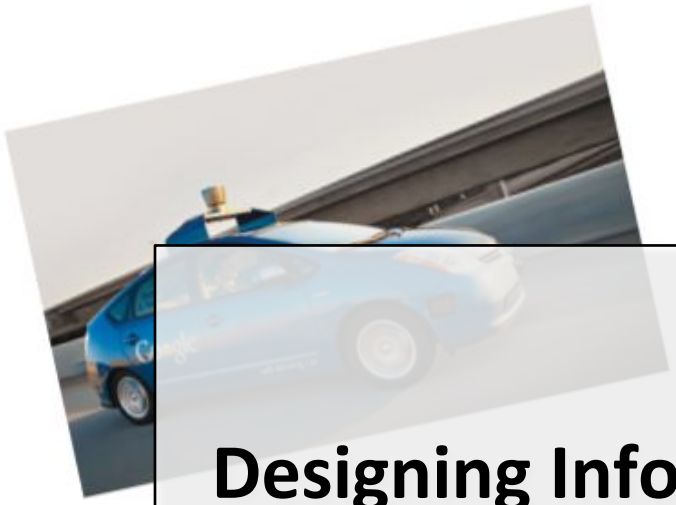
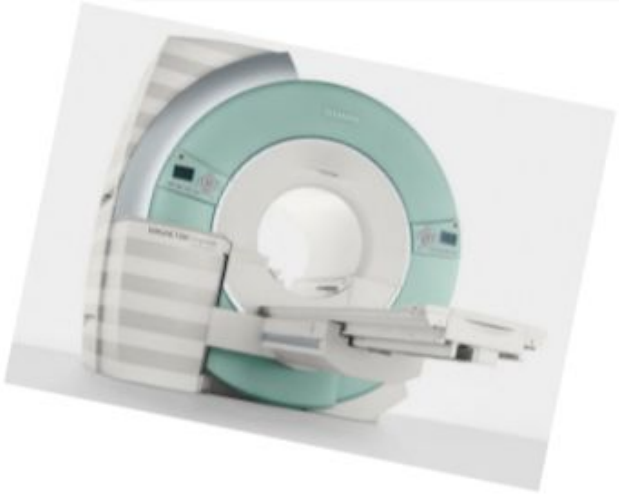
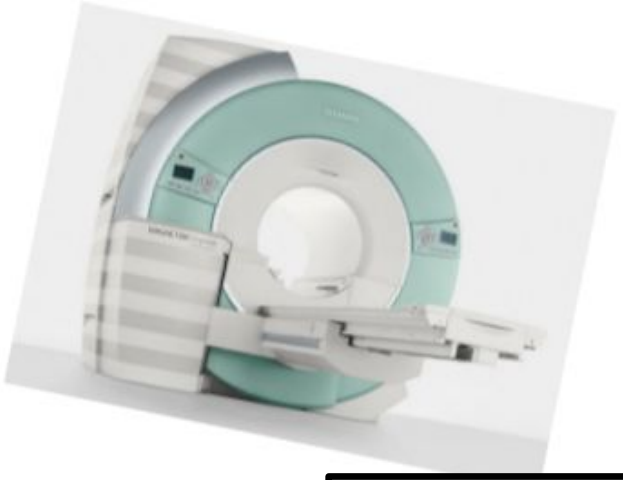




# EE16A

## Designing Information Devices and Systems I

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
gireeja@eecs.berkeley.edu
565 Cory
OH: 212 Cory/144MA Cory

Prof. Vladimir Stojanovic
vlada@berkeley.edu
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

Credit: Akshay Madhani

# 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 | | | |
|---|---|---|---|---|
| 8:00 AM | (217: Etch 3107): Alice | | | |
| 9:00 AM | (207: Etch 3111): Chris | (222: Etch 3109): Terry | | |
| 9:30 AM | | | | |
| 10:00 AM | (201: Cory 521): Elena | (221: Etch 3113): Chris | | |
| 11:00 AM | | | | |
| 12:00 PM | | | | |
| 1:00 PM | (209: Etch 3111): Michael | | | |
| 2:00 PM | (202: Cory 521): Dana | (210: Etch 3111): Ed | (211: Etch 3109): Laura | |
| 3:00 PM | (203: Cory 521): Dana | (212: Dwin 182): Terry | (213: Wheeler 222): Rishi | (220: Cory 241): Vijay |
| 4:00 PM | (206: Etch 3109): Lydia | (214: Etch 3107): Laura | | |
| 5:00 PM | (215: Etch 3113): Urmita | (218: Wheeler 222): Sam | (216: Moffitt 106): Nick | |
| 5:30 PM | (204: Cory 521): Lydia | | | |
| 6:00 PM | (219: Etch 3111): Sam | | | |
| 6:30 PM | (205: Cory 521): Avi | | | |

| 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!

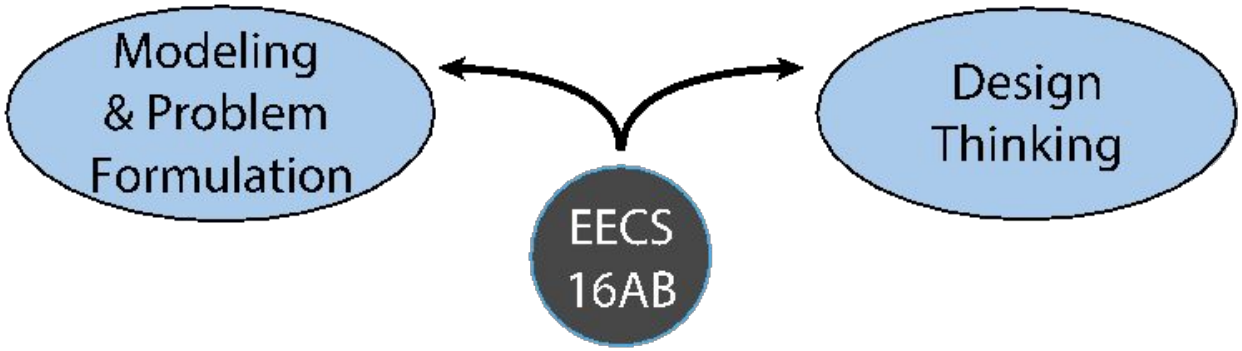
- Our staff wants to help you learn
  - In-lecture Q&A, Professor and TA OH, HW parties, Lab
- Cheating directly detracts from learning
  - Any cheating will be immediately sent to the Office of Student Conduct
  - Report bad behavior
- Be kind and compassionate to each other and to your GSIs
  - Everyone 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.



