JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Computer Science 601.641/441
Blockchains and Cryptocurrencies
Fall 2020 (3 credits)

Instructor
Professor Matthew D. Green, mgreen@cs.jhu.edu, https://isi.jhu.edu/~mgreen
Office: Malone 313 (currently closed for COVID-19 reasons), 410-861-0344 (texts acceptable)
Office hours: Thursdays 3:00–5:00 pm, and by appointment

Teaching Assistant
Gijs van Laer, gijs.vanlaer@jhu.edu
Office: Online
Office hours: Thursdays 9:00-10:30 am, online

Meetings
Monday, Wednesday, 12:00–1:15 pm, Online

Textbook
Required: Narayanan, Bonneau, Felten, Miller, Goldfeder: Bitcoin and Cryptocurrency Technologies. Available free online at: http://bitcoinbook.cs.princeton.edu/

Online Resources
- Please log in to Blackboard for assignments and materials related to this course.
- Github page, includes complete assignment list and reading assignments: https://github.com/matthewdgreen/blockchains
- Piazza page: https://piazza.com/class/kd5wgzsmwis16w

Course Information

This course will introduce students to cryptocurrencies and the main underlying technology of Blockchains. The course will start with the relevant background in cryptography and then proceed to cover the recent advances in the design and applications of blockchains. This course should primarily appeal to students who want to conduct research in this area or wish to build new applications on top of blockchains. It should also appeal to those who have a casual interest in this topic or are generally interested in cryptography.

Prereq: 601.226 and (EN.553.310 or EN.553.410 probability).

- **Prerequisites**
  601.226 and (EN.553.310 or EN.553.410 probability).
  Students are expected to have mathematical maturity.

Students may receive credit for only one of 600.451, 601.441, 601.641.

Course Goals

Specific Outcomes for this course are that

- Students will learn basic and advanced concepts related to modern distributed ledger technology (DLT), including cryptocurrency and smart contract system
- Students will gain basic theory in the areas of cryptogrpahy, consensus networks, and distributed systems design
- Students will gain basic skills in modern DLT programming frameworks
- Students will develop technical presentation skills

This course will address the following Criterion 3 Student Outcomes

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Course Topics

- Electronic payment systems
- Nakamoto consensus and Bitcoin
- Bitcoin and Ethereum
- Privacy technologies
- Proof of work
- Proof of stake
- Fundamental cryptography techniques
- Consensus networking

Course Expectations & Grading

Multiple programming-based assignments will be given, approximately once every two to three weeks. Weekly reading assignments will be assigned. There will be two course exams, given online. Approximately 10% of the course grade will be based on participation, which includes attendance, in-class instant quizzes and course interaction. Attendance of real-time classes will be expected, with some degree of flexibility applied given the current pandemic situation.

Key Dates

All dates will be provided via the Github link above. Dates will be subject to change throughout the semester.

Assignments & Readings

All readings will be provided via the Github link above. Readings are assigned on the date specified, and are "due" by the following class session.

Ethics

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.

Some assignments may be assigned individually, while others may be assigned for work with partners. In the former case, you are expected to work independently. In the latter case, you are expected to identify your collaborators on any work submitted. Please ask the instructor or TA if you have specific questions about this policy.

Report any violations you witness to the instructor. You may consult the associate dean of student conduct (or designee) by calling the Office of the Dean of Students at 410-516-8208 or via email at integrity@jhu.edu. You can find more information about university misconduct policies on the web at these sites:

- For undergraduates: https://studentaffairs.jhu.edu/policies-guidelines/undergrad-ethics/
- For graduate students: http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/

