

Answer Key:

FINAL EXAM, VERSION 4
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 = "Kay_Alan/Grove_Andy/Turing_Alan"
i. num = pioneers.count('_') + 1
   print(pioneers[len(pioneers)-num:])
```

Answer Key:

Alan

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

Answer Key:

TURING

```
for n in names:
iii.     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      ☒ purple
- ii. After the command: `thomasH.color("#1F1F1F")`, what color is `thomasH`?  
☐ black      ☐ blue      ☐ white      ☒ 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 |
|---|---|----|----|----|

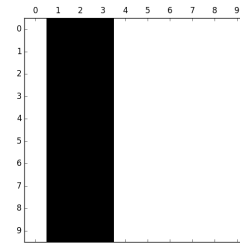
**Answer Key:**

```

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

 4
im[:,1:4,:] = 0
plt.imshow(im)
plt.show()

```

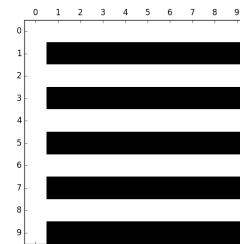
**Output:****Answer Key:**

```

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

 2 1
im[1::2, 1::1, :] = 0
plt.imshow(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
```

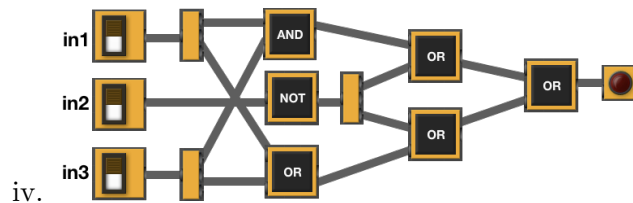
```
in2 = True or not in1
```

iii. in3 = in1 or in2

```
out = in1 and not in3
```

**Answer Key:**

```
out = False
```



in1 = True  
in2 = False  
in3 = False

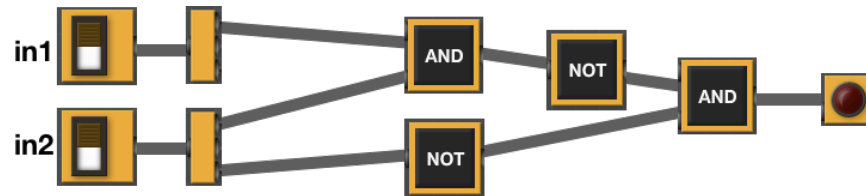
**Answer Key:**

out = True

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

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

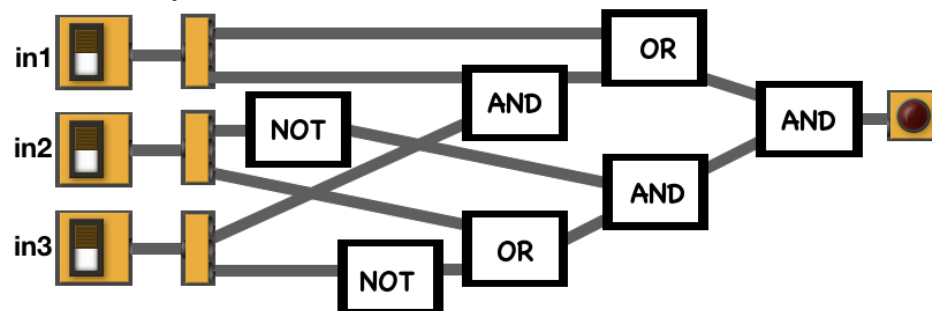
**Answer Key:**



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

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

**Answer Key:**



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

i. `ramble(fdr,9)`

**Answer Key:**

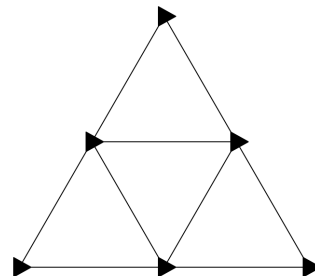
```
import turtle
fdr = turtle.Turtle()
fdr.shape('triangle')
```



```
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//2)
 else:
 tr.stamp()
```

ii. `ramble(fdr,30)`

**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:**

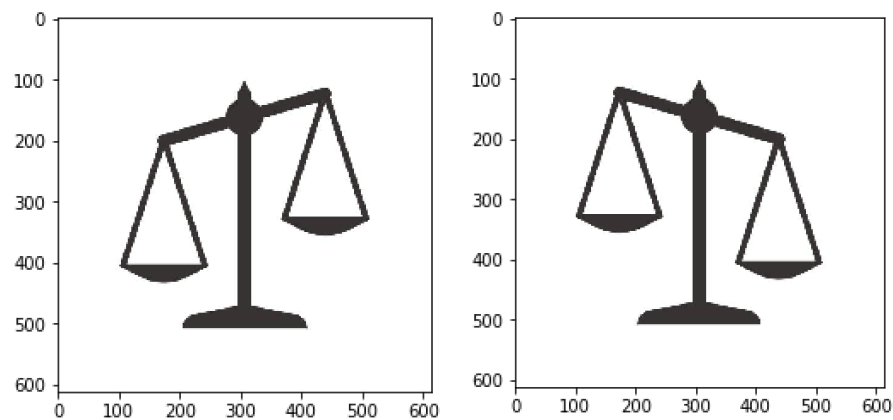
- ☒ the `if`-clause only,
- ☐ the `elif`-clause only,
- ☐ the `else`-clause only,
- ☐ `if`-clause and the `else`-clause, or
- ☐ all the clauses are visited from this invocation (call).

(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
- ☒ 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 height 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`, and 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 t     | 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?

```

//Quote by Alan Turing
#include <iostream>
using namespace std;
int main()
{
(a) 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?'
#include <iostream>
using namespace std;
int main()
{
 double num = 0;
 double tot = 0;
 while (tot < 100) {
(b) cout <<"Please enter amount\n";
 cin >> tot;
 num++;
 }
 cout << num << endl;
 return 0;
}

```

### Answer Key:

Please enter amount

```

Please enter amount
Please enter amount
#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)
(c) cout << "X";
 else
 cout << "0";
 }
 cout << endl;
 }
 return 0;
}

```

**Answer Key:**

```

0
0X
0X0
0X0X
0X0X0

```

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;

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

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

 return 0;
}
```