UNIVERSITY of NICOSIA

Course Syllabus

Course Code	Course Title	ECTS Credits
BLOC-523	Permissioned Blockchains Programming	10
Prerequisites	**Department**	**Semester**
BLOC-512 BLOC-514D	Digital Innovation	Fall/Spring
Type of Course	**Field**	**Language of Instruction**
Elective	Software engineering	English
Level of Course	**Lecturer(s)**	**Year of Study**
2nd Cycle	Dr. Elias Iosif	2nd
Mode of Delivery	**Work Placement**	**Corequisites**
Face to face	N/A	N/A

Course Objectives:

The main objective of this course is to provide students with a solid technical expertise (focusing on software engineering aspects with hands-on experience) regarding the development and application of permissioned Distributed Ledger Technologies (DLTs). This type of DLTs exhibits a complementary character with respect to permissionless (public) DLTs, e.g., as Bitcoin and Ethereum, and they are meant to facilitate enterprise-oriented decentralized applications.

The course is structured around three broad sections:
The position of permissioned DLTs in the entire spectrum of DLTs with particular focus on their technical properties from a software engineering point of view;
Hands-on experience with a major/indicative type of permissioned DLT along with the presentation of the respective theory and models: in particular, the course will be focused on the Hyperledger Fabric covering network setup and management as well as development of smart contracts-based backend applications;
Data structures utilized at the core of DLTs, i.e., for the implementation of the ledgers. In this context, recently proposed database models will be presented along with a number of indicative distributed/decentralized structures.

Learning Outcomes:

After completion of the course students are expected to be able to:
Evaluate the role of DLTs in software engineering: the functional properties of DLTs as architectural/storage/computational/communication element;
Examine the key differences between permissionless and permissioned DLTs;
Analyze enterprise use cases and identify the conditions according to which permissioned DLTs are required;
Dissect the technical terminology of Hyperledger Fabric;
Setup/configure and manage a Hyperledger Fabric network;
Develop and deploy smart contracts in Hyperledger Fabric;
Setup/configure and manage database systems used in DLTs;
Examine the core functionality of non-blockchain data structures that enable distributed/decentralized data storage.

Course Content:

1. DLTs in software engineering (as architectural/storage/computational/communication elements)
2. DLTs as enterprise systems (permissionless vs. permissioned ledgers)
3. DLTs: Architectural overview
4. DLTs: Main functionalities and model
5. DLTs: Blockchain network
6. DLTs: Identities
7. DLTs: Memberships
8. DLTs: Policies and peers
9. DLTs: Chaincode
10. DLTs: Ledger
11. Databases in DLTs: CouchDB and LevelDB
12. Alternative data structures: InterPlanetary File System (IPFS), distributed hash tables

Learning Activities and Teaching Methods:

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

Assessment Methods:

Formative Self-Assessment (not graded):

A number of formative self-assessment questions (not graded) will be provided during each lecture. An indicative sample is provided in the last part of this Guide along with the respective answers.

Summative Assessments

Assignment: 16%

Summative activities: 12 sessions x 2% = 24%

Overall, the short summative activities are designed to exhibit a clear interactive character. In total, four different approaches are utilized for this purpose as follows:

Interactive discussions during the class

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

Interactive quiz (questions)

Interactive use of wiki for sharing content developed by students.

For each session, the specific combination of the above approaches is reported in the respective section of this guide.

Final exam, assessed out of 100, 60% of the total mark.

Required Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Hyperledger fabric: a distributed operating system for permissioned blockchains	Androulaki, E., Barger, A., Bortnikov, V., Cachin, C., Christidis, K., De Caro, A., Enyeart, D., Ferris, C., Laventman, G., Manevich, Y. and Muralidharan, S.	In Proceedings of the Thirteenth EuroSys Conference. ACM.	2018	
IPFS-content addressed, versioned, P2P file system	Benet, J.	arXiv preprint arXiv:1407.3561.	2014	
Identity Discovery in Bitcoin Blockchain: Leveraging Transactions Metadata via Supervised Learning	Christodoulou, C., Iosif, E., Louca, S., and Themistocleous, M	International Conference on Big Data and Blockchain.	2019	

Recommended Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Pervasive decentralisation of digital infrastructures: a framework for blockchain enabled system and use case analysis	Glaser, F	In the 50th Hawaii International Conference on System Sciences (HICSS 2017).	2017	
Hyperledgerfabricdocs Documentation: Release master	Hyperledger (2019).	Online	2019	

A performance comparison of SQL and NoSQL databases.	Li, Y., and Manoharan, S.	In 2013 IEEE Pacific Rim Conference on Communications, Computers and Signal Processing (PACRIM) (pp. 15-19). IEEE.	2013	
Hydras and IPFS: a decentralised playground for malware	Patsakis, C., and Casino, F.	International Journal of Information Security, 1-13.	2019	
A byzantine fault-tolerant ordering service for the hyperledger fabric blockchain platform	Sousa, J., Bessani, A., and Vukolic, M.	In the 48th annual IEEE/IFIP international conference on dependable systems and networks (DSN).	2018	
Business Transformation Through Blockchain: Volume I	Treiblmaier, H., & Beck, R. (Eds.)	Palgrave Macmillan.	2019	
Architecture for blockchain applications	Xu, X., Weber, I., & Staples, M	Springer.	2019	
The blockchain as a software connector	Xu, X., Pautasso, C., Zhu, L., Gramoli, V., Ponomarev, A., Tran, A. B., and Chen, S.	In 2016 13th Working IEEE/IFIP Conference on Software Architecture (WICSA).	2016	
Distributed hash table: Theory, platforms and applications (pp. 5-20)	Zhang, H., Wen, Y., Xie, H., and Yu, N.	New York: Springer	2013	