CompSci 101
Problem Solving

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O is for …

- **Open Source**
  - Copyright meets the Creative Commons
- **Object Oriented**
  - Using classes and more in programming
- **Occam’s Razor**
  - Not just compsci. Simple is good

The Tech Twins

- Troy and Travis Nunnally
- Between them: 2 master’s and 1 doctorate from Georgia Tech
- Cofounders of Brain Rain Solutions
  - Augmented-reality
  - Internet-of-things
- Applied machine learning

Troy: “My advice would be to stay consistent. Always think persistently and consistently about learning a particular craft.”

Travis: “I think that you have to be passionate and find something that you simply love and enjoy. Not only find that thing — but actually be a lifelong learner around that.”

Announcements

- Assign 4 GuessWord due Thursday, March 23
- Sakai Assignment Quiz due **TUESDAY, March 21**
- APT-5 and Assign 5 out, March 23
- Will talk about Thursday after spring break
- No Lab Friday!
- APT Quiz 2 on March 30-Apr 3
- Do not discuss Exam 2 until handed back!

Problem Solving – What to use

• Do you need to loop over anything?
  • Do you need the index of the item?
• Do you need to make a decision?
• Do you need unique elements?
• Are you working with two groups of things?
  • Are they parallel lists?
  • Are you comparing elements in some way with two groups of elements?

Example: do you need to know the index position of the longest word in the list?

for item in range(len(alist))

Do you need to keep the order of the elements?
Do you need the original list AND a separate set of the elements just to know how many unique elements?

Use a set?

Use an if?

Do you need elif or a second if?
Problem Solving – What to use

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Now let's look at an APT from APT-5

Sandwich Bar

APT: SandwichBar Search

Problem Statement

It's time to get something to eat and I've come across a sandwich bar. Like most people, I prefer certain types of sandwiches. In fact, I keep a list of the types of sandwiches I like.

The sandwich bar has certain ingredients available. I will list the types of sandwiches I like in order of preference and buy the first sandwich the bar can make for me. In order for the bar to make a sandwich for me, it must include all of the ingredients I desire.

Given available, a list of Strings/ingredients the sandwich bar can use, and a orders, a list of Strings that represent the types of sandwiches I like, in order of preference (most preferred first), return the 0-based index of the sandwich I will buy. Each element of orders represents one type of sandwich I like as a space-separated list of ingredients in the sandwich. If the bar can make no sandwiches I like, return -1.
Sandwich Bar Example

- available = [ "cheese", "cheese", "cheese", "tomato" ]
- orders = [ "ham ham ham", "water", "pork", "bread", "cheese tomato cheese", "beef" ]

- Returns 4
- Can make “cheese tomato cheese”
- Ignore any duplicates!

Another Trip to the SandwichBar

- Use sets to solve this!

- Idea

```python
for index in range(len(orders)):
    if canMake(orders[index], available):
        return index
```

- You would need to write the function canmake
- What type does it return?
- What set operation could you use?

```python
def canMake(order, available):
    sandwichSet = set(order.split())
    availableSet = set(available)
    intersection = availableSet & sandwichSet
    if len(intersection) == len(sandwichSet):
        return True
    return False
```

order is "cheese tomato cheese"
sandwichSet is {"cheese", "tomato"}
availableSet is {"cheese", "onion", "tomato"}
intersection is [ "cheese", "tomato" ]
if len(intersection) == len(sandwichSet): True
return True
return False
Given two lists A and B

- Determine if all elements in A are also in B
  - Examine each element in A
    - If not in B? False
    - After examining all elements? True

- Think: Could we use sets instead?

Given two sets A and B

- Determine if all elements in A are also in B
  - if len(A & B) == len(A)
  - if len(A - B) == 0

Jotto: Game similar to GuessWord

- http://jotto.augiehill.com/single.jsp
- No letters repeat – have to agree on this
- Shall we play a game?

Write program where Computer Guesses Your Word

- You give the computer a word to guess, called wordToGuess
- Computer does brute force, no thinking or eliminating letters
  - It picks a word at random
  - Calculates how many letters in common with wordToGuess, say x letters
  - Only keep words with x letters in common
  - Repeats until guesses the word
We will build useful functions to use to build the game.

WOTO-2 Approaching Implementation

- What is needed?
- What order should the code do things?

Start with Blank Screen

1. Computer gets a list of words
2. Computer chooses a word at random
3. User/player enters # letters in common
4. Only keep words with that # in common

Initialization

Loop

Iterative Programming!

- Start with a task
- Implement only that task
- Write some code to check that the code works
  - Run and debug until it works
- Repeat

Should you write all the code first and then run it?

“Debugging is twice as hard as writing the code in the first place. Therefore, If you write the code as cleverly as possible, you are, by definition, not smart enough to debug it.”
- Brian Kernighan (original Unix contributor)
SimpleJotto.py

• We have a file of five letter words: `kwords5.txt`
  • Would you like to play a game?

• Let's start! Simple version that sort of works 😊

Jotto Step 1

• Read the file `kwords5.txt`
  • Read the file `kwords5.txt`
  • Don't continue until we know this works

  • Let's go code up!

Jotto Step 2

• Pick a word at random
  • Pick a word at random, show the user
  • Don't continue until we know this works

Jotto Step 3

• Get number of letters in common
  • Get # letters in common, *do something*?
  • Don't continue until we know this works
Let's code those up!

- chooseAWord
- commonCount

updateWordList

- The next function updateWordList can be done with a list comprehension

Try writing updateWordList

- Given:
  - words – a list of words
  - nextWord – the word the computer just guessed
  - numInCommon – the number of letters in common between nextWord and wordToGuess, which is the word the user wants the computer to guess
- Return
  - A new list that has only the words from the list words that have the same number of letters in common that nextWord has with wordToGuess
Now put together game

- **wordToGuess** is  #Ask user for word to guess
- Read in list of word from file
- **While not found word**
  - nextWord is  #choose a word at random
  - Get number of letters in common between nextWord and wordToGuess
  - Update word list to keep only those with same number of letters in common as nextWord
  - Check to see if nextWord is wordToGuess

Think about how to put the game together with all these pieces

Next slides show how to put the game together

Code up `getWordList` and `chooseAWord`

```python
9  def getWordList(filename):
10     ret = []
11     f = open(filename)
12     for line in f:
13         ret.append(line.strip())
14     f.close()
15     return ret
17  def chooseAWord(words):
18      return random.choice(words)
```
Code up `updateWordList` and `commonCount`

```python
def handleUserInput():
    wordToGuess = input("Guess a word with 5 letters: ")
    return wordToGuess

def updateWordList(words, numInCommon, userword):
    return [w for w in words if numInCommon == commonCount(w, userword)]

def commonCount(word1, word2):
    # assumes words don't have duplicate letters
    set1 = set(list(word1))
    set2 = set(list(word2))
    #print(set1, set2)
    return len(set1 & set2)
```

`playGame` First part

```python
def playGame():
    won = False
    wordToGuess = handleUserInput()
    numTries = 0

    # Initialize
    ## Read the file kwords5.txt
    words = getWordList('kwords5.txt')

playGame loop

```python
while (not won and numTries < 30):
    # Loop
    nextWord = chooseAWord(words)
    ## Get number of letters in common
    numInCommon = commonCount(wordToGuess, nextWord)
    ## Only keep words with that number in common
    words = updateWordList(words, numInCommon, nextWord)
    print("next word is: ", nextWord)
    print("num letters in common is: ", numInCommon)
    print("words remaining: ", len(words))

    # check stopping condition
    if nextWord == wordToGuess:
        won = True
        numTries += 1

    return won
```