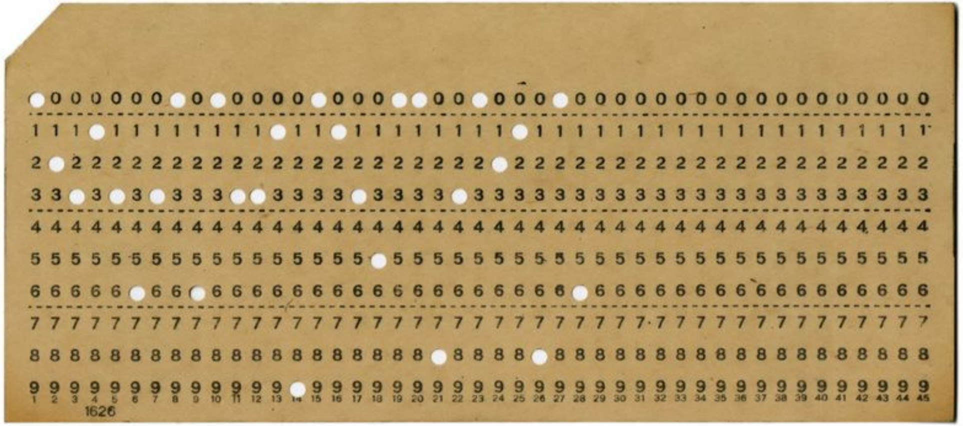
CS 61C

Great Ideas in Computer Architecture

Course Intro

Instructors: Connor (Cece) McMahon, Jenny Song, Jonathan Shi



Agenda

- Staff Introduction
- Course Overview
- Course Information

Introducing Connor (she/her)

Mt. Hood National Forest

- **Upbringing:** Born in the New Orleans, lived in Atlanta since 8
- **Education:** BS in Computer Engineering from Georgia Tech, Pursing MS in CS at UC Berkeley
- **Teaching:** 61C TA
- **Interests**: Hiking, Traveling

View from Georiga Tech library

Paris, France

Oregon Coast

My amazing dog, Belle

Introducing Jonathan (he/him)

few known pictures of me facing the camera exist

- **Upbringing:** born in the East Bay, raised in the South Bay
- **Education:** finished undergrad this year (EECS), coming back for MS
- **Teaching:** 61C + 162 course staff, formerly 16A CSM
- **Interests**: dinosaur comics, amateur saxophonist, amateur chess player, amateur smash bros. player

PLACEHOLDER TEXT, TO PROVOKE THE IMAGINATION

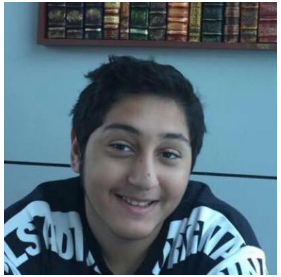
Introducing Jenny (she/her)

- **Upbringing:** Born in Hangzhou, China, High school in New Jersey
- **Education:** Berkeley grads, Masters at CMU
- **Teaching:** 61CCC
- **Interests**: Baking, Running, Tiktoking, Procreating

