Final Exam, Version 3
CSci 127: Introduction to Computer Science
Hunter College, City University of New York

22 May 2018

Answer Key:

1. (a) What will the following Python code print:

    i.
    ```
    a = "one+two+three+four+five+six"
    print(a.count("+"))
    ```

    Answer Key:
    ```
    5
    ```

    ii.
    ```
    b = a.split("+")
    print(b[0])
    ```

    Answer Key:
    ```
    one
    ```

    iii.
    ```
    num = b[-1].upper()
    print(num)
    ```

    Answer Key:
    ```
    SIX
    ```

    iv.
    ```
    for c in num:
        print(c.lower())
    ```

    Answer Key:

```
s
i
x
```

(b) Consider the following shell commands:

```
$ ls
nyc.txt  p50.py  p51.py  p52.py
```

   i. What is the output for:
```
$ ls *.py
```

   Answer Key:
```
p50.py  p51.py  p52.py
```

  ii. What is the output for:
```
$ ls *.py | wc -l
```

   Answer Key:
```
3
```

 iii. What is the output for:
```
$ mkdir programs
$ mv *.py programs
$ ls | wc -l
```

   Answer Key:
```
2
```

2. (a) After executing the Python code, write the name of the turtle:

i. which is purple:

Answer Key:

savannah

ii. which is pink:

```
import turtle
turtle.colormode(255)

brian = turtle.Turtle()
brian.color(255,0,0)
savannah = turtle.Turtle()
savannah.color(1.0,0.0,1.0)
calvin = turtle.Turtle()
calvin.color("#DDDDDD")
olga = turtle.Turtle()
olga.color("#BB0000")
```

Answer Key:

olga

iii. which is red:

Answer Key:

brian

iv. which is gray:

Answer Key:

calvin

(b) Write the Python code for the following algorithm:

```
function  decodeMessage(numberList)
    Create an empty message
    For each number in the list of numberList
        code = 65 + ((number + 1) modulo 26)
        Convert the code to the corresponding Unicode character
        Concatenate the character to the beginning of the message
    Return the message
```

Answer Key:

```
#Shift message right by 1 and make upper case:
def decodeMessage(numberList):
  mess = ""
  for number in numbers:
    code = 65 + ((numberList + 1)%26)
    ch = chr(code)
```

```
        mess = mess + ch
    return(mess)
```

3. (a) What is the value (True/False):

    i.
```
in1 = True
in2 = True
out = in1 and in2
```

Answer Key:
```
out = True
```

    ii.
```
in1 = True
in2 = True
out = not in1 or (in2 and not in1)
```
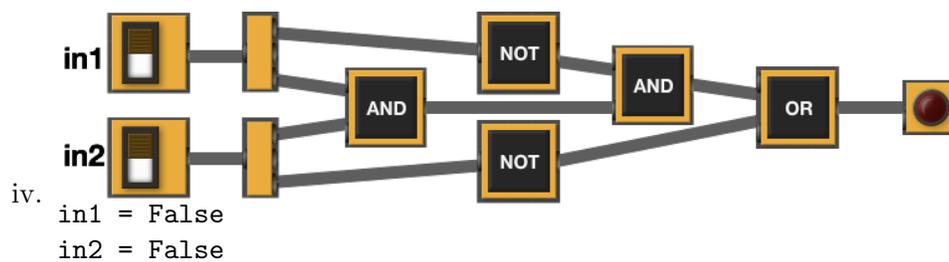
Answer Key:
```
out = False
```

    iii.
```
in1 = False
in2 = True or not in1
in3 = in1 and in2
out = in1 and not in3
```

