

Blockchain and Cryptocurrencies

Professors: Dr. Gabriel Rodríguez Garnica and Dr. David Tercero Lucas

Office hours: By Appointment

Course Type: Elective

Credits: 4 ECTS

Term: Second Term, 2024

Course description

Blockchain is a disruptive foundation technology that enables complex use cases where a single source of truth is needed. Blockchain and Distributed Ledger Technologies are fundamental in the development of cryptocurrencies, tokenised trading solutions and in enterprise blockchain solutions. These solutions will be core components of the next evolution of financial market infrastructure that will reshape financial markets and transform economies.

Enterprise blockchain solutions can transform business relationships through increased trust, allow for the reinvention of products and business processes, and dramatically reduces operating costs and deliver new business value. Enterprise blockchain solutions are still in the early stages of development but the emerging use cases are already demonstrating significant value, and the collaboration within the blockchain community generating rapid progress in both the open source and commercial software communities.

This course will examine the fundamental technologies that make up blockchain solutions, review dominant blockchain platforms, and will examine how these technologies are being used to deliver real business value. Students will examine the importance of blockchain, non-stable cryptocurrencies, stablecoins and Central Bank Digital Currencies, apart from analysing the relevance of DeFi, NFTs and Initial Coin Offerings.

Objectives

This course demonstrates the development of a new system of data storage that will dramatically impact not only financial services and the underlying infrastructure of financial markets, but other non-financial markets. The course will examine the fundamentals of blockchain enabled assets and discuss how to develop enterprise blockchain solutions. The course will also allow students to have a perfect understanding of the whole crypto market, including not only non-stable cryptocurrencies such as Bitcoin but also utility tokens, initial coin offerings, stablecoins, and Central Bank Digital Currencies (CBDCs). The course will help the student to understand how blockchain solutions are integrated into existing and new enterprise services as well as in new markets.

Methodology

This class will use mixture of lectures (in person), tutorials and demonstrations to explain the fundamental concepts of blockchain solutions and cryptocurrencies. The course material will provide a wider context.

Evaluation Criteria

Students will primarily be evaluated in their ability to understand the material covered in class, analysing specific white papers of some cryptocurrencies and presenting some case studies.

Students will be assessed in four ways:

- Participation, short assignments, and attendance (30%). Summary of 1 white paper, short assignments (individual) or quick tests in class after a lesson.
- Case study I (25%). Business idea of blockchain uses in the market (in groups).
- Case study II (25%). Report and presentation. Choosing a country and design a CBDC for that specific country (arguments in favour and against) (in groups).
- Final test (20%).

Students are required to attend 80% of classes. Failing to do so without justified reason will imply a Zero grade in the participation/attendance evaluation item and may lead to suspension from the program. Any student that fails to submit any of the assessment items will receive a failing grade. Late submissions of any assessment items will also attract a late penalty to the awarded grade.

Students who fail the course during the regular evaluation are allowed ONE re-take of the evaluation, in the conditions specified above. If the course is again failed after the retake, the student will have to register again for the course the following year.

In case of a justified no-show to an exam, the student must inform the corresponding faculty member and the director(s) of the program so that they study the possibility of rescheduling the exam (one possibility being during the “Retake” period). In the meantime, the student will get an “incomplete”, which will be replaced by the actual grade after the final exam is taken. The “incomplete” will not be reflected on the student’s Academic Transcript.

Plagiarism is to use another’s work and to present it as one’s own without acknowledging the sources in the correct way. All essays, reports or projects handed in by a student must be original work completed by the student. By enrolling at any UPF BSM Master of Science and signing the “Honor Code,” students acknowledge that they understand the schools’ policy on plagiarism and certify that all course assignments will be their own work, except where indicated by correct referencing. Failing to do so may result in automatic expulsion from the program.”

