Universität Zürich[UZH]

UZH Blockchain Center

Syllabus

Blockchain and Crypto-economics

03SM22MI0036

Prof. Dr Claudio J. Tessone

Autumn Semester 2023

Blockchain & Distributed Ledger Technologies
Department of Informatics (IfI)
University of Zurich, Switzerland

PREAMBLE

Welcome

This course takes place every Fall Semester. You will find all necessary information concerning the course within this Syllabus. From time to time, updates will be communicated on MS Teams and on the Blockchain & Distributed Ledger Technologies Group's webpage at IfI (http://www.ifi.uzh.ch/bdlt).

We are very happy to welcome you to our lecture.

Prof. Dr Claudio J. Tessone
Blockchain & Distributed Ledger Technologies Group
Department of Informatics
Faculty of Business, Economics, and Informatics
University of Zurich

QUICK OVERVIEW

Module coordinator

- Prof. Dr Claudio J. Tessone

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  Switzerland

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  Webpage: https://www.ifi.uzh.ch/en/bdlt/Team/Tessone.html

Meetings are online (MS Teams, or equivalent) after previous appointment

Instructors

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Teaching Assistants

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Details

Type: Lecture

Target Audience: This course is acknowledged for MSc and MA students and is assigned to the Core elective areas „Wahlpflichtbereich”:

- MSc in Informatics (Major 90 ECTS, RVO22) - Data Science Major: Core Elective Area
- MSc in Informatics (Major 90 ECTS, RVO22) - Information Systems: Core Elective Area
- MSc in Informatics (Major 90 ECTS, RVO22) - Artificial Intelligence: Elective Area
- MSc in Informatics (Major 90 ECTS, RVO22) - Software Systems: Elective Area
- MA in Data Science (Minor 30 ECTS, RVO22) - Data Science: Core Elective Area
- MSc in Informatics (Minor 30 ECTS, RVO22) - Data Science: Core Elective Area

- MA in Informatics (Minor 30 ECTS) - Information Systems (RVO16) and Informatics (RVO22): Elective Area INF

- MA in Business and Economics (Minor 30 ECTS), MSc Faculty of Science

Frequency: Each Autumn Semester
AP: 6 ECTS
Language: English

Prerequisites

Programming skills in any of the popular general purpose programming languages (C++, Java, Python). Optional experience in Web technologies (HTML, CSS, JavaScript) for building Web applications.

Content:

This course aims to give students a fundamental overview of a set of Blockchains and Crypto Economic concepts and incentives. Much is spoken about the trading markets around cryptocurrencies and other tokenized assets. However, little is discussed about different economic and social aspects that enable the functioning of blockchain- based systems. Thus, this course overviews the incentive schemes embedded at different levels that ultimately determine the long-term functioning of these systems and digs into real-world use-cases of this technology, critically analysing the suitability of their implementation within each context.

Grading:

Assignments + Final Written Exam.

Further information:

https://www.ifi.uzh.ch/en/bdlt/Teaching/Blockchain-and-Crypto-Economics.html

Registration:

Through the registration tools at the University of Zurich.

1. Introduction and Objectives

This course is designed as a combination of theoretical and practical sessions to provide first-hand experience in employing decentralized applications on the most popular blockchain protocols, including Bitcoin, Ethereum, Cardano, IOTA, Polkadot, among many others.

During the hands-on practical sessions, students will be given theoretical and technical guidance and technical infrastructure such as forks of before-mentioned blockchains to work on a set of practical exercises as mini-projects on their own deploying or developing decentralized applications on platforms akin to the original ones. Examples of these platforms include Decentralised Finance (DeFi) protocols (like UniSwap, SushiSwap, or Aave), using Smart Contract functionalities on Ethereum or other blockchains, deployment of second-layer solutions, forking and development of own blockchains, and deployment of monitoring tools. Based on the theoretical and technical concepts covered in sufficient detail, students will be able to start working on their own projects.

Prior programming knowledge and experience are required, not necessarily in blockchain technologies. During their project work, students are expected to develop and deploy their selected applications in two different protocols, followed by critically assessing all relevant technical aspects of their developed application within a comparative fashion.

Students will assess the usability of decentralised applications compared to centralised solutions and provide an in-depth comparison of the technical and efficiency differences of employed blockchains.

2. Course Contents

LECTURE 1. Introduction to blockchains, Cryptoeconomics, and Consensus, Bitcoin Hands-on (CT, NV) [19.09.23]

- Introduction to blockchains and crypto-economics
- UTXO model: Transactions and ledger structure
- Consensus mechanism: Proof-of-Work
- Incentives
- Mining

LECTURE 2. Bitcoin and Derivatives (NV) [26.09.23]

- Supply policy
- Data Structure
- Privacy model: pseudo-anonymity
- User identification
- Bitcoin derivatives and forks

LECTURE 3. Ethereum (SR) [03.10.23 - 10.10.23]

- Transactions and ledger structure
- Consensus mechanism: Proof-of-Work
- Incentives
- Supply policy
- Data Structure
- User identification
- Script Language / Smart Contracts

LECTURE 4. Tokens and Stablecoins and NFTs (CT, SR) [10.10.23]

- Overview of token types
- NFTs and NFT marketplaces
- Price volatility of tokens
- Introduction to stablecoins
- Overview of stablecoin types

LECTURE 5. Decentralised Finance (DeFi) (SR) [17.10.23]

- Introduction
- Use cases
- De-/centralised Exchange systems
- Automated Market Makers

LECTURE 6. Governance and DAOs (SR) [24.10.23]

- Overview of Ethereum forks history

- Governance in Blockchains
- The DAO

LECTURE 7. Proof-of-Stake based Blockchains (SNL, MC) [31.10.23]

