CS101
"What is computer science?"

Prof. Patrick H. Madden
pmadden@acm.org
www.cs.binghamton.edu/~pmadden

A Bit of History

- Born in Detroit, Michigan
- Grew up in Albuquerque, New Mexico
- Undergrad: New Mexico Institute of Mining and Technology
- Startup company doing ***oil field automation***
- MS: New Mexico Institute of Mining and Technology
- Startup company doing oil field automation, part 2

New Mexico Tech

NEW MEXICO TECH
SCIENCE · ENGINEERING · RESEARCH · UNIVERSITY

Current enrollment: 1800

Socorro population: 9000

A Bit of History

- After going out of business a few times.... PhD at UCLA
  - I got in to UCLA based on research I did while at NMT.
  - The education I got at the super-cheap school was every bit as good as anything at UCLA.

- While at UCLA
  - Part-time work at Activision making games
  - MechWarrior, Muppet Treasure Island, and a really great game that never got released. This payed very well....

Current Stuff

- Teaching CS210, CS333, CS480A at the undergrad level
- Teach CS575 at the grad level
- Chair of ACM/SIGDA -- a professional society for integrated circuit design researchers
- Some research on circuit design. Also some work on protein identification. And I also do a lot of coffee drinking.

And a quick advertisement

- The local ACM chapter is at http://acm.cs.binghamton.edu
- They run local programming contests about once a month, and will be competing in the ICPC on October 18th
- A few years ago, our team went to the world finals (one of about 80 teams from 3500 worldwide).
  - We beat Harvard and Brown on our way there. We beat some good schools too.
  - Our team was flown to the finals by Google (they paid for all the teams). And then they got a trip to Google HQ. And then they all got offers from Microsoft that were too good to turn down. And now two of the three have been lured away -- one to Facebook, one to a Facebook app builder.
- Want to have a successful career? Put in the effort. There's an abundance of people who want to be computer scientists, but a shortage of people who are willing to put in the work required to become great.

What is Computer Science

What is Computer Science

- Remember the Romans?

What is Computer Science

- Remember the Romans?
  - Aquaducts.

What is Computer Science

- Remember the Romans?
  - Aquaducts.
  - Buildings with arches, and some stuff like that.

What is Computer Science

- Remember the Romans?
  - Aquaducts.
  - Buildings with arches, and some stuff like that.
  - Fixed the wheel base of your car.

What is Computer Science

- Remember the Romans?
  - Aquaducts.
  - Buildings with arches, and some stuff like that.
  - Fixed the wheel base of your car.
  - Drinking with lead cups.

What is Computer Science

- Remember the Romans?
  - Aquaducts.
  - Buildings with arches, and some stuff like that.
  - Fixed the wheel base of your car.
  - Drinking with lead cups.
  - And the dumbest thing ever.... their number system...

Roman Numerals

Roman Numerals

- One == I

Roman Numerals

- One == I
- Two == II

Roman Numerals

- One == I
- Two == II
- Three == III

Roman Numerals

- One == I
- Two == II
- Three == III
- Four == IV (?)

Roman Numerals

- One == I
- Two == II
- Three == III
- Four == IV (?)
- 4973 = MMMMCMLXXIII

What is Computer Science?

- One part is knowing good representations for information. The Roman system seems like a practical joke, compared to Arabic (and Hindu) systems.
- CS240 -- a course that revolves around stacks, queues, and ways to represent information. CS210 -- also addresses number representations.

This stuff matters

- Suppose you need to add two numbers together, but you only knew Roman numerals. Seriously painful, right?
- And then try multiplying.
- And then try calculus.
- Good data representations are not necessarily obvious. If you pay attention in the next few years, you'll learn a bunch that are very useful.
  - And note: even if you get a job, how long do you think you could fake it if you didn't understand Arabic numerals?
  - Pay attention to the material. Even if it's dull. Yes, some of it is really really boring. Sorry. It's still worth knowing.
- **Understanding the material matters. GRADES DO NOT.**

The Representation of Data is Changing

- We have a lot more information now
- How it is organized is hugely important
- Google succeeded because they figured out good ways to organize (and search) information

Algorithms

- Methods of doing something
  - Follow a well defined set of steps, to obtain some sort of result
  - There are algorithms for adding numbers, multiplying, and so on (that work because we have a reasonable number system)

Different Algorithms Require Different Amounts of Work

- Suppose we want to paint a stripe down a road.

- Algorithm 1:
  - Dip brush in bucket
  - Walk to unpainted spot
  - Paint
  - Walk back to bucket

- Algorithm 2:
  - Dip brush in bucket
  - Paint
  - Pick up bucket
  - Walk
  - Put bucket down.

What is Computer Science?

- Both of the prior algorithms will get the road painted
- But the second one will require much less effort if there's a lot of road to paint
- This is a topic from CS333...

