

FINAL EXAM, VERSION 2
CSci 127: Introduction to Computer Science
Hunter College, City University of New York

16 December 2019

Answer Key:

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

```
pioneers = "Easley;Annie/Wilkes;Mary Ann/Goldberg;Adele"  
i. print(pioneers.count('A'))  
   print(pioneers[-5:].upper())
```

Answer Key:

3
ADELE

```
names = pioneers.split('/')  
ii. m = names[1]  
    print(m[7:])
```

Answer Key:

Mary Ann

```
iii. for n in names:  
      print(n.split(';')[0])
```

Answer Key:

Easley
Wilkes
Goldberg

- (b) Consider the following shell commands:

```
$ pwd
/Users/login/hwk
$ ls
tickets.csv  p30.py  p40.py  nyc.csv
```

- i. What is the output for:
- ```
$ mkdir csci127
$ mv *csv csci127
$ ls
```

**Answer Key:**

```
csci127 p30.py p40.py
```

- ii. What is the output for:
- ```
$ cd csci127
$ ls | grep nyc
```

Answer Key:

```
nyc.csv
```

- iii. What is the output for:
- ```
$ cd ../
$ pwd
```

**Answer Key:**

```
/Users/login/hwk
```

2. (a) Consider the code:

**Answer Key:**

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

- i. After the command: `thomasH.color("#000000")`, what color is `thomasH`?  
☒ black      ☐ green      ☐ white      ☐ gray      ☐ purple
- ii. After the command: `thomasH.color("#00BC00")`, what color is `thomasH`?  
☐ black      ☒ green      ☐ white      ☐ gray      ☐ purple
- iii. Fill in the code below to change `thomasH` to be the color white:  
`thomasH.color("# 

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| F | F | F | F | F | F |
|---|---|---|---|---|---|

 ")`
- iv. Fill in the code below to change `thomasH` to be the brightest red:  
`thomasH.color("# 

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| F | F | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|

 ")`

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

- i. **Answer Key:** `for i in range( 5 ):`  
`print(i, end=" ")`

**Output:**

0 1 2 3 4

- ii. **Answer Key:** `for j in range( 1, 6, 1 ):`  
`print(i, end=" ")`

**Output:**

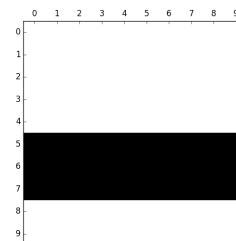
1 2 3 4 5

**Answer Key:**

`import numpy as np`  
`import matplotlib.pyplot as plt`

- iii. `im = np.ones( (10,10,3) )`

`im[5:  , :, :] = 0`  
`plt.matshow(im)`  
`plt.show()`



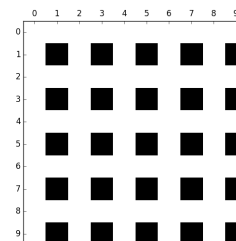
**Answer Key:**

`import numpy as np`  
`import matplotlib.pyplot as plt`

- iv. `im = np.ones( (10,10,3) )`

`im[1::  , 1::  , :] = 0`  
`plt.matshow(im)`  
`plt.show()`

**Output:**



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

`in1 = False`

- i. `in2 = True`

`out = in1 or in2`

**Answer Key:**

`out = True`

`in1 = True`

- ii. `in2 = True`

`out = not in1 or (in2 and not in2)`

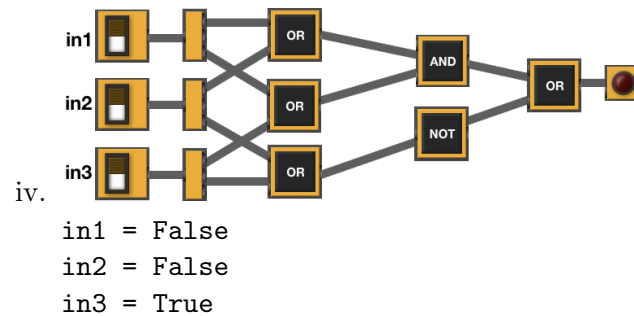
**Answer Key:**

`out = True`

$\text{in1} = \text{True}$   
 iii.  $\text{in2} = \text{True or not in1}$   
 $\text{in3} = \text{in1 or in2}$   
 $\text{out} = \text{in1 and not in3}$

