Final Exam, Version 4

CSci 127: Introduction to Computer Science

Hunter College, City University of New York

January 2020

Answer Key:

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

i.

```
pioneers = "Kay_Alan/Grove_Andy/Turing_Alan"
num = pioneers.count('_') + 1
print(pioneers[len(pioneers)-num:])
```

Answer Key:

```
Alan
```

ii.

```
names = pioneers.split('/')
m = names[2]
print(m[:6].upper())
```

Answer Key:

```
TURING
```

iii.

```
for n in names:
    print(n.split('_')[1])
```

Answer Key:

```
Alan
Andy
Alan
```

(b) Consider the following shell commands:

```
$ ls
```

```
hello.py  ps1.txt  ps3.txt   triangles.py
```

i. What is the output for:

```
$ mkdir submit
$ mv triangles.py submit
$ ls
```

Answer Key:

```
hello.py  ps1.txt  ps3.txt  submit
```

ii. What is the output for:

```
$ ls | grep py | wc -l
```

Answer Key:

```
1
```

iii. What is the output for:

```
$ cd submit
$ touch hwk
$ ls
```

Answer Key:

```
hwk  triangles.py
```

2. (a) Consider the code:

Answer Key:

```
import turtle
thomasH = turtle.Turtle()
```

i. After the command: `thomasH.color("#AA00AA")`, what color is `thomasH`?
□ black □ blue □ white □ gray **X** purple

ii. After the command: `thomasH.color("#1F1F1F")`, what color is `thomasH`?
□ black □ blue □ white **X** gray □ purple

iii. Fill in the code below to change `thomasH` to be the color black:
`thomasH.color("#` **0 0 0 0 0 0** `")`

iv. Fill in the code below to change `thomasH` to be the brightest green:
`thomasH.color("#` **0 0 F F 0 0** `")`

(b) Fill in the code to produce the output on the right:

i. **Answer Key:**
```
for i in range( 11 ):
  print(i, end=" ")
```

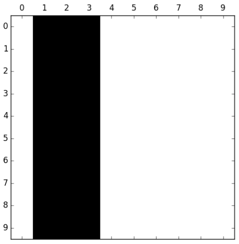
Output:
```
0 1 2 3 4 5 6 7 8 9 10
```

ii. **Answer Key:**
```
for j in range( 0, 5, 21 ):
  print(i, end=" ")
```

Output:
```
0 5 10 15 20
```

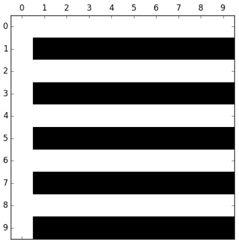
iii. **Answer Key:**
```
import numpy as np
import matplotlib.pyplot as plt
im = np.ones( (10,10,3) )
im[:,1: 4 ,:]  = 0
plt.imshow(im)
plt.show()
```

Output:



iv. **Answer Key:**
```
import numpy as np
import matplotlib.pyplot as plt
im = np.ones( (10,10,3) )
im[1:: 2 , 1:: 1 , :]  = 0
plt.imshow(im)
plt.show()
```

Output:



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

i.
```
in1 = False
in2 = True
out = in1 or in2
```

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

ii.
```
in1 = True
in2 = True
out = not in1 or (in2 and not in2)
```

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

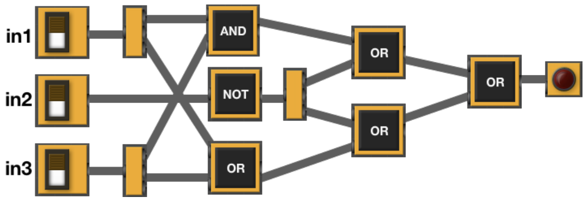
iii.

```
in1 = True
in2 = True or not in1
in3 = in1 or in2
out = in1 and not in3
```

Answer Key:

```
out = False
```

iv.



```
in1 = True
in2 = False
in3 = False
```

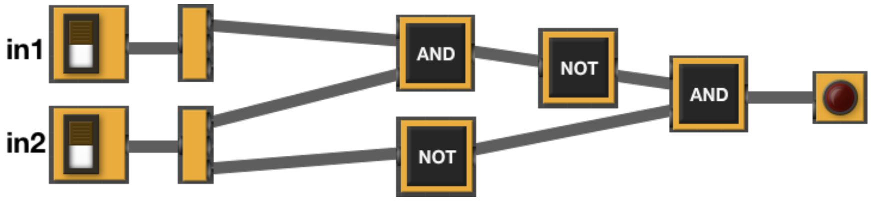
Answer Key:

```
out = True
```

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

```
(not (in1 and in2)) and (not in2)
```

