CMPS 10: Following National NSF Initiative for CS Principles

Introduction to Computer Science

Dr. Dustin Adams. Office E2 249B.

Office Hours MWF 11am-noon

Introductions …

- Instructor: Dustin Adams, Ph.D – CS Dept.
- Teaching Assistants:
  - Sinjoni Mukhopadhyay (simukhop@ucsc.edu)
  - Anuradha Talur (atalur@ucsc.edu)
  - Sneha Das (sndas@ucsc.edu)
  - Shubham Goel (sgoel2@ucsc.edu)

Introductions …

- Instructor Dustin Adams, Ph.D in CS
    - Academic Degrees:
        - Bachelor's Degree in Mathematics Sam Houston State University, Ph.D. Computer Science UC Santa Cruz
- Research Interests: Human-Computer Interaction, Assistive Technology

The most interesting things in Computer Science are…..

AIMS: Cover the Seven Big Ideas in computing

- As defined by the College Board for new AP test
1. Computing is a **creative** human activity that enables innovation
2. **Abstraction** is a way to understand and solve problems
3. Data and information help to **create knowledge**
4. **Algorithms** are tools for developing and expressing solutions to computational problems
5. **Programming** is a creative process that produces computational artifacts
6. Digital devices, systems, and the networks that interconnect them enable and foster computational approaches **to solving problems**
7. Computing **enables innovation** in other fields, like science, engineering, humanities, etc.

Two Aspects to the 7 Big Ideas

- Computational Principles – "bits can represent all information" – that everyone should know

- Computational Thinking – thinking approaches you can use to solve (your) problems with computers

- At least one homework assignment each week that can generally be completed during your lab session.

- Class should not be 'too hard', similar classes being taught at 8th grade and high school level

- At the end: understand much better what is going on inside your phone, computer, facebook, google

- Hope you might even consider a double major in CS

Computing as part of our lives

- "Computing capacity is increasing at 58% annually, telecommunications at 28%, and storage at 23% per year. The former rate is approximately the rate of Moore's Law, a doubling every 18 months. Communications are doubling every 34 months and storage every 40 months. Information has been expanding at this rate for the past decade."

