Course Syllabus

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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: Fridays 12:30 to 1:30pm (US Eastern time) via Zoom (use the Zoom link in the navigation bar on the left side of the course website.

TAs
TBD

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 your knowledge of the prerequisite material prior to taking CS 6290:

- Have you taken a computer organization course before?
- Are you familiar with at least 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 recommend, 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

The grade is determined by your performance on projects and exams. You will receive these grades through Canvas. The projects and exams will count toward the final grade as follows:

- Projects (50% of overall grade): 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.
  - Project 0 (5% of overall grade)
  - Project 1 (10% of overall grade)
  - Project 2 (15% of overall grade)
  - Project 3 (20% of overall grade)
- Exams (50% of overall grade)
  - Midterm (20% of overall grade)
  - Final (30% of overall grade), it **does** include questions about material covered in the Midterm

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.

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 the 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 net 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 are 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 (https://osi.gatech.edu/students/honor-code)** . **You should read it (including the Graduate Addendum)!** We take cheating **very** seriously. Note 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.

For both exams and projects, students are required to complete the assignment on their own, without trying to acquire information that is specific to thew assignment from any other person, tool, or anyone/anything else Examples of this include getting help from other students in the class, any other person, artificial intelligence agents (e.g. ChatGPT), AI-based generative or transformation tools for program code, looking up CS 6290 project code posted by former students of this class, and any other methods that would cause the answers and program code submitted by a student to not be entirely their own.

The only exceptions to this is that 1) seeking help from the instructor or the TAs is allowed, although we will not give you any of the answers and/or code beyond those that are provided with the assignment to all of the students in the class, and 2) work on program code and discussion of project concepts with your project partner is allowed, but only on Project 2 and Project 3 (which allow having a partner).

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 19-23	Introduction, Metrics and Evaluation, Pipelining Review
	Aug 21	Project 0 Released
2	Aug 26-30	Branch Prediction and Predication
	Aug 28	Project 1 Released
3	Sep 2	Official School Holiday
	Sep 3-6	ILP and Instruction Scheduling
	Sep 8	Project 0 Due at midnight AOE (GMT-12)
4	Sep 9-13	ROB
	Sep 11	Project 2 Released
5	Sep 16-20	Memory Ordering
6	Sep 23-27	Compiler ILP and VLIW

Week	Dates	Topics
	Sep 29	Project 1 Due at midnight AOE (GMT-12)
7	Sep 30-Oct 4	Cache Review and Virtual Memory
	Oct 4-6	Midterm Exam (2-hour proctored exam)
8	Oct 7-11	Advanced Caches
	Oct 9	Project 3 Released
9	Oct 14-15	Official School Fall Break
	Oct 16-18	Memory, Storage and Fault Tolerance
10	Oct 21-25	Multi-Processing
	Oct 26	Last day to drop course with "W" grade
	Oct 27	Project 2 Due at midnight AOE (GMT-12)
11	Oct 28-Nov 1	Cache Coherence
12	Nov 4-8	Synchronization
13	Nov 11-15	Memory Consistency
	Nov 17	Project 3 Due at midnight AOE (GMT-12)
14	Nov 18-19	Many-Core
15	Nov 25-26	Review and Catch-Up
	Nov 27-29	Student Recess and Official School Holiday
16	Dec 2-4	Final Instructional Class Days and Reading Day (Prepare for Exams)
	Dec 6-8	Final Exam (3-hour proctored exam)

Course Summary:

Date	Details	Due
Mon Sep 9, 2024	**Project 0** (https://gatech.instructure.com/courses/389958/assignments/1800892)	due by 8am
Mon Sep 30, 2024	**Project 1** (https://gatech.instructure.com/courses/389958/assignments/1800894)	due by 8am
Mon Oct 7, 2024	**Midterm** (https://gatech.instructure.com/courses/389958/assignments/1800888)	due by 10am

Date	Details	Due
Mon Oct 28, 2024	**Project 2** (https://gatech.instructure.com/courses/389958/assignments/1800896)	due by 8am
Mon Nov 18, 2024	**Project 3** (https://gatech.instructure.com/courses/389958/assignments/1800898)	due by 8am
Mon Dec 9, 2024	**Final** (https://gatech.instructure.com/courses/389958/assignments/1800886)	due by 11am