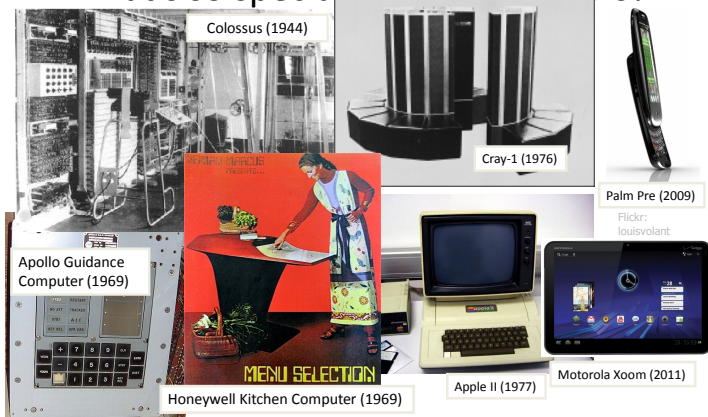Class 1: Introduction

cs1120 Fall 2011
24 August 2011
David Evans

What is Computer Science?

What's so special about computers?

Colossus (1944)

Cray-1 (1976)

Palm Pre (2009)
Flickr: louisvolant

Apollo Guidance Computer (1969)

MENU SELECTION

Honeywell Kitchen Computer (1969)

Apple II (1977)

Motorola Xoom (2011)

Toaster Science?

Let *AB* and *CD* be the two given numbers not relatively prime. It is required to find the greatest common measure of *AB* and *CD*.

If now *CD* measures *AB*, since it also measures itself, then *CD* is a common measure of *CD* and *AB*. And it is manifest that it is also the greatest, for no greater number than *CD* measures *CD*.

Euclid's Elements, Book VII, Proposition 2 (300BC)

The note on the *inflected* line is only difficult to you, *because it is so easy.* There is in fact nothing in it, but you think there must be some grand mystery hidden under that word *inflected*!

Whenever from any point *without* a given line, you draw a long to any point *in the given line*, you have *inflected* a line *upon a given line.*

Ada Byron (age 19), letter to Annabella Acheson (explaining Euclid), 1834

What is the difference between Euclid and Ada?

"It depends on what your definition of 'is' is." (Bill Clinton)

Geometry vs. Computer Science

Geometry (mathematics) is about *declarative* knowledge: "what is"

> If now *CD* measures *AB*, since it also measures itself, then *CD* **is** a common measure of *CD* and *AB*

Computer Science is about *imperative* knowledge: "how to"

Computer Science

"**How to**" knowledge:

Ways of ***describing*** information processes (computations)

Ways of ***predicting*** properties of information processes

Ways of ***executing*** information processes

Language

Logic

Machines

Outline

Science?

Real Science is about **understanding nature through observation**

> About *real* things like bowling balls, black holes, antimatter, electrons, comets, etc.

Math and Computer Science are about *fake* things like numbers, graphs, functions, lists, etc.

> Computer Science is a useful tool for *doing* real science, but not a real science

Science

Better view: there is lots of interesting computation in nature and we need computer science to understand it.
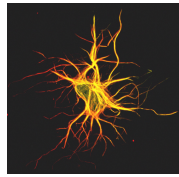
Science

Better view: there is lots of interesting computation in nature and we need computer science to understand it.

Plant Growth (ps3)

Evolution is an information process

How do brains compute?

Engineering?

"Engineering is **design under constraint**... Engineering is synthetic - it strives to create what can be, but it is constrained by nature, by cost, by concerns of safety, reliability, environmental impact, manufacturability, maintainability and many other such 'ilities.' ..."

William Wulf and George Fisher
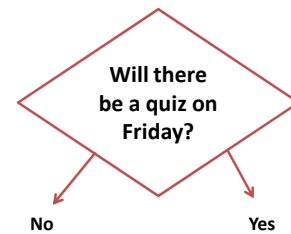
Apollo Guidance Computer, 1969

1 Cubic Foot

Why did they need to fit the guidance computer in the rocket?

Measuring Computers

bit = smallest unit of information

If we start with 2 possible choices, and get one bit of information, we can eliminate one of the choices.

Will there be a quiz on Friday?

No   Yes

How much power?

Apollo Computer: 61440 bits of changeable memory
Machines today have (at least) 1 GB (RAM)

1 Gigabyte = 1024 Megabytes,
  1 Megabyte = 1024 Kilobytes,
   1 Kilobyte = 1024 Bytes,
    1 Byte = 8 bits

> (* 1024 1024 1024 8)

You will understand this notation soon...but don't worry if you don't now

8589934592   ~ 8.6 Billion bits

> (round (/ (* 1024 1024 1024 8) 61440))

139810   You have 139 810 times more power than AGC

If Apollo Guidance Computer power is 1 inch, you have 2.2 miles!

