



## Computer Architecture

CS 315 (4 units)

Fall 2025

Section 01 - TR 8:00am - 9:45am 08/19/25 - 12/02/25 LS 307

Section 02 - TR 2:40pm-4:25pm 8/20/24 - 12/03/22 LS 307

Section 01 Lab W 4:45pm-6:15pm LS 307

Section 02 Lab W 6:25pm-7:55pm LS 307

## Instructor Information

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Gregory Benson

benson@usfca.edu (Campuswire Preferred)

### Office Hours

TR 1:30pm-2:20pm, W 3:40pm-4:30pm

Office Location: HR 412A

### Additional Information

Unless announced otherwise, office hours will be in person and on Zoom.

Shreyas Yadav

ssyadav3@dons.usfca.edu (Campuswire Preferred)

### Office Hours

Mon 1:00pm-2:00pm (in-person), Fri 1:00pm-2:00pm (in-person)

Office Location: HR 411/413

Joon Park

jspark6@dons.usfca.edu (Campuswire Preferred)

### Office Hours

M 3:30pm-5:30pm (in-person and Zoom), W 11:00am-12:00pm (in-person and Zoom), F 4:00pm-5:00pm (in-person and Zoom)

Office Location: HR 411/413

## Course Description

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Performance analysis techniques, instruction set design, computer arithmetic, digital design, processor implementation, and memory systems. Performance enhancement using pipelining and cache memory. Four hours lecture and two hours lab.

## Course Learning Outcomes

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Upon completion of this course the students will have learned the following topics:

1. Understand and manipulate the machine-level representation of numbers and data in C (Project01)
2. Write C and assembly language programs for the RISC-V architecture (Project02, Project03)
3. Design and implement an emulator that executes RISC-V machine code (Project04)
4. Learn about digital design by building circuits which solve computational problems (Project05)
5. Design and implement a single-cycle processor using schematics in a simulator (Project06)
6. Design and implement a pipelined processor using schematics in a simulator (Project07)

## Assignments

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In this class there will be three types of student work: labs, projects, and exams.

**Labs** consist of programming and analytical problems to help you learn the concepts discussed in class and to help prepare you for the types of questions you will see on the exams. The labs also

prepare you for the upcoming projects. In some cases the code you write in the labs will be used in the projects. The score for the programming part of the labs will generally be determined by Autograder tests. Analytical problems will be spot checked for attempted work. Labs must be turned in on time; no late lab work will be accepted.

**Projects** are one of the main assessment tools for the course and correspond to each learning outcome shown in parenthesis above. Projects will be graded for both correctness (using the Autograder), repo/code quality, and comprehension using 1:1 interactive grading meetings with the instructor or TA. Note, if a project meeting is required for a project, you must attend the meeting to earn credit for the project. Unless an exception has been granted, you must do interactive graded during the schedule interactive grade day(s). Failure to schedule or show up for an interactive grading appointment will result in a zero for the project. If you do not finish a project by the due date and time, turn in what you have completed for partial credit. You will be allowed 1 week after scores have been submitted to Canvas to earn up to 75% back on any points missed. After 1 week you can earn up to 50% back on any points missed. You can earn back 100% of any points missed for repo/code quality.

We will have one **midterm exam** and a **final exam**. The exams will be in-class only (no exceptions) and you will solve the exam problems with pencil and paper. You will be allowed to bring one piece of paper with notes (front and back). No electronic devices will be allowed during the exams. The final exam will be comprehensive and cover all the material from the semester. You must earn an average of C or higher on the midterm and final combined in order to pass the class. That is, the average of your labs + projects + exams may be higher than a C, but if your exams score is lower than a C, you will not pass.

