



LGST 299/799

Blockchain, Cryptocurrency, and Distributed Ledger Technology

Fall 2018 Syllabus

Overview

The meteoric rise of cryptocurrencies such as Bitcoin and Ethereum has attracted huge attention, as well as money and talent, to the blockchain and distributed ledger technology space. At a broad level, this is the first technology platform that seemingly enables trust without government or religion. It offers a radically new value proposition and enables applications that seek to disrupt every industry from commercial contracts to supply chains to financial instruments. At the same time, there are major concerns about speculation, business adoption, fraud, regulatory compliance, criminal activity, user experience, governance, and other challenges. This course examines the foundations of blockchain technology from multiple perspectives, including engineering, law, and economics. It is designed to provide students with an understanding of key concepts and developments. Co-taught by instructors from Wharton and SEAS, it will heavily feature interactive activities and group project work among students from different backgrounds.

Instructors

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Learning Objectives

This is a new, experimental, interdisciplinary course. It addresses a field that is developing very rapidly. You may be interested for a variety of reasons, ranging from philosophical curiosity to day-trading cryptocurrencies to seeking a job at a major technology vendor. Our philosophy is we should teach something more than you can get from dozens of "introduction to blockchain" websites and videos out there. The course is interactive project-based. Please only sign up if you are committed to participating actively and contributing to a shared learning experience for all of us.

At the end of this course, you should be able to:

1. Explain the essential features of blockchain, cryptocurrency, and distributed ledger technology.
2. Take a reasoned position on claims about blockchain-related technology.
3. Evaluate potential use cases from a business, legal, and engineering perspective.
4. Understand major developments related to blockchain and cryptocurrencies.

Materials

- Narayanan et al, [Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction](#) (2016)
- Kevin Werbach, [The Blockchain and the New Architecture of Trust](#) (forthcoming 2018; page proofs will be provided)
- Coursepack available from Study.net. (Most materials are available for free via hyperlinks from the syllabus.)

Course Requirements and Grading

The course is open to both undergraduate and masters-level students from both Wharton and SEAS. It does not require any technical skills, finance knowledge, or prior experience with cryptocurrencies. However, any of the above are welcome!

Project (40%)

- You will be assigned to a team of approximately 5 students, and given a cryptocurrency or distributed-ledger project to evaluate. (We will do our best to organize teams and assign projects based on your skills and interests.)
- By the end of the course, your team must produce a case study assessing the project. A framework and other materials to structure your report will be provided.
- The project will include both group and individual submissions throughout the course of the semester, as well as a peer feedback score for group members.

Online Quizzes (10%)

- There will be a brief, graded multiple-choice quiz administered every week via Canvas, focused primarily on the readings and other pre-class assignments.

Independent Activities (30%)

- You will be provided with a list of possible assignments. You must complete at least three of them: one by September 30, one by October 31, and one by November 30. Which assignments you complete, in what order, is up to you, although many of the assignments are best done after class sessions covering relevant material.
- You may also contact the professors to propose alternate assignments of your own design. With approval, these will receive equivalent credit.
- You may submit your work to Canvas in your choice of formats: written essay, narrated slide deck, video, etc. At least one of your assignments must also be submitted via a public online channel, such as a blog, YouTube video, or Reddit comment. Identify the public posting location in your Canvas submission.
- If you complete more than one assignment before the relevant deadline, you will receive the highest score.

Participation (20%)

- We will assess your overall contribution to the course, including comments in class, involvement in the group project, and posts to online discussion boards. Pre-class preparation assignments listed in the syllabus also count toward your participation score.

There is no final exam.

Syllabus

Note: We reserve the right to adapt on the fly to maximize the quality of the student experience. This is a new and very fast-developing area. There may be significant developments between the creation of this syllabus and the start of the course, or even during the course.

8/28	Down the Rabbit Hole <ul style="list-style-type: none"> - Course Overview - Basic concepts - Map of the landscape 	<u>Assignments</u> Submit individual pre-class survey of interests and knowledge. <u>Watch Videos</u> How Blockchains Could Change the World James Altucher predicts bitcoin will reach \$1 million by 2020 Nouriel Roubini Says Bitcoin “Much Worse” Than Tulip Mania
8/30	Trust <ul style="list-style-type: none"> - The need for trust - Forms of trust - The problem space for blockchain 	<u>Read</u> Werbach, Chapter 1
9/4	Cryptography <ul style="list-style-type: none"> - Information security as a form of trust - Public and private keys - Digital signatures - Hashing 	<u>Read</u> Lisk Academy: Cryptography, Digital Signatures, Hashing Narayanan et al, Chapter 1
9/6	Money <ul style="list-style-type: none"> - Money as a form of trust - What is money, really? - Financial history - What’s wrong with the money we had? 	<u>Read</u> Martin, Chapter 1 Narayanan et al, Preface
9/11	Blockchain <ul style="list-style-type: none"> - Ledgers - Databases - Distributed systems - Hash-linked chains - Hard and soft forks - Blockchain as new form of trust 	<u>Read</u> Haber & Stornetta, How to Time-Stamp a Digital Document Lisk Academy: Nodes, Peer to Peer Network Berg et al, The Blockchain Economy
9/13	Bitcoin <ul style="list-style-type: none"> - How Bitcoin achieves trust - Proof of work consensus - History of Bitcoin development - Bitcoin’s significance 	<u>Read</u> Narayanan et al, Chapter 2 Bitcoin Whitepaper Andreessen, Why Bitcoin Matters
9/18	Cryptocurrencies <ul style="list-style-type: none"> - Altcoins, sidechains, merge mining - Ethereum and Bitcoin 2.0 - Major cryptocurrency networks - Wallets and exchanges - ERC 20 and the token explosion 	<u>Read</u> Werbach, Chapter 3 Kasireddy, How Does Ethereum Work, Anyway? Coindesk, State of Blockchain , Chapter 2: Public Blockchains
9/20	Cryptoeconomics <ul style="list-style-type: none"> - Tokens as incentives - Cryptocurrency mechanism design - Rethinking the firm 	<u>Assignment</u> Rank your top three requests for project case studies, explain your reasons, and identify what you uniquely bring to the table.

