Programming Languages: Theory and Practice

CIS 531 at Syracuse University — Fall 2025

Instructor: Kris Micinski

Note: Parts of this syllabus are subject to change with adequate notice to students. Changes will be notated (last changed: **Aug 23, 2025**).

1. Course Description

An introduction to compilers. Compilers translate "high-level" (source) languages into "low-level" (object) languages, and are typically constructed via a sequence of *passes*. The class will explain the major concerns involved in compiling rich high-level languages to object-level languages, including syntactic analysis (parsing), translation (*e.g.*, instruction selection), and semantic analysis. The class will involve building compilers (to x86-64) for increasingly-complex languages, culminating in a final project; advanced topics (e.g., MLIR and declarative program analysis) will be discussed as time permits.

2. Instructors

Instructors:

- Kris Micinski, Asst. Prof at Syracuse ECS
  - Office hours in person (CST 4–185, Zoom by appointment):
    - **Monday** 2:00 PM – 3:30 PM
    - **Thursday**: 4:00 – 5:00 PM
    - **Friday**: By appointment (Zoom).

3. Workload

- 4–5 programming homeworks: 40%
- Final project: 15%
- Exams: 40%
  - 2 midterms and 1 final, each worth 20%; the lowest exam grade drops.

- Attendance quizzes: 5% (can miss some class, see details)
- Bonus: +4% max

This is a *project-heavy* course. Approximately 3–5 hours per week outside of class is expected. It is recommended to avoid taking this course concurrently with other project-heavy courses.

3.1. Course Tags

The university recommends instructors label their courses with shared competencies. We intend for this course to fit the following:

- Critical and Creative Thinking
- Scientific Inquiry and Research Skills

3.2. Office Hours

Office hours are on Mondays and Thursday (before class). There will be Friday office hours available upon request. Additionally, the instructor is available by appointment to meet (either in person or on zoom) upon request and mutual availability—please email me if none of the times are acceptable to you, so that we may organize a time to chat.

4. Grading

4.1. Exams – 40%

- **Midterms:** Two midterms, each worth 20%. Focus topics will be announced via electronic announcement (Blackboard, email) several days before the exam. Students are allowed a handwritten, one-sided, US letter-sized note sheet.
- **Final Exam:** Comprehensive, slightly longer than the midterms, worth 20%. The lowest exam grade drops (effectively replaced); students are encouraged to skip the final if they are otherwise happy with their exam grades.

4.2. Programming Homework – 40%

- **4–5 individual or group programming homeworks** worth 40% in total.
  - See the **important AI usage policy below**.
  - See the **important group work policy below, anyone working in a group must follow this policy for each project.**

4.3. Final Project – 15%

- The final project will occur during the last 3–4 weeks of class. The project will extend previous projects to include a new language feature, alongside a report, presentation, and extensive testcases developed by you.

- Around week 10, you will submit a final project proposal. You are encouraged to keep the proposal modest: the final project should not be more work (as in code) than previous projects, the challenge is that it is open-ended, requiring you to write your own testcases and develop your own debugging infrastructure.

4.4. Attendance Quizzes – 5% (max)

- In general, attendance is required for all Syracuse University classes. I personally expect you to attend at least 70% of classes this semester—missing a class here and there for good reasons (e.g., attending an academic event) is fine—but you should not systematically be skipping class, especially multiple days in a row. Please email me in advance if you plan to skip a class for a legitimate reason.
- I will give attendance quizzes each week—with at least 10 throughout the term (aiming for 15).
- Use a consistent (and your own) name when you log into the quiz website—this helps me grade.
- Each attendance quiz will be worth 0.5%, with the maximum category attainable of 5%.
- Quizzes are based on participation only, but the instructor reserves the right to nullify low-effort answers.
- Make-up or exceptions will be made only for valid reasons (e.g., religious observance, relevant conference, excused medical absence, etc.). The instructor must be notified (by email) before the absence unless otherwise unable for a justified reason.