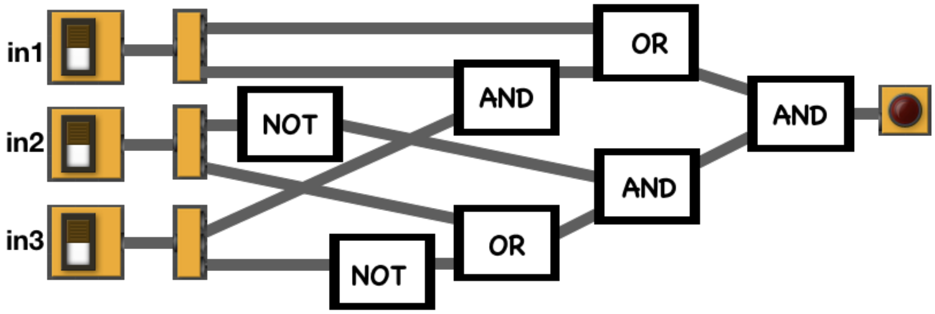
Answer Key:



(c) Fill in the circuit that implements the logical expression:

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

Answer Key:



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

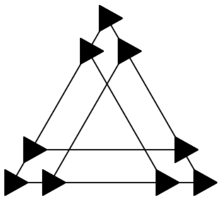
```
import turtle
fdr = turtle.Turtle()
fdr.shape('triangle')

def ramble(tr, side):
     if side < 10:
          tr.stamp()
     elif side % 3 == 0:
          for i in range(3):
               tr.left(120)
               tr.forward(side*10)
               ramble(tr, side-1)
     else:
          tr.stamp()
          ramble(tr, side-1)
```

i. `ramble(fdr,9)`

Answer Key:

ii. `ramble(fdr,15)`

Answer Key:



(b) What are the formal parameters for `ramble()`:

Answer Key: tr, side

(c) If you call `ramble(fdr,9)`, which branches of the function are tested:

Answer Key:

X the `if`-clause only,

□ the `elif`-clause only,

□ the `else`-clause only,

□ `if`-clause and the `else`-clause, or

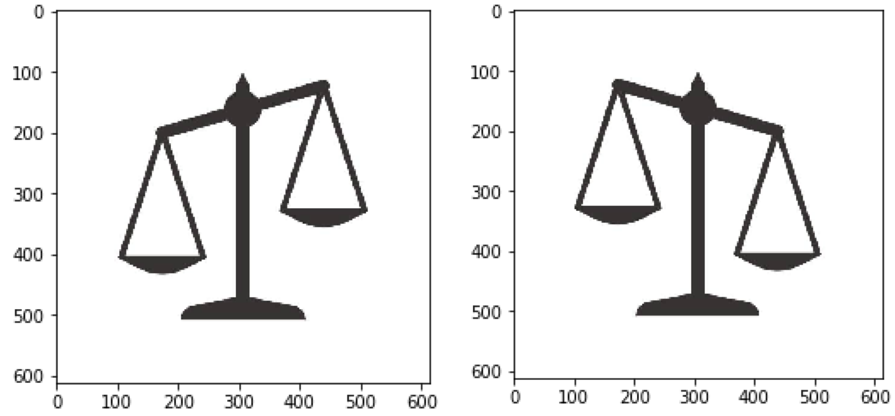
□ all the clauses are visited from this invocation (call).

(d) If you call `ramble(fdr,15)`, which branches of the function are tested:

Answer Key:

□ the `if`-clause only,
□ the `elif`-clause only,
□ the `else`-clause only,
□ `if`-clause and the `else`-clause, or
X all the clauses are visited from this invocation (call).

