# The Beauty and Joy of Computing

## Lecture #1
## Welcome; Abstraction

UC Berkeley EECS
Sr Lecturer SOE
Dan Garcia
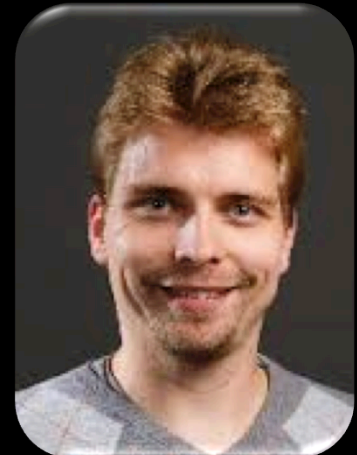
UC Berkeley EECS
Lecturer
Gerald Friedland

## BJC: YOU'LL LOVE IT!

Watch the student testimonials about the course, what it means to them, and how it has changed their lives. Inspiring!

inst.eecs.berkeley.edu/~cs10/

# BJC in one slide

- **Big Ideas of Programming**
  - Abstraction
  - Algorithms (2)
  - Recursion (2)
  - Functions-as-data, λ (2)
  - *Programming Paradigms*
  - *Concurrency*
  - *Distributed Computing*
- **Beauty and Joy**
  - "CS Unplugged" activities
  - All lab work in pairs
  - Two 3-week projects in pairs
    - Of their own choice!! (data + prog)
  - One writeup
    - Of students' own choice!!

- **Big Ideas of Computing**
  - HowStuffWorks
    - 3D Graphics + Video Games
    - Internet
  - Research Summaries
    - AI
    - HCI
  - The Power of Data (big, small, etc)
  - Apps that Changed the World
  - Social Implications of Computing
  - Saving the World with Computing
  - Cloud Computing
  - Limits of Computing
  - Future of Computing

# Format & Textbooks

- ## Format (7 hrs/wk * 14 wks)

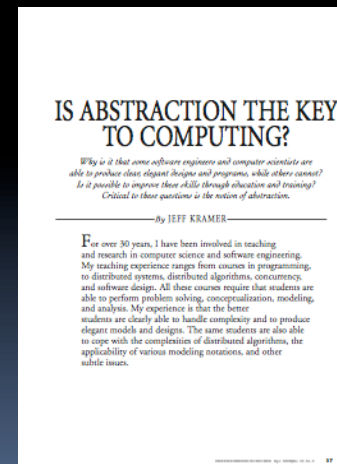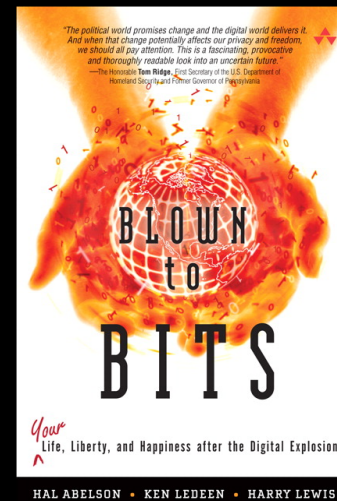| Mon | Tue | Wed | Thu | Fri |
|---|---|---|---|---|
| Lecture | Lab | Lecture | Lab | Discussion |
| | Lab | | Lab | |

- ## Selected Reading
  - Taken from great book ("Blown to Bits" by Abelson, Ledeen & Lewis) + articles + videos
  - Current events EVERY LECTURE (e.g., IBM's Watson vs Jeopardy)

- ## All resources FREE
  - Even clickers!

- ## Pair Programming!



. . .