Introducing Your TAs

Anjan
Das

Abel
Yagubyan

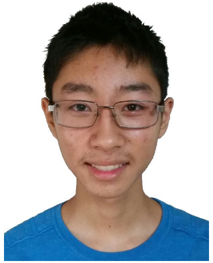


Arunan
Thiviyanathan

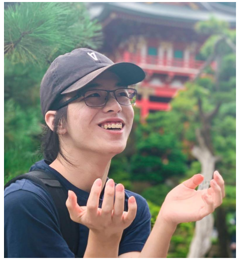
Aadith
Srinivasan

Raghav Singh

Raghav Gupta



Justin Yokota



Jerry Xu

Caroline Liu

Introducing Your Tutors

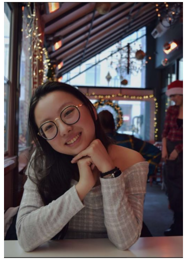
Amit Narang

Carolyn Duan

Cindy Lin

Edwin Lim

Ella Schwarz



Rosalie Fang

Vinay Guatam

Yuanhan Li

Kenneth Lien

Riley Dyer

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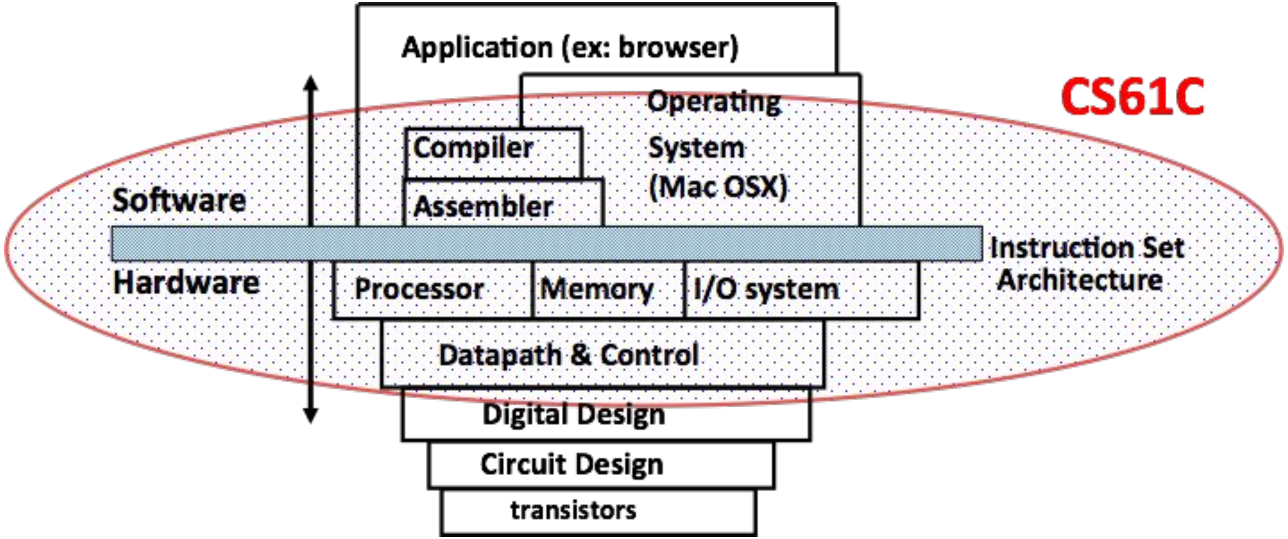
Course Goals

1. How do computer processors and memories work, and how do they affect software design and performance?

2. Introduction to “computer systems” areas: architecture, compilers, security, embedded, operating systems, digital design, and more!

   → (CS 152, CS 164, CS 161, CS 149, CS 162, EECS 151, etc.)

Hardware-Software Interface



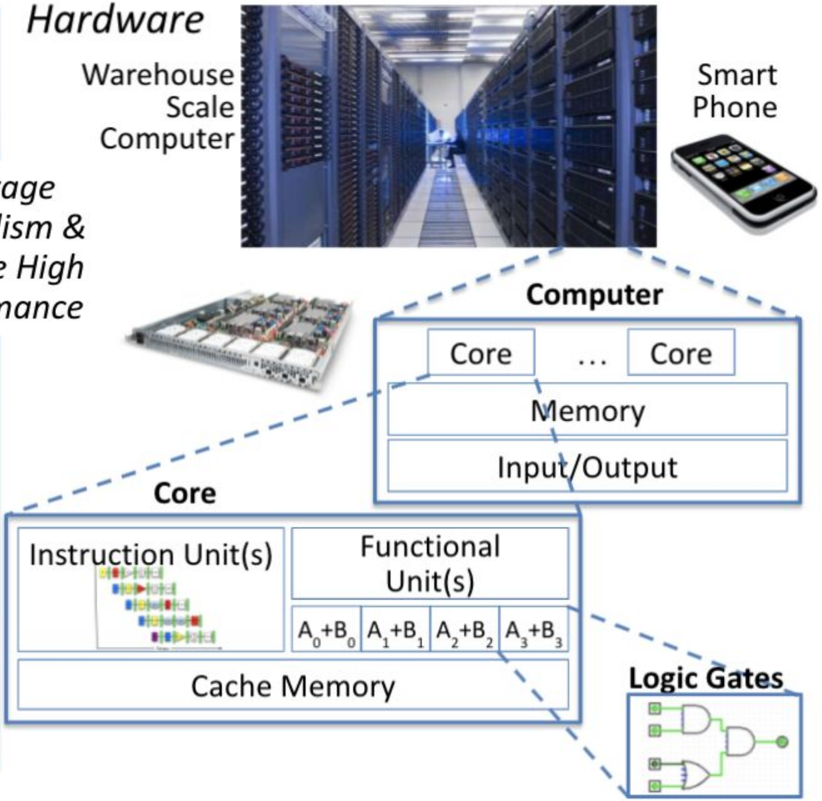
Hardware-Software Interface

Software

- Parallel Requests
  Assigned to computer
  e.g. search "Steven Ho"
- Parallel Threads
  Assigned to core
  e.g. lookup, ads
- Parallel Instructions
  > 1 instruction @ one time
  e.g. 5 pipelined instructions
- Parallel Data
  > 1 data item @ one time
  e.g. add of 4 pairs of words
- Hardware descriptions
  All gates functioning in
  parallel at same time

Leverage Parallelism & Achieve High Performance

Hardware



Warehouse Scale Computer

Smart Phone

Computer

Core ... Core

Memory

Input/Output

Core

Instruction Unit(s)

Functional Unit(s)

A_0+B_0 A_1+B_1 A_2+B_2 A_3+B_3

Cache Memory

Logic Gates

CS61C For Software Development

(aka, what if I never want to work on hardware?)

