Motivation. Modern computer systems are designed and implemented as a hierarchy of sophisticated virtual machines. At the high end, these machines are implemented by compilers and operating systems. At the low end, digital logic components and microprogrammed interpreters are found. The goal of this course is to make you familiar with the structure and implementation of the virtual machines found at the lower levels: the machine language level, the microprogramming level, and the digital logic level. All this will make you better at whatever you do.

Organization. We will switch context between several lecture threads (e.g. C programming, assembly, and logic) throughout the semester. The lectures are organized in this way so that you will have the opportunity to study and understand each topic before we study more advanced aspects of any closely related topic.

Work. You can expect me to assign significant work, at least once per week. Now is a good time to become reasonably proficient in C, an important language for any computer scientist to understand thoroughly. We will initially be experimenting with C-based exercises developed on Unix boxes. I believe that Kernighan and Ritchie (ISBN 0131103628) is the best source. I've put copies of “K&R” on Schow reserve, but with knowledge of Java almost any book or on-line tutorial on C will be sufficient. I will provide all the information you need to learn the Intel x86-64 instruction set. Logic design projects will be completed using software, or directly on breadboards. If you attend classes and labs, you will have the materials you need. A substantial project will be assigned during the last few weeks of the semester. This assignment is expected to take a considerable amount of time and you should be prepared to rededicate yourself to this course from the midterm onward.

Week of | Monday | Wednesday | Friday | Lab
---|---|---|---|---
September 4 | 1. C | | | |
September 18 | — | — | 5. x86-64 | II. C
September 25 | 6. Assembly | 7. Assembly/Logic | 8. Logic | III. Assembly
October 9 | Reading | 11. Gray Codes | 12. K. Maps | —

47 Hour Take Home Midterm: November 8-November 10

November 6 | 22. Pipelines | Midterm Out | Midterm In | VIII. WARM
November 20 | 26. Exceptions | Thanksgiving Break | | Project: WAVE

Final exam: December 14, 1:30pm

He went to the ballpark every day
and he let them know he came to play.
—epitaph for a professor
Honor. Since the material in this course is highly technical, I consider it important and beneficial that you freely share information of a technical nature with other members of this class (students, faculty, TAs, and tutors) when working on assignments. All other collaboration is prohibited. I will address this in more detail in class and before individual assignments, as needed.

Dedication. A Williams-style education requires both you and me to ask and answer probing questions. Your obligation is to see me when you need help. My obligation is to challenge you to develop tools to solve problems you may encounter in environments that we cannot yet imagine. I put a lot of effort into this course; I expect no less from you.

Reward. Regular assignments (labs and C programs) will account for 25% of your grade, the final project 25%, and the midterm and final will be 25% each. Class participation may sway your grade (either direction) by as much as 5%.

Reflection. The following comments are sent to you from alums of previous classes:

";;; # /* */
* You have one week to add/drop. Good luck!!!
* "Call your mother and tell her you love her." *
"Buckle up, but enjoy the ride." * "Count the number of times in this course that you say to yourself, ‘Wow! That’s so amazingly cool!’ You will be surprised." * "Unite. Work with each other. Work with Duane.... Be happy. Be engaged.... Good luck!" * "Start now, no excuses." * "Get started on those labs early, for the love of all that is good in this world!" * "Don’t forget to shower...personal hygiene is never on vacation." * "Listen...and take every word as the ultimate truth." * "Learn the debugger." * "Time spent practicing emacs...is time well spent." * "This course taught me how important office hours are." * "Go...even if you don’t need help, you probably do." * "Ask about things in Duane’s office." * "Get help immediately when you don’t understand seemingly unimportant concepts; they’ll become crucial later." * "You will get more zked after taking this course." * "You cannot start the WAVE early enough." * "Once you finish one iteration you won’t be able to stop thinking of every tiny improvement that can be made." * "The man is crazy." * "Embrace the craziness...fighting it only distracts you." * "Don’t hack." * "Be hacky, but not too hacky." * "Don’t worry, Duane’s lectures will seem less crazy as the semester progresses." * "Duane expects the best in you, so should you." * "When in doubt, ask Duane." * "Keep your eyes fixed on the blackboard...Do NOT Look Away." * "Do laundry when the project starts. You won’t have time later." * "Push yourself." * "Engage yourself in the labs and project. They are really cool." * "Spend time in lab, you won’t regret it." * "Nothing scares me more than what is inside a computer." * "I am a cow." * "Start on the project early." * "TA hours: always. Office hours: even more." * "Ask Duane. He will give you the answer." * "Ask about nums." * "Mention BBQ." * "Get Duane to tell stories..." * "Do what you can...it’s not all or nothing...then you can learn." * "Start EARLY." * "Get sleep early in the semester." * "Sleep is good for the brain." * "Start on the 9 programs early." * "The time is right now." * "Think: If this crashes once every billion times, that’s several times a second...." * "Duane and the TAs have your back." * "Duane will lie to you." * "When your program doesn’t work, print it out, take it home, and don’t think about it. You’ll get inspired." * "Force yourself to really think." * "When you start to develop a nervous control-k finger twitch, seek help." * "Learn to hate multiplication." * "The key to this class is organization." * "Work in the lab not in the dorm. Somebody will understand your problems." * "There will be a time where your only friends are the people in the lab. Embrace it." * "Prepare for no sleep." * "When Duane says don’t work over Thanksgiving, he only means Thanksgiving day." * "Try to make it to Duane’s house for Thanksgiving." * "It’s not too late to major in History." * "This course was a pain in my ass." * "It’s not as bad as it sounds." * "Don’t save LDM and STM for last." * "Read [the handouts] thoroughly...read every damn word." * "Microcode is actually kind of fun." * "Make friends with the TA’s early." * "Don’t schedule extracurriculars during office hours." * "Call your mom. Again." * "Bring snacks to lab & make lots of jokes." * "Look around & decide if you will be O.K. with spending...the last week of the semester with these people. If not, drop now." * "The ‘Rant Lecture’ should never die." * "Do try to be in lab when Duane orders pizza." * "Feel the WIND." * "You will be baffled by how much you learn in this course. Pay attention." * "You will believe." * "Good luck!" * "Have a blast!" * "It’ll be fun, I promise." * "Embrace the opportunity and you will grow as a...thinker and as a human being." * "This course changes your life. And you won’t regret it. Period." * "It was refreshing to take a course that didn’t take itself seriously all the time." * "And that comment about laundry...it’s true.”

These students are now teachers, researchers, artists, musicians, rocket scientists, authors, and, yes: microcode engineers.

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