Increase of Computing Power
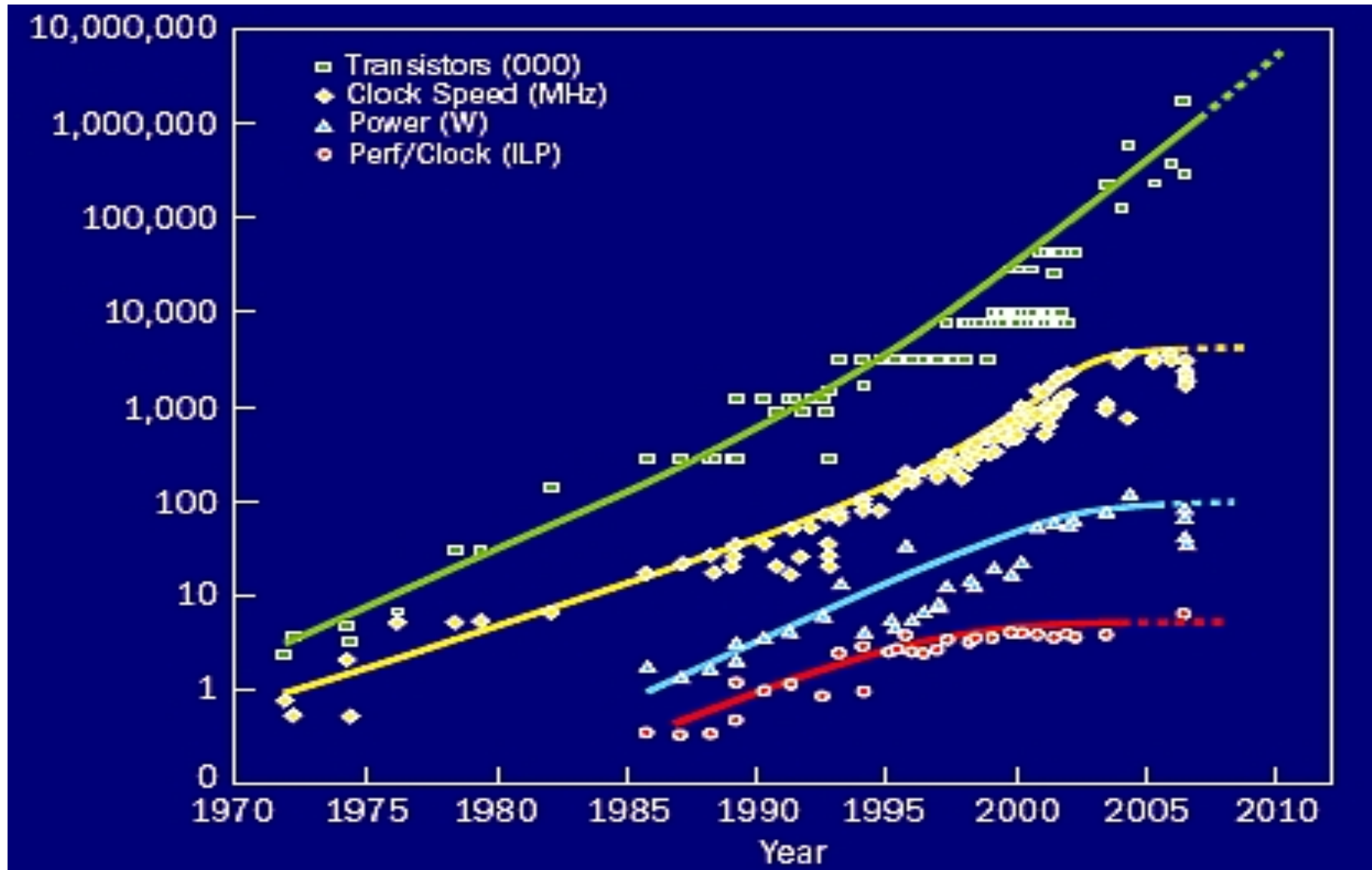
Exponential Growth

You are offered a job, which lasts for **7 weeks**. You get to choose your salary.

A. **Either**, you get $100 for the first day, $200 for the second day, $300 for the third day. Each day you are paid $100 more than the day before.

B. **Or**, you get 1 cent for the first day, 2 cents for the second day, 4 cents for the third day. Each day you are paid double what you were paid the day before.

- Computing techniques same, but can do it now more quickly
- Miniaturization & Mobile
- Apple SIRI:
  - Speech recognition and Text to Speech
  - PERSONALIZED & CONTEXT: who and where the user is