**Answer Key:**

$\text{out} = \text{False}$



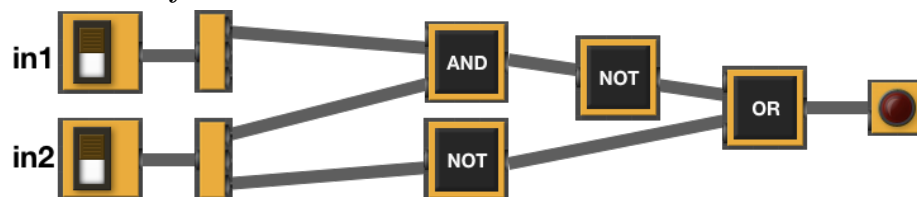
**Answer Key:**

$\text{out} = \text{False}$

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

$((\text{in1 or in2}) \text{ and } (\text{not in2}))$

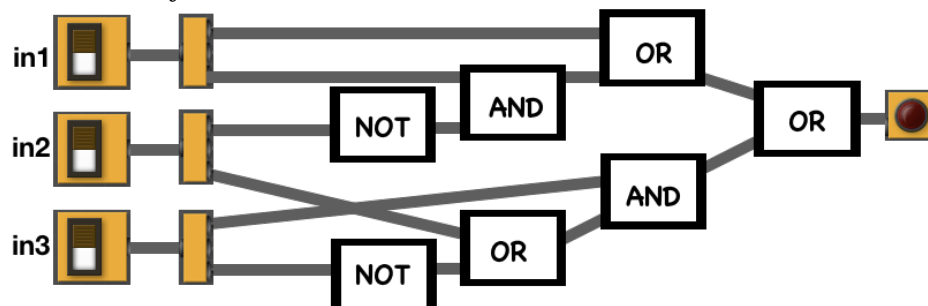
**Answer Key:**



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

$(\text{in1 or } (\text{in1 and } (\text{not in2})) \text{ or } (\text{in3 and } (\text{in2 or } (\text{not in3}))))$

**Answer Key:**



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

i. `ramble(tom,8,False)`

**Answer Key:**

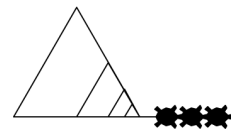
```
import turtle
tom = turtle.Turtle()
tom.shape('turtle')
```



```
def ramble(ty, dist, stamp):
 if dist > 10:
 for i in range(3):
 ty.left(120)
 ty.forward(dist)
 ramble(ty,dist//2,stamp)
 elif stamp:
 for i in range(3):
 ty.forward(20)
 ty.stamp()
 else:
 ty.forward(20)
```

ii. `ramble(tom,100,True)`

**Answer Key:**



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

**Answer Key:** `ty, dist, stamp`

(c) If you call `ramble(tom,8,False)`, which branches of the function are tested:

**Answer Key:**

- ☐ the `if`-clause only,
- ☐ the `elif`-clause only,
- ☒ the `else`-clause only,
- ☐ the `else`-clause only,

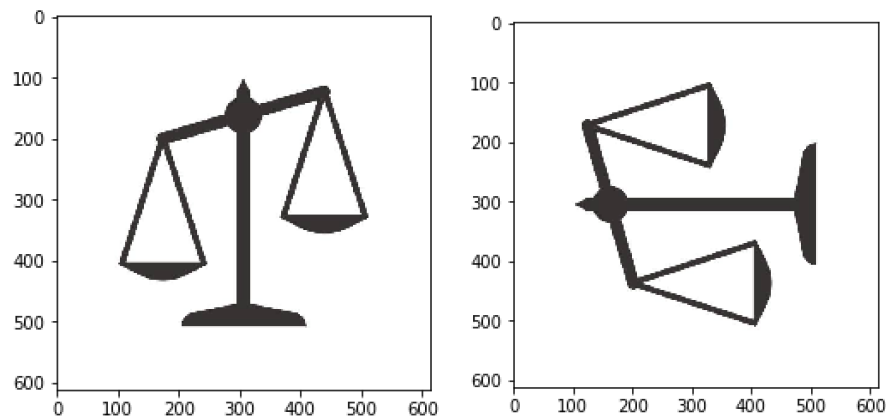
- ☐ `if`-clause and the `elif`-clause, or
- ☐ all the clauses are visited from this invocation (call).

(d) If you call `ramble(tom,100,True)`, 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 `elif`-clause, or
- ☐ all the clauses are visited from this invocation (call).

