USC Viterbi

School of Engineering

Course ID and Title : CSCI 599: Blockchain Technology and Applications

Units: 4
Term—Day—Time: Spring 2018 - Thursday - 2.00pm-5.20pm

Instructor: Bhaskar Krishnamachari
Office: RTH 410
Office Hours: TBD
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Course Description

This course is aimed at graduate students doing MS/Ph.D. in computer science, computer engineering and related fields. Blockchain technologies present a novel class of programmable platforms providing decentralized trust. Students will start learning the basics of blockchain technology and algorithms underlying Bitcoin, Ethereum and smart contracts. They will further learn about permissioned blockchains, consensus algorithms, proof of work and alternatives, enhancements utilizing directed acyclic graphs, use of blockchains for distributed storage and as the basis of decentralized application-layer Internet protocols and public key infrastructure, use of blockchain-based utility tokens for IoT applications ranging from smart grid and supply chain to smart parking, and also security issues related to blockchain. No prior background in blockchain technologies is assumed

Learning Objectives
Through this course, students will be able to demonstrate:
- an understanding of the design of non-permissioned / public blockchains such as the original Bitcoin system
- an understanding of what smart contracts are
- the ability to program smart contracts in software
- the ability to develop blockchain-based decentralized applications (DApps)
- an understanding of what permissioned blockchains are, and how they differ from non-permissioned/public blockchains
- an understanding of distributed consensus algorithms such as Paxos, RAFT, PBFT, and how they are used in permissioned blockchains
- an understanding of data consistency issues in distributed systems applied to blockchain technologies
- an understanding of proof of work and alternatives to proof of work such as proof of stake, proof of importance, etc.
- an understanding of key performance metrics for blockchain technologies
- an understanding of when blockchains may not be the right technology for an application
- an understanding of how decentralized storage can be built using blockchain technologies
- an understanding of how decentralized Internet application-layer services can be built using blockchain technologies and what advantages they have over traditional implementations
- an understanding of some of the open research problems pertaining to blockchain technology
- an awareness of the general state of the art in the literature on blockchain
- the development of a novel proof of concept or prototype of either an innovation in blockchain technology or an innovative application of blockchain technology

Prerequisite(s): Graduate Standing (MS or Ph.D.) in Computer Science or any other area of Engineering
Co-Requisite(s): N/A
Concurrent Enrollment: N/A
Recommended Preparation: Strong Programming Skills, Knowledge of network protocols may be hepful

Course Notes
Letter Grade. Web-Enhanced Course (Blackboard) - course notes, links to reading will be posted online. Course will include programming assignments and a final project to be done in groups of 2-3 students.

Technological Proficiency and Hardware/Software Required
Students must have significant experience with computer programming. Students will need to have access to a sufficiently up-to-date computer for programming, the needed software and related instructions will be provided by the course instructor and teaching assistant.

Required Readings and Supplementary Materials
Required readings (in the form of course notes developed and prepared by the instructor) and pointers to supplementary materials (research papers, tutorials and surveys) will be posted online on the course website.

There will be no required textbooks for the course, though we may suggest readings from the Bitcoin and cryptocurrency book at http://bitcoinbook.cs.princeton.edu/

Description and Assessment of Assignments

There will be about four programming assignments, regular writing assignments (critiques of research papers) and a final group project.

Grading Breakdown

Assignments: 1-4: 20%
Paper reviews/critiques: 25%
Participation: 15%
Final Project: 40%

Grading Scale (Example)
Course final grades will be determined using the following scale
A   95-100
A-   90-94
B+   87-89
B   83-86
B-   80-82
C+   77-79
C   73-76
C-   70-72
D+   67-69
D   63-66
D-   60-62
F   59 and below

Assignment Submission Policy

Due dates for each assignment will be indicated with the assignment. Submissions will be due either in person in class or via online submission, as specified. Late Submissions will incur grade penalties.

Grading Timeline

Most assignments will be graded and returned within 2 weeks.

Additional Policies

Late assignments will not be accepted unless approved before deadline by instructor. Students are expected to attend all classes in person.

Course Schedule: A Weekly Breakdown (tentative)

The topics numbered below and their corresponding readings are listed online at
http://blockchain.usc.edu/index.php/blockchain-research-reading-group-fall-2017/

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1	Introduction to Blockchain	Topic 1, paper critique	
Week 2	Introduction to Ethereum	Topic 2, paper critique	paper critique due
Week 3	Introduction to Smart Contracts , Programming on Solidity	Topic 2, programming assignment 1	paper critique due
Week 4	Programming a Decentralized App	Topic 2, programming assignment 2	programming assignment 1
Week 5	Permissioned Blockchain	Topic 3, paper critique	
Week 6	Consensus Protocols	Topic 3, paper critique	paper critique due programming assignment 2
Week 7	Distributed Consistency	Topic 4, programming assignment 3	paper critique due, draft proposal for project
Week 8	Alternatives to Proof of Work	Topic 5, paper critique	programming assignment 3
Week 9	Scaling and Performance of Blockchains	Topic 6, paper critique	paper critique due, final project proposal
Week 10	From Chains to Graphs	Topic 7, programming assignment 4	paper critique due
Week 11	Blockchain Applications	Topic 8, paper critique	programming assignment 4
Week 12	Decentralized Storage via Blockchain	Topic 9, paper critique	paper critique due, mid-project update
Week 13	Decentralized Internet Application-Layer Services	Topic 10, paper critique	paper critique due

Week 14	Utility Tokens	suggested reading, paper critique	paper critique due
Week 15	Security challenges	suggested reading	paper critique due
FINAL	**Final Project**		report and final presentations due Date: For the date and time of the final for this class, consult the USC *Schedule of Classes* at classes.usc.edu.

Statement on Academic Conduct and Support Systems

Academic Conduct:
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems:
Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.
Provides overall safety to USC community. dps.usc.edu