EECS 16A Lecture 1!

We will start at 9:40.

If you're bored, talk to your neighbor about their favorite summer activities, or about their favorite fruits.

Humans of EECS 16A

Instructors

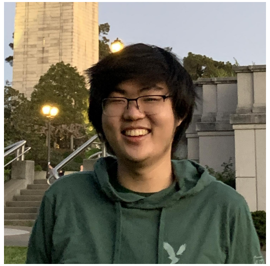
Tiffany Chien
(she/her)

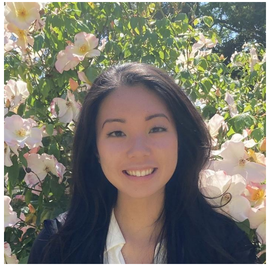
Nathan Brooks
(he/him)

Anvitha Kachinthaya
(she/her)

EECS Faculty Contributors to 16A: Vladimir Stojanovic, Anant Sahai, Gireeja Ranade, Ali Niknejad, Claire Tomlin, Michel Maharbiz, Miki Lustig, Vivek Subramanian, Thomas Courtade, Babak Ayazifar, Ana Arias, Laura Waller, Rikky Muller

Staff


Thomas Chen (Discussion/ Content)

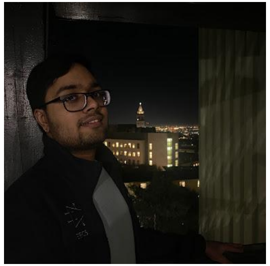

Joyce Zhu (Head Lab)


Amy Song (Discussion)


Jack Kang (Lab)


SooHyuk Cho (Tutor)


Alexander Di (Lab ASE)


Kapil Malladi (Lab ASE)


Anish Dhanashekar (Lab ASE)


Oscar Tapia Gallegos (Lab ASE)

