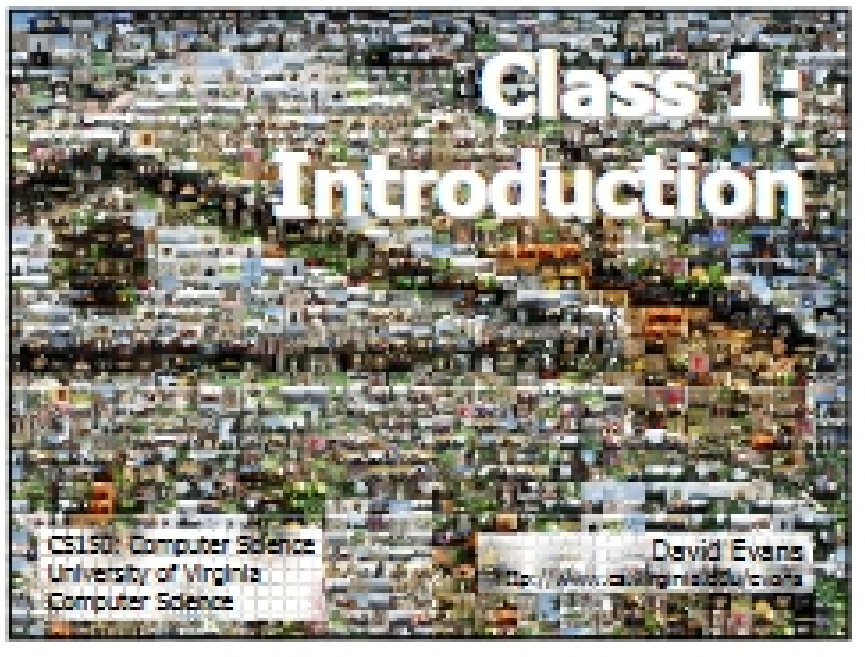


What is
Computer Science?

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 Gates (at Microsoft's anti-trust trial)

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 has little to do with beige (or translucent blue) boxes called "computers" and is not a real science.

Computer Science

"How to" knowledge:

- Ways of describing information processes (computations)

  Language

- Ways of predicting properties of information processes

  Logic

What kinds of things do we want to predict?

Science, Engineering, Other?

Science?

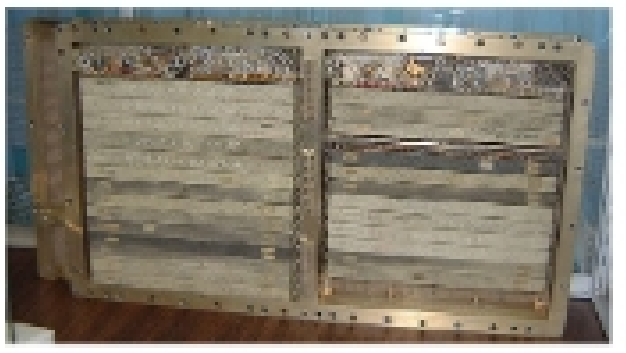
- Understanding Nature through Observation
  - About *real* things like bowling balls, black holes, antimatter, electrons, comets, etc.
- Math and Computer Science are about *fake* things like numbers, graphs, functions, lists, etc.
  - Computer Science is a useful tool for *doing* real science, but not a real science

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

Apollo Guidance Computer, 1969



1 Cubic Foot

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

Measuring Computers

- 1 bit = smallest unit of information
  - True or False
  - 0 or 1
  - If we start with 2 possible choices, and get 1 bit, we can eliminate one of the choices

How much power?

- Apollo Computer: 30720 bits of changeable memory
- Lab machines have 512 MB (RAM)
  - 1 Megabyte = 1024 Kilobytes, 1 Kilobyte = 1024 Bytes, 1 Byte = 8 bits
  - 512 MB

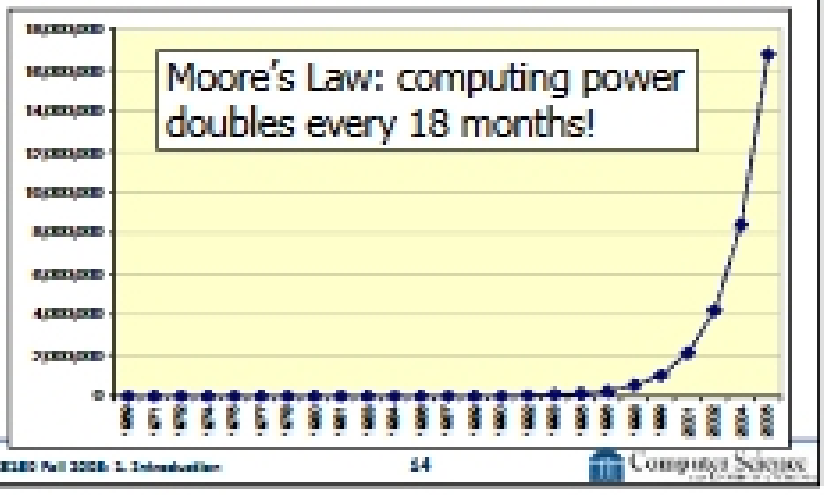
You will understand this notation soon...but don't worry if you don't now

```
> (* 512 1024 1024 8)
4294967296          ~ 4.3 Billion bits
> (round (/ (* 386 1024 1024 8) 30720))
139810
```

You have 105 404 times more power than AGC

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

Computing Power 1969-2005 (in Apollo Control Computer Units)



Constraints Computer Scientists Face

- Not like those for engineers:
  - Cost, weight, physics, etc.
  - If ~8 Million times what people had in 1969 isn't enough for you, wait until 2007 and you will have 20 Million times...
- More like those for Musicians and Poets:
  - Imagination and Creativity
  - Complexity of what we can understand

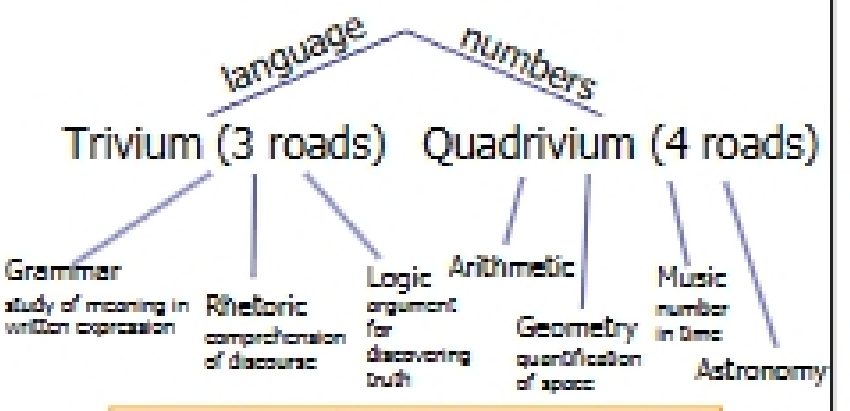
So, what is computer science?

- ~~Science~~
  - No: its about fake things like numbers, not about observing and understanding nature
- ~~Engineering~~
  - No: we don't have to deal with engineering-type 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



We will see all of these in this class!