## Grading Breakdown and Grading Policies

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### Grading Breakdown

1. Attendance: 10%
2. Labs: 10%
3. Project01 - Dev Environment Setup and C Number Conversion: 3%
4. Project02 - C and RISC-V Assembly: 3%
5. Project03 - C and RISC-V Assembly: 3%
6. Project04 - RISC-V Emulator and Cache Simulation: 7%
7. Project05 - Digital Design: 3%
8. Project06 - Implementation of a Single Cycle Processor: 8%
9. Project07 - Implementation of a Pipelined Processor: 3%
10. Midterm Exam: 15%

## 11. Final Exam: 35%

### Course Policies

1. Neatness counts, for both source code and circuit schematics.

#### 2. Submitted work

1. You may get explanatory help from the instructor, TAs, friends, tutors, Internet sites, and generative AI.
2. You can use coding assistants and AI pair programming to formulate your solutions.
3. You should only submit work that you fully understand and can explain.
4. You must not provide your work to other students (giving your solutions can result in a 0).

#### 3. Deadlines

1. If you are not done with an assignment by the deadline, you should turn in what you have working to get full credit for that work.
2. Labs must be turning in on time to earn credit.
3. Projects may be turned in for 75% credit up to one week late and 50% credit after that until the last day of class.
4. Extensions for full credit are not given except in extenuating circumstances, which you must discuss with the instructor in advance

4. Letter Grades are assigned according to the following table, without rounding or curving

| Grade shown in Canvas | Letter Grade           |
|-----------------------|------------------------|
| 100.0% - 93.33%       | A                      |
| < 93.33% - 90.0%      | A-                     |
| < 90.0% - 86.67%      | B+                     |
| < 86.67% - 83.33%     | B                      |
| < 83.33% - 80.0%      | B-                     |
| < 80.0% - 76.67%      | C+                     |
| < 76.67% - 73.33%     | C (minimum grade for C |

| Grade shown in Canvas | Letter Grade |
|-----------------------|--------------|
| < 73.33% - 70.0%      | C-           |
| < 70.0% - 66.67%      | D+           |
| < 66.67% - 63.33%     | D            |
| < 63.33% - 60.0%      | D-           |
| < 60.0%               | F            |

## Texts and Supplies

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### **The RISC-V Reader**

ISBN: 9780999249116

Authors: David A. Patterson, Andrew Waterman

Publication Date: 2017-01-01

Required or recommended?: Optional

### **he C Programming Language**

ISBN: 978-0131103627

Authors: Brian W. Kernighan and Dennis M. Ritchie

Publisher: Pearson

Publication Date: March 1988

Edition: 2nd

Where to purchase (URL): [https://www.amazon.com/Programming-Language-2nd-BrianKernighan/dp/0131103628/ref=sr\\_1\\_1?](https://www.amazon.com/Programming-Language-2nd-BrianKernighan/dp/0131103628/ref=sr_1_1?keywords=the+c+programming+language&qid=1674547425&prefix=The+C+programm+n%2Caps%2C336&sr=8-1)

[keywords=the+c+programming+language&qid=1674547425&prefix=The+C+programm  
n%2Caps%2C336&sr=8-1](https://www.amazon.com/Programming-Language-2nd-BrianKernighan/dp/0131103628/ref=sr_1_1?keywords=the+c+programming+language&qid=1674547425&prefix=The+C+programm+n%2Caps%2C336&sr=8-1)