4.5. Bonus Points – Up to 4%

Several *bonus* handouts / exercises will be offered, taking various forms (e.g., short writeups, small extra coding tasks). These will be announced in class. They are often in the form of a short writing or coding assignment. s

4.6. Final Letter Grading Bars

Final grades will be assigned as follows. A small "bump" (0–2 points usually) may be given in practice, but is not guaranteed. This will be announced at the end of the course. The instructor will attempt to provide an approximate estimate of any bump will be provided before the final exam.

- A – 92%
- A- – 90%
- B+ – 87%
- B – 83%
- B- – 78%

- C+ – 74%
- C – 70%
- C- – 65%
- D – 60%
- < D – < 60%

5. Topics

Topics include the following, based on pacing and course progression:

- Lexical analysis
- Grammars and parsing
- Forms and callsites
- Lexical environments and scoping
- Branching Control-Flow
- Tail calls and tail recursion
- Operational semantics (interpreters)
- Reduction strategies
- Instruction Selection
- Data-Flow and Control-Flow Analysis
- Monotone frameworks
- Worklist / fixed-point algorithms
- Type checking
- Loops
- Activation Records and Procedure Calls
- Closures
- Objects
- Assignment conversion and boxing
- Garbage collection
- MLIR & LLVM

6. Academic Drop Deadline

As part of our efforts to track satisfactory academic progress, the Academic Drop Deadline and the Financial Drop deadline will both occur on September 15, 2025, for the fall. Students may still withdraw from courses after these deadlines; this would place a 'WD' grade on their transcripts.

7. Autograder Homeworks (40%)

There are 4–5 *individual or group programming homeworks* in Racket. Homeworks will be graded using an *autograder* at https://autograde.org. You will receive credentials for the autograder (let the professor know if not received by the second week of class). You must learn Git to use the autograder. I will cover the Autograder in class—if you have not used it before, I recommend getting help from a previous CIS352 student, though I will spend some class time discussing how to use it.

7.1. Group Work Policy

Note: PhD students enrolled in CIS531 **must** complete projects individually.

Each homework may be completed in a group of 2–4 people. This policy only applies to group work: if you work by yourself, skip this section. If you are not a strong Racket programmer, I recommend finding a partner or group to work with. When working in a group, it is important to keep the following in mind: groupwork is often a frustrating experience for many students, especially when one member of the group is ultimately tasked with doing all of the work the night before the deadline. If you are to work in a group, you **must** do the following:

One member of the group must send me (Kristopher Micinski, `kkmicins@syr.edu`) an email for **each homework** where you plan to work in a group, titled "CIS531 Homework N collaboration plan" (where N is the homework number). Your email will include:

- Who does your group contain (names and CC them).
- What range of times you are available to work together.
- A certification that any amount of code you write by yourself will be reviewed by the group and agreed upon.
- A certification that each group member will interact with the code in some way. By "interact with" I mean: each group member has *executed* the code themselves, and seen that it runs, substantively engaging with at least some aspect of the code (e.g., writing a testcase, fixing a bug, adding a new piece of functionality). It is **not permissible** to have a group member that cannot articulate a **single** (line-level) contribution to the codebase.
- A certification that you will all review and discuss the code before submitting it to the autograder.

- Each group member must reply to the email: "I, `<YOUR NAME>`, will not put this homework off until the last minute and thereby force a single student to carry the weight of the effort. I recognize that part of being in a group means committing to organizing my time so that I may effectively collaborate."

After you submit the *final* version of your project, each student is **required** to send me an email: "Group Work Summary: Homework *N*" detailing (in a few sentences) what they did. **Failure to send me either the project plan or summary may result in a point penalty, as I have no way to verify your contribution.**

It is generally reasonable, expected, and even healthy to have different amounts of work invested in the project by each student, e.g., due to differing student programming abilities; even in large software organizations, some folks contribute more code than others, and "number of lines written" is not an absolute measure of productivity. But it is crucial to ensure that one person is not simply doing all of the work, submitting the project on behalf of the others. Group work should be leveraged thoughtfully, to practice professional collaboration style. You are encouraged to use GitHub for collaboration but you **must** make (and keep) your repository private.

