Electrical Engineering and Computer Sciences

EECS 16A
First Lecture Plan

• Introductions
• Administrative Details (grading, etc.)
• Overview of 16A’s material and how it fits
• Introduction to the technology ecosystem
Introduce Faculty

• Babak Ayazifar
  ayazifar@eecs.berkeley.edu
  517 Cory
• No surprise visits, please!
  – For one-on-one matters,
    • make appointment by e-mail;
    • provide your availability; and
    • we’ll pick a mutually-convenient slot to meet.
Introduce Faculty

• Elad Alon
  elad@eecs.berkeley.edu
  519 Cory

• Story...

• Other contributors to 16 (besides Babak/Elad):
  – Anant Sahai, Ali Niknejad, Claire Tomlin, Gireeja Ranade, Michel Maharbiz, Laura Waller, Miki Lustig, Vivek Subramanian, Thomas Courtade
Introduce TAs
And we have even more!

• An army of Academic Interns...
Announcements

• No office hours this week
• Tues/Thurs. 8am discussions cancelled
• HW party will focus on iPython installation for those who had failures during lab
• HWo is posted
  – Doesn’t count for grade, but you should do it to get used to the procedure
• All administrative questions should be directed to Reia Cho (and no one else): chor346@berkeley
• Webcast 1 week delay
Important Web Sites

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

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

- Illnesses
- Religious Holidays
- Disabled Students Program (DSP) Accommodations
- No Distraction Policy
- Grading
- Class Participation
- Labs and Discussion
- HW Cycle
- Piazza
- Extra Credit
- HW Parties & Tips for Success
Grading

• **No curve**: In theory, each of you can get an A

• Breakdown
  
  – 30% Cumulative Final
    • Fri, 13 May, 19:00-22:00
  
  – 30% Midterms
    • Tue, 16 Feb, 19:00-21:00
    • Thu, 17 Mar, 19:00-21:00

  – 15% Labs (Attendance Mandatory; drop one)
  
  – 15% HWs (drop one)

  – 10% Participation
Interlocking Weekly Homework Cycles

- HW N released Tuesday afternoon
- HW N-1 self-grades due Friday at noon
- HW N HW Party on Fri morning (Woz, 9am-12pm)
- HW N due Tuesday at noon
- HW N solutions released (no late submissions!)
- HW N+1 released Tuesday afternoon
- HW N self-grades due Friday at noon

- Midterm weeks, redoing midterm is a part of HW.
- HW has mechanics, proofs, word problems, and coding.
Course Policies

• Illness policy
• Grading
• Class Participation
• Labs and Discussion
• HW Cycle
• Piazza: www.piazza.com
• Extra Credit
• HW Parties and How to Succeed
Tips for Success in 16A:

• Focus on understanding, get enough sleep, and keep up!

• Suggested cycle (reading, lecture, discussion):
  – Skim the readings in the posted notes before lecture
  – Attend lecture; participate, discuss w/ classmates
  – Read notes actively, mark what is challenging
  – Attend discussion, participate, discuss w/ classmates
  – Reread notes carefully, aim at full mastery
Tips for Success in 16A: Marathon not Sprint (Continued)

• Suggested cycle (HW)
  – Parse the HW
  – Try HW on your own
  – Collaborate in study group and/or attend HW Party
    • Woz, Fri days 09:00-12:00
  – Ask/Lurk and help others on Piazza
  – Write up HW on your own
  – Study solutions carefully and reflect on what you understand;
    keep track of various methods of tackling problems

• Do extra problems, and attend bonus sections that we offer.

• Study with others as well as alone.

• Seek and offer help.
Content Introduction

- 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!
16A: Information Devices and Systems

• **Imaging/Tomography (~4 wks)**
  • Topics: Basics of linear algebraic thinking and graphs
  • Lab: Single-pixel imager

• **Touchscreens (5 wks)**
  • Topics: Basics of linear circuits and design
  • Lab: Home-made R and C touchscreens

• **Locationing and Google PageRank (5 wks)**
  • Topics: Linear-algebraic optimization, eigenvalues/eigenvectors
  • Lab: Acoustic “GPS”
Some detailed topics for 16A

- Vectors and vector spaces
- Inner products, projection, orthogonality
- Matrices and linear transformations
- Rank and solving systems of linear equations
- Graphs, flows, and matrices
- How to do design and synthesis
- KCL, KVL, Ohm’s Law
- Equivalence, modeling, and abstraction
- Capacitance and charge
- Gain and feedback
- Correlation and interference
- Linear regression and optimization
- Determinants, eigenvalues and eigenvectors
- Diagonalization
### EECS Upper Divs: What 16AB feed

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A Little Bit More Background/History
How Did We Get From This...
To This?
In Fact…

Foundations of the Information Age

- Food, Water, and *Electricity*
- Ethics, Liberty, Equality, Freedom of Speech, Justice
  - (regardless of race, ethnicity, gender, and age)
- Access to Information:
  - Telephone, Entertainment, News
- Universal wireless connectivity!

Courtesy Ali Niknejad
Moore’s Law

Microprocessor Transistor Counts 1971-2011 & Moore’s Law

- The curve shows transistor count doubling every two years.
- The diagram illustrates the exponential growth in transistor count from 1971 to 2011.
That’s Just One Piece of the Puzzle...
Where This is Used:
Who We’re Training You to Be

You

2016
An example system: iPad Air 2

• Runs apps, but:
  – How is it charged / discharged?
  – What makes the display tick?
  – How does the Wi-Fi work?
  – How does it sense touch on the touch screen?
  – How does it sense motion?
  – How do the “brains” operate?

... and how can I learn stuff so I can work on such cool technology?
Inside an iPad Air 2

Physical world interaction:
- Camera
- Speakers

Communication:
- Antenna

Energy:
- Battery

Display / touch screen

“Brains”: the main board

User interface device:
- Home button

User interface device:
- Home button
The Camera

Goal: Convert light into electrical signals

Get color spatial distribution by using an array of “light” detectors, each under a color filter
Cameras: “Mathematical” Guts

Focus/exposure Control → preprocessing → white-balancing
demosaic → Color transform → Post-processing
Compression → CMOS Image Sensor Integrated Circuit Architecture
Analog-to-Digital Conversion

Figure 1

Digital Logic (Interface, Timing, Processing, Output)
Cameras: Compression

• Compression of 40x without perceptual loss of quality.

• Example of slight overcompression: difference enables x60 compression!