EECS Departmental Staff

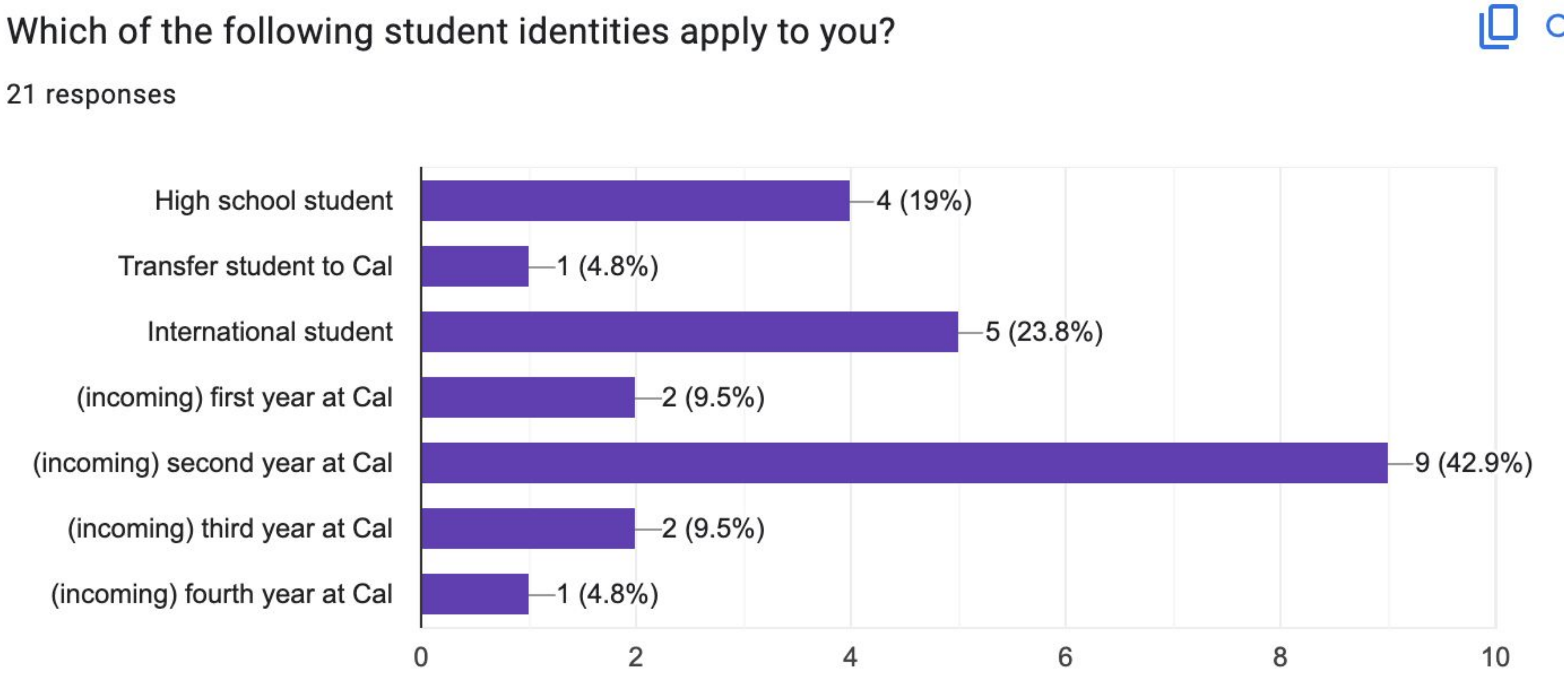
Course Manager

Great resource for 1-on-1 concerns

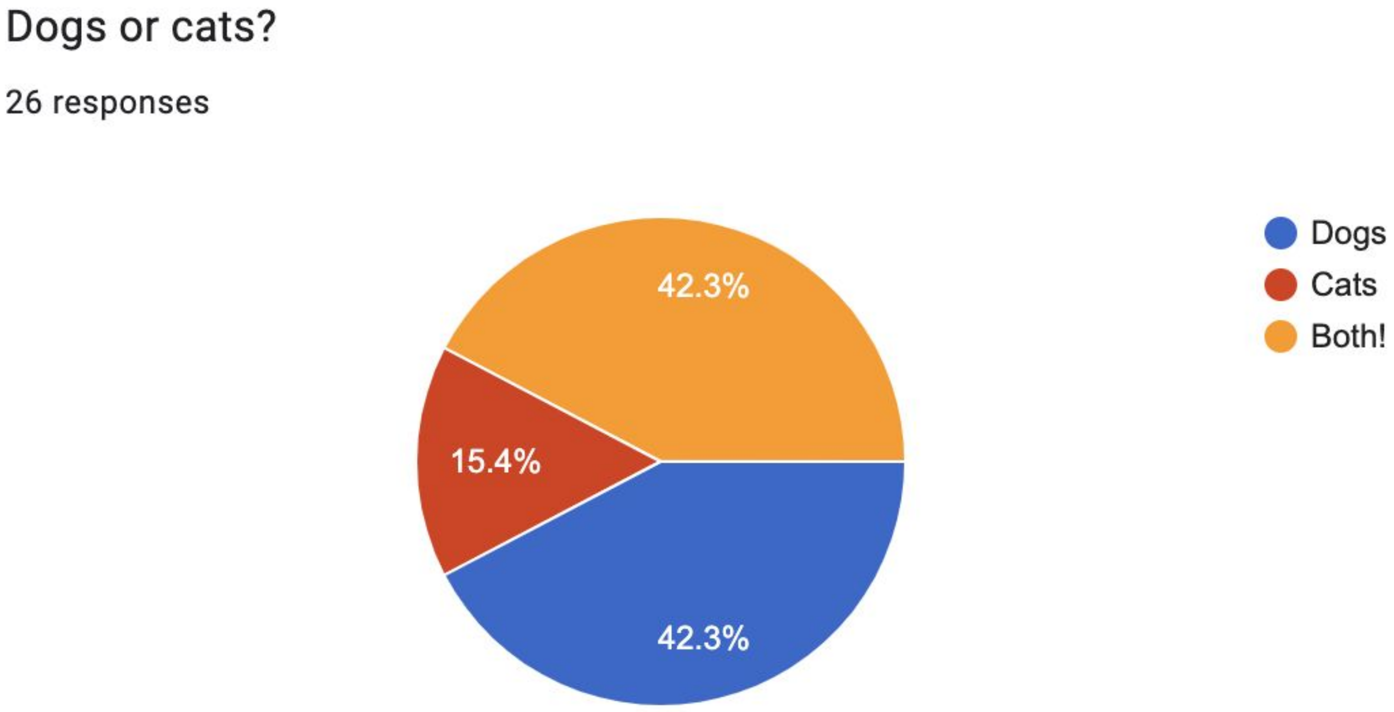
krystle@eecs.berkeley.edu

Krystle Simon

You!


Which of the following student identities apply to you?
21 responses
High school student
4 (19%)
Transfer student to Cal
1 (4.8%)
International student
5 (23.8%)
(incoming) first year at Cal
2 (9.5%)
(incoming) second year at Cal
9 (42.9%)
(incoming) third year at Cal
2 (9.5%)
(incoming) fourth year at Cal
1 (4.8%)
0
2
4
6
8
10

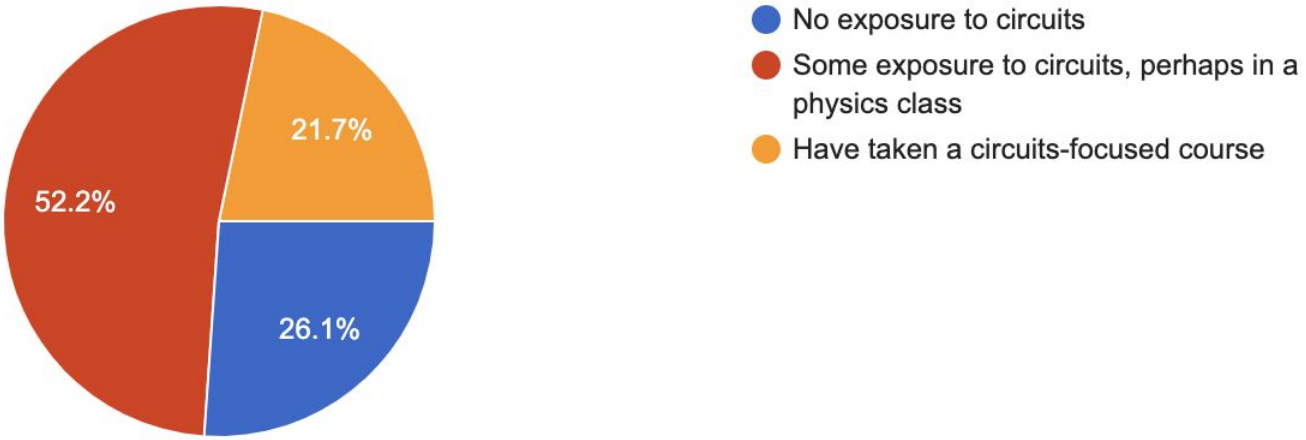
There are many different kinds of people in this class.



