CMPSC 64 – Computer Organization and Digital Logic Design

Syllabus – Winter 2025

Class Time:	**Mon. & Wed. 12:30 – 1:45 PM**	**Location:**	**TDW 1701**
Instructor:	**Dr. Ziad Matni**	**Email:**	ziad.matni@ucsb.edu
Office Hours:	**Thursdays, 10:30 AM – 12:00 PM** in HFH 1123 *or by appointment (email the prof)*		
Lab Sections:	**Tuesdays, 2, 3, 4, 5, and 6 PM** in PHELPS 3525		

Teaching Assistants:	Kirill Aristarkhov	kya@ucsb.edu	*CHECK CANVAS PAGE FOR TIMES AND LOCATIONS OF OFFICE HOURS*
	Kali Hale	kalihale@ucsb.edu	
	Matthew Peng	mpeng@ucsb.edu	
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Undergraduate Learning Assistants:	Tanay Biradar	tbiradar@ucsb.edu	
	Riya Gupta	riyagupta@ucsb.edu	
	Kate Larrick	katelarrick@ucsb.edu	

Class Main Website:	**Canvas**	**Canvas website**
Assignment Submissions:	**Gradescope**	**Gradescope website**
Q&A/Discussion Site:	**Piazza**	**Piazza website for CS64 W25**
iClicker Software:	**iClicker**	**iClicker for UCSB Students**

Syllabus Contents

A. Class Overview and Pre-Requisites

Have you ever wondered how a computer actually computes? Deep beneath your phone's glossy exterior and flashy screen, a network of literally miles of wires carries information between many billions of little switches that, when working properly, allow you to run your favorite app. This class is the beginning of the story of how that happens. We will explore the fundamental principles of computing hardware, what it "means" for a program to actually run on a computer, and start to drill down through intricately stacked layers of abstraction that make what you call a "computer" even possible. Along the way you will learn some assembly language programming, you will better understand how and why computers are organized the way they are, and how to actually start to build your own computers using the basic digital logic design elements of gates, combinational circuits, flip-flops, and much more. You are expected to have taken and passed (i.e., C grade or higher) **CMPSC 16** before you take this course, as well as **MATH 3C/4A**.

B. What you need to know BEFORE you take this course

It is very important that you took **CMPSC 16** as we will be referring *a lot* to memory maps, pointers, and C/C++ code. You are also expected to be familiar with using the **UNIX command line** to navigate folders, view files, and compile and run programs. In addition, you must have a **College of Engineering UNIX account** ready to use by the end of the first week of class.

C. What you will learn by the end of this course

You'll have the opportunity to learn all of these things (though not necessarily in this order):

- Computer organization concepts
- Binary arithmetic and logic operations
- Assembly programming language for 32-bit MIPS architecture, including:
  - Basic arithmetic & variable use
  - Flow control (branching)
  - Memory addressing
  - Functions and function calls
- Basic digital logic design, including:
  - Logic gates and truth tables
  - Combinatorial logic
  - Sequential logic
  - Finite state machine

D. How to succeed in this course

Come to all the lectures, take good notes, PRACTICE the examples done in lecture, start your homework early, and ask us questions often!

E. A Note on Conduct: A Shared Expectation of Respect

Our opportunity to go through this really interesting material together is something that I very much enjoy teaching. I truly believe every student entering my class is more than capable of mastering this material with some hard work, curiosity, and persistence. Your instructional team will be working hard for you, and while we are far from perfect, you should never expect anything less than dignity and respect in 100% of our interactions. We, in turn, expect the same from you. As professionals, or professionals in training, we are all responsible to treat the members of this academic community (e.g. your peers, our staff and faculty, and even yourself) respectfully and professionally. With this as our foundation I know we can build some wonderful things.

Additionally, I do expect you to be responsible for your own learning and to ask questions. We will always strive to make the classroom, the lab, and our offices safe spaces for you to ask questions and to learn and, yes, even to make mistakes. *Believe it or not, making mistakes is one of the most effective ways to learn!*

Finally, I do expect you to do your own work at all times. Please familiarize yourselves with the university's policies on academic integrity and honesty and **READ** the section in this syllabus that details this further (on **pg. 9**). Failure to comply with these policies will result in a zero grade and likely incur additional penalties.