Personal Wellbeing

- If you are sick please notify me by email so that we can make appropriate accommodations should this affect your ability to attend class, complete assignments, or participate in assessments. The Student Health and Wellness Center is open and operational for primary care needs. If you would like to speak with a medical provider, please call 410-516-8270, and staff will determine an appropriate course of action based on your geographic location, presenting symptoms, and insurance needs. Telemedicine visits are available only to people currently in Maryland. See also https://studentaffairs.jhu.edu/student-life/student-outreach-support/absences-from-class/illness-note-policy/
- The Johns Hopkins COVID-19 Call Center (JHCCC), which can be reached at 833-546-7546 seven days a week from 7 a.m. to 7 p.m., supports all JHU students, faculty, and staff experiencing COVID-19 symptoms. Primarily intended for those currently within driving distance of Baltimore, the JHCCC will evaluate your symptoms, order testing if needed, and conduct contact investigation for those affiliates who test positive. More information on the JHCCC and testing is on the coronavirus information website.
- All students with disabilities who require accommodations for this course should contact me at their earliest convenience to discuss their specific needs. If you have a documented disability, you must be registered with the JHU Office for Student Disability Services (385 Garland Hall; 410-516-4720; http://web.jhu.edu/disabilities/) to receive accommodations.
- Students who are struggling with anxiety, stress, depression or other mental health related concerns, please consider connecting with resources through the JHU Counseling Center. The Counseling Center will be providing services remotely to protect the health of students, staff, and communities. Please reach out to get connected and learn about service options based on where you are living this fall at 410-516-8278 and online at http://studentaffairs.jhu.edu/counselingcenter/.
- Student Outreach & Support will be fully operational (virtually) to help support students. Students can self-refer or refer a friend who may need extra support or help getting connected to resources. To connect with SOS, please email deanofstudents@jhu.edu, call 410-516-7857, or students can schedule to meet with a Case Manager by visiting the Student Outreach & Support website and follow “Schedule an Appointment”.

Classroom Climate

As your instructor, I am committed to creating a classroom environment that values the diversity of experiences and perspectives that all students bring. Everyone here has the right to be treated with dignity and respect. I believe fostering an inclusive climate is important because research and my experience show that students who interact with peers who are different from themselves learn new things and experience tangible educational outcomes. Please join me in creating a welcoming and vibrant classroom climate. Note

that you should expect to be challenged intellectually by me, the TAs, and your peers, and at times this may feel uncomfortable. Indeed, it can be helpful to be pushed sometimes in order to learn and grow. But at no time in this learning process should someone be singled out or treated unequally on the basis of any seen or unseen part of their identity.

If you ever have concerns in this course about harassment, discrimination, or any unequal treatment, or if you seek accommodations or resources, I invite you to share directly with me or the TAs. I promise that we will take your communication seriously and to seek mutually acceptable resolutions and accommodations. Reporting will never impact your course grade. You may also share concerns with the CS department head, Randal Burns (randal@cs.jhu.edu), the Director of Undergraduate Studies (Joanne Selinsky, joanne@cs.jhu.edu), the Assistant Dean for Diversity and Inclusion (Darlene Saporu, dsaporu@jhu.edu), or the Office of Institutional Equity (oie@jhu.edu). In handling reports, people will protect your privacy as much as possible, but faculty and staff are required to officially report information for some cases (e.g. sexual harassment).

Family Accommodations Policy

You are welcome to bring a family member to class on occasional days when your responsibilities require it (for example, if emergency child care is unavailable, or for health needs of a relative). In fact, you may see my children in class on days when their school is closed. Please be sensitive to the classroom environment, and if your family member becomes uncomfortably disruptive, you may leave the classroom and return as needed.

University Policy on Incompletes

The university recognizes that the Fall 2020 semester is surrounded with uncertainty and many students may find themselves in unexpected situations where study is difficult if not impossible. Students who are confronted with extraordinary circumstances that interfere with their ability perform their academic work may request an incomplete grade from the instructor. While approval of such a request is not automatic, it is expected that faculty will make every effort to accommodate students dealing with illness in the family and other pandemic-related hardships. The instructor and student must establish a timetable for submitting the unfinished work with a final deadline no later than the end of the third week of the Spring 2021 semester (**February 12, 2021**). Exceptions to this deadline require a petition from the instructor to the student's academic advising office by February 12, 2021. When entering an Incomplete grade in SIS, faculty must include a reversion grade which represents the grade the student will receive if s/he does not complete the missing work by the agreed-upon deadline.

Deadlines for Adding, Dropping and Withdrawing from Courses

Students may add a course up to **September 11, 2020**. They may drop courses up to **October 12, 2020** provided they remain registered for a minimum of 12 credits. Between

October 12 and November 13, 2020, a student may withdraw from a course with a W on their academic record. A record of the course will remain on the academic record with a W appearing in the grade column to indicate that the student registered and then withdrew from the course.

For more information on these and other academic policies, see https://e-catalogue.jhu.edu/engineering/full-time-residential-programs/undergraduate-policies/academic-policies/grading-policies/