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
- HW0 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

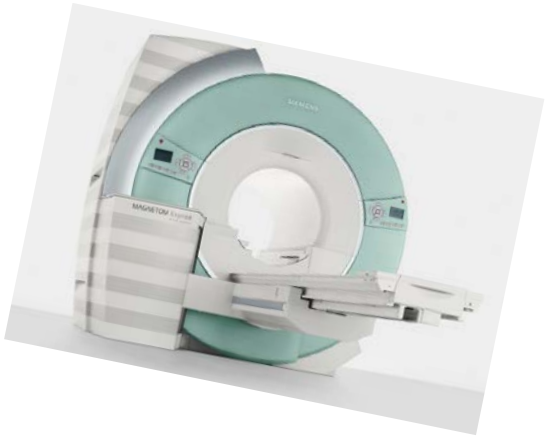
Tips for Success in 16A:

- 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 days09:00-12:00
  - 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/eiegnvectors
  - 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

16AB ~~**20**~~ **70** **61B** **61A** **61C**	**Modeling and Algorithms**	**170**, 126, 188, **127**	**189**, **120**, *121*, 123, 174, 144, 172	**Specific Domains**	
				121, 122, *168* Comm+Net	176, 145B CompBio, Imaging
				191 Quantum	128, 106, 192 Control + Robotics
	General Software	162, 161, 169	160, *168*, 149	184 Graphics	186 Databases
				164 Compilers	152 Computers
~~**40**~~ **16AB**	General Hardware	105, 140, 151	130, 143, 145L	145MO Bio	147 MEMS
				117 Antennas	142 Comm ICs
				118 Optics	113, 137AB, 134 Power+SolarEnergy

