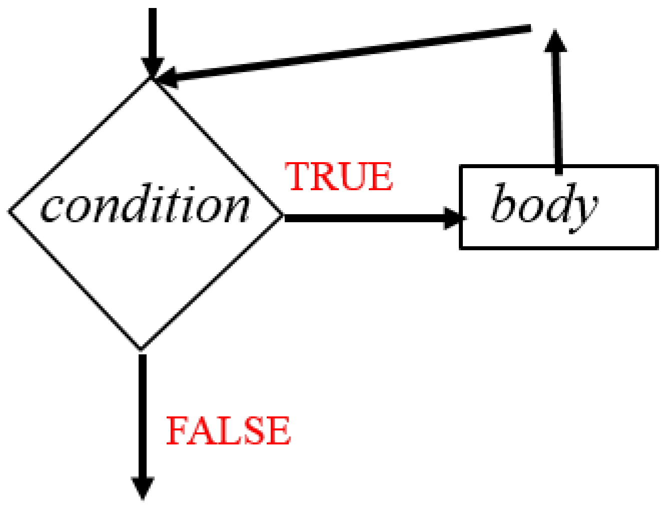
CompSci 101
Introduction to Computer Science



Sept 28, 2017

Prof. Rodger

Announcements

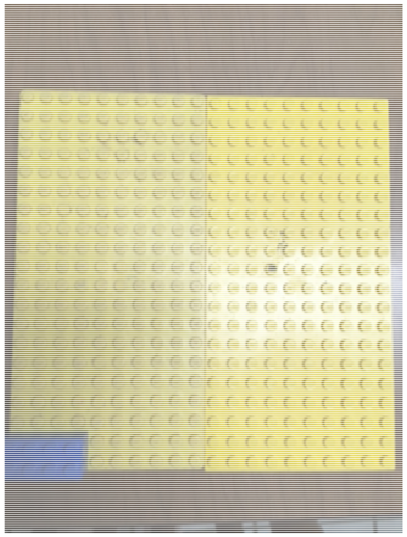
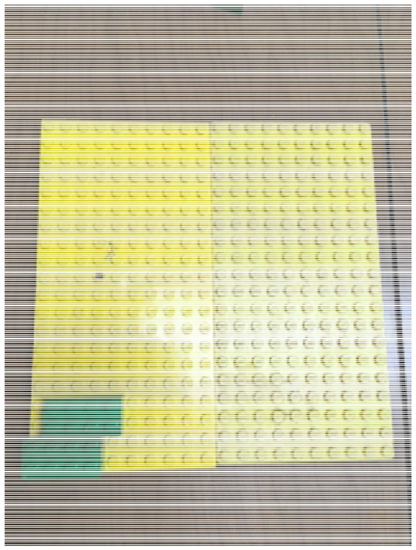
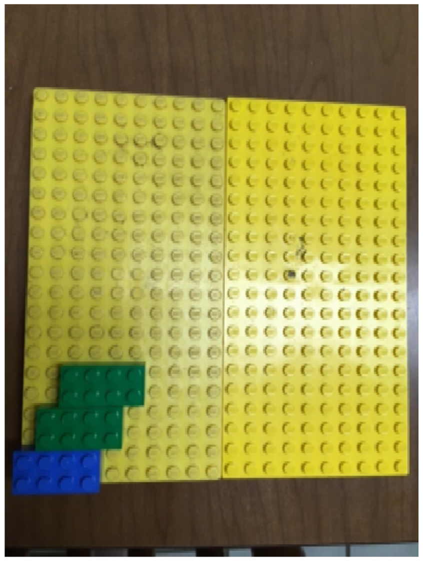
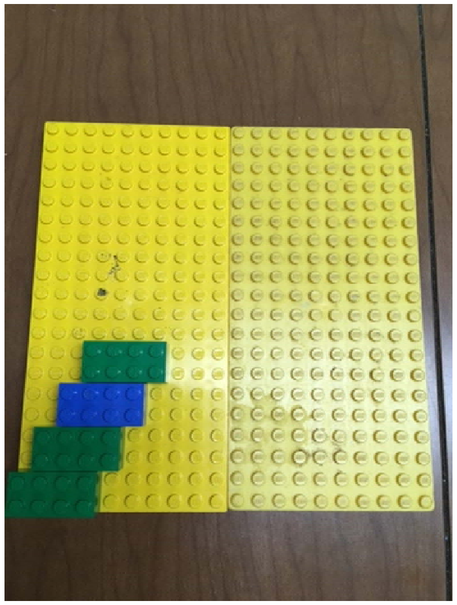
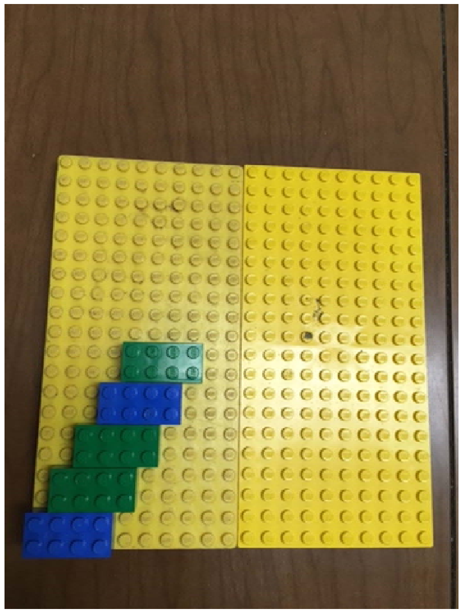
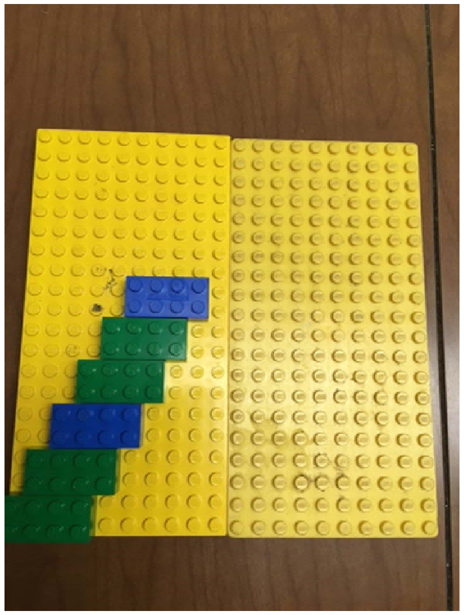
- Exam 1 is Thursday, Oct 5
- RQ Reviews available today – not for credit
- Practice exams on today's date
  - Work them **on paper** before Tuesday
- Assignment 4 due Tuesday, try for Monday!
- No Lab next 2 weeks

- Today:
  - Loops – While, While True
  - Problem Solving

Lab 5 – First part

- Practicing the first four steps of the 7 steps for problem solving
- Find the pattern, what is next, then generalize