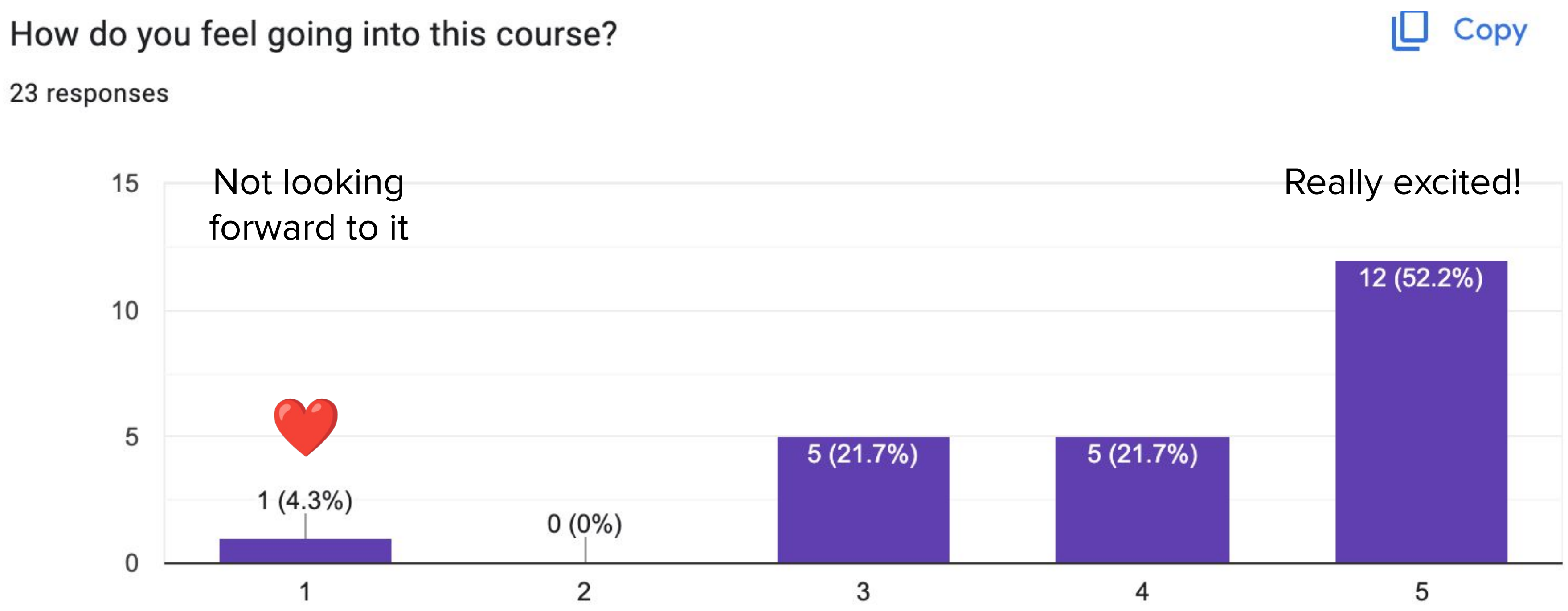
You all are starting from different places.

What is your experience with circuits? (note: none is expected for this course)

23 responses



And care about different things in life.



All of you deserve to be here and to be supported.

Together, all of you and our course staff are the creators of our course culture.

We all have the power to make other people feel welcome (or not).

We expect you to bring respect, openness, and kindness to everyone.

We expect you to help out and support each other.

We are not here to show off or prove how smart we are (please).

What are you all excited about?

- Hands-on labs!
- Building circuits!
- Math!
- New knowledge!
- Meeting new people!
- What is electrical engineering?
- How theory leads to applications!
- Connecting linear algebra and circuits!

Yay!

What are you all nervous about?

- Heard this class is tough
- Not knowing enough about math or EE
- Workload
- Learning new things
- First Berkeley class
- Homework
- Grades
- Exams
- Stressssss

This class will be hard and new for many of you! But you are not alone.

Make a friend

Introduce yourself to one person near you that you don’t know.

- What are some hobbies you enjoy?

Exchange contact information so you can work together on assignments!

Course Logistics and Policies

Parts of the course

- Lecture
- Discussion
- Lab
- Homework
- Office hours, homework party
- Exams

All details of policies are listed out in syllabus! https://eecs16a.org/policies.html

Lecture (M/Tu/W/Th)

We expect everyone to come to live lecture.

Popcorn 🍿! Lecture quizzes once a week on a random day. You can work with your neighbors and ask us questions.

- If you must miss lecture, you can watch the recording and submit the popcorn within 24 hours.

