**Course Description**

This course covers modern computer architecture, including branch prediction, out-of-order instruction execution, cache optimizations, multi-level caches, memory and storage, cache coherence and consistency, and multi- and many-core processors.

**Professor and TAs**

**Professor**
Milos Prvulovic
Office hours: WebEx, Thursdays 1-2pm Atlanta (US Eastern) time

**TAs**
Nolan Capehart

**Prerequisites**

Undergraduate computer architecture course that covers basic computer organization; working knowledge of topics such as instruction sets, pipelining, etc. For the course project, you will also need to be familiar with C/C++, Linux, and be comfortable making modifications to large programs.

If you answer “no” to any of the following questions, it may be beneficial to refresh you knowledge of the prerequisite material prior to taking CS 6290:

- Have you taken a computer organization course before?
- Are you familiar with at last one RISC instruction set and would you feel comfortable reading and writing small assembler programs?
- Are you familiar with basic computer architecture concepts, such as pipelines and caches?
- Are you familiar with C/C++ and would you be comfortable writing and/or modifying 100+ lines of code in a program that has over 100,000 lines of code?
- Are you comfortable with, or even excited about, learning about how real processors work and using simulation to see how changes in processor design affect its performance?
- Have you successfully completed the HPCA0 "course" at Udacity?

**Textbook**

There are no required readings. When appropriate, additional class materials will be available as instructor notes that are associated with the video lectures. Although we do not require and do not officially recommended a textbook, a useful textbook for this course is “Computer Architecture: A Quantitative Approach” by John L. Hennessy and David A. Patterson. A recent edition should work, but editions 1-4 put less emphasis on multi-core topics than our course does.

**Grading**

You will receive grades through T-Square. There are three types of grades:

- Projects – You will be given four projects, each requiring more work than the previous one. Each project is to be completed individually or in two-student teams, as specified in each project assignment.
- Exams – You will be given two exams – a midterm and a final exam.
- Udacity quizzes - You should complete all Udacity quizzes. Please note that you are not required to get the correct answer on these quizzes on the first try, but you do need to complete them all before you take the final exam.

The projects and exams will count toward the final grade as follows:

| | Total Weight | Breakdown |
|---|---|---|
| Projects | 50% | |
| | | Project 0: 5% |
| | | Project 1: 10% |
| | | Project 2: 15% |
| | | Project 3: 20% |
| Exams | 50% | |

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|---|---|---|
| | | Midterm: 20% |
| | | Final Exam: 30% |

Note that completing Udacity quizzes does not contribute to your grade. You are expected to complete all quizzes within each lesson correctly regardless of the grade you expect. The only exception to this are problem sets (quizzes named "Problem 1", etc.) that appear at the end of most lessons - you are not required to complete all of those. For every non-problem-set quiz you do not complete, you will lose 1% of all the points you earned on projects and exams. E.g. a student who neglects to complete 10 quizzes will lose 10% of the points earned on projects and exams.

Also note that the Final Exam **does** include questions about material that was covered in the Midterm exam.

The plan is to assign final (letter) grades based on your total score, with 90% and above earning an A, 80% and above earning a B, etc. If this results in too few As, we may decide to lower the thresholds somewhat, or to use some sort of a curve - the final decision whether and what to do in this regard is up to the instructor (Milos).

There will be **no make-up assignments**, so if you need a particular grade plan to perform accordingly on projects and exams. Once a homework, project, or exam is over and graded, the only way the score on that assignment or exam will be changed is if a legitimate mistake in grading has been made. Due to the large number of students in this class, assignment and exam re-grades can only be requested during 14 days that follow the release of scores from that assignment/exam. When requesting a re-grade, keep in mind **that the entire submitted project/exam will be regraded**, so a request for a regrade may result in a loss of points.

The grade in this class will be based solely on demonstrated performance. No grade will ever be changed because the student **needs** a better grade to stay in the program, to keep a fellowship, to get a job, or any other reason. If you believe you need some particular grade in this class, the only way to get that grade is to earn it on projects and exams.

### Emergencies and Late Policy

No late assignments or exams will be accepted unless we advised to do so by the Dean of Students. Please contact the office of the Dean of Students with health emergencies, family emergencies, personal disabilities, or other significant events. The Dean's office is equipped to verify these exceptions better than us, and provides a level of uniformity across courses on how emergencies are handled.

### Academic Integrity

All Georgia Tech students are expected to uphold the Georgia Tech Honor Code. **You should read it (including the Graduate Addendum)!** We take cheating **very** seriously, that all Georgia Tech faculty (including the instructor for this course) are **required** to report cases of academic dishonesty to the Dean of Students' office at Georgia Tech, and that cheating, unauthorized, collaboration, etc.

### Class Schedule

This schedule lists important dates (exams, project release and due dates, etc.). The white-background items show the recommended schedule for completing lessons. Of course you can complete lessons at a faster pace, but projects and exams are timed assuming that you will take the lectures according to the provided schedule - so do not fall behind!

| Week | Dates | Topics |
|---|---|---|
| 1 | Aug 20-24 | Introduction, Metrics and Evaluation; Pipelining Review |
| | Aug 22nd | Project 0 Released |
| 2 | Aug 27-31 | Branch Prediction and Predication |
| | Aug 29th | Project 1 Released |
| 3 | Sep 3rd | Official Georgia Tech School Holiday - Labor Day |
| | Sep 4-7 | ILP and Instruction Scheduling |
| | Sep 9th | Project 0 Due at midnight AOE (GMT-12) |
| 4 | Sep 10-14 | ROB |
| 5 | Sep 17-21 | Memory Ordering |
| | Sep 19th | Project 2 Released |
| 6 | Sep 24-28 | Compiler ILP and VLIW |
| | Sep 30th | Project 1 Due at midnight AOE (GMT-12) |
| 7 | Oct 1-5 | Cache Review and Virtual Memory |
| 8 | Oct 8-9 | Official Georgia Tech Student Recess |
| | Oct 10-12 | Advanced Caches |

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| | Oct 12-14 | Midterm Exam (2-hour proctored exam) |
| 9 | Oct 15-19 | Memory and Storage |
| | Oct 17th | Project 3 Released |
| 10 | Oct 22-26 | Fault Tolerance, Multi-Processing |
| | Oct 27th | Last day to drop course with "W" grade |
| | Oct 28th | Project 2 Due at midnight AOE (GMT-12) |
| 11 | Oct 29-Nov 2 | Cache Coherence |
| 12 | Nov 5-9 | Synchronization |
| 13 | Nov 12-16 | Memory Consistency |
| 14 | Nov 19-20 | Many-Core |
| | Nov 21-23 | Official Georgia Tech Student Recess and School Holiday - Thanksgiving Break |
| 15 | Nov 26-30 | Catch-up and Review |
| | Dec 2rd | Project 3 Due at midnight AOE (GMT-12) |
| 16 | Dec 3-4 | Catch-Up and Review |
| | Dec 6-9 | Final Exam (3-hour proctored exam) |