ECE 18-743 - Energy Aware Computing
Spring 2006 Syllabus

Course Overview

The purpose of this course is to cover a variety of aspects related to energy aware computing. While it is recognized that power consumption has become the limiting factor in keeping up with increasing performance trends, static or point solutions for power reduction are beginning to reach their limits. This course is intended to provide an insight into how various power reduction techniques can be used and orchestrated such that the best performance can be achieved within a given power budget, or the best power efficiency can be obtained under prescribed performance constraints. The paradigm of energy aware computing is intended to fill the gap between gate/circuit-level and system level power management techniques, by providing more power management levels and application-driven adaptability. **Recommended**: 15-213, basic compiler design and OS knowledge. **Prerequisites** - one of: 18-741, 18-760, 18-525, or instructor's consent.

What This Course Is About

This is a graduate-level, research-oriented course. In addition to attending lectures, you will be expected to read papers, make presentations or reviews on them and come up with critiques to current solutions or new solutions to open problems. A lot of emphasis will be placed on class discussions, interaction and Q&A sessions during paper survey presentations. Several thrusts will be addressed during the entire semester and will be available for further study within projects:

- Circuit, gate and register-transfer level power modeling and optimization
- Microarchitecture-driven power modeling and management
- Compiler-driven power management and software power analysis
- OS-driven power management
- System-level power modeling and management, including multi-core and SoC systems
- Special topics:
    - Energy awareness and uncertainty in design
    - Partially asynchronous systems
    - Ambient Inteligent Systems

Lecture Professor

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Web Page: http://www.cmu.edu/blackboard

Teaching Intern

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Course Administrative Assistant

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Course Hours:

Class meets:	Tuesday, Thursday 3:00 - 4:20 pm
Lecture room:	PH 225B

Textbooks

- No required textbook
- Recommended reading (you do **not** have to buy these books!):
  - Low Power Electronics Design, by C. Piguet (ed.) (ISBN 0849319412)
  - Power Aware Computing, by R. Melhem, R. Graybill (eds.) (May 2002, ISBN 0-306-46786-0)
  - Power Aware Design Methodologies, by M. Pedram, J.M. Rabaey (eds.) (June 2002, ISBN 1-4020-7152-3)
- Reading material will be distributed in class and/or will be available on the Blackboard electronically

Assignments/Grading

The course will be graded on a curve scale. Tentatively the 1000 points will be partitioned as:

- 300 points - homeworks (**no late homeworks** will be accepted)
- 150 points - paper presentation and discussion:
  - 100 for the presentation
  - 50 for the Q&A sessions after paper presentations
- 550 points - project:
  - 150 for each of the two intermediate project reports/presentations/demos
  - 250 for the final project report/presentation/demo

Homeworks

The primary purpose of the homeworks is to help you master the material and prepare for the projects and exams. We encourage you to work together with your classmates to help you understand the basic concepts. However, you are required to do your own homework. Homeworks are due at the beginning of class. **No late homework assignments will be accepted.**

Projects & Late Policy

The project is designed to 1) help you understand and synthesize all of the course concepts; 2) demonstrate your abilities at correctly stating and implementing the project's goals; 3) demonstrate your ability to explore and incorporate good engineering trade-offs in a system/subsystem implementation. Any project proposal, report or presentation can be submitted up to 5 days late, but is subject to a 10% per day late penalty. The 10% penalty is computed based on the *maximum* number of points, not on your actual achieved score. **No other extensions will be given**.

Web Pages and the Class Mailing List

Class web pages are on the Blackboard at **http://www.cmu.edu/blackboard**. Assignments, announcements, and class notes will be posted on these web pages. Announcements will also be posted on the Blackboard.

ECE Department and Course Policy on Cheating

We would like to promote a collaborative environment where people feel free to openly discuss and ask questions. However, when assignments are submitted, the work must be the author's own and any aid received from other people must be documented in the assignment. **Simply put, cheating is submitting work that is not your own; material handed in for grading must be the product of individual effort; anything else constitutes cheating**. **Cheating** in any form or shape will result in a **failing grade** for the course. **No exceptions will be made.** Students are referred to the University Policy about Cheating and Plagiarism.

Schedule

The schedule below is the tentative outline for lectures, homeworks, paper presentations and project.

Session	Date	Topic	HW	Paper presentation	Project
1	Jan 17	*Introduction*			
2	Jan 19	*Power consumption basics*			
3	Jan 24	*Gate/RT-level power modeling*	1 out		Project topics out
4	Jan 26	Paper presentations		Session I	
5	Jan 31	*Gate/RT-level power optimization/ management*			
6	Feb 2	*Energy awareness and uncertainty in design at gate/RT level*			
7	Feb 7	*Microarchitecture power modeling*	1 due/2 out		
8	Feb 9	Paper presentations		Session II	
9-10	Feb 14-16	`Project presentations`			First report, demo, and presentation due
11	Feb 21	*Microarchitecture-driven power management (core only)*			
12	Feb 23	*Partially asynchronous processors*	2 due/3 out		
	Feb 28	Out of town (no class)			
13	Mar 2	Paper presentations		Session III	
14	Mar 7	*Energy awareness and uncertainty in design at microarchitecture-level*			
15	Mar 9	*Microarchitecture-driven power management (memory system)*	3 due/4 out		
16	Mar 21	*Power modeling of software applications*			
17	Mar 23	Paper presentations		Session IV	
18-19	Mar 28-30	`Project presentations`			Second report, demo, and presentation due
20	Apr 4	*Compiler-driven power-management*	4 due/5 out		

Session	Date	Topic	HW	Paper presentation	Project
	Apr 6	Out of town (no class)			
21	Apr 11	Paper presentations		Session V	
	Apr 13	Out of town (no class)			
22	Apr 18	*System level power modeling*	5 due/6 out		
23	Apr 20	*System level power optimization and management*			
24	Apr 25	Paper presentations		Session VI	
25	Apr 27	*Sensor networks: Ambient intelligent systems*			
26	May 2	*Summary and directions for the future*	6 due		
27	May 4	`Final project posters and demos`			Final report due by May 5