15-112: Final Exam Review

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1 Important Concepts

1. Variable Types
2. Functions
3. Comparisons (ifs)
4. Loops/Break/Continue
5. Stacks
6. Recursion
7. Exceptions
8. Sort / Sorted
9. List Comprehensions
10. Tuples/Lists
11. Dictionaries/Sets
12. File I/O
13. String Functions
14. Generators vs Coroutines
15. Classes/Objects
16. Networks/Socket API
17. Lambda Functions
18. TKinter

2 Lists and Loops

2.1 General Knowledge

Loops:

```
lst = [1,2,3]
for i in lst:
  print i
```

```
count = 1
while count <= 3:
  print count
```

These print:

```
1
2
3
```

Lists:

```
lst = []
for i in range(1,6):
  lst.append(i)
lst.remove(4)
print(tuple(lst))
```

Prints:

```
(1,2,3,5)
```

2.2 Questions

Question: Write a for loop that stores odd numbers between 1 and 100 in a list

Question: Print the sum of the numbers in the list

Question: Use both a for and while loop to create a remainder method that takes in two numbers x and y and calculates the remainder when x is divided by y

Question: Write a method mean(x) that takes in a list of numbers and returns the average

Question: Write a method isPal that takes in a number and returns True or False depending on whether or not the number is a palindrome. Extra Hard: Do it without using strings

3 Dictionaries and Sets

3.1 General Knowledge

Example Code:

```
  random = set()
  dict = {
'hi' : 17,18
'random' : 9,4}
```

3.2 Questions

Question: Write a method that takes in a number and stores the odds in a dictionary under one key and stores the evens in a dictionary under another key

Question: Write the function reverseGet(d, v) that takes a dictionary and a value, and returns either a key that is mapped to the given value in the dictionary, or None if no such key exists. For example, reverseGet([”Steelers”: 14, ”Browns”: 3], 14) would return ”Steelers”, and reverseGet([”Steelers”: 14, ”Browns”: 3], 10) would return None

Question: Write an XOR function that returns a set

4 Recursion

Question: Write a recursive Factorial function

Question: Write a recursive function sumFib(n) that returns the sum of the first n even Fibonacci numbers

Question: Write a recursive prime factorizing function that takes in a number n and recursively returns a list of prime factors

Question: Right a recursive function that finds the remainder when x is divided by y using only subtraction

5 File I/O

5.1 General Knowledge

```
inputfile = open ("input.txt")

line = inputfile.readline()
print line                    # (but, nothing to see here)
line = inputfile.readline()   # (or here)
print line

line = inputfile.readline()
print line,                   # NOTICE THE COMMA HERE
line = inputfile.readline()   # AND THE COMMA HERE
print line,

# Done wiht this use
inputfile.close()
```

5.2 Questions

Question: Read the lines of a txt file one by one. Print out each individual word, followed by the word's number in its line on its own line

Question: Create a txt file with comma and space separated words(eg. hi, my, name, is, Danny). Read the words one by one and print them out in all uppercase letters on separate lines with no spaces or commas

6 Class Structures/Exceptions

6.1 General Knowledge

Example Class:

```
class Employee:
   'Common base class for all employees'
   empCount = 0

   def __init__(self, name, salary):
      self.name = name
      self.salary = salary
      Employee.empCount += 1

   def displayCount(self):
     print "Total Employee %d" % Employee.empCount

   def displayEmployee(self):
      print "Name : ", self.name,  ", Salary: ", self.salary
```

Example Exception:

```
  class MyError(Exception):
    def __init__(self, value):
      self.value=value
    def __str__(self):
      return repr(self.value)
```

Note that variables defined at the top of a class will be class variables, usable anywhere within that class, whereas variables defined within methods of the class will only be usable in their specific methods. This concept is called scope. Additionally remember that when calling a method from within a class you must first call the class name, then call the method, eg. Employee.displayEmployee(emp)

7 TKinter

For any questions on using TKinter, please refer to the examples given on Kosbie's website.

