

semantics and LLMs

Course Information

Instructor: Qirun Zhang (qrzhang@gatech.edu)

Course Prefix and Number: CS 8803 A

Term: Fall 2026

Course Description

This class is cross-listed with CS 6390. They are the same class. CS 6390 is a graduate course on the fundamentals of Programming Languages (PL). We will study the foundations of different programming paradigms and techniques in the programming languages literature. Instead of focusing on applied or industry-specific topics, this course is highly theoretical and geared toward students wanting to pursue graduate research in programming languages.

This course explores the foundations of programming languages and program semantics, with a particular emphasis on how large language models (LLMs) can support programming-language implementation and reasoning tasks. The class will cover the mathematical foundations of programming languages, operational and denotational semantics using the IMP language, and techniques for reasoning about program types, control and data flow, execution paths, functions, and pointers. Throughout the semester, students will apply these concepts through a sequence of programming projects that use LLMs to help implement, extend, and optimize an IMP interpreter. In addition, by the end of the course, students should be able to formulate their own novel PL ideas into a course research project.

Course Expectations

Students are expected to attend lecture, ask questions, be proactive, and complete a course project.

- Lectures – I will make my best effort to make lectures an interactive experience for all. You are encouraged to share questions and comments on lecture material in class. Doing so will also count towards your class participation grade, as will in-class worksheet discussions, Piazza comments, and discussions in office hours.
- Open-book homework – As is typical, all homework will be “open book”. They are designed to be completed using material from the textbook and the course Piazza site. However, they must be completed individually with no help from anyone else. Unlike in a traditional class setting, students will complete their homework questions and submit them in class.

- Closed-book exams – The two midterm exams will cover the topics discussed in the preceding weeks leading up to each exam. Both exams will be held in-person, and must be completed individually without consulting anyone or any resources.
- Class Project – The goal of the class project is to perform an in-depth study of the IMP language and its extensions and apply it to a practical usage scenario. The project should be done individually or in groups of 1 - 3 students. The size of the group will also impact the project expectations.
- Class Participation – As mentioned earlier, this component of your grade will be assessed based on your level of participation in lectures, worksheets, office hours, and on Piazza.

Course Learning Outcomes

By the end of this course, the desired outcome is that students will have developed an understanding of the fundamentals of programming languages. The goal of this course is also for students to apply their understanding to a novel PL problem in the form of a course project. While publishing a course-project as a paper represents a best-case scenario, that outcome is not necessary to obtain an A for this course.

Required Course Materials

No textbooks or materials are required. Resources for research are determined in consultation with the instructor.

- Glynn Winskel, *The Formal Semantics of Programming Languages: An Introduction*, MIT Press, 1993.
- Michael Scott and Jonathan Aldrich, *Programming Language Pragmatics*, Morgan Kaufmann, 2025.

Grading Policy

This course is graded on a letter grade basis. The table below summarizes all course assignments that contribute to course assessment, and the percentage of the overall.

Assignment	Percentage of course grade
Homework assignments	15%
Two midterm exams	25%+25%
Class participation	5%
Class project	30%

Academic and Research Honesty/Integrity Statement

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review the [Student Code of Conduct](#) and the [Academic Honor Code](#), especially [Appendix A: Graduate Addendum to the Academic Honor Code](#).

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Allegations of scientific or scholarly misconduct are handled in accordance with the procedures outlined by the [Policy for Responding to Allegations of Scientific or Other Scholarly Misconduct](#).

Late submissions

- Within 1 hour after the assignment is due: You can email the TAs to request removal of the late submission penalty, provided the request is made within 24 hours of your submission time. If you do not send this request, your work will be treated as a late submission;
- Within 24 hours after the assignment is due: 50% point deduction;
- More than 24 hours late: 100% point deduction.

Exceptions will only be made in the case of personal emergencies.

Core IMPACTS

Not applicable

Accommodations

If you are a student with learning needs that require special accommodation, [contact the Office of Disability Services](#) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

If a student encounters a personal emergency during the semester, they must notify the instructor immediately, defined as within one day of the incident, in order to make alternate arrangements for assignments, projects, or examinations as necessary.

For non-emergency matters that may affect the submission of any deliverable, the student must notify the instructor at least five days prior to the relevant deadline. The instructor will determine whether the matter is relevant and whether an accommodation will be granted.

All requests, whether for emergency or non-emergency situations, must be supported by official documentation from an appropriate campus office (e.g., Dean of Students, Registrar's Office, ODS). No accommodation will be granted without both timely communication and proper verification.

Student-Faculty Expectations

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. [The Student-Faculty Expectations](#) articulates some basic expectations that you can have of me and that I have of you. Additional information for research-related work is given in [The Expectations of Advisors and Advisees](#). In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.