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# Week at a glance

## Weekly Schedule

| Hour | Monday | Tuesday | Wednesday | Thursday | Friday | |
|------|--------|---------|-----------|----------|--------|---|
| 7:00am | | Lab Section J (Zach) 200 Sutardja Dai | | Lab Section J (Zach) 200 Sutardja Dai | | |
| 8:00am | | | | | | Discussion Section A (Zach) 310 Soda Hall |
| 9:00am | | Lab Section A (Zach) 200 Sutardja Dai | Lab Section B (Max) 200 Sutardja Dai | Lab Section A (Zach) 200 Sutardja Dai | Lab Section B (Max) 200 Sutardja Dai | |
| 10:00am | | | | | | Discussion Section B (Ian) 310 Soda Hall |
| 11:00am | | Lab Section C (Ian) 200 Sutardja Dai | Lab Section D (Michael) 200 Sutardja Dai | Lab Section C (Ian) 200 Sutardja Dai | Lab Section D (Jon) 200 Sutardja Dai | Discussion Section G (Michael) 310 Soda Hall |
| 12:00pm | | | | | Discussion Section C (Max) 310 Soda Hall | Discussion Section D (Zach) 320 Soda Hall |
| 1:00pm | Lecture Li Ka Shing 245 | Lab Section E (Peter) 200 Sutardja Dai | Lecture Li Ka Shing 245 | Lab Section E (Peter) 200 Sutardja Dai | | Discussion Section E (Jon) 310 Soda Hall |
| 2:00pm | | | | | Discussion Section H (Jon) 310 Soda Hall | Discussion Section I (Peter) 320 Soda Hall |
| 3:00pm | Lab Section K (Michael) 200 Sutardja Dai | Lab Section G (Max) 200 Sutardja Dai | Lab Section K (Jon) 200 Sutardja Dai | Lab Section G (Max) 200 Sutardja Dai | Discussion Section J (Max) 310 Soda Hall | Discussion Section K (Peter) 320 Soda Hall |
| 4:00pm | | | | | | Discussion Section L (Samir) 310 Soda Hall |
| 5:00pm | Lab Section I (Jon) 200 Sutardja Dai | Lab Section H (Samir) 200 Sutardja Dai | Lab Section I (Jon) 200 Sutardja Dai | Lab Section H (Samir) 200 Sutardja Dai | | Discussion Section M (Michael) 310 Soda Hall |
| 6:00pm | | | | | | |
| 7:00pm | Lab Section L (Michael) 330 Soda | | Lab Section L (Michael) 271 Soda | | | |
| 8:00pm | | Lab Section M (Peter) 273 Soda | | Lab Section M (Peter) 273 Soda | | |
| 9:00pm | | | | | | |

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# Let's check enrollments (in real time)

- **We have NEVER turned anyone away … if more students sign up, we'll open up more sections!**

- **We don't intend to turn anyone away now**

# Peer Instruction

- **Increase real-time learning in lecture, test understanding of concepts vs. details**

- **As complete a "segment" ask multiple choice question**
  - 1-2 minutes to decide yourself
  - 2 minutes in pairs/triples to reach consensus. Teach others!
  - 2 minute discussion of answers, questions, clarifications

# Piazza for {ask,answer}ing questions

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# Pro-student Grading Policies

- **EPA**
  - Rewards good behavior
  - <u>E</u>ffort
    - E.g., Office hours, doing every single lab, hw, reading Piazza pages
  - <u>P</u>articipation
    - E.g., Raising hand in lec or discussion, asking questions on Piazza
  - <u>A</u>ltruism
    - E.g., helping other students in lab, answering questions on Piazza

- **You have 3 "Slip Days"**
  - You use them to extend due date, 1 slip day for 1 day extension
  - You can use them one at a time or all at once or in any combination
  - They follow you around when you pair up (you are counted individually)
    - E.g., A has 2, B has 0. Project is late by 1 day. A uses 1, B is 1 day late
  - Late is 1/3 off/day

# Abstraction

- ## Detail removal
  - □ "The act or process of leaving out of consideration one or more properties of a complex object so as to attend to others."

- ## Generalization
  - □ "The process of formulating general concepts by abstracting common properties of instances"
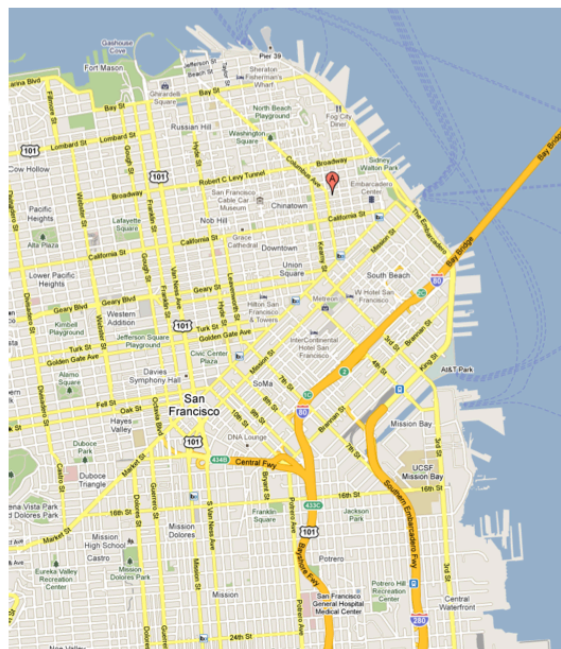


