CS536 - Science of Programming
Fall 2024 Syllabus
for sections 04 and 05

Xiaolang Wang

August 2024

1 Course Summary

Welcome to CS-536 - Science of Programming. This is a theoretical computer science graduate course about program verification: we will use a simple programming language to show how to design and prove reliable programs. Class starts on August 19th, lectures will be given on Tuesdays and Thursdays 10:00 am- 11:15 am, at SB104. Section 05 (online) students are encouraged to attend lectures in person.

2 Prerequisites and Course Outcome

- Prerequisites of this class are propositional logic and predicate logic (covered in CS-330 and maybe CS-401).
- Based on professor Sasaki's handout, by the end of the class, students should be able to answer the following questions:

  1. How does verification differ from testing?
  2. How do we understand the semantics of programs?
  3. How do semantics affect the way we understand program correctness?
  4. What rules of reasoning can we use to discuss program correctness?
  5. How is correctness of parallel programs different?
  6. What if program execution isn't deterministic?

3 Textbook

There is no required textbook for this course. Class notes will be provided before each class. I will also share handouts by Professor James Sasaki on the Canvas as a reference.

A helpful book is *The Science of Programming* by David Gries (ISBN-10: 0387964800 — ISBN-13: 978-0387964805).

Any Discrete Maths textbook that covers propositional logic and predicate logic can also be helpful.

4 Getting Help

- Instructor: Xiaolang Wang's office hours are on Fridays 11:00 am - 2:00 pm at SB 208-D (no appointment needed, first-come-first-serve). If extra help is needed, please email **xwang122@iit.edu**, I will answer emails on every week day.

- TAs:

  ◦ Hassan Alamri (halamri@hawk.iit.edu), office hours: Tuesdays 12:00 pm - 1:00 pm on Zoom at

  `https://iit-edu.zoom.us/j/3612485997?pwd=UGRZaUtuOXZ6Q1VsQU5yU1VTNStUdz09` ;

  ◦ Baixiang Huang (bhuang15@hawk.iit.edu), office hours: Fridays 2:00 pm - 3:00 pm on Zoom at `https://iit-edu.zoom.us/j/5488183866` ;

  ◦ Nagalakshmi Kolagani (nkolagani@hawk.iit.edu), office hours: Wednesdays 2:00 pm - 3:00 pm on Zoom at

  `https://iit-edu.zoom.us/meeting/register/tZAsfuyvpjovGdcTF5_l4AHSbvOiOonV3Axl` ;

  ◦ Chaoqi Ma (cma17@hawk.iit.edu), office hours: Fridays 10:00 am - 11:00 am on Zoom at

  `https://iit-edu.zoom.us/j/85100822250?pwd=kUeJjtQgTna4E0WWKJgJzYsJFbMebQ.1` ;

  ◦ Shriniwas Oza (soza1@hawk.iit.edu), office hours: Thursdays 12:00 pm - 1:00 pm at SB-019.

  ◦ Yunpeng Xiao (yxiao28@hawk.iit.edu), office hours: Mondays 2:00 pm - 3:00 pm at SB-019.

Note that, Chaoqi's office hours are primarily designated for students of Section 06 (Beacon Section). As such, please anticipate that he will primarily be using Mandarin during these sessions.

We will use Zoom on the Canvas for this class so that students can access the class online easily. Students can access the online class on the Canvas: **CS536 course page → Zoom → Upcoming Meetings**.

Students can also find the recordings of each class on the Canvas: **CS536 course page → Zoom → Cloud Recordings**.

Class notes and partial homework solutions will be posted on the Canvas.

Students are expected to check email every week day of the semester. Clarifications on assignments or other important announcements might be sent by email - and will also be posted on the Canvas.

5 Grading and Assignments

The grading allocation is given below.

- Homework 6% $\times$ 6
- Midterm 28%
- Final 36%

There will be (approximately) six homework assignments. In each assignment, students will see questions similar to the examples in class. Each student is expected to write their own solution but discussion between students are highly encouraged. Do not use any online resources (including ChatGPT) other than the textbook for homework. A student can seek help from me and TA's if they is having difficulties with the homework. (But, please spend time trying to understand a homework problem before asking for help.)

Each assignment is expected to be submitted on Canvas before its deadline. The penalty for late submission is 20% for each day after the deadline. No make-up assignment or extra credits in assignments.