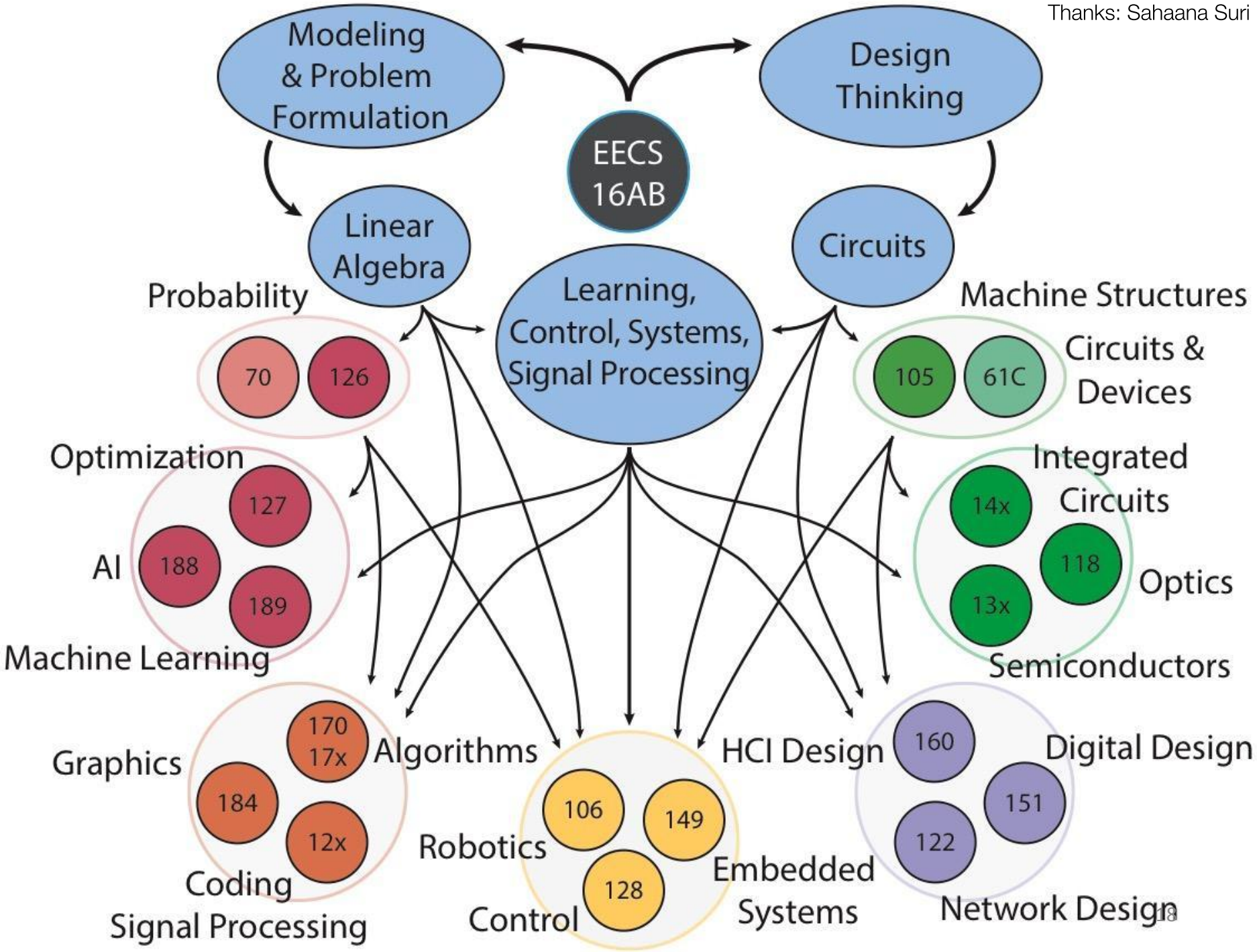

- 16AB: "How to think like an engineer"

