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TOPICS IN COMPUTERS I

Hardware/Software Codesign of Embedded Systems

ELG7186D (EACJ5807)
Carleton CRN: 15998

Winter 2010

Professor: Dr. Voicu Groza

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Schedule:

Monday	LEC	19:30-21:00	CBY	Room: E016
Wednesday	LEC	19:30-21:00	CBY	Room: E016
Office Hours: Wednesda, 15:30-19:30				

Goals: To introduce issues and methods for the specification and design of embedded computing systems, to present techniques for codesign.

Course Description

Hardware/software specification and system modeling. Architecture selection. Embedded systems hardware and software components. Hardware/software partitioning. Co-synthesis and code-generation techniques. Interface analysis and synthesis. Co-simulation and co-verification. Rapid prototyping. Reconfigurable System-on-Chip.

Prerequisites for the course is basic knowledge in: computer architecture, digital design, software design, and embedded systems.

References

1. Peter Marwedel, "Embedded System Design," 2nd edition, Springer: Paperback, 2006, 258 pp. ISBN-10 0-387-29237-3; ISBN-13 978-0-387-29237-3
2. Daniel D. Gajski, Franck Vahid, Sanjiv Narayan, Jie Gong, "Specification and Design of Embedded Systems," PTR Prentice Hall, Englewood Cliffs, New Jersey 07632, 1994, ISBN 0-13-150731-1
3. Wayne Wolf, "Computers as Components. Principles of Embedded Computing Systems Design," Morgan Kaufmann, 2002, Elsevier Science ISBN: 1-55860-541
4. Tim Mikkelsen, "Embedded Computers In Electronic Instruments," from "Standard Handbook Of Electronic Engineering," The McGraw-Hill Companies, 2004
5. A. Jantsch, "Modeling Embedded Systems and SoC's - Concurrency and Time in Models of Computation," Morgan Kaufmann, 2003.
6. Sao-Jie Chen, Guang-Huei Lin, Pao-Ann Hsiung, Yu-Hen Hu., "Hardware software co-design of a multimedia SOC platform" [electronic resource], Dordrecht : Springer-Verlag, 2009.
7. Frank Vahid, Tony Givargis. "Embedded system design : a unified hardware/software introduction," New York : Wiley, c2002.

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Marking Scheme

- **Assignments (15 %)**
 - One or two assignments, dealing with co-design methodologies and/or tools will be given out to familiarize the student with system modeling
- **First project task (15 %)**
 - This task involves a literature review of an agreed upon topic, preferably in line with the student's research
 - A paper presentation is given to the class discussing one of the literatures surveyed in the first project task. This will be scheduled for sometime in the middle of the semester.
- **Second project task (35 %)**
 - This task complements the first one, through the design, simulation and/or implementation of the chosen topic. The student is free to utilize any available tools and languages to carry out the research.
 - A presentation outlining the project's details and results is given to the class. Each student is required to choose at least one of the presentations (paper or project)
- **Final examination (35%)**

Course Outline

1. Introduction: concurrent engineering
2. System specification: models (State Machines, Codesign FSM, StateCharts, Petri-Nets, Communicating Sequential Processes, Synchronous Dataflow) and languages.
3. Hardware/Software components and architectures of embedded systems
4. Optimization techniques: Pareto Points, Genetic Algorithms, Hill Climbing, Simulated Annealing, Tabu search
5. System-level synthesis: architecture selection. HW/SW partitioning (cost functions, performance metrics, constraints), behavioral synthesis and co-simulation.
6. Interface analysis and synthesis.
7. Hardware and software synthesis.
8. Co-Verification and rapid prototyping of hardware/software systems. HW/SW codesign environments.
9. System-on-Chip and Reconfigurable Computing