CSE498V/598V Computer-Aided Design of Digital Systems

Fall, 2003

Class: Room 3315
Tues. & Thur. 9:30am - 10:45am

Instructor: Dr. X. Sharon Hu
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Office Hours: Tues. & Thurs. 11:00am - 12:00pm

Required Texts:

- G. De Micheli, *Synthesis and Optimization of Digital Circuits*, McGraw–Hill, 1994.
- Papers selected from relevant journals and conferences in the topic areas.

Recommended Reference Texts:

- Sabih H. Gerez, *Algorithms for VLSI Design Automation*, John Wiley & Sons, 1999.
- T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms*, 2nd edition, McGraw-Hill, 2001.

Course Overview and Objectives

With state–of–the–art design tools it is possible to design Systems–On–a–Chip (SOCs) featuring more than 100 million gates with device feature sizes of $\leq 0.18\mu m$. As a result, complex systems like cell phones, PDAs (Personal Digital Assistants), digital cameras etc. can potentially be integrated onto only one single chip, thus facilitating low chip production costs, low power consumption etc. However, these state–of–the–art design tools are not "push–button" tools. In order to obtain optimum results it is crucial for a designer to understand the underlying algorithms. Only then the designer is able to exploit the whole potential of those tools resulting in designs that fulfill the given constraints.

This course intends to expose students to the fundamental concepts and algorithms behind computer-aided design tools. The course starts with discussing the role of synthesis, the meaning of hierarchy and abstraction and a review of basic algorithmic techniques. The three levels of synthesis that are subject of this course, are: Logic Synthesis, Architectural Synthesis and System Design. In the *Logic Synthesis Section*, students will learn the difference between two-level logic and multiple-level logic as well as specific optimization and transformation algorithms. As for the section on *Architectural Synthesis*, scheduling, resource binding and resource sharing, data path synthesis and controller synthesis etc. will be handled. The third part, *System Design*, finally deals with the design and synthesis of whole systems and various design methodologies. Since low power design is becoming an increasingly important design goal, the latter part will focus on low power design issues.

At the end of this course, students are expected to be able to:

- implement basic synthesis and optimization algorithms for scheduling, allocation etc. in a high–level language like C or C++,
- judge the complexity of various synthesis/design algorithms that are part of commercial synthesis/design tools,
- understand the optimization steps in selected synthesis/design tools and thus choosing the right design steps/parameters in order to fulfill the given design constraints, and
- use and purchase the right synthesis/design tool for a given design project

Course Policies and Procedures:

- The lectures will be presented mainly on transparencies. Class Notes will be made available before each lecture and the students are responsible to print and bring the notes to class.
- The class will have two exams, regular homework assignments, as well as a project. Details of the exams and the project will be provided later.
- Only under unusual circumstances (medical excuse or prior instructor approval) can a make-up tests be considered. Otherwise, a zero point will be counted towards your grade.
- Homework should be turned in prior to the start of the class on the due date. No late homework will be accepted. Homework solutions will not be posted, and you are responsible for finding out how to solve the problems before or after they are due.
- Class presentation is also part of this class. You will be given papers throughout the semester and are required to digest them and present them in class. You are also expected to raise questions when others present. The guidelines for this exercise will be distributed with the papers.

Grading Guidelines:

- Inquiries about graded homework and tests will be accepted only if made **within one week** after they are handed back. Such inquiries should be made in writing, which clearly explains the complaints. Only after reviewing the written complaints, can the instructor make any grade adjustments.
- Grade components:

Exams	55%
Homework	25%
Project	15%
Class participation	5%