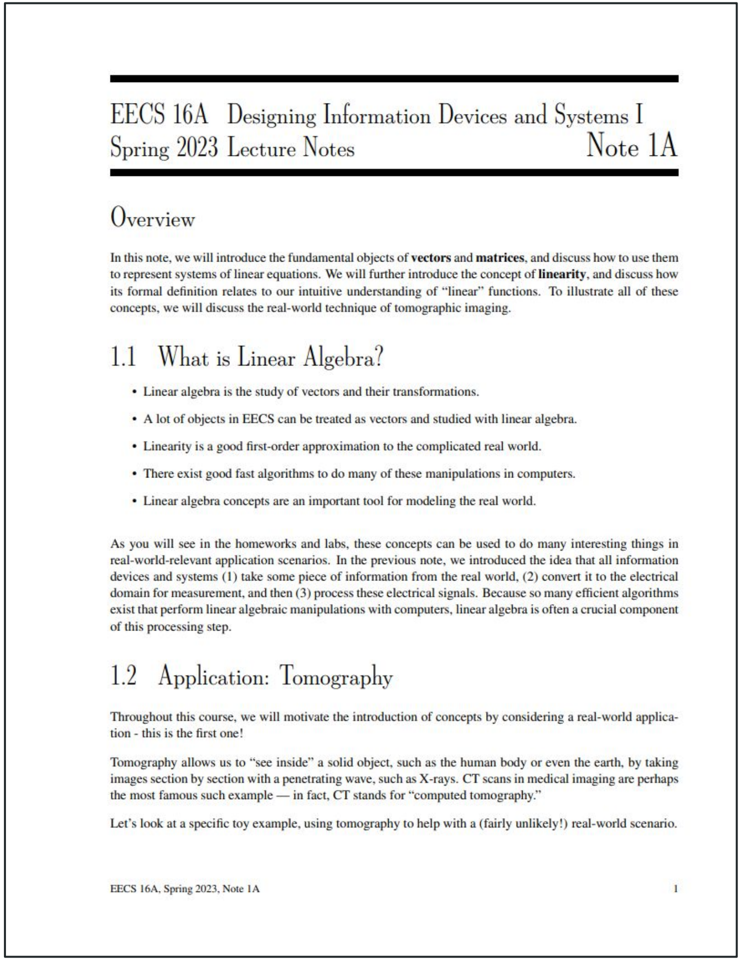
The course moves very fast in the summer!

Course notes

Supplements lecture. Like a textbook, written specifically for this course.

Website will link relevant notes for each lecture

Sometimes we need things explained to us another way!



EECS 16A Designing Information Devices and Systems I
Spring 2023 Lecture Notes — Note 1A

Overview

In this note, we will introduce the fundamental objects of **vectors** and **matrices**, and discuss how to use them to represent systems of linear equations. We will further introduce the concept of **linearity**, and discuss how its formal definition relates to our intuitive understanding of "linear" functions. To illustrate all of these concepts, we will discuss the real-world technique of tomographic imaging.

1.1 What is Linear Algebra?

- Linear algebra is the study of vectors and their transformations.
- A lot of objects in EECS can be treated as vectors and studied with linear algebra.
- Linearity is a good first-order approximation to the complicated real world.
- There exist good fast algorithms to do many of these manipulations in computers.
- Linear algebra concepts are an important tool for modeling the real world.

As you will see in the homeworks and labs, these concepts can be used to do many interesting things in real-world-relevant application scenarios. In the previous note, we introduced the idea that all information devices and systems (1) take some piece of information from the real world, (2) convert it to the electrical domain for measurement, and then (3) process these electrical signals. Because so many efficient algorithms exist that perform linear algebraic manipulations with computers, linear algebra is often a crucial component of this processing step.

1.2 Application: Tomography

Throughout this course, we will motivate the introduction of concepts by considering a real-world application - this is the first one!

Tomography allows us to "see inside" a solid object, such as the human body or even the earth, by taking images section by section with a penetrating wave, such as X-rays. CT scans in medical imaging are perhaps the most famous such example — in fact, CT stands for "computed tomography."

Let's look at a specific toy example, using tomography to help with a (fairly unlikely!) real-world scenario.

Discussion (M/Tu/W/Th)

TAs review that day's lecture material and you work on problems with each other.

A lot of learning happens in discussion!

Attendance taken. Attend 16 out of 25 sessions for full credit.

Discussion **starts today**: 11-12 or 12-1 in Cory 540AB

- Two different TAs — try out both to see whose style you like

Lab (Tu/Th)

This course's design is motivated by real-world applications — you explore these in lab!

Lab starts next week. (2-5pm and 5-8pm in room Cory 140)

You must attend the lab section you are officially enrolled in.

Finishing lab and being checked off is part of your grade. There will be a chance to make up missed labs. More details in syllabus.

Homework

One per week, due on Friday night.

- First HW is now available on the website. It's **due this Friday!**
- Covers material up through Wednesday's lecture

Gradescope

HW is self graded + staff graded

- If you score >80%, then you receive 100% credit
- You must self-grade to receive full credit

Slip days, hw drops

Work with study group!

Office hours (OH) and Homework Party

Instructor OH: Mon 1-2pm + Wed 3-4pm in Cory 144MA.