7.1 Questions

Question: Create a global canvas and store variables length and width globally to it. Construct a rectangle with these dimensions and color it blue

8 Generators, Coroutines, and Decorators

8.1 Generators

Example Generator:

```
def generateEvens(start):    #define generator

  if ((start % 2) != 0): start += 1    #make sure we start with an even number

  even = start   #setting variable equal to start
  while True:    #always runs
    yield even   #gives us back our value. REMEMBER: Use yield, NOT return
    even +=2     #adds two to get to next even

evens = generateEvens(3)    #initializes generator for 3 total values

#calls the 3 instances and prints them.
#Calling another one would throw an (...)
#out of range error because we only initialized for 3 values
print next(evens)
print next(evens)
print next(evens)
```

8.2 Coroutines

Example Coroutine:

```
def printValue():       #define coroutine
  while True:           #always true
    value = (yield)     #sets value equal to what we take in
    print value         #prints the result

pv = printValue()       # Create an assign
# Advance until it blocks at the first "(yield)"
pv.next()
pv.send("This string is sent and becomes the value of the (yield)")
pv.send("And again...")    #sending in more values for yield
pv.send("And again...")
```

8.3 Decorator

Definition 1. *A decorator is a wrapper function that both takes in and returns a function. Decorators allow us to easily impose a restriction on the functions we apply it to or their inputs.*

Example Decorator:

```
#decorators take in and return functions
def noNegativeNums(func):       #defines our wrapper function
  def checker(*args):           #defines the inner checker function that checks inputs
    for i in args:              #scans through inputs
      if i<0:                   #if there is a negative input ...
        raise negativeNumError    #raise error
    return args                 #if error not raised, return the inputs
  return checker                #return the checker function
def add(x,y):                   #defining a test function
  return x+y

decorator1 = noNegativeNums(add)        #instantiating our decorator
print decorator1(2,3)                   #calling decorator1 ... prints 5
print decorator1(4,-1)                  #calling decorator1 ... raises negativeNumError
```

8.4 Questions

Question: Write a decorator that takes in many strings and checks to see if they are all lowercase. If they are not, it makes them lowercase and then returns a function concatString that concatenates all of the strings. Use concatString with different numbers of parameters to test your decorator

Question: Write two coroutines, readWords and upperWords, the first of which reads each individual word out of a story in a txt file, and the second which capitalizes each word. Then pipeline these together and print the words out on separate lines

9 Problem Solving

Definition 2. *An interesting unproven conjecture is the Collatz Conjecture. It states that if you start with any number n and apply the following property, that n will reduce to 1 in a finite number of steps.*

$$f(x) = \begin{cases} \textit{if } x \textit{ is even} : x = x/2 \\ \textit{if } x \textit{ is odd} : x = 3x + 1 \end{cases}$$

This has been proven up to numbers on the order of 10^{20} *and is generally accepted as true.*

Question: Write a recursive function collatzSteps(n) which takes in a number n and returns the total number of steps it takes for n to be reduced to 1 by the above method

Question: Write collatzSteps without using recursion

Question: Which number $1 < n < 1,000,000$ produces the longest sequence from collatzSteps

Question: Write the function subsetSum(a,n) which takes in a list of integers (might be negative!), and a number n and returns True if and only if there is a sublist of the numbers in a that sums to n. For example:

$$subsetSum([1,2],1) = subsetSum([1,2,3,4],7) = \text{True}$$

Question: Write the function mode(L) that takes a list and returns the set of elements that occur the most number of times

Question: Write the function findMedian(L) that takes a list of numbers and returns the median. If there are an odd number of elements, this is the middle elements, and if there are an even number, this is the average of the 'middle' two. findMedian([1,5,1,3,6,4]) should return 3.5

Question: Write the function primeLessThan, which takes an integer n and returns the largest prime less than n

Question: Write a class farm animal with the following properties:

1. Has two animals, cows and chickens
2. init method allows adding a new cow or chicken to my class
3. has a total population method
4. each cow/chicken has variables for both age and number of legs (4 and 2 respectively)