

HC 441: Bitcoin: What could possibly go wrong?
Fall 2022, MW 10:00 - 11:50, PLC 361

Professor Micah Warren

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Office Hours: Tuesdays and Thursdays 1:30 - 2:20 or by appointment.

Text:

- (Required) *Attack of the 50 foot blockchain*, by David Gerard.
- (Required) *Check Your Financial Privilege*, by Alex Gladstein (selected chapters).
- (Required) *Bitcoin: A Game-theoretic analysis*, (available on Canvas) by Micah Warren (selected chapters).
- (Required) *The Blocksize War*, by Jonathan Bier.
- (Optional) *The Strategy of Conflict*, by Thomas Schelling.

Description: Proponents of Bitcoin have hailed cryptocurrency as tool for resisting authoritarian governments, disrupting economic hegemony, defying censorship, banking the unbanked, disintermediating corrupt or self-dealing actors, and enabling powerful and useful technologies to bring third-world nations out of poverty and into prosperity. One of the goals of this class is to assess these claims from a perspective of game theory. Introducing game theory and probability as needed, we will go through the mechanisms that hold the major decentralized currencies in place. The most notable, Nakamoto consensus (which uses Proof of Work) is a fascinating innovation barely a decade old that spawned the cryptocurrency phenomenon. Proponents of Bitcoin suggest that Proof of Work motivates the miners, who maintain the ledger, to be honest at all times. We will examine this more closely, looking at various aspect of this protocol, including stability (or lack thereof) against censorship, manipulation and fraudulent “double spend” or other attacks. We also consider the external costs created in the protocol, most notably the electricity consumption of Bitcoin, which is larger than many developed nations. Since Proof of Work, more energy efficient proposals have emerged, including Proof of Stake, which, while much more efficient, must be very carefully calibrated in order to maintain an incentive structure that will remain robust against attacks.

We will discuss the suggested positive use cases for cryptocurrency as well as the not-so-positive use cases.

Motivating questions: What would a corrupt or authoritarian government have to gain or lose if a cryptocurrency was widely adopted? Could an authoritarian government or manipulative corporation censor transactions? Could a corrupt self-dealing government or corporation manipulate cryptocurrency markets to gain immense wealth? Could terrorists use cryptocurrencies to anonymously crowd-fund malicious behaviors? Could a rogue nation-state leverage cryptocurrency to hold advanced economies hostage? How do the incentive structures scale when the size of a cryptocurrency market becomes comparable to the value of large corporations or national economies?

Final Writing Project: The final writing project is a “treatment” for a future science fiction film or limited series. (A treatment is somewhere between a synopsis and a script, for this course let’s say 8-12 pages.) The objective is to (while having fun) creatively apply understanding of consensus mechanisms and game theory at scale, and grade will be determined based on demonstration of understanding of the technical and social principles underpinning cryptocurrency.

Learning Outcomes:

- Develop an understanding of game theory underpinning Bitcoin and other cryptocurrencies
- Identify strengths and weakness of consensus protocols for payments
- Apply game trees, backwards induction and other tools from game theory to predict outcomes
- Apply critical thinking skills to arguments for and against blockchain technology
- Creatively explore possible futures in which cryptocurrency plays a role

Format and Workload: (See the course outline below) Most of the (110 minute) class periods will begin with a discussion of assigned reading material, followed by lectures on topics to fill in the subject matter.

Reading responses are to be turned in on canvas by 9:15 am prior to class. I will print and distribute these randomly and anonymously, students are then to summarize and present the responses to the class, and they will be discussed.

As class proceeds, we will be taking class time to present and discuss each other’s story lines.

Reading Responses: Less than a page: Provide a paragraph or two summary, and then a paragraph or two of your own response. This can be anything from agreement or disagreement with the arguments to stating points of confusion. Points of confusions are particularly valuable in stimulating class discussion (and also provide valuable feedback to the author, where applicable). Obviously, there’s no wrong answers, honesty is encouraged.