- Ask questions about lecture or course content
- Hang out and get to know instructors :)
- Ask questions about Berkeley and about life

Homework Party: Fridays 10-12 in Cory 144MA

- Work with other students on homework! 16A Staff will be around to help too

Ed (https://edstem.org/us/courses/40181/discussion/)

Academic Dishonesty

We take academic dishonesty very seriously.

There will be harsh consequences!

When in doubt:

- Write up your own work
- Don’t copy other people’s work
- Don’t look at solutions

Exams

Dates:

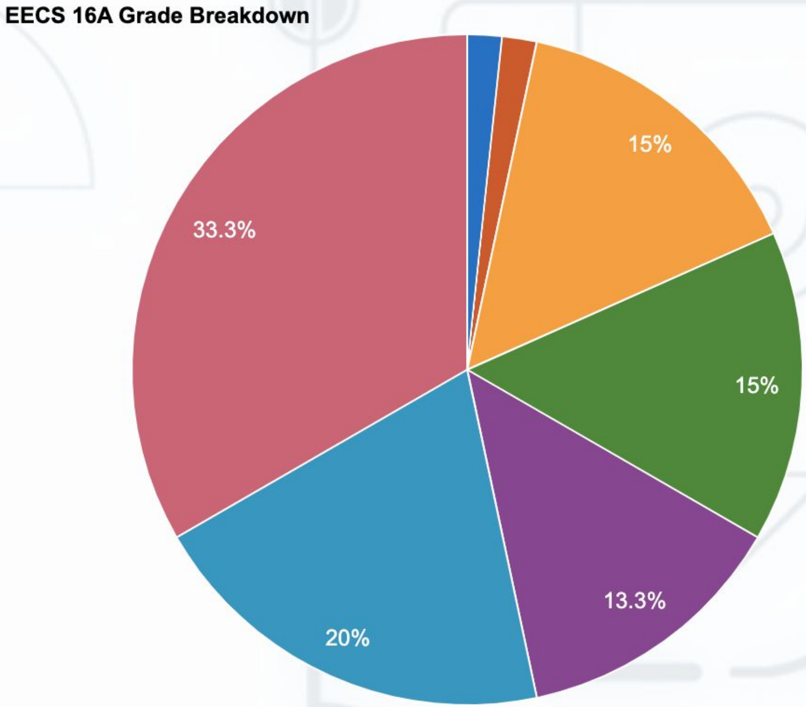
- Quest: **Monday, July 10, 2023, 9:30am-11am** (2040 VLSB)
- Midterm: **Monday, July 24th, 2023, 5pm-7pm** (145 Dwinelle Hall)
- Final: **Wednesday, August 9th, 2023, 6pm-9pm** (2040 VLSB)

Put these in your calendar today!

If you need to request an alternate time for any exam, you must email eecs16a@berkeley.edu by **THIS FRIDAY, June 30, 2023.**

Grading

Category	Points (out of 300)
Lecture Participation	5 points
Discussion Attendance	5 points
Homework	45 points
Labs	45 points
Quest	40 points
Midterm	60 points
Final	100 points



Accommodations

- Disabled Students Program: make sure letters are uploaded ASAP
  - More information about DSP here
- We are here to help and support you!

Communication

- **Ed** will be our primary mode of course communication
    - Check frequently for announcements!
    - Post content questions on Ed
- For personal or private questions or concerns, please email
    - **eecs16a.homework@berkeley.edu**: homework-related questions
    - **eecs16a.lab@berkeley.edu**: lab-related questions
    - **eecs16a@berkeley.edu**: logistical or administrative questions, emergencies, conflicts, accommodations, etc.

How to succeed in this course!

Actively listen and participate in lecture, discussion, and lab.

Keep up with the material - catching up is hard!