Contents

Topic 1. A primer on Blockchain and Cryptocurrencies

- a. What is a DLT?
- b. Types of blockchain; permissioned vs permissionless.
- c. Mining. Consensus mechanisms: PoW vs PoS (and others: Proof of reserves). Energy consumption and security.
- d. Public and private keys. Digital signatures
- e. Cold vs Hot wallets
- f. Forks, disputes and code = law. Threats (attacks)
- g. Block explorers
- h. Types of cryptoassets: Crypto currencies, Security Tokens, Utility Tokens, Stable coins, Tokenized assets
- i. Smart contracts.
- j. Intro to crypto regulation.

Topic 2. Early Cryptocurrencies: Bitcoin and Ethereum

- a. History and functions of Money.
- b. Evolution of Cryptocurrencies: From the first Bitcoin “gold” rush to a long crypto winter.
- c. The survival of cryptocurrencies.
- d. Bitcoin
 - i. Satoshi Nakamoto whitepaper. Original purpose and main features.
 - ii. Bitcoin dominance and impact on the crypto market.
 - iii. Drawbacks
- e. Ethereum, more than a cryptocurrency
 - i. Ether: features and monetary policy.
 - ii. Smart contracts from Ethereum, possibilities, more than a coin, more than Bitcoin: the TOOL needed!
- f. Other major (old) altcoins: LTC, XRP, BNB
- g. Ethereum killers: ADA, SOL, DOT, AVAX
- h. Meme coins (Dogecoin).

Topic 3. Blockchain Use Cases: Tokenization, enterprise applications and financing.

- a. Tools for creating new tokens.
- b. Types of tokens: Security based tokens, utility tokens and others
- c. Connecting blockchain to the real world: Oracles.
- d. Enterprise/Blockchain applications in different industries (focus in finance industry):
 - i. Financial services
 - ii. Supply chain management
 - iii. Healthcare
 - iv. Other industries and applications
- e. Integration of blockchain into Business:
 - i. Real-world case studies: Success and failures.
 - ii. Benefits, opportunities and challenges
 - iii. TASK explanation: Business idea of blockchain uses in the market.
- f. Enterprise financing: ICOs, STOs, and whitepapers.

Topic 4. Stablecoins.

- a. Definition and use cases. The importance of stablecoins in DeFi.
- b. Capitalization and magnitude of stablecoins.
- c. Types of stablecoins:
 - i. Off-chain collateralized stablecoins.
 - ii. On-chain collateralized stablecoins.
 - iii. Algorithmic stablecoins.
- d. Are they really stable? A forensic analysis of stablecoins. Terra crash.
- e. Tether and the mystery of its reserves.
- f. USDC and other relevant stablecoins.
- g. Dollar dominance and the irrelevance of Euro-based stablecoins.
- h. Regulatory issues. MiCA.
- i. Fintech and stablecoins: From Facebook to PayPal.

Topic 5. Beyond Crypto: Initial Coin Offerings (ICOs – STOs), Decentralized Applications (Dapps) and Non-Fungible Tokens (NFTs).

- a. ICOs
 - i. Fundraising with ICOs.
 - ii. Risks and regulations.
- b. STOs.
- c. Ingredients to DeFi: Smart contracts, DApps, DAOs.
- d. DeFi: A special case of smart contracts
 - i. Characteristics.
 - ii. Governance mechanisms.
 - iii. Decentralized Applications.
 - iv. MakerDao.
 - v. DeFi attacks and Limitations.
- e. NFTs.

Topic 6. Central Bank Digital Currencies.

- a. Origins, definition and the money flower.
- b. CBDC design and possible features.
- c. Benefits, risks and concerns:
 - i. Financial stability considerations.
 - ii. Monetary policy considerations.
 - iii. Financial inclusion and payments efficiency.
 - iv. Privacy and technological considerations. Risks mitigation.
- d. CBDC projects:
 - i. Live CBDC projects: Bahamas, ECCB, Nigeria and Jamaica.
 - ii. Advanced pilots: E-Yuan, digital Rupee, digital real.
 - iii. Other projects in Europe: Digital pound and e-Krona.
 - iv. What is the USA doing?
- e. Digital Euro:
 - i. Key objectives and functions of a possible digital euro.
 - ii. Stakeholders.
 - iii. Phases of the digital euro project
- f. Conclusion: Are CBDCs doomed to fail?