F. Where Do I Find Stuff?

All information you need about what today's lecture is, to what homework or lab is due today, is found in **THIS SYLLABUS**! Please read this syllabus in its entirety as it contains all the important information on how this class runs and what my policies are – I will quiz you about it (for points!)

All material (class slides, example codes, all assignments, grades, etc.) will be listed on our **main website** (Canvas). Please check out our website and familiarize yourselves with it as soon as possible.

All questions you have should be posted on our class' **Piazza** site. I encourage EVERYONE to participate on Piazza and answer each other's questions to the best of your ability. My team and I will observe Piazza postings and chime-in when needed!

G. Assistance to Students

Remember to periodically go to your TA's or ULA's or instructor's office hours for questions you want answered!

This class has teaching assistants (TAs) and undergraduate learning assistants (ULAs). The TAs will lead labs and hold office hours. The ULAs will help students by tutoring and assisting them during lab sections and in their office hours.

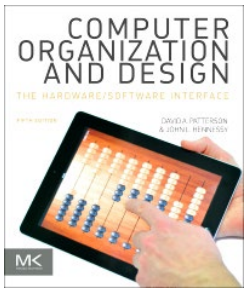
All office hours (prof's, TAs', ULAs') are listed on the 1st page of this class' Canvas site as well as on the front page of our class website. ***You are highly encouraged to go to office hours with your questions***. You can also pose questions – and answer each other's questions – on **Piazza**.

Invariably, you are going to have questions on lecture or lab-related stuff. What do you do? **Your first choice should always be to use Piazza to post the question** (or see if anyone's asked it and received an answer). Make it a habit to check Piazza many times a week – see if you can answer your fellow students' questions yourself! The instructor and the TAs/ULAs will also be looking at Piazza questions periodically to help you out. If you can, please make your questions visible to everyone, but if you just want to ask something of one of the teaching staff, make sure you ask all "Instructors" (i.e. the prof, the TAs, the ULAs) in order to get the timeliest response.
Please do **not** use Piazza to post outright solutions to homework problems – you can, of course, *discuss* the exercises and ways to solve the problems.

If you need to email me because you'd rather not share your question on Piazza with anyone else, please feel free to do so, *but please indicate which course you are in* (i.e., put "**CS64**" in the subject line!)

H. Textbooks and Other Learning Material

(also used in CS 154 – so keep this copy!!)



This textbook is ***required*** and also available to be checked out at the UCSB library: Patterson, D.A., & Hennessy, J.L. (2013). *Computer Organization and Design: The Hardware/Software Interface*, **5th** edition. Morgan Kaufmann.

You can get the (newer) 6th edition instead, if you want to.

I will also give you handouts to read. These will be also announced and posted on the course website.

I. Coding and Software Particulars for this Course

For a large part of this course, we will be programming in MIPS assembly language. We will use a MIPS emulator software to run our programs – more will be explained in lecture. This software is available for use on the CSIL machines, which students can also access remotely via **ssh**.

J. Class Lectures and Lab Sections

This is a lecture class that meets in-person twice a week and is accompanied by a weekly lab section. Attending lectures is **VERY** important to doing well. Even though I will only take attendance in the 1st week of lecture, we will have several participation activities during the scheduled class that *cannot* be made up later. We will take attendance in the first few weekly labs. You cannot make up missed labs sections.

The purpose of the *lectures* in this course is to guide you through the readings and assignments. Especially as it pertains to:

- providing an overview of how everything fits together,
- providing hands-on demonstrations of things that you'll do on your own later,
- providing additional information that is not in the textbook/handouts (and to sometimes clarify the textbook/handouts), and
- providing an opportunity to ask questions, and hear answers to questions asked by others.

This course moves quickly, so keeping up with the course material every week is ***very*** important and is ***key*** to doing well in this class.