  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

Thanks: Sahaana Suri



# 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”

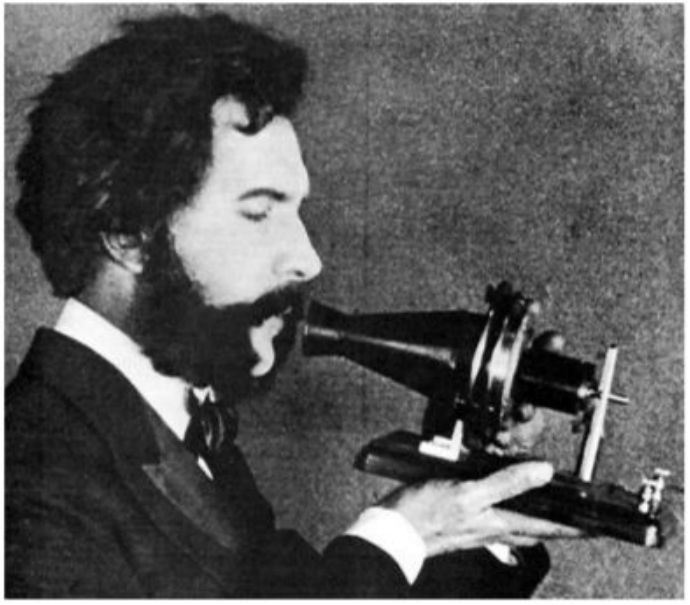
START

# How Did We Get From This…

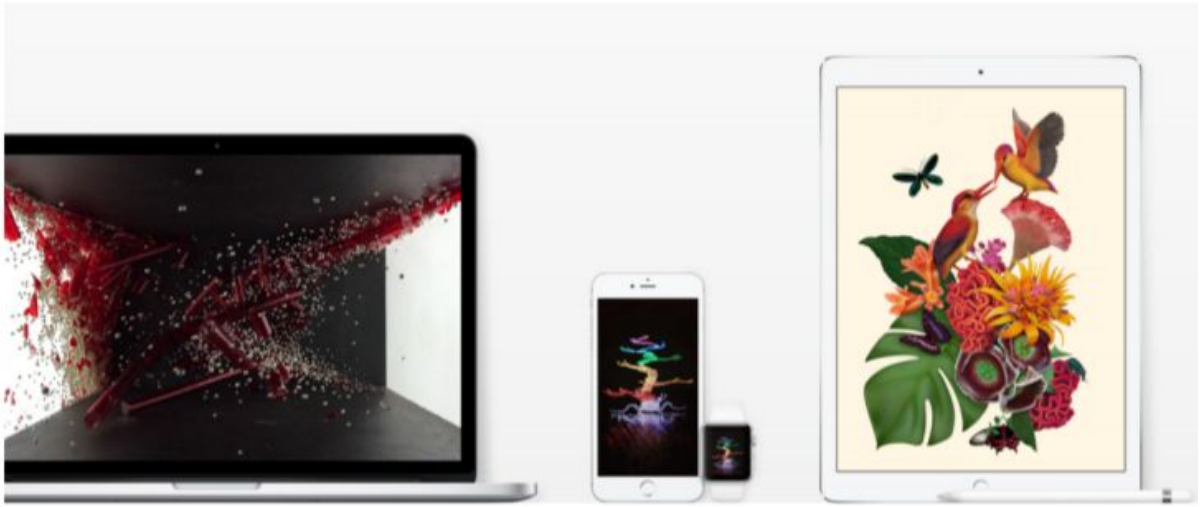
1837

1866

1876

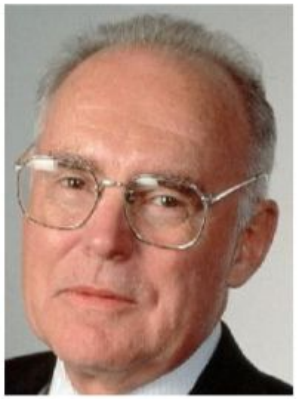


# To This?



WHO WANTS TO SEE 83 PICTURES OF MY LUNCH?!
-brian.
BEANS
FACEBOOK.COM/SHOEBOXBLOG

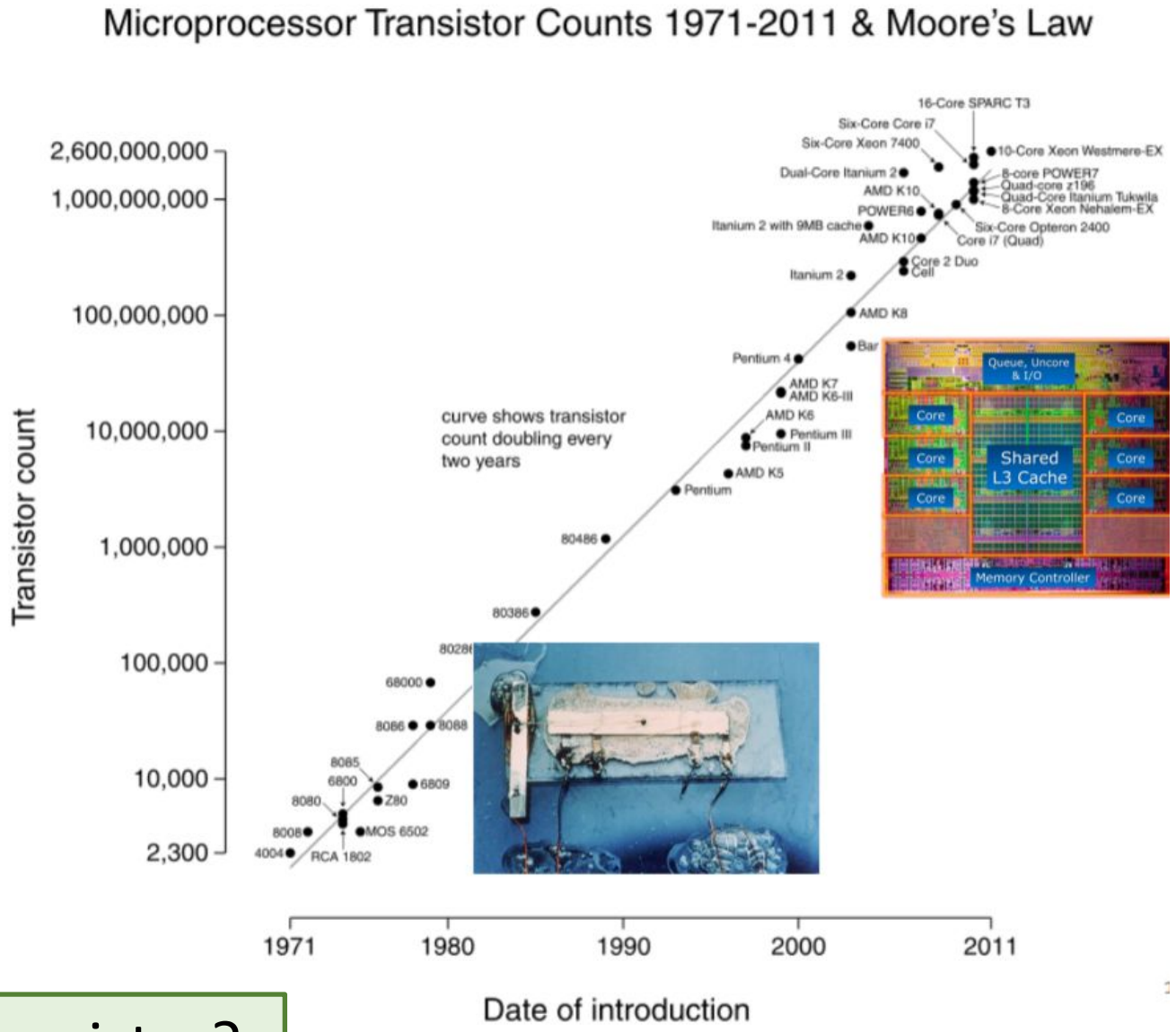
# Moore's Law



**Gordon Moore**

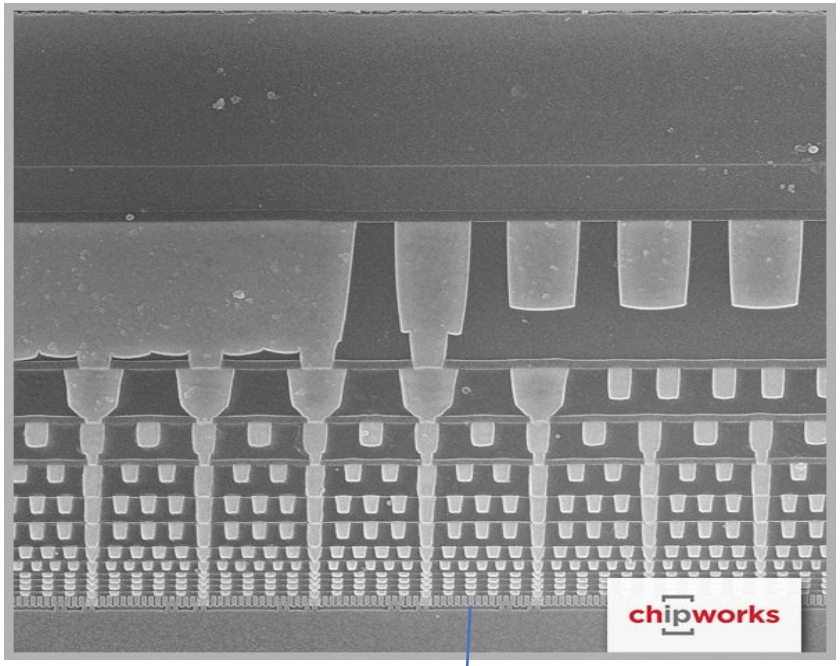
**Intel Cofounder**

**B.S. Cal 1950!**




What is a transistor?