Required or recommended?: Optional

## Course Schedule

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| Day      | Date       | Activity                          |
|----------|------------|-----------------------------------|
| Tuesday  | 8/23/2022  | First Day of Class                |
|          | 2          |                                   |
| Thursday | 8/25/2022  |                                   |
| Tuesday  | 8/30/2022  |                                   |
| Thursday | 9/1/2022   |                                   |
| Tuesday  | 9/6/2022   |                                   |
| Thursday | 9/8/2022   |                                   |
| Tuesday  | 9/13/2022  |                                   |
| Thursday | 9/15/2022  |                                   |
| Tuesday  | 9/20/2022  |                                   |
| Thursday | 9/22/2022  |                                   |
| Tuesday  | 9/27/2022  |                                   |
| Thursday | 9/29/2022  |                                   |
| Tuesday  | 10/4/2022  |                                   |
| Thursday | 10/6/2022  |                                   |
| Tuesday  | 10/11/2022 |                                   |
| Thursday | 10/13/2022 |                                   |
| Tuesday  | 10/18/2022 | Fall Break (No Classes)           |
| Thursday | 10/20/2022 |                                   |
| Tuesday  | 10/25/2022 |                                   |
| Thursday | 10/27/2022 |                                   |
| Tuesday  | 11/1/2022  |                                   |
| Thursday | 11/3/2022  |                                   |
| Tuesday  | 11/8/2022  |                                   |
| Thursday | 11/10/2022 |                                   |
| Tuesday  | 11/15/2022 |                                   |
| Thursday | 11/17/2022 |                                   |
| Tuesday  | 11/22/2022 |                                   |
| Thursday | 11/24/2022 | Thanksgiving Holiday (No Classes) |
| Tuesday  | 11/29/2022 |                                   |
| Thursday | 12/1/2022  |                                   |

## Program Learning Outcomes

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**Theory:** explain and analyze standard computer science algorithms and describe and analyze theoretical aspects of various programming languages

**Application:** apply problem-solving skills to implement medium- and large- scale programs in a variety of programming languages

**Systems:** describe the interactions between low-level hardware, operating systems, and applications

**Project:** demonstrate effective communication and organization as part of a team of software developers or researchers collaborating on a large computer program

## University Policies

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### Credit-hour Policy

One unit of credit in lecture, seminar, and discussion work approximates one hour of direct faculty instruction (or 50 minutes plus a break) and a minimum of two hours of out-of-class student work per week through one 15-week semester. For further details, see USF's [Credit Hour Policy](#).

The below resources and additional information can be found in the [Student Life Resource Toolkit](#).

### Students with Disabilities

The University of San Francisco is committed to providing equal access to students with disabilities. If you are a student with a disability, or if you think you may have a disability, please contact Student Disability Services (SDS) at [sds@usfca.edu](mailto:sds@usfca.edu) or (415) 422-2613, to speak with a disability specialist (please note all communication with SDS is private and confidential).

If you are eligible for accommodations, please request that your accommodation letter be sent to me as soon as possible (students are encouraged to contact SDS at the beginning of the semester), as accommodations are not retroactive. Once I have been notified by

SDS of your accommodations we can discuss your accommodations and ensure your access to this class or clinical setting. For more information please visit the [SDS website](#).

## Behavioral Expectations

The University of San Francisco is committed to providing an environment consistent with the academic nature and core values of the institution in which students can participate in learning as a humanizing, social activity rather than a competitive exercise to support the full, integral development of each person and all persons, with the belief that no individual or group may rightfully prosper at the expense of others.

It is important you know what is expected of you academically and behaviorally through the published course syllabus, the [Student Conduct Code](#), and other instructions provided by the instructor. Therefore, you are expected to uphold the following:

- Behave in accordance with the Student Conduct Code and other USF policies
- Refrain from disrupting the ability of fellow students to learn or the instructor's ability to teach. Examples of disruption include:
  - Cell phone or computer use that significantly or repeatedly distracts others
  - Coming to class late, leaving early, or excessively physically relocating oneself in the classroom
  - Speaking frequently without being called on
  - Yelling, cursing, or engaging in aggressive behavior
- When interacting online, communicate in a respectful fashion. This includes, but is not limited to:
  - Refraining from name calling, profanity, or typing in all capital letters
  - Sending multiple emails with one sentence
  - Avoiding rants or discussing non-relevant topics

Open discussion and disagreement are encouraged when done respectfully and in the spirit of academic discourse. There are also a variety of behaviors that, while not against a specific University policy, may create disruption in this course. Students whose behavior is disruptive or who fail to comply with the instructor may be dismissed from the class for the remainder of the class period and may need to meet with the instructor or Dean prior



to returning to the next class period. If necessary, referrals may also be made to the Student Conduct process for violations of the Student Conduct Code.