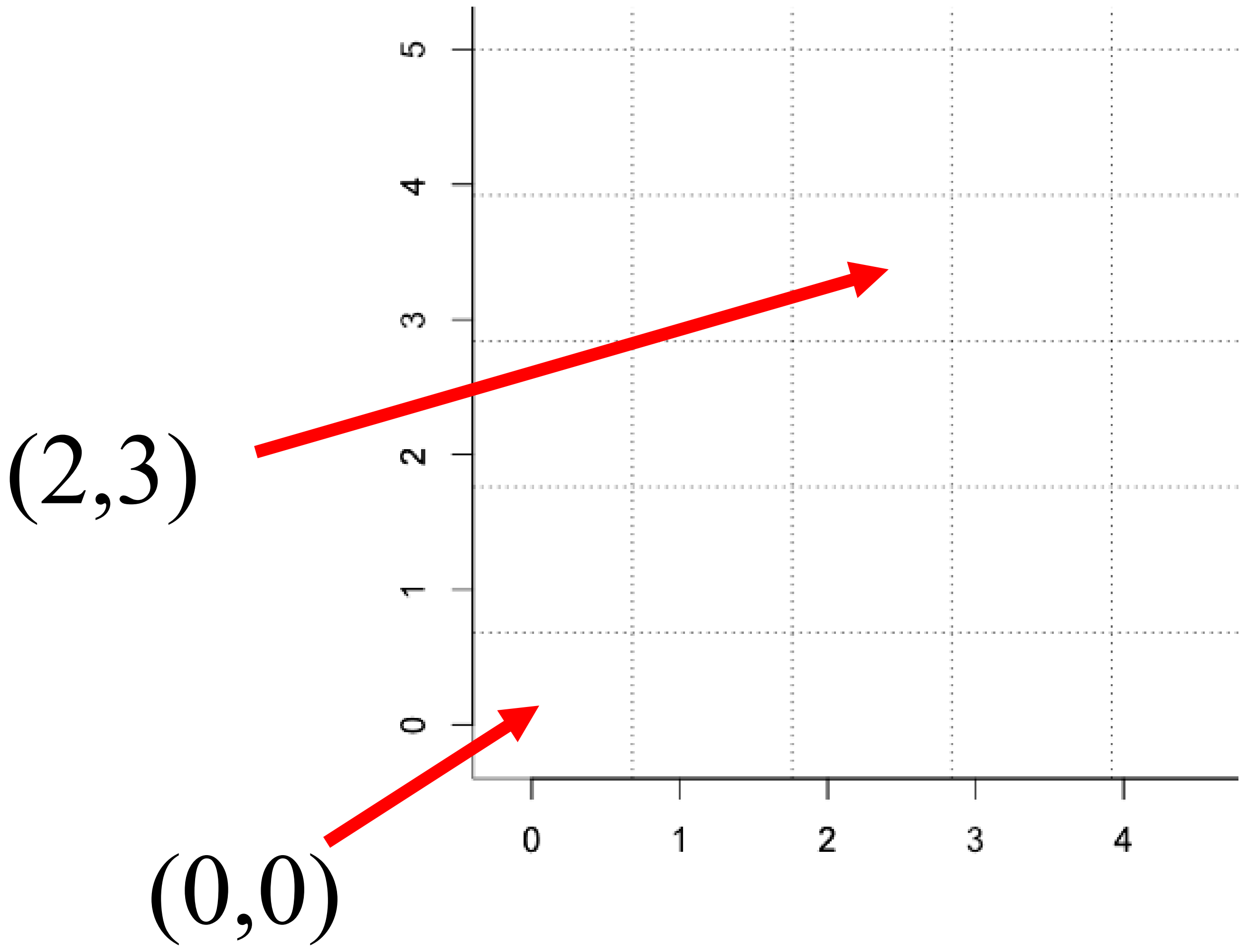
Pattern 1

Notice things about the pattern

- You want to place N legos
- If N is odd – Start with a green
  - First blue is third lego
- If N is even – start with a blue
- Every third lego is blue

Bottom Left is (0,0)



Try it N=8

Num	Location	Lego color
1	(0,0)	blue
2	(1,2)	green
3	(2,4)	green
4	(3,5)	blue
5	(4, 6)	green
6	(5, 8)	green
7	(6, 10)	blue
8	(7, 12)	green

Algorithm for placing N legos

- Legos placed long way with bottom left at location, explain the grid
- For num from 1 to N
  - Location is ((num-1), (num-1)*2)
  - If N is even
    - If num is divisible by 3
      - Place blue lego at location
    - Else
      - Place green lego at location
  - If N is odd
    - …

