Game of Life: The Theory of Strategic Behavior

Welcome

Welcome to The Game of Life! My name is Ben, and I'll be your instructor this session. I've been an instructor for a similar CTY course, Mathematics of Competitive Behavior, the past three summers, and I'm looking forward to delving into the material in a unique setting.

In the course outline below, you will see some references to *Game Theory and Strategy* by Philip Straffin, an excellent resource on the topic. Rest assured you do not need to rent or purchase the textbook—I will provide you with copies of all readings and problems as needed.

I am excited to get to know you and to delve into the theory of how individuals make decisions! If you have any questions, you can reach me using the contact information below.

Instructor Contact Information

INSTRUCTOR: Ben Cohen
Email: bcohen49@jhu.edu

Communication Guidelines

If you have any questions or concerns about the course, contact me by email and I will respond as soon as possible. If you need to schedule an individual conference, email your request and we can schedule a Zoom meeting.

Course Description

How do individuals interact? How do they cooperate, compete, and respond to incentives? All involve strategic behavior, the purview of the economic theory of games. Study game theory through experiments, competitions, mathematical analysis, and debate, and apply game theory to model, evaluate, and predict outcomes of strategic behavior in the real world. Conduct a final research project in which you model and analyze a real-world strategic interaction. By engaging in simulations, problem sets, collaboration, and independent research, you will gain the ability to describe prototype games like the Prisoner's Dilemma and Stag Hunt; explain formal concepts such as players, strategies, payoffs, dominance, backward induction, and equilibrium; identify and evaluate Nash equilibria of simultaneous and sequential games; and model and analyze real-world strategic interactions as formal games.

Course Goals

The primary goals of the course are to extend students' knowledge and understanding of the role of rational behavior in social decision-making. Upon completing the course, students are able to:

- Apply basic concepts of probability to strategic decision-making.
- Solve for equilibria in normal-form and extensive-form games.
- Understand and explain how to mathematically model real-world decision scenarios by applying the methods of game theory.

Course Outline

WEEK	TOPICS AND ACTIVITIES
1	*In class:* • Introductions • Course and topic overview • Historical introduction to probability (The Unfinished Game) *Outside of class:* • Introduction to probability: dependent and mutually exclusive events; expected value *(video)* • Probability with permutations and combinations *(video)* • "The Birthday Problem" *(worksheet)* • Practice with probability and expected value *(two worksheets)* • Discussion board: SAT requirement for college admissions
2	*In class:* • Go over any questions from last class/videos (~10 min.) • "A Fascinating Game" • Introduction to games and payoff matrices *Outside of class:* • Two-person *N*-strategy zero-sum games; saddle points *(video)* • Dominance and IESDS *(video)* • Oddments and mixed strategies; importance of unpredictability *(video)* • "Solving 2x2 Zero-Sum Games" *(worksheet)* • Straffin ch. 2, exercises #2-5 *(to be posted by instructor)*
3	*In class:* • Go over any questions from last class/videos (~10 min.) • Introduce individual project • Graphical solution to *M* x 2 or 2 x *N* games • Jamaican fisherman problem • The Umbrella Problem *Outside of class:* • Algebraic solution to 3 x 3 games *(video)* • Games against nature *(video)* • Bayes' theorem *(video)* • Bayes' theorem *(worksheet)* • Straffin ch. 3, exercises #3-6, 8 *(to be posted by instructor)* • Work on individual projects
4	*In class:* • Go over any questions from last class/videos (~10 min.)

	• Utility theory • Newcomb's Problem *Outside of class:* • 2-person non-zero-sum games *(video)* • Pure strategy Nash equilibrium *(video)* • Pareto optimality *(video)* • Payoff polygons *(video)* • Solving Non-Zero-Sum Games *(worksheet)* • Straffin ch. 4, exercises #1, 2; read ch. 6, exercise #2a *(to be posted by instructor)* • Discussion board: Read and respond to *Ars Technica* article on cyberattack response strategies
5	*In class:* • Go over any questions from last class/videos (~10 min.) • Mixed strategy Nash equilibrium • SSS games *Outside of class:* • Extensive form of a game *(video)* • Backward induction *(video)* • Straffin ch. 11, exercises #1, 2a-c, 3, 4a *(to be posted by instructor)* • "Card Bingo" *(worksheet)* • Work on individual projects
6	*In class:* • Go over any questions from last class/videos (~10 min.) • Monty Hall Problem • Mutually assured destruction • Prisoner's Dilemma simulation • Introduction to fair division: "Divide the Chip" and Pirate Game *Outside of class:* • Straffin ch. 7, exercises #2, 5, 6a-c *(to be posted by instructor)* • Market structure *(video)* • Monopoly *(video)* • Work on individual projects
7	*In class:* • Go over any questions from last class/videos (~10 min.) • Chicken and stag hunt • Trust, suspicion, and the F-scale: "split or steal?" *Outside of class:* • *n*-person Games *(video)* • Tragedy of the Commons *(video)* • Discussion board: Tragedy of the Commons • Straffin ch. 19, exercises #1-3 *(to be posted by instructor)* • Work on individual projects
8	*In class:* • Strategic Moves

	• Iterated prisoner's dilemma *Outside of class:* • Voting games and methods: majority, plurality, runoff, sequential runoff, Borda count, pairwise comparisons *(video)* • Arrow's Impossibility Theorem *(video)* • Voting Exercises *(worksheet)* • Finish individual projects
9	*In class:* • Go over any questions from last class/videos (~10 min.) • Individual presentations (five students; ~25-30 min.) • Case study: Supreme Court nominations • Case study: Nassau County Board of Supervisors *Outside of class:* • Straffin ch. 14, exercises #1, 3 • Discussion board: Apportionment and the Alabama Paradox
10	*In class:* • Go over any questions from last class/videos (~10 min.) • Individual presentations (five students; ~25-30 min.) • Course wrap-up and evaluation

Required Materials

The materials needed for the course are as follows:

- Access to a scanner or scanner app (e.g., Tiny Scanner).
- Access to cloud storage (e.g., Google Drive).
- A graphing calculator is helpful, but not required. You may access a free calculator at www.desmos.com.
- There is no required textbook to purchase for this class. Some readings and problems will be posted on Moodle by the instructor throughout the session.

