

# Course Syllabus

## 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 12:05pm to 12:55pm (US Eastern time) via Zoom (use the Zoom link in the navigation bar on the left side of the course website, just below "Assignments" and just above "Grades").

### 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?

## 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**. 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 may 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 confidentially, 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](#) 

<http://osi.gatech.edu/content/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.








## 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    | Jan 9-13       | Introduction, Metrics and Evaluation; Pipelining Review |
|      | Jan 11         | Project 0 Released                                      |
| 2    | Jan 16         | Official School Holiday                                 |
|      | Jan 17-20      | Branch Prediction; Predication                          |
|      | Jan 18         | Project 1 Released                                      |
| 3    | Jan 23-27      | ILP and Instruction Scheduling                          |
|      | Jan 29         | Project 0 Due at midnight AOE (GMT-12)                  |
| 4    | Jan 30 - Feb 3 | ROB   |
|      | Feb 1          | Project 2 Released                                      |
| 5    | Feb 6-10       | Memory Ordering   |
| 6    | Feb 13-17      | Compiler ILP and VLIW                                   |
|      | Feb 19         | Project 1 Due at midnight AOE (GMT-12)                  |
| 7    | Feb 20-24      | Cache Review and Virtual Memory                         |
|      | Feb 24-26      | Midterm Exam (2-hour proctored exam)                    |
| 8    | Feb 27 - Mar 3 | Advanced Caches; Begin Memory                           |
|      | Mar 1          | Project 3 Released                                      |
| 9    | Mar 6-10       | Finish Memory; Storage and Fault Tolerance              |
|      | Mar 12         | Project 2 Due at midnight AOE (GMT-12)                  |
| 10   | Mar 13-17      | Multi-Processing  |
|      | Mar 15         | Last day to drop course with "W" grade                  |
| 11   | Nov 20-24      | Spring Break  |
| 12   | Mar 27-31      | Cache Coherence   |
| 13   | Apr 3-7        | Synchronization   |

| Week | Dates     | Topics   |
|------|-----------|--|
| 14   | Apr 10-14 | Memory Consistency   |
|      | Apr 16    | Project 3 Due at midnight AOE (GMT-12)                             |
| 15   | Apr 17-21 | Many-Core  |
| 16   | Apr 24-26 | Final Instructional Class Days and Reading Day (Prepare for Exams) |
|      | Apr 28-30 | Final Exam (3-hour proctored exam)                                 |

## Course Summary:

| Date             | Details  | Due         |
|------------------|--|-------------|
| Fri Jan 13, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919847&amp;include_contexts=course_299574">OMS CS 6290 Office Hours (Optional)</a><br><a href="https://gatech.instructure.com/calendar?event_id=3919847&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919847&amp;include_contexts=course_299574</a>   | 12pm to 1pm |
| Fri Jan 20, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919849&amp;include_contexts=course_299574">OMS CS 6290 Office Hours (Optional)</a><br><a href="https://gatech.instructure.com/calendar?event_id=3919849&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919849&amp;include_contexts=course_299574</a>   | 12pm to 1pm |
| Fri Jan 27, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919851&amp;include_contexts=course_299574">OMS CS 6290 Office Hours (Optional)</a><br><a href="https://gatech.instructure.com/calendar?event_id=3919851&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919851&amp;include_contexts=course_299574</a> | 12pm to 1pm |
| Mon Jan 30, 2023 |  <a href="https://gatech.instructure.com/courses/299574/assignments/1280448">Project 0</a><br><a href="https://gatech.instructure.com/courses/299574/assignments/1280448">https://gatech.instructure.com/courses/299574/assignments/1280448</a>   | due by 7am  |
| Fri Feb 3, 2023  |  <a href="https://gatech.instructure.com/calendar?event_id=3919853&amp;include_contexts=course_299574">OMS CS 6290 Office Hours (Optional)</a><br><a href="https://gatech.instructure.com/calendar?event_id=3919853&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919853&amp;include_contexts=course_299574</a> | 12pm to 1pm |
| Fri Feb 10, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919855&amp;include_contexts=course_299574">OMS CS 6290 Office Hours (Optional)</a><br><a href="https://gatech.instructure.com/calendar?event_id=3919855&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919855&amp;include_contexts=course_299574</a> | 12pm to 1pm |
| Fri Feb 17, 2023 |  <a href="#">OMS CS 6290 Office Hours (Optional)</a>  | 12pm to 1pm |

