

CompSci 635
Modern Computer Architecture
Course Syllabus
Fall 2023: TuTh 10:00 - 11:15 ET CS140

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Text: Collected readings, available on Moodle. See separate reading schedule on Moodle for list.

Prerequisite: A standard course on computer architecture, equivalent to CmpSci 535, using a text such as Hennessy and Patterson, Computer Architecture: A Quantitative Approach. You should feel comfortable with the basic concepts of instruction set architecture, microarchitecture, cache memory, pipelining, branch prediction, virtual memory, secondary storage, shared memory and vector parallel processing.

Course Goals: The architecture of computers underlies everything that we do with our software. For many years, the progress of architecture was primarily in the realm of enhancing the performance of serial processors. Today we are facing a dramatic shift toward more and more explicit parallelism, along with reliance on cloud computing resources. Our goal is to examine where we are, how we got here, and where we might be headed. We will be looking at material in a variety of papers ranging from classics in the field to recent ideas in architecture. Along the way, we'll be looking at research methodology and experiences from architecture development projects, followed by modern approaches to memory, cache, threading, pipelines, branch prediction, virtual memory, secondary storage, security, control and data parallelism, and architectural issues related to data centers.

Reading: You will be reading at least one paper for each class. There will typically be a choice two papers per class. In a few cases, a single reading will involve a combination of papers.

Course Notes: Slides, recordings of lectures, exercises, handouts, etc, will be on Moodle.

Grading: Reading: 80% In-class discussion notes: 20%

Grade Scale:

A: 95%, A-: 90%, B+: 85%, B: 80%, B-: 75%, C+: 70%, C: 65%, C-: 60%, D+ 55%, D: 50%

Exams: There are no exams in this class.

Reading Homework

Assignment: For each reading, list two points of strength, two points of weakness, and two discussion points (questions or assertions to be debated). The separate course schedule lists all of the reading. Each paper will have a corresponding assignment in Moodle.

Due Dates: They are each due at the start of class on the assigned day of the reading.

Late Policy: You must do your work on time because we'll be using it in class as the basis for group discussions — you are expected to attend class for these. Better to turn in partial work than to lose full credit. If you provide advance notice of an absence, or have a documented illness, we can work out an individual accommodation.

Collaboration: The purpose of the homework is to give each person a chance to show their unique comprehension of the reading. If I feel people are submitting answers that are merely copies of each other, I will grade the one solution and divide the credit equally among the copies.

Grading: Reading submissions are graded on a 30 point scale, with 5 points allocated for each of the six required responses. The grading basis for the responses is that they show evidence that you have done the reading and gained an understanding of the content from your distinct perspective. Each reading makes up the same percentage (2.5%) of your final grade.

In-class discussion notes: A portion of each class will be reserved for discussing the readings in small groups, using the discussion points identified by the members of the groups. An assignment on Moodle will be open during this time for recording notes from the discussion. Everyone in the group is expected to take notes. They are graded on a standard of making a good faith effort to capture the key ideas of the discussion. Each set of notes is 1% of the grade. Because the first four classes are during add-drop, those discussions are not counted in the grade, and are just for practice, with feedback. There is also an allowance for two absences and still receiving full credit. Those who submit more than 20 of the 22 in-class discussion assignments that follow the add-drop period will receive 1% extra credit per assignment.

Overall Grading: Fulfilling the requirement for reading and summarizing one paper counts for 2.5% of the grade. Therefore, submitting one paper per class (25 papers in total), along with all 20 sets of discussion notes will yield a grade of B (82.5%). One way to earn a higher grade is to do extra readings (extending the preceding example, 26 = B+, 28 = A-, 30 = A). You can earn up to 20% (0.5% of the overall grade) extra per paper by listing additional points for a paper (1 point each for the first two extra in each of the three sections: Weaknesses, strengths, discussion points). Thus, maxing out the extra credit per paper, for all 25 classes, is another way to reach an A. You could review a paper beyond those that are given, for up to an extra 3% (you must show it to me in advance so I can check that it is appropriate). A third way is to do additional research to address the weaknesses you identify in a paper, and write a summary of what you find, including references (be sure to use refereed sources, e.g., not Wikipedia). Credit for additional research will depend on what you propose, and will be agreed upon in advance, along with criteria for what constitutes completeness.