Labs will be conducted in **PHELP 3525** on **Tuesdays**. I will put up the lab assignments on our main website and you will turn them in online by the posted due date. Lab TAs/ULAs will be available for help in the lab sessions.

K. Participation and Attendance

I will often ask for participation, usually in the form of answering poll questions in class using **iClicker**, a free tool that can be used from a smart phone or laptop computer. **This link** will tell you more about how to download and use **iClicker** as a UCSB student. Students are expected to keep up their attendance of lectures, although I will not actively take attendance in class (after Week 1). Attendance *is* taken in the lab sections and students are allowed to miss up to 2 sections without penalty.

L. Assignments

The homework assignments are released on Canvas and Gradescope and students are expected to adhere to the course's strict **late policy**. Assignments have to be submitted ONLY using the **Gradescope** tool. We will not accept nor grade assignments emailed to us.

Most of your assignments will be given to you as a **PDF** document on the class website. You can print this PDF, write your answers on it, then re-scan it, *or alternatively* you can edit the assignment PDF directly using various different software applications (I will list some of these for you at a later date). You then have to submit your assignment as **your own** PDF document on Gradescope. Please note that only **PDF submissions will be accepted and graded**.

The only exception to this, is that a few assignments will be programming-based (C++, MIPS assembly), in which case, you'll be given directions on how to upload them onto Gradescope.

Students are allowed to work together on homework in **groups of two** (but not more!), and may discuss assignment solution details within the group and with other class members. However, each member of the group is still accountable for their own work (***and every individual should turn in a separate assignment***). Students may change groups between assignments, *though not within an assignment*. Forming groups is *optional*; students may work alone if they want.

Please, ***do not copy material from somewhere else (including online sources, other people, LLMs like ChatGPT etc…) WITHOUT giving it proper citation/prompt used*** – otherwise, it WILL be considered to be **plagiarism** (**please familiarize yourselves with my policy and the University's policy on plagiarism**). You do not have to cite something the instructor or the TAs explicitly said in lecture or lab.

If you believe that a grade on an assignment question is wrong, you may ask for a review for a possible re-grade using Gradescope's "*Regrade Request*" feature. Note that such requests will only be made available for 3 days after an assignment grade has been released. You should have a good reason to ask for a regrade and understand that it is not a guarantee of a grade change.

M. Quizzes and Exams

This course has 4 quizzes and 1 final exam:

- The quizzes will take place on the **Wednesdays** of **Weeks 2**, **4**, **6**, and **8**.
- a *final exam* on **Tuesday, March 18** (as set by the University).

All quizzes and exams will be in-person and in our classroom.
There are absolutely NO make ups for missed quizzes or exams.
More details on these quizzes and the final exam will be provided at a later date.

N. Late Policy and Make Up Policy – PLEASE READ!

A late assignment submission means **submitting 24 hours after a deadline**. Late submissions will result in a **20% penalty**. Anything submitted *beyond* the deadline + 24 hours will receive a **zero**. No makeup is allowed for assignments except in rare cases, if there is a documented family emergency, documented extended illness, documented required court appearance, or other situation beyond the students' control (with documentation), then the professor *may* grant additional make up days entirely at the instructor's discretion – but this is **not** a guarantee or a right.

No makeup is allowed for missed exams whatsoever.

O. Grading

Item	Grade %	Notes
In-class Participation	3%	
Assignments	27%	All assignments are equally weighed.
Quizzes	30%	See pg. 8 for dates. In-person, required, no makeup.
Final Exam	40%	See pg. 8 for date. In-person, required, no makeup.
TOTAL	**100 %**	

P. Class Grade Distributions

These are calculated to 2 decimal places and very strictly assigned.