If you work in a group, it *is* permissible to copy the submission. Each student should submit their own copy of `compiler.rkt` (or similar)

7.2. Homework Late Policy

- Homeworks turned in within 72 hours of the deadline will receive a 15% penalty. Homeworks turned in after 72 hours and until the end of the course will receive a 25% penalty.
- **No** one-off project extensions will be granted without a good reason. The late policy is already liberal. A single late submission likely will not change the final course grade.
- The instructor will move homework deadlines for religious observances, excused medical absence, or similar unforeseen circumstances. Please email to discuss.

8. Exams (40%)

Exams measure your ability to produce solutions regarding relevant course content in an open-ended fashion. There will be two midterms. Questions will be drawn from the learning objectives at the top of the page. A practice exam will be released several days before each midterm, which we will work through in class.

The final exam will occur during the time slot scheduled by the registrar.

Exams can be stressful. Students may wish to look into the resources provided by the Barnes Center (such as extended exam time). I am happy to accommodate exam-related needs but request at least 72 hours notice for each exam so that I can arrange for testing center materials if needed.

9. Academic Integrity and Generative AI Policy

As a pre-eminent and inclusive student-focused research institution, Syracuse University considers academic integrity at the forefront of learning, serving as a core value and guiding pillar of education. Syracuse University's Academic Integrity Policy provides students with the necessary guidelines to complete academic work with integrity throughout their studies. Students are required to uphold both course-specific and university-wide academic integrity expectations such as crediting your sources, doing your own work, communicating honestly, and supporting academic integrity. The full Syracuse University Academic Integrity Policy can be viewed by visiting the Syracuse University Policies website.

Upholding Academic Integrity includes the protection of faculty's intellectual property. Students should not upload, distribute, or share instructors' course materials, including presentations, assignments, exams, or other evaluative materials without permission. Using websites that charge fees or require uploading of course material (e.g., Chegg, Course Hero) to obtain exam solutions or assignments completed by others, which are then presented as your own violates academic integrity expectations in this course and may be classified as a Level 3 violation. All academic integrity expectations that apply to in-person assignments, quizzes, and exams also apply online.

Students found in violation of the policy are subject to grade sanctions determined by the course instructor and non-grade sanctions determined by the School or College where the course is offered. Students may not drop or withdraw from courses in which they face a suspected violation. Any established violation in this course may result in course failure regardless of violation level.

All academic integrity expectations that apply to in-person quizzes and exams also apply to online quizzes and exams. In this course, all work submitted for quizzes and exams must be yours alone. Discussing quiz or exam questions with anyone during the quiz or exam period violates academic integrity expectations for this course.

If a student is found in violation of the policy (by the academic integrity coucnil), I, as the instructor of CIS531, reserve the right to impose *any* grade-related sanction I see fit, up to and including course failure.

9.1. Generative AI Policy

The following is option 2 of Syracuse University's required generative AI policy language:

Based on the specific learning outcomes and assignments in this course, artificial intelligence is permitted on the following: all Autograder-based homeworks and final project. See each assignment, quiz, or exam instructions for more information about what artificial intelligence tools are permitted and to what extent, as well as citation requirements. If no instructions are provided for a specific assignment, then no use of any artificial intelligence tool is permitted. Any AI use beyond that which is detailed in course assignments is explicitly prohibited except when documented permission is granted.

