Welcome to EECS 16A!
Designing Information Devices and Systems I

Ana Arias and Miki Lustig
Fall 2021
Instructors

• Other contributors to 16: Elad Alon, Vladimir Stojanovic, Anant Sahai, Gireeja Ranade, Ali Niknejad, Claire Tomlin, Michel Maharbiz, Miki Lustig, Vivek Subramanian, Thomas Courtade, Babak Ayazifar, Laura Waller
Miki Pandemic Special
Other Staff

Head GSIs:
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Email with:
Questions not for Piazza
Conflicts, accommodations for exams etc.
Emergencies
Administrative questions

Dahlia Saba
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Course manager
Great resource for 1-1 concerns
Krystle@eecs.Berkeley.edu

Krystle Simon
Teaching Assistants (TAs) Intro - We are here to help!

• 29 TAs, 51 ASEs!
  - Lots of different research areas and interests represented (by design)
EECS Pathway

- We are here to help!
- We want you to do well in class
  - Have 83 people committed to support you

- If you do well in class — you can get involved!
  - Become an ASE
    - Grade homeworks, assist in labs, tutor and help out in OH, work on improving the notes …
  - Become a uGSI
    - Lab / Discussion / content
  - Become head TA…
Course policies

• Our goal is learning!

• Syllabus is on the course website: https://eecs16a.org/
  - You are responsible for reading and following all course policies listed
  - Almost as long as the US tax code.
    ▶ HW0 is your tax return

• Piazza: http://piazza.com/
  - a resource for you to help each other out

• Gradescope

• Exams via bCourses
Home work

- Due Fridays 11:59pm, on GradeScope
- We have a HW Party! W9-11am, F8-10am  @Woz
- Office hours — almost every hour of the week

- You grade, we check!
  - Self-grading due Mon 11:59pm
  - Resubmissions due Mon 11:59pm
  - Resub, self-grading due Mon 11:59pm

- Graders verify your self-grading
Class Weekly Events

• Attend lecture — best way to keep along
• Attend discussions (MW)
  - “Free” participation points!
• Lab
  - Required!
  - Attend at your scheduled time!
  - Checkoff during your lab
• Office Hours
  - Faculty after class
  - GSI many
  - HW Party Friday 9-11am @Woz
Learning

• Collaborate and build community on Piazza/HW Party/Study Groups
• Encourage different perspectives – this is Berkeley!
• Everyone here is smart
  - Students have different backgrounds
  - Professors make mistakes – feedback helps
  - If you are struggling, ask for help!

• Optional system to match you into study groups
  - Fill out info in HW0
  - Chance to meet new friends and study mates
Slope is more important than intercept
Slope is more important than intercept

The graph shows the progression of skills (in arbitrary units) for three students over time. The x-axis represents the timeline from Day 1 to the End of the 2nd semester, and the y-axis represents the skills in arbitrary units. The lines for each student illustrate their respective growth patterns, with the slope indicating the rate of improvement. Student 1 shows the steepest slope, indicating faster improvement compared to Students 2 and 3.
Academic Honesty

We treat all our students with utmost trust and respect, and expect students to return the same trust and respect. In EECS16A we will have zero-tolerance for academic dishonesty. There will be dire consequences for students that violate that trust and the Berkeley code of conduct. Both professors Arias and Lustig are committed to enforcing academic honesty, and dishonesty cases will be punished in their fullest -- no excuses or special circumstances will be considered. Always seek help, never cheat.
Any questions?
Some ideas taught in the class (1)
Some ideas taught in the class (1)
Eigen Values (and vectors)

- Used in detection of touch in touch screens
- Used in control and Robotics — make autonomous cars run straight!
- Used in Ranking of webpages (and other recommendation systems)
- Controlling Eigen-Values make optimization problem converge faster (training Deep Neural Nets for example)
Some ideas taught in the class (2)

Sent

Received

Reflections
Some ideas taught in the class (2)
Cross Correlation

Fundamental operation for detection / classification

Used in Radar / Sonar

Used in GPS

Used for cellphone communication

Used in Convolutional Neural Networks
Some ideas taught in the class (3)

Amount of water a plant receives

Plant growth rate

$ax + b$

$ax^2 + bx + c$

$y$

$x$
Least Squares

Fundamental approach for solving inconsistent sets of linear equations (due to noise and disturbances…)

Used for regression and prediction

Applications in Biology, Social sciences, brain-machine interface, AI
Example application: self-driving cars

- Sense
- Process Data
- Make a model
- Predict
- Actuate i.e. take action

External environment

16a

16b
Learning Goals

Not a survey class — rigorous and deep

EECS 16A

• Module 1: Introduction to systems
  - How do we collect data? build a model?
• Module 2: Introduction to circuits and design
  - How do we use a model to solve a problem
• Module 3: Introduction Signal Processing and Machine Learning
  - How do we “learn” models from data, and make predictions?

EECS 16B

• Module 4: Advanced circuit design / analysis
• Module 5: Introduction to control and robotics
• Module 6: Introduction to data analysis and signal processing
16A Lab Examples

**Real World**
- Imaging: 
  - [Image of a circuit]
- Touchscreens: 
  - [Image of a touchscreen device]
- Positioning: 
  - [Image of a location marker]

**Measurement**
- Measurement circuits
  - [Image of a circuit]

**Processing**
- Systems of linear equations
- Matrix analysis
- Processing circuits
- Cross-correlation Optimization
How did we get from this...
To this…

Drone delivery

Autonomous cars

Smallest wireless camera

A 1000 student class on a computer screen
Devices as part of a system

- Resistor
- Capacitor
- Inductor
- Diode
- Transistor
Transistor

First transistor - Dec 1947

First integrated circuit 1958
Computational advances due to fabrication advances

**Moore's law** is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.
FinFET

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**Go Bears!**
Sense of Scale

- Miki: 172 cm
- Ana: 158 cm
- Fly: 7 mm
- Mite: 300 um
- Blood Cell: 7 um
- Virus: 100 nm
- Silicon Atom: 0.24 nm

Source: Mark Bohr, IDF14
Completing the puzzle …

Ada Lovelace wrote the first computer program

Alan Turing figured out how to build a computer to execute programs

Claude Shannon Information theorist
Module 1: Imaging
Image

Merriam-Webster: A visual representation of something

Imaging

Merriam-Webster: the action or the process of producing an image
Different Images

- Thermal Image
- Radiograph
- Computed Tomography (X-Ray)
- Camera (Visible light, Photons)
- MRI
- Cosmic-Microwave background Radiation
- Ultrasound
- PET
- Gamma radiation

- Infra-red
- X-Ray
- Magnetic-fields
- Radio waves
- Camera
- Background Radiation
- Ultrasound
- PET
- Gamma radiation
Imaging Systems in General

Energy source

Imaged body

Energy detection

Imaging System
(electronics, control, computing, algorithms, visualization…)

“Medical imaging” circa 1632
“The Anatomy Lesson of Dr. Nicolaes Tulp”, Rembrandt
Mauritshuis, The Hague