

Answer Key:

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

16 December 2019

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

```
for n in names:
iii. 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
---	---	---	---	---

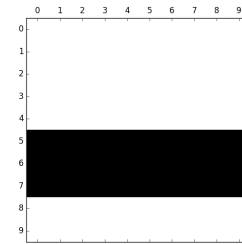
Answer Key:

```

import numpy as np
import matplotlib.pyplot as plt
iii. im = np.ones( (10,10,3) )

      8
im[5: ,:,:] = 0
plt.matshow(im)
plt.show()

```

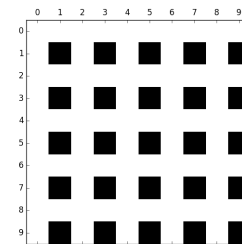
Output:**Answer Key:**

```

import numpy as np
import matplotlib.pyplot as plt
iv. im = np.ones( (10,10,3) )

      2      2
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
```

```
in1 = True
```

```
in2 = True or not in1
```

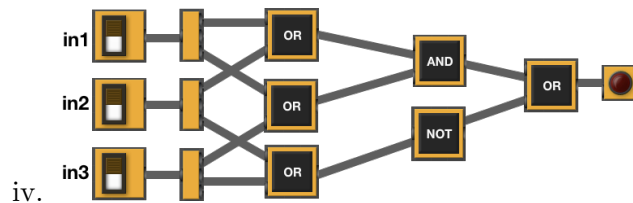
```

iii. in3 = in1 or in2
      out = in1 and not in3

```

Answer Key:

```
out = False
```



in1 = False

in2 = False

in3 = True

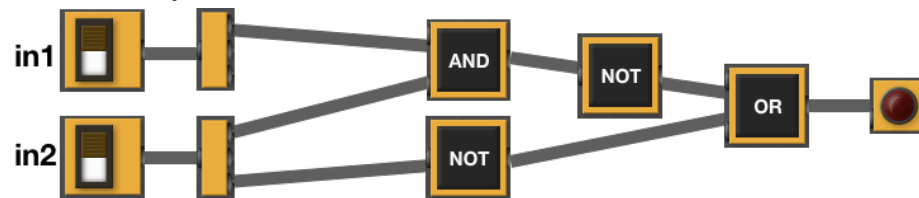
Answer Key:

out = False

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

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

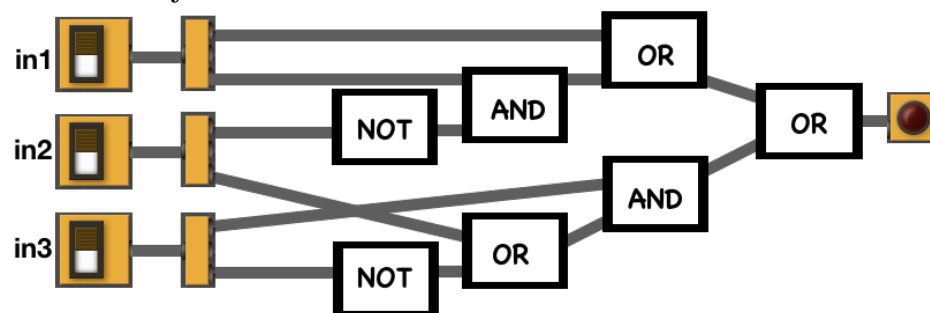
Answer Key:



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

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

Answer Key:



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

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

Answer Key:

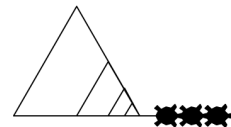
```
1: import turtle
2: tom = turtle.Turtle()
3: tom.shape('turtle')
```



```
4: def ramble(ty, dist, stamp):
5:     if dist > 10:
6:         for i in range(3):
7:             ty.left(120)
8:             ty.forward(dist)
9:             ramble(ty,dist//2,stamp)
10:    elif stamp:
11:        for i in range(3):
12:            ty.forward(20)
13:            ty.stamp()
14:    else:
15:        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 (check all that apply):

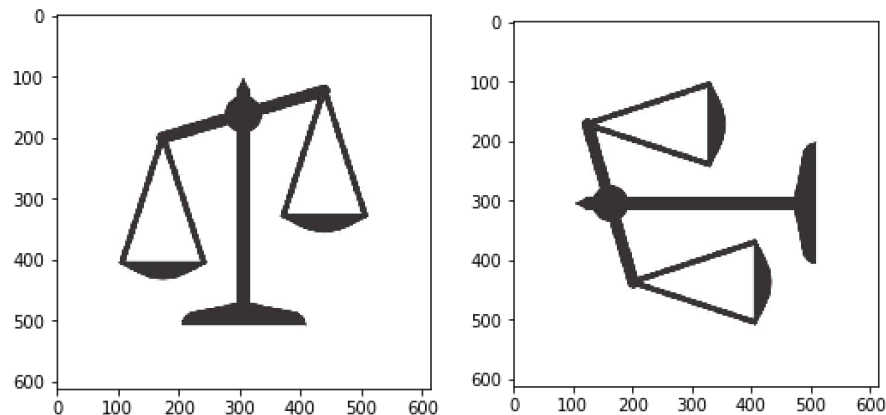
Answer Key:

- ☐ The block of code at Lines 6-9.
- ☐ The block of code at Lines 11-13.
- ☒ The block of code at Line 15.
- ☐ None of these blocks of code (lines 6-9, 11-13, 15) are visited from this invocation (call).

- (d) If you call `ramble(tom,100,True)`, which branches of the function are tested (check all that apply):

Answer Key:

- ☒ The block of code at Lines 6-9.
 - ☒ The block of code at Lines 11-13.
 - ☐ The block of code at Line 15.
 - ☐ None of these blocks of code (lines 6-9, 11-13, 15) 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 `img[0,0,:] == img2[n,0,:]`, `img[0,1,:] == img2[n-1,0,:]`, ... , `img[0,n,:] == 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 << "Don't ask whether\nyou ";
      cout << "can do something, \nbut";
      cout << " how to do it.";
      cout << endl << "A.G.";
      return 0;
}

```

Answer Key:

```

Don't 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 <iostream>
using namespace std;
int main(){
    int i, j;
    for (i = 4; i > 0; i--){
        for (j = 0; j < i; j++){
            if(j % 2 == 0)
(c)         cout << "0";
            else
                cout << "X";
        }
        cout << endl;
    }
    return 0;
}

```

Answer Key:

```

OXOX
OXO
OX
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 <iostream>
using namespace std;
int main()
{
    for(int i=1; i<20; i+=4)
        cout << "*" << i << " *\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)))/12;

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

    return 0;
}
```