BARCELONA SCHOOL OF MANAGEMENT

Blockchain and Cryptocurrencies

Professor: Dr Craig Chatfield
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Office hours: By Appointment
Course Type: Elective
Credits: 4 ECTS
Term: Term Two, 2022

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 dominate blockchain platforms, and will examine how these technologies are being used to deliver real business value. Students will examine how blockchain components are integrated into business ecosystems, and will work through the development processes to they understand the design decisions that lead to successful business outcomes and identify the risks associated with different design choices and platform selections.

The course examines the most common business use cases and looks forward to future financial systems solutions that will define financial and business integration

systems in the 21st Century. Students will learn how the solutions integrate with traditional computing solutions, have access to experts that are developing real world solutions, and understand the power of analytics in realising the true value of enterprise blockchain solutions. The course will cover an introduction to common analytics approaches, help the students develop blockchain strategies for their solutions, and will provide a deep dive on existing blockchain analytics tools and approaches. This will cover real-time visibility strategies, look at IoT or AI integration with blockchain solutions, and will provide the students with some hands on experience working with common blockchain solutions and applications.

Objectives

This course demonstrates the development of a new system of data storage that will dramatically impact both financial services and the underlying infrastructure of financial markets. The course will examine the fundamentals of cryptocurrencies and discuss how to develop enterprise blockchain solutions. The course will help the student to understand how to integrate blockchain solutions into new markets, and will anchor the student's other studies by providing a real world look at how modern banking and financial services systems will be integrated into legacy enterprise systems.

Methodology

This class will use mixture of lectures (both online and in person), tutorials and demonstrations to explain the fundamental concepts of blockchain solutions and cryptocurrencies. The course material will provide a wider context to these solutions by considering enterprise blockchain solutions, and by looking at the approach required to develop, integrate and operate the solutions in a business context.

The course will assist the students in developing their own blockchain solution, and will provide opportunities to present their solution to the class and to a fictional business audience. Students are expected to demonstrate an understanding not only of the course material, but also of the market and competitors to the solution they develop in order to effectively communicate their solution's value.

The competences, the learning outcomes, the assessment elements and the quality of the learning process included in this Teaching Plan will not be affected if during

the academic trimester the teaching model has to switch either to a hybrid model (combination of face-to-face and on-line sessions) or to a complete on-line model.

Evaluation Criteria

Students will primarily be evaluated in their ability to apply the course material to a new enterprise blockchain solution that they will devise. They will develop the solution throughout the course and assessments will be based upon their development and presentation of this idea. Students will be assessed in four ways:

1. **Blockchain Solution Outline (10%).** Students will present the outline of their course and define the solution value and receive feedback from the class.
2. **Blockchain Analytics Strategy (20%).** Students will develop an analytics approach for their solution, and will define in the approach how data will be captured, utilised in their analytics solution, and what value the analytics process will bring.
3. **Blockchain Hands-on Tutorials (20%).** The blockchain tutorials will cover analytics and the development of an analytics strategy.
4. **Blockchain Strategy Presentation (50%).** Building on the previous assessments, this presentation will define the student's blockchain solution and the strategy for how it would be implemented in the real world. This pitch will cover the solution value, its architecture and development approach, and will sell the solution to a potential investor or future participant.

Students that fail the course will have the opportunity to resubmit the final Blockchain Strategy Presentation in order to make up a passing grade (but no higher grade would be possible for a resubmitted presentation). Any student that fails to submit any of the four assessment items will receive a failing grade. Late submissions of any assessment items will also attract a late penalty to the awarded grade.

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.

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."

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Calendar and Contents

Session	Content	Week
1	**Blockchain Fundamentals** • Blockchain / DLT Fundamentals (including encryption and high-level overview) • Blockchain Platforms • Blockchain Components (Tokens, Oracles, Smart Contracts)	1
2	**Blockchain Solutions** • Blockchain Solution Types (Public or Private Systems, Permissioned or Permissionless Ecosystems) • Blockchain Architectures and Data Architectures • Cryptocurrencies and Blockchain Mining	2
3	**Enterprise Blockchain Use Cases** • Enterprise Blockchain Solutions (Identity, Supply Chain, Financial Services, Digital Objects) • Government Use Cases (Healthcare, Identity and Education) • Financial Systems (Asset Management, Payments, Insurance, De-Fi) • Digital Twin and Supply Chain	3
4	**Cryptocurrencies, Stablecoins and Central Bank Digital Currencies (CBDC)** • Cryptocurrencies • Stable Coins • Central Bank Digital Currencies • Delivery versus Payment Approaches	4
5	**Decentralised Finance & Central Bank Digital Currencies** • Remaking of Digital Money through CBDCs i. CBDC Solution Value ii. Development Considerations iii. Common Architectures (Retail and Wholesale CBDC)	5