Computing Power 1969-2011
(in Apollo Control Computer Units)

43 years: should have doubled 27+ times
2^{27} > 200 million
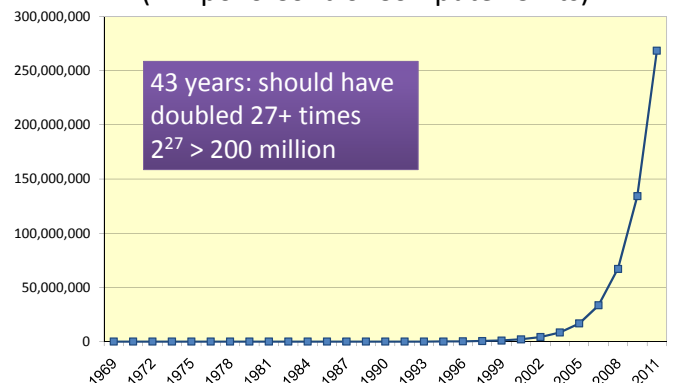
Constraints Computer Scientists Face

Not like those for engineers (weight, physics, etc.)

 If 4 Million times what NASA had in 1969 isn't enough for you, wait until 2014 and you will have 8 Million times…

More like those for Musicians and Poets:

 Imagination and **Creativity**

 Complexity of what we can understand

Is there anything else that has improved like (or faster than?) computing power in your lifetime? (post your answers/guesses as comments on the blog)

So, what is computer science?

Science

not about Real things

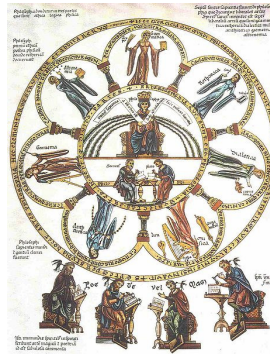Engineering

no real constraints

Liberal Art
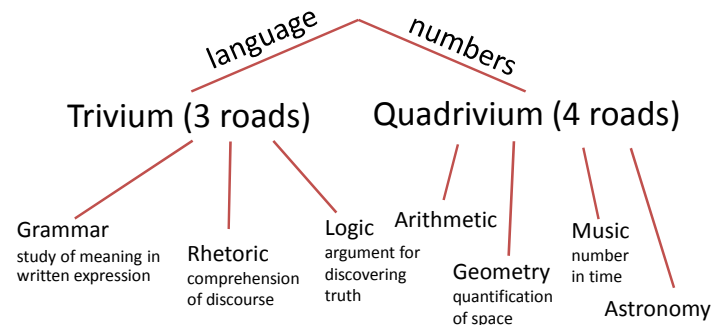

Liberal Arts: ~1100

Illiberal Arts

 arts for the non-free: pursued for economic reasons

Liberal Arts

 arts for the *free*: pursued for intrinsic reasons

The Liberal Arts

language   numbers

Trivium (3 roads)   Quadrivium (4 roads)

Grammar
study of meaning in written expression

Rhetoric
comprehension of discourse

Logic
argument for discovering truth

Arithmetic

Geometry
quantification of space

Music
number in time

Astronomy

Yes, we will see all of these in this class!

Outline

What is Computer Science

Science, Engineering, Other?

 Introduction to Information

About the Course

First main theme: Recursive Definitions

A Course for Everyone!

CLAS, SEAS, Commerce, Arch, etc.

Pre-College, 1st, 2nd, 3rd, 4th, 5th Years, Community Scholars, University Professors

No computing background expected…but challenging even for students with lots of previous programming experience

(Future) Computer Science majors…but worthwhile even if you don't take another CS course

Help Available

Me: **David Evans** (Call me "Dave" or "Coach")

Office: Olsson 236A

Tomorrow (Thursday): **4-5:30pm Office "Packing" Hours**

Regular office hours will be scheduled after (most of) you submit: http://www.whenisgood.net/cs1120

Post questions on the **course blog**

Personal questions email, if I don't reply in 24 hours send again and complain
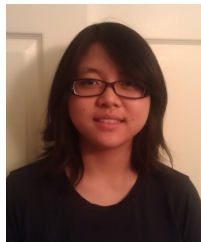
Assistant coaches (next slide and Friday)
Your classmates (read the **course pledge** carefully!)