Range	Grade
[93 – 100]	A
[90 – 93)	A-
[87 – 90)	B+
[83 – 87)	B
[80 – 83)	B-

Range	Grade
[77 – 80)	C+
[73 – 77)	C
[70 – 73)	C-
[60 – 70)	D
< 60	F

[X – Y) means ***"X to Y inclusive of X (but not Y)"***

A+ grades: These may be awarded to the *very* best performing students in the class—but the cutoff for A+ grades will be determined at the end of the course *at the discretion of the instructor* (there is no pre-determined cutoff---an average of 97 or more doesn't guarantee you an A+ grade.) If I decide to curve the grade (it's not guaranteed that I will), I will do so on the final class scores and not on any individual item.

F grades: ***If you miss your final exam, you will receive an F, regardless of your running score in the class***. If you feel that I or the TAs have made a mistake (like adding up a grade incorrectly), then you should certainly bring that to my attention in an expedient fashion (*within one week's time*), ***but please do not engage in* grade-grubbing** (for example, do NOT ask me to round up your final class grade at the end of the quarter). If you have any questions about how grades are computed, please feel free to ask, and I would be happy to explain further.

Q. Note to Students with Disabilities

Please register your accommodation requests with DSP at your very earliest opportunity – this is best done by the first or second week of the quarter. Make sure that you submit your DSP request *no later than one week before a scheduled exam.* The instructor will accommodate students only according to information gotten from the DSP office. See **Section** Error! Reference source not found. (Additional Campus Resources) for contact details for the DSP Office.

R. Class Schedule

The lecture topics are subject to change or re-arrangement.

Week	Topic(s)	Readings from Book or *Handouts*	Assignments Due
1	Intro to the course; Numerical bases Binary Arithmetic & 2s complement	*Handout #1*	-
2	Binary logic operations Assembly: intro; processing a program	*Handout #1*	Assignment 1
3	**No Class on Monday – MLK Jr. Day** Assembly: i/o and types of instructions	*Handout #2*	Assignment 2
4	Assembly: flow control (branches & loops) Assembly: accessing memory	Ch. 2.7	Assignment 3
5	Assembly: representing instructions Assembly: functions and the stack	Ch. 2.5, 2.8	Assignment 4
6	Assembly: MIPS calling convention Assembly: recursive functions	Ch. 2.8	Assignment 5
7	**No Class on Monday – Presidents Day** Digital Design: Logic Design & Simplification techniques	- *Handout #3*	None
8	Digital Design: Logic Design & Simplification techniques Digital Design: Combinatorial logic, Muxes, ALUs	*Handout #3* Appendix B.1 thru B.4	Assignment 6
9	Digital Design: Sequential logic	Appendix B.5 thru B.10	Assignment 7
10	Digital Design: FSMs	Appendix B.5 thru B.10	Assignment 8
11	**FINAL EXAM on Tuesday, March 18 at 12:00 PM**		

NOTE:

This syllabus and schedule are subject to change. The professor will do his best to convey changes in a timely fashion to the students, if they occur. If a change is made to the syllabus it will be announced AND the version of the syllabus will be incremented (e.g. from v0 to v1).

S. UCSB and Instructor's Policies on Academic Integrity and Honesty

Academic Integrity

It is expected that students attending the University of California understand and subscribe to the ideal of academic integrity, and are willing to bear individual responsibility for their work. Any work (written or otherwise) submitted to fulfill an academic requirement must represent a student's original work. **Any act of academic dishonesty, such as cheating or plagiarism, will subject a person to University disciplinary action**. Using or attempting to use materials, information, study aids, or commercial "research" services not authorized by the instructor of the course constitutes cheating. Representing the words, ideas, or concepts of another person without appropriate attribution is plagiarism – ***this includes utilizing answers obtained from artificial intelligence (AI) programs and applications***. Whenever another person's written work is utilized, whether it be a single phrase or longer, quotation marks must be used and sources cited. Paraphrasing another's work, i.e., borrowing the ideas or concepts and putting them into one's "own" words, must also be acknowledged.
I will report the violation to the Associate Dean of Students for possible referral to the Conduct Committee. That committee has the authority to impose a range of sanctions, including suspension.
Further information is available at: https://studentconduct.sa.ucsb.edu/academic-integrity