# Sense of Scale



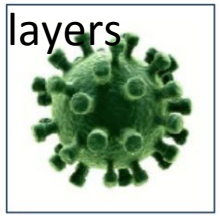

Side view of wiring layers

Mark
1.66 m

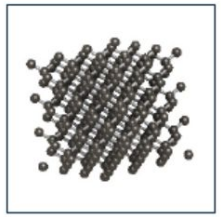
Fly
7 mm

Mite
300 um

Blood Cell
7 um



Virus
100 nm



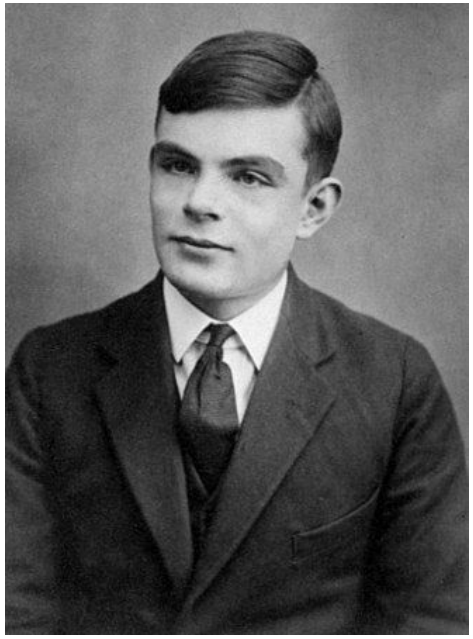
Silicon Atom
0.24 nm

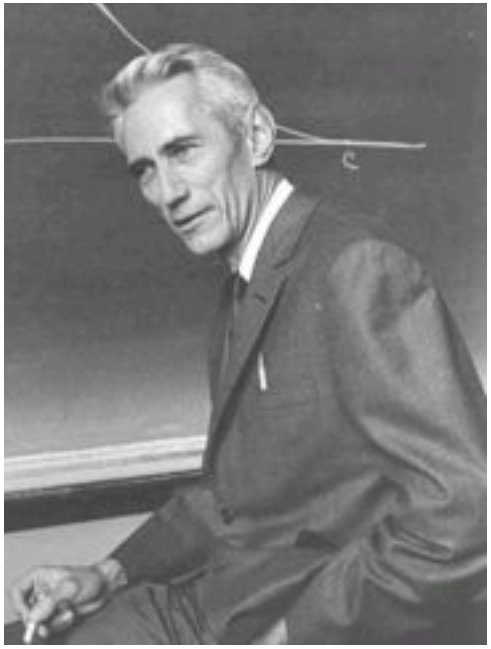
10 1 100 10 1 100 10 1 100 10 1 0.1

meter | millimeter | micrometer | nanometer

Source: Mark Bohr, IDF14

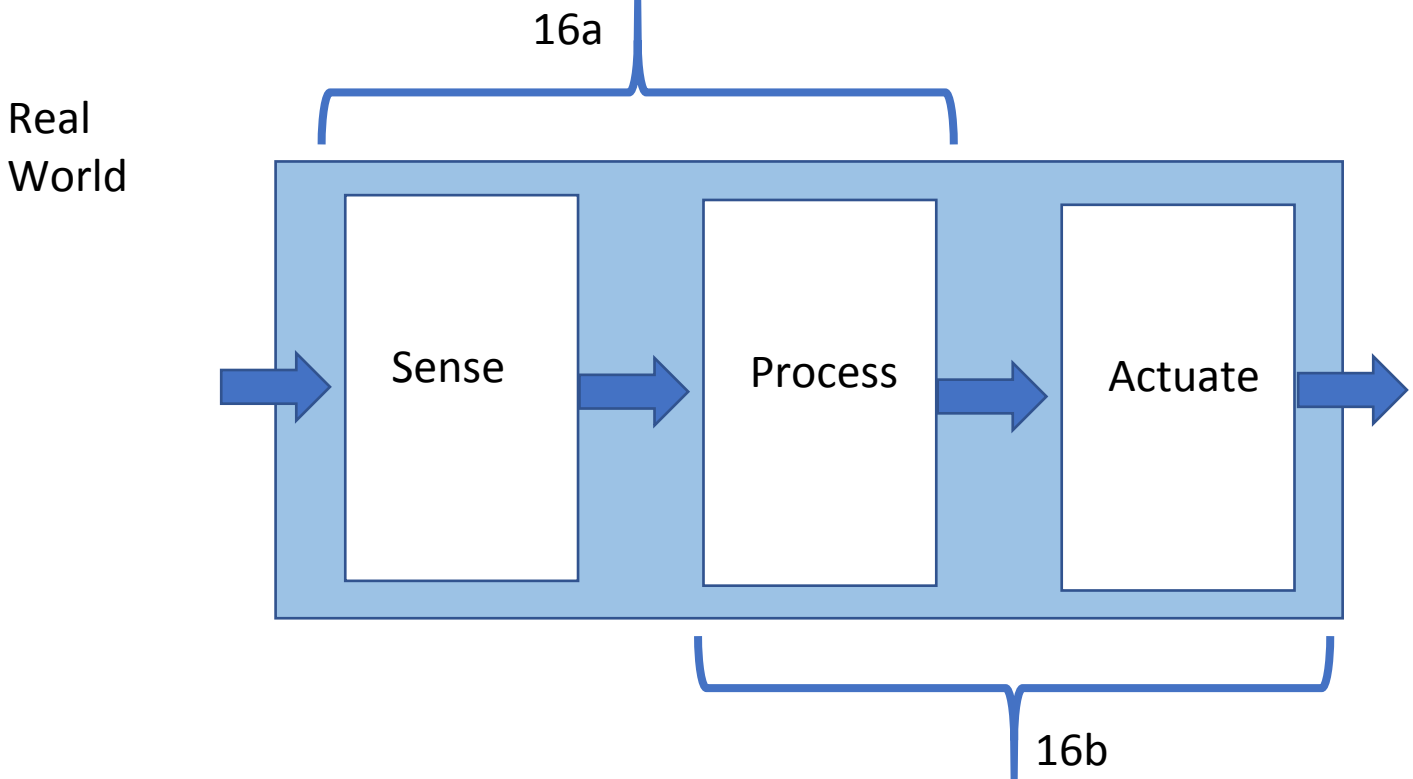
# Completing the puzzle …





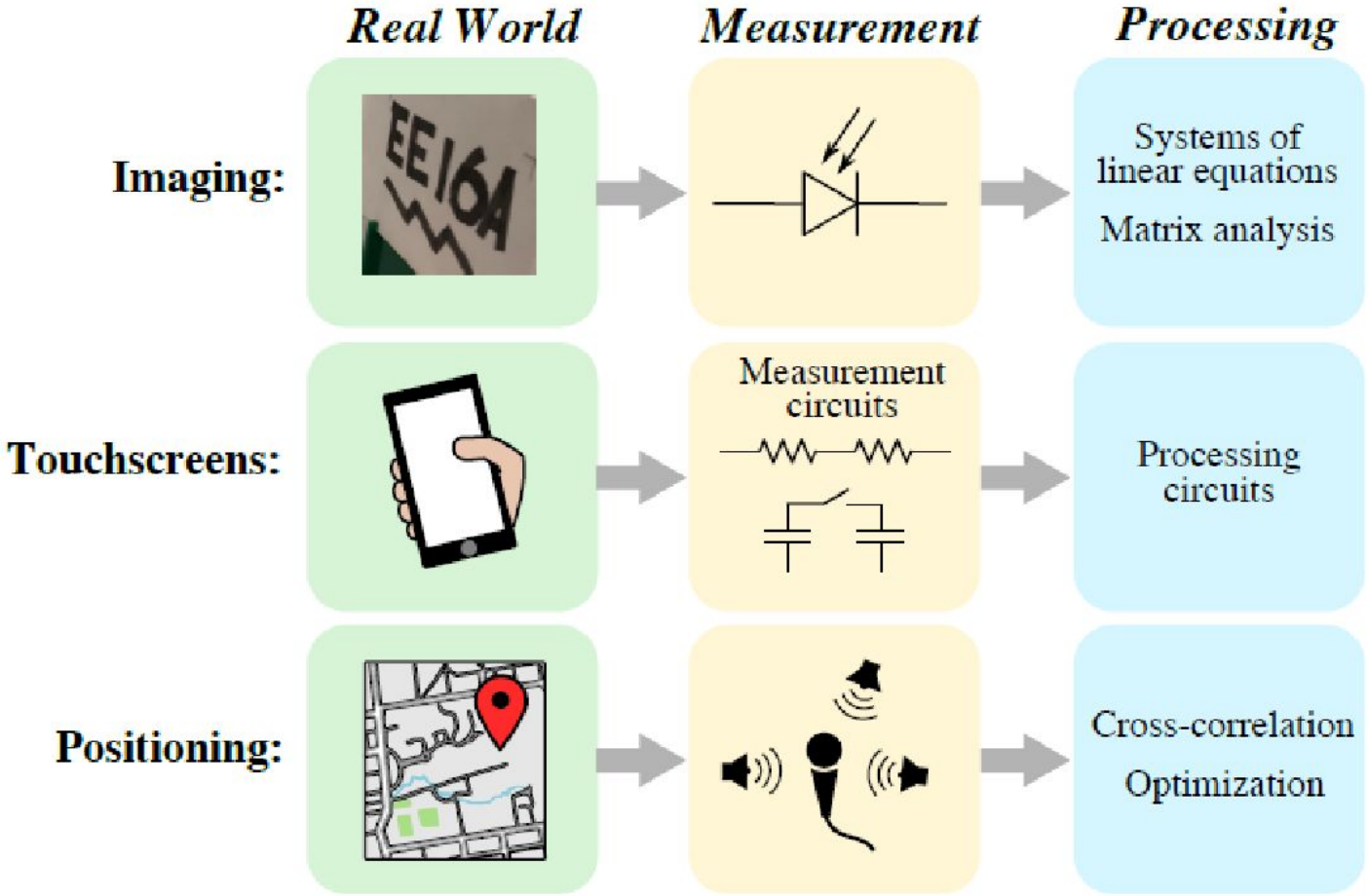
- Ada Lovelace - wrote the first computer program
- Turing – invented the Turing machine – how to build a computer to execute programs – what is actually computable?
- Claude Shannon – info theory, + how to implement logic out of EM switches