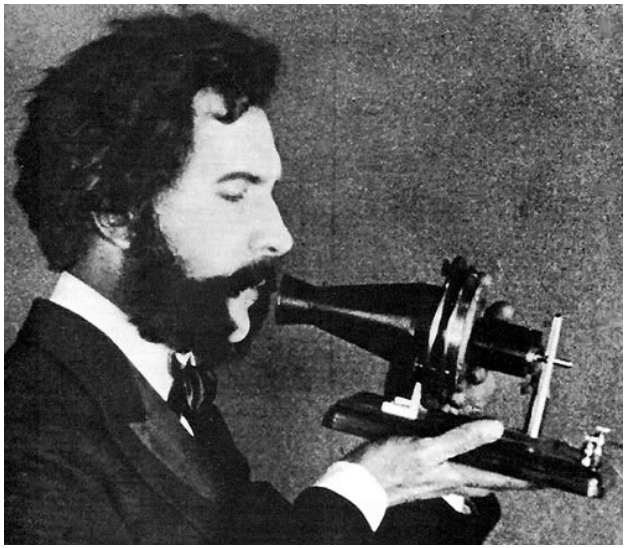
A Little Bit More Background/History

How Did We Get From This…

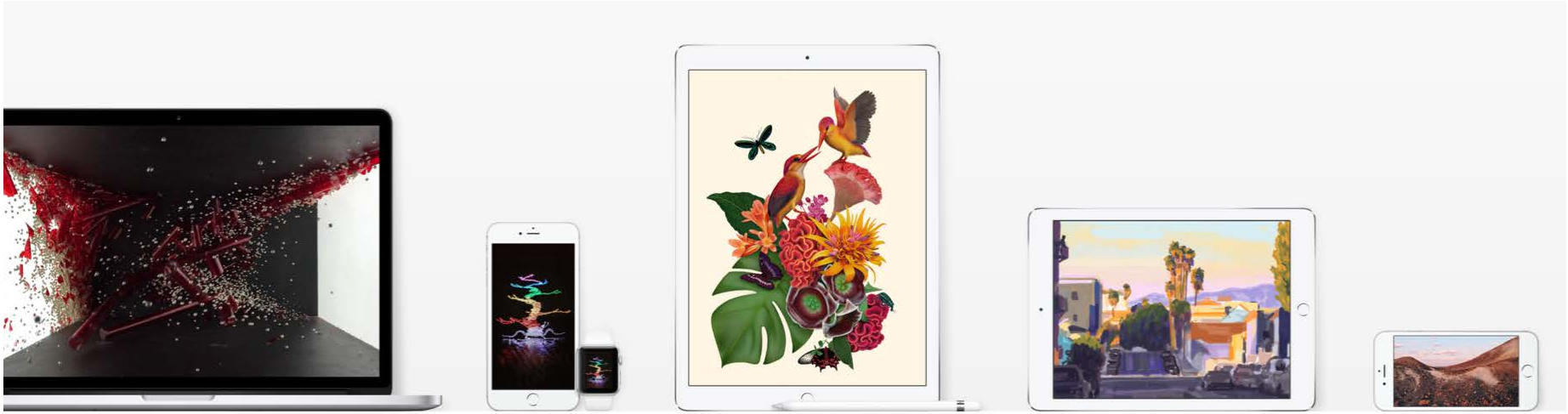
1837

1866

1876

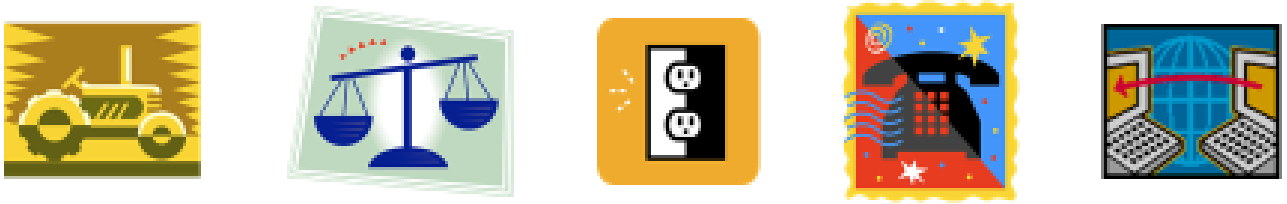


To This?



