Spring 2025 CS 331 04 23988

California State University San Marcos
College of Science, Technology, Engineering and Mathematics
CS 331, Computer Architecture, Fall 2022

Instructor:	Justin Morris
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Meeting Times:	TuTh 5:30 pm – 6:45 pm, Markstein Hall 208
Class Webpage:	**Canvas (https://csusm.instructure.com/courses)**
Office Hours:	12:30 pm – 1:30 pm Mondays and Wednesdays or by appointment (email me) at VEP 6018
Prerequisites:	CS 231

Course Catalog Description

The goal of this course is to develop students' understanding of hardware and software structure of modern computer systems as well as stimulate their interest and improve their abilities to acquire independently new computer-related information and skills. The central ideas of computer organization and design are covered with emphasis on the following topics: performance evaluation, instruction set architecture, computer arithmetic, processor design, pipelining, and memory hierarchy.

Course Learning Objectives

Upon successful completion of this course, students will be able to:

	Course Learning Objectives (CLOs)	Relevant Topics Covered

O1	Comprehend the trend of modern computer architectures towards multi-core and research potential applications and directions for future changes	Computer Abstraction, Processor Datapath, Domain Specific Accelerators
O2	Describe alternative formats to represent numerical data and understand the principle and implementation of computer arithmetic	Binary, Hex, and Floating Point Representations. Computer Arithmetic using Binary, Hex, and Floating Point.
O3	Explain the organization of modern computer systems and the fundamentals of instruction set architectures	Processor Datapath, Von Neumann Architecture, Instruction Set Architectures, MIPS
O4	Create, analyze, and debug assembly language programs and their equivalent higher-level procedural language	MIPS Assembly Language
O5	Design a complete processor, including Datapath and control	Single-cycle and Pipelined Processor datapaths
O6	Discuss instruction level parallelism using pipelining, identify major hazards that may occur and respective solutions, and assess branch prediction utility	Pipelined Processor datapath Hazards and Control
O7	Analyze the performance of computer systems in terms of average cycles per instruction, CPU execution time, and the speedup resulting from system optimization using Amdahl’s law	Processor Performance Equations, CPI, Amdahl's Law
O8	Analyze how the memory hierarchy reduces the effective memory latency and measure the impact of various cache designs and mixes of instruction and data references on performance	Memory, Caches, Impact on Performance Equation

Program Learning Outcomes (With Maps to Course Learning Outcomes)

	Program Learning Outcomes	**Course Learning Outcomes**

CS1	Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions	O1-O8
CS2	Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline	O1-O8
SE1/CE1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	O1-O8
SE6/CE6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	O4, O7, O8

Required Textbook

"Computer organization and design : the hardware/software interface" by David A. Patterson

ISBN: 1483221180

NOTE: THIS IS A ZERO COST COURSE. ALTHOUGH THESE TEXTBOOKS ARE REQUIRED, THEY ARE PROVIDED BY LIBRARY RESERVES ON CANVAS FOR YOUR USE.

Lecture Meetings, Weekly Readings, and Participation Requirements

This class meets tri weekly. Students are assigned material to **Read, Watch, or Listen** which includes specific readings from the book, power point slides, and posted videos. Students are also assigned reading assignments to complete at home prior to coming to class.

Students are also expected to attend all meetings, and actively participate in class discussions. Students will use **Poll Everywhere** to answer questions during the lecture. Poll Everywhere scores, weekly readings assignments and participating in discussion forums are used to calculate the class participation (10% of class grade).

Students are encouraged to ask questions during lectures, office hours, in the "Questions and Answers" forum, and study regularly. Students may set up an appointment online up to two hours in advance. I will make sure to respond to emails within 36 hours (about 1 and a half days) except during the weekend. Similarly, students are expected to check their emails and Canvas posts regularly.

Homework Assignments

There are 6 homework assignments. Students should individually work on all homework assignments and turn them in on Gradescope by the due date. No late assignments are accepted unless there is a family or work emergency, in which case students must provide the instructor with valid written proof before the assignment due date. If the reason seems valid, students will be granted an extension.

Exams

There are 2 closed-book exams. Students should not skip exams as no makeup exam will be given. In case of a medical or family emergency, students must notify the instructor ahead of time and if the circumstances are unavoidable, students may sit for an exam before the actual exam date.

Research Presentation

Students need to work in groups and give a class presentation about recent advances in one of the topics covered in class during the last week of classes. Students are encouraged to read online materials about recent developments in computer architecture. Students should show their work progress throughout the semester and get regular feedback accordingly.

Grading Standards

The final score will be compiled from the following parts:

Homework assignments	20%
Exams	45%
Weekly reading assignments	15%
Class participation	10%
Group presentation	10%

Grading scale: A: >= 90 %, B: 80 - <90 %, C: 70 - <80 %,

D: 60 - <70 %, F: < 60 % (+ and - are usually assigned based on a

standard scale, under the instructor's discretion:

89.99 - 86,67 = B+, 86.66 - 83.33 = B, 83.32 - 80.00 = B-, etc.)