## **Academic Integrity**

As a Jesuit institution committed to *cura personalis*—the care and education of the whole person — USF has an obligation to embody and foster the values of honesty and integrity. All members of the USF academic community are responsible for maintaining the standards of honesty and integrity. The [honor code](#) applies to all students (undergraduate and graduate) in the College of Arts and Sciences, the School of Education, the School of Management, and the School of Nursing and Health Professions. Faculty and students in the School of Law should review their own [honor code](#) for policies and procedures. Students enrolled in distance learning (online courses) are subject to these policies as well as supplemental policies set forth by their program. All students should review and familiarize themselves with the honor code, prohibited conduct, and procedures.

## **Counseling and Psychological Services**

Many college students experience mental health difficulties. Counseling and Psychological Services (CAPS) is a great source of support for addressing a range of mental health needs, including anxiety, stress, loneliness, relationship struggles, grief/loss, adjusting to change, identity development, racial/cultural concerns, and mild to moderate depression.

CAPS offers in-person and remote individual and group therapy to enrolled students. Students seeking services are scheduled for a 15-20-minute phone screening to assess immediate risk, as well as identify initial treatment needs, and make recommendations for next steps. These may include a crisis or risk assessment, brief individual therapy (every 2-3 weeks), single session therapy, weekly group therapy, or referrals to off-campus providers. Please note, CAPS does not have a psychiatrist on staff to prescribe medication. Students in need of medication or with more complex mental health concerns are referred off-campus for specialized, comprehensive, treatment and/or ongoing, longer-term therapy. To make an appointment, call CAPS at 415.422.6352 or request an appointment via the [CAPS](#) website. CAPS does not accept walk-in appointments.

Students with urgent mental health needs can call the **CAPS All-Hours line (855-531-0761)** to immediately speak with a mental health clinician. The CAPS All Hours line is **available 24/7**, including weekends/holidays, and accepts international calls, and should only be accessed for mental health crises. For all other mental health concerns, including scheduling, canceling, rescheduling, or leaving a message for a CAPS clinician, please call CAPS at 415.422.6352 during normal business hours.

All students are encouraged to check out the [CAPS website](#) and access our extensive online resources, podcasts, mental health apps, videos, self-care strategies, and more.

If you are concerned about a student and would like someone to follow up, please contact the Dean of Students Office at 415.422.5330. If you know someone who is an immediate risk of harming themselves or others, please contact Public Safety at 415.422.2911 in San Francisco, out of state or additional locations within California dial 911, or call the National Suicide & Crisis Lifeline by dialing 988.

## **Title IX**

The Title IX Office seeks to stop, remedy, and prevent occurrences of sex and gender-based discrimination, sexual harassment, and sexual violence. The University has a [Policy](#) on Nondiscrimination Based on Sex and Gender, Sexual Harassment, and Sexual Misconduct for all Students, Employees, and Third-Parties. If you have experienced any behaviors related to this policy, we encourage you to report the incident. If you report these behaviors to any staff or faculty member, they must notify the USF Title IX Coordinator.

Students who wish to report any sexual misconduct should use the online mandatory reporting [form](#). You can also contact the Title IX Office directly by calling (415)422-4563, emailing [titleix@usfca.edu](mailto:titleix@usfca.edu), or visiting our office in Lone Mountain, Room 145.

As an employee at USF, and your Professor, I am a mandatory reporter, meaning I have to share any instances of sexual harassment or sexual violence shared with me or that become known to me. I will have to share this information, including names and any details known, to the Title IX Office to connect you with resources. If you would like more information about the resources available, you can ask me at any time this semester. You do not need to tell me why you are asking to get help for a friend, another student, or yourself.