In Fact…

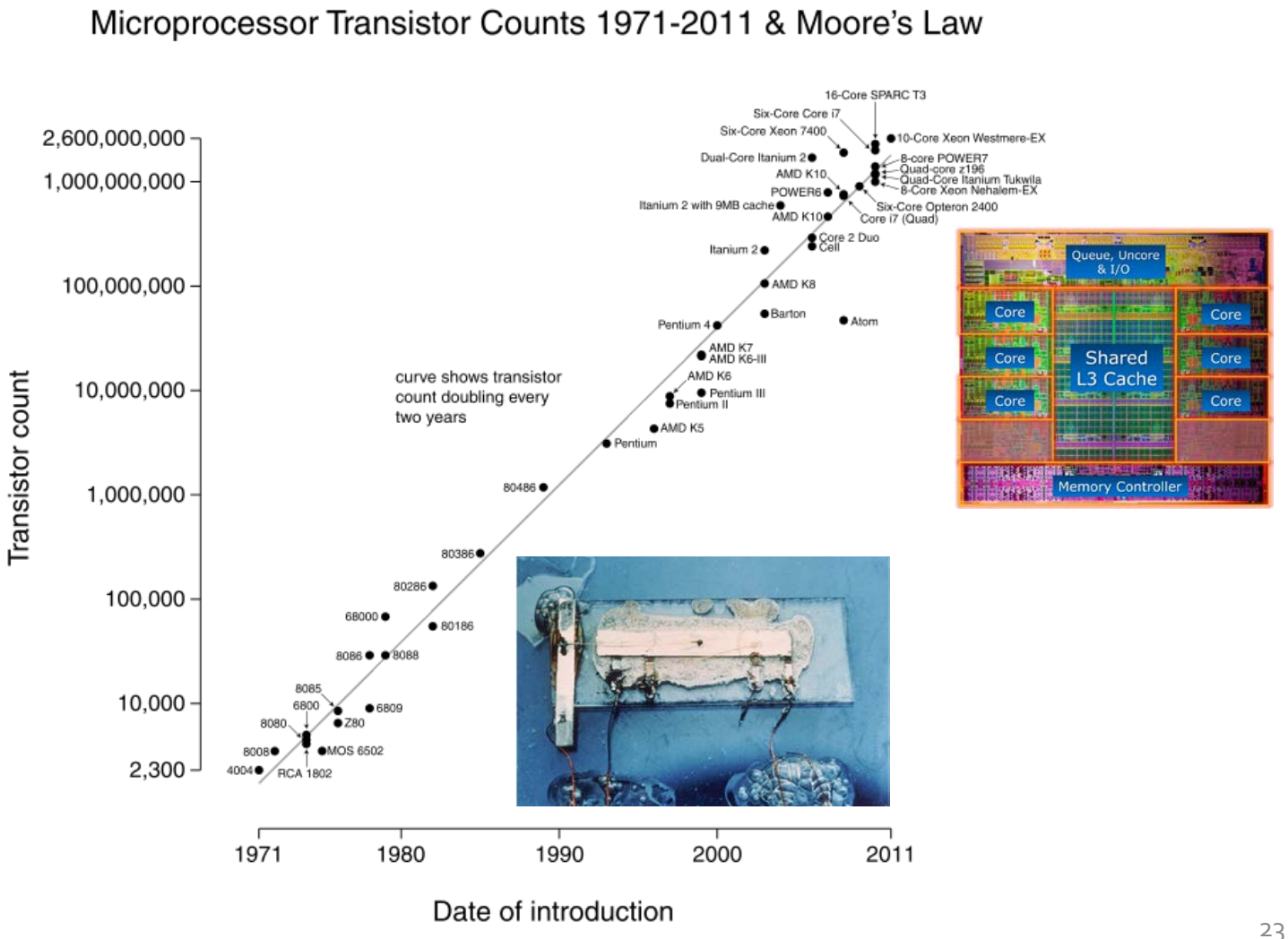
Foundations of the Information Age



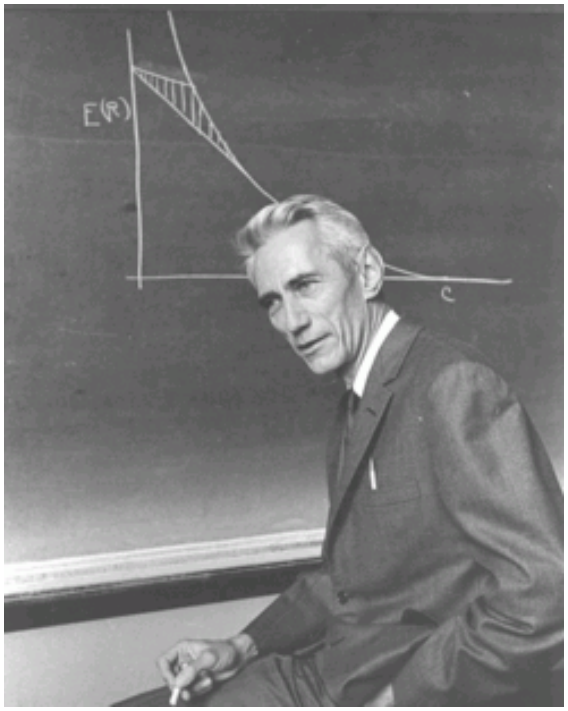
- Food, Water, and *Electricity*
- Ethics, Liberty, Equality, Freedom of Speech, Justice
  - (regardless of race, ethnicity, gender, and age)
- Access to Information:
  - Telephone, Entertainment, News
- Universal wireless connectivity!

Courtesy Ali Niknejad

Moore's Law

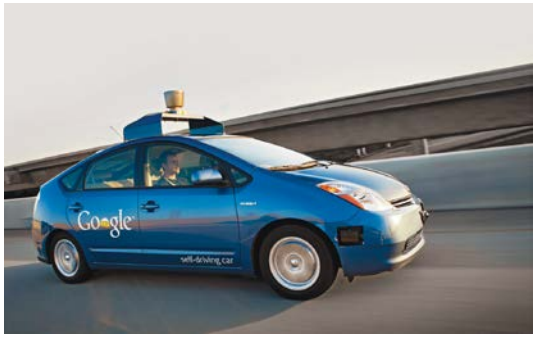

Microprocessor Transistor Counts 1971-2011 & Moore's Law
Transistor count
2,600,000,000
1,000,000,000
100,000,000
10,000,000
1,000,000
100,000
10,000
2,300
curve shows transistor count doubling every two years
16-Core SPARC T3
Six-Core Core i7
Six-Core Xeon 7400
10-Core Xeon Westmere-EX
Dual-Core Itanium 2
8-core POWER7
Quad-core z196
AMD K10
Quad-Core Itanium Tukwila
POWER6
8-Core Xeon Nehalem-EX
Itanium 2 with 9MB cache
Six-Core Opteron 2400
AMD K10
Core i7 (Quad)
Core 2 Duo
Itanium 2
Cell
AMD K8
Barton
Atom
Pentium 4
AMD K7
AMD K6-III
AMD K6
Pentium III
Pentium II
AMD K5
Pentium
80486
80386
80286
68000
80186
8086
8088
8085
6800
6809
8080
Z80
8008
MOS 6502
4004
RCA 1802
1971
1980
1990
2000
2011
Date of introduction
Queue, Uncore & I/O
Core
Core
Core
Core
Core
Core
Shared L3 Cache
Memory Controller