(Fixed to reflect the actual grade scale pesented on the first day of class **Lecture 1 (https://csusm.instructure.com/courses/40281/files/folder/Lectures?preview=4754363)**)

Any discrepancy on grades should be submitted to the instructor ASAP, no later than one week from the day an assignment or exam grade is posted on Canvas. No changes will be made at the end of the semester.

Schedule

Date	Topics	Textbook Chapters
Week 1-2	Computer Abstraction and Technologies	Chap 1
Week 3-4	MIPS Instructions	Chap 2
Week 5-7	Computer Arithmetic	Chap 3
Week 6	Exam 1	
Week 8	Single Cycle Processor	Chap 4
Week 9-12	Pipelining	Chap 4
Week 11	Exam 2	
Week 13-14	Memory Hierarchy	Chap 5
Week 15	Presentations and review	
Week 16	Exam 3	

* Please note that this schedule is tentative, and subject to change as deemed appropriate.

Email Policy:

I usually respond to email within 24 hours Monday-Friday. I respond to emails during regular business hours (meaning Monday-Friday between 9:00 AM-5:00 PM PST). For all messages sent after 5:00 pm or over the weekend please expect a reply on the following business day. If you have not received a reply to your message within 72 hours, please resend to make sure I have received your inquiry. I am not on email during days designated as official campus observed holidays.

Gradescope:

You will use gradescope (**www.gradescope.com (http://www.gradescope.com/)** (Links to an external site.)) for submitting your quizzes and lab reports. We will grade them using gradescope. You will be added to our course on gradescope automatically sometime during week 1. If you are not added please contact me.

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 and instructional staff. 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 (mailto:team@piazza.com)** .

We will use Piazza as our course discussion board. Please ask all course content-related questions via piazza. Make your post public unless it contains personal information. This will help you get the fastest response possible to your post. **DO NOT POST YOUR CODE or SOLUTIONS** as a public post on Piazza as it will be considered as an Academic Integrity (AI) violation.

Piazza homepage: **piazza.com/ (http://piazza.com/)**

General Policy:

- LATE work will be penalized by one letter grade for each day it is late, up to 3 days. After 3 days, assignments will not be accepted. **Be prepared beforehand!**
- **NO MAKE-UP** exams. In case of a medical or family emergency, students must notify the instructor ahead of time and if the circumstances are unavoidable, students may sit for an exam before the actual exam date.
- All equipment and items are to be used strictly for the purposes of this class and **RETURNED** after the semester.

- If you do not submit the first homework assignment on time or are absent for more than 50% of scheduled class time by week 2, you will be **DROPED** from the course. It will then be your responsibility to go through the steps to be readded if you wish to enroll.

Academic Honesty:

Students will be expected to adhere to standards of academic honesty and integrity, as outlined in the **Student Academic Honesty Policy (http://www.csusm.edu/policies/active/documents/Academic_Honesty_Policy.html)** . All assignments must be original work, clear and error-free. All ideas/material that are borrowed from other sources must have appropriate references to the original sources. Any quoted material should give credit to the source and be punctuated accordingly.

Academic Honesty and Integrity: Students are responsible for honest completion and representation of their work. Your course catalog details the ethical standards and penalties for infractions. There will be zero tolerance for infractions. If you believe there has been an infraction by someone in the class, please bring it to the instructor's attention. The instructor reserves the right to discipline any student for academic dishonesty, in accordance with the general rules and regulations of the university. Disciplinary action may include the lowering of grades and/or the assignment of a failing grade for an exam, assignment, or the class.

Students may not record (audio or video) in this class except in accordance with ADA accommodations. Any recordings made in connection with disability accommodation are for the student's personal academic use only and may not be distributed in any manner to any other individual.

STEM Success Center (for Math, Chem, etc):

Free drop-in tutoring is available to all students through the STEM Success Center, available through Zoom and in-person (ELB 205). Website: **www.csusm.edu/stemsc (http://www.csusm.edu/stemsc)**

Our trained peer educators (tutors) will assist you in developing a deeper understanding of course concepts, problem solving, preparation for quizzes and exams, and identifying effective study strategies. In fact, students who attend early and often have demonstrated increases in their final grades. Follow us on Instagram @csusm_stemcenter.

University Credit Hour Policy:

Campus policy states that students are expected to spend a minimum of two hours outside of the classroom each week for each unit of credit engaged in learning. As a 3-unit class, students should

expect to spend around of six hours each week outside of classroom time preparing for class, working on projects and labs, and writing lab reports.

University Writing Requirement:

The campus has a university writing requirement that specifies students must write at least 2,500 words per 3-unit class. Students will meet this requirement through lab reports and the final project report.