5. Design an algorithm that rotates an image by 90 degrees to the left. For simplicity, you may assume a square image (i.e. same height and length)



**Libraries:**

**Answer Key:** `matplotlib.pyplot` and `numpy`

**Input:**

**Answer Key:** The name of the image file

**Output:**

**Answer Key:** The rotated 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 row of img into the first column of img2, such that  $\text{img}[0,0,:] == \text{img2}[n,0,:]$ ,  $\text{img}[0,1,:] == \text{img2}[n-1,0,:]$ , ... ,  $\text{img}[0,n,:] == \text{img2}[0,0,:]$
  - (e) Repeat analogous process to copy the second row of img into the second column of img2, third row of img into third column of img2, and so on for all rows 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 ti    | 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,V2: extracts trolls with highest number of tweets
```

```
#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)
```

```
#Count the number of tweets for each author/troll:
```

```
frequentTrolls = trolls["author"].value_counts()
```

```
#Print the top 10 authors/trolls with largest number of tweets
```

```
print(frequentTrolls[:10])
```

```
#Generate a bar plot of the top 10 authors/trolls with largest number of tweets
frequentTrolls()
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 very dark. A pixel is very dark if the red, green, and blue values are **all** 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 very dark and update count:
 if (img[row,col,0] < .1) and (img[row,col,1] < .1) and (img[row,col,2] < .1):
 count = count + 1
#Compute and print fraction:
frac = count/(height*width)
print('Fraction dark is', frac)
```

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

**Answer Key:**

ZZZZZZZZZZ

- (b) Modify the program to print out 100 copies of the letter '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, -101 # Set up stack
ADDI $s3, $zero, 1 # Store 1 in a registrar
```



```

ADDI $t0, $zero, 90 # Set $t0 at 90 (Z)
ADDI $s2, $zero, 100 # Use to test when you reach 10
SETUP: SB $t0, 0($sp) # Next letter in $t0
ADDI $sp, $sp, 1 # Increment the stack
SUB $s2, $s2, $s3 # Decrease the counter by 1
BEQ $s2, $zero, DONE # Jump to done if $s0 == 0
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, -101 # 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?

```

//Quote by Adele Goldberg
#include <iostream>
using namespace std;
int main()
{
(a) cout << "Dont ask whether\nyou ";
 cout << "can do something, \nbut";
 cout << " how to do it.";
 cout << endl << "A.G.";
 return 0;
}

```

### Answer Key:

```

Dont ask whether
you can do something,
but how to do it.
A.G.
#include <iostream>
using namespace std;
int main()
{
 double num = 0;
 double weight = 0;
 while (weight < 100) {
(b) cout << "Please enter weight\n";
 cin >> weight;
 num++;
 }
 cout << num << endl;
 return 0;
}

```

**Answer Key:**

Please enter weight

Please enter weight

Please enter weight

#include &lt;iostream&gt;

using namespace std;

int main(){

int i, j;

for (i = 4; i &gt; 0; i--){

for (j = 0; j &lt; i; j++){

if(j % 2 == 0)

(c) cout &lt;&lt; "0";

else

cout &lt;&lt; "X";

}

cout &lt;&lt; endl;

}

return 0;

}

**Answer Key:**

0X0X

0X0

0X

0

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

#Python Loops, V2

for i in range(1,20,4):

print('\*',i,'\*')

**Answer Key:**

//C++ Loop, V2

#include &lt;iostream&gt;

using namespace std;

int main()

{

for(int i=1; i&lt;20; i+=4)

cout &lt;&lt; "\*" &lt;&lt; i &lt;&lt; " \*\n";

return 0;

}

- (b) The number of Twitter monthly active users grew from ~10 million in 2010 to ~68 million

in 2019. The average annual growth rate can then be estimated as

$$\text{avgGrowth} = \frac{\% \text{growth}}{\text{number-of-years}} = \frac{100 \cdot \frac{68-10}{10}}{2019 - 2010} = 64.4\%$$

We can thus estimate the average annual growth: **avgGrowth = 64.4%**.

Write a **complete C++ program** that asks the user for a year greater than 2010 (assume user complies) and prints the estimated number (in millions) of Twitter users in that year.

**Answer Key:**

```
//Twitter monthly active users V2
#include <iostream>
using namespace std;
int main()
{
 double past = 10;
 double avgGrowth = past * .644;
 int year = 0;

 cout << "Please enter a year between 2010 and 2019: ";
 cin >> year;

 double users = past + (avgGrowth * (year-2010));

 cout << "The number of Twitter users in ";
 cout << year << " is approximately ";
 cout << users << " millions" << endl;

 return 0;
}
```