# Design of Information Devices and Systems



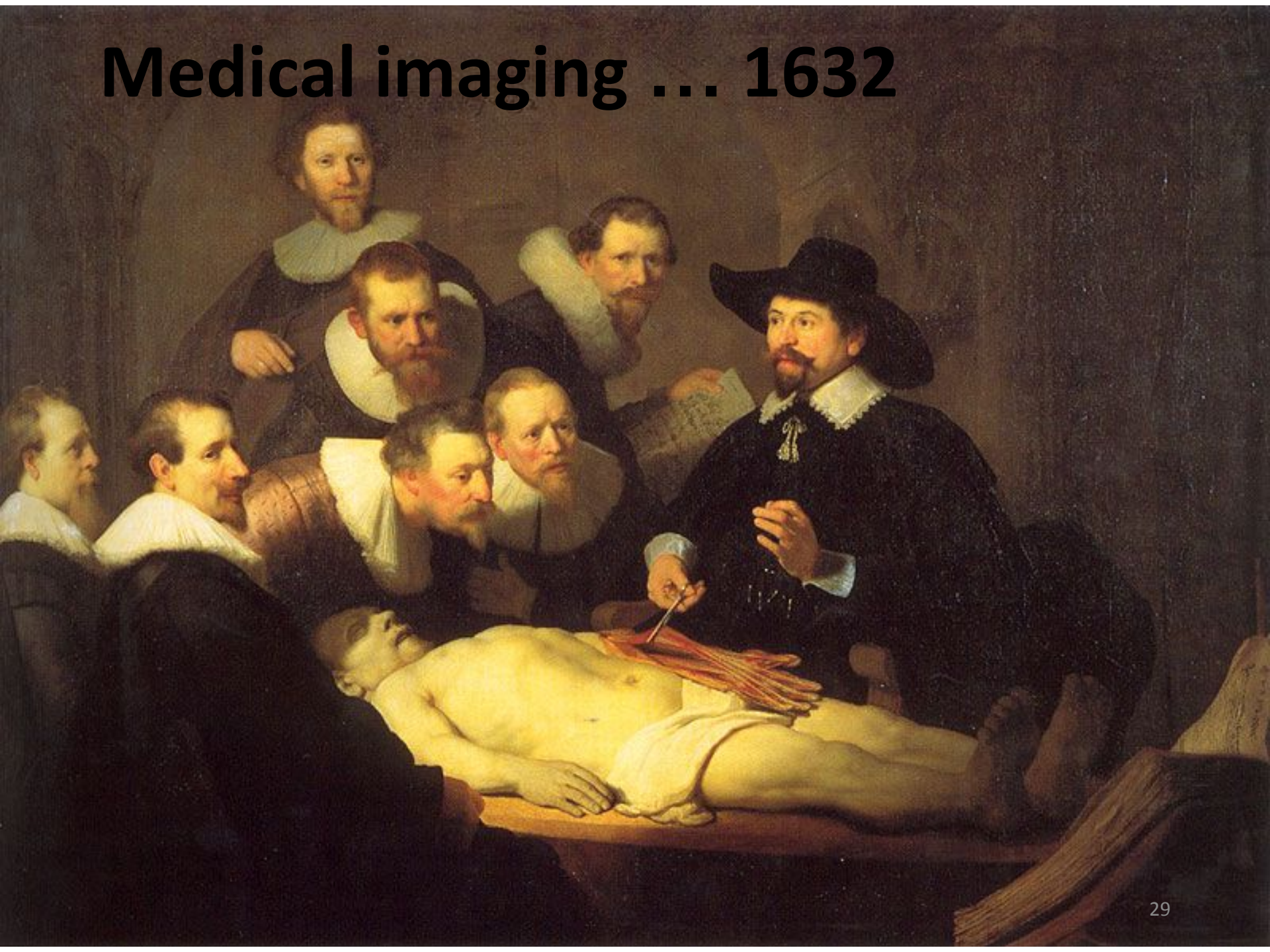

- Best when hardware and software work together
  - Best algorithms and best code written by understanding the sensing and compute mechanisms
  - Best devices designed understanding the physical limitations

# 16a Examples



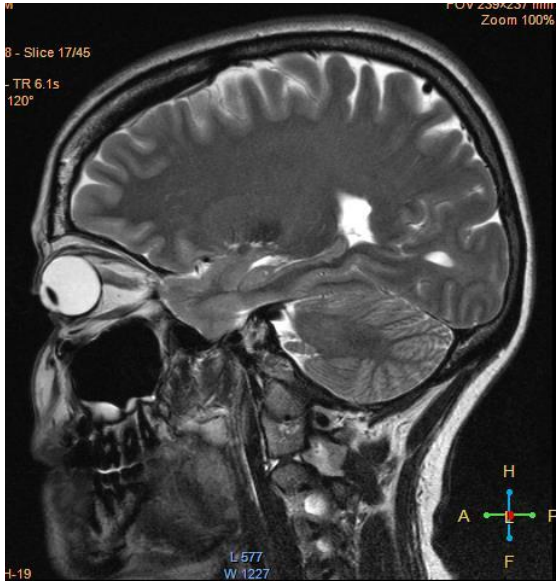
# Module 1: Imaging

# Medical imaging … 1632



# Seeing inside bodies: sans surgery…

MRI



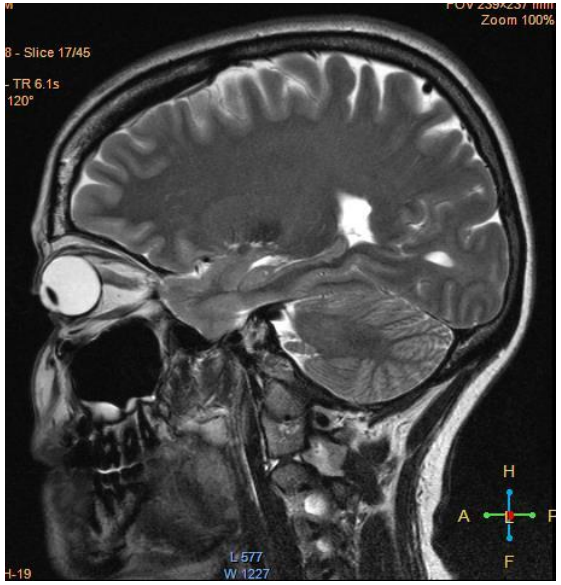
X-Ray

CT

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

Ultrasound

# Tomography

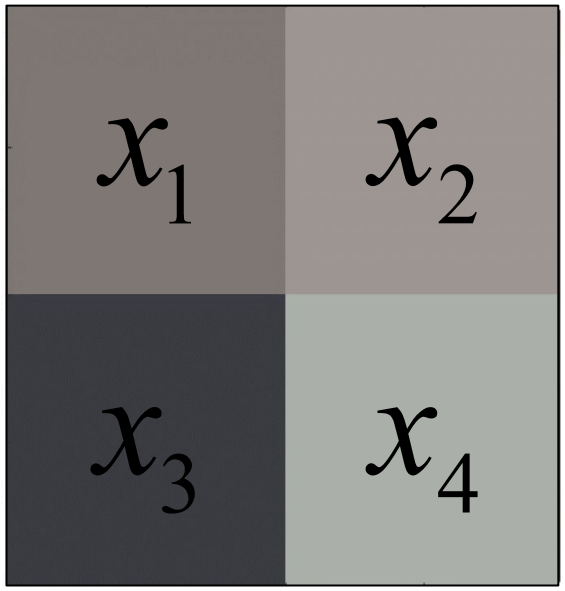



‘tomo’ – slice

‘graphy’ – to write

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

# Example: Tomography




What do pixel values represent?