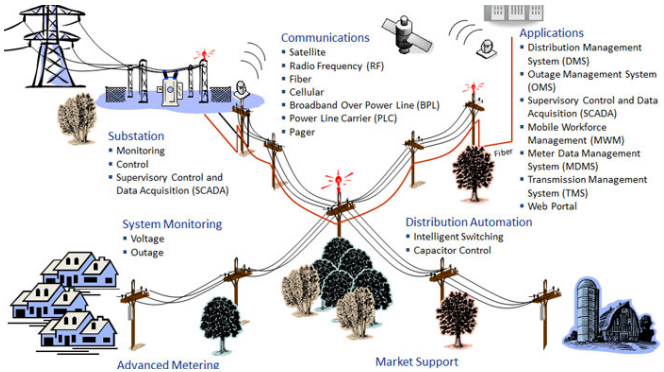
That's Just One Piece of the Puzzle…



1940's

Where This is Used:





Who We're Training You to Be

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

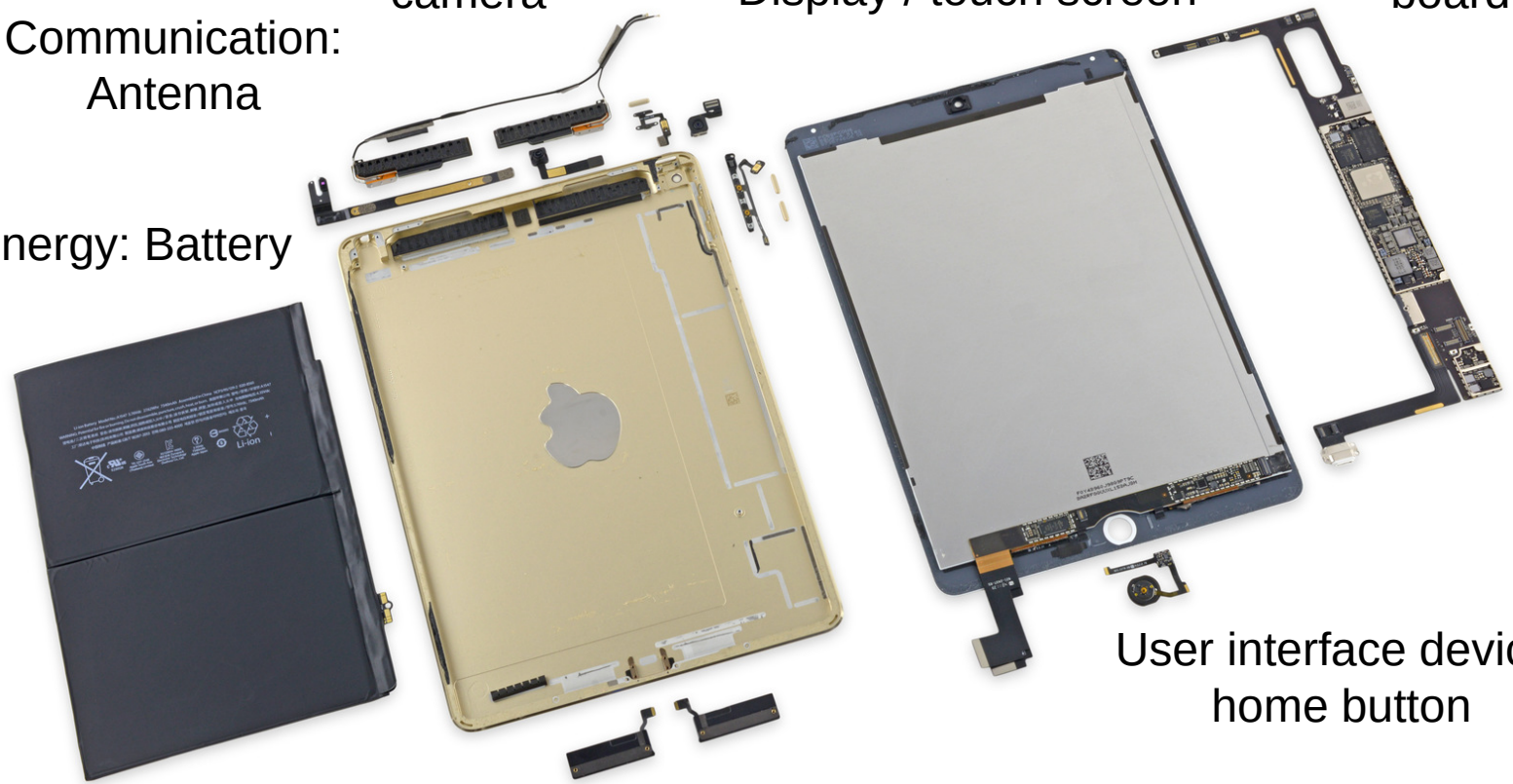
Physical world interaction: camera

Display / touch screen

“Brains”: the main board

