CS 6890/7910: GREEN COMPUTING
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Abstract
As mobile devices are becoming the primary means of accessing computing resources for the majority of computer users, the issues of energy efficiency have come to the forefront of software design and development. Thus, this graduate seminar course pursues two objectives. First, we will survey and discuss state-of-the-art techniques for green computing. Then, based on the findings, students will complete a term project, in which they will develop new techniques or apply existing techniques to their respective research areas.

Topics
Green Computing Knowledges + Green Computing Practices

1. Software engineering & programming language approaches for green computing
   1. Software design patterns
   2. New programming languages
   3. Program analysis
   4. Refactoring
2. Measurement framework and studies
   1. Energy model
   2. Hardware/software-based measurement
   3. Measurement framework/software
3. Middleware
   1. Dynamic execution adaptation
   2. Runtime monitoring
4. Systems
   1. Operating System
   2. Networks
   3. Compiler/Runtime system

Impacts
1. Global Economy: In 2020, mobile devices will consume about 10 billion kWh per year (about $1.175 billion) and 10% energy consumption of mobile software can save $117 million per year
2. Educational Impact: Students will have hands-on experiences that only can be faced in real software development.

Actions to Implement

Project-based Learning
- Measurement tool
  - E.g., energy monitoring tool
- Empirical study
  - E.g., energy consumption of different software, algorithms, etc.
- Energy-aware software development
  - E.g., finding and fixing energy hotspots
  - E.g., Design patterns or development guidelines for energy efficiency
- Working on their own research projects with energy-efficiency
  - E.g., Energy-efficient face recognition
  - Energy-efficient network protocols

Problem-based Learning
- Real-world scenarios and problems
  - E.g., invite people from industry and share their story
- Open-ended questions
  - E.g., initiate in-class discussion based on the above problems

Student Outcomes
- Standard Student Outcomes
  - An ability to use current techniques, skills, and tools necessary for computing practices.
  - An ability to communicate effectively with a range of audiences
  - An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- Specific Student Outcomes
  - An ability to develop new green computing techniques
  - An ability to improve existing green computing techniques
  - An ability to apply green computing paradigms to students' research domains