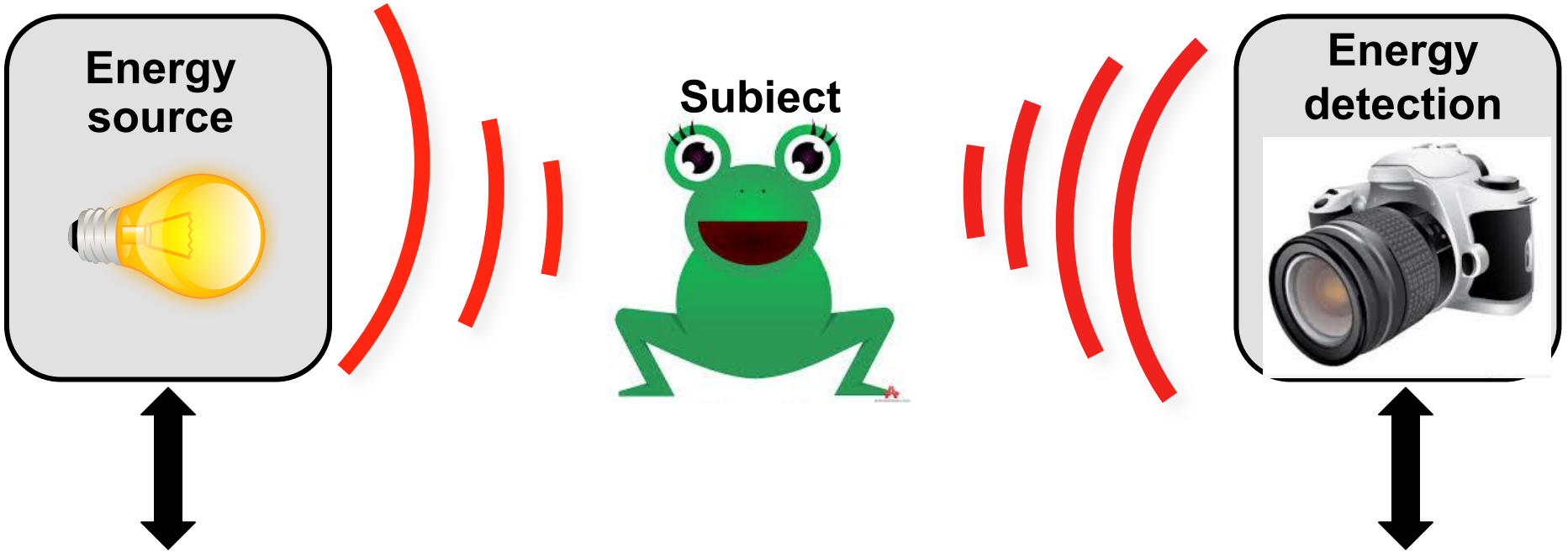
e.g. density, absorption, etc.

Can we solve for the pixel values from projections?

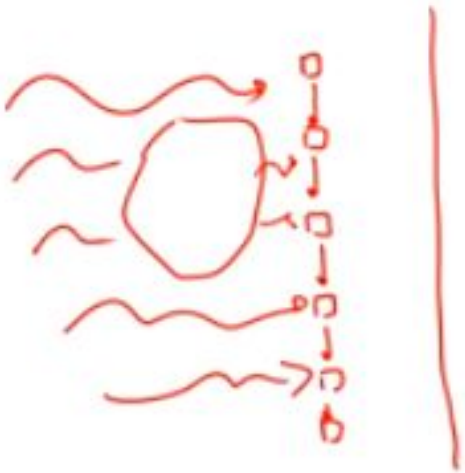
Yes, with tomography.

# DocuCam

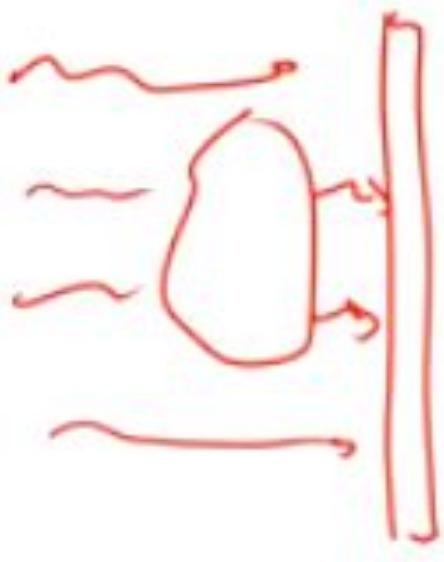
# Imaging in general



What is the absolute smallest number of components you need to make an imaging system?