Cheating on exams/quizzes

I have never released an exam/quiz from a previous quarter. Thus, *any* exam/quiz from a previous quarter that you get hold of *must have been illegally obtained*. If you come across a previous quarter's quiz or midterm or final, you are under the obligation of the university's "code of conduct" to surrender it (and all copies of it) to me. If, however, you choose to study from a previous quarter's midterm or final, no matter how that exam came into your possession, be aware that ***you are cheating***, and if found out will receive a ***zero***. Furthermore, if I discover that a particular organization (e.g., sorority, fraternity, or other club) provides to students or maintains an archive of any of my previous exams, I will file a code of conduct complaint with the University against the organization.

During exams, you may not look at another student's test or answers, share your answers/test with another student, nor remove a test from the exam room. All of these behaviors are forms of **cheating** and will result in a **zero** on the exam, at minimum.

Inappropriate Use of Course Materials

My lectures and course materials, including PowerPoint presentations, tests, outlines, and similar materials, are protected by U.S. copyright law and by University policy. I am the exclusive owner of the copyright in those materials I create. You may take notes and make copies of course materials for your own use. You may also share those materials with another student who is enrolled in or auditing this course.

You may not reproduce, distribute or display (post/upload) lecture notes or recordings or course materials in any other way — whether or not a fee is charged — without my express prior written consent. You also may not allow others to do so. If you do so, you may be subject to student conduct proceedings under the **UC Santa Barbara Student Code of Conduct**. Similarly, you own the copyright in your original papers and exam essays. If I am interested in posting your answers or papers on the course web site, I will ask for your written permission.

T. Non-discrimination policies

Under Title IX, university students are protected from harassment and discrimination based on gender and sex. If a student feels uncomfortable or in need of support at any time related to their gender, sex, and/or sexual orientation, please contact your TA and/or course instructor immediately. If a student would like to disclose information related to pronouns, name changes, or identities, we encourage you to do so. UCSB's Resource Center for Sexual and Gender Diversity on the 3rd floor of the Student Resource Building is also available to advocate and be of and support to students. You can also specify your preferred pronouns on GOLD. Similarly, you can check others' pronouns when responding to refer to them properly in this class. Remember that it is always okay to use someone's name to avoid using the wrong pronouns for them. For more information, visit http://rcsgd.sa.ucsb.edu/education/pronouns

All students have the right to learn and participate in a classroom environment free of intimidation, harassment, and discrimination based on characteristics such as gender, race, age, sexual orientation, disability, religious or political beliefs and affiliations. I will address any related issues that surface immediately; *please help me to cultivate a positive classroom environment by communicating any concerns that you have*.

U. Statement on sexual harassment

UCSB does not tolerate sexual harassment/sexual violence, which is prohibited by University policy and state and federal law. The Title IX Compliance and Sexual Harassment Policy Compliance Office (TIX/SHPC) assists in preventing and resolving and investigating complaints of sexual harassment/sexual violence and gender discrimination. https://titleix.ucsb.edu/

V. Mandatory reporting

As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. I want to ensure that students feel they can speak to me, but I also want students to be informed that I have a mandatory reporting responsibility related to my role as an instructor. I am required to share information regarding sexual misconduct or information about a crime that may have occurred on UCSB's campus or in the community. A result of my mandated report will be that students will receive outreach and resources from the campus Title IX office. Students may speak to someone confidentially by contacting CARE, Campus Advocacy, Resources & Education at the 24/7 advocacy line at (805) 893-4613 or visit them in person at the Student Resource Building.

W. Mental health

On top of the usual stress factors, switching to in-person education may require some mental adjustment or create additional stress. Personal concerns such as stress, anxiety, relationships, depression, cultural differences, can interfere with the ability of students to succeed and thrive. For helpful resources, please contact UCSB Counseling & Psychological Services (CAPS) at 805-893-4411 or visit https://caps.sa.ucsb.edu/

X. Additional Campus Resources

If you experience difficulty in this course for any reason, please don't hesitate to contact your instructor. The following campus services might also be beneficial to you. Please use them as needed.

