Introduction to Blockchain and Cryptocurrencies
MBA and EMBA classes, Columbia Business School
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This course will introduce the fundamental building blocks of blockchain technology as well as its application in cryptocurrencies, decentralized finance and enterprise networks. It will begin by covering the fundamentals of money, banking, and payment systems, as well as relevant areas of computer science such as cryptography and distributed systems. It will dive into both blockchain and Bitcoin, as well as other decentralized platforms. It will cover smart contracts and tokens, and their most contemporary applications in the areas of stablecoins, central bank digital currencies and decentralized banking. The course will conclude with a focus on private networks for enterprise use-cases. There will be live demonstrations throughout the class and guest speakers from the industry.

Grading
Students will form groups and present two reports. For the midterm, they will use the building blocks they have learned about to imagine their own application. For the final, they will provide a comprehensive study of an existing project, with a focus on analytics. Both presentations will be graded based on student comprehension of what problem is solved, the economics of the solution, network governance and the road to adoption.
Active class participation will be rewarded with extra credit.
Greater detail on group formation and assignments will be provided once class sizes are known.

Course Outline:

Class 1 – Money, banking & payment systems

This session will provide theories on the origins of money and its history. It will cover the generally accepted functions of money as well as its characteristics. It will discuss the basics of banking and the design of payment systems.

Class 2 – Challenges of digitization, consensus, hash functions & symmetric cryptography

Laying the foundation for why blockchain technology was invented and how it functions, the primary focus of this class will be how distributed systems can reach consensus, and the technical concepts of hashing and basic cryptography.
Subsequently we'll discuss how blockchain was invented prior to Bitcoin, how it can be used to authenticate digital documents, and why doing so is a proper foundation for a decentralized payment network. We'll conclude with a review of public key cryptography.

Class 3 Bitcoin

All of the technical concepts learned so far will be used to understand the invention and working of Bitcoin. The focus will be on the use of economic incentives, mining, transaction fees and algorithmic inflation.

Class 4 Smart contracts & Ethereum

This session will cover conditional transactions as enabled by the second most prominent blockchain platform, tokens, and the notion of trustless computing.

Class 5 The user's perspective; vulnerabilities

This session will cover the different aspects of owning cryptocurrency and interacting with a blockchain, including buying and selling, wallets, and the dangers of a digital bearer asset. We will also discuss the risks and tradeoffs of decentralized networks, including possible attack vectors and 51% attacks, with a review of several successful breaches. Soft and hard forks will be covered.

Class 6 Midterm presentations

Class 7 Stablecoins

This class will cover the history of blockchain applied to fiat currency, the difference between token and ledger money, similarities and differences with existing payment solutions, and the possible disruption of the payments industry.

Class 8 Libra & central bank digital currencies GH

This session will begin with the Facebook led initiative and how it differs from existing stablecoins. It will also cover the difference between public and private money and various designs for central bank digital currencies.

Class 9 Decentralized finance; Tokenization of capital markets

This session will cover decentralized applications for credit creation, money markets and synthetic assets on the Ethereum blockchain, with a deep dive into MakerDao, a decentralized bank. We will then switch gears and cover capital market applications of blockchain technology, including new fundraising models, initial coin offerings and the tokenization of existing assets.

Class 10 Permissioned blockchain

This class will pivot to private and permissioned blockchains. It will first review differences with public chains, BFT and confidential transactions. It will conclude with a review of the most common protocols available for use today.

Class 11 Enterprise applications

This class will review existing enterprise applications of blockchain technology and discuss both challenges and opportunities. The focus will be on what problems such networks solve, data models and the challenges of building new consortia.

Class 12 Student presentations