuesday, October 31

Topics:

- The Endowment Effect
- The Ikea Effect
- Not Invented Here disorder
- The Illusion of Control

17. **On the troubled history of intelligence**

Thursday, November 2

Topics:

- What is intelligence?
- The troubled history of studying intelligence
- The foundations of eugenics
- Measuring and modeling "general" intelligence (G)
- The concept of multiple intelligences
- The Intelligence Quotient (IQ)

18. Midterm exam

Tuesday, November 7

Part II: Computational models of collective thought and behavior.

19. **On evolving over time**

Thursday, November 9

Topics:

- Is evolution actually survival of the fittest?
- The Iterated Prisoner's Dilemma (IPD)
- IPD on structured networks

Readings:

- NCM Chapter 6

Assignment #7: In this assignment, you will write an evolutionary IPD tournament in Python.

20. **On the wisdom of the crowd**

Tuesday, November 14

Topics:

- Francis Galton and the voice of the people
- The Delphi Method

- The Bayesian Truth Serum

Readings:
- Vox Populi
- Bayesian Truth Serum paper

Assignment #8: In this assignment, you will replicte the wisdom of the crowds effect from the Galton reading.

21. **On designing good mechanisms**

Thursday, November 16

Topics:
- Algorithmic Game Theory
- Game theory vs. mechanism design
- Algorithmic mechanism design
- The Price of Anarchy
- Mechanisms for Voting
- Mechanisms for Auctions

22. **On collective intelligence**

Tuesday, November 21

Topics:
- Schooling in fish
- Social learning
- Collective intelligence
- Crowdsourced markets

23. **On recursive social reasoning**

Tuesday, November 28

Topics:
- Theory of mind
- Schelling coordination games
- Keynesian beauty contests
- El Farol Bar Problem
- The minority game
- Limits to recursive reasoning

24. **On social influence**

Thursday, November 30

Topics:
- Conformity bias

- Prestige bias
- Herding in crowds
- Information cascades
- Ingroup bias
- Fundamental attribution error

25. **On being fair**

    Tuesday, December 5

    Topics:
    - Algorithmic fairness
    - Cake cutting
    - Fair division

    Assignment #9: In this assignment, you will study the fairness of an AI system.

26. **On being altruistic**

    Thursday, December 7

    Topics:
    - The Dictator Game
    - The Ultimatum Game

27. **On remembering together**

    Tuesday, December 12

    Topics:
    - Collective memory
    - Transactive memory
    - Interactive cueing
    - Forgetting on networks

    Assignment #10: In this assignment, you will replicate the effect of interactive cueing with a friend.

28. Final exam

    Thursday, December 14

COURSE MATERIALS

The following texts are required. Please note that they are available from Amazon and all major booksellers at a reasonable price:

- Kahneman, D. (2011). Thinking, fast and slow. Macmillan. (TFS) (~$10)

- Ariely, D. (2008). Predictably irrational. New York, NY: Harper (PI) (~$15)
- Easley, D., & Kleinberg, J. (2012). Networks, crowds, and markets. Cambridge University Press. (NCM) (~$50)

Additional readings will be distributed by the instructor on Canvas at no cost to students.

GRADING PROCEDURES

The course grade will be determined based on the following weighting:

Class Participation	30%
Assignments	30%
Midterm Exam	15%
Final Exam	15%
CITI Certification Program	10%
Total	100%

CLASS PARTICIPATION
Class preparation, attendance, and participation are together worth 30% of your final grade (1% for each class meeting), the ten assignments another 30% (i.e., 3% each; all-or-none for handing in something that meets the requirements in the description by the deadline), the midterm 15%, the final 15%, and the CITI Certification Program 10%.

In preparation for each class, you should read and think about each of the assigned readings. As part of that preparation, you will be asked to create a tweet-length summary of each reading, which you will submit on Canvas before each class.

Attendance is mandatory. If you don't show up to class without having been excused, you won't receive any credit for preparation, attendance, or participation for that class. Of course, you are excused if there is an emergency (medical, family, or other), just let me know.

CITI Training Program
HSR provides foundational training in human subjects research and includes the historical development of human subject protections, ethical issues, and current regulatory and guidance information. Human Subjects Research (HSR) basic content is organized into two courses: Biomedical (Biomed) and Social-Behavioral-Educational (SBE). They are intended for anyone involved in research studies with human subjects, or who have responsibilities for setting policies and procedures with respect to such research, including Institutional Review Boards

(IRBs). Additional modules of interest within HSR allow for exploration of several important topics and may be selected to meet organizational needs.

As part of this course, you will obtain certification in human subjects research by completing the CITI Training Program.

EXAMS
There will be a midterm and final exam; I'll provide you with a list of concepts that are in scope for that exam. Collaboration isn't allowed on exams but is encouraged for studying.

ASSIGNMENTS
The assignments are short activities that you'll complete and submit. There are 10 of them. Assignments are due by 5 p.m. on Friday of that week. I will grant you a courtesy extension until midnight if you write to me before the deadline with your plan for getting it done. Collaboration isn't allowed on assignments.

ACADEMIC INTEGRITY

Undergraduate Honor System
Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/.

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity
All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found on the Office of Graduate Academics web page.

Special Provisions for Undergraduate Students in 500-level Courses
The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Senior Vice Provost for Graduate Education or to the Honor Board, who will refer the report to the senior vice provost. The Honor Board Chairman will give the Senior Vice Provost for Graduate Education weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other disabilities to help students achieve their academic and personal potential. They facilitate equitable access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/student-diversity-and-inclusion/disability-services. If you have any questions please contact the Office of Disability Services at disabilityservices@stevens.edu or by phone: 201.216.3748.

Disability Services Confidentiality Policy
Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

Name and Pronoun Usage
As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your pronouns and/or name, please inform the instructor of the necessary changes.

Religious Holidays
Stevens is a diverse community that is committed to providing equitable educational opportunities and supporting students of all ethnicities and belief systems. Religious observance is an essential reflection of that rich diversity. Students will not be subject to any grade penalties for missing a class, examination, or any other course requirement due to religious observance. In addition, students will not be asked to choose between religious observance and academic work. Therefore, students should inform the instructor at the beginning of the semester if a requirement for this course conflicts with religious observance so that accommodations can be made for students to observe religious practices and complete the requirements for the course.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments can be made by phone (201-216-5177), online at https://stevensportal.pointnclick.com/confirm.aspx, or in person on the 2nd Floor of the Student Wellness Center.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about your own safety or the safety of someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year-round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text "Home" to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.