Disabled Students Program

Location: 2120 Student Resources Building | 805.893.2668 | http://dsp.sa.ucsb.edu/
The Disabled Students Program offers many services, such as reading services, notetaking assistance, test-taking accommodations, and registration assistance. For more information on these services, eligibility, and registration, please call or visit the Disabled Students Program office.

CSO Safety Escorts

805.893.2000 | https://www.police.ucsb.edu/cso/cso-safety-escorts
The CSO (Community Service Organization) Escort Program is a free service provided to all students, faculty and community members during the evening and early morning hours. The objective of the escort service is to provide a safer mode of transportation through campus and Isla Vista. The escort service is based on the "buddy" system which is to simply provide another person to travel with you to your destination. The CSO Escort Service can be used by simply calling the Police Dispatch through the Escort Phone Line at 893-2000. Escorts can also be requested through the Red Emergency Phones located all over campus.

Food For All

If you are facing any challenges securing food or housing, and believe this may affect your performance in the class, you are urged to meet with a Food Security and Calfresh Advocate, who is aware of the broad variety of resources that UCSB has to offer (see their drop-in hours at food.ucsb.edu). You are also urged to contact the professor or teaching assistant if you are comfortable doing so. Please visit food.ucsb.edu for additional resources including Calfresh, and the AS Food Bank.

Campus Learning Assistance Service

Location: Student Resource Building 3210 | 805.893.3269 | http://clas.sa.ucsb.edu/
CLAS helps students increase their mastery of course material through course-specific tutoring and academic skills development. The tutorial groups and drop-in tutoring schedules are posted on the website. CLAS also provides workshops and counseling in test-taking as well as paper-writing skills.

Counseling Services (CAPS)

Location: Building 599 | 805.893.4411 | http://caps.sa.ucsb.edu/
Counseling Services offers counseling for personal concerns and crisis intervention, stress management, self-help information, and connections to off-campus mental health resources.
There is a Mental Health Peer Services in CAPS that offers drop-in peer counseling, massage & egg chairs, workshops on managing stress (and many other topics), as well as one-on-one sessions with a peer to help students learn coping skills to reduce anxiety (School Anxiety Program).

CARE (Campus Advocacy, Resources & Education)
Location: Student Resource Building, 1st Floor | http://wgse.sa.ucsb.edu/Care/
Provides confidential advocacy and support to anyone impacted by sexual assault, dating/domestic violence and stalking.

Student Engagement and Leadership (SEAL)
Location: Student Resource Building 1104 & 2260 | 805.893.4569 | https://seal.sa.ucsb.edu/
promotes undergraduate and graduate student engagement and development through co-curricular programs, including campus organizations, fraternities and sororities, leadership development, and civic engagement.

ONDAS Student Center
Location: Kerr Hall 1150 | 805.893.3457| http://ondas.ucsb.edu/
The OSC offers academic support, mentoring, special programming, and community for all UCSB students, especially first-generation students.

Transfer Student Center
Location: UCSB Library, First Floor, Ocean Side | http://www.transfercenter.ucsb.edu/
A space for transfer students to make connections, find academic support, mentoring, and special programs.

Undocumented Student Services
Location: 2210 Student Resource Building | 805.893.5609 http://www.sa.ucsb.edu/DreamScholars/
USS provides general counseling to undocumented and mixed status students. Services include access to student mentors, programs and legal service referrals.

Educational Opportunity Program
Location: Student Resource Building, Room 2210 | 805.893.4758 | http://eop.sa.ucsb.edu/
EOP provides advising, mentoring, and programming for first generation and income eligible students.

Office of International Students & Scholars
Location: Student Resource Building, Room 3130 | 805.893.2929 | http://oiss.sa.ucsb.edu/oiss-home
OISS provides immigration support for the UCSB community, advising for international students, and cultural programming.

Academic Initiatives
Number: 805.893.2720 | http://academics.sa.ucsb.edu/
Student Affairs Academic Initiatives facilitates student academic and leadership opportunities, and community engagement.