To get the breadth of coverage we are aiming for in the course, you must do at least one of the readings per class. If you do not submit a reading for a class, it will result not just in lost credit, but in a further 2.5% deduction from your total score in the class.

In summary, the grading for the class is structured so that you can earn a passing grade by doing all of the basic work. Beyond that, you have considerable flexibility to combine additional readings, extra depth of analysis of the reading, outside research, and participating in more than the minimum number of discussions, to earn a higher grade.

Grades on Moodle: Please note that Moodle doesn't support the kind of flexible grading structure used in this class. There will be a "quiz" for each paper, so you can provide responses for whatever combination of papers you choose. This isn't really a quiz, but that is the only vehicle Moodle provides for this kind of multi-part assignment. Within each "quiz", there will be places for the required responses, along with spaces for additional strengths/weaknesses/discussion points. Moodle can't handle optional quiz questions, so everything must be manually re-graded. It also can't handle the idea of optional quizzes, so it will try to calculate a grade by counting papers you chose to not read. In the end, the grades will be exported into a spreadsheet where they will be recalculated with the grading scheme explained above.

Learning Outcomes: You are a unique human being with your own history and capacities. Not a vessel to be filled or an animal to be trained. Therefore, what you learn in this class will be a unique set of concepts, capacities, and understanding. The class is structured to provide you with a set of experiences in which you gain a deeper understanding of the key issues facing designers of modern computer architectures. The grading criteria are an opportunity for you to demonstrate that you have engaged fully with these experiences, and can then reason about them in a discussion with peers. This is not an outcome-oriented learning environment, with a goal of ensuring that every student will answer the same question on the same test the same way. It's your responsibility to bring your whole self to the experiences, and to show what you've gained from them through active intellectual engagement in the classroom discussions.

University Accommodation Statement: The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of students with disabilities and help create a barrier-free campus. If you have a disability and require accommodations, please register with Disability Services to have an accommodation letter sent to your faculty. Information on services and materials for registering are also available on the [University of Massachusetts Amherst Disability Services page](#)

Course Inclusiveness Statement: No matter who you are or how you define yourself you are welcome in this class. Each person here is a human being deserving of dignity and respect. My goal is to help you learn the subject matter in a way that you will find useful, and to help you have an enjoyable and empowering experience in doing so. It is important to keep in mind that we are all coming to this class with different backgrounds. We are all here to learn together! There are no dumb questions! From time to time, I may enlist some students to help others in class. If I ask you to help, remember that we all have different modes of learning, and there is no stigma to be associated with needing assistance. Please reach out to me if you have any concerns.

Pronouns Policy Statement: Everyone has the right to be addressed by the name and pronouns that they use for themselves. You can indicate your preferred/chosen first name and pronouns on SPIRE, which appear on class rosters. I will do my best to ensure that I address you with your chosen name and pronouns. Please let me know what name and pronouns I should use for you if they are not on the roster. Please remember: A student's chosen name and pronouns are to be respected at all times in the classroom.

University Academic Honesty Statement: Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).

College Title IX Policy Statement: UMass is committed to fostering a safe learning environment by responding promptly and effectively to complaints of all kinds of sexual misconduct. If you have been the victim of sexual violence, gender discrimination, or sexual harassment, the university can provide you with a variety of support resources and accommodations

If you experience or witness sexual misconduct and wish to report the incident, please contact the UMass Amherst Equal Opportunity (EO) Office (413-545-3464 | equalopportunity@admin.umass.edu) to request an intake meeting with EO staff. Members of the CICS community can also contact Erika Lynn Dawson Head, director of diversity and inclusive community development (erikahead@cics.umass.edu | 860-770-4770).