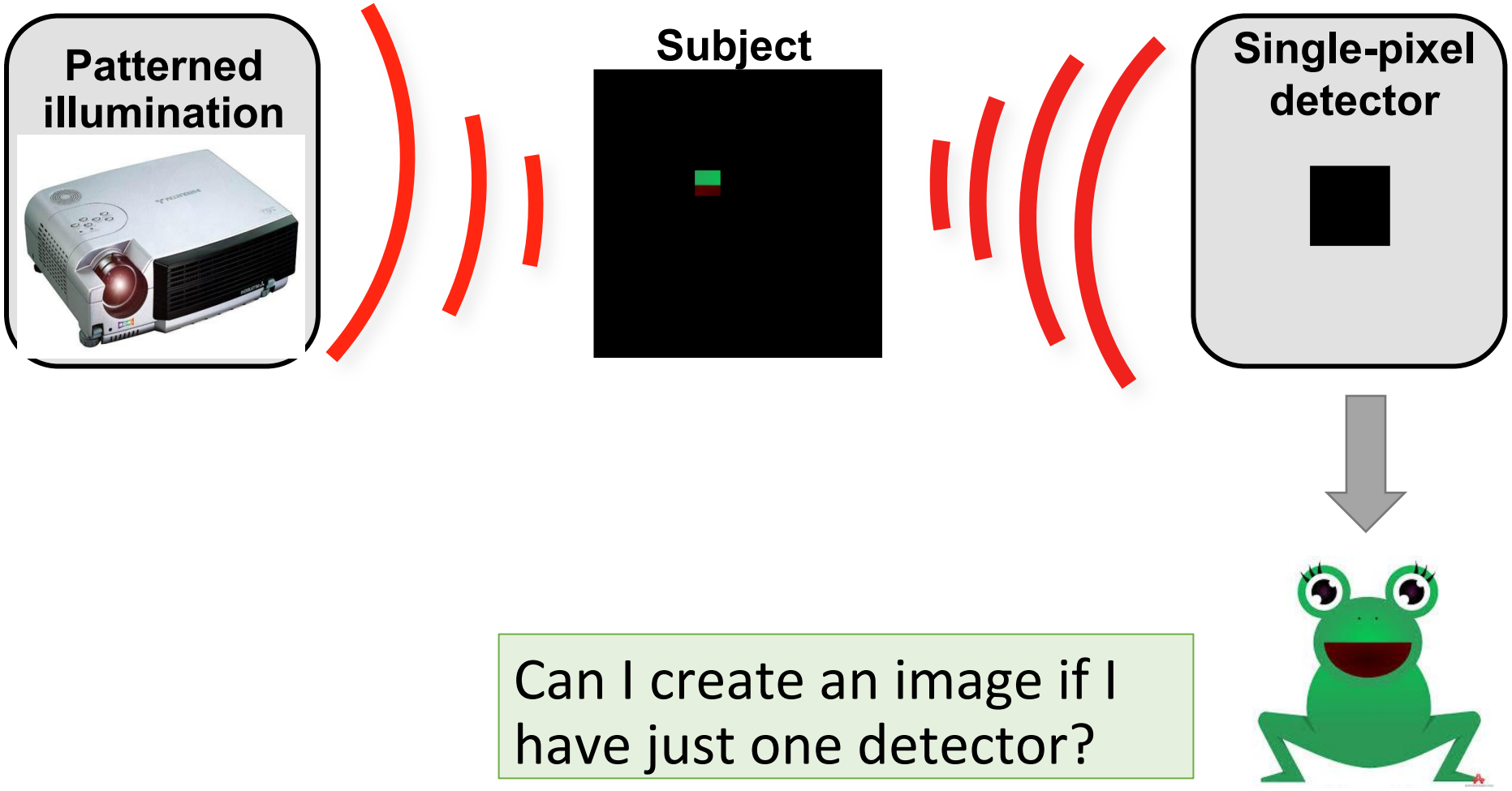


Example: flat illumination, one photosensor scans through pixels



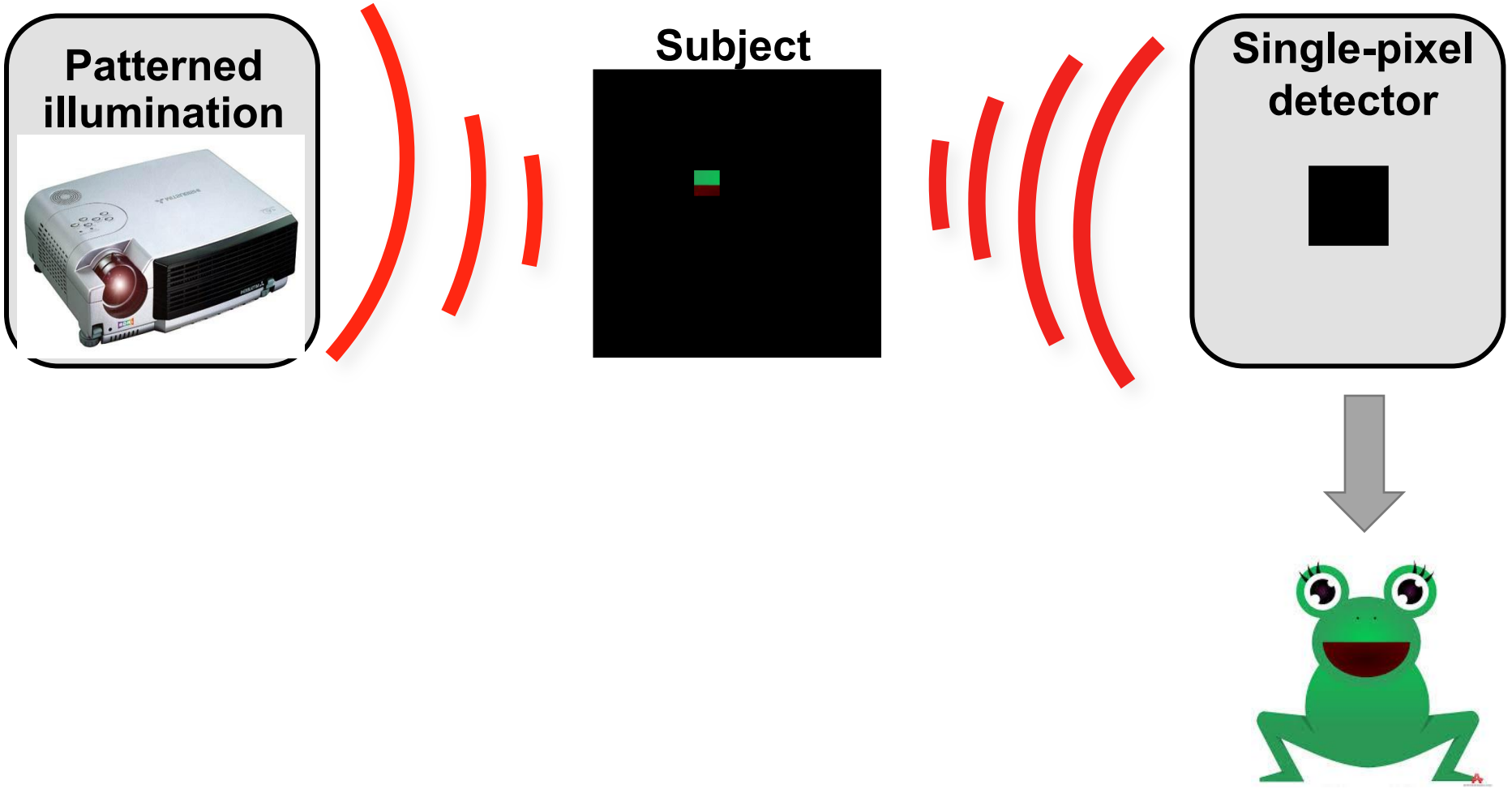
OR scan the illumination, use only one big pixel