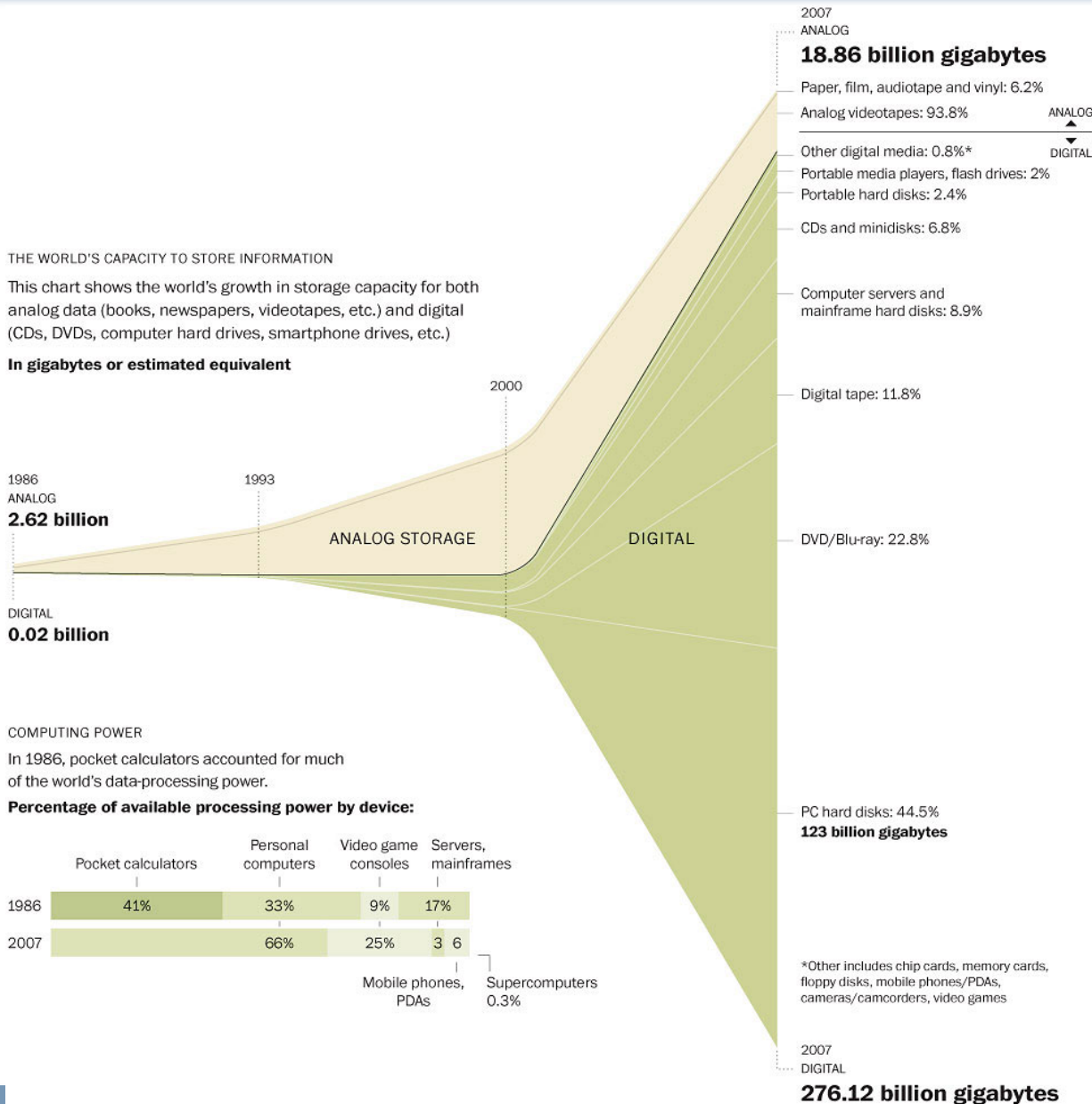Your new humble assistant

Big Data is here

THE WORLD'S CAPACITY TO STORE INFORMATION

This chart shows the world's growth in storage capacity for both analog data (books, newspapers, videotapes, etc.) and digital (CDs, DVDs, computer hard drives, smartphone drives, etc.)

In gigabytes or estimated equivalent

1986
ANALOG
2.62 billion

DIGITAL
0.02 billion

1993

2000

ANALOG STORAGE

DIGITAL

2007
ANALOG
18.86 billion gigabytes

Paper, film, audiotape and vinyl: 6.2%
Analog videotapes: 93.8%

ANALOG
DIGITAL

Other digital media: 0.8%*
Portable media players, flash drives: 2%
Portable hard disks: 2.4%
CDs and minidisks: 6.8%

Computer servers and mainframe hard disks: 8.9%

Digital tape: 11.8%

DVD/Blu-ray: 22.8%

PC hard disks: 44.5%
123 billion gigabytes

COMPUTING POWER

In 1986, pocket calculators accounted for much of the world's data-processing power.

Percentage of available processing power by device:

	Pocket calculators	Personal computers	Video game consoles	Servers, mainframes	
1986	41%	33%	9%	17%	
2007		66%	25%	3	6

Mobile phones, PDAs

Supercomputers 0.3%

*Other includes chip cards, memory cards, floppy disks, mobile phones/PDAs, cameras/camcorders, video games

2007
DIGITAL
276.12 billion gigabytes

How big?