9.2. Rules and Advice Specific to CIS531

- In general, it is fine to make limited use AI (LLMs, coding agents, etc.) for studying and *inspiration* for how to write snippets of code, but you should not be using AI to drive your development in substance (colloquially referred to as "vibe coding"). Doing so deprives you of the requirement that you learn how to architect your project at a high-level: the instructor has put significant thought into high-level project structure, and recommends you follow it.
- It is allowable, and you are *encouraged* to use LLMs (or similar AI tools) to help you write *tests* for your code. I myself used LLMs to generate large input testcases, and found these tools immensely valuable at exercising broad behavior. I strongly recommend this to you as a legitimate and recommended usage of AI.
- You may not simply take any output from an AI coding tool and use it verbatim, you must rewrite it in some manner. I understand there are reasonable exceptions: 2-3 line snippets. In general, these cases may be fine, as long as you feel you genuinely would have written the code yourself—but you must be very careful that you are not accidentally acceding to the AI's style.
- If you feel like the AI is doing too much of the work and depriving you of the ability to engage with the substance of the effort, you are probably correct and should take a step back. I wrote the solutions (and built test/debug infrastucture) to all CIS531 projects and—after writing a manual solution—attempted to use several popular AI tools. My subjective opinion is that the tools helped significantly in some tedious circumstances, but did not fundamentally change the development task in substance; I will elaborate more during class.
- If you have *any* concerns about usage of generative AI, ask me.
- Projects and exams must be completed by either yourself of your authorized group members (see the "Group Work Policy").
- You must *never* send your code to anyone or allow anyone (*outside of your group*) to watch you code, obtain your code, or otherwise copy your code in any manner.
- The Autograder uses advanced cheat-detection techniques (including static analyses) to compare submissions across current and previous semesters. As a matter of policy, **all apparent cases** of academic dishonesty (with credible evidence, as determined by the instructor) will be reported to the Syracuse University academic integrity council.
- In-class or self-study exercises may be collaborated on to any degree
- You may discuss the *project specification* with peers outside of your group, but *never* share your code.
- "*Hard coding*" solutions to tests for projects is forbidden and considered a serious violation of academic integrity as it is inherently deceptive.
- Cite all help other than the professor, T.A., and required/recommended text. Proper

citation is not sufficient to avoid potential dishonesty charges if the code used completes the substance of the project for you.

- Duplicate *project* submissions, even those arising from identical AI-generated outputs, will be considered honor code violations.
- If a student is found to have violated academic integrity policy, the instructor reserves the right to impose any grade-related sanction, up to and including course failure.

9.3. My (Non)-Use of Generative AI

I will not be using generative AI to generate any amount of the course material in substance. I have used generative AI in several orthogonal ways, however: first, I have generated a subset of abstract icons for the slides using generative AI tools, second, I have experimented extensively with advanced AI coding assistants to measure whether current coding assistants can successfully complete the course projects. I did this not for the purposes of penalizing students, but to help better understand the landscape of the limitations and capabilities of current-generation tools across various AI-based approaches (including AI agents and also traditional LLMs). I will discuss the results of my efforts during class, but in summary: I still require that you do the bulk of coding yourself (and believe this will be best for your learning). Last, I have used LLMs to generate large, chaotic testcases as input. This is explicitly encouraged by the policy.

10. Email Policy

- Please keep all questions related to course projects on university email and include the text "CIS531" somewhere in your email.
- FERPA requirements prohibit discussing grades or other course records on any non-university platform.
- For official business (notifications of course absence due to illness, etc.), please email me.
- The instructor aims to acknowledge emails within 24 hours. Feel free to follow up after 24 hours if there is no response.

11. Student Support

Syracuse University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. There may be aspects of the instruction or design of this course that result in barriers to your inclusion and full participation in this course. I invite any student to contact me to discuss strategies and/or accommodations (academic adjustments) that may be essential to your success and to collaborate with the Center for Disability Resources (CDR) in this process.

If you would like to discuss disability accommodations or register with CDR, please visit Center for Disability Resources. Please call (315) 443-4498 or email `disabilityresources@syr.edu` for more detailed information.

12. Accreditation and Use of Student Work

As part of the regular ABET accreditation process for the undergraduate program in computer science, we may be collecting samples of students' work in each of our undergraduate classes. Some of your labs/homeworks/exams may be photocopied or electronically copied for accreditation at some later point. When doing so, your name and other personally-identifying information will be scrubbed.