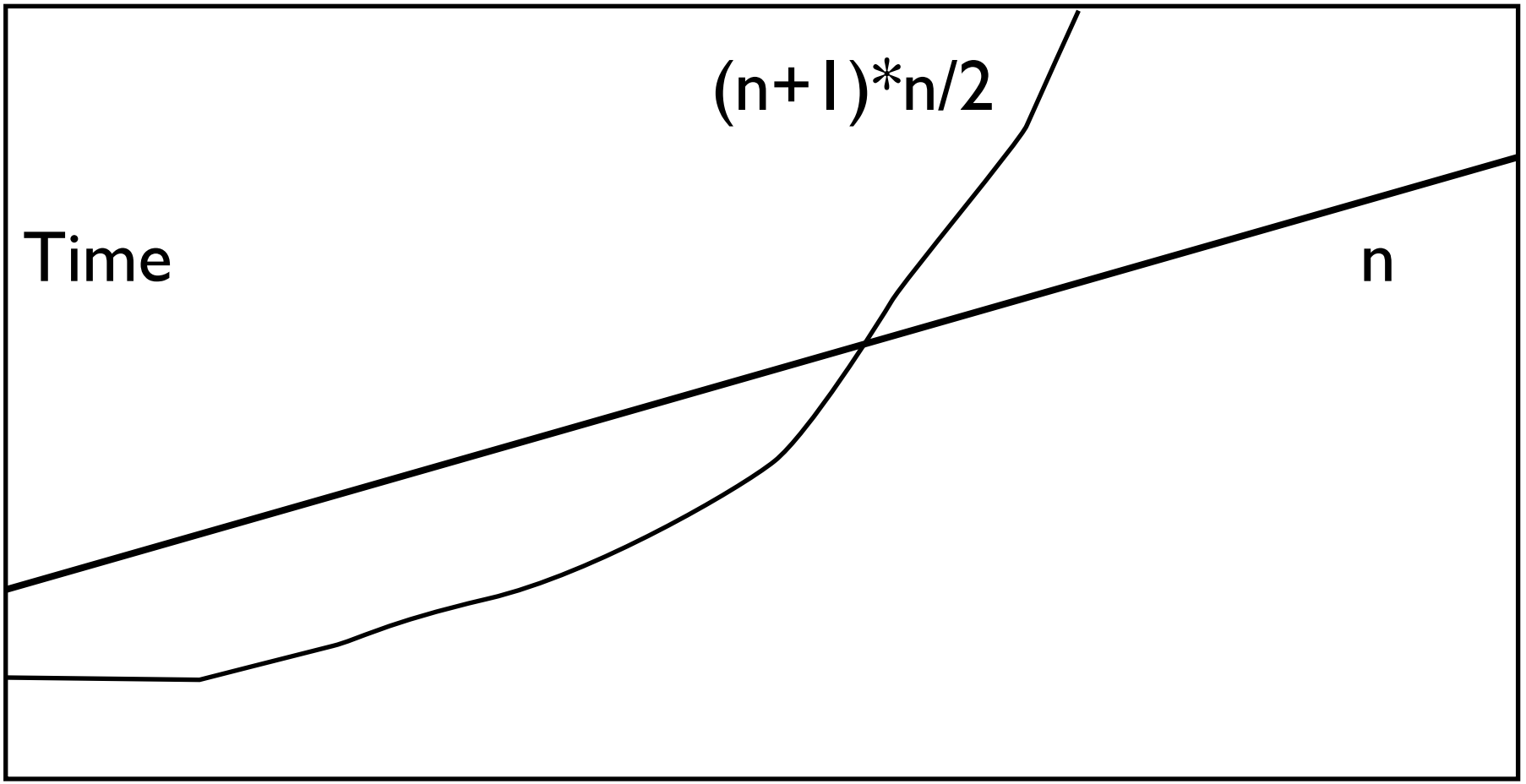
A Little Analysis

- Suppose we just count the walking
  - The first method: 1 step, then 2, then 3, then 4, going back and forth
  - 1 + 2 + 3 + ... n = (n + 1)*(n)/2

A Little Analysis

- We always walk the same direction, so to paint a line n steps long, it takes us n steps

Suppose we have to paint a lot....



An Important Thing

- There may be many ways to solve a problem
  - The amount of work required varies
  - The algorithm you choose has more impact than how fast you do the work
- For big problems, the most efficient algorithm is ALWAYS the best choice

What is Computer Science?

- Not just how you organize information, but also how you manipulate it

- It's not always obvious what the best approach is -- that's what you're supposed to learn here.
- And if you don't learn it, it's kind of hard to hide.

The Right Idea at the Right Time

- It's impossible to guess what will happen in the next few years.
- Think of the founders of Google, Microsoft, Apple, HP, YouTube, Facebook... They had the right set of skills, saw an opportunity, and grabbed it.
- Want to get rich?
  - Have the right skills. No telling what those will be, so be good at everything.