If you are interested in accessing confidential resources, please consider these options. If you report any information to the following, it will not generate a report to the Title IX office:

- Students may speak to someone confidentially by contacting Counseling and Psychological Services at (415) 422-6352, or speaking to a clergy member in University Ministry at (415) 422-4463.
- To find more about reporting sexual misconduct (including sexual assault, relationship violence, or stalking) and resources at USF, visit the USF Title IX website.
- For off-campus resources, contact San Francisco Women Against Rape (SFWAR) at (415) 647-7273; [www.sfwar.org](http://www.sfwar.org)

If during the course of the semester you need accommodations related to pregnancy or parenting, please let me know and I can connect you to the Title IX office. They are able to offer support through arranging accommodations, leave, or other support. The Title IX office is responsible for ensuring pregnant and postpartum students get the changes they need to stay healthy while being able to continue their education.

## Confidential Resources for Reporting Sexual Misconduct

- Students may speak to someone confidentially which will not generate a report to the Title IX Office by contacting Counseling and Psychological Services at (415) 422-6352 during M-F 9-4pm, or speaking to a clergy member in University Ministry at (415) 422-4463.
- If you need to speak to a mental health clinician immediately, please call the **CAPS 24/7 All Hours Line at 855-531-0761** (available daily, including weekends and holidays, and accepts international calls), Public Safety (415-422-2911), 911, the Suicide Hotline (dial 988), or go to your nearest emergency room
- For off-campus resources and local Bay Area organizations check [here](#).

## Learning, Writing, and Speaking Centers

The Learning, Writing, and Speaking Centers (LWSC) at USF provide individualized support to assist students in better understanding course material and to aid them on their path to success. Services are free and include tutoring, collaborative peer support

services, academic skills coaching, writing, and speaking support. Services are available in-person and on Zoom.

LWSC staff can be reached Monday through Thursday between 9:00am-8:00pm and Friday between 9:00am-5:00pm at [LWSC@usfca.edu](mailto:LWSC@usfca.edu) or through the chatbox on [our myUSF webpages](#) or by phone at (415) 422-6713. To make an appointment for subject tutoring, academic skills coaching, the writing center, or the speaking center, students should visit the [Student Appointment Dashboard](#).

## Communication

All course communications, like all other USF communications, will be sent to your USF official email address. You are therefore strongly encouraged to monitor that email account.

## Gleeson Library

Looking for help with a research paper or project? Set up a consultation with a Librarian or get 24/7 research help [online](#).

## Attendance Policy

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Attendance is strongly recommended but will not be formally recorded.

However exams will be in-class only.

## Additional USF Resources

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### USF Food Pantry

The USF Food Pantry is an intermediate, short-term solution for any registered USF student to receive food and toiletry resources. Students are invited to stop by the pantry located on the first floor of Gleeson Library in the Atrium, and take the items that they need. Items are available on a first-come, first-serve basis until our supply is depleted. You will be asked to check-in via QR code before entering the pantry. For more information

and the current schedule, visit the [USF food pantry website](#). If you have further questions, please contact the Pantry Coordinator at [usfpantry@usfca.edu](mailto:usfpantry@usfca.edu) or 415-422-4099 (during business hours Monday thru Friday from 9:00am - 5:00pm). You can find out about additional food security resources through the [USF food insecurity resource page](#) and the [CalFresh resources site](#).

## Use of Generative AI in This Course

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In alignment with the [USF Honor Code](#), students must present work that is authentically their own. In this course, the use of generative AI tools is only permitted for learning purposes, e.g. explaining concepts, explaining given code, or generating examples with explanations. You may not ask generative AI to create solutions to specific lab or project assignments. As this policy may be different from other course AI policies, please ask your instructor to clarify any questions you may have. To mitigate risks associated with the use of generative AI, please review the [Guidelines for Responsible Use of Artificial Intelligence \(AI\) at USF](#)