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

bit.ly/101f17-0928-1

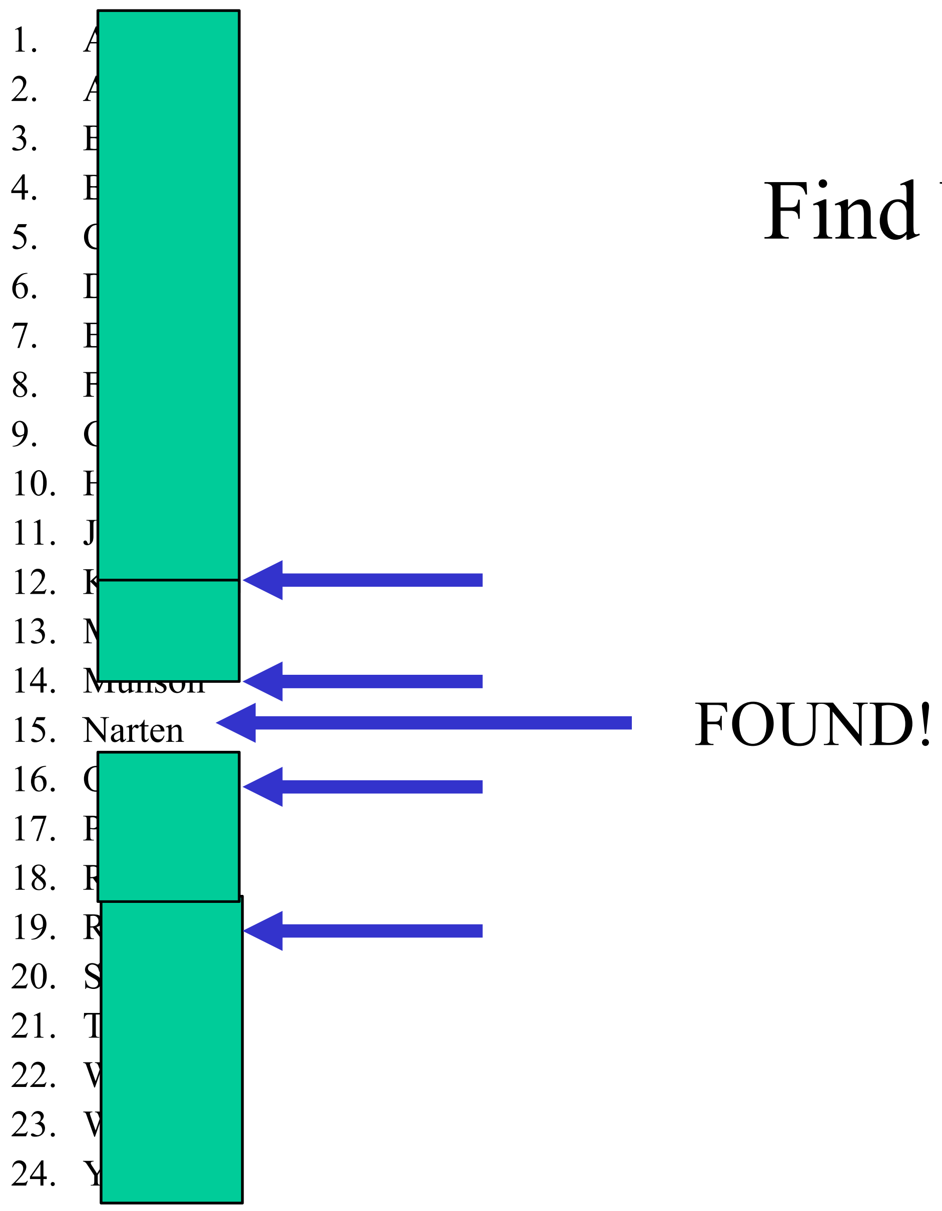
Analyzing the *binary search* algorithm

- 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?