	<ul style="list-style-type: none"> - Mining - Non-fungible tokens 	<p><u>Read</u> Werbach, Chapter 5 Dixon, Crypto Tokens: A Breakthrough in Open Network Design Stark, Making Sense of "Cryptoeconomics" Narayanan et al, Chapter 5</p>
9/25	<p>From Concept to Reality</p> <ul style="list-style-type: none"> - When do you really need a blockchain? - Case study example 	<p><u>Read</u> Maersk, Betting on Blockchain Iansiti & Lakhani, The Truth About Blockchain Stinchcombe, Nobody Has Come Up With a Use for Blockchain Stinchcome, Blockchain Is Not Only Crappy Tech but a Bad Vision Case study evaluation framework</p>
9/27	<p>Project Initiation</p> <ul style="list-style-type: none"> - Initial meeting of teams - Introduction to case framework - Assignment of case studies 	<p><u>Read</u> World Economic Forum, Blockchain Beyond the Hype McKinsey, Blockchain Beyond the Hype</p>
10/2	<p>The Challenge of Consensus</p> <ul style="list-style-type: none"> - Concerns about proof of work - Proof of stake - Alternative consensus protocols - Are cryptocurrencies viable long-term? 	<p><u>Read</u> Cachin & Vukolic, Blockchain Consensus Protocols in the Wild Buterin, What Proof of Stake is and Why it Matters BIS, Cryptocurrencies: Looking Beyond the Hype</p>
(10/4)	Fall Break -- no class	Begin Cryptozombies lessons
10/9	<p>Smart Contracts in Concept</p> <ul style="list-style-type: none"> - History of smart contracts - Implementation in blockchain networks - Legal concept of contracts - Economic concept of contracts - Smart contract failures, and responses 	<p><u>Read</u> Szabo, Formalizing and Securing Relationships on Public Networks Werbach & Cornell, Contracts Ex Machina, pp. 313-52</p>
10/11	<p>Smart Contracts in Practice</p> <ul style="list-style-type: none"> - Coding smart contracts - What is going on under the hood - Rigidity of coding versus nuance of law 	<p><u>Assignment</u> Complete Cryptozombies lessons prior to class</p>
10/16	<p>Enterprise DLT platforms</p> <ul style="list-style-type: none"> - Blockchain vs. distributed ledger - Hyperledger, R3, Enterprise Ethereum 	<p><u>Read</u> Swanson, Consensus-as-a-Service Valenta & Sandner, Comparison of Ethereum, Hyperledger, Corda Coindesk, State of Blockchain, Chapter 3: Enterprise Blockchains</p>
10/18	<p>DLT Implementation</p> <ul style="list-style-type: none"> - Consortia and other DLT structures - Industry applications - Business value proposition - Practical challenges 	<p><u>Read</u> Hileman, Global Blockchain Benchmarking Survey 2017, pp. 20-50 Catalini & Gans, Some Simple Economics of the Blockchain</p>
10/23	<p>Project Update</p> <ul style="list-style-type: none"> - Preliminary reports on group projects - Feedback sessions in GSRs 	<p><u>Group Assignment</u> Submit project update document.</p>