Office after Friday at 9am:
Rice Hall 507

First Help Hours

Tomorrow (Thursday),
Thorton Stacks, 4:30-6:30pm
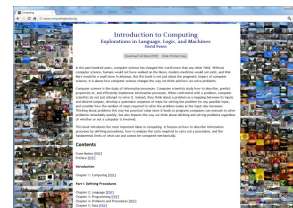

Jiamin Chen
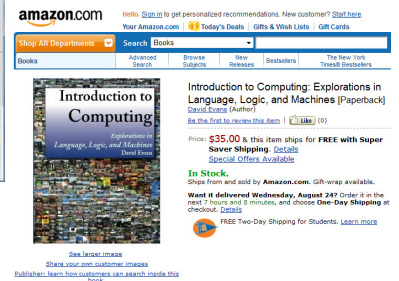
Jonathan Burket

Course Book

www.computingbook.org

Available free on-line, but **print for reading!**

Subject: CS 1120
From: Textbook <textbook@virginia.edu>
To: <dee2b@Virginia.EDU>

Dear Professor Evans,

I have just spoken to Createspace. The textbook title '**INTRODUCTION TO COMPUTING ' is not released for distribution. We are unable to purchase this title. The author has the same name. Are you him? Can you please let us know what we can do so we can obtain the materials needed for your class? Let us know if there are any questions that you may have.

Thank you
Cindy Garwood
Textbook Department
Univeristy of Virginia Bookst
434-924-4253

Subject: Re: CS 1120
From: David Evans <evans@virginia.edu>
To: Textbook <textbook@virginia.edu>

Hi Cindy,

Yes, I am the author. Apparently, I need to increase the list price for you to be able to be able to buy it through your channels. (And they wonder why textbooks are overpriced!) I will do this temporarily, but let me know when you've finished, so I can reduce it again.

Thanks,

--- Dave

Subject: Re: CS 1120
From: Textbook <textbook@virginia.edu>
To: David Evans <evans@virginia.edu>

Dear Professor Evans,

I will be going online in just a couple of minutes. **Have you increased the price so we may purchase it for your students?**

Thank you
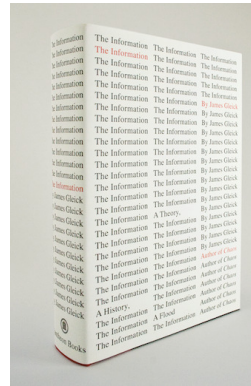Cindy

In return for a free book…

Feedback
- Things that are hard to understand
- Parts that are boring to read
- Any mistakes (including simple writing errors, but especially any technical errors)

Solutions to exercises

Shameless publicity: Amazon reviews, HackerNews posts, etc.

Reading Book

James Gleick,
The Information: A History, a Theory, a Flood
(March 2011)

Non-technical, required reading

Course Website/Blog

http://www.cs.virginia.edu/cs1120

Everything goes on the web, visit it often or subscribe to RSS feeds

Register to submit comments (or post anonymously)

If you send me a question that should be posted on the blog by email, my response will be to asked you to post it on the blog and I'll answer it there.

First main theme:
Recursive Definitions

What's the l o n g e s t word in the English language?

Longest Words?

honorificabilitudinitatibus (27 letters, longest by Shakespeare)
    With honor.
antidisestablishmentarianism (28 letters)
    Movement against division of church and state.
hippopotomonstrosesquipedaliophobia (35 letters)
    Fear of long words.
pneumonoultramicroscopicsilicovolcanoconiosis (45 letters)
    (longest word in most dictionaries)
    Lung disease contracted from volcanic particles.

Like all words, these words are "made up".

Making Longer Words

*anti*hippopotomonstrosesquipedaliophobia
Against the fear of long words.

*antianti*hippopotomonstrosesquipedaliophobia

Against a thing against the fear of long words.

Language is *Recursive*

No matter what word you think is the longest word, I can always make up a longer one!

word ::= **anti-***word*

By itself, this definition of *word* is **circular**.

Zero, One, Infinity

word ::= **anti-***word*   This rule can make **0** words.

word ::= **hippopotomonstrosesquipedaliophobia**
This rule can make **1** word.

word ::= **anti-***word*

word ::= **hippopotomonstrosesquipedaliophobia**

These two rules can make **infinitely** many words, enough to express all ideas in the universe!

Recursive Definitions

We can define things in terms of themselves
Recursive definitions are not circular:
they eventually end with something real

word ::= **anti-***word*
word ::= **hippopotomonstrosesquipedaliophobia**

Recursive Definitions

Allow us to express infinitely many things starting with a few.

This is really powerful!

We will see **lots** of examples in this course.

Charge

Tomorrow
4-5:30pm, Office "Packing" Hours
Olsson 236A (pick up course book)
4:30-6:30pm, Assistant Coaches - Thorton Stacks
Jonathan Burket, Jiamin Chen
Before Friday's class:
Read and sign course pledge
Read Course Book Chapters 1 and 2

Before 5:59pm Sunday: submit PS0 (getting started with Racket, Course Registration)