- Introduction to Algorand, Tezos, Cardano, and Ethereum "The Merge"
- Consensus mechanism: Proof-of-Stake variants
- Incentives
- Tokenomics
- Governance
- Hands-on on Cardano

LECTURE 8. Directed Acyclic Graphs (DAG) Ledgers (SNL) [07.11.23]

- Introduction to DAG-based ledgers
- Hashgraph Consensus mechanism
- IOTA Consensus protocol

LECTURE 9. Layer 2 Scaling Solutions (SR, MY) [14.11.23]

- Incentives
- Introduction to ZK-Rollups
- Introduction to Optimistic Rollups
- Sidechains
- Plasma
- State Channels

LECTURE 10. Layer-0 Blockchains (SNL) [21.11.23]

- Introduction to Cosmos
- Introduction to Polkadot
- Consensus mechanisms
- Incentives
- Governance

LECTURE 11. Other Blockchains (MP) [28.11.23]

- Introduction to Ripple and Stellar
- Transactions and ledger structure
- Consensus mechanism
- Incentives
- Supply policy
- Data Structure
- Script Language / Smart Contracts
- Governance

LECTURE 12. Adversarial Attacks (SNL) [28.11.23]

- Introduction to adversarial attacks
- Bitcoin case: 51% attacks
- Bitcoin case: selfish mining
- Ethereum case: NFT Wash trading

LECTURE 13. Blockchain Analytics (CT) [05.12.23]

- Data analytics of cryptocurrencies

Final Exam [19.12.23]

3. Course Material

Material Offered

Students have access to a Team specifically created on OLAT to download the slides presented in class, find relevant material, datasets and literature.

The following procedure is strongly recommended as preparation for the classes.

Overview of classes

On the webpage an overview of all classes given by our team can be found. Develop an idea of the classes and how they best fit into your personal agenda. Keep in mind that network science classes are only offered once a year.

Syllabus

For each course, a detailed syllabus exists with all details concerning that specific course. This is your guideline for the class and a MUST read. You'll find everything in here concerning the grading of the course, the agenda, the planned topics and much more...
The main materials used in this course are Bibliography and the Slides.

The Slides

The slides presented and discussed in class are available in a digital format. You can download the slides for each class. The slides do not completely cover the entire Syllabus; therefore, it is necessary to participate in the class. All slides will be distributed after each module. All our slides follow our detailed standardised slide format. All presentations in the classroom also have to follow this format.

All course slides, recordings of the lectures, the assignments (and sample solutions after their due date) will be given on a dedicated Team on MS Teams communicated to all students.

4. Reading

Bibliography

- Antonopoulos, Andreas M. Mastering Bitcoin: unlocking digital cryptocurrencies. " O'Reilly Media, Inc.", 2014.
- Mastering Ethereum by Antonopoulos A.M., Wood G. (O'Reilly Media): https://github.com/ethereumbook/ethereumbook

Related scientific journals

- Ledger
- Frontiers in Blockchain

5. Application Procedure

Please enrol to the course using the usual UZH planning tools. In case of doubts, contact the instructor of the booking service of the Faculty.

E-Mail: modulbuchung@oec.uzh.ch

6. Evaluation

6.1 Active participation in class

Credits are awarded for thoughtful and active participation in class and in discussions throughout the course. Credits will be given for knowledge of readings, cogent articulation of arguments and comments, and contribution to case discussion. Participation will be

evaluated for quality as well as consistency. Attending the class and the exercises regularly and on time is an indication of professionalism and will also improve your participation grade.

6.2 Practical hands-on sessions

All the hands-ons are mandatory to participate. Do the readings, follow our instructions and answer questions in the related assignments. These hands-on sessions share the 40% of their final grade.

6.3 Final exam

A written final exam will be held on 19 December 2023, 12 – 14h. The exam will account for 60% of the final grade. The topics of the exam will be the ones covered during the theoretical lectures in the classroom.

7. Academic Fraud

The Code of Honour of the University of Zurich applies to all work in this course and will be strictly enforced. The intent of the Honour Code in this course is to ensure that each student claims and receives credits for his/her own efforts. Violations to this are considered academic fraud.

Definition

Academic fraud is an act by a student, which may result in a false academic evaluation of that student or of another student. Plagiarism is understood as the use or imitation of another people's work, either wholly or partially, without acknowledging the source and the author. In principle, plagiarism is an infringement of copyright law. Short passages from another author may be quoted.

All documents you will hand-in are going to be checked by software and manually for plagiarism. Documents with a score above 10% are going to be intensively validated and in suspicious cases we hand-out penalties for fraud behaviour.

8. Administrative Comments

8.1 Course format

Lectures. As of 19.09.2023, all lectures will be held onsite.

8.2 Getting in contact with us

- The first option for you is to contact us on the General Channel on MS Teams (and eventually other channels when appropriate) if the question is relevant to all students. This channel is there for you to post questions, and we will strive to have a rapid answering time. If it is a bilateral question, we suggest you to write on MS Teams on a bilateral chat.
- We will strive to provide you with speedy answers to the questions posted on MS Teams.
- You can reach us either bilaterally (if it is a matter that concerns only you), or through the appropriate, common channels (in case your question may be of help to others).
- *We do not guarantee answering e-mail communication*

8.3 Students with disabilities

Any student with a documented disability needing academic adjustment or accommodation is requested to speak with the instructors during the first two weeks of class. All discussion will remain confidential. Students with disabilities will need to also contact the directors of the Faculty.

8.4 Laptops

Laptops or equivalent computing devices are needed in for the sole purpose of supporting the individual learning process.