CS 407: Foundations of Mobile Systems and Applications

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Summary of course content

Smart mobile devices have taken the world by storm. These devices have significantly expanded capabilities that have transformed user experience and behavior. As users continue to depend on these devices for their daily activities, a large range of applications and services continue to emerge. Application stores are gaining in popularity and every day many new applications are being available for download targeting these mobile devices.

These devices require a new way of application design due to their unique features and constraints. They are characterized by limited processing, memory and storage capabilities; mobility across different types of networks (untrusted WiFi hotspots, various cellular data services) that have intermittent connectivity in some cases; a different user interface (touchscreens, gestures, and limited keyboards); and limited battery power. They are multi-function in nature and often come equipped with a large array of sensors — cameras, accelerometers, touch capabilities, GPS, and even electronic compasses. Usage models for these devices are also quite unique with people using them as personal digital assistants, as notetakers, as alarm clocks, as cameras, and sometimes as a mainstream computing platform. Hence, the considerations for designing applications and services are significantly different.

This course will explore efficient strategies to design and implement applications and services for this emerging class of mobile platforms. The course will start with an overview various mobile platforms that are broadly available today. It will be followed by a roughly 8-9 week period where the students will be led through a series of laboratory exercises in building simple applications. The platform of choice may vary across different semesters. Beyond this 8-9 week period, the course will foray into broad array of topics in developing such applications and services, that include wireless communication issues, location-based services, cloud-based design, energy consumption and efficiency issues, human-computer interaction for small form factor devices, and system integration.

Further, a key component of the course will be a semester-long programming project that will be done in groups. Students will be required to quickly come up to speed with their programming platform, define a specific project objectives in detail, and showcase a full application by the end of the semester.

Course syllabus and reading list

The first part of the course that focuses on prescribed programming assignments will leverage online content that is available from the course website or from other sources. In the second part of the course, the material will be drawn mainly from research literature and supplemented from readings from various text books. While it is natural to characterize topics according to layers of the protocol stack as discussed below, in many cases cross-layer design mechanisms are relevant. Such mechanisms will be discussed in an appropriate context. The following is a rough overview of the course lectures and related content. The content and its distribution is, of course, subject to change.

- Mobile platforms introduction: (1 week)

- Programming platform in detail: (8 weeks)

- Mobile sensors and their functions: (1 week)
  How do accelerometer, gyroscope, and some other sensors work.

- Wireless communication, location services, energy efficiency, etc.: (3 weeks)
  Variability of the wireless channel, intermittent connectivity, and design for unpredictable performance. GPS and how it works, non-GPS localization techniques. Energy consumption by different components, computation and communication tradeoffs for energy.

Programming assignments and projects

There will be multiple small programming assignments that will be required in the first 8-9 weeks. These programming assignments will help you to get a better hands-on experience about a particular mobile platform and services available.

However, a key focus of the course will be a semester long programming project which will be done in groups. More details on the programming project will be available soon. Please form your project groups early and please select your platform of choice quickly.

For this main project, you can use any programming environment as long as it is a mobile environment:
- iPhone SDK (programming in Swift or Objective C)
- Android SDK (programming in Java)
- HTML5/Jasvascript is also an option

Grading criteria (subject to change)

- Quizzes / Exams: 20
- Initial class programming assignments : 40
- Project : 40
Total: 100

Text book and reference material

There is no required text book for this class. However, there are many different forms of reference material. We will post them in piazza (which will be used extensively for the class).

Learning Outcomes

The course strives to teach how to design systems and applications for mobile systems. In particular, at the end of the course, a student should be able to design and create applications or systems for at least one mobile platform.

Creating a learning environment

In our class we strive to create an environment where everyone willing to do their part can learn and thrive. You should always feel free to ask a question: asking and pondering questions is how we learn. Being confused is unfailingly an opportunity to advance our knowledge. Please, commit to helping create a climate where we treat everyone with dignity and respect. Listening to different viewpoints and approaches enriches our experience, and it is up to us to be sure others feel safe to contribute. Creating an environment where we are all comfortable learning is everyone?s job: offer support and seek help from others if you need it, not only in class but also outside class while working with classmates.