CS 525: Advanced Distributed Systems

Course Overview
Over the past few decades, the functions of "traditional" operating systems have been scattered out to the edges of distributed systems. Peer-to-peer systems (think: Kazaa), sensor networks, the Grid, PlanetLab, the Internet and the Web are examples. New classes of these systems include datacenters and computing clouds (e.g., EC2, Appengine, Cirrus, Google-IBM cloud). This course focuses on three case study areas, spanning the classical to bleeding edge: **cloud computing**, **peer-to-peer systems**, and **sensor networks**. We will study efficient protocol design and evaluation, as well as learn high-level system issues. Research in these areas also tends to be scattered across disjoint sets of researchers and conferences, and the course attempts to study commonalities. Projects can be one of two types - **research projects** or **entrepreneurial projects**.

Prerequisites
Basic Computer Science and basic computer programming skills are essential. Knowledge of Operating Systems (CS 241 or CS 423), or Networks (CS 438), or Distributed Systems (CS 425), or an equivalent course, or instructor consent, is required.

Course Website `http://courses.engr.illinois.edu/cs525/`

Timings
Class: Tuesday and Thursday, 3:30 PM - 4:45 PM, 1304 Siebel Center.
Professor Office Hours (tentative, class days only): Tuesday and Thursday 4.45 PM - 5.30 PM, 3112 SC.

Course Staff

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Course Content
The first few weeks of lectures introduce ground basics in peer to peer systems, cloud computing, distributed algorithms and sensor networks. Subsequently, over 70 research papers in various areas of distributed systems are presented, discussed, and debated by the students. The selection includes papers from industry and successful companies, as well as classical and contemporary papers from conferences including, but not limited to, SOSP, OSDI, SOCC, FAST, NSDI, PODC, VLDB, Middleware, Usenix, Infocom, SIGCOMM, SASO, etc., as well as ACM and IEEE journal papers. Rather than running through all the papers in a few of such proceedings and journals, we will pick and choose publications appropriate to the stated goals of this course.

An essential component of this course is a project that could be either a research project or an entrepreneurial project (your choice, but you must make this choice at the semester start).

A research project will solve a cutting-edge research problem with innovative ideas, build systems solutions (real implementation required!), and evaluate it experimentally in a deployment scenario. The goal of this project is a conference-quality paper submission and acceptance; many past course projects have been published in conferences and journals.

An entrepreneurial project will explore a new idea for a startup or non-profit company. You will have to build the system or working prototype (real implementation required!) and evaluate it experimentally. Think about who your potential customers are.

In all projects (research or entrepreneurial), the core ideas have to come from the students. The instructor will work with you in refining your ideas. In some cases, the instructor might offer initial ideas for projects. It is highly recommended that you work in groups. Teams are suggested to be 2 students, although groups of 3 will be allowed if the work is proportionally scaled up. All projects will have to submit three versions of reports (survey, midterm, and final reports) - for research projects, these submissions should read like research papers (or parts thereof), while for entrepreneurial projects, these submissions should be readable documentations of ideas, systems, implementations and (a required) business plan.

At the end of the course, a top few "best" project papers will be selected, and given special attention, e.g., for submission to conferences or fast-tracking to the Illinois EnterpriseWorks startup incubator.

This course's projects in past semesters have been extremely successful. Research papers have been accepted in conferences (e.g., ICDCS, Infocom, Middleware, MMCN, SASO, QShine, CollaborateCom, GRID, etc.), as well as appear in several top journals (e.g., ACM TAAS, ACM TOSN, IEEE TNSM, JSS, Distributed Computing, etc.). Some course project papers have won Best Paper Awards in these conferences.

About the Class

The initial few weeks of class will consist of lecturing, with the intent of building up common knowledge and grounding for the latter half of the course. We will then transition to student-led presentations of papers. Once student-led presentations start, students who are not presenting are expected to write short reviews (1-2 pages total) for any two of the "Main Papers" in that session. Active class participation is required, even in the initial part of the course!

Class Evaluation: Project (survey + midterm + final), reviews of papers, presentation, and class participation (may include a quiz). Tentative splits are 50% (5% + 15% + 30%), 20%, 25%, 5% respectively.

Abridged list of Topics (see course website for more comprehensive list): Cloud computing, theory, peer to peer systems, sensor networks, overlays, cloud scheduling, cloud programming, storage, key-value stores, NoSQL, epidemics, in-network processing, membership, industrial systems, security, geo-distribution, green computing, pricing, measurement studies, structure of networks.