ECE 751:
Embedded Computing Systems

Prof. Mikko Lipasti

Lecture notes adapted from Prof. Mike Schulte

Course Overview

Class Details

Class Times: 2:30 PM to 3:45 PM on T, R in 2305 ENGR HALL

Instructor: Prof. Mikko Lipasti, 3621 ENGR HALL, 265-2639
mikko@engr.wisc.edu

Office Hours: TBD or by appointment

Website:

http://ece751.ece.wisc.edu

Credits: 3 **Section:** 1

Prerequisites: ECE/CS 552 (Introduction to Computer Architecture)

Please complete course survey (should have received email):

https://docs.google.com/forms/d/17boCwK_C8oK6tU6fHngtAdurEintRxYh85oWOmGFHtE/viewform?usp=send_form

Goals

- The course goals to provide students with:
  - The skills and knowledge needed to better understand embedded computing systems and to initiate original research in this domain
  - Gain experience in designing and evaluating embedded processor architectures and microarchitectures.
  - An understanding of compiler and run-time software for embedded systems.
  - An opportunity to research embedded computing systems through a class project and presentation.

Course Description

- Examines recent research in high-performance embedded computing systems
  - *Emphasis on embedded processor architectures and microarchitectures*
  - Also covers embedded system design and simulation, embedded compilers and tool chains, run-time systems, and application design
- Places a large emphasis on
  - Reading and discussing research papers and textbook material
  - Working through real/practical examples
- Course project used to help you put the ideas from the course into practice

Course Textbook and Tools

- There is no required textbook for the course
  - We will rely on readings from the literature
- Useful reference texts include
  - Wayne Wolf, *High-Performance Embedded Computing*, Morgan Kaufman Publishers, Elsevier, 2007.
    - Textbook Website: http://www.waynewolf.us/hiperf-book/ Joseph A. Fisher, Paolo Faraboshi, and Cliff Young, *Embedded Computing: A VLIW Approach to Architecture, Compilers and Tools*, Morgan Kaufman Publishers, Elsevier, 2005
  - Wayne Wolf*, Computers as Components: Principles of Embedded Computing System Design*, 2nd Edition, Morgan Kaufman Publishers, 2005.
  - John L. Hennessy and David A. Patterson*, Computer Architecture: A Quantitative Approach*, 4th Edition, Morgan Kaufmann Publishers, 2006.

Course Research Papers

- About 30 research papers will be assigned
  - Typically two per week
  - Available from the course website
  - Read before coming to class & be ready to discuss
- Subset of papers must be reviewed in writing
  - Typically one per week
  - Review due dates will be posted on course website: typically the night before scheduled class discussion
  - Reviews must be uploaded to learn@uw dropbox

Research Paper Presentations

- Each student will be asked to lead discussion on a research paper
- Prepare 15-minute talk w/slides
  - Thoroughly understand, describe paper
  - Read 6-10 additional papers for full context
    - For newer papers, primarily citations from the paper
    - For older papers, also include newer papers that cite this one (find using Google scholar, ACM digital library, IEEE Explorer)
- Excellent practice for ECE PhD Qualifier

Course Grading [1]

Paper reviews and discussion:	25%
Paper presentations:	15%
Final exam:	20%
Course Project:	40%

Course Outline

- Introduction
  - Course introduction
  - Embedded system design goals
  - Categories of embedded processing
- Review of CPU concepts (please fill out survey)
- Microarchitectures for high-performance/low-power embedded computing
- Embedded software
- Memory architecture for high performance embedded computing
- Embedded Multiprocessors
- Accelerators and peripheral processors
- Design and Modeling tools and methodologies

Project [1]

- For the course project, you will be expected to complete original work related to embedded systems in teams of three or four students.
- Projects will consist of a proposal, status report, final report, and short presentation.
- You are encouraged to come up with your own topic for the project, but will be provided with a list of possible ideas.
- Projects can consist of an in-depth survey, original research, and/or hardware or software development related to embedded systems.

Project [2]

- The class project counts for 40% of the overall grade.
- Students will be expected to turn in a summary of the contribution to the project to facilitate fair grading to individual team members.
- Additional details on the course projects will be provided in a separate document.

Other Items

- **Plagiarism:** using someone else's ideas, words, figures without proper acknowledgement
  - Is illegal and not allowed in this class
  - Be sure to phrase statements in your own words and cite appropriate references directly in the text
  - Failure to do so will result in severe grading penalties
- **Communication:**
  - Questions and comments during class are encouraged
  - I encourage you to meet with me during office hours
  - I will frequently email the class
  - When sending email include **ECE751** in subject

Next Steps

- Visit course website ece751.ece.wisc.edu
- Read over first two papers (no reviews)

[1]T. Austin, D. Blaauw, S. Mahlke, T. Mudge, “Mobile Supercomputers,” IEEE Computer, vol. 37, no. 5, pp 81-83.

[2]P. Kocher, R. Lee, G. McGraw, A. Raghunathan, S. Ravi, “Security as New Dimension in Embedded System Design,” DAC 2004.

- Course website has a lot of material with copyrights – do not post or distribute