Answer Key:
```
out = False
```
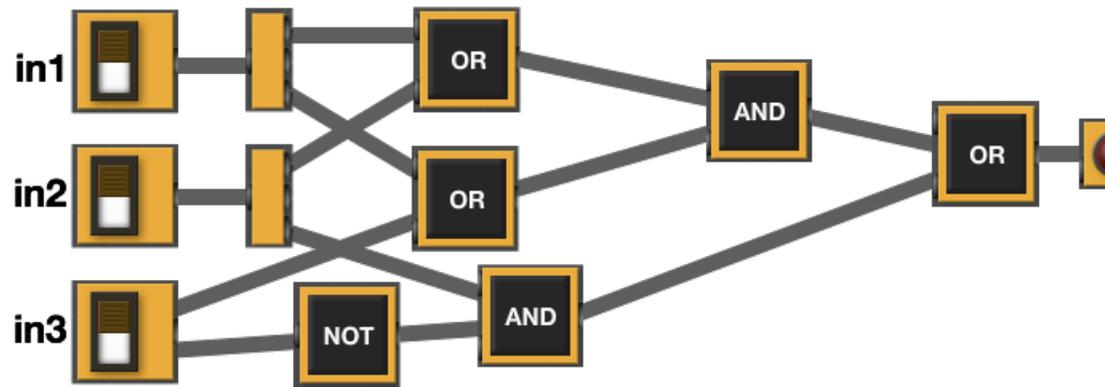
iv.


```
in1 = False
in2 = False
```

Answer Key:
```
out = True
```

(b) Design a circuit that implements the logical expression:

```
((in1 or in2) and (in1 or in3)) and (in2 or not in3)
```

Answer Key:

4. (a) Draw the output for the function calls:

   i. `ramble(tess,0)`
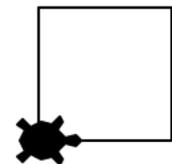
```
import turtle
tess = turtle.Turtle()
tess.shape("turtle")

def ramble(t,side):
    if side == 0:
        t.stamp()
    else:
        for i in range(side):
            t.forward(50)
            t.left(360/side)
```


Answer Key:

   ii. `ramble(tess,4)`

Answer Key:

(b) For the following code:

```
def v3(panda, lily):           def start():
    if panda + lily > 10:          xiaojie = 5
        return lily                karoline = 11
    else:                          nicky = v3(xiaojie,karoline)
        return -1                  return nicky
```

   i. What are the formal parameters for `v3()`:

   Answer Key: panda, lily

ii. What are the formal parameters for `start()`:

Answer Key: None

iii. What does `start()` return:

Answer Key: 11

5. Write a **complete Python program** that asks the user for numbers (separated by spaces) and prints how many end in `0`.

   For example:

   - If the user entered: `101 15 50 640`
   - Your program should print: `2`

   Answer Key:

   ```
   #Counting numbers ending in 0


   numbers = input('Enter numbers: ')
   num = numbers.count('0 ')
   if numbers[-1] == '0':
       num = num+1
   print("Number of numbers ending in 0 is", num)
   ```

6. Write a **complete Python program** that asks the user for the name of a .png (image) file and displays the lower right quarter of the image.

   For example if the image is `hunterLogo.png` (left), the displayed image would be (right):

   Answer Key:

   ```
   #Name:  CSci 127 Teaching Staff
   #Date:  Fall 2017
   #This program loads an image, displays it, and then creates and displays
   #    a new image that is only the lower right corner.

   #Import the packages for images and arrays:
   import matplotlib.pyplot as plt
   ```

```
import numpy as np

inF = input('Enter file name: ')
img = plt.imread(inF)    #Read in image from inF

height = img.shape[0]               #Get height
width = img.shape[1]                #Get width
print(height,width)

img2 = img[height/2:, width/2:]     #Crop to lower right corner

plt.imshow(img2)                    #Load our new image into pyplot
plt.show()                          #Show the image (waits until closed to continue)
```

7. Fill in the following functions that creates a graph of the fraction of population over time:

   - **getData()**: asks the user for the name of the CSV and returns a DataFrame of the contents,
   - **makeFraction()**: creates a column of the fraction of the two columns, and
   - **makeGraph()**: makes a plot of the x versus y columns specified.

