Answer Key:

Final Exam, Version 1
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:

i.
```
pioneers = "Lovelace,Ada-Fleming,Williamina-Hopper,Grace"
num = pioneers.count(',')
num = num + pioneers.count('-')
print(pioneers[len(pioneers)-num:])
```

Answer Key:
```
Grace
```

ii.
```
names = pioneers.split('-')
l = names[0].split(',')
print(l[1].upper())
```

Answer Key:
```
ADA
```

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

Answer Key:
```
L.
F.
H.
```

(b) Consider the following shell commands:

```
$ pwd
/Users/login/csci127
$ ls
elev.csv  p50.py  p60.py  snow.csv
```

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

Answer Key:

```
elev.csv hwk snow.csv
```

ii. What is the output for:

```
$ cd hwk
$ ls | grep ^p
```

Answer Key:

```
p50.py
p60.py
```

iii. What is the output for:

```
$ cd ../
$ pwd
```

Answer Key:

```
/Users/login/csci127
```

2. (a) Consider the code:

Answer Key:

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

i. After the command: `thomasH.color("#000000")`, what color is `thomasH`?
X black ☐ red ☐ white ☐ gray ☐ purple

ii. After the command: `thomasH.color("#AB0000")`, what color is `thomasH`?
☐ black **X** red ☐ white ☐ gray ☐ purple

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

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

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

i. **Answer Key:**

```
for i in range( 8 ):
  print(i, end=" ")
```

Output:

```
0 1 2 3 4 5 6 7
```

ii. **Answer Key:**

```
for j in range( -5, 2, 2 ):
  print(i, end=" ")
```

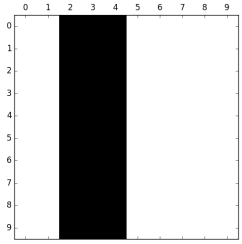
Output:

```
-5 -3 -1 1
```

iii. **Answer Key:**

```
import numpy as np
import matplotlib.pyplot as plt
im = np.ones( (10,10,3) )
im[:,2:5,:]  = 0
plt.imshow(im)
plt.show()
```

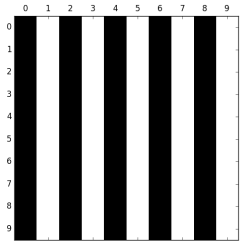
Output:



iv. **Answer Key:**

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

Output:



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

i.
```
in1 = True
in2 = False
out = in1 or (not in2)
```

Answer Key:

```
out = True
```

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

Answer Key:

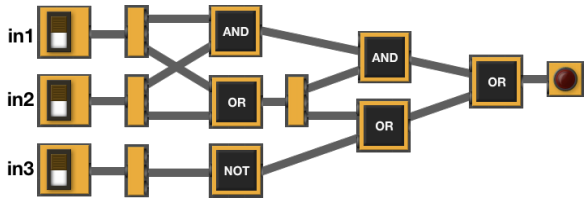
```
out = False
```

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

Answer Key:

```
out = False
```

iv.




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

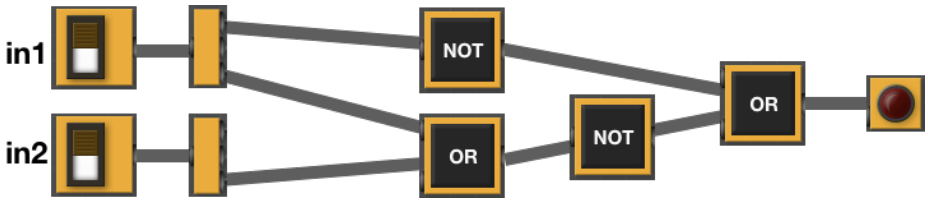
Answer Key:

```
out = True
```

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

```
not in1 or not (in1 or in2)
```

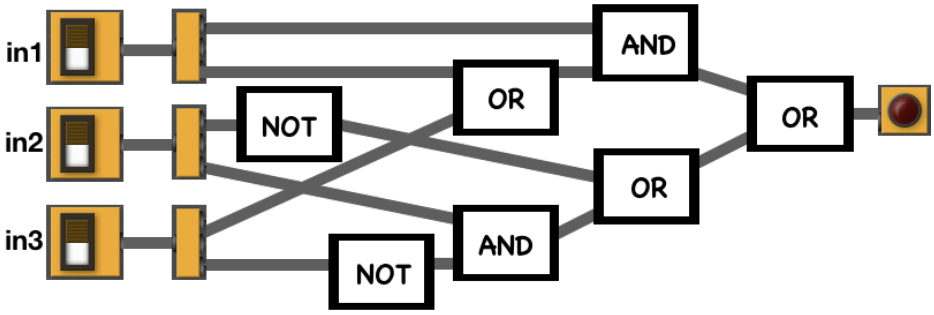
Answer Key:



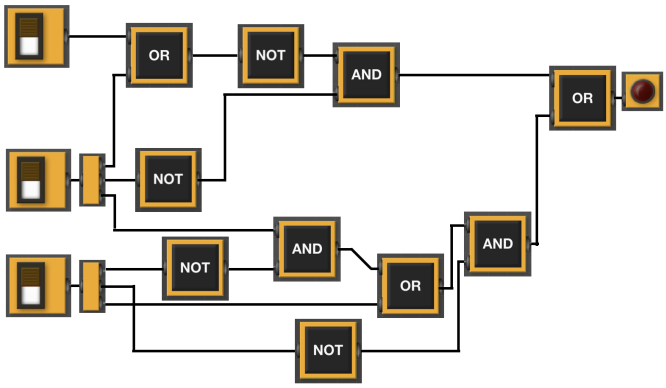
(c) Fill in the circuit that implements the logical expression:

