No: ECE 7650

Title: Scalable and Secure Internet Services and Architecture Cr. 4 (LCT: 4)

WSU Catalog Description: Prereq: graduate standing; ECE 5610 or ECE 5650. Advanced principles of distributed and cloud computing systems, the Internet, Internet server and data center, content delivery networks, performance scalability, energy-aware resource management, security and privacy, cost-effective engineering design.

Coordinator: Song Jiang, Associate Professor of Electrical and Computer Engineering.

Instructor: Song Jiang, Associate Professor of Electrical and Computer Engineering.

Office Hours: T/Th 2:00pm – 3:00pm
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Email: sjiang@wayne.edu
Web Page: http://www.ece.eng.wayne.edu/~sjiang/ECE7650-winter-16/ECE7650.htm

Course Meeting Time: T/Th 10:40 – 12:30pm
Course Meeting Location: 0020 MANO

Goals: The goals of this course are to become familiar with principles of Internet-wide distributed and cloud computing systems, to understand layers of system and application software in data centers for providing Internet-wide scalable and reliable services, to learn techniques for addressing critical issues such as data replication and consistency, failure management, system reliability, scalability, availability, and efficiency, to learn techniques of configuring a distributed computing platform matching expected workload characteristics, and to prepare students for better job opportunities in the area of distributed and cloud computing.

Learning Objectives: After completing this course, students should be able to do the following:

1. Explain various software layers in a data center supporting Internet-scale services.
2. Explain various critical issues that must be addressed in building a data-center’s software infrastructure, and state-of-the-art techniques to address them.
3. Choose design alternatives based on workload characteristics.
4. Design resource management policies according to given optimization goals.

Textbook: Lecture Notes by Song Jiang

Prerequisites by Topic: (ECE5610 and ECE 5650) Parallel programming models, metrics for evaluating parallel programs, Internet protocols, and sockets programming, multithreading, operating system.

Corequisites by Topic: none

Topics:
1. Revisiting components in a typical operating system
   - Separation of user- and kernel modes
   - Process management
   - Memory management
   - File system and distributed file system

2. Overview of distributed systems
   - Distributed system and cloud computing
   - The issues: reliability, scalability, availability, consistency, and performance.

3. Distributed Storage Systems
   - Google’s GFS: the Google file system
   - Facebook’s Haystack: Facebook’s photo storage
   - Microsoft’s Azure: a highly available cloud storage service with strong consistency
   - Ceph: a scalable, high-performance distributed file system

4. Key-value data management systems
   - LevelDB: a key-value store based on LSM tree
   - Google’s Bigtable: a distributed storage system for structured data
   - SILT: a memory-efficient key-value store
   - Amazon’s Dynamo: a highly available key-value store

5. Distributed Execution Frameworks
   - Google’s MapReduce: simplified data processing on large clusters
   - Single-source shortest paths: Dijkstra’s algorithm
   - Google’s Pregel: a system for large-scale graph processing
   - Microsoft’s Dryad: constructing distributed data-parallel programs from sequential building blocks
   - Berkeley’s Spark and Shark

Course Structure: The class is divided into a number of groups and each group contains 2 to 3 students. During the first half of the semester, the students attend lectures and work on three design assignments. During the second half of the semester, the students work on a major design project.

Distribution of Points:

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<td>Final Exam</td>
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<td>Homework Assignments:</td>
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<td>Programming Projects</td>
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<td>Study, Presentation, and Report:</td>
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<td>Class participation and discussions</td>
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Grading Scale:

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Makeup Exam and Makeup Assignment Policy:

No make-up exams will be given except for university sanctioned excused absences. If you miss an exam (for a good reason), it is your responsibility to contact instructor before the exam, or soon after the exam.

Late Policy

Each student has three late days. Clearly indicate this on your submission if late days are used. Beyond these days, homework assignments and projects must be handed in by due time and no late assignments will be accepted unless compelling reasons are provided and verified.

Outcome Coverage:

a) **Demonstrate mastery of advanced principles pertaining to the computer engineering research path of the Ph.D. candidate.** The assignments/lab projects/presentation and final exams components require direct application of mathematical, scientific, and engineering knowledge to successfully complete the course. Students are required to perform design, analysis, implementation, and optimization of distributed management policies to complete the tasks.

b) **Plan and conduct independent research which leads to the development of new knowledge, approaches and solutions for computer engineering problems.** The Study/Presentation/Report components require students to independently study challenging issues, to understand the proposed solutions, and to propose their own strategies for further improvements.

c) **Effectively communicate, both verbally and in writing, scientific and engineering concepts to audiences with a broad range of technical knowledge.** The presentation requires students to present their projects and experiment results before the class and answer questions from the audience.

**Cheating Policy and Penalty for Cheating:** Cheating is defined by the University as “intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise.” This includes any group efforts on assignments or exams unless specifically approved by the professor for that assignment or exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure “Academic Integrity,” will also result in downgrading for the course. Students who cheat on any assignment or during any examination will be assigned a failing grade for the course.
Accommodations for Students with Disabilities: If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services’ mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

Please refer to the SDS website for further information about students with disabilities and the services we provide for faculty and students: http://studentdisability.wayne.edu/

Prepared By: Song Jiang Associate Professor of Electrical and Computer Engineering

Last Revised: January 8, 2016