Find Narten

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


1. A
2. A
3. B
4. B
5. C
6. D
7. E
8. F
9. G
10. H
11. J
12. K
13. M
14. Munson
15. Narten
16. O
17. P
18. R
19. R
20. S
21. T
22. W
23. W
24. Y
FOUND!

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: $2^{10} = 1024$

Review - Searching for words

- If we had a million words in alphabetical order, how many would we need to look at worst case to find a word?

Review - Searching for words

- If we had a million words in alphabetical order, how many would we need to look at worst case to find a word?

- 20 words!

If you are clever, cut the number of numbers to look at in half, over and over again

1,000,000	976.56
500,000	488
250,000	244
125,000	122
62,500	61
31,250	30
15,625	15
7812.5	7.5
3906	3.75
1953	1.875

Prime Numbers

- An integer > 1 is prime if it has no positive divisors other than 1 and itself.
- 12 is not prime!
  - 12 is divisible by 2, 3, 4, 6
  - 3*4 = 12, 2*6 = 12
- Prime numbers: 2, 3, 5, 7, 11, 13, 17, 19, 23
- Is 8315411 prime?

Is number a Prime number? Bit.ly/101f17-0928-2

```
def isPrime(number):
    if number < 2:     # must be greater than 1
        return False
    if number < 4:      # 2 and 3 are prime
        return True
    for n in range(4,number):
        if number/n * n == number:
            return False
    return True
```

Write Helper functions to help solve problems!!!!

- Find all the primes between 10 and 100
  - Use isPrime as a helper function
- Assignment 4 helper functions
  - **isVowel(letter)** – return true if letter is a vowel
  - **NoVowels(word)** – return True if no vowels in word
  - Automatic Decrypt, what helper function?

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- Assignment 4 helper functions
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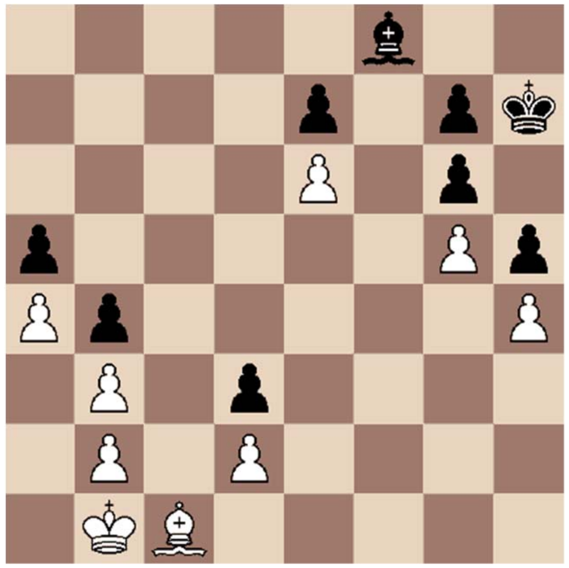
  - Automatic Decrypt, what helper function?
    - **countWords(wordlist, shift, phrase)**
    - Decrypt with shift, then count how many words in phrase are in wordlist

Undetermined Repetition

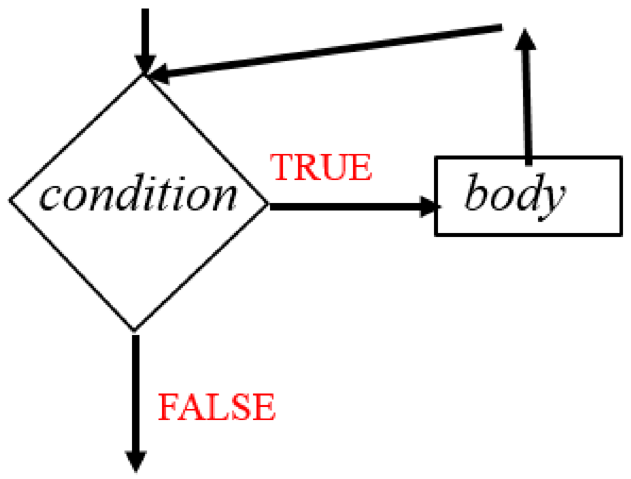
- Game of chess, when does it end?
- What is the 100th prime number?
- Guessing a number from 1 to 100?