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

Answer Key:



Answer Key:



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

i. `ramble(tara,5)`

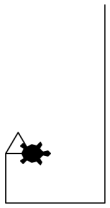
Answer Key:

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

4:  def ramble(tex, side):
5:       if side <= 0:
6:            tex.stamp()
7:       elif side <= 10:
8:            for i in range(3):
9:                 tex.left(120)
10:                tex.forward(20)
11:      else:
12:           tex.right(90)
13:           tex.forward(side)
14:           ramble(tex, side//2)
```

ii. `ramble(tara,160)`

Answer Key:



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

Answer Key: tara, side

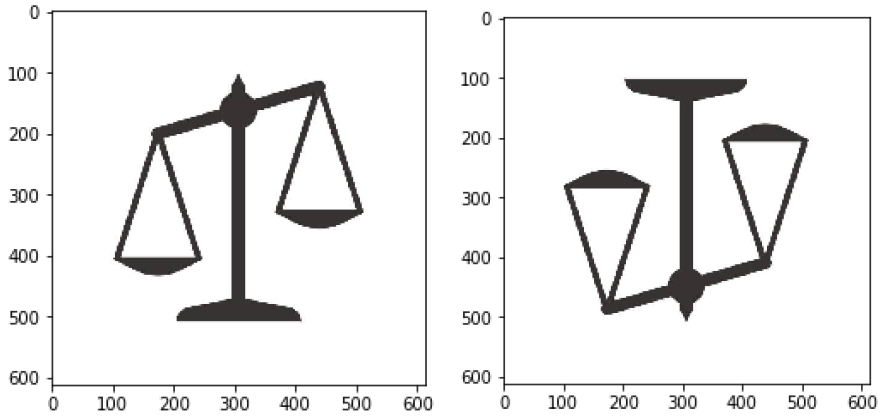
(c) If you call `ramble(tara, 5)`, which branches of the function are tested (check all that apply): **Answer Key:**

- ☐ The block of code at Line 6.
- **X** The block of code at Lines 8-10.
- ☐ The block of code at Lines 12-14.
- ☐ None of these blocks of code (lines 6, 8-10, 12-14) are visited from this invocation (call).

(d) If you call `ramble(tara, 160)`, which branches of the function are tested (check all that apply): **Answer Key:**

- ☐ The block of code at Line 6.
- **X** The block of code at Lines 8-10.
- **X** The block of code at Lines 12-14.
- ☐ None of these blocks of code (lines 6, 8-10, 12-14) are visited from this invocation (call).

5. Design an algorithm that rotates an image by 180 degrees (upside down 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 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 reversed into the last row of img2, such that img[0,0,:] == img2[n,n,:], img[0,1,:] == img2[n,n-1,:], ... , img[0,n,:] == img2[n,0,:]

(e) Repeat analogous process to copy the second row of img into the second-to-last row of img2, third row of img into third-to-last row 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 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,V1: extracts trolls with highest number of followers

#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 followers
trollFollowers = trolls.groupby(['author'])["followers"].max()

#Print the top 3 authors/trolls with largest number of followers
print(trollFollowers[:3])

#Generate a bar plot of the top 3 authors/trolls with largest number of followers
trollFollowers.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 red. A pixel is primarly red if the red value is over 90% and the green and blue values are 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 red and update count:
        if (img[row,col,0] > .9) 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 red is', frac)
```

8. (a) What does the MIPS program below print:

Answer Key:

```
JIHGFEDCBA
```

(b) Modify the program to print out 26 consecutive letters in decreasing order ('Z' down to 'A'). 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 $s3, $zero, 1 # Store 1 in a registrar
ADDI $t0, $zero, 90 # Start $t0 at 90 (Z)
ADDI $s2, $zero, 64 # Use to test when you reach 64
SETUP: SB $t0, 0($sp) # Next letter in $t0
ADDI $sp, $sp, 1    # Increment the stack
SUB $t0, $t0, $s3    # Decrease the letter by 1
BEQ $t0, $s2, DONE  # Jump to done if $t0 == $s2
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? For (b) assume the user enters 5,2,5 in that order.

(a)

```
//Quote by Grace Hopper
#include <iostream>
using namespace std;
int main()
{
    cout << "One accurate measurement ";
    cout << "is \nworth a thousand ";
    cout << "expert ";
    cout << "opinions. "<<endl<<"G.H.";
    return 0;
}
```

Answer Key:

```
One accurate measurement is
worth a thousand expert opinions.
G.H.
```

(b)
```
#include <iostream>
using namespace std;
int main()
{
    double num = 0;
    double tot = 0;
    while (tot < 10) {
        cout <<"Please enter amount\n";
        cin >> num;
        tot += num;
    }
    cout << tot << endl;
    return 0;
}
```

Answer Key:

```
Please enter amount
Please enter amount
Please enter amount
12
```

(c)
```
#include <iostream>
using namespace std;
int main(){
    int i, j;
    for (i = 1; i < 5; i++){
        for (j = 0; j < i; j++){
            if(j % 2 == 0)
