

ECE 4930/6930 Algorithms for VLSI Design Automation

Spring 2020

General Information

Instructor: Yingjie Lao (ylao@clermson.edu)

Office: Riggs Hall 313B

Office Hours: Tue/Thu 2:00pm-3:00pm or by appointment

Class Time: Mon/Wed 3:35pm to 4:50pm

Location: Rhodes Annex 111

Grader: Xiaojia Wang (xiaojw@g.clemson.edu)

Office Hours: Friday 1:00pm-3:00pm or by appointment

Objective

This course is intended to be an introduction to computer-aided design (CAD) algorithms that are used to automate the design of very large scale integrated (VLSI) circuits. These tools are one of the pillars supporting the VLSI revolution. This course briefly discusses some related mathematical topics such as graphs, data structures, algorithms and heuristic techniques. We focus on the class of designs, called Application Specific Integrated Circuit (ASIC), where the goal is to go from a high-level design specification down to a mask layout correctly, automatically, and efficiently. At the completion of the course, students should be able to understand VLSI design flow and CAD algorithms used in the design process.

Course Text

We will not be using a formal text for this class. Course materials will be provided on the class Canvas site.

Reference Reading Material

L. T. Wang, Y.-W. Chang, and K.-T. Cheng, eds., *Electronic Design Automation: Synthesis, Verification, and Test*, Morgan Kaufmann, San Francisco, CA, 2009. ISBN: 978-0123743640.

Course Topics (subject to change)

- Introduction to Computer-Aided Design (1 week)
- Data Structure and Basic Algorithms (2 weeks)
- Graph Theory (2 weeks)
- Routing (1.5 weeks)

- Partitioning (1.5 weeks)
- Floorplanning (1.5weeks)
- Placement (1.5weeks)
- Logic Synthesis (2 weeks)
- Timing (2 weeks)

Mini-Projects

The class requires an understanding of algorithms used in VLSI design tools. Achieving a reasonable level of understanding is only possible by developing the ability to implement some of these algorithms in software. This is what you will do as part of this course: programming mini-projects are an integral part of this class. It is assumed that all students have some background in programming. The preferred programming language is C/C++.

Evaluation

<p>Undergraduate:</p> <ul style="list-style-type: none"> • Homework (20%) • Projects (25%) • Midterm Exams (30%) • Final Exam (25%) 	<p>Graduate:</p> <ul style="list-style-type: none"> • Homework (20%) • Projects (40%) • Midterm Exams (20%) • Final Exam (20%)
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Graduate students are required to complete an extra or more challenging mini-project.

Grading

No late homework or mini-project is allowed!

All exams will be open book, open notes, with no computers or objects with transmission/reception capability allowed.

A 100% scale will be used.

Undergraduate Students: A – 85% to 100%; B – 75% to 85%; C – 65% to 75%; D – 55% to 65% & F – < 55%

Graduate Students: A – 85% to 100%; B – 75% to 85%; C – 65% to 75%; & F – < 65%

I reserve the right to curve test scores in situations that I deem warrant such. Curving test scores is NOT a given.

Policies

- You are responsible for all assigned readings and information presented in class and on class Canvas site, including important announcements, due dates, assignments, exams and so forth.
- Regular class attendance is strongly recommended. Every attempt will be made to announce class cancellations in advance. A time for make-up lectures will be determined. Students may leave after 15 minutes if no one shows up to teach a class.
- Cheating of any kind is extremely serious and may result in a course grade of F and/or expulsion from the University.
- Discussion is ok, but plagiarism is not. You can discuss homework or mini-projects with your colleagues but *the solutions you turn in must clearly be your own*.
- Collaboration on exams is NOT ok!
- No "Incomplete" grades will be given for the class, except under verifiable extraordinary circumstances.
- Exams must be taken on the date and time at which they are administered in class. A student absent from a test will receive a grade of 0 for that test. In case of compelling reasons (as judged by the instructor), the instructor will make an effort to accommodate the student, but this should be a last resort. Note: valid excuses MUST be presented to the instructor before or within three days of the missed test or exam. No exceptions will be accepted.
- Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather related cancellation.
- Any student who disagrees with the grading of a homework assignment, project, or exam must contest the grading within one week of the date on which the graded material is returned to the class. This must be done by returning the original graded material to the instructor accompanied by a *written* description of the student's disagreement that is sufficiently detailed to allow accurate consideration of the claim.
- You are not permitted to submit extra work in an attempt to raise your grade.