- Know the tools of the trade – computers!
  - “Computers” come in all shapes and sizes
  - Computing achieved in many different ways nowadays
- Know how to improve program performance
  - Parallelism techniques
  - OS + computer architecture basics
- Design large systems – abstraction in hardware
- Design methodology – limitations and tradeoffs

Course Learning Objectives

After taking this class students should be able to:

- ✓ Identify and explain the various layers of abstraction that allow computer users to perform complex software tasks without understanding what the computer hardware is actually doing
- ✓ Judge the effect of changing computer components (e.g. processor, RAM, HDD, cache) on the performance of a computer program
- ✓ Understand how the memory hierarchy enables fast memory accesses
- ✓ Construct a working CPU from logic gates for a specified instruction set architecture
- ✓ Identify the different types of parallelism and predict their effects on different types of applications

Course Learning Objectives

In addition, this class will requires students to work on the following skills:

- Creating and modifying designs to meet a given set of *specifications*
- Identifying unexpected or problematic situations using debugging tools, and creating test cases to ensure proper behavior
- Defending design choices based on tradeoffs and limitations

Six Great Ideas in Computer Architecture

1) Abstraction
2) Moore’s Law
3) Principle of Locality/Memory Hierarchy
4) Parallelism
5) Performance Measurement & Improvement
6) Dependability via Redundancy

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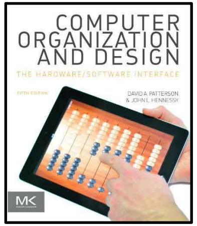
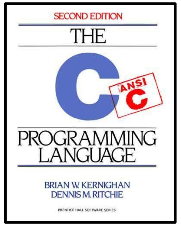
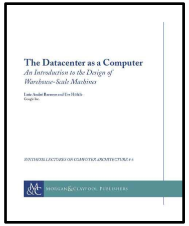
Course Information

- **Course Website:** https://cs61c.org/
  - Check for weekly schedule, assignments, staff contact info
- **Ed:**
  - Core platform for announcement, discussion and clarification
- **PrairieLearn**
  - Home assignments and exam
- **Gradescope**
  - Lab and project
- **Inst account:** http://inst.eecs.berkeley.edu/webacct
  - Access instructional ("hive") machines for project and lab work
- **Textbook**


COMPUTER ORGANIZATION AND DESIGN
THE HARDWARE/SOFTWARE INTERFACE
FIFTH EDITION
DAVID A. PATTERSON
& JOHN L. HENNESSY
MK




The Datacenter as a Computer
An Introduction to the Design of Warehouse-Scale Machines
Luiz André Barroso and Urs Hölzle
Google Inc.
SYNTHESIS LECTURES ON COMPUTER ARCHITECTURE # 6
M&C MORGAN&CLAYPOOL PUBLISHERS

Course elements

Lecture	Lecture content is pre-recorded all delivered asynchronously.
Lab	We encourage you to work with a partner (in your own zoom rooms) on your own time. Labs are auto-graded on Gradescope based on correctness.
Discussion	3 Live 1hr discussions and a 2hrs lost section are host on W/F. Pre-recorded discussion of TAs going over the worksheet are also available.
Office Hour	OHs are held on zoom throughout the day. We have dedicated project OH, and regular OH.
Project	4 projects graded on correctness and ran with plagiarism detection programs.
Homework	Weekly homework, you will have infinite tries, graded on correctness.
Exam	1 midterm and a final, both proctored, alternative time request will be available.

Course Assignments and Grading

- **Labs** (10%) – 30 pts
- **Homework** (11%) – 33 pts
- **Projects** (48%) – 4 total, weighted equally
  - Proj1 (12%) – Proj2 (12%)
  - Proj3 (12%) – Proj4 (12%)
- **Exams** (31%)
  - **Midterm** (11%): Thursday 7/22 9:30AM
  - **Final** (20%): Thursday 8/12 9:30AM
- **EPA** (Effort Participation Altruism)
  - Attendance and active engagement in course events
  - (eg: discussions, OHs, review sessions, guerilla sessions, tutoring, etc)

Project Partners

- You may work with a partner for projects
- We will have an Ed thread for you to find partners, also a meet-n-greet session, partner-matching, more on ed post
- Pair programming works great!
- Guidelines: https://cs61a.org/articles/pair-programming/

Exam Clobbering & Conflicts

- Midterm is clobber-able with your score on the final exam!
- We will offer a full (z-score) clobber to the midterm from the final. This means that your midterm score will be the max of what your current score and the z-score of the final mapped to the midterm.

