Introduction to theory and techniques to shift digital circuit design verification to earlier stages of development. Topics include an introduction to pre-silicon validation, emulation, formal verification, system specification and verification. Familiarity with computer architecture and hardware description languages required. A design project is an integral part of this course.

Students will gain experience using different techniques used to validate modern digital designs. The course will cover theory and methodology followed by hands on experience with emulation and formal methods. The course material complements other ECE pre-silicon and post-silicon functional validation courses.

Prerequisites: ECE 351 and ECE 371 or permission of instructor.

Course Coordinator/Instructor: Tom Schubert
Office Hours: Wednesday 12-1 and Friday 1-2, or by appointment
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TA (for Emulation): Sameer Ghewari (office hours TBD).

D2L website active: Lecture notes, papers, homework assignments and dropbox, announcements, etc

Required Texts and/or Required Reading List (all materials online)
- Specifying Systems, Leslie Lamport
- PSU ECE Veloce Documentation Website (access restricted to Students in the class)
- Multiple Papers

Outline of Course Content
- Design verification principles overview
  - Problem definition and solution strategies
  - Product lifecycle and risk management
  - System Verilog Assertions
  - Methods for design stimulus, checking, and coverage
- Emulation
  - Veloce system and tools
- Formal Methods
  - Protocol and Architecture Specification using TLA+ language and TLC verification tool
  - Formal Verification: theory; BDD and SAT based verification; assertions, assumptions and covers

Student Learning Outcomes
1. Knowledge of role of validation in modern digital design projects
2. Knowledge of formal verification theory and application to digital design
3. Knowledge of emulation techniques as a complement to simulation
4. Ability to test digital designs using emulation technology
5. Ability to use formal verification tools to model and validate evolving architecture ideas
6. Understanding of the central nature of validation and the need for a structured, measured approach
Course requirements
  - Midterm (20%), Final (25%), Project (30%), Homework (25%)

There will be approximately 5 homework assignments. To pass the course, each assignment must be turned in on or before its due date. Some assignments may be done in groups. If you choose to work in a group, please turn in only one solution, indicating the names of all group members. Of course, individually, you will be expected to understand the material and demonstrate so on exams.

Some of the solutions might be obtained from previous classes. Using such solutions is very counterproductive! To pass exams, you'll need to develop analysis skills by working through problems. More importantly, working through the problems yourself, discussing in groups, or with the TA or me is the best way to learn the material. I strongly encourage you to come to my office hours after struggling and we’ll work out the correct answer together.

Project: The project is an important educational complement to the material presented in lectures. A good project will encounter problems that will require some research to find a solution. We'll discuss the project in more detail in a few weeks, but you should soon start thinking about possible projects. While I am receptive to projects either exploring formal methods or emulation, previous classes have opted for emulation based projects. To complete the project, the first step is to identify a design to verify. The design needs to be sufficiently complicated to require significant testing such that you can insert a subtle error in the design that might be difficult to catch. You are welcome to create a new design from scratch, though I recommend students start with a pre-existing Verilog design, possibly one you’ve created from another class (e.g. ECE585). I also encourage students to work in groups of 2-3 people. Students are expected to orally present their projects as well as turn in a written report.

ECE 510 paper requirement: For graduate students, there is an additional requirement to write a paper critiquing 3-4 technical papers (roughly 1 page per paper). I will provide some suggestions, but students are also welcome to propose other papers as well.

Professionalism:
In our worldwide discipline, we must work with many men and women from different cultures, races, sexual preferences, religions, political affiliations, etc. To pass this course, each student must demonstrate they are a good team player. Students are expected to work/learn in a harassment free environment with the highest professional standards.

Academic Honesty: I enjoy teaching very much and consider students to be future colleagues. Thus plagiarism is an extremely depressing thing for me to encounter and will be taken very seriously. Plagiarism is definitely not just a harmless prank. It can have very serious effects, harmful to your standing at the university, and also possibly very harmful to your job prospects when you seek employment after graduation. The penalty for plagiarism is an F in the course and a letter describing the incident sent to the Vice Provost for Student Affairs. Please avoid any actions during an exam (e.g. talking, looking around, etc.) which might make the exam proctors doubt your honesty.

Please also view PSU’s Student Code of Conduct at http://www.pdx.edu/dos/codeofconduct

Doing Well: Lectures cannot cover all aspects of the material. Much of the detail will be learned through exercises or supplied by consulting the book and other online material. Ask me about anything that you don’t understand, no matter how minor it seems. I recommend actively attending lectures. This is not a video/distance learning class. Though the class is recorded, it is automated and isn’t a perfect system---sometimes there are audio problems or a lecture cannot be posted at all. You are responsible for learning the lecture material regardless. Most lectures will be interactive or include interactive small group discussions that are not well captured by recordings. Finally, note that grading is non-competitive, so it is possible for everyone to do well.