Communication: Antenna

Energy: Battery

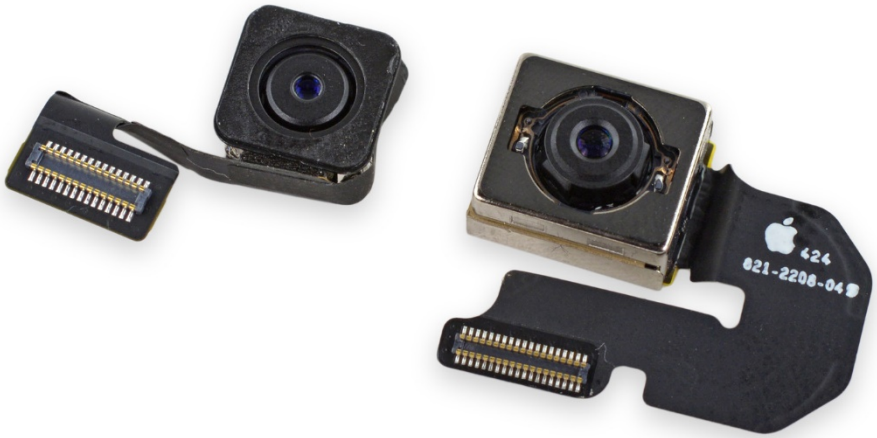


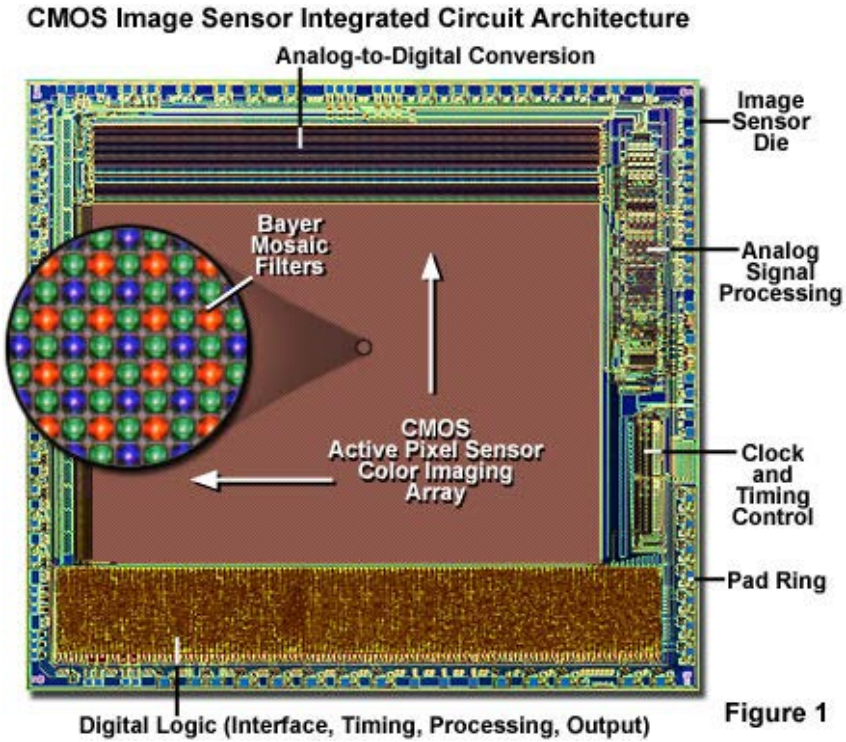
User interface device: home button

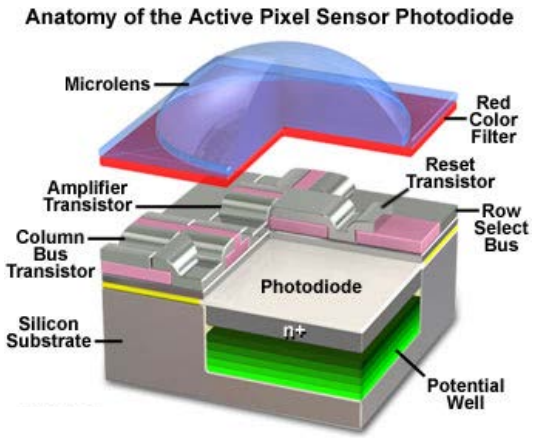
Physical world interaction: speakers

The Camera

Goal: Convert light into electrical signals

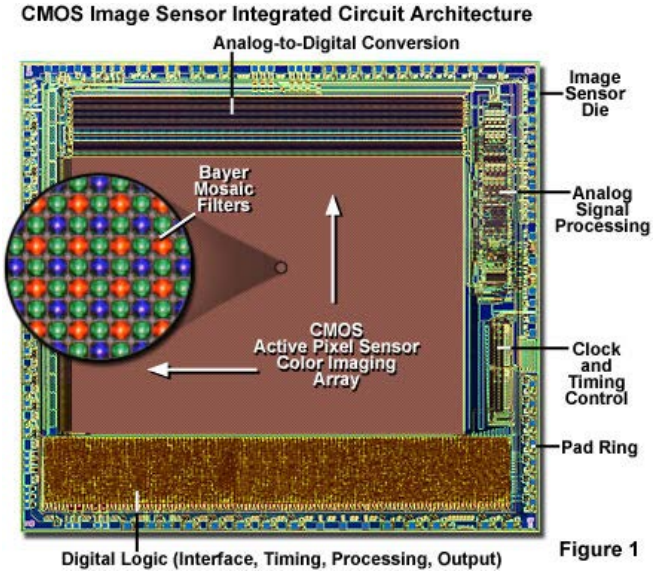


