

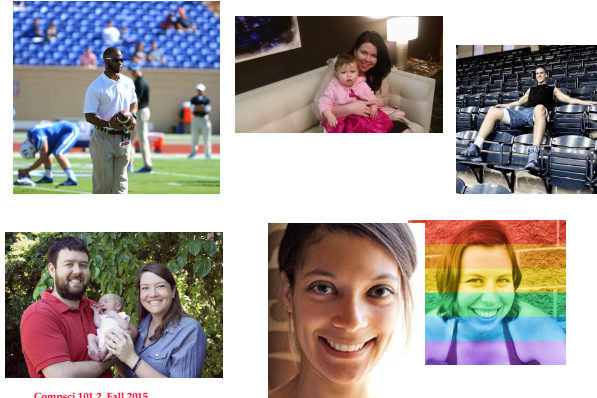
Plan For the Day

- **Discuss Algorithms and Programming at a high level, examples with cooperative/group work**
 - Connect to reading when appropriate
 - Use real-world examples, thinking for now, programming next week
- **Administrivia/details about course**
 - Including Due Dates and course information
- **Vocabulary and Concepts**
 - Again, related to book when possible

Compsci 101.2, Fall 2015

2.1

Who took Compsci 101 (Astrachan)?



Compsci 101.2, Fall 2015

2.2

Algorithm

- **Recipe**
- **Sequence of steps that constitute instructions**
- **Step-by-step procedure for calculations**

What does Nate Silver do?

<http://53eig.ht/1tZy909>



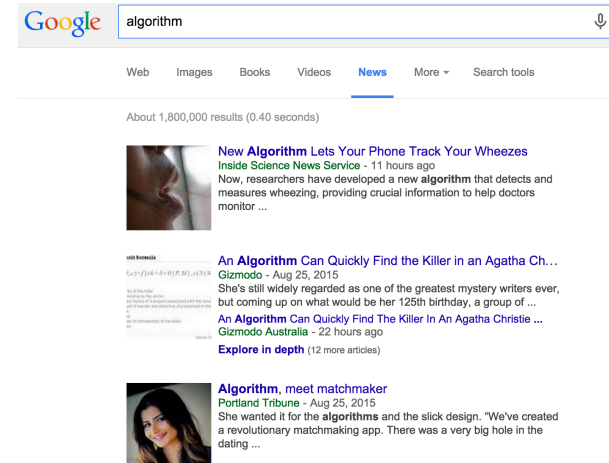
How do Netflix and Amazon know me?

- **Compsci101 project: capable of implementation as a program, but much more basic**

<http://moreintelligentlife.com/content/features/anonymous/slaves-algorithm>

Compsci 101.2, Fall 2015

2.3



Google algorithm

Web Images Books Videos News More Search tools

About 1,800,000 results (0.40 seconds)

New Algorithm Lets Your Phone Track Your Wheezes
Inside Science News Service - 11 hours ago
Now, researchers have developed a new **algorithm** that detects and measures wheezing, providing crucial information to help doctors monitor ...

An Algorithm Can Quickly Find the Killer in an Agatha Ch...
Gizmodo - Aug 25, 2015
She's still widely regarded as one of the greatest mystery writers ever, but coming up on what would be her 125th birthday, a group of ...

An Algorithm Can Quickly Find The Killer In An Agatha Christie ...
Gizmodo Australia - 22 hours ago
[Explore in depth](#) (12 more articles)

Algorithm, meet matchmaker
Portland Tribune - Aug 25, 2015
She wanted it for the **algorithms** and the slick design. "We've created a revolutionary matchmaking app. There was a very big hole in the dating ...

Compsci 101.2, Fall 2015

2.4

What is Computer Science?

- You each/all answered this in last class
 - How is this connected to algorithms? Ask Wikipedia: "An alternate, more succinct definition of computer science is the study of automating algorithmic processes that scale."



Duke Connection: Fred Brooks '53

- What Would FB Say?
"The most important single decision I ever made was to change the IBM 360 series from a 6-bit byte to an 8-bit byte, thereby enabling the use of lowercase letters. That change propagated everywhere."



- "Fred Brooks" by Copyright owned by SD&M (www.sdm.de) - Request for picture sent by email to Fred Brooks by uploader (Mark Pellegrini; user:Raul654) Fred sent this photo back, along with contact information for Carola Lauber at SD&M, who gave copyright permission.. Licensed under CC BY-SA 3.0 via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Fred_Brooks.jpg#/media/File:Fred_Brooks.jpg

Why is programming fun? Fred Brooks

- First is the sheer joy of making things
- Second is the pleasure of making things that are useful
- Third is the fascination of fashioning complex puzzle-like objects of interlocking moving parts
- Fourth is the joy of always learning
- Finally, there is the delight of working in such a tractable medium. The programmer, like the poet, works only slightly removed from pure thought-stuff.



Developing an Algorithm

- <http://www.youtube.com/watch?v=AEBbsZK39es>



\$193, \$540, \$820, \$700, \$749. Are these reasonable? Why?

I'm thinking of a number ...