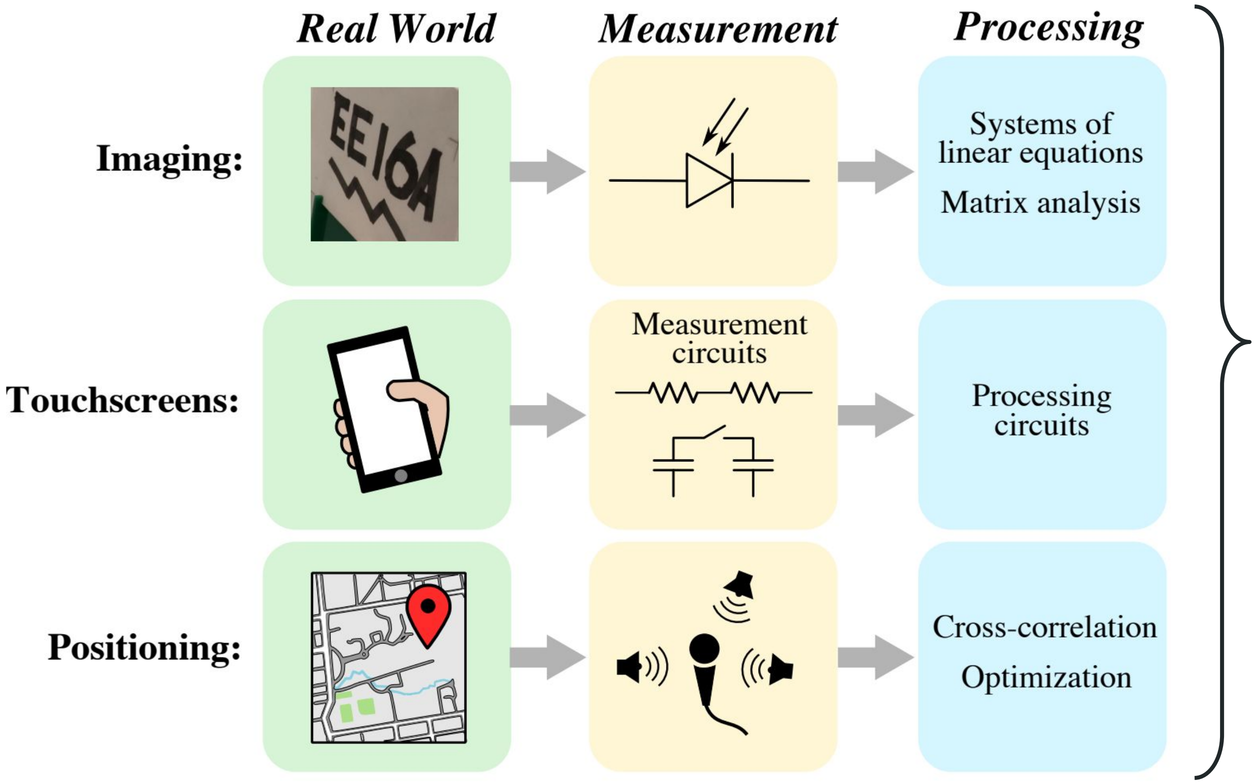
Come to office hours and homework party - we don’t expect you to do this without support from us!

Work with other students!!

Sleep, take care of your mental health, and remember that your grades aren’t everything.

What will you learn in this class?

16A and 16B introduce the field of EE(CS)



Take action

Self-Driving Car

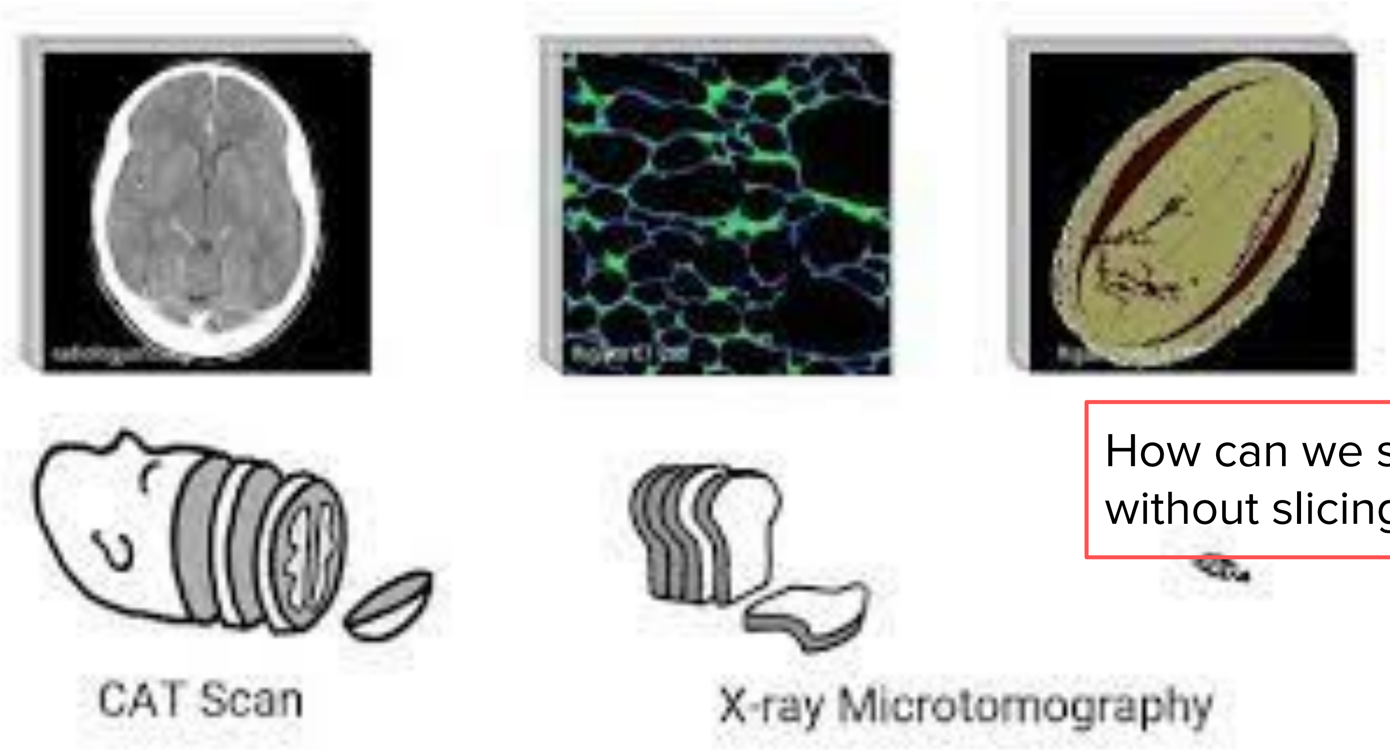
EECS 16A is split into three modules

1. Introduction to Systems
   - How do we collect data? Build a model?
   - Foundations of linear algebra
   - Application: Imaging
2. Introduction to Circuits and Design
   - How do we use a model to solve a problem?
   - Application: Touchscreens
3. Introduction to Signal Processing and Machine Learning
   - How do we “learn” models from data, and make predictions?
   - Application: Positioning (GPS)

Let’s do this!