All assignments are to be turned in on canvas via upload: To keep it simple, late assignments do not receive credit.

week	Monday	Wednesday
1	Holiday	Introduction, lecture on Proof of Work Protocol
2	Reading and response: Chapters 1,2 in each of Gerard and Gladstein	Reading and response: chs 3-8 in Gerard
	Discuss: Gerard and Gladstein	Discuss: Gerard
	Lecture: More on Nakamoto Consensus	Lecture: Game theory
3	Reading and response: ch 9-end in Gerard	Reading and response: chs 3 and 5 in Gladstein
	Discuss: Gerard	Discuss: Gladstein
	Lecture: Economics of Censorship Resistance, Futarchy	Lecture: Lightning Network
4	Reading and response: ch 6,10 in Gladstein	Reading and response: ch 12 in Gladstein
	Discuss: Gladstein	Discuss: Gladstein
	Presentations: plot outlines	Presentations: plot outlines
5	Reading and response: ch 13 in Warren	Reading and response: ch 14 in Warren
	Discuss: Attacks on Bitcoin	Discuss: Takeovers
	Lecture: Selfish Mining	Lectures: bribery mechanisms
6	Reading and response: ch 17 in Warren	Reading and response: ch 18 in Warren
	Discuss: Economic incentives to attack	Discuss: International game theory of Bitcoin
	Lecture: Coalitional Game Theory	Lecture: ? topics TBD
7	Reading and response: chs 1-4 in Bier	Reading and response: chs 5-10 in Bier
	Discuss: Bier	Discuss: Bier
	Presentations: revised plot outlines	Presentations: revised plot outlines
8	Reading and response: chs 11-17 in Bier	Reading and response: chs 18- end in Bier
	Discuss: Bier	Discuss: Bier
	Lecture: ? topics TBD	Lecture: ? topics TBD
9	Explore: Energy debate	Podcasts and response: "Bitcoin Security Debate - Vijay Boyapati vs Justin Drake", "The PoW vs. PoS Debate — Lyn Alden Justin Drake"
	Discuss: Energy debate	Discuss: PoS vs PoW
10	Present and discuss treatments	Present and discuss treatments

Attendance: Attendance is expected. We would like to take advantage of the small class to engage in productive discussions. Obviously if you are sick, we don't want to pass around COVID, it looks like the room is tiny, so please use your better judgment and keep me in the loop. The university attendance policy requires that I do not distinguish between excused and unexcused absences, excepting for certain classes of reasons: I can't distinguish between COVID and "sorry not feeling it today." So my policy is that 2 absences are freebies for the participation grade. Beyond that, for 3 absences you can do a makeup assignment: The first step of the makeup assignment is to email me before class and tell me how long you will expect to be absent, if you know. University policy forbids me from asking why you are absent, but does not forbid you from telling me. For more information see

<https://provost.uoregon.edu/course-attendance-and-engagement-policy>,

Grading:

- 20% Reading Responses
- 20% Class participation
- 12% Turn in draft of project
- 12% Peer response to project
- 36% Final Project

Grading standards for responses:

- Turned in on-time
- Provides evidence of engagement with material

Grading standards for participation:

- Student is in class
- Student engages in conversation

Grading standards for projects and peer responses:

A: Demonstrates a nuanced understanding of the material

B: Demonstrates a good understanding of the material

C: Demonstrates a satisfactory ability to engage with material.

D: Rudimentary understanding but no grasp of nuances.

F: Unable to describe basic concepts .

A grade of A+ will be given only in exceptional circumstances, if a student exceeds the expectations of the class.

Statement on expected classroom behavior: Students are expected to behave respectfully toward each other and toward the instructor during class time. This includes refraining from using cell phones during lectures.