5. Design an algorithm that flips an image on its vertical axis (mirror image). For simplicity, you may assume a square image (i.e. same hight and length)



Libraries:

Answer Key: matplotlib.pyplot and numpy

Input:

Answer Key: The name of the image file

Output:

Answer Key: The mirrored image

Process (as a list of steps):

Answer Key:

(a) Ask user for image file name

(b) Read the image in a numpy array, call it img

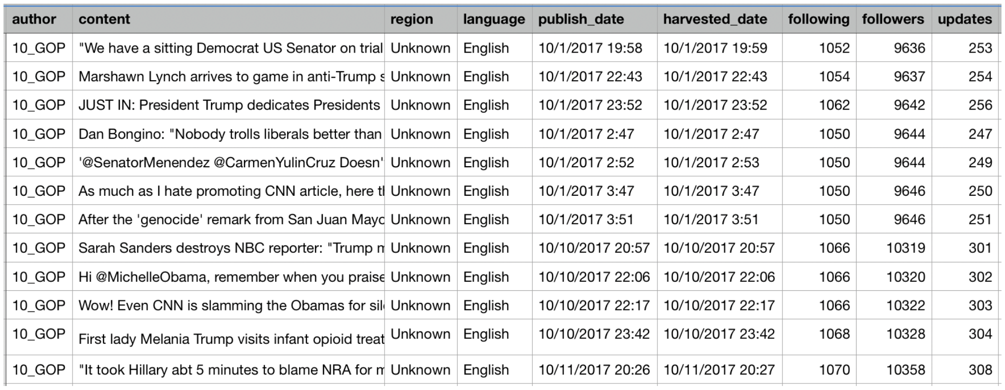
(c) Create a new numpy array with same dimensions, call it img2

(d) Copy the first column of img into the last column of img2, such that img[0,0,:] == img2[0,n,:], img[1,0,:] == img2[1,n,:], ... , img[n,0,:] == img2[n,n,:]

(e) Repeat analogous process to copy the second column of img into the second-to-last column of img2, third column of img into third-to-last column of img2, ad so on for all columns in img

(f) Save img2

6. Given the FiveThirtyEight dataset containing data on nearly 3 million tweets sent from Twitter handles connected to the Internet Research Agency, a Russian "troll factory", a snapshot given in the image below:



author	content	region	language	publish_date	harvested_date	following	followers	updates
10_GOP	"We have a sitting Democrat US Senator on trial	Unknown	English	10/1/2017 19:58	10/1/2017 19:59	1052	9636	253
10_GOP	Marshawn Lynch arrives to game in anti-Trump s	Unknown	English	10/1/2017 22:43	10/1/2017 22:43	1054	9637	254
10_GOP	JUST IN: President Trump dedicates Presidents	Unknown	English	10/1/2017 23:52	10/1/2017 23:52	1062	9642	256
10_GOP	Dan Bongino: "Nobody trolls liberals better than	Unknown	English	10/1/2017 2:47	10/1/2017 2:47	1050	9644	247
10_GOP	'@SenatorMenendez @CarmenYulinCruz Doesn'	Unknown	English	10/1/2017 2:52	10/1/2017 2:53	1050	9644	249
10_GOP	As much as I hate promoting CNN article, here tl	Unknown	English	10/1/2017 3:47	10/1/2017 3:47	1050	9646	250
10_GOP	After the 'genocide' remark from San Juan Mayc	Unknown	English	10/1/2017 3:51	10/1/2017 3:51	1050	9646	251
10_GOP	Sarah Sanders destroys NBC reporter: "Trump n	Unknown	English	10/10/2017 20:57	10/10/2017 20:57	1066	10319	301
10_GOP	Hi @MichelleObama, remember when you praise	Unknown	English	10/10/2017 22:06	10/10/2017 22:06	1066	10320	302
10_GOP	Wow! Even CNN is slamming the Obamas for sil	Unknown	English	10/10/2017 22:17	10/10/2017 22:17	1066	10322	303
10_GOP	First lady Melania Trump visits infant opioid treat	Unknown	English	10/10/2017 23:42	10/10/2017 23:42	1068	10328	304
10_GOP	"It took Hillary abt 5 minutes to blame NRA for n	Unknown	English	10/11/2017 20:26	10/11/2017 20:27	1070	10358	308

Fill in the Python program below:

Answer Key:

```
#P6,V4: extracts trolls with highest number of updates

#Import the libraries for data frames and plotting data:
import pandas as pd
import matplotlib.pyplot as plt

#Prompt user for input file name:
csvFile = input(’Enter CSV file name: ’)

#Read input data into data frame:
trolls = pd.read_csv(csvFile)

#Group tweets by author and organize by the number of updates
trollUpdates = trolls.groupby([’author’])["updates"].max()

#Print the top 6 authors/trolls with largest number of updates
print(trollUpdates[:6])
```

```
#Generate a bar plot of the top 3 authors/trolls with largest number of updates
trollUpdates.plot.bar()
plt.show()
```

7. Write a **complete Python program** that prompts the user for the name of an .png (image) file and prints the fraction of pixels that are primarily purple. A pixel is primarily purple if the red and blue values are over 90%, and the green value is less than 10%.