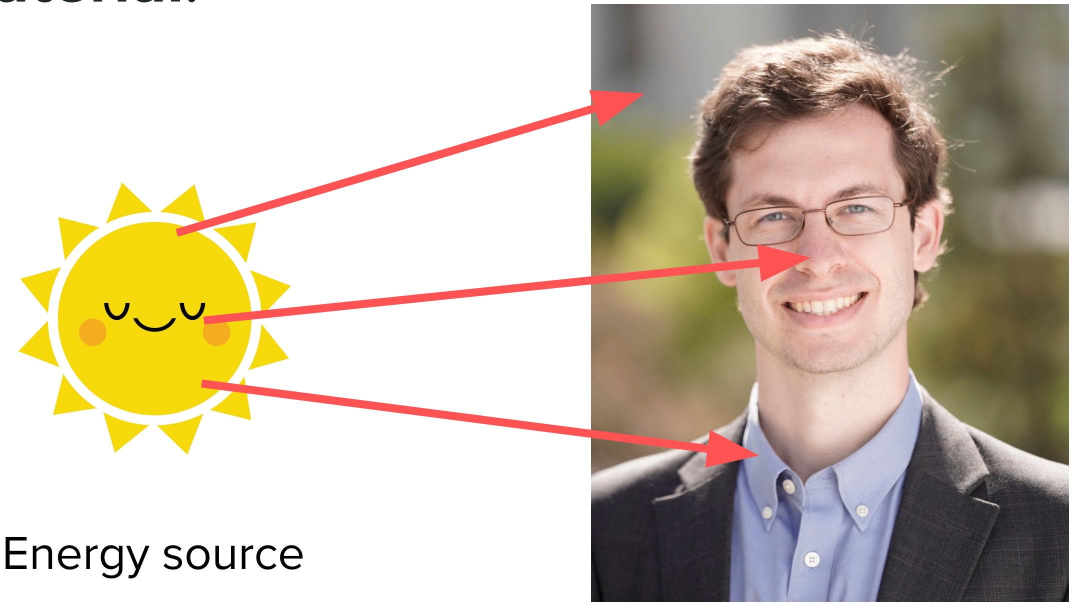
Before we had medical imaging...

Now:



How can we slice without slicing?!

Imaging = measuring how an **energy source** *interacts* with a **material**.

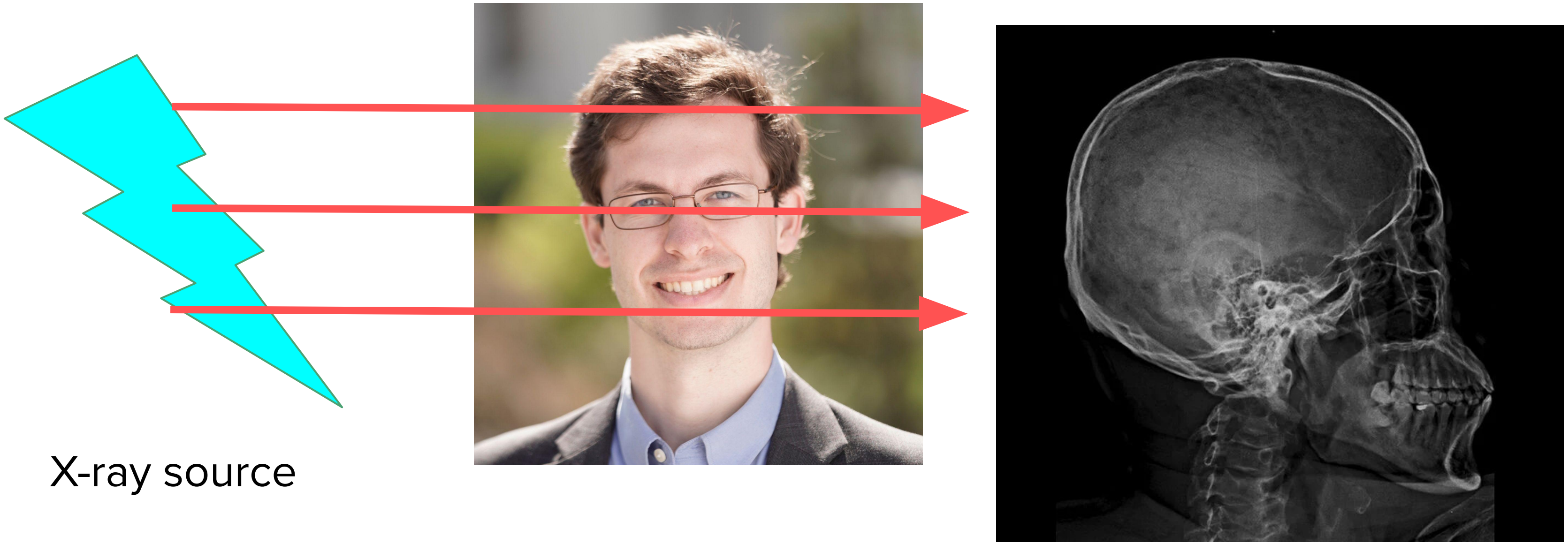


Energy source

Interaction with material = absorption, reflection, etc.