# Single-pixel camera

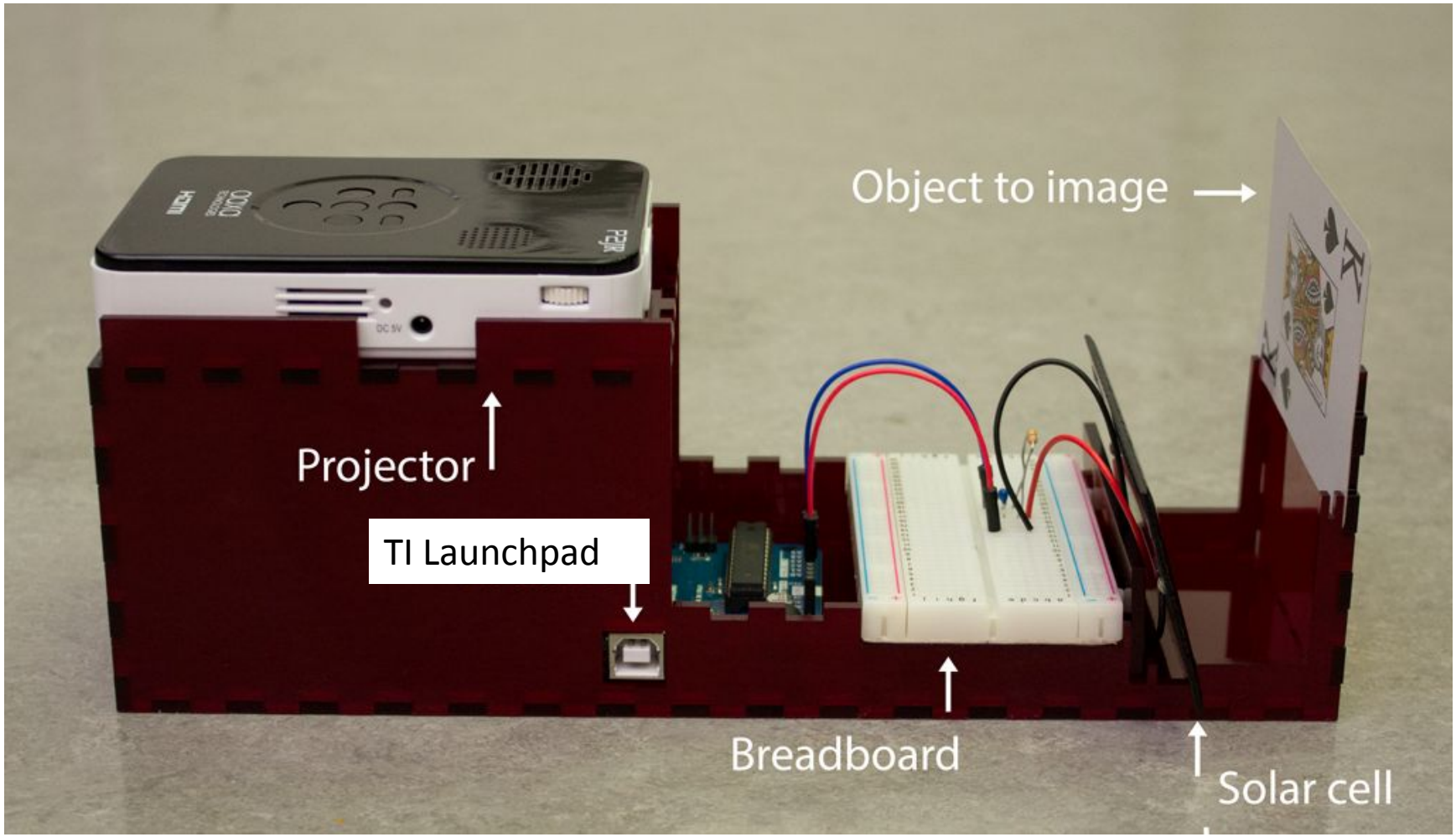



Can I create an image if I have just one detector?

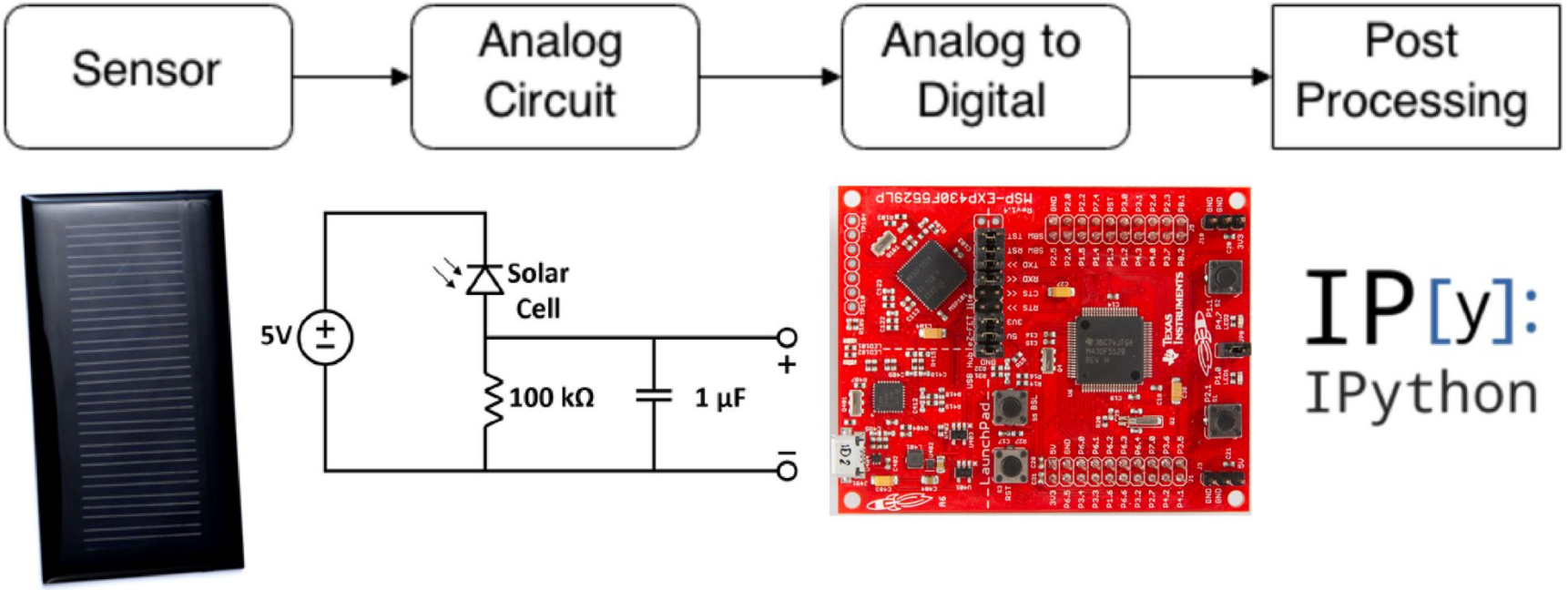
# Single-pixel camera



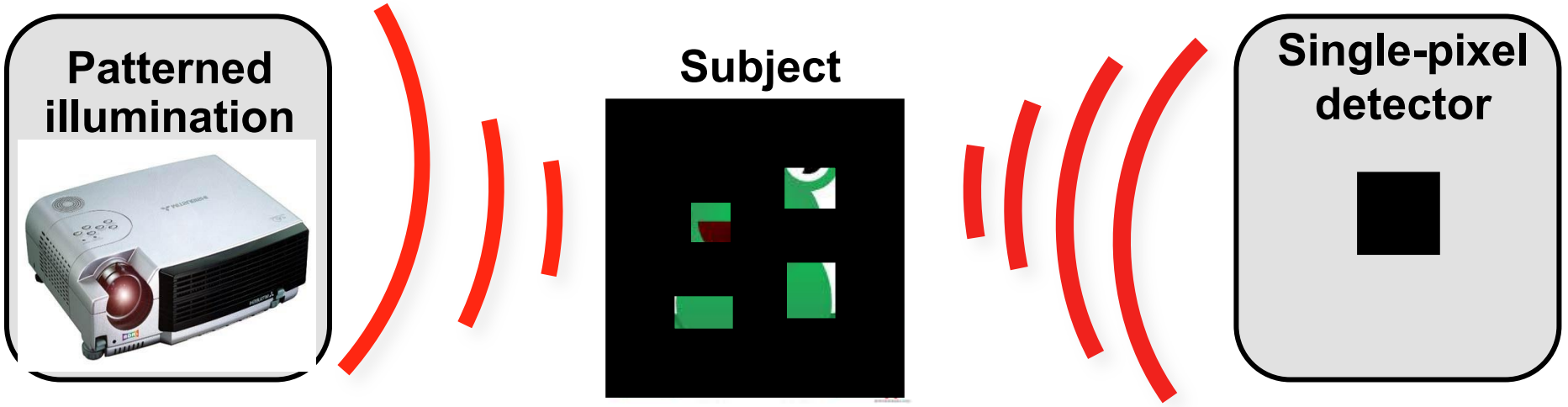
# Imaging Lab #1 Setup



# Imaging Lab #1

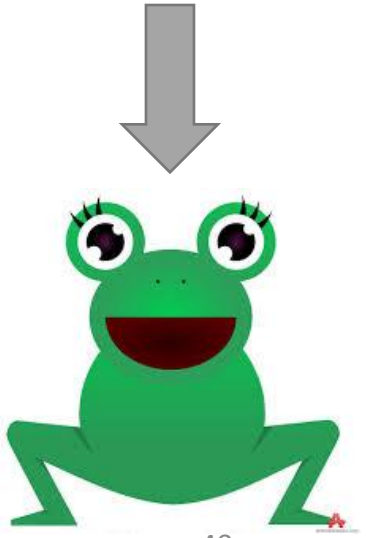


# Single-pixel camera




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?