- "The full scale of how much information we make is hard to appreciate. We humans collectively now have capacity to store approximately 300 exabytes of information (that's giga giga bytes). This is close the total amount of information stored in one person's DNA. Or, as Hilbert puts it, it's the equivalent of 80 Library of Alexandrias per person on the planet. And remember, the technium is doubling its capacity every year and a half, and your DNA is not... Broadcasting has grown at about the same speed as world's GDP; but our information storage capacity has grown 4 times faster and telecommunication capacity has grown roughly 5 times faster than the world's economic power." Kevin Kelly

- http://www.kk.org/thetechnium/archives/2011/03/the_amount_of_i.php

kilo, mega, giga, tera, peta, exa (10^{18})

kilo, mega, giga, tera, peta, exa

1 Tera Byte is how many bytes?

A. 1,000,000

B. 1,000,000,000

C. 1,000,000,000,000

D. 1,000,000,000,000,000

Why might you be interested in CS? A job?

- http://www.inc.com/keith-cline/talent-shortages-in-2012.html

- Although the economy continues to face many challenges, the startup and tech industries are very much alive. The IPO window slightly opened up for companies like LinkedIn, Pandora, Groupon, Zynga, and Carbonite. We saw monster rounds of funding for companies like Facebook, Twitter, Dropbox. The appetite for seed and angel investing was extremely active. Tech incubators and accelerator programs kept popping up.

CS is collaborative!

Meeting of a project team at Google

CS is creative!

- **CS is NOT just code**
- **Code is technical, but it's also creative!**

Introducing Leah Buechley

Before College: Interested in art and design, liked math.

In College: Studied fine arts, then computer science.

Now: Creates clothes that light up.

CS Jobs Benefit Society

The Human Genome Project and the field of bioinformatics have revolutionized what is possible in forensics, health care, science, criminal justice and other fields through the creation of the DNA database.
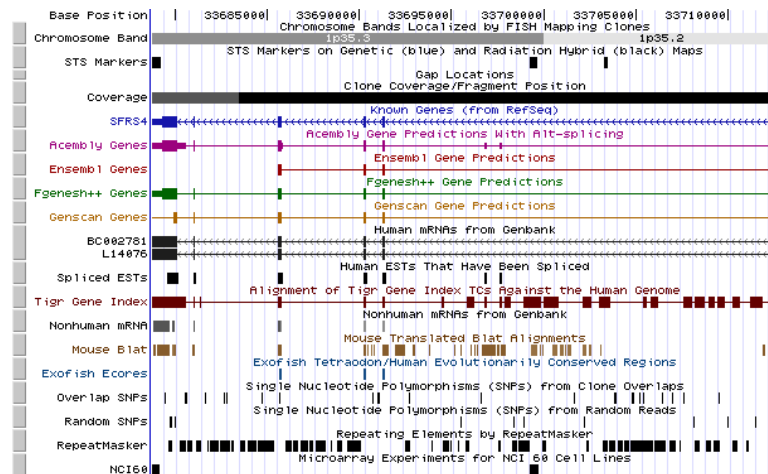
genome.ucsc.edu

Student Interests + CS =

Innovative Careers!

" *Find out what you love to do and do that. It's that simple.*

~ Dr. A. L. Garcia

Science + CS = Something for everyone

- **Bioinformatics**
- **Computational biology**
- **Genome informatics**
- **Cheminformatics**

Pictured above: Human chromosomes on a black background, from the National Human Genome Research Institute

Humanities/Social Science + CS =

- **Motion graphic design**
- **Animation (2D & 3D)**
- **Computer graphics**
- **Computational linguistics**
- **Speech recognition software**
- **Human computer interaction**

Pictured above: Digital art collage created by students at the Texas School for the Deaf in Austin, TX

Education + CS =

- **Educational technology**
- **Instructional design**
- **Assistive technology**
- **Electronic learning/ e-learning/online learning**
- **Distance education**
- **Educational animation**

Pictured above: Assistive speech generating devices for language learners and disabled learners