| Date             | Details  | Due         |
|------------------|--|-------------|
|                  | <a href="https://gatech.instructure.com/calendar?event_id=3919857&amp;include_contexts=course_299574">           (https://gatech.instructure.com/calendar?event_id=3919857&amp;include_contexts=course_299574)         </a>  |             |
| Mon Feb 20, 2023 |  <a href="https://gatech.instructure.com/courses/299574/assignments/1280450">Project 1</a><br><a href="https://gatech.instructure.com/courses/299574/assignments/1280450">           (https://gatech.instructure.com/courses/299574/assignments/1280450)         </a>                         | due by 7am  |
| Mon Feb 27, 2023 |  <a href="https://gatech.instructure.com/courses/299574/assignments/1280446">Midterm</a><br><a href="https://gatech.instructure.com/courses/299574/assignments/1280446">           (https://gatech.instructure.com/courses/299574/assignments/1280446)         </a>                           | due by 9am  |
| Fri Mar 3, 2023  |  <a href="https://gatech.instructure.com/calendar?event_id=3919861&amp;include_contexts=course_299574"> <b>OMS CS 6290 Office Hours</b><br/>           (Optional)<br/>           (https://gatech.instructure.com/calendar?event_id=3919861&amp;include_contexts=course_299574)         </a>   | 12pm to 1pm |
| Fri Mar 10, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919863&amp;include_contexts=course_299574"> <b>OMS CS 6290 Office Hours</b><br/>           (Optional)<br/>           (https://gatech.instructure.com/calendar?event_id=3919863&amp;include_contexts=course_299574)         </a>   | 12pm to 1pm |
| Mon Mar 13, 2023 |  <a href="https://gatech.instructure.com/courses/299574/assignments/1280452">Project 2</a><br><a href="https://gatech.instructure.com/courses/299574/assignments/1280452">           (https://gatech.instructure.com/courses/299574/assignments/1280452)         </a>                         | due by 8am  |
| Fri Mar 17, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919865&amp;include_contexts=course_299574"> <b>OMS CS 6290 Office Hours</b><br/>           (Optional)<br/>           (https://gatech.instructure.com/calendar?event_id=3919865&amp;include_contexts=course_299574)         </a> | 12pm to 1pm |
| Fri Mar 24, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919867&amp;include_contexts=course_299574"> <b>OMS CS 6290 Office Hours</b><br/>           (Optional)<br/>           (https://gatech.instructure.com/calendar?event_id=3919867&amp;include_contexts=course_299574)         </a> | 12pm to 1pm |
| Fri Mar 31, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919869&amp;include_contexts=course_299574"> <b>OMS CS 6290 Office Hours</b><br/>           (Optional)<br/>           (https://gatech.instructure.com/calendar?event_id=3919869&amp;include_contexts=course_299574)         </a> | 12pm to 1pm |
| Fri Apr 7, 2023  |  <a href="https://gatech.instructure.com/calendar?event_id=3919871&amp;include_contexts=course_299574"> <b>OMS CS 6290 Office Hours</b><br/>           (Optional)<br/>           (https://gatech.instructure.com/calendar?event_id=3919871&amp;include_contexts=course_299574)         </a> | 12pm to 1pm |
| Fri Apr 14, 2023 |  <a href="#"> <b>OMS CS 6290 Office Hours</b><br/>           (Optional)         </a>  | 12pm to 1pm |

| Date             | Details   | Due         |
|------------------|---|-------------|
| Mon Apr 17, 2023 | <a href="https://gatech.instructure.com/calendar?event_id=3919873&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919873&amp;include_contexts=course_299574</a>   |             |
| Mon Apr 17, 2023 |  <a href="https://gatech.instructure.com/courses/299574/assignments/1280454">Project 3</a><br>( <a href="https://gatech.instructure.com/courses/299574/assignments/1280454">https://gatech.instructure.com/courses/299574/assignments/1280454</a> )  | due by 8am  |
| Fri Apr 21, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919875&amp;include_contexts=course_299574">OMS CS 6290 Office Hours</a><br>( <a href="https://gatech.instructure.com/calendar?event_id=3919875&amp;include_contexts=course_299574">Optional</a> )<br>( <a href="https://gatech.instructure.com/calendar?event_id=3919875&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919875&amp;include_contexts=course_299574</a> ) | 12pm to 1pm |
| Fri Apr 28, 2023 |  <a href="https://gatech.instructure.com/calendar?event_id=3919877&amp;include_contexts=course_299574">OMS CS 6290 Office Hours</a><br>( <a href="https://gatech.instructure.com/calendar?event_id=3919877&amp;include_contexts=course_299574">Optional</a> )<br>( <a href="https://gatech.instructure.com/calendar?event_id=3919877&amp;include_contexts=course_299574">https://gatech.instructure.com/calendar?event_id=3919877&amp;include_contexts=course_299574</a> ) | 12pm to 1pm |
| Mon May 1, 2023  |  <a href="https://gatech.instructure.com/courses/299574/assignments/1280444">Final</a><br>( <a href="https://gatech.instructure.com/courses/299574/assignments/1280444">https://gatech.instructure.com/courses/299574/assignments/1280444</a> )  | due by 11am |