Northeastern University
College of Engineering

INFO 7510 Smart Contract Application Engineering and Development

Course Information
Course Title: Smart Contract Application Engineering and Development
Course Number: INFO 7510
Term and Year: Spring 2022
Credit Hour: 4
Course Format: On-Ground

Instructor Information
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Course Prerequisites
Graduate level INFO 7500 Minimum Grade of C-

Course Description
Emphasizes the essential coding skills for implementing self-enforcing, multiparty, mutually beneficial, contractual rights and obligations on top of blockchain technologies. Offers students an opportunity to learn how to leverage the principles and mechanisms of "decentralized autonomous organization" to programmatically coordinate the interaction between participating parties at a global scale without the need for trusting a third party and how to build blockchaintype applications that automate the interaction of a network of participating entities such as buyers, sellers, suppliers, insurance, and finance.

Standard Learning Outcomes

Learning outcomes common to all College of Engineering Graduate programs:
1. *An ability to identify, formulate, and solve complex engineering problems.*
2. *An ability to explain and apply engineering design principles, as appropriate to the program's educational objectives.*
3. *An ability to produce solutions that meet specified end-user needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.*

The Information Systems Program accepts students of different engineering backgrounds with minimum programming skills and produces first class Information Systems engineers that operate at the intersection of real-world complexity, software development, and IT management. Graduating students will be able to construct end-to-end advanced software applications that meet business needs.

Specific Learning Outcomes for the Information Systems program:
1. *Create a strong technical foundation through diverse, high-level courses*
2. *Built crucial interpersonal skills needed to succeed in any industry*
3. *Foster a deep level of applied learning through project based case studies*

Syllabus

Part 1: Blockchain fundamentals
- Distributed computing essentials
- basic concepts of blockchain, bitcoin, ethereum, dapp, smart contracts.
    - What's blockchain? Cryptographically secure, transaction-based state machine.
    - What is bitcoin? First broadly used cryptocurrency. Transaction is transparent and can be fully anonymous. The underlying technology is blockchain.
    - What is Ethereum? One of the most widely recognized and used blockchain platform. Easy to be used as private blockchain.
    - What is DAPP? Decentralized application. Application run on blockchain.
    - What is smart contract? A program that can be executed on blockchain.

This class is to introduce the basic concepts of blockchain and related technologies. The goal of the class is to familiarize students with blockchain background and terminologies.

Part 2: Development environment
- Setup an multi-node Ethereum platform
- Deployment and monitoring tools
- Identity management: uport for identity management
- Testrpc for testing smart contracts.

This class is to give an overview of the technologies involved in the ethereum based development environment. The goal of the class is to prepare students with understanding of the development environment and tools.

Part 3: Tools for building dapps
- The development process for decentralized applications
- Solidity for smart contract development
- web3.js, meteor for user interaction with the blackchain
- Uport for identity management

This class is to guide students with examples using development tools such as solidity, web3.js, meteor to develop decentralized applications on blockchain. The goal of the class is to familiarize students with DAPP development.

Part 4: Disintermediation, trust computing and counter examples
- address the trust issue in multi-party concept.
- Case study: programming a stock settlement process

- Students will engage in group discussion about the critical use cases that are related to stock settlement involving a network of participating entities

This class is an instructor-led discussion. The goal of the class is to present the issue and possible solutions in addressing trust in multi-party interactions.

Part 5: Identity management
- self-governance identity management solutions
- Introduce the Uport and Civic platforms and their underlying design philosophies.
- Detailed look at the design and implementation of the Uport platform
- Uses case for Uport and Civic: KYC (know your customer), city management of its residents, property, etc.
- Uport for implementing governance, authorization, and authentication of entities in eco- systems of participating enterprises.

UPort is a popular tool for self-governance identity management. This class is to introduce UPort and Civic framework. The goal of the class is to bring the identity management topic to student's awareness.

Part 6: Reference architecture of dapp
- The scalability challenge for distributed ledger technologies and ways to work around the problems.
- Introduce the Digital Assets reference architecture model and its applications in the financial space.
- Discuss on-chain and off-chain implementation of smart contracts.

Scalability is another important topic that students would need to understand on blockchain. With generalized state transition function, it becomes difficult to partition and parallelize transactions to apply the divide-and-conquer strategy. How to maximize the value of on-chain transactions and keep other activities off-chain is critical. The goal of the class is to present students with examples to understand and address such issues.

Part 7: Final project
This week students are given directions of their final project – building trust multi-party smart contract dapps with ethereum. Students are going to practice the tools and techniques they learn from the course to demonstrate their capability of understanding and developing smart contracts.

Part 8: Final project (Lab and QA for the Final project) 4 weeks

Part 9: Final project demo
Each student will present and demo their final project.

End-of-Course Evaluation Surveys
Your feedback regarding your educational experience in this class is very important to the College of Professional Studies. Your comments will make a difference in the future planning and presentation of our curriculum.

At the end of this course, please take the time to complete the evaluation survey at https://neu.evaluationkit.com. Your survey responses are **completely anonymous and confidential**. For courses 6 weeks in length or shorter, surveys will be open one week prior to the end of the courses; for courses greater than 6 weeks in length, surveys will be open for two weeks. An email will be sent to your HuskyMail account notifying you when surveys are available.

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A commitment to the principles of academic integrity is essential to the mission of Northeastern University. The promotion of independent and original scholarship ensures that students derive the most from their educational experience and their pursuit of knowledge. Academic dishonesty violates the most fundamental values of an intellectual community and undermines the achievements of the entire University.

As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, examinations of whatever kind, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Students are responsible for learning the conventions of documentation and acknowledgment of sources in their fields. Northeastern University expects students to complete all examinations, tests, papers, creative projects, and assignments of any kind according to the highest ethical standards, as set forth either explicitly or implicitly in this Code or by the direction of instructors.

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For more information, visit http://www.northeastern.edu/drc/getting-started-with-the-drc/.

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For more information and for Education specific resources, visit http://subjectguides.lib.neu.edu/edresearch.

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Within Blackboard, open a support case via the red support button on the right side of the screen, click Create Case

myNortheastern, e-mail, and basic technical support
Visit the Information Technology Services (ITS) Support Portal
Email: help@northeastern.edu
ITS Customer Service Desk: 617-373-4357

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Northeastern University is committed to equal opportunity, affirmative action, diversity and social justice while building a climate of inclusion on and beyond campus. In the classroom, member of the University community

work to cultivate an inclusive environment that denounces discrimination through innovation, collaboration and an awareness of global perspectives on social justice.

Please visit http://www.northeastern.edu/oidi/ for complete information on Diversity and Inclusion

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In case of an emergency, please call 911.

Please visit www.northeastern.edu/titleix for a complete list of reporting options and resources both on- and off-campus.