Photo: Spectronicsinoz

Business + CS =

- **Management information systems (MIS)**
- **Computer information systems (CIS)**
- **Database administrator**
- **Network administrator**
- **IT Portfolio Management**

Annual Degrees and Job Openings in Broad S&E Fields (2006-2016)

CRA – COMPUTING RESEARCH ASSOCIATION

Legend:
- PhD
- Master's
- Bachelor's
- Projected Job Openings

(in thousands)

Engineering: PhD 6.4, Master's 34.1, Bachelor's 66, Projected Job Openings 50.5

Physical Sciences: PhD 4.36, Master's 4.1, Bachelor's 15, Projected Job Openings 10.9

Mathematics/Computer Science: PhD 2.34, Master's 22.4, Bachelor's 65.4, Projected Job Openings 156.8

Biological/Agricultural Sciences: PhD 7.41, Master's 12.3, Bachelor's 85.1, Projected Job Openings 26.8

Source: Bureau of Labor Statistics, Monthly Labor Review, 2007

Forbes Nov 12, 2014

Top Bachelor's Degrees In Demand

No. of Respondents That Will Hire

Degree	No. of Respondents That Will Hire
Finance	128
Accounting	125
Computer Science	120
Mechanical Engineering	116
Business Administration/Mgmt.	106
Electrical Engineering	104
Information Sciences & Systems	101
Marketing	93
Logistics/Supply Chain	91
Management Information Systems	87

Made with Chartbuilder

Data: National Association of Colleges and Employers

What areas are the most competitive areas for talent (hiring challenges) these days?

- http://www.inc.com/keith-cline/talent-shortages-in-2012.html

- **Software Engineers and Web Developers**: **The demand for top-tier engineering talent sharply outweighs the supply** in almost every market especially in San Francisco, New York, and Boston. This is a major, major pain point and problem that almost every company is facing, regardless of the technology "stack" their engineers are working on.

- **Creative Design and User Experience**: After engineers, the biggest challenge for companies is finding high-quality creative design and user-experience talent. **Since almost every company is trying to create a highly compelling user experience that keeps people engaged with their product, it is tough to find people who have this type of experience (especially with mobile devices including tablets)** and a demonstrated track record of success.

- **Product Management**: It is always helpful for an early-stage company to hire someone who has very relevant and specific experience in your industry. This is especially true for product management, since the person in this role will interface with customers and define the product strategy and use cases. However, be prepared, as **it will be a challenge to find people with experience in these high-growth industries: consumer web, e-commerce, mobile, software as a service, and cloud computing.**

More missing talent

- **Marketing**
- I'm not talking about old-school marketing communications. Companies are looking for expert online marketers who know how to create a buzz of inbound marketing or viral traffic through the web, social media, and content discovery. Writing a good press release just doesn't cut it anymore, as everyone is looking **for the savvy online marketing professional who understands how the current state of the web operates and knows how to make it work to their benefit**.

- **Analytics**
- Since data is becoming more and more accessible, smart companies are increasingly making decisions driven by metrics. Analytics is becoming a central hub across companies where everything (web, marketing, sales, operations) is being measured and each decision is supported by data. Thus, we are seeing a high level of demand for analytics and business intelligence professionals who almost act like internal consultants; they help determine what should be measured and then build out the capability for a company.
    - **Big Data: Even Safeway wants to be able to predict what you might buy from your past spending patterns, and spending of others like you**

The designer who programs?

http://www.inc.com/garry-tan/the-great-value-of-the-designer-who-codes.html

The powerful fusion of great design, great engineering, and real authority in the hands of those people, results in magical user experiences.

