CSE 720 SYLLABUS

DESCRIPTION

Consumer demand for the latest technologies along with carrier replacement programs cause smartphones to be discarded three times faster than other consumer devices such as laptop and desktop computers. These short lifetimes produce large amounts of electronic waste, which is difficult to dispose of safely.

This semester we will attempt to address this sustainability challenge by addressing energy consumption, frequently cited by users as a top performance problem with current smartphones. Redesign, reduce, and reuse will be our mantram: redesigning smartphone hardware for improved energy consumption, reducing energy usage during active use, and finding novel ways to reuse phones after they are discarded, potentially as cheap, easily-deployed environmental sensors.

Throughout the semester we will read research papers about smartphone energy management and power-aware design. Students will lead discussion and work in teams to initiate research projects organized around our sustainability theme. Our goal will be to prepare several papers for publication in Spring 2014.

COURSE INFORMATION

- **Prerequisites:** Permission of the instructor.
- **Website:** `http://piazza.com/buffalo/fall2013/cse720/home`. We will use the Piazza forum for online discussions and to distribute information about assigned papers.
- **Instructor:** Geoffrey Challen (`challen@buffalo.edu`). It is unlikely that you will need to contact me directly. Instead, please use the forum. Also never call me "Professor", or "Dr" (worse), or "Sir" (even worse). Never.
- **Times and Locations:** The seminar meets Tuesday and Thursday from 12:30–2PM in Davis 310. Please feel free to bring a lunch as long as you can eat quietly.
- **Exam and Midterm:** There will be no exam or midterm.
- **Auditing**: No auditors are permitted.

APPROACH

Graduate seminars exist to fulfill a variety of ends: some introduce students to published research in a specific area, or walk them through a particular set of ideas or solutions to a particular problem. CSE 720 is different, mainly because there *isn't* much research in this area and not many solutions to this problem. We're right out there on the cutting edge, which is fun but can be a bit disorienting. We'll have to do a lot of thinking for ourselves about how to solve this problem, which is the fun part.

Unfortunately, because of the dearth of material specifically addressing sustainability for mobile devices, some of the papers may seem off-topic at first. However, my goal is to introduce you to aspects of smartphone energy usage that are significant from a sustainability perspective. Viewed in this way, the following topics become potentially relevant to our challenge:

- Next generation mobile architectures
- "Dark silicon" and its impact on future hardware designs
- Energy-saving hardware features and their interaction with software

- Reconfigurable hardware
- Energy-management tools developed for energy-constrained devices like wireless sensor nodes
- Energy-harvesting technologies and energy-forecasting algorithms
- Energy-aware operating systems and frameworks
- Tools to measure application and system energy consumption
- Approaches to energy modeling and prediction
- Alternative uses for smartphones
- Interfaces between smartphones and other kinds of devices or peripherals
- Energy-management interfaces between smartphones and their users
- Approaches that leverage smartphones to improve the sustainability of *other* things

My hope is that as we begin reading papers and discussing smartphone sustainability, several new research directions will emerge naturally within our group. While I have a few of my own projects that may be a good fit for our objectives, I am eager to allow students in the seminar to develop their own ideas along these lines. Choosing sustainability as our focus provides a broad purview for work at the hardware, operating system, platform and application layers, and I hope that whatever your specific interest we can find a project that excites you.

STRUCTURE
I will assign two papers per meeting, which we will roughly break into two 45-minute intervals. For each paper, I will assign a single student to briefly present a 5–10 minute overview of the the paper. Please don't feel the need to prepare slides or notes unless you feel that this is helpful. We are looking for a broad overview to help guide our discussion. For the next 15 minutes of class we will break into pairs to continue discussing the paper, followed by a group discussion for the remainder of the class.

The goal of this structure is to help develop your ability to read and discuss papers. Too many seminar courses end up dominated by only a few voices, and the pair-wise structure is intended to ensure that everyone gets a chance to (or has to) speak during each meeting. It also makes preparation essential, since there is nowhere to hide during the one-on-one discussion. **If you did not have time to read the paper, please do not attend class.** It is fine if this happens a few times during the semester. My goal is to keep the reading level manageable, but also to help you develop the ability to rapidly read and absorb research manuscripts on a variety of topics.

Once course projects begin, we may also schedule weekly project meetings on Fridays if needed.

LEARNING OBJECTIVES
The primary goal of this course is to begin several research projects addressing smartphone sustainability, either through better hardware design or hardware-software interaction (*redesign*), energy management software (*reduce*), or end-of-life smartphone management (*reuse*). CSE 720 attempts to address the following learning objectives defined for doctoral students by the SUNY Buffalo Graduate School:

- Ability to conduct independent research
- Ability to communicate effectively

- Ability to understand fundamental principles of field
- Ability to publish in a peer-reviewed venue

To these I would add:

- Ability to critically read and discuss a research paper
- Ability to formulate a research problem
- Ability to develop a plan to investigate a research problem, including collecting evidence and presenting a compelling conclusion
- Ability to write a short research paper

PROJECT

The project is the heart of this course. Working with a small group of students, you will perform research on a topic related to smartphone sustainability. Given the broad nature of our theme, a variety of projects are possible that will hopefully appeal to many different students, as well as students with different abilities.

We will work together to develop project topics and assemble project teams. Each project group will submit a single six-page report at the end of the semester formatted in the style of a submission to a typical computer science workshop. My goal is that some of these papers *will be* submitted to workshops, whereas others may eventually develop into full-length conference submissions. I will be more than happy to continue working with CSE 720 students after the semester ends on projects of mutual interest. In fact, this is what I hope will happen.

GRADING

Only satisfactory (S) and unsatisfactory (U) grades will be given. To earn a satisfactory grade, you must attend and contribute to in-class discussions and work together on a project team to perform research and prepare a report.

TEXTBOOK

There is no required textbook for this course.

ACADEMIC INTEGRITY

Please review the CSE Department's policy on academic integrity. As this is a graduate seminar with the aim of preparing work to submit to the broader research community, any violations of academic integrity will be taken extremely seriously. Students will receive a U for the course, and the violation will be reported to the department which will result in the cessation of any and all departmental support, according to the department's academic integrity policy:

> It is the policy of this department that any violation of academic integrity will result in an F for the course, that all departmental financial support including teaching assistanceship, research assistanceship or scholarships be terminated, that notification of this action be placed in the student's confidential departmental record, and that the student be permanently ineligible for future departmental financial support.

STUDENTS WITH DISABILITIES

Please register and coordinate with the Office of Disability Services. Let the course staff know when accommodations need to be made. We are committed to helping you learn!