CIS341
Computer Organization & Programming Systems
Syracuse University, Fall 2023

1 Overview

About the course

Core course for computer science; 3 credits

Prerequisite: CIS351 Data Structures

Course description: Digital logic, data type and representation, instruction set architecture, assembly language, program construction, processors, memory hierarchy, traps and interrupts, privilege and security, I/O

Time & location

Lecture (M001): TuTh 3:30pm – 4:50pm @ CST 4-201

Lab (M002): Fr 10:35am – 11:30am @ CST 3-116

Lab (M003): Fr 11:40am – 12:35pm @ CST 3-116

Instructor: Prof. Bryan S. Kim

E-mail: bkim01@syr.edu

Office & office hours:

Mondays 11am – 12pm, Zoom

Fridays 2pm – 3pm, CST 4-181

Teaching assistants: Xiangqun (David) Zhang

E-mail: xzhang84@syr.edu

Office & office hours:

Tuesdays 5pm – 6pm, CST 0-121

Wednesdays 3pm – 4pm, CST 0-121

Thursdays 5pm – 6pm, CST 0-121

Peer-learning assistants: Miya Kang and Joshua Liu

Office & office hours:

Mondays 9am – 11am, CST 0-123

Tuesdays 12pm – 2pm, CST 0-123

Thursdays 12pm – 2pm, CST 0-121

Fridays 9am – 11am, CST 0-123

2 Objectives

The course is designed to help you understand *how computers are built* and *how computers are programmed*. Although it may seem like computers are magical mystery machines to *users*, they are, in fact, very far from it. As computer scientists and engineers, we must understand what really happens when a program runs on a machine and think about more efficient ways to do so.

In detail, we set forth the following learning objectives, as activities you should be able to do after completing the course:

1. Explain common bit-level representations of numeric values and the consequent mathematical properties of arithmetic and bit-level operations on them.
2. Translate a C function into an assembly code including the implementation of expressions, control, and procedures by recalling the corresponding instruction set architecture.
3. Explain the organization of the classical von Neumann machine and its major functional units, and estimate the performance improvements of common performance optimization techniques in modern processors.
4. Modify a C function to maximize performance while retaining its functional correctness by assessing the effect of each expression on the processor and its memory subsystem.
5. Estimate the performance of cache memory, and explain the workings of a system with virtual memory management.
6. Examine the sources of conflict that can arise when multiple threads of execution share resources, and demonstrate the ability to use synchronization constructs to mediate those conflicts.
7. Explain the programmer's interaction with the underlying system through the different APIs and abstractions, including system support for process and thread control, virtual memory, and system I/O.

3 Textbook

Randal E. Bryant and David R. O'Hallaron, *Computer Systems: A Programmer's Perspective*, Third Edition, Pearson, 2015. (ISBN: 9780134092669)

Orange Inclusive Access (OIA) provides you with an online copy of the book for $36.71. You are automatically enrolled and your required course material will be accessible via Blackboard — all you need to do is log in. No additional purchase is needed. You will have until Sep. 11, 2023, to decide if you would like to remain enrolled in OIA. If you would like to opt out of participation in this program, you may do so through the "Orange Inclusive Access" link on Blackboard. If you opt out, you are still responsible for obtaining the materials elsewhere.

4 Piazza

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you

have any problems or feedback for the developers, email team@piazza.com. Our class page is https://piazza.com/syr/fall2023/cis341.

5 Schedule

The following is a tentative schedule and is subject to change.

