Computer Science 141: Computing Hardware
Course Information – Fall 2015

September 1, 2015

1 Outline

The main emphasis of this course is on the basic concepts of digital computing hardware and fundamental digital design principles and practices for computer systems. This course will cover topics ranging from logic design to machine organization and will address the impact of hardware design on applications and system software.

An integral component of this course will be a sequence of hands-on hardware laboratory assignments where you will build digital circuits using simple logic gates and make use of some common software packages for Computer-Aided Design (CAD) and FPGA-based prototyping. Through these laboratory assignments, you will learn how to design, test, and construct complex hardware systems that interact with the real world.

There is overlap between *CS 141* and *Physics 123*. If you have questions about which course you should take, please feel free to see Professor Brooks. *CS 141* is more focused on computer architecture and machine organization while *Physics 123* (and *ES 154*) addresses the design of practical analog and digital circuits. *CS 141* is good preparation for students interested in computer architecture (*CS 146/246*) and VLSI (*CS 148/248*).

2 Administrative Information

Lectures:	Monday, Wednesday 1–2:30pm in Maxwell Dworkin G125
Laboratory:	TBA, 2-3 hours on Thursday or Friday in Maxwell Dworkin Basement Lab
Instructor:	Professor David Brooks (`dbrooks@eecs.harvard.edu`) 141 Maxwell Dworkin, 495-3989
Course Admin:	Carol Harlow (`harlow@seas.harvard.edu`) 343 Maxwell Dworkin, 496-1440

Preceptor: Avinash Uttamchandani (`avinash@seas.harvard.edu`)

TFs: Saketh Rama (rama@seas.harvard.edu)
Brandon Reagen (reagen@fas.harvard.edu)
Sam Xi (samxi@seas.harvard.edu)

Regular office hours and lab-specific office hours will be posted on the course website.

3 Course Prerequisites

CS 50 is the formal prerequisite for this course. *CS61* is helpful preparation but not required. An understanding of binary numbers and some knowledge of basic electronics are helpful but not necessary. If you have any questions about your preparation, please contact Prof. Brooks directly.

4 Course Requirements

Lectures

While attendance at lecture is not required, it is encouraged. In addition, while some lecture note handouts will be provided, they are not complete nor guaranteed to be correct nor a substitute for attending lecture.

Sections

We will arrange *non-weekly* sections that will be led by one of the TFs. The section will discuss additional material and examples that cannot be covered during the lecture. Again, attendance is not required, but is encouraged, as the material will be helpful for weekly assignments and exams.

Regular Assignments

Assignments consisting of a Problem Set and associated Hardware Lab will be assigned most weeks of the class.

Problem sets

Problem sets are due at the **beginning** of the specified class section, unless otherwise noted. Problem sets should be done individually.

ELECTRONIC SUBMISSION RULES: Problem sets may either be submitted as a hardcopy or electronically to harvard.cs141.hw@gmail.com. We strongly encourage you to turn in a hardcopy in class if possible. This course requires many circuit diagrams, which past students have preferred to draw by hand. If you submit electronically, you **MUST** obey

the following rules. Failure to comply may result in you receiving a zero on that assignment.

- Subject line: [Homework #][Name]
- Attach your homework as a single PDF file. Do not attach multiple files, one per page.
- Handwriting must be legible. Illegible text will receive a zero for that problem.
- Your homework must be scanned using a proper scanner. DO NOT use phone apps like CamScanner or simply take photos of each page. If you do so, you WILL receive a zero. There will be no exceptions.

Please see the *Policy on Late Problem Sets and Missed Labs* below.

Hardware Labs

Associated with each weekly assignment will also be a hardware lab that you will work on with an assigned partner. Pre-lab assigments are considered part of your normal weekly assignments and need to be completed before you attend the lab sessions. Please make sure that you are fully prepared when you come to lab. You and your partner will have only 2 hours (or less) in lab to complete and demonstrate your work to the TF. A lab pair will turn in a single copy of the lab. It will be up to you and your partner to distribute work appropriately, but everyone is responsible for understanding the entire lab. During the demo, the TF will ask both of you individual questions about the lab, and grades will be assigned separately based on your individual responses to the question. Do not let the first few labs lull you into a false sense of security; you will not be able to complete the later labs if you have not done the pre-lab work and fully prepared for lab. Note that your TF will check to make sure that you have completed the pre-lab work before lab. You must complete all of the lab assignments (please see the *Policy on Late Problem Sets and Missed Labs* below).

Examinations

There will be an in-class midterm examination in mid to late October. There will be a take-home final examination at the end of the class.

Policy on Late Problem Sets and Missed Labs

The Late Problem Set policy is that each student has 3 "late days" which can be used at any time throughout the semester. These days can be used in any combination (e.g. 1 day for 3 assignments, or 3 days for 1 assignment). A late day is defined as 24 hours from the

original deadline. However, solutions will be made available three days after the deadline and problem sets will not be accepted after solutions are posted.

Late days **cannot** be used for labs.You are expected to attend your assigned lab section and to work with your assigned lab partner. If you must miss your lab section on a particular week, we will attempt to accommodate you in another lab section during that same week. Please contact your TF and your lab partner **in advance** of your absence! In those rare instances where you have a valid reason for missing an entire week, you will be allowed to make up the lab in the following week (realize that this means you will have to do two labs in one week). At the end of each week, a reference solution to the lab will be posted which can be used by students to work on the subsequent weeks lab.

Policy on Cooperation

Please feel free to discuss the problem sets and labs with other class members and the teaching staff, but always turn in only your own work. The exception is that lab assignments will be a single joint submission between you and your partner. It is in your best interest to understand the problem sets and the laboratories for the midterm and final exams.

5 Grading

Your final grade will be based roughly on the following weighting of your course work:

20%	Midterm Exam
20%	Final Exam
20%	Problem Sets
40%	Hardware Lab Work

6 Reading

Required Text

David M. Harris and Sarah L. Harris. **Digital Design and Computer Architecture.** Morgan Kaufmann.

Recommended Texts

John F. Wakerly. **Digital Design Principles and Practices.** Prentice Hall.

David A. Patterson and John L. Hennessy. **Computer Organization & Design: The Hardware/Software Interface.** Morgan Kauffman.

Randy Katz. **Contemporary Logic Design.** Benjamin/Cummings.

Educational Software

Software will be provided to compile designs onto the FPGA prototype boards.