- You guess. I'll tell you *high, low, or correct*
 - Goal: guess quickly, minimal number of guesses
 - Number between 1 and 100...
 - Number between 1 and 1000...
- Can you describe an algorithm, instructions, that would allow someone to use your instructions to play this game correctly. Start with 1 and 100, but ideally your instructions work with 1 and N

<http://bit.ly/101fall15-827-1>

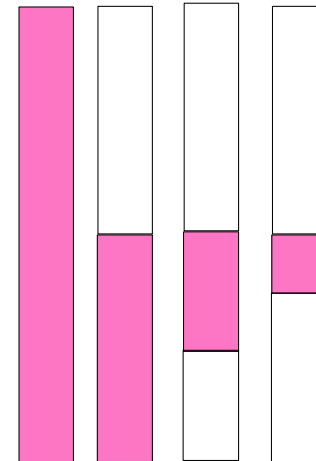
Guess a Number Algorithm

<http://bit.ly/101fall15-827-1>

Analyzing the *binary search* algorithm

- Is the algorithm correct?
 - Try it, again, and again and ...
 - Reason about it: logically, informally, ...
- How efficient is the algorithm?
 - How many guesses will it take (roughly, exactly)
 - Should we care about efficiency?
- When do we really care about efficiency?
 - Examples?

1. Anderson
2. Applegate
3. Bethune
4. Brooks
5. Carter
6. Douglas
7. Edwards
8. Franklin
9. Griffin
10. Holhouser
11. Jefferson
12. Klatchy
13. Morgan
14. Munson
15. Narten
16. Oliver
17. Parker
18. Rivers
19. Roberts
20. Stevenson
21. Thomas
22. Wilson
23. Woodrow
24. Yarbrow



Find Narten

Looking for a Needle in a Haystack

- If a computer can examine 10 million names/numbers a second, suppose the list isn't sorted, or I say "yes/no", not "high/low"
 - How long to search a list of 10 million?
 - How long to search a list of a billion?
 - 14 billion pixels in a 2 hour blu-ray movie
- What about using binary search? How many guesses for 1000, 10^6 , 10^9 , 10^{12}
 - One of the things to remember: $2^{10} = 1024$

Administrivia for Compsci 101

- Lab 1 this week, complete by Sunday
 - Install software used in the course, test it
- Reading Quizzes: RQ01 was due today, next quiz, RQ02, due Tuesday
- Assignment one going out today, due in one week (doesn't use Python/Eclipse)

- Keep up with Piazza and Sakai, also course website linked-to from Sakai

How to succeed in Compsci 101

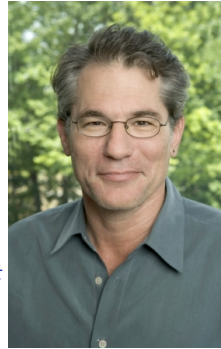
- Start assignments early, they'll take longer than you think they will
- Read the book, but we'll cover the material in class, so ...
- Collaborate well, but be sure you can do work on your own!
- Be curious, work hard at beginning, think carefully, visit Prof. Rodger or Prof. Astrachan

Algorithms that scale: another example

- Human Genome Project
 - Multiple approaches, relying heavily on computational power and algorithms
 - Combine reads of DNA sequences, we'll look at an illustrative example
- These combine bio/chemistry techniques with computational techniques to recreate the sequencing, e.g., CGATTCGG... from "live data", actual DNA.

Eugene (Gene) Myers

- Lead computer scientist/ software engineer at Celera Genomics, then at Berkeley, now at Janelia Farms Research Institute (HHMI)



"What really astounds me is the architecture of life. The system is extremely complex. It's like it was designed." ... "There's a huge intelligence there."

- BLAST and WG-Shotgun

Whole Genome Shotgun with words

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- **Creation algorithm**
 - Take a phrase
 - Replicate it four times
 - Chop into "chunks"
 - 15-22 characters
- **How to recreate original phrase?**

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<http://bit.ly/101fall15-827-2>

From Algorithms to Code

- An algorithm that scales needs to run on a computer --- programming to the rescue!
- Extensive libraries help with programming
 - Brain or Neuroscience
 - Engineering and Mathematics
 - Genomics
 - Graphic User Interfaces, ...
- We are using Python, extensible and simple

Understanding terminology: code

- Move from "Hello World" to "Hello Around the World"
 - Look at Python, code, libraries
 - Learning (reviewing) terminology about Python

```
print "hello world"
```

```
f = open("hello_unicode.txt")
for line in f:
    print line)
```

Getting ready to code in Python

- You need a programming environment
 - Eclipse, PyDev, Python, Ambient
 - Open source or free for academics
- You need a computer with an operating system
 - Installing the suite of tools can be cumbersome
 - Persist, Perservere, Get Help, start over ☹
- Getting used to the environment can take time
 - Once you've got it, second nature!
 - Easy to reuse with a new language

Running and Understanding Code

- Need Python compiler/interpreter
 - We're using Canopy, includes libraries
- Need an editor development environment
 - We use Eclipse and PyDev, open source and widely used, Ambient is Duke Plugin
- You need experience thinking and coding and debugging ideas and code:
 - Installing the suite of tools can be cumbersome
 - Persist, Perservere, Get Help, start over ☹

Code Dissection

- Every line thought about, occasionally understood at different levels
 - Use your understanding of natural language and experience, apply to Python
 - Run program and apply knowledge to each of the other lines

```
f = open("hello_unicode.txt")
```

```
for line in f:
    print line
```

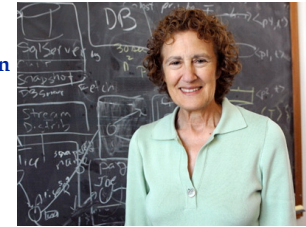
Questions about Python Code

- **Every line thought about, occasionally understood**
 - What about when you make changes to the program?
Answer these questions about possible errors introduced when making changes

<http://bit.ly/101fall15-827-3>

Barbara Liskov

- (one of) first women to earn PhD from compsci dept
 - Stanford 1968
- Turing award in 2008
 - OO, SE, PL



“It's much better to go for the thing that's exciting. But the question of how you know what's worth working on and what's not separates someone who's going to be really good at research and someone who's not. There's no prescription. It comes from your own intuition and judgment.”