   Answer Key:

```
#Import the packages for images and arrays:
import matplotlib.pyplot as plt
import numpy as np
#Ask user for image name and read into img:
inImg = input('Enter input image: ')
img = plt.imread(inImg)
#Get height and width:
height = img.shape[0]
width = img.shape[1]
#Initialize counter:
count = 0
#Loop through all the pixels:
for row in range(height):
    for col in range(width):
        #Check if each pixel is primarily purple and update count:
        if (img[row,col,0] > .9) and (img[row,col,1] < .1) and (img[row,col,2] > .9):
             count = count + 1
#Compute and print fraction:
frac = count/(height*width)
print('Fraction purple is', frac)
```

8. (a) What is printed by the MIPS program below:

   Answer Key:

```
acegikmoqsuwy
```

   (b) Modify the program to print out the lower-case alphabet, 'a',...'z'. Shade in the box for each line that needs to be changed and rewrite the instruction below.

   Answer Key:

```
#Loop through characters
ADDI $sp, $sp, -27       # Set up stack
ADDI $t0, $zero, 97      # Start $t0 at 97 (a)
ADDI $s2, $zero, 123     # Use to test when you reach 123
```

```
SETUP: SB $t0, 0($sp)    # Next letter in $t0
ADDI $sp, $sp, 1         # Increment the stack
ADDI $t0, $t0, 1         # Increase the letter by 1
BEQ $t0, $s2, DONE       # Jump to done if $t0 == 85
J SETUP                  # If not, jump back to SETUP for loop
DONE: ADDI $t0, $zero, 0 # Null (0) to terminate string
SB $t0, 0($sp)           # Add null to stack
ADDI $sp, $sp, -27       # Set up stack to print
ADDI $v0, $zero, 4       # 4 is for print string
ADDI $a0, $sp, 0         # Set $a0 to stack pointer for printing
syscall                  # Print to the log
```

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

(a)

```
//Quote by Alan Turing
#include <iostream>
using namespace std;
int main()
{
  cout<<"I propose to\nconsider";
  cout<<" the question,\n'Can machines";
  cout<<" think?'"<<endl<< "A.T.";
  return 0;
}
```

Answer Key:

```
I propose to
consider the question,
'Can machines think?'
A.T.
```

(b)

```
#include <iostream>
using namespace std;
int main()
{
    double num = 0;
    double tot = 0;
    while (tot < 100) {
        cout <<"Please enter amount\n";
        cin >> tot;
        num++;
    }
    cout << num << endl;
    return 0;
}
```

Answer Key:

```
Please enter amount
Please enter amount
Please enter amount
```

(c)

```
#include <iostream>
using namespace std;
int main(){
    int i, j;
    for (i = 1; i < 6; i++){
        for (j = 0; j < i; j++){
            if(j % 2 == 1)
                cout << "X";
            else
                cout << "O";
        }
        cout << endl;
    }
    return 0;
}
```

Answer Key:

```
O
OX
OXO
OXOX
OXOXO
```

10. (a) Translate the following program into a **complete C++ program**:

```
#Python Loops, V4
for i in range(25,50,5):
    print(i, i+1)
```

Answer Key:

```
//C++ Loop, V4
#include <iostream>
using namespace std;
int main()
{
    for(int i=25; i<50; i+=5)
        cout << i << " " <<  i+1 << endl;
    return 0;
}
```

(b) The number of active monthly WeChat users grew from ∼151 million in 2012 to ∼1132.7 million (1.13 billion) in 2019. The average annual growth rate can then be estimated as

$$\text{avgGrowth} = \frac{\%\text{growth}}{\text{number-of-years}} = \frac{100 \cdot \frac{1132.7-151}{151}}{2019-2012} = 92.87\%$$

We can thus estimating an average annual growth: **avgGrowth = 92.87%**

Write a **complete C++ program** that asks the user for a year greater than 2012 (assume user complies) and prints the estimated number (in millions) of active monthly WeChat users in that year.

Answer Key:

```
//WeChat monthly active users V4
#include <iostream>
using namespace std;
int main()
{
    double past = 151;
    double avgGrowth = past * .9287;
    int year = 0;

    cout << "Please enter a year between 2012 and 2019 : ";
    cin >> year;t

    double users = past + (avgGrowth * (year-2012));

    cout << "The number of monthly active WeChat users in ";
    cout << year << " is approximately " << users << " millions" << endl;

    return 0;
}
```