Midterm and Final will be **in-person**, no electronic devices (including calculators) and closed-books-closed-notes with an exception of one page of "cheat sheet". A cheat sheet is an A4 sized or US Standard Letter paper with notes written on both sides. Students are expecting multiple-choice / True-or-False questions and short-answer questions similar to class examples and questions in homework assignments in each exam. **Midterm will be in class on October 15th**, and the final will be held in the final week.

Important: In each exam, there will be one (or more) extra questions for Section 02 (PHD) students. Other students can also answer these questions for extra credits.

Important: Section 05 (online) students need to attend exams in person as well.

Important: If a student is located in Chicago then the student is encouraged to attend exam together with other students in class. If a student is located in other cities in the US, we will work together with the Center for Learning Innovation to find a exam center close to the student; in the case, please email me and Charles Scott (scott@iit.edu) from the Center **at least 2 weeks** before each exam to schedule this services. If a student is in Chicago but cannot attend the exam at the scheduled time, please email me **at least 2 weeks** before each exam to find an alternative time for that exam.

The final grades will be assigned by comparison to the students who took this class with me in previous and current semesters. As a guideline, about 81% will be needed for an A, and 67% for a B; these lines might change. So far, there are 104 students got A, 116 students got B, 144 students got C and 12 students got E.

Standard departmental policy regarding academic (dis)honesty applies. See the IIT Code of Academic Honesty, `https://web.iit.edu/student-affairs/`

`handbook/fine-print/code-academic-honesty`. Engaging in any form of academic dishonesty during exam will result in an assigned letter grade of E for the student involved.

6 Lecture Schedule

Week	**Topics**	**Notes**
#1 (Aug. 20 & 22)	Syllabus, Propositional Logic, Predicate Logic	
#2 (Aug. 27 & 29)	Expressions, States, Satisfaction and State Updates	HW1 assigned
#3 (Sep. 03 & 05)	Language Syntax, Operational Semantics	No class on Sep. 03 (Labor Day)
#4 (Sep. 10 & 12)	Denotational Semantics, Runtime Errs	HW2 assigned
#5 (Sep. 17 & 19)	Hoare Triples	
#6 (Sep. 24 & 26)	Weakest Preconditions	HW3 assigned
#7 (Oct. 01 & 03)	Syntactic Substitution	
#8 (Oct. 08 & 10)	Strongest Postconditions and Forward Assignment	No class on Oct. 08 (Fall Break); HW4 assigned
#9 (Oct. 15 & 17)	Proof Rules, Proof Outlines	**Midterm on October 15th (Tuesday, in class), topics: HW 1 to 3**
#10 (Oct. 22 & 24)	Partial and Minimal Proof Outlines, Total Correctness Rules	HW5 assigned
#11 (Oct. 29 & 31)	Loop Invariants	
#12 (Nov. 05 & 07)	Array Assignments, Basics of Parallel Programs	HW6 assigned
#13 (Nov. 12 & 14)	Disjoint Programs	
#14 (Nov. 19 & 21)	Disjoint Conditions, Shared Vars and Interference, Auxiliary Variables	
#15 (Nov. 26 & 28)	Await and Deadlocks	No class on Nov. 28 (Thanksgiving)
#16 (Dec. 2 -)		Final, topics: everything discussed after the midterm

(Some topics might be removed from the schedule if we have time issues.)

7 Administrative Matters

Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources (CDR) located at 3424 S. State Street - 1C3-2, 312 567.5744 or `disabilities@iit.edu`.

Illinois Tech's Sexual Harassment and Discrimination Information:

Illinois Tech prohibits all sexual harassment, sexual misconduct, and gender discrimination by any member of our community. This includes harassment among students, staff, or faculty. Sexual harassment of a student by a faculty member or sexual harassment of an employee by a supervisor is particularly serious. Such conduct may easily create an intimidating, hostile, or offensive environment.

Illinois Tech encourages anyone experiencing sexual harassment or sexual misconduct to speak with the Office of Title IX Compliance for information on support options and the resolution process.

You can report sexual harassment electronically at `iit.edu/incidentreport`, which may be completed anonymously. You may additionally report by contacting the Title IX Coordinator, Virginia Foster at `foster@iit.edu` or the Deputy Title IX Coordinator at `eespeland@iit.edu`.

For confidential support, you may reach Illinois Tech's Confidential Advisor at (773) 907-1062. You can also contact a licensed practitioner in Illinois Tech's Student Health and Wellness Center at `student.health@iit.edu` or (312)567-7550

For a comprehensive list of resources regarding counseling services, medical assistance, legal assistance and visa and immigration services, you can visit the Office of Title IX Compliance website at `https://www.iit.edu/title-ix/resources`.