Green Computing

08-840 (PhD, M.S.) 08-540 (M.S. and Undergraduate)
Tu/Th (TR) 10:30am -- 11:50am
Room: GHC 5222

Instructor: Yuvraj Agarwal, *Assistant Professor of Computer Science, SCS*
Contact: Office: WEAN 5313, Phone: x8-7328, Email: **yuvraj.agarwal@cs.cmu.edu**
Office Hours: Tuesdays, 3pm - 4pm or by appointment.
Textbook: No required textbook, although periodic reading material will be given.

Prerequisites: The course is open to all graduate students, and advanced undergraduates, with a technical background. Some programming experience will be needed to work on the project. No actual pre-requisites but undergraduate coursework in Electrical Engineering or Computer Science or a related field will generally be helpful. If in doubt, send an email to me and come to the first day of class.

Course Description: Our societal energy usage is rising at an alarming rate and thus it is critical to manage its consumption more efficiently for long term sustainability. This course introduces students to the exciting area of "Green Computing" aiming to help students acquire the knowledge and skills needed to do research in this space. It is organizationally divided into two tracks. The first track is "Energy-Efficient Computing", which considers the state of the art techniques for improving the energy efficiency of mobile devices, to laptop and desktop class computers and finally to data centers. We will cover energy efficiency across the hardware/software stack, starting from the individual components like processors and radio interfaces to system level architectures and optimizations. The second track is "Applying Computing towards Sustainability", covering topics that leverage computing to reduce the energy footprint of our society. In particular, we will focus on Smart Buildings and the Smart Grid, covering topics such as sensing, modeling and controlling the energy usage of buildings, as well as new operating systems and software stacks for the smart infrastructure.

Course Logistics: This is a graduate level course and will comprise of both lectures and discussing research papers. The course will require all students to do reading assignments (most of the weeks) and send in a short review via email to the instructor (due midnight before the day of the class). In addition, one student will lead the discussion about the papers in class each week (total 2-3 times in the Semester depending on enrollment) which includes making slides. There will also be a semester long project (can be done in a group or individually) on a topic related to the class. The instructor will provide some project ideas, and students are free to propose their own projects on topics related to the class but will need consent from the instructor to ensure its suitability. The final deliverable for the project is a polished research style paper (in ACM format), 10-12 pages in length and a final presentation at the end of the semester.

Note about different sections: The 12-unit section (08-840) is for PhD and Masters level students, and they are expected to work on a substantial project. The 9-unit section (08-540) are meant for Juniors/Senior level Undergraduate students and Masters level students who can choose a less demanding project or do individual summary papers with a presentation on a mutually agreeable topic related to the course. The lectures taught and the other course requirements remain the same.

Grading Details: Grades will be computed as follows (subject to minor changes):

Class Participation	10%
Paper Summaries	20%
Paper Presentations in Class	20%
Final Project: Report (30%) + Presentation (20%)	50%

Important Dates:

First Day of Class ..... January 13th, 2015
Spring Break (no class) ..... March 10th and March 12th, 2015
Last day of Class ..... May 1st, 2015
Final Project Presentations (Tentative) ..... May 5th and May 8th 2015

Course Outline (Approximate number of days):

Logistics, Introduction to Green Computing & Background ..... 3 days
Energy Management in Embedded Systems and Sensor Networks ..... 2 days
Energy Management in Mobile Systems and Smartphones ..... 4 days
Greening Desktop and Laptop PCs ..... 3 days
Energy Efficient Networking and Communication ..... 2 days
Greening Data Centers and Servers ..... 2 days

IT Enabled Smart Buildings ..... 2 days
Sensing within Buildings (Occupancy) ..... 2 days
Sensing within Buildings (Energy and Water) ..... 2 days
Managing the Data Deluge and "App Platforms" for Smart Buildings ..... 3 days
Energy Management in Smart Homes ..... 2 days
Modeling, Prediction and Control for Smart Buildings ..... 2 days
Security and Privacy ..... 2 days

Course Policies:

Collaboration: Collaboration is expected within the limits of discussing concepts. However, each student is expected to work on the paper summaries individually. In addition, the final project report must comprise of original text written by the student. Note that CMU maintains a policy regarding cheating and the use of copyrighted materials. Specific policy documents can be found at: `http://www.cmu.edu/policies/documents/AcademicIntegrity.htm`

Class Participation: Students are expected to be in class on time and attend regularly. One goal of this class is to foster discussions and therefore you are encouraged to ask questions, identify limitations in the papers we discuss in class and suggest potential solutions. Participation will be monitored and used to calculate the participation grade. If you cannot make class, please inform your instructor and group members (for projects done in a group) ahead of time.

Class Material: All material used in this class (syllabus, readings, presentations, reports) is intended for use in this class only. No unauthorized posting, publications, or redistribution is permitted. If in doubt, check with the instructor.

Accessing Reading List and Papers: There will be regular reading lists in terms of paper assignments. In almost all of these cases these papers can be found by a search on the Web, and can be downloaded from ACM DL, USENIX, or IEEE Explorer. Students are responsible for finding a copy of the paper. In some cases the instructor may post local copies of a paper for classroom use; the relevant original copyrights of the authors and the publishing agencies apply in all of those cases.