The syllabus is subject to change based on extenuating circumstances or at the instructor's discretion.

Attendance

In the event of an emergency, students should contact the course instructor, preferably before class or the exam. Students should speak with instructors regarding any scheduled absence as soon as possible and develop a plan for any make-up work, if allowed by the instructor. It is the student's responsibility to secure documentation of emergencies, if required by the instructor. A student with an excessive number of absences may be withdrawn at the discretion of the course instructor.

If the instructor is late, students are expected to wait 15 minutes for the instructor to arrive.

Any further attendance policies in place will be listed on the course specific syllabus and will serve to supplement these policies.

Notification of Absence

The Notification of Absence module in Canvas allows students to quickly notify instructors (via an email) of an absence from class and provides for the following categories: court attendance, death of family member, illness, illness of family member, injury, military duty, religious observance, scheduled surgery, university function, unscheduled hospitalization, other anticipated absence, or other unanticipated absence. The notification form requires a brief explanation, dates and times. Based on the dates and times indicated, instructors are automatically selected, but students may decide which instructors will receive the notification. This does not serve as an "excuse" from class, and students are encouraged to discuss the absence with their instructors, as the instructor is the only person who can excuse an absence. If a student is unable to report the absence electronically, he/she may call the Office of Advocacy and Success at 864-656-0935 for assistance and guidance.

The Office of Advocacy and Success also assists students in identifying various appropriate methods of documenting absences and assists families in using the electronic Notification of Absence system when students are unable to do so themselves.

Academic Continuity Plan

In the event the physical classroom facility becomes unavailable, as determined by the University's administration, class will be conducted in a virtual (online) format. The University issues official disruption notifications through email /www /text notification/social media. When notified, use one of the following links to navigate to Clemson Canvas where you will find important information about attending class:

- Primary access link: <https://www.clemson.edu/canvas>
- Secondary access link, if needed: <https://clemson.instructure.com>
- You can also use the Canvas Student App.

February 19, 2020, has been declared an E-Learning Day by the university. A real-time test of the Academic Continuity Plan will be conducted.

Inclement Weather Policy

Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather related cancellation.

Academic Integrity

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity.

Further information on Academic Integrity can be found in the [Undergraduate Announcements](#) and in the [Graduate School Policy Handbook](#).

Access Accommodations

Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to this class should let the professor know, and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen if possible, but there could be a significant wait due to scheduled appointments. Students who receive Academic Access Letters are strongly encouraged

to request, obtain and present these to their professors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: <https://www.clemson.edu/academics/studentaccess/index.html>.

Anti-Harassment and Non-Discrimination

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This policy is located at <http://www.clemson.edu/campus-life/campus-services/access/title-ix/>.

Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 110 Holtzendorff Hall, 864.656.3181 (voice) or 864.656.0899 (TDD).

Emergency Procedures

Emergency procedures have been posted in all buildings and on all elevators. Students should review these procedures for their own safety. Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

- Ensure you are signed up for emergency alerts: <https://www.getrave.com/login/clemson>
- Download the Rave Guardian app to your phone: <https://www.clemson.edu/cusafety/cupd/rave-guardian/>
- Learn what you can do to prepare yourself in the event of an active threat: <http://www.clemson.edu/cusafety/EmergencyManagement/>

Copyright Statement

Materials in some of the courses are copyrighted. They are intended for use only by students registered and enrolled in a particular course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: <https://clemson.libguides.com/copyright>.