While loops

- Repetition when you stop a loop based on a condition
- while CONDITION:

  BODY



  - As long as condition is true, keep executing loop.
  - Must have an update in the body to get closer to condition being false

Example for while

- Playing chess

```
while (game not over)
    make a move in the game
    (game must get closer to ending)
```

Example2 for while

- What is the 100th prime number?

```
number = 2
while (not 100th prime)
    is number prime?
        update count
    generate next number to check
    (program must get closer to ending)
```

Example3 - Factorial

- 5! = 5 * 4 * 3 * 2 * 1 = 120
- 3! = 3 * 2 * 1 = 6

Example with while loop

```python
def factorial(num):
    result = 1
    while num > 0:
        result = result * num
        num = num - 1
    return result

for n in range(8):
    print n, factorial(n)
```

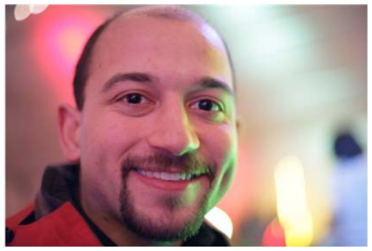
Mystery While example

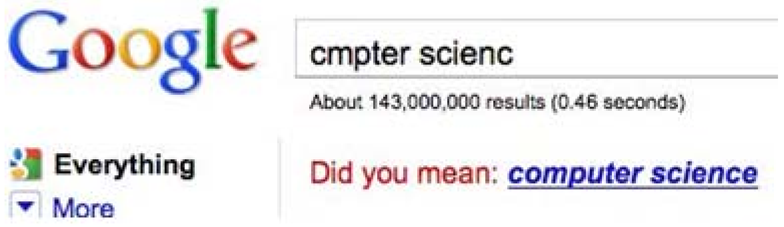
bit.ly/101f17-0928-3

```python
def mystery(strng, letter):
    pos = 0
    count = 0
    result = ''
    while count < 4 and pos < len(strng):
        if strng[pos] == letter:
            result += strng[pos] + strng[pos]
            count += 1
        else:
            result += strng[pos]
        pos += 1
    result += strng[pos:]
    return result

print mystery("September December", "e")
```