   Answer Key:

```
import pandas as pd
import matplotlib.pyplot as plt

def getData():
    """
    Asks the user for the name of the CSV. Returns a DataFrame of the contents.
    """
    fName = input('Enter current latitude: ')
    df = pd.read_csv(fName)
    return(df)

def makeFraction(df,top,total,frac):
    """
    Makes a new column, frac, of df that is df[top]/df[total]
    Returns the DataFrame, df
    """
    df[frac] = df[top]/df[total]
    return df

def makeGraph(df,xCol,yCol):
    """
    Makes a pyplot plot of x versus y column in DataFrame df
    """
    df.plot(x = xCol, y = yCol)
```

8. (a) What are the values of register, `$s0` for the run of this MIPS program:

```
#Sample program that loops from 20 down to 5
ADDI $s0, $zero, 20 #set s0 to 20
ADDI $s1, $zero, 5  #use to decrement counter, $s0
ADDI $s2, $zero, 5  #use to compare for branching
AGAIN: SUB $s0, $s0, $s1
BEQ $s0, $s2, DONE
J AGAIN
DONE:  #To break out of the loop
```

Values of $s0:

Answer Key:

```
20
15
10
5
```

(b) Write a MIPS program where the register, `$s0` loops through the values: `3,6,9,12`

Answer Key:

```
#Program that loops from 3 up to 12, by threes
ADDI $s0, $zero, 3  #set s0 to 2
ADDI $s1, $zero, 3  #use to increment counter, s0
ADDI $s2, $zero, 12 #set s2 to use for comparison
AGAIN: ADD $s0, $s0, $s1
BEQ $s0, $s2, DONE
J AGAIN
DONE:  #To break out of the loop
```

9. What is the output of the following C++ programs?

(a)
```
//Walt Whitman
#include <iostream>
using namespace std;
int main()
{
  cout << "I exist as\nI am,";
  cout << "\nthat is enough" << endl;
  cout << "--W. Whitman";
}
```

Answer Key:

```
I exist as
I am,
```

(b)
```
that is enough
--W. Whitman
//Greetings!
#include <iostream>
using namespace std;
int main()
{
  cout << "Begin" << endl;
  int x = 2;
  while (x > 0) {
    cout <<"Again\n";
    x--;
  }
  cout << "End"
}
```

Answer Key:

```
Begin
Again
Again
End
```

(c)
```
//Pluses and minuses
#include <iostream>
using namespace std;
int main()
{
  int i, j;
  for (i = -2; i < 2; i++)
  {
    for (j = 0; j < 3; j++)
      if (i < 0)
        cout << "+";
      else
        cout << "-";
    cout << endl;
  }
}
```

Answer Key:

```
+++
+++
---
---
```

10. (a) Write a **complete Python program** that asks the user for their graduation year. If they enter a number before 1920, the program continues to ask for their graduation year. The

program then prints the year that was entered.

Answer Key:

```
#Input checking:

year = int(input('Enter your graduation year: '))
while year < 1920:
    year = int(input('Enter your graduation year: '))
print("You entered:',year)
```

(b) Write a **complete C++ program** that prints the change in population of the the United States:
$$p \;\; = \;\; p + Bp - Dp$$

where p is the population, B is the birth rate of 12.4 births for every 1000 people $\left(\frac{12.4}{1000}\right)$ each year, and D is the death rate of 8.4 for every 1000 people $\left(\frac{8.4}{1000}\right)$. In 2017, the population of United States was 325.7 million. Your program should print expected population over the 10 years from 2017 to 2026. Each line should have: the year and the population (in millions).

Answer Key:

```
//NY State Population Growth
#include <iostream>
using namespace std;
int main()
{
  float p = 325.7;
  int year;
  cout << "Year\tPopulation (in Millions)\n";
  for (year = 2017; year < 2027; year++) {
    cout << year << "\t" << p << "\n";
    p = p + p*(12.4/1000) - p*(8.4/1000);
  }
  return 0;
}
```