Academic Disruption due to Campus Emergency: In the event of a campus emergency that disrupts academic activities, course requirements, deadlines, and grading percentages are subject to change. Information about changes in this course will be communicated as soon as possible by email, and on Canvas. If we are not able to meet face-to-face, students should immediately log onto Canvas and read any announcements and/or access alternative assignments. Students are also expected to continue coursework as outlined in this syllabus or other instructions on Canvas. In the event that the instructor of this course has to quarantine, this course may be taught online during that time.

Academic Misconduct: The University Student Conduct Code, available at

<https://conduct.uoregon.edu>,

defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. By way of example, students should not give or receive (or attempt to give or receive) unauthorized help on assignments or examinations without express permission from the instructor. Students should properly acknowledge and document all sources of information (e.g. quotations, paraphrases, ideas) and use only the sources and resources authorized by the instructor. If there is any question about whether an act constitutes academic misconduct, it is the student's obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at

<https://researchguides.uoregon.edu/citing-plagiarism>.

Accessible Education: The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Accommodation for Religious Observances: The university makes reasonable accommodations, upon request, for students who are unable to attend a class for religious obligations or observance reasons, in accordance with the university discrimination policy which says " Any student who, because of religious beliefs, is unable to attend classes on a particular day shall be excused from attendance requirements and from any examination or other assignment on that day. The student shall make up the examination or other assignment missed because of the absence. To request accommodations for this course for religious

observance, visit the Office of the Registrar's website

<https://registrar.uoregon.edu/calendars/religious-observances>

and complete and submit to the instructor the "Student Religious Accommodation Request" form prior to the end of the second week of the term.

Basic Needs: Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course is urged to contact the Dean of Students Office (346-3216, 164 Oregon Hall) for support. This UO webpage includes resources for food, housing, healthcare, childcare, transportation, technology, finances, and legal support:

<https://blogs.uoregon.edu/basicneeds/food>.

Inclement Weather: It is generally expected that class will meet unless the University is officially closed for inclement weather. If it becomes necessary to cancel class while the University remains open, this will be announced on Canvas and by email. Updates on inclement weather and closure are also communicated in other ways described here:

<https://hr.uoregon.edu/about-hr/campus-notifications/inclement-weather>.

Mental Health and Wellness: Life at college can be very complicated. Students often feel overwhelmed or stressed, experience anxiety or depression, struggle with relationships, or just need help navigating challenges in their life. If you're facing such challenges, you don't need to handle them on your own—there's help and support on campus.

As your instructor if I believe you may need additional support, I will express my concerns, the reasons for them, and refer you to resources that might be helpful. It is not my intention to know the details of what might be bothering you, but simply to let you know I care and that help is available. Getting help is a courageous thing to do for yourself and those you care about.

University Health Services help students cope with difficult emotions and life stressors. If you need general resources on coping with stress or want to talk with another student who has been in the same place as you, visit the Duck Nest (located in the EMU on the ground floor) and get help from one of the specially trained Peer Wellness Advocates. Find out more at health.uoregon.edu/ducknest.

University Counseling Services (UCS) has a team of dedicated staff members to support you with your concerns, many of whom can provide identity-based support. All clinical services are free and confidential. Find out more at counseling.uoregon.edu or by calling 541-346-3227 (anytime UCS is closed, the After-Hours Support and Crisis Line is available by calling this same number).

Reporting Obligations: I am an assisting employee, not a designated reporter. For information about my reporting obligations as an employee, please see Employee Reporting Obligations on the Office of Investigations and Civil Rights Compliance (OICRC) website.

Students experiencing sex or gender-based discrimination, harassment or violence should call the 24-7 hotline 541-346-SAFE [7244] or visit safe.uoregon.edu for help. Students experiencing all forms of prohibited discrimination or harassment may contact the Dean of Students Office at 541-346-3216 or the non-confidential Title IX Coordinator/OICRC at 541-346-3123. Additional resources are available at

<https://investigations.uoregon.edu/how-get-support>.