One Skill You Need For Sure

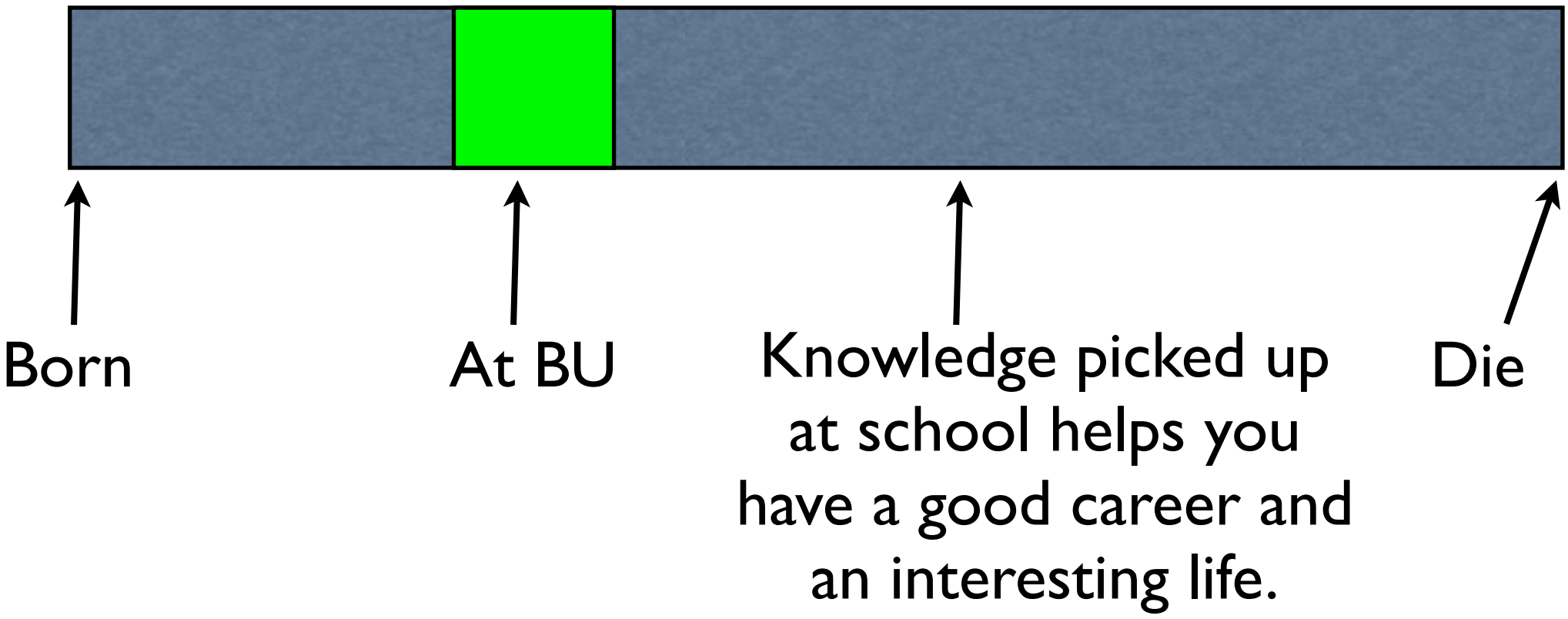
- **Be able to program.** Check out http://www.topcoder.com and http://acm.cs.binghamton.edu.

- The ACM is the largest professional society for computer scientists. Join!
  - Each year, they run a world-wide programming competition (ICPC)

One Other Skill You'll Need For Sure

- Communication. Invest time in this.
- If you can't explain yourself, people will assume you don't know anything. Sorry, that's the way it goes.
- If you can explain yourself well, you will get more opportunities, people will listen.

Time Line


Born
At BU
Knowledge picked up at school helps you have a good career and an interesting life.
Die

Objective while here

- Learn as much as you can about everything that might possibly be useful.
- Learn how to learn things on your own.
- Learn how to figure stuff out on your own.
- Learn to be reliable, resourceful, responsible.

- A side note: the faculty can't learn it for you. You've got to do some of the work.

And those other annoying classes...

- Nearly all of it will be useful at some point. Don't slack off in the other courses.
- There's no way of predicting when or where you will need some bit of knowledge.
- And if you don't have that knowledge, don't worry. Someone else will have it, and take advantage of the opportunity. This leaves you with an enjoyable lifetime of telling yourself "if only..."

Where Do You Want to Be in 10 Years?

- This is a good time to decide if you wish to be good at what you do.
- If not, plan on having a really boring job that doesn't pay well.

What is Computer Science?

- Representing and manipulating information.
- The amount of information available, and the ways it can be used, are rapidly changing. This is a great time to get involved, because there are opportunities.