Week	Tue. lecture	Thu. lecture	Events
1	Overview	C basics	
2	C pointers & arrays	C memory management	Honor pledge due
3	Bits & bytes	Integers	`proj0-Clab` due
4	Machine organization	Instruction control flow 1	`hw0` due
5	Instruction control flow 2	Procedures	`proj1-datalab` due
6	Array & structs	Stack buffer overflow	`hw1` due
7	Fall break (no class)	C to asm	`proj2-attacklab` due
8	Midterm	Memory hierarchy	Midterm (Oct. 17, 3:30pm–4:50pm)
9	Cache memory 1	Cache memory 2	`hw2` due
10	Virtual memory 1	Virtual memory 2	`proj3-cachelab` due
11	Memory coherency	Hard disk drives	`hw3` due
12	Solid-state drive 1	Solid-state drive 2	`proj4-vmlab` due
		Thanksgiving break	
13	Flash translation layer 1	Flash translation layer 2	`hw4` due
14	Reliability	System-level I/O	`proj5-ssdlab` due
15	Computers of the future		
			Final exam (Dec. 18, 3pm–5pm)

6 Class Policies

This course has five components, and their contributions toward the total grade are as follows.

- Midterm exam: 20%
- Final exam: 20%
- Projects: 35%
- Homework: 15%
- In-class activities: 8%
- Honor pledge: 2%

Final letter grades will be assigned based on numerical thresholds, and the exact threshold values will be determined at the end of class. However, you can expect the letter grade cutoffs as shown in the table below. Let X be the cutoff between two letter grades.

Letter grades	Cutoff
Between B+ and A-	$80 \leq X < 90$
Between C+ and B-	$70 \leq X < 80$
Between D and C-	$60 \leq X < 70$
Between F and D	$50 \leq X < 60$

No **incomplete** grade will be provided without a valid reason. Violations of academic integrity override the foregoing table and could result in an F grade. Finally, the instructor reserves the right to change this grading scale.

6.1 Exams

There will be two exams: one midterm in class on Oct. 17 and a final exam during finals week on Dec. 18. These exam dates are fixed and will not change. Each accounts for 20% and 20% of the total grade. All contents covered in class prior to the exams would be tested: the final exam will include materials covered prior to the midterm.

Most of the exam questions will be variations of (1) the practice and homework problems of the textbook (B&O), (2) the previous exams from the B&O authors' class (`https://www.cs.cmu.edu/afs/cs/academic/class/15213-f21/www/exams.html`), and (3) the examples and exercises performed in lectures and recitations.

Exams are closed books and closed notes. However, if deemed necessary, we will provide you with an appendix with relevant materials for reference.

6.2 Projects & Homework

Project. The projects are designed to provide hands-on experience in understanding the learning objectives of the course. There are six assignments, from `proj0-Clab` to `proj5-ssdlab`. The `C` programming language plays a critical role in these assignments. However, the level of proficiency required for the PAs incrementally increases, and students without prior exposure to the language should be able to learn as the course progresses.

The projects are based on the course contents developed by the authors of the textbook (B&O). You may find useful information on their course webpage at `https://www.cs.cmu.edu/afs/cs/academic/class/15213-f21/www/`. There are plenty of resources online (e.g. StackOverflow) for debugging, and please use office hours and recitations for helpful pointers.

All PAs will be made available and submitted through our class Linux server (`lcs-vc-cis341.syr.edu`): We will not accept work turned in via e-mail. To log in to the server, use your NetID and its password. The submissions will be cross-checked through a code-similarity analysis tool, comparing not only the student's submissions, but also the solution from the instructor's manual. Please do NOT cheat.

In general, all projects will be due on Wednesdays at 11:59pm.

Homework. We will assign a number of homework problems that reinforce the concepts. The problems will be similar to the in-classes quizzes, and you are to work alone.

In general, all homework will also be due on Wednesdays at 11:59pm.

Late turn-in. Aside from the due date, there is a 24-hour *grace period* for all assignments, both projects and homework. Beyond this grace period, each late day will reduce the maximum attainable score for the assignment by 20% of the assignment. Even one minute after the deadline will count as a full day late once the grace hours are exhausted.

Extensions. For projects and homework, extensions may be granted based on a need basis. Please e-mail the instructor a well-reasoned e-mail as to why you would need an extension. Keep in mind that fairness is a prime consideration for granting extensions. Furthermore, no extensions will be granted after the deadline for that assignment.

For exams, there are no extensions or make-ups, except for university-accepted reasons. If a student misses exams without a university-accepted reason, a zero will be assigned. Students are responsible for contacting the instructor as soon as possible if they are unable to take any exams due to university-accepted reasons.