13. Faith Tradition Observances

Syracuse University's Religious Observances Policy (link) recognizes the diversity of faiths represented in the campus community and protects the rights of students, faculty, and staff to observe religious holy days according to their traditions. Under the policy, students are given an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance, provided they notify their instructors no later than the academic drop deadline. For observances occurring before the drop deadline, notification is required at least two academic days in advance. Students may enter their observances in MySlice under `Student Services/Enrollment/My Religious Observances/Add a Notification`.

14. Student Mental Health

Mental health and overall well-being are significant predictors of academic success. As such, it is essential that during your college experience you develop the skills and resources effectively to navigate stress, anxiety, depression, and other mental health concerns. Please familiarize yourself with the range of resources the Barnes Center provides at https://ese.syr.edu/bewell and seek out support as needed. Counseling services are available 24/7, 365 days a year, at 315.443.8000.

15. Disability Statement

Syracuse University values access and inclusion; we are committed to a climate of mutual respect and full participation. There may be aspects of the instruction or design of this course that result in barriers to your inclusion and full participation in this course. I invite any student to contact me to discuss strategies and/or accommodations (academic adjustments) that may be necessary to ensure equitable access, and to collaborate with the Center for Disability Resources (CDR) in this process.

If you would like to discuss disability-related accommodations or register with CDR, please visit Center for Disability Resources. Please call (315) 443-4498 or email CDRspecialist@syr.edu for more detailed information.

CDR is responsible for coordinating disability-related academic accommodations and will work with the student to develop an access plan. Since academic accommodations are generally not provided retroactively, please contact CDR as soon as possible to initiate this process.

16. Discrimination and Harassment

The University does not discriminate and prohibits harassment or discrimination related to any protected category including creed, ethnicity, citizenship, sexual orientation, national origin, sex, gender, pregnancy, reproductive health decisions, disability, marital status, political or social affiliation, age, race, color, veteran status, military status, religion, sexual orientation, domestic violence status, genetic information, gender identity, gender expression or perceived gender.

Any complaint of discrimination or harassment related to any of these protected bases should be reported to Sheila Johnson-Willis, the University's Chief Equal Opportunity & Title IX Officer for Faculty and Staff. She is responsible for coordinating compliance efforts under the various laws including Titles VI, VII, IX and Section 504 of the Rehabilitation Act. She can be contacted at Equal Opportunity, Inclusion, and Resolution Services, 621 Skytop Road, Suite 1001, Syracuse University, Syracuse, NY 13244-1120; or by email: equalopp@syr.edu; or by telephone: 315-443-4018.

Federal and state law, and University policy prohibit discrimination and harassment based on sex or gender (including sexual harassment, sexual assault, domestic/dating violence, stalking, and sexual exploitation). If a student has been impacted by any prohibited behavior based on sex or gender, they can obtain confidential counseling support, 24-hours a day, 7 days a week, from the Sexual and Relationship Violence Response Team at the Counseling Center (315-443-8000, Barnes Center at The Arch, 150 Sims Drive, Syracuse, New York 13244). Incidents of sexual or relationship violence or harassment can be reported to the University's Title IX Coordinators (Sheila Johnson Willis, Chief Equal Opportunity Officer and Title IX Officer for Faculty and Staff, 315-443-4018, equalopp@syr.edu or Pamela Peter, Director/Coordinator of Student Title IX Case Management, 315-443-0211, titleix@syr.edu). Reports to law enforcement can be made to the University's Department of Public Safety (315-443-2224, 005 Sims Hall), the Syracuse Police Department (511 South State Street, Syracuse, New York, 911 in case of emergency or 315-435-3016 to speak with the Abused Persons Unit), or the State Police (Campus Sexual Assault Victims Unit, 844-845-7269). I will seek to keep information you share with me private to the greatest extent possible, but as a professor I have mandatory reporting responsibilities to share information regarding sexual misconduct, relationship violence, stalking, harassment, and crimes I learn about with the University's Title IX Officer to help make our campus a safer place for all and to ensure you have access to available resources.