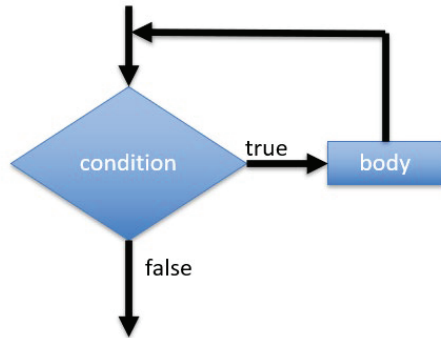


Compsci 101

Files, While loops, Bagels

Susan Rodger
February 16, 2023



2/16/23

Compsci 101, Spring 2023 1

J is for ...



- **JSON**
 - Format for data transmitted across the web
- **JPEG**
 - Image format based on lossy compression
- **Jacquard Loom**
 - 1804 "automated" loom



2/16/23

Compsci 101, Spring 2023

2

Latanya Sweeney

PhD. Computer Science, MIT – first black woman
Over 100 publications, Fellow ACMI



“I am a computer scientist with a long history of weaving technology and policy together to remove stakeholder barriers to technology adoption. My focus is on "computational policy" and I term myself a "computer (cross) policy" scientist. I have enjoyed success at creating technology that weaves with policy to resolve real-world technology-privacy clashes.



<http://latanyasweeney.org/>
Identify 87% of US population using (dob,zip,gender). Prof. Government and Technology @ Harvard, instrumental in HIPAA because if *de-identification* work. Former CTO of the Federal Trade Comm.

2/16/23

Compsci 101, Spring 2023 3

One of her websites you can try:
<https://aboutmyinfo.org/identity>

How unique am I?
Find out how much different you are among the masses.

About Samples

Fill out the form below to see how unique you are, and therefore how easy it is to identify you from these values.
Please note that this service is still under development.

Date of Birth Month Day Year
Gender Male Female
ZIP Code
ZIP code must be 5 digits long.

Your Profile

Submit →

Results will appear here.

2/16/23

Compsci 101, Spring 2023 4

Announcements

- **APT-3 out, due Thurs. Feb 23**
- **Assignment 2 program due tonight**
 - Do have one grace day
- **Do prelab before going to Lab on Friday**
- **APT Quiz 1 coming ... 2/23-2/27**
 - APTs you take **by yourself** during this period
 - Take online, timed, there are two parts
 - Each part has two problems
 - APT practice quiz is up today, optional (old problems)
- **There will be one more APT Quiz**

2/16/23

Compsci 101, Spring 2023 10

Sage has added new spots!

- **Small groups of students working on additional problems related to CompSci 101**
- **ADDED MORE SPOTS**
- **SAGE – Stem Advancement through Group Engagement**
- **See Ed Discussion Post (pinned at top) on how to sign up**

2/16/23

Compsci 101, Spring 2023 11

PFTD

- **Files and Data**
- **While loops and Collatz sequence**
- **Bagel APT**

2/16/23

Compsci 101, Spring 2023 12

Review - Last Time on Files

- **Open and Close file**

```
f = open(fname)
do stuff with file
f.close()
```
- **Read line by line**

- **OR Read file into list of strings – one string for each line**

2/16/23

Compsci 101, Spring 2023 14

Text File Processing Pattern

- See module `FileStuff.py`
 - If newline `'\n'` is read, call `.strip()`
 - If want to break line into “words”, call `.split()`
- Process the list that is returned by `.split()`
 - May need to convert strings to int or float or ...
- The `for line in f:` pattern is efficient
 - Contrast list returned by `f.readlines()`

2/16/23

Compsci 101, Spring 2023 15

FileStuff.py: avgWord

```
def avgWord(fname):  
    f = open(fname, encoding="utf-8")  
    totalWords = 0  
    totalLen = 0  
    for line in f:  
        line = line.strip() #remove newline  
        data = line.split()  
        for word in data:  
            totalWords = totalWords + 1  
            totalLen = totalLen + len(word)  
  
    f.close()  
    return totalLen/totalWords
```

2/16/23

Compsci 101, Spring 2023 16

Run FileStuff

```
20 if __name__ == '__main__':  
21     files = ["poe.txt", "confucius.txt", "kjbv10.txt", "oz.txt", "species.txt"]  
22     for f in files:  
23         avg = avgWord("data/"+f)  
24         print(f, avg)
```

Output:

```
poe.txt 4.601549053356282  
confucius.txt 4.398126192817072  
kjbv10.txt 4.245566037162798  
oz.txt 4.496446700507614  
species.txt 5.036
```

2/16/23

Compsci 101, Spring 2023 18

Files - Summary

- Open file: `f = open(filename)`
- “Process” file (2 different ways):
 - `for line in f:` # get one line at a time with `“\n”`
 - `x = f.readlines()` # x is a list of lines with `“\n”`
- Close file: `f.close()`
- To think about when processing lines
 - Line is a string with `“\n”` – `.strip()` it
 - Maybe `.split()` line into list of strings (words)?
 - Convert string to int or float - `int(“376”)`

2/16/23

Compsci 101, Spring 2023 19

When is a game of chess over?

- If you were to write a program to play chess
 - how many rounds in a game?



2/16/23

Compsci 101, Spring 2023 20

Example: while

- Playing chess

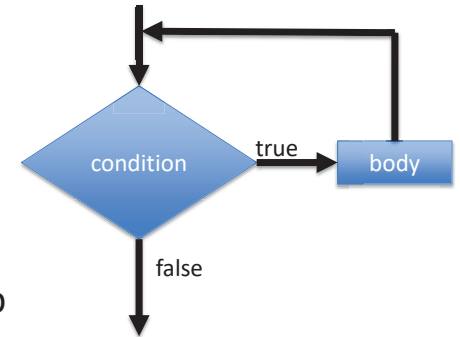
```
while (game not over)
    make a move in the game
    (game must get closer to ending)
```

2/16/23

Compsci 101, Spring 2023 22

Another type of loop: While loop

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



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

2/16/23

Compsci 101, Spring 2023 21

Example: while loop – sum list

```
lst = [4,1,8]
sum = 0
i = 0
while i < len(lst):
    sum += lst[i]
    i += 1
print(sum)
```

2/16/23

Compsci 101, Spring 2023 23

Alternative while -while True

initialize

while True:

if something:

break

if something2:

update

update

Continue or return

while condition vs while True

while condition:

body

continue

while True:

body

if condition:

break

continue

While condition is true - must update

- must get closer to making condition false

- use break to exit

Compare: while - while True

```
lst = [4,1,8]
```

```
sum = 0
```

```
i = 0
```

```
while i < len(lst):
```

```
    sum += lst[i]
```

```
    i += 1
```

```
print(sum)
```

```
lst = [4,1,8]
```

```
sum = 0
```

```
i = 0
```

```
while True:
```

```
    if i >= len(lst):
```

```
        break
```

```
    sum += lst[i]
```

```
    i += 1
```

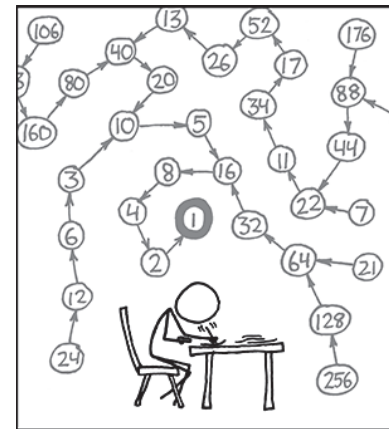
```
print(sum)
```

WOTO-1 While loops

<http://bit.ly/101s23-0216-1>

Now let's see a problem that needs a while loop

<https://xkcd.com/710/>



Collatz Conjecture (Hailstone)

If number is even
divide by 2

If number is odd
multiply by 3 and add 1

THE COLLATZ CONJECTURE STATES THAT IF YOU PICK A NUMBER, AND IF IT'S EVEN DIVIDE IT BY TWO AND IF IT'S ODD MULTIPLY IT BY THREE AND ADD ONE, AND YOU REPEAT THIS PROCEDURE LONG ENOUGH, EVENTUALLY YOUR FRIENDS WILL STOP CALLING TO SEE IF YOU WANT TO HANG OUT.

Always end up at 1!

Why Solve This? In Python?

- https://en.wikipedia.org/wiki/Collatz_conjecture
- **We want to illustrate an indefinite loop**
 - One of many mathematical sequences, but ...
- **There's an XKCD comic about it!**
 - Not everyone enjoys XKCD, but ...
- **Mathematics is foundational in computer science, but**
 - Not everyone enjoys logic/math puzzles, but ...

Developing and Reasoning about While Loops

- **Don't know: *how many times* loop executes**
 - *a priori* knowledge, we'll know afterward
- **Do know: condition that should be true after loop**
 - Its negation is the expression for `BOOL_CONDITION` (loop guard)

```
while BOOL_CONDITION:  
    LOOP_BODY  
    # modify variables, affect expression
```

Concrete Example: Collatz/Hailstone

- **Don't know: *how many times* loop executes**
 - some numbers: long sequences, others short
- **Do know: condition that should be true after loop**
 - It's negation is the expression for loop guard!
 - What is true after loop below finishes?

```
while value != 1:
    loop body
    # modify value somehow
```

Collatz Code

```
6 def hailstone(start, printing=False):
7     """..."""
14    steps = 0
15    current = start
16    while current != 1:
17        if printing:
18            print("{:3d}\t{:6d}".format(steps, current))
19        if current % 2 == 0:
20            current //= 2
21        else:
22            current = current * 3 + 1
23            steps += 1
24
25    if printing:
26        print("{:3d}\t{:6d}".format(steps, current))
27    return steps
```

Sample run

```
44 if __name__ == '__main__':
45     num = 6
46     s = hailstone(num, True)
47     print('num =', num, 'steps =', s)
```

Output:

```
0      6
1      3
2     10
3      5
4     16
5      8
6      4
7      2
8      1
num = 6 steps = 8
```

Collatz Data – Average no. of steps

- **How do we gather data for numbers $\leq 10,000$?**
 - In general for numbers in range(low,high) ?
 - Call function, store result, store 10,000 results?
- **We'd like counts[k] to be length of sequence for k**
 - How do we allocate 10,000 list elements?
 - Like there is "hello" * 3
 - There is [0] * 10000

Analysis in Collatz.py

```

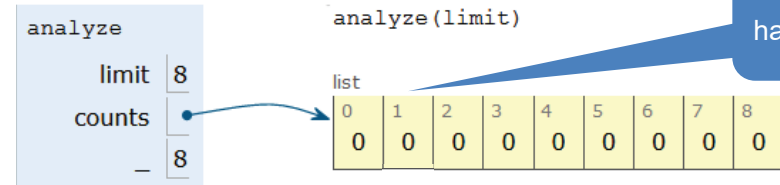
29 def analyze(limit):
30     counts = []
31     # max index into count is limit, but start at 1
32     for _ in range(limit+1):
33         counts.append(0)
34
35     for n in range(1, limit+1):
36         counts[n] = hailstone(n)
37
38     avg = sum(counts)/len(counts)-1 # ignore index 0
39     mx = max(counts)
40     dex = counts.index(mx)
41     print("average", avg)
42     print("max is %d at %d" % (mx, dex))

```

counts list when limit is 8?

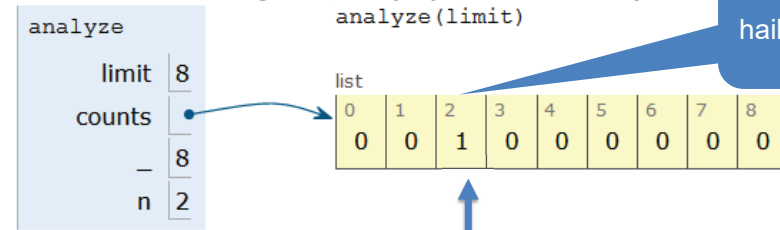
- Counts is of size 8+1, we ignore slot 0

Store answer for hailstone(1) in index 1



- hailstone(1), get 0
- hailstone(2), get 1 step, just divide by 2

Store answer for hailstone(2) in index 2

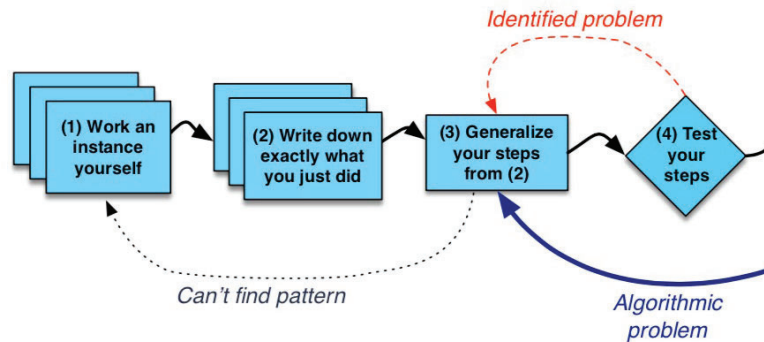


WOTO-2 Collatz and While
<http://bit.ly/101s23-0216-2>



APT Bagels

- How figure out how many bagels needed?
 - 7-steps!



2/16/23

Compsci 101, Spring 2023 63

APT: Bagel Counting

Problem Statement

You are in charge of web-based orders for your neighborhood bagel store, *The Bagel Byte*. Each evening you must total the orders to be picked up the next day. Some orders are simply for N bagels, but each order of a dozen or more bagels is topped off with an extra bagel, the so-called "baker's dozen". This means, for example, that an order for 25 bagels actually requires 27 bagels to fulfill since there are two extra bagels needed for each dozen in the order. An order for 11 bagels doesn't require any extra since it's for less than a dozen.

Given a list of integers representing bagel orders determine the number of bagels needed to fulfill all the orders.

```
Class
filename: Bagels.py
def bagelCount(orders) :
    """
    return number of bagels needed to fulfill
    the orders in integer list parameter orders
    """
    # you write code here
```

2/16/23

Compsci 101, Spring 2023 64

Examples

Examples

1. `orders = [1, 3, 5, 7]`

Returns: 16

No order is for more than a dozen, return the total of all orders.

2.

`orders = [11, 22, 33, 44, 55]`

Returns: 175 since $11 + (22+1) + (33+2) + (44+3) + (55+4) = 175$

2/16/23

Compsci 101, Spring 2023 65

Step 1 and 2

- Step 1: Solve an instance (think)
 - `orders = [11, 3, 24, 17]`

2/16/23

Compsci 101, Spring 2023 66

WOTO-3 Step 3: Generalize

<http://bit.ly/101s23-0216-3>