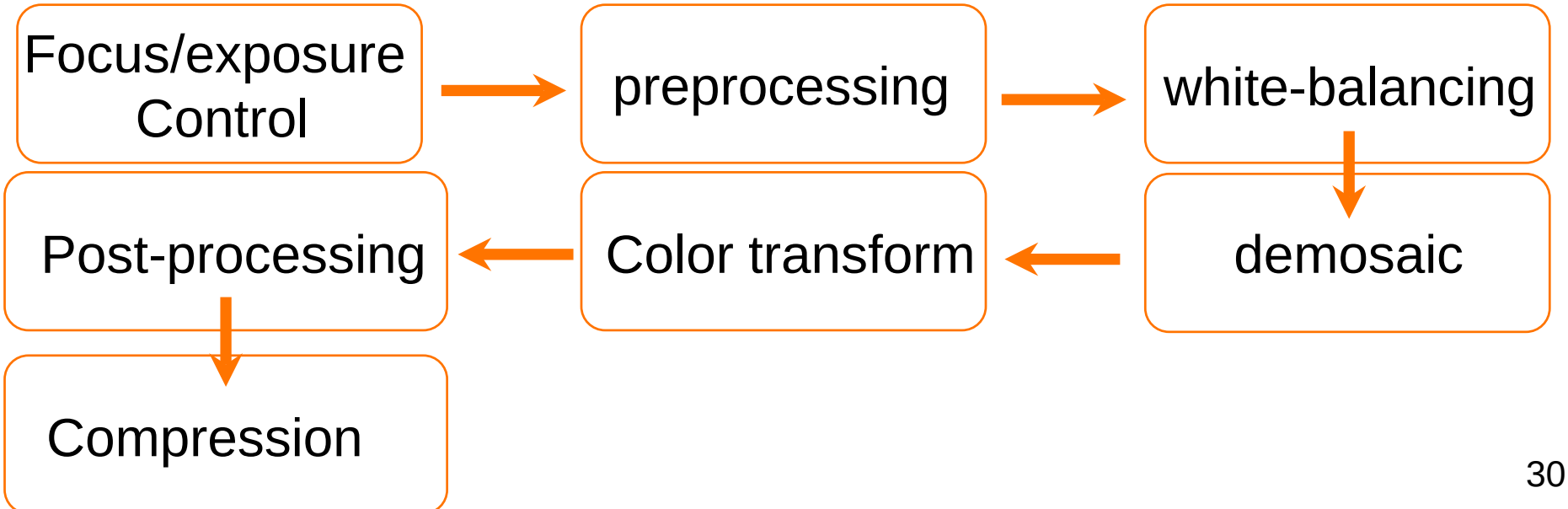




Get color spatial distribution by using an array of “light” detectors, each under a color filter

Cameras: "Mathematical" Guts





Cameras: Compression

- Compression of 40x without perceptual loss of quality.

- Example of slight overcompression: difference enables x60 compression!