Computer Science Duke Alum





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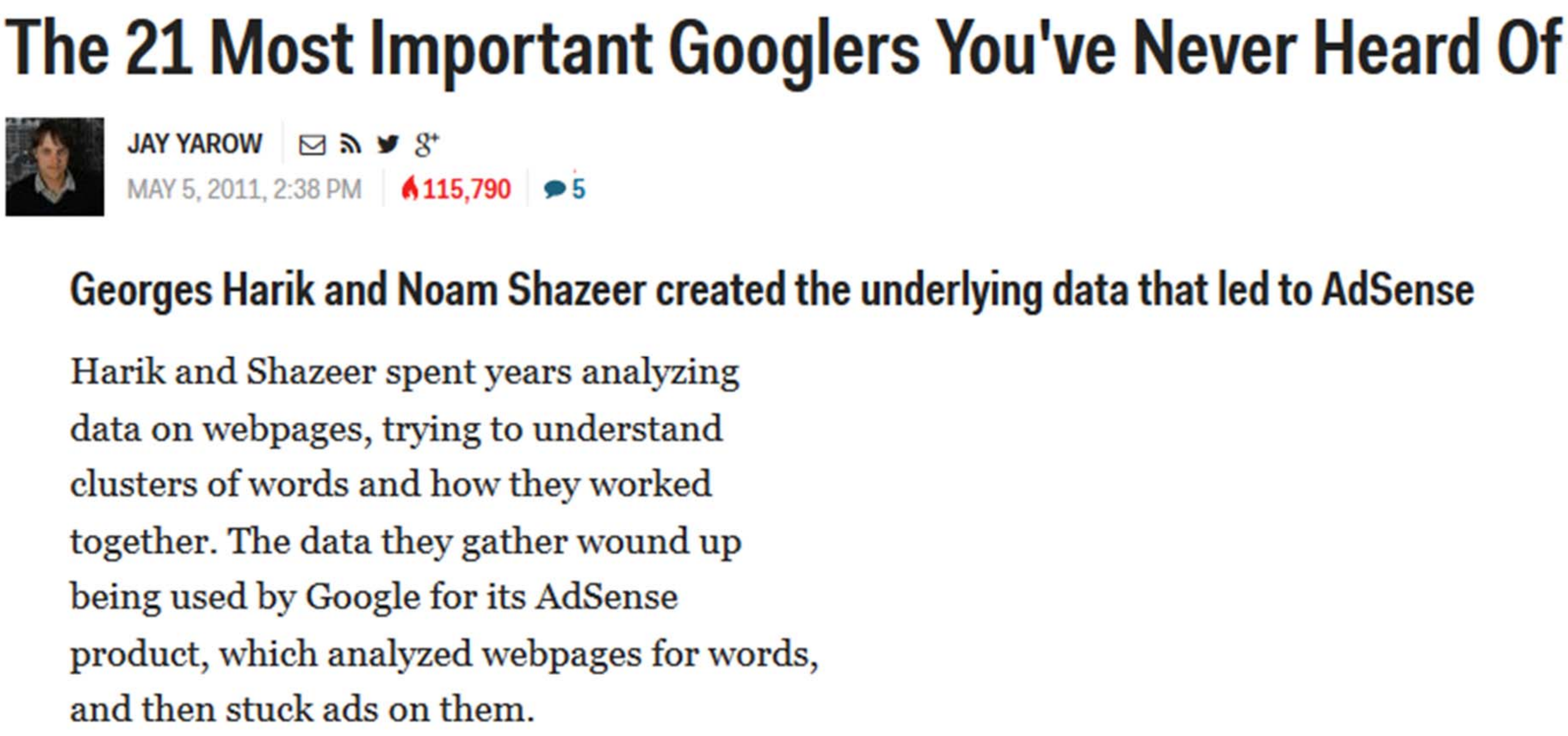
Did you mean: ***computer science***



The 21 Most Important Googlers You've Never Heard Of

JAY YAROW

MAY 5, 2011, 2:38 PM | 115,790 | 5

Georges Harik and Noam Shazeer created the underlying data that led to AdSense

Harik and Shazeer spent years analyzing data on webpages, trying to understand clusters of words and how they worked together. The data they gather wound up being used by Google for its AdSense product, which analyzed webpages for words, and then stuck ads on them.

Looping with while – not sure when to stop

- Playing chess
- Determining the 100th prime number

- Another way – while True – EASIER!
  - Must have ways to break out of infinite loop
  - Must have update – gets closer to ending

while condition vs while True

```
while condition:                  while True:
    body                              body
continue                              if condition:
                                          break
                                   continue
```

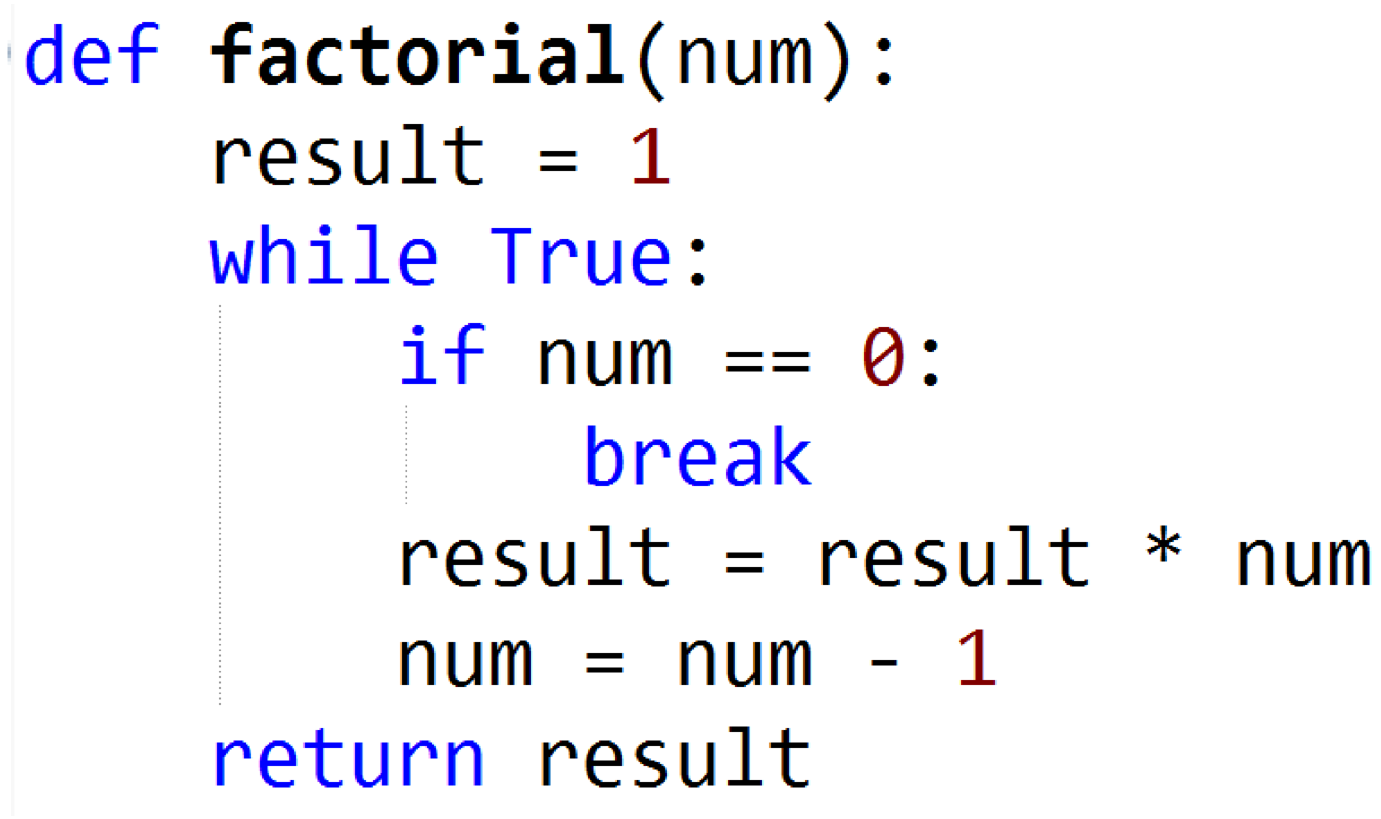
While condition is true - must update

- must get closer to making condition false
- use break to exit

Format of While True

```
initialize
while True:
    if something:
        break
    if something2:
        update
    update
Continue or return
```

Revisit Factorial with while True



```
def factorial(num):
    result = 1
    while True:
        if num == 0:
            break
        result = result * num
        num = num - 1
    return result
```

Revisit Mystery with while True

bit.ly/101f17-0928-4

```
def mystery2(strng, letter):
    pos = 0
    count = 0
    result = ''
    while True:
        # missing code to break out of while
        if strng[pos] == letter:
            result += strng[pos] + strng[pos]
            count += 1
        else:
            result += strng[pos]
        pos += 1
    result += strng[pos:]
    return result
```