Humans are pretty opaque to visible light...

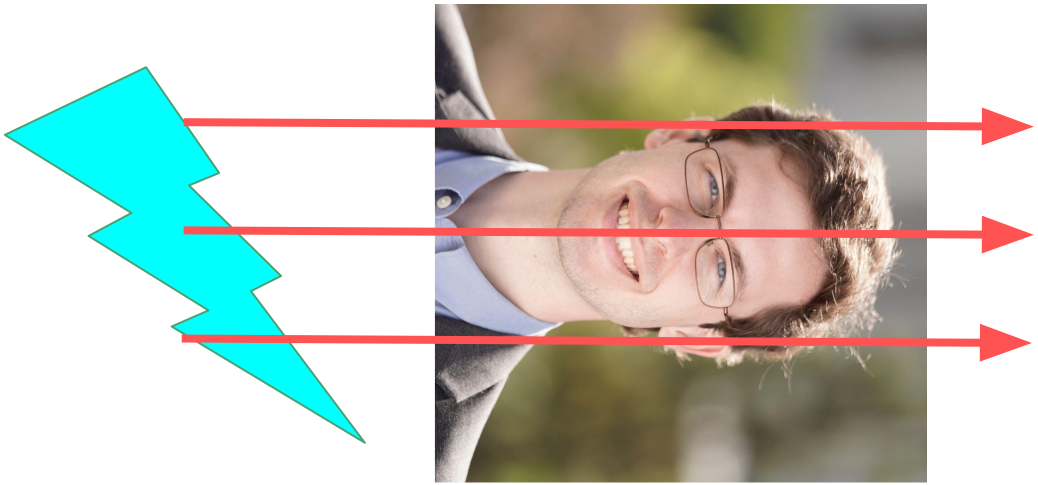
… but humans are translucent to X-rays!



X-ray source

Measured interaction = how much X-ray gets through different materials

How do we get 3D from 2D images?



Take shadows from many directions!

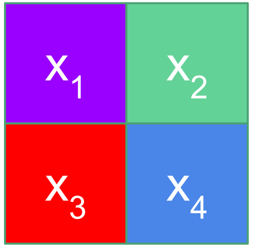
These are called **projections**.

Now how do we actually solve for the 3D?

We need a **model** for this system.

Make the problem simple first: 2D object with only 4 “pixels”

And name some variables.



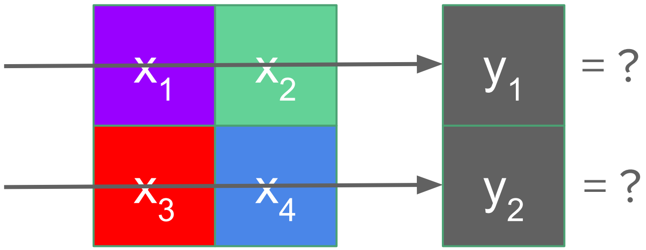
Unknown object to solve for

What do the pixels represent?
How many unknowns do we have?

What measurements could we take to help us solve?

Tomography!

Let's connect the knowns (measurements) and unknowns with some equations.

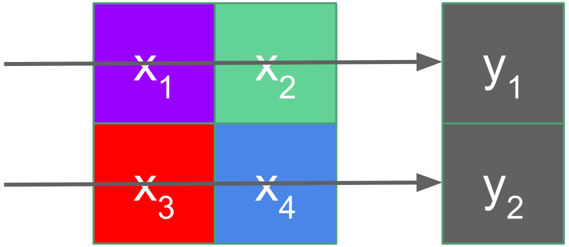


Unknown object

Tomographic projection: **known** measurements

Tomography!

Let's connect the knowns (measurements) and unknowns with some equations.



$= \boxed{x_1 + x_2}$ OR $= x_1 * x_2$ OR $= e^{x1+x2}$

Unknown object

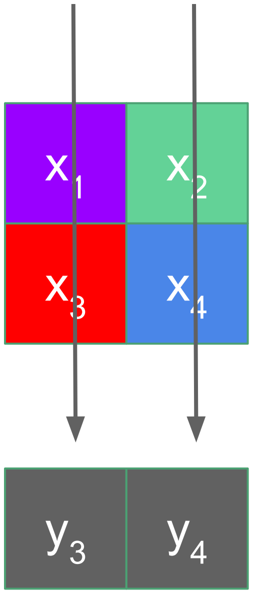
Tomographic projection: **known** measurements

Depends on the physics! This will just be a *model*.

We will choose the easiest one here (which turns out to be useful in many cases).

How can we **model** this imaging system?

Another angle:



Do I sense a system of equations?

$y_1 = x_1 + x_2$

$y_2 = x_3 + x_4$

$y_3 = x_1 + x_3$

$y_4 = x_2 + x_4$

How many measurements do we need to take?

Does the system have a unique solution?

We built a model that perhaps we know how to solve!

To be continued...