6.3 In-class Activities

Group-based activities will be done during some of the lectures. Each group consists of 4 members, each with an assigned role.

- **Facilitator** makes sure that the team remains focused and on time.
- **Reflector** guides the consensus-building process and observes team dynamics and behavior.
- **Presenter** asks the team questions to the instructor and presents their answers to the class.
- **Recorder** summarizes the group's discussion and records the response.

The group activities are based on that day, week, or unit's lecture contents, and the team's written response will be graded.

6.4 Academic Integrity

For general expectations and policies of the University, please refer to `http://class.syr.edu/academic-integrity/policy/`. A short summary of what you need to know can be found at `https://class.syr.edu/wp-content/uploads/2018/08/What-Students-Need-to-Know-About-Academic-Integrity-8.6.18.pdf`.

6.5 E-mail Etiquette

- E-mails should be used only for the following purposes:
  - For non-technical course-related issues (e.g., about grading, scheduling one-on-one meetings, or discussing sensitive information). Technical questions should be posted on Piazza.
  - Asking logistical questions (i.e., date/time of exams, conflict with exam times, etc.).
  - Notifying emergency situations.
- You must use your official university email address.
- All emails should have the prefix **[CIS341]** in the subject line. A best-effort attempt will be made to respond to emails within 48 hours on weekdays during normal working hours.

6.6 Data Collection

As part of the regular ABET (Accreditation Board for Engineering and Technology) process for the undergraduate programs in our department, we will be collecting samples of students' work in this class. As a result, some of your work (programming assignments, weekly assignments, exams) may be photocopied, scanned, and saved.

7 University Policies

7.1 University Attendance Policy

Attendance in classes is expected in all courses at Syracuse University. Students are expected to arrive on campus in time to attend the first meeting of all classes for which they are registered. Students who do not attend classes starting with the first scheduled meeting may be academically withdrawn as not making progress toward degree by failure to attend. Instructors set course-specific policies for absences from scheduled class meetings in their syllabi.

It is a federal requirement that students who do not attend or cease to attend a class to be reported at the time of determination by the faculty. Faculty should use "ESPR" and "MSPR" in Orange SUccess to alert the Office of the Registrar and the Office of Financial Aid. A grade of NA is posted to any student for whom the Never Attended flag is raised in Orange SUccess. More information regarding Orange SUccess can be found at `http://orangesuccess.syr.edu/getting-started-2/`.

Students should also review the University's religious observance policy and make the required arrangements at the beginning of each semester

7.2 Syracuse University Policies

Syracuse University has a variety of other policies designed to guarantee that students live and study in a community respectful of their needs and those of fellow students. Some of the most important of these concern:

Diversity and Disability (ensuring that students are aware of their rights and responsibilities in a diverse, inclusive, accessible, bias-free campus community) can be found at: `https://www.syracuse.edu/life/accessibilitydiversity/`.

Religious Observances Notification and Policy (steps to follow to request accommodations for the observance of religious holidays) can be found at: `http://supolicies.syr.edu/studs/religious_observance.htm`.

Orange SUccess (tools to access a variety of SU resources, including ways to communicate with advisors and faculty members) can be found at: `http://orangesuccess.syr.edu/getting-started-2/`.

7.3 Disability-Related Accommodations

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 meet with

me to discuss strategies and/or accommodations (academic adjustments) that may be essential to your success and to collaborate with the Office of Disability Services (ODS) in this process.

If you would like to discuss disability-accommodations or register with ODS, please visit their website at http://disabilityservices.syr.edu. Please call (315) 443-4498 or email disabilityservices@syr.edu for more detailed information.

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

7.4 Academic Integrity Policy

Syracuse University's Academic Integrity Policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same work in more than one class without receiving written authorization in advance from both instructors. Under the policy, students found in violation are subject to grade sanctions determined by the course instructor and nongrade sanctions determined by the School or College where the course is offered as described in the Violation and Sanction Classification Rubric. SU students are required to read an online summary of the University's academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice.