CompSci 101
Fall 2021

Lecture 22

Reminders

- Assignments
  - Assign 7 and APT 8 due Thursday (12/2)
  - GRACE PERIOD ENDS DEC 3! NOT ACCEPTED AFTER THIS!
- Lab 11
  - Pre-lab this week
- Ethics in AI talk

- Spring 2022 UTA applications open
  - See Ed announcement

Final Exam

- APT quiz style
  - Part A and B
    - 90 minutes each
  - Official schedule (12/10-9am-12pm)
    - May complete anytime between 12/10 (8am EST) and 12/12 (11pm EST)
  - Same rules apply of what can/cannot be used
    - Do not violate academic code of conduct!

Key instructions

- Input ✔
- Output ✔
- Assignments* ✔
- Math/Logic ✔
- Conditionals ✔
- Repetition ✔

**not listed in book*

Python Data Types

- int, float, bool ✔
- Collections
  - Strings ✔
  - Lists ✔
  - Tuples ✔
  - Sets ✔
  - Dictionaries ✔

PFTD

- How do Dictionaries work so fast!
  - Access an element in constant time
- Recursion
  - Solving a problem by solving smaller problems

KISS Principle

- Think of the non-computing context for any word/terms
- KISS model
  - Work smarter, not harder!!
- “Good programmers are simply good designers.”
  - *-Dr. Washington*
- Design first and always!
- Importance of reusability
- *USE PyCharm/PythonTutor IF YOU HAVE QUESTIONS!*

People to Know: Dr. Rediet Abebe

- BS/MS/MA (Math/Applied Math)
  - Harvard, University of Cambridge
- Ph.D. (CS)
  - Cornell
- Co-founder
  - Black in AI
  - Mechanism Design for Social Good

Assignment 7: Create, Due 12/2

Grace period til 12/3, No late days!

Must be turned in by 12/3

This assignment is required!

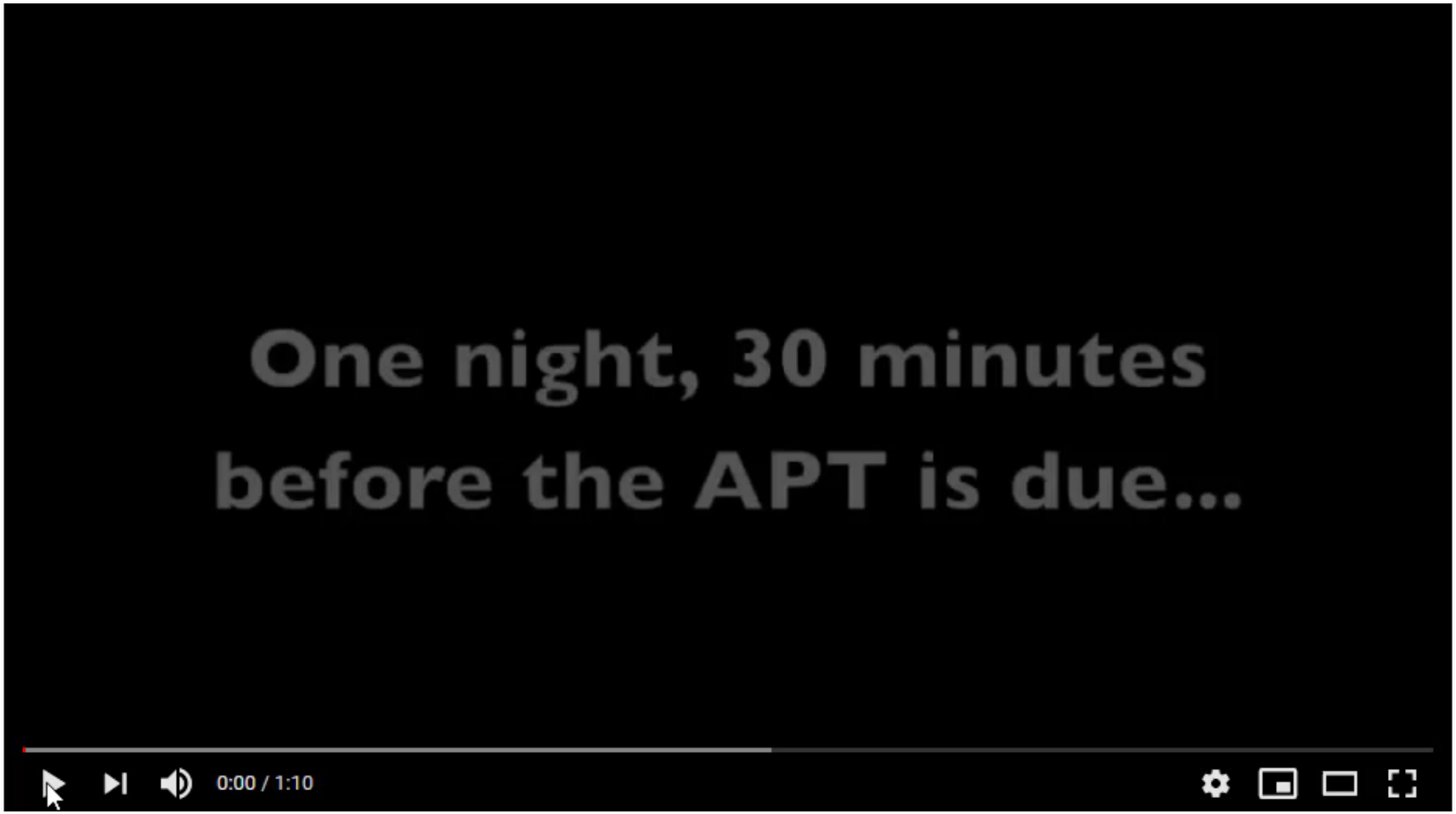
Pick one:

- Video: Green dance, advertisement for 101, song, other
- Poem or Multiple Haikus
- Story
- Comic
- One-pager
- Feedback

Let's see some examples

A Story – One Eternity Later

APT Due



Some Haikus

Haiku #1

A single red square

Defiant among all greens

APT: not done :(

Haiku #2

My first day of class

Prof. Rodgers speaking while on mute

What a start to Zoom

Advice on Final Exam APTs

- Work an example, or 2 or 3 by hand
  - How are you solving it?
- What would the algorithm be?
- What tools do you need to implement?
  - Dictionary? Set? What do you need to loop over?
- What helper function could you write? Or two?
  - Debug it
- As you write code, print a lot!
- See debugging tips on APT main page

More on Grades

- Class Participation-WOTOs – **ignore** the first two weeks (drop/add period), plus drop 10 **points**
- Lab – drop **15** points (each lab is 5 pts)
  - Lab 11 covers recursion and debugging!

Recursion

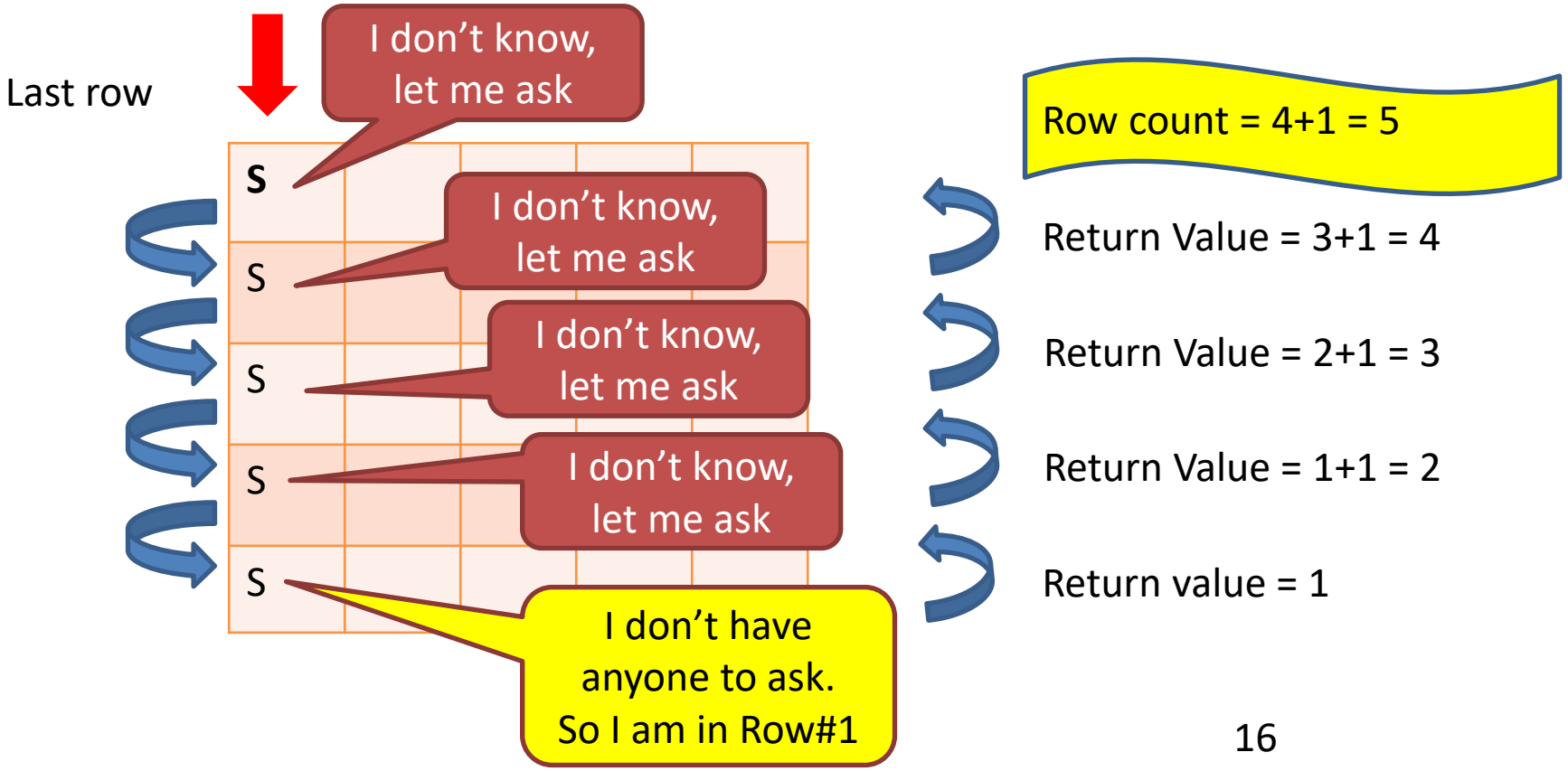
- Solving a problem by solving similar but smaller problems

Recursion

Solving a problem by solving similar but smaller problems

Question - How many **rows** are there in this classroom?

Similar but smaller question - How many **rows** are there until your row?



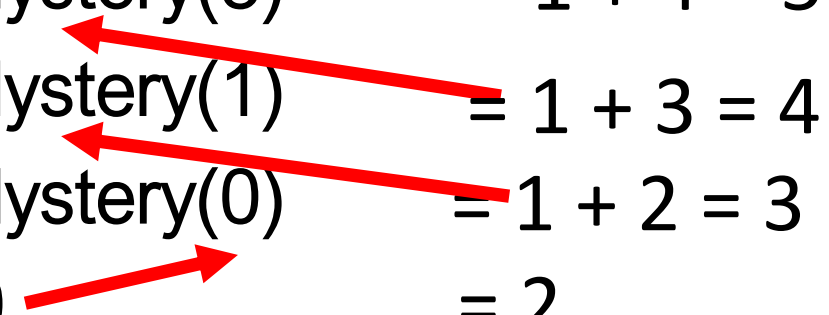
Review: Recursion Summary

- **Function calls smaller version of itself**
  - Different input
  - Each call gets closer to base case
- **Must have a base case (when no recursive call can be made)**
    - Example: n=0→Factorial
    - This is the way out of recursion! (Work backwards)

Example

```
def Mystery(num):
    if num > 0:
        return 1 + Mystery(num//2)
    else:
        return 2 + num
```

- Mystery(7) is 1 + Mystery(3) = 1 + 4 = 5
- Mystery(3) is 1 + Mystery(1) = 1 + 3 = 4
- Mystery(1) is 1 + Mystery(0) = 1 + 2 = 3
- Mystery(0) is 2 + 0 = 2



Something Recursion
https://bit.ly/101f21-12-02-1

Something Recursion

What is Something([3,5,1]) ?

```
def Something(data):
    # data is a list of integers
    if len(data) == 0:
        return 0
    if data[0]%2 == 0:  # it is even
        return data[0] + Something(data[1:])
    else:
        return Something(data[1:])
```

Something Recursion

```
def Something(data):
    # data is a list of integers
    if len(data) == 0:
        return 0
    if data[0]%2 == 0:  # it is even
        return data[0] + Something(data[1:])
    else:
        return Something(data[1:])
```

- Something([3,5,1]) is Something([5,1]) = 0
- Something([5,1] is Something([1]) = 0
- Something([1]) is Something([ ]) = 0
- Something([ ]) is 0

Something([3,5,1]) is 0

Something Recursion

What is Something([5,4,2,3]) ?

```
def Something(data):
    # data is a list of integers
    if len(data) == 0:
        return 0
    if data[0]%2 == 0:  # it is even
        return data[0] + Something(data[1:])
    else:
        return Something(data[1:])
```

Something Recursion

```
def Something(data):
    # data is a list of integers
    if len(data) == 0:
        return 0
    if data[0]%2 == 0:  # it is even
        return data[0] + Something(data[1:])
    else:
        return Something(data[1:])
```

Something([5,4,2,3]) is 6

- Something([5,4,2,3]) is Something([4,2,3]) = 6
- Something([4,2,3] is 4 + Something([2,3]) = 6
- Something([2,3]) is 2 + Something([3]) = 2
- Something([3]) is Something([ ]) = 0
- Something([ ]) is 0

Revisit the APT Bagels Recursively

```
filename:  Bagels.py

def bagelCount(orders) :
    """
    return number of bagels needed to fulfill
    the orders in integer list parameter orders
    """
```

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
```

APT Bagels Recursively
https://bit.ly/101f21-12-02-2

APT Bagels Recursively

A)
```
def bagelCount(orders):
    if len(orders) > 0:
        return orders[0]//12 + orders[0] + bagelCount(orders[1:])
    else:
        return 0
```

B)
```
def bagelCount(orders):
    if len(orders) > 0:
        return orders[-1]//12 + orders[-1] + bagelCount(orders[:-1])
    else:
        return 0
```

C)
```
def bagelCount(orders):
    return orders[0] + orders[0]//12 + bagelCount(orders[1:])
```

D)
```
def bagelCount(orders):
    if len(orders)>1:
        return orders[1] + orders[1]//12 + bagelCount(orders[2:])
    else:
        return bagelCount(orders[0])
```

How is Python like all other programming languages, how is it different?

Find all unique/different words in a file, in sorted order

Unique Words in Python

```
def main():
    f = open('/data/melville.txt', 'r')
    words = f.read().strip().split()
    allWords = set(words)

    for word in sorted(allWords):
        print(word)

if __name__ == "__main__":
    main()
```

Unique words in Java

```
import java.util.*;
import java.io.*;
public class Unique {
  public static void main(String[] args)
                                  throws IOException{
    Scanner scan =
             new Scanner(new
   File("/data/melville.txt"));
    TreeSet<String> set = new TreeSet<String>();
    while (scan.hasNext()){
        String str = scan.next();
        set.add(str);
    }
    for(String s : set){
        System.out.println(s);
    }
  }
}
```

Unique words in C++

```
#include <iostream>
#include <fstream>
#include <set>
using namespace std;

int main(){
  ifstream input("/data/melville.txt");
  set<string> unique;
  string word;
  while (input >> word){
    unique.insert(word);
  }
  set<string>::iterator it = unique.begin();
  for(; it != unique.end(); it++){
    cout << *it << endl;
  }
  return 0;
}
```

Unique words in PHP

```
<?php

$wholething = file_get_contents("file:///data/melville.txt");
$wholething = trim($wholething);

$array = preg_split("/\s+/",$wholething);
$uni = array_unique($array);
sort($uni);
foreach ($uni as $word){
   echo $word."<br>";
}

?>
```

What is next?

- CompSci 201
  - Java, efficiency, other ways to organize data
- CompSci 230 – can take concurrently with 201
  - Discrete Mathematics

- CompSci 260 Computational Biology
- CompSci 216 Everything Data
- CompSci 240 Race, Gender, Class and Computing

Reminders

- Work smarter, not harder
- Design first
- Get smaller parts working, then build on it
- Try to identify where you are stuck
  - Identify resources to help solve problem
- Leverage your design and PythonTutor to understand program flow of control
  - http://pythontutor.com