This class

Introduction to this class

- http://www.bitsbook.com/excerpts/

- Snap - http://snap.berkeley.edu/

- Supplemented with reading/watching online sources, e.g. Wikipedia, You Tube


```
when [flag] clicked
hide
go to x: -100 y: 100
clear
set pen color to [blue]
pen down
point in direction 90 ▼
repeat 4
    snowflake size 200 lev
    turn ↻ 90 degrees
```
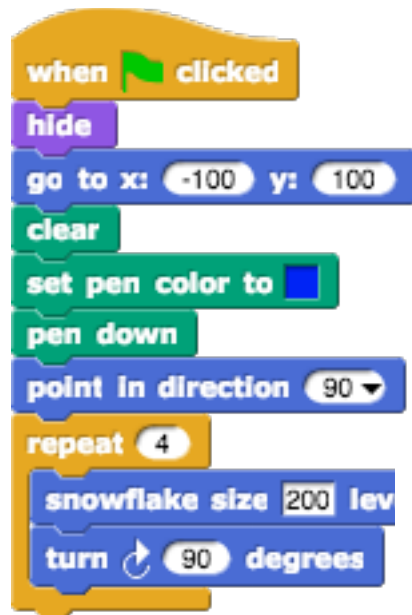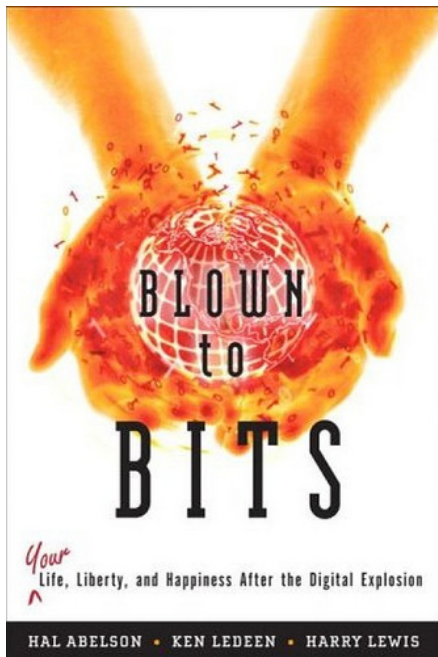

WIKIPEDIA
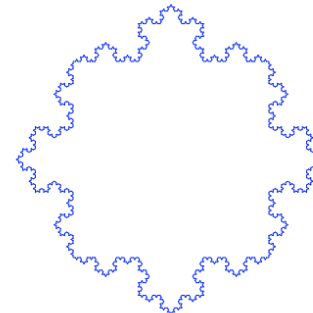
Class Structure

- 3 "lectures" a week— I will talk, show you how stuff works, discuss various topics, **ask you to discuss stuff**

- Lecture slides will be available before class and **should be read before class**

- Lab/Homework – exercises that help you learn a bit about programming.

- Reading – you will get the most out of this class if you do the reading BEFORE class.

- Sections: Mandatory (the Programming part of this class). Put it on your schedule!

- Midterm, Final

Grading

- lab attendance (10%)
  - 8 weeks we take attendance – 1 free pass – so 7 attendances = 100%
- HW/Lab assignments (30%) – mostly programming in Snap
- Midterm (30%)
- Final (30%)

HW Grading

- HW/Lab assignments (30%) – mostly programming in Snap
- Graded as:
    - ✓+   12 points out of 10 – Outstanding (and rare)
    - ✓   10 points out of 10 – Did what was expected
    - ✓-   8 points out of 10 – Mostly ok, but some deficiencies
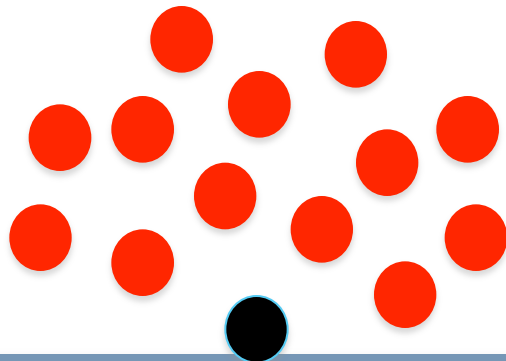   - zero   0 points – seriously deficient

How does this class work?

- This class is designed a bit differently from what you might normally be used to
  - "Lecture" will be focused around YOU
  - What YOU understand
- So, lecture will be different
  - Ever thought about why we have "lecture"?