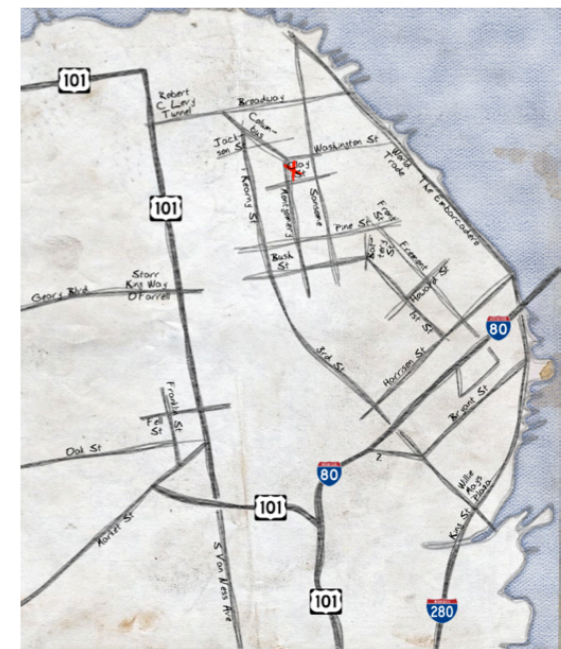Henri Matisse *"Naked Blue IV"*

# Detail Removal



General Purpose Online Map          Selected Roads          Our Result

**Automatic Generation of Detail Maps**
Maneesh Agrawala (UCB EECS), among others

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# Detail Removal (in BJC)

- You'll want to write a project to **simulate a real-world situation**, or play a game, or …

- Abstraction is the idea that you **focus on the essence**, the cleanest way to map the messy real world to one you can build

- **Experts are often brought in to know what to remove and what to keep!**



The London Underground 1928 Map & the 1933 map by Harry Beck.

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# Generalization Example

- **You have a farm with many animal kinds.**

- **Different food for each**

- **You have directions that say**
  - To feed dog, put dog food in dog dish
  - To feed chicken, put chicken food in chicken dish
  - To feed rabbit, put rabbit food in rabbit dish
  - Etc…

- **How could you do better?**
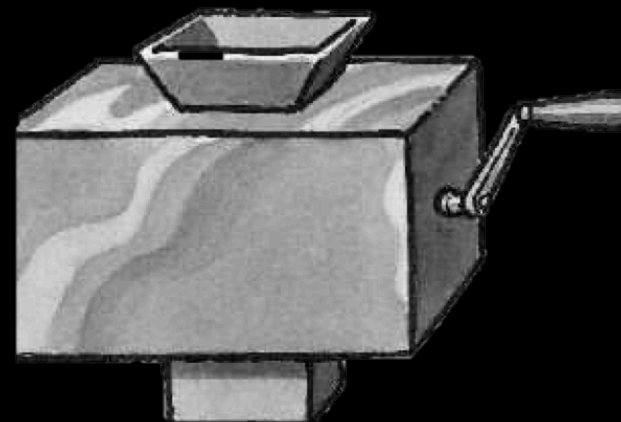  - To feed <animal>, put <animal> food in <animal> dish



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# Generalization (in BJC)

- **You are going to learn to write functions, like in math class:**

$$y = \sin(x)$$

- **You should think about what inputs make sense to use so you don't have to duplicate code**

"Function machine" from *Simply Scheme* (Harvey)

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# The Power of Abstraction, everywhere!

- **Examples:**
  - Functions (e.g., sin x)
  - Hiring contractors
  - Application Programming Interfaces (APIs)
  - Technology (e.g., cars)
- **Amazing things are built when these layer**
  - And the abstraction layers are getting deeper by the day!

*We only need to worry about the interface, or specification, or contract NOT how (or by whom) it's built*

**Above the abstraction line**

**Abstraction Barrier (Interface)**
(the interface, or specification, or contract)

**Below the abstraction line**

*This is where / how / when / by whom it is actually built, which is done according to the interface, specification, or contract.*

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# Summary

- **Abstraction is one of the big ideas of computing and computational thinking**

- **Think about driving. How many of you know how a car works? How many can drive a car? Abstraction!**



Someone who drove in 1930 could still drive a car today because they've kept the same Abstraction!
*(right pedal faster, left pedal slow)*