Late Policy – Slip Days

- Assignment submissions due at 11:59pm
- **Homework**: 3 slip days, 1 drop, no late credit after slip days
- **Lab**: 1 drop, half credit if submitted within a week late, no credit after that
- **Project**: 3 slip days, 33% deduction of score per day after slip days

- Slip day tokens will be distributed amongst your late submissions at the end of the semester to maximize your grade to benefit to having leftover tokens.

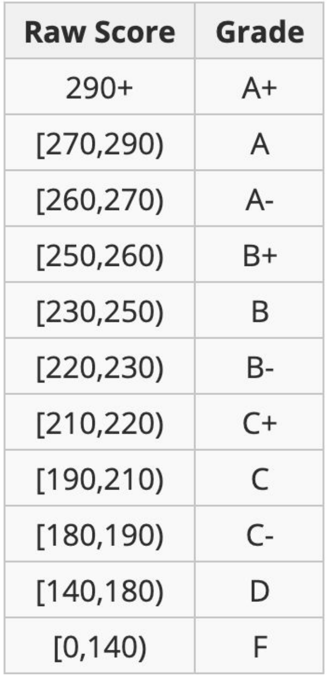
- Use the slip tokens at own risk – don’t want to fall too far behind.
- If you have an emergency, request an extension!

EECS Grading Policy

- http://www.eecs.berkeley.edu/Policies/ugrad.grading.shtml

  “A typical GPA for a lower division course will fall in the range 2.8 - 3.3, depending on the course and the students who enroll. For example, a GPA of 3.0 would result from 35% A's, 45% B's, 13% C's, and 7% D's and F's.”

61C Grade Bins



Raw Score	Grade
290+	A+
[270,290)	A
[260,270)	A-
[250,260)	B+
[230,250)	B
[220,230)	B-
[210,220)	C+
[190,210)	C
[180,190)	C-
[140,180)	D
[0,140)	F

- Course is graded out of 300 points
- If the grade bins result in an average GPA that is too low, the course will be curved to match department guidelines BEFORE adding EPA.

Policy on Assignments and Independent Work

- We understand that this class is stressful and can become overwhelming
- You learn by doing, not cheating
- When students cheat, it is impossible for instructors to understand what material the students are struggling with
- Cheating hurts you, your classmates, and your professors
- If you need help, please reach out to us

Policy on Assignments and Independent Work

- All submissions should be completed by you or you and your partner alone
- You are encouraged to discuss your assignments with other students (ideas), but we expect that what you turn in is yours
- It is NOT acceptable to copy solutions from other students
- It is NOT acceptable to copy (or start your) solutions from the Web (including Github)
- More information on the course policy webpage

Policy on Assignments and Independent Work

- We have tools and methods, developed over many years, for detecting cheating. You WILL be caught, and the penalties WILL be severe.
- Both the cheater and the enabler receive –100% for the assignment. Letter to your university record documenting the incidence of cheating.
  - IT IS BETTER TO NOT DO THE ASSIGNMENT THEN TO CHEAT
- People are caught every semester of 61C

Tutor Resources

- Weekly Guerrilla Sessions (synchronous but recorded)
  - Review sessions covering exam problems on specific topics
- Small-group tutoring (synchronous NOT recorded)
  - Sign up for a weekly tutoring session w/ a tutor
  - Groups are as small as 5-10 people; personalized help
  - Sign-ups will be posted on Ed

Successful Behaviors

- Practice, practice, practice
  - Learn by doing: deep learning doesn't happen in lecture (and it shouldn't!)
  - Growth mindset: success through effort and repetition
- Find a learning community
  - Learning is much more fun with friends
  - Learn via discussion of concepts with other students
- Avoid comparison
  - do your best, and judge yourself on your progress alone.
  - Remember, we have the clobber policy!!
- You learn best from your mistakes
  - Don't be afraid to be wrong; you are here to learn, please ask us any questions you may have

This Week

- Intro form
- Lab 0 released today, due Friday
- Lab 1 released Thursday, due next Monday
- Homework 1 released this afternoon (will make Ed post), due next Monday
- Homework 2 released Wednesday, due next Tuesday
- Project 1 released Friday, due next Friday

Reminder

- Please only email us for private matters. All other questions should be posted on Ed.

Thank you and good luck!