CS 407: Foundations of Mobile Systems and Applications

Instructor: Suman Banerjee (suman@cs.wisc.edu)

Summary of course content

Smartphones 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 smartphones 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 phones.

Smartphones form a unique class of devices requiring new way of application design. 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 phone 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)

- Wireless communication: (2 weeks)
  Variability of the wireless channel, intermittent connectivity, and design for unpredictable performance.

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

- Location and location-based services: (1 week)
  GPS and how it works, non-GPS localization techniques.

- Energy efficiency: (1 week)
  Energy consumption by different components, computation and communication tradeoffs for energy

- Miscellany: (1 week)
  Mobile device security, privacy; cloud-based services, peer-to-peer applications, and delay-tolerance

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).