University of Nicosia

Course Syllabus

Course Code	Course Title	ECTS Credits
BLOC-512DL	Blockchain Systems and Architectures	10
Prerequisites	**Department**	**Semester**
N/A	Digital Innovation	Fall / Spring
Type of Course	**Field**	**Language of Instruction**
Required	Blockchain, Distributed Systems, Architectures	English
Level of Course	**Lecturer(s)**	**Year of Study**
2nd Cycle	Prof M. Themistocleous, Prof S. Louca, Dr E. Iosif	1st
Mode of Delivery	**Work Placement**	**Corequisites**
Distance Learning	N/A	BLOC-511DL

Course Objectives:

This course is designed to provide an understanding to the building blocks and components that fuel modern Blockchain-based systems or Distributed Ledgers in general. Thus, the aim of the course is to position Distributed Ledger Systems (DLTs) in the ecosystem and investigate the roots of the architecture that goes back to distributed systems, cryptography, peer-to-peer networks, data integrity, incentivization mechanisms etc.

The main pillars on which this course is structured are the following:

The architecture of distributed ledger systems (including Blockchains) by discussing the fundamental building blocks of the technology.

The perspective of using a blockchain-based systems as a building block for a software architecture (e.g., as a storage element)

The problem of synchronization and the relationship with Distributed Systems and Consensus algorithms.

The hidden dimensions of the architecture, such as, game theoretical aspects, incentivization, and governance models (including algorithmic governance).

Learning Outcomes:

After completion of the course students are expected to be able to:

- Classify the key characteristics of Blockchains (i.e., decentralization, persistency, anonymity, auditability etc.);
- Dissect the different layers of components that compose the architecture of a blockchain-based system;
- Contrast a blockchain-based system with a replicated state-machine;
- Analyze the challenges of consensus algorithms at the high-level;
- Analyze and dissect the components of blockchain-based technologies which support Turing-complete languages;
- Establish a deep understanding of algorithmic execution in DLTs, their consensus model, code execution, operation of its network, storage options and main actors that participate on each protocol;
- Analyze the inner workings of smart contracts as means for developing decentralized applications;
- Examine the interaction between the enclosed smart contract network and the external world, be aware of further implications these interactions;
- Evaluate a set of technologies that support the backbone decentralized storage network (e.g., IPFS, Swarm);
- Demonstrate the various categories of DLTs
- understand the underlying incentivization and governance models;
- Examine the development and adoption of DLTs in the future through various use-cases;
- Analyze how other emerging technologies (e.g., IoT and AI) can be exploited and combined with blockchains.

Course Content:

1.Describe the Blockchain Architecture
2.Blockchains and the Architecture of Trust
3.Databases vs. Blockchain Architectures (Types of Blockchain Architectures Explained)

4.Hidden Incentivized Model and Game Theoretical Aspects

5.Algorithmic Governance with Smart Contracts

6.Hierarchical and Alternative Blockchain Structures

7.From Blockchains to Distributed Ledger Technologies (DLTs)

8.Permission-less vs. Permissioned Architectures

9.Programmable Chains vs. Enterprise Architectures (towards inter-chains, interoperable chains)

10.Blockchains-as-a-Service

11.Interoperability and Scalability in Blockchains

12.Oracles & On-Chain/ Off- Chain Governance

13.Development and Adoption challenges

Learning Activities and Teaching Methods:

Lectures, Seminars, Assignments, Live Discussions, Forum Discussions, Practical Projects

Assessment Methods:

Formative Self-Assessment (not graded)

A number of formative self-assessment questions (not graded) will be provided during each lecture.

Summative Assessments

•   Assignment: assigned on Session 6, deadline at the end of Session 10, assessed out of 100. This assignment corresponds to 10% of the total mark.

Interactive Summative Activities: Assigned every session starting from session 1 on-going until session 12, assessed out of 100. Each interactive activity corresponds to 2.5% of the total mark. Overall, the total grade from all summative interactive activities corresponds to 12 sessions x 2.5% = 30% of the total mark.

Purpose of interactive summative activities:

Overall, these activities are designed to engage students with the learning outcomes leveraging on an interactive character. Different interactive approaches are utilized as follows:

1.   Interactive discussions during the class

2.   Interactive use of command line tools (including simulators) or related computational tools

3.   Interactive quiz (questions)

4. Interactive use of a Wiki for sharing content generated by the students

5. Final exam: Takes place after session 12, assessed out of 100, contributes 60% of the total course mark.

Required Textbooks / Readings:

Teaching material including PowerPoint (PPT) presentations with extended descriptions and explanations, asynchronous video presentations, additional readings (journal articles and/or ebooks), access to additional videos and commercials related to the course, synchronous meetings (Engageli), forums, chats, case studies and other formative and summative assessments.