We ask for 100% of your focus.
Please turn off all technology.
All of these extract information from the real world and interact with it; we will be learning how to design and understand these devices & systems.
First Lecture Plan

• Introductions
• Administrative Details (discussions, homework, etc.)
• Overview of 16A’s material and how it fits into EECS
• Start with module 1
Instructors

Prof. Gireeja Ranade
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OH: 212 Cory/144MA Cory

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513 Cory
Other contributors to 16: Elad Alon, Anant Sahai, Laura Waller, Ali Niknejad, Claire Tomlin, Michel Maharbiz, Miki Lustig, Vivek Subramanian, Thomas Courtade, Babak Ayazifar
GSIs and uGSIs

Head GSIs:

ee16a.staff@gmail.com

Email with:
- Questions not for Piazza
- All conflicts
- Any emergencies
- Administrative questions

Grace Zhang

Rohan Lageweg
Lots of you, but lots of us too!

• Many many Academic Student Employees…
  • Former 16A students just like you …

• The path to being on 16A staff
  • Do great in 16A
  • Become an Academic Student Employee
    • Grade homeworks, assist in labs, tutor and help out in OH, work on improving the notes …
    • Become a uGSI
    • Become faculty!
Some logistics

• EECS 16A
http://inst.eecs.berkeley.edu/~ee16a/fa18/

• Piazza
http://piazza.com/
Course policies

• Syllabus is on course website
  • Please read and follow all course policies listed. You are responsible for this.

• Grading is absolute (no curve)
  • You are not competing against one another

• No technology (usage) during lecture!
  • Sleeping is OK
Course audience

• Freshmen and incoming junior-transfers (like 61A)

• Sophomores who for some reason were unable to take the class their first year

• We assume no prior background in linear algebra or physics
### Monday

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<td>(204: Cory 521): Lydia</td>
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### Wednesday

- (217: Etch 3107): Alice
- (207: Etch 3111): Chris
- (222: Etch 3109): Urmita
- (201: Cory 521): Elena
- (221: Etch 3113): Chris
- (209: Etch 3111): Michael
- (202: Cory 521): Sarika
- (210: Etch 3111): Ed
- (211: Etch 3109): Laura
- (203: Cory 521): Varsha
- (212: Dwin 182): Hitesh
- (213: Wheeler 222): Rishi
- (220: Cory 241): Vijay
- (206: Etch 3109): Lydia
- (214: Etch 3107): Laura
- (215: Etch 3113): Varsha
- (218: Wheeler 222): Hitesh
- (216: Moffitt 106): Nick
- (204: Cory 521): Lydia
- (219: Etch 3111): Sarika
- (205: Cory 521): Avi
Homeworks

- Due Friday at midnight
  - Except HW 0, due Monday, Aug 27 at midnight
- HW Party: Wed 9-11 am and Thu 2-4 pm
- OH: See website
- Self-grades due Tuesdays at midnight
- Resubmissions due along with self-grades
How to succeed in this 16A Marathon, not a sprint

• Focus on understanding, get enough sleep, and keep up!
• Attend lecture (especially freshmen and junior transfers)
• Actively read notes, mark what is challenging
• Attend discussion
• Try HW on your own, early on
• Discuss problems with study group and/or at HW Party
• Ask/Lurk and help others on Piazza
• Write up HW on your own
• Reflect on solutions while self-grading
• Study with others as well as alone.
• Seek and offer help.
• We are here to help you and to have you succeed!
You are here to learn!

• Our staff wants to help you learn
  • In-lecture Q&A, Professor and TA OH, HW parties, Lab

• Cheating directly detracts from learning
  • Any cheating will be immediately sent to the Office of Student Conduct
  • Report bad behavior

• Be kind and compassionate to each other and to your GSIs
  • Everyone here is smart, everyone comes from different backgrounds
  • Helping others is good for both of you
  • Professors can make mistakes – feedback helps
  • Ask for help! If you are confused about something, most likely others are too!
EE16A Playlist
Extra credit

**Good citizen credit**
- Award each other tokens for being helpful!
- Each student can award up to two tokens to other students each week
- Can award tokens to the same student at most twice
- These tokens can count as extra credit

**Content creation extra credit**
- Extra-credit for creating demos, videos, good explanations etc.
• 16AB: “How to think like an engineer”
  
  Model, design and build systems
  (driven by linear algebra, circuits, information systems, signals, and learning)

• Complementary perspective to 61AB
  - Computational thinking on the mathematical and hardware side

• “Thinking tools” that are relevant to all careers
  - Show you the different parts of EECS
Topics

• Imaging/Tomography and Google PageRank (5 weeks)
  • Topics: Linear algebraic thinking and graphs
  • Lab: Single-pixel imager

• Touchscreens (5 weeks)
  • Topics: Linear circuits and design
  • Lab: Home-made R and C touchscreens

• Locationing and Least-Squares (4 weeks)
  • Topics: Linear-algebraic optimization
  • Lab: Acoustic localization “GPS”
How Did We Get From This...
To This?
Moore’s Law

Microprocessor Transistor Counts 1971-2011 & Moore’s Law

What is a transistor?

Gordon Moore
Intel Cofounder
B.S. Cal 1950!
Sense of Scale

Source: Mark Bohr, IDF14
Completing the puzzle ...

• Ada Lovelace - wrote the first computer program
• Turing – invented the Turing machine – how to build a computer to execute programs – what is actually computable?
• Claude Shannon – info theory, + how to implement logic out of EM switches
Design of Information Devices and Systems

- Best when hardware and software work together
  - Best algorithms and best code written by understanding the sensing and compute mechanisms
  - Best devices designed understanding the physical limitations
16a Examples

Real World | Measurement | Processing
---|---|---
Imaging: | | Systems of linear equations
Touchscreens: | | Processing circuits
Positioning: | | Cross-correlation Optimization
Module 1: Imaging
Medical imaging ... 1632
Seeing inside bodies: sans surgery...

All of these benefitted from the math/hardware design techniques you will learn in this class!
Tomography

‘tomo’ – slice
‘graphy’ – to write

Assume it is not desirable to slice open my brain. How does tomography ‘see’ inside?
Example: Tomography

Can we solve for the pixel values from projections?

What do pixel values represent?

e.g. density, absorption, etc.

Yes, with tomography.

\[
\begin{array}{cc}
  x_1 & x_2 \\
  x_3 & x_4 \\
\end{array}
\]
DocuCam
Imaging in general

Energy source

Subject

Energy detection

Imaging System
(electronics, control, computing, algorithms, visualization...)
What is the absolute smallest number of components you need to make an imaging system?

Example: flat illumination, one photosensor scans through pixels

OR scan the illumination, use only one big pixel
Single-pixel camera

Patterned illumination

Subject

Single-pixel detector

Can I create an image if I have just one detector?
Single-pixel camera

Patterned illumination

Subject

Single-pixel detector

Barniauk et al., Rice University.
Imaging Lab #1 Setup

![Diagram of Imaging Lab Setup]

- Object to image
- Projector
- TI Launchpad
- Breadboard
- Solar cell
Imaging Lab #1
What if I can’t light up just one pixel at a time?

Can we recover the frog?

How many measurements do I need?

How should I choose illumination patterns?