Technical Requirements and Support

Find the technical requirements at: https://cty.jhu.edu/online/enrolled/support.html. To request technical support, complete and submit the form found at: https://cty.jhu.edu/online/about/contact.html.

CTY L.I.V.E Community Standards

CTY L.I.V.E. provides a unique opportunity for intellectually curious people from diverse backgrounds to come together in pursuit of academic challenges and growth within a supportive virtual community built on respect, responsibility, and trust.

As a member of the CTY L.I.V.E. community, you are expected to uphold academic and personal integrity, and to ensure that those around you do the same. Specifically, you are expected to:

- Strive to do the best academic work possible.
- Respect individuals of different races, cultures, religions, genders, gender identities or expressions, sexual orientations, ages, disabilities, and national origins.
- Behave in a friendly, cooperative, safe and responsible manner to all people in the CTY L.I.V.E. community.
- Attend all class sessions and meetings.
- Take responsibility for your own work and actions.
- Observe all rules for student conduct.

If you wish to help or receive help from someone other than your instructor, or if you are interested in collaborating with another student, you must review the course syllabus and check with your instructor first to reach an understanding of what is considered acceptable collaboration for your particular course.

Synchronous Class Sessions Policy

Synchronous class sessions include your weekly scheduled class period and any additional synchronous sessions scheduled by your instructor for small group work or student collaboration. You must adhere to the following:

- Be on time, and dress appropriately (no pajamas, T-shirts with inappropriate images or text, etc.)
- Mute your microphone. Your instructor will guide microphone and video camera usage. In general, your video camera is expected to be on with your face in full view.
- Use appropriate screen names and virtual backgrounds. You will be removed from the room if they are inappropriate.
- Have on hand any classroom supplies and course materials needed for the session (i.e., earbuds, required texts, notebooks, writing implements, etc.)
- Follow your instructor's guidelines for classroom discussions. This may involve physically raising your hand, using the "raise hand" feature or Zoom chat, or taking part in a break-out room.
- Do not use your cell phone for any purpose unless you are directed by your instructor to do so for educational purposes.
- Do not engage in private digital chat functions or other means of digital communication without specific direction and permission of the instructor.
- Do not record, screenshot, share, re-post otherwise capture or disseminate digital content created for CTY L.I.V.E.
- Do not under any circumstances share the links for your Zoom conferences, especially on social media, where they can be viewed by others.

Discussion Forums Policy

Whenever you are interacting with other students via discussion forums in which you are posting pictures of projects, responding to questions, reading other posts, or contributing to class discussions, you must follow good posting practices and conduct yourself appropriately:

- Treat your instructor and classmates with politeness and respect. Remember that what we type online can sometimes be interpreted in ways we did not mean.
- Use proper language at all times.
- Be sure your posts are on topic and in the appropriate forum.
- Use correct spelling, grammar, and punctuation to the best of your ability. Do not type in all caps.
- Never share your password or personal information, such as your phone number or address.
- Provide feedback in a kind, considerate manner. Feedback should always be constructive in nature, even if critical.
- Be open to the ideas and opinions of others who have different perspectives and beliefs than you do. When sharing disagreement, be respectful.

Student Attendance Policy

The synchronous course sessions are central to the CTY L.I.V.E. experience. Because of the short duration of the program, CTY expects you to attend all synchronous sessions in order to successfully complete your course. Synchronous class sessions are not recorded and cannot be made up.

In the event of illness or another emergency where you absolutely cannot arrange to participate in a synchronous session, you, or your parent or guardian, must notify your instructor immediately and provide the reason. Your instructor will then contact you about options for catching up with the class.

Reasons for Dismissal

You may be dismissed from CTY L.I.V.E, with no tuition refunds, for any of the following reasons:

- Not attending to your academic work in a satisfactory manner.
- Engaging in any act of academic dishonesty, such as cheating or plagiarizing; plagiarizing is submitting or presenting the work of another as your own in any form without acknowledgement of the source.
- Interfering with the work of others, whether via email or any other medium.
- Violating expectations for student behavior during synchronous class sessions.

- Missing synchronous class sessions.
- Harassing, bullying, hazing, stalking, abusing, threatening, or defaming others via social media, email or any other medium in violation of any John Hopkins University or CTY policies, including without limitation policies prohibiting discrimination, harassment, and sexual misconduct.
- Sending messages, images, website postings, or other content that appear to come from someone other than the sender.
- Sending or forwarding sexually explicit messages, photographs, or images.
- The making, attempting to make, sharing, or distribution of an audio or visual recording, or photographing of, any person(s) without the knowledge and consent of all such person(s).
- Engaging in any illegal conduct.

Special Needs/Accessibility

CTY is committed to providing reasonable, appropriate, and necessary accommodations for qualified students with disabilities. To do so, open communication between CTY and parents is essential to meeting students' needs. More information can be found on the program website.