Topic 7: Investment and trading.

- a. Approaches and models to cryptocurrency valuation.
- b. Price volatility
- c. Cryptocurrency Trading and Centralized and Decentralized Exchanges
- d. Investors. Types of investors and investors' identification (wallets).
- e. Blockchain analysis
- f. Investment opportunities and strategies
- g. Taxation of cryptocurrencies:
 - i. Tax compliance
 - ii. Reporting and record-keeping
 - iii. SEC vs Ripple

Topic 8. Further topics in digital currencies.

- a. Crypto investors in an international context.
- b. The importance of social media in crypto.
- c. The future of cryptocurrencies:
 - i. Where is the market going?
 - ii. Are CBDCs a threat?
 - iii. Will regulation destroy the market?
 - iv. Scalability issues
 - v. Present and future implications
 - vi. Opportunities and challenges
- d. CBDC debate and presentation.

Calendar

Session	Prof.	Content	Week	Time
1	GRG	A primer on Blockchain and Cryptocurrencies	8 Jan	4h
2	DTC	Early Cryptocurrencies: Bitcoin and Ethereum	11 and 12 Jan	4h
3	GRG	Blockchain Use Cases	22 Jan	4h
4	DTC	Stablecoins	29 Jan	4h
5	GRG	Beyond Crypto	5 Feb	4h
6	DTC	Central Bank Digital Currencies	12 Feb	4h
7	GRG	Investment and trading	19 Feb	3h
8	DTC	Further topics in digital currencies	26 Feb	3h

Bio of Professors

Gabriel Rodríguez Garnica is an Assistant Professor of Finance at Universidad Pontificia Comillas, ICADE Business School, Madrid. He earned his Ph.D. in Business and Finance from the University Carlos III Madrid (UC3M), received a FPU scholarship, and held a visiting position at Boston University, Questrom School of Business (BU). Professor Rodríguez Garnica's research interests focus on entrepreneurial finance and behavioral finance in the fields of alternative finance and FinTech markets, with a particular focus on crowdfunding, initial coin offerings, tokenization, and blockchain-enabled assets. He has taught various finance-related courses, including Financial Economics, Blockchain and Cryptocurrencies, FinTech, and Digital Finance, at the undergraduate, graduate and executive master's levels. He has also contributed to the book "The Emerald Handbook on Cryptoassets – Investment opportunities and challenges" aimed at academics and practitioners.

David Tercero Lucas holds a Ph.D. in Applied Economics from the Autonomous University of Barcelona. He is an Assistant Professor in the Department of Economics at Comillas Pontifical University – ICADE. Previously, he worked as an expert in payments and digital currencies at a Berlin-based consultancy company. During his doctoral studies, he conducted research stays at CREST (Center for Research in Economics and Statistics) in Paris, at Pablo de Olavide University in Seville, and at the International Policy Division of the European Central Bank (ECB) in Frankfurt. Additionally, he served as a technical advisor at the Bank for International Settlements (BIS). His research interests are in the fields of digital currencies (cryptocurrencies, stablecoins and CBDCs), payment systems, monetary economics and applied microeconomics. His academic work has been referenced in the Financial Times and The Economist, cited in working papers by the IMF, World Bank, Bank of Canada, and BIS, and published in international peer-reviewed research journals such as the Journal of Financial Stability and the European Journal of Political Economy. Prior to his Ph.D., he completed a Master's in International Economics at the Autonomous University of Madrid and a Master's in International Economic Policy at the Kiel Institute for the World Economy.