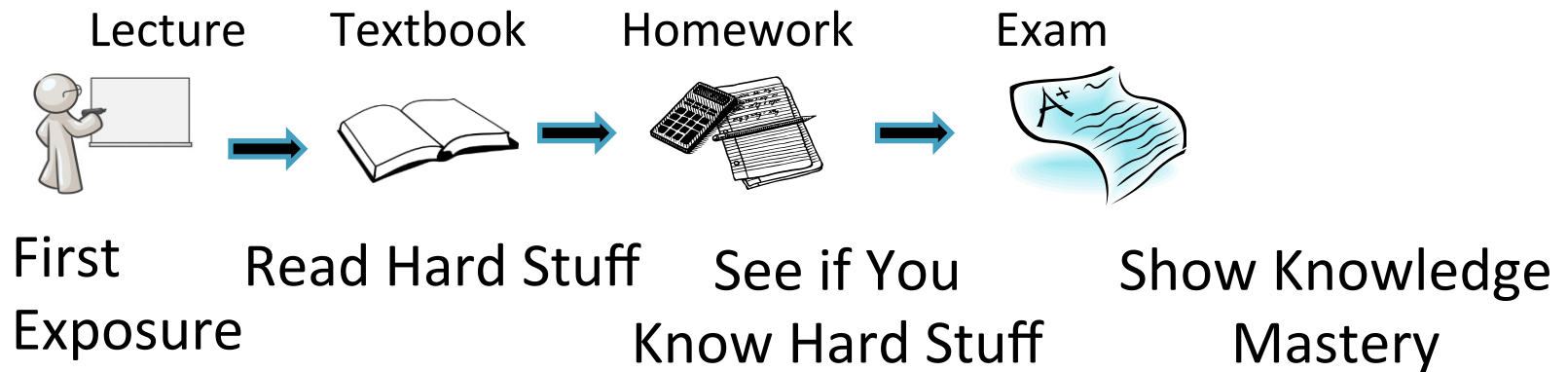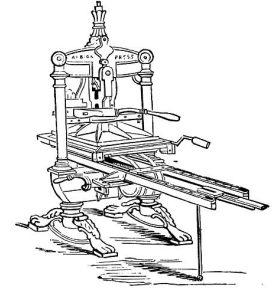# Why do we have lecture?
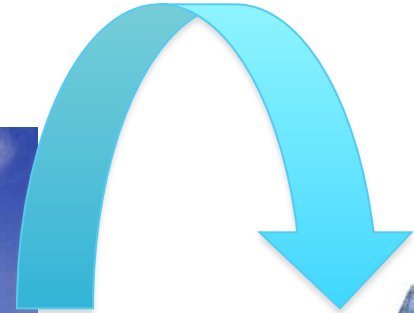
Why do we have lecture?

Why do we have lecture?

GREAT Innovations:
The printing press, The web
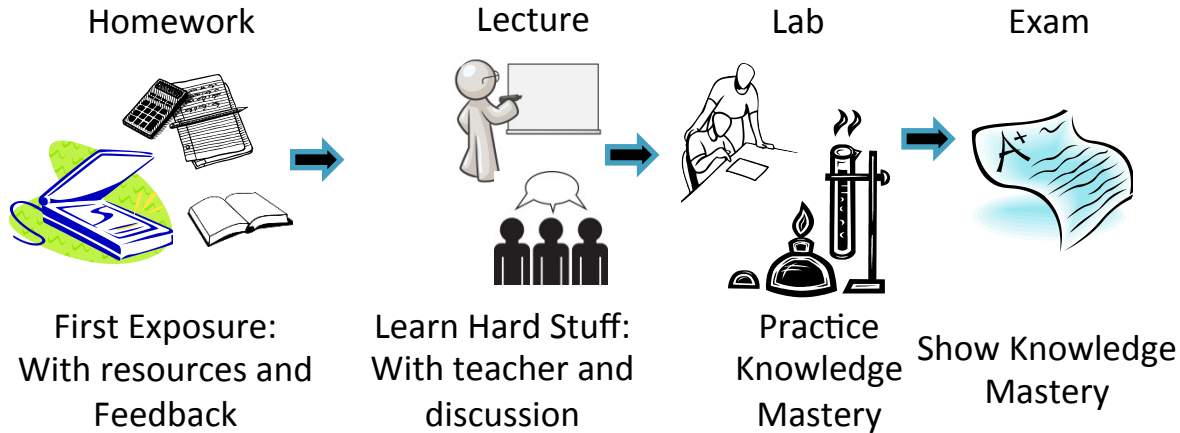
- You don't have to trust the monk!
  - Read it and analyze for YOURSELF!
  - If I rephrase it for you, what purpose does that serve?
- Traditional class structures often look like:

Lecture	Textbook	Homework	Exam
First Exposure	Read Hard Stuff	See if You Know Hard Stuff	Show Knowledge Mastery

- You get very little opportunity for "expert" feedback

Peer Instruction-Based Design

Homework	Lecture	Lab	Exam
First Exposure: With resources and Feedback	Learn Hard Stuff: With teacher and discussion	Practice Knowledge Mastery	Show Knowledge Mastery

- Greater opportunity for expert feedback!

- Research on how people learn:
  - Everyone constructs their own understanding
    - I can't dump understanding into your brain
  - To learn YOU must actively work with a problem and construct your own understanding of it

Lecture: Peer Instruction

- **Pose carefully designed question**
  - Solo vote: Think for yourself and select answer
  - Discuss: Analyze problem in teams of 3
    - Practice analyzing, talking about challenging concepts
    - Reach consensus
    - If you have questions, raise your hand and I or the TAs will come around
  - Group vote: Everyone in group votes
    - You must all vote the same to get your point
  - Class wide discussion:
    - Led by YOU (students) – tell us what you talked about in discussion that everyone should know!

How to do well in this class

- **Come to class & go to section every week**
- Make a sincere effort to understand the material
- Go online to work on this class each day …
  - Do your pair programming as a pair. Always work together.
  - Make constructive comments about improving this class

More details.

- http://courses.soe.ucsc.edu/courses/cmps10/Fall16/01

- ecommons.ucsc.edu

- piazza.com

- Labs - Location: Ming Ong (Merrill 103)
  - A: Mondays, 9-10:30am
  - B: Mondays, 3-4:30pm
  - C: Tuesdays, 9-10:30am
  - D: Tuesdays, 3-4:30pm
  - E: Wednesdays, 9-10:30am
  - F: Wednesdays, 4:30-6pm
  - G: Thursdays, 9-10:30am
  - H: Thursdays, 10:30am-12:00pm
  - I: Thursdays, 12-1:30pm
  - J: Fridays, 3:30-5:00pm

A Brief Word About Programming

- Some people panic at the mention of the word *programming* … as if saying it would cause them to become social outcasts, nerdy, …

- Programming is actually fun, and creative!
  - You get immediate feedback if what you are doing is working
  - Programming is solving a puzzle, have to stick to it

- Programming's a career; it takes years to learn

- We teach some programming in this class as part of teaching computational thinking
  - You wont be a programmer at the end
  - You will, I hope, think differently as a result

A Brief Word About Programming

- This is NOT a programming class. If you just want to learn to program, take CMPS 5J or 5P or 12A or CMPE 13.

- You will get just enough exposure to programming to have a better understanding of what a program is and what it means to write a program.

Announcements

- Please note that we are no longer receiving Accommodation Authorization forms from the DRC.
- **DRC students must bring form to me, to turn in to the Faculty Services desk.**
- To DO: Familiarize yourself with the class Web page at cmps010-fall16-01.courses.soe.ucsc.edu
- Know
    - The location of announcements, assignments, etc.
    - Look at the syllabus for the whole quarter, midterm etc
    - The Academic Conduct guideline

FIRST HOMEWORK: CODE.ORG

Okay that's it!

- Do your homework
- Come to class on Monday prepared to talk about your experiences with code.org and Blown to Bits, Chapter 1!