10/25	Token Offerings <ul style="list-style-type: none"> - Tokens as a funding mechanism - The ICO phenomenon - Regulatory questions - The rise of security tokens 	<u>Read</u> PWC, ICOs: A Strategic Perspective Srinivasan, Thoughts on Tokens K&L Gates, ICOs: Hottest Thing in FinTech and a Trap for the Unwary SEC, Howeycoins white paper
10/30	Blockchain Meets Law <ul style="list-style-type: none"> - Illegal activity - Regulation of cryptocurrency services - Tax issues - Global and state-level approaches - Code vs. Law 	<u>Read</u> Werbach, Chapters 8-9
11/1	Privacy <ul style="list-style-type: none"> - Anonymity vs. pseudonymity - Tumblers and mixers - Privacy coins - Anti-money laundering rules 	<u>Read</u> Narayanan et al, Chapter 6
11/6	Identity <ul style="list-style-type: none"> - Centralized identity systems - Public key infrastructure - Name services - Self-sovereign identity 	<u>Assignment</u> Get an ENS address and write about your experience <u>Read</u> Olshansky, Do Blockchains Have Anything to Offer Identity? Allen, The Path to Self-Sovereign Identity Ali et al, Blockstack: A Global Naming and Storage System
11/8	Governance <ul style="list-style-type: none"> - Political theory of governance - Economic governance - Cryptocurrency governance battles - On-chain governance 	<u>Read</u> Werbach, Chapter 7 De Filippi et al, The Invisible Politics of Bitcoin Buterin, Notes on Blockchain Governance
11/13	Cryptoassets <ul style="list-style-type: none"> - The rise of crypto trading markets - Cryptoasset valuation models - Asset-backed tokenization - Centralized and distributed exchanges - Stablecoins 	<u>Read</u> Burniske, Cryptoasset Valuations Lannquist, Today's Crypto Asset Valuation Frameworks Greco, Move Over Crypto-Enthusiasts, Wall St. Will Take it From Here McKeon, The Security Token Thesis
11/15	Decentralizing & Re-Decentralizing <ul style="list-style-type: none"> - The value of decentralization - The fat protocol thesis - Re-decentralizing the internet 	<u>Read</u> Monegro, Fat Protocols Dixon, Why Decentralization Matters Werbach, Chapter 11
11/20	Scaling <ul style="list-style-type: none"> - Cryptocurrency scaling challenges - The Bitcoin block size war - Sidechains and interoperability - Sharding - Layer 2 approaches 	<u>Read</u> Hearn, The Resolution of the Bitcoin Experiment Croman et al, On Scaling Decentralized Blockchains Chester, Your Guide on Bitcoin's Lightning Network

(11/22)	Thanksgiving -- No Class	
11/27	Presentations 1 - Class-only poster session	<u>Group Assignment</u> Submit project report.
11/29	Presentations 2 - Poster session for Penn and broader community	
12/4	Emerging Issues - Something new is bound to happen!	Readings TBA
12/6	Where Do We Go From Here - Future scenarios - Course feedback and review	Readings TBA <u>Assignment</u> Individual project reflection.

Classroom Expectations and Participation

- Please arrive on time.
- Bring a name tent and display it for each class.
- Turn off all electronic devices not used for active note-taking.
- Be prepared to contribute to the class discussion.

Participation is your responsibility. Prepare for class. Raise your hand, and make comments that show engagement with the readings and course concepts. Don't be afraid to make a mistake or take a stand. That's how learning happens.

The course is interactive, so it won't be as successful (nor will you) if students are frequently absent. That being said, we all face tradeoffs in life. We recognize students sometimes miss class for understandable but unexcused reasons such as recruiting. Your grade will reflect your overall level of participation; active, high-quality contributions will counterbalance an occasional absence.

There is no way to "make up" a class. Also, you do not need to contact us in advance or afterwards to explain an un-excused absence (i.e., not involving a medical issue, obligatory university/athletic trip, or family/personal emergency.) If you believe your absence should be excused, please email an explanation and, where possible, documentation. Video recordings will be available on Canvas; however, these will not always be useful when the class involves an interactive group activity.

We will ask you to bring a laptop to class for certain activities involving live interaction with blockchains and cryptocurrencies. However, we will observe the Wharton MBA Program's policy on student use of electronic devices in the classroom:

- Phones must be turned off and put away. If a student must keep a phone on by reason of a personal emergency, the student must inform the instructor before class begins.
- The use of laptops and tablets is allowed only for educational purposes (e.g., note taking, reading, or data analysis).

Violations of the rules will be reflected in the class participation aspect of the course grade.

Instructor Bios

Kevin Werbach is a Professor of Legal Studies and Business Ethics at Wharton. His work examines the intersection of business, policy, and emerging technologies in areas such as broadband, big data, and blockchain. Werbach served on the Obama Administration's Presidential Transition Team, founded the Supernova Group (a technology conference and consulting firm), helped develop the U.S. government's approach to internet policy during the Clinton Administration, and created one of the most successful massive open online courses, with over 450,000 enrollments. His books include For the Win: How Game Thinking Can Revolutionize Your Business and the forthcoming The Blockchain and the New Architecture of Trust.

David Crosbie trained as Engineer at Oxford University, received an MBA from Insead, has worked from the jungles of Borneo to the board rooms of Wall Street, and successfully founded three venture funded technology companies (adero, Bluesocket, and Leostream). David is an experienced practitioner of the "lean development" model, where the "minimum viable solution" is developed and tested with real customers in order to determine the viability of the company strategy and the product design. David successfully "bootstrapped" Leostream and exited as it was successfully selling mission critical software to an enviable roster of Fortune 500s, Wall Street banks, and other clients. David also has extensive experience in establishing and foster successful partnerships with a wide range of organizations.