	iv. Ecosystem Development (CBDCs) • Decentralised Finance (De-Fi) Projects i. De-Fi Architectures ii. Public Network Development	
6	**Blockchain Enterprise System Development** • Blockchain Solution Value • Ecosystem Partner Selection • Blockchain Development • Blockchain Integration Frameworks	6
7	**Blockchain Solution Definitions** • Solution Definitions and Project Approaches • Ecosystem Governance • Data Architecture, Privacy and Security • Solution Value and Trust Assessment • Blockchain Solution Development	7
8	**Blockchain Solution Tutorial**	7
9	**Student Presentations and Feedback**	7
10	**Introduction to Blockchain Analytics** • NLP on Blockchain Whitepapers Demo • Common Analytics Approaches • Common Blockchain Analytics Solutions & Services	7
11	**Blockchain Analytics Deep-Dive** • Real-Time visibility i. CBDC Demo • Chain Analysis i. Definition and common applications ii. Network Analysis fundamentals iii. Blockchain Explorers (including Hyperledger Explorer) • IoT Integration i. Track & Trace • Analytics and AI i. Federated Learning	8

	ii. Trading cryptos with Reinforcement Learning	
12	**Blockchain Analytics Tutorial** • Transacting in a Blockchain i. Transacting Ether ii. Searching in Blockchain Explorers • DAPPs i. Context ii. Review of a smart contract iii. DAPPs powered with Analytics iv. Biding on an NFT	9
13	**Blockchain Analytics and Development Tutorial**	10
14	**Blockchain Analytics and Development Tutorial**	11
15	**Blockchain Solution Tutorial**	12

All course sessions will be 2 hours long. Week 7 will have four class sessions including a student presentation session. Please note the course session dates and delivery order detailed above is tentative and will be verified prior to the course commencing.

Reading Materials/ Bibliography/Resources

Bank of International Settlement (BIS) Annual Economic Report, 23 June 2021. 'CBDCs: an opportunity for the monetary system'. https://www.bis.org/publ/arpdf/ar2021e3.pdf

Bank of International Settlement (BIS) April 2012. 'Principles for Financial Market Infrastructure' https://www.bis.org/cpmi/publ/d101a.pdf

WEF July 2019. 'Building Value with Blockchain Technology: How to Evaluate Blockchain's Benefits'. http://www3.weforum.org/docs/WEF_Building_Value_with_Blockchain.pdf

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Bio of Professor

Craig Chatfield has extensive research and architecture experience in enterprise systems, service personalisation, security solutions and user privacy. Since completing his PhD Craig has worked for over 10 years as an enterprise solution and security architect, and has spent the last four years as a Blockchain Architect working for top tier global financial services and market infrastructure organisations. He has experience developing identity, digital assets, payments, and supply chain blockchain solutions across a wide range of industries.

Sandra Orozco is a Senior Data Scientist at Accenture Applied Intelligence. She holds a master's degree in Statistics and Operations Research as well as a master's degree in Industrial Engineering (Universitat Politècnica de Catalunya, UPC). Her main area of expertise is Operations Research related to Supply Chain & Operations. She has more than 4 years of experience on the translation of real-world problems into mathematical or conceptual models and their implementation through linear programming and metaheuristics. She is very keen of innovation, lecturing at the BGSE and developing analytics use cases related to Blockchain and IoT.

Adrià Thorson is a Senior Data Scientist at Accenture Applied Intelligence. He holds a bachelor's degree in Statistics (Universitat Politècnica de Catalunya, UPC) as well as a bachelor's degree in Economics (Universitat de Barcelona, UB). His main area of expertise is Data Science applied to the Supply Chain. He has more than 3 years of experience on the implementation of Heuristics and Machine Learning to solve actual business needs, specially related to the variability of Supply Chains. Adrià is also deeply involved in the Blockchain world. On one hand he is an active member of the Innovation team within Accenture where several Blockchain solutions have been built. On the other, he has been lecturing about Blockchain Dapp Development for several years at the BGSE.