High-Level Design of HW/SW Systems

EECE7368
Fall 2015

Instructor: **Prof. Gunar Schirner**
Office: 328 Dana Research Center
Northeastern University
Phone: +1 (617) 373 5707
Email: schirner@ece.neu.edu
Please include "**EECE7368**" in the subject and use a Northeastern email ID. Both help categorizing the email.
Office Hours: **Tuesdays and Fridays 4:45pm - 6:00pm**

Lectures: **Tuesdays: 11:45am-1:25pm**
Thursday: 2:50pm - 4:30pm
Location: **Shillman Hall, Room 325** (building 30 on map)
Web page: on Blackboard, plus online forum on blackboard Discussion Board

Course Overview

System complexities are growing exponentially driven by ever increasing application demands and technological advances that allow us to put complete multi-processor systems on a chip (MPSoCs). System-level design that jointly covers hardware and software is one approach to address the associated complexities in the design process and the market pressures. This course presents state-of-the-art methods, tools and techniques for system-level design and modeling of complete multi-processor systems from specification down to implementation across hardware-software boundaries. Using the SpecC language and the System-On-Chip Environment (SCE), we will specify, simulate, analyze, model and design hardware-software systems based on examples of typical embedded applications.

Topics

- Overview of Embedded systems, electronic system-level (ESL) design
- Models of Computation: FSMs, dataflow, process networks
- Introduction to System-level design languages (SLDLs): SpecC, SystemC
- Discrete event simulation semantics
- Specification, profiling and analysis of HW/SW systems
- System-level design methodologies and tools for:
  - Partitioning
  - Scheduling
  - Communication synthesis
- System-level modeling:
  - Transaction-Level Modeling (TLM) for communication
  - Processor and RTOS modeling
- Embedded hardware and software implementation: synthesis and cosimulation
- System design examples and case studies.

Prerequisites

- EECE 7205 - Fundamentals of Computer Engineering
- Working knowledge of C/C++, algorithms and data structures
- Working knowledge of operating systems (preferably real-time operating systems)
- Understanding of digital systems and computer architecture
- Familiarity with Unix

Textbooks

Primary

- D. D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, **Embedded System Design: Modeling, Synthesis, Verification**, Springer, September 2009. ISBN 978-1-4419-0503-1 *link*
- Resources on the web, see tab References on Blackboard

Optional

- Gerstlauer, R. Doemer, J. Peng, D. Gajski, "**System Design: A Practical Guide with SpecC**", Kluwer Academic Publishers, Boston, June 2001. ISBN 0-7923-7387-1 *link*
- T. Groetker, S. Liao, G. Martin, S. Swan, "**System Design with SystemC**" , Kluwer Academic Publishers, Boston, May 2002. ISBN 1-4020-7072-1 *link*
- Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition, http://LeeSeshia.org, ISBN 978-1-312-42740-2, 2015.

Programming and Homework Assignments

There will be several programming assignments mostly using the SpecC programming language (some in SystemC). The programming environment and compilation tools will be provided in the Engineering Computing Center of the College of Engineering (room 274 SNELL). They are Linux-based and remotely accessible. Details of for accessing the tools will be provided, as well as details on submitting the homework. Assignments are due at noon time 12pm on the due date. Late homework submissions or assignments will not be accepted. Your code will be graded on how well it accomplishes the assignment, readability and completeness. Each programming and homework assignment has to be an *individual* contribution unless otherwise stated. Please see "Academic Honesty" below.

Midterm

We will be a midterm in class, tentatively Thursday 11/24/2015.

Final Project

This course will include a final project about modeling a SoC design at different levels of abstraction and which shows some design space exploration. Each student is expected to complete an *individual* project (unless explicitly noted otherwise), which must include a comprehensive final report. The project report is due at the start of finals week. Intermediate milestones and deadlines will be defined. The details of the final project will be discussed in class.

Grading

Programming and Homework Assignments:	40%
Midterm:	30%
Final Project:	30%

Academic Honesty

Plagiarism, cheating, and any form of unauthorized collaboration will not be tolerated and will be handled in accordance with University policies described in the Student Handbook. You are expected to be familiar with the University's policies about academic honesty: http://www.northeastern.edu/osccr/academichonesty.html.

Although students are encouraged to discuss some homework assignments and work together to develop a deeper understanding of the topics presented in this course, submission of others' work, efforts, or ideas as your own is not permitted. Each student is expected to prepare and submit his/her own programs, reports, drawings, and other materials unless otherwise designated as collaborative work.

Copying and sharing of student work such as computer files, documents, spreadsheets, or drawings is not allowed. If multiple students' work is suspiciously similar, a penalty may be assessed to all students involved. If a situation arises in which you are uncertain whether cooperation with another student would constitute cheating or some other violation of the honor code, please ask the instructor for guidance and clarification of these rules. Any evidence of cheating will be referred to the Office of Student Conduct.

[Thanks to Prof. Leeser for the academic honesty policy.]

Other Class Policies

For questions about class material including assignments, please use the Discussion Board on Blackboard. You may get an answer sooner, and it gives your fellow classmates the opportunity also benefit from your learning experience. I highly encourage you to read the Discussion Board and also answer questions to help your classmates.

The issuance of incomplete grades will strictly follow the College of Engineering guidelines. An incomplete will only be given for missed work at the end of the term due to illness.