Writing Help:

The Writing Center offers welcoming digital and face-to-face learning environments where certified student consultants offer constructive guidance at any stage of the writing process--idea generation, argument development, sentence-polishing, and more. They start with the prompt and ask guiding questions as you work to develop compelling work. Chat, voice, and video sessions are available on Microsoft Teams by appointment; Quick Help is available on Teams on a drop-in basis; asynchronous feedback is available by request; and in-person tutoring is available by appointment. Additional services include Academic English support, webinars, and various online resources. Follow them on Instagram @wccsusm. Questions? Email **writing@csusm.edu (mailto:writing@csusm.edu)** Check out details here: **https://www.csusm.edu/writingcenter/index.html (https://www.csusm.edu/writingcenter/index.html)**

Class Conduct and Civility:

In accordance with the campus Civility Statement, all students should conduct themselves "with care, respect, and empathy while acknowledging the culture and humanity of others." Class discussions (including those held online) are meant to be intellectually engaging and challenging, which may mean a variety of perspectives and opinions will be heard/shared. Conversation is encouraged but please remember to pose criticisms and questions in a respectful manner.

ADA Statement:

Students with disabilities who require reasonable accommodation must be approved for services by providing appropriate and recent documentation to the **Office of Disability Support (DSS) (http://www.csusm.edu/dss/)** . This office is at Craven Hall 4200 and can be contacted by phone on (760) 750-4905, or TTY (760) 750-4909. Email inquiries can be sent to **dss@csusm.edu (mailto:dss@csusm.edu)** . Students authorized by DSS to receive reasonable accommodations should meet with me during my office hours to ensure confidentiality.

Cougar Care Network:

The Dean of Students division provides support resources via the Cougar Care Network (CCN). CCN can be used by faculty, staff, and students. Per the CCN homepage, “Cougar Care Network (CCN) provides information, connection to resources, advocacy and support for students dealing with personal, academic, financial or other challenges which may adversely affect their academic success and/or collegiate experience.” As a student you may self-refer if you find that you need help with connecting with campus support resources. As your instructor, I may refer you to CCN if I see that you would benefit from campus assistance beyond what I can provide academically for the scope of this class. For more information visit the CCN home page: **https://www.csusm.edu/ccn/index.html (https://www.csusm.edu/ccn/index.html)**

Diversity, Equity, and Inclusion

Students in this class are encouraged to speak up and participate during class meetings. During these discussions and communications between peers, the students are expected to show respect for a diversity of individual beliefs, backgrounds, cultures, genders, and experiences. Racism, sexism, bigotry, and/or harassment in any form will NOT be tolerated. Additionally, in this course we may be discussing current events and issues surrounding racism, equity, and inclusion. The students should be prepared to have a civil discussion around these subjects.

Policies on Children in Class

The University currently does not have a policy for children in classrooms. Below is a reflection of my own commitments to students as parents:

- You are welcome to feed your baby (breastfed and/or bottlefed) in my classroom;
- If you need to pump breastmilk during class time, I would be happy to coordinate timing lecture breaks around this;
- Unforeseen disruptions in childcare should not be a deterrent for attending class; it is perfectly acceptable to bring your child to class, as needed;
- As students and parents, you are held to the same standards as your peers (deadlines, etc.) but I am happy to discuss routines and practices that facilitate a healthy school-parenting balance.

Contact Information for Technical Support Assistance:

For questions or assistance with a technical part of the course, your campus username/password, your campus email, etc., please contact the **CSUSM Student Technology Help Desk (http://www.csusm.edu/sth/index.html)** . Email inquiries can be sent to **sth@csusm.edu (mailto:sth@csusm.edu)** .

If you require support for hardware issues (computer, webcam, etc.) or with any software tools (Canvas, Zoom, etc.), please visit IITS (Information Technology Services) For You Student page.

If you need technology items for your coursework (laptop, webcam, wireless hotspot, etc.), please visit IITS For You Appointment page.

The new USU computer lab offers computer access and free printing. The lab is open Monday-Friday 10:00 am-4:00 pm and the computers are cleaned after every use for your safety. The computer labs on the 2nd and 3rd floors of Kellogg Library are closed.

Mandated reporting & sexual violence resources:

“CSUSM is committed to fostering a campus community based on respect. To this end, we recognize that all CSUSM community members are responsible for helping to ensure that our community is free from harassment, discrimination, sexual misconduct, domestic violence, and stalking. In accordance with Title IX, CSUSM is legally obligated to respond to reported incidents of harassment, discrimination, sexual misconduct, domestic violence, and stalking. Faculty who become aware of an incident of harassment, discrimination, sexual misconduct, domestic violence, and stalking are required to notify CSUSM’s Title IX Coordinator. The purpose of this disclosure is to ensure that students are made aware of their reporting options and resources for support. For more information about your rights and reporting options at CSUSM, including confidential and anonymous reporting options, please visit **http://www.csusm.edu/title9/ (http://www.csusm.edu/title9/)**

Land Acknowledgment:

We acknowledge that the land on which we gather is the traditional territory of the Luiseño/Payómkawichum people. Today, the meeting place of CSUSM and its surrounding areas is still home to the six federally recognized bands of the La Jolla, Pala, Pauma, Pechanga, Rincon, Soboba Luiseño/Payómkawichum people. It is also important to acknowledge that this land remains the shared space among the Kuupangaxwichem/ Cupeño and Kumeyaay and Ipai peoples. For more information, please go to **https://www.csusm.edu/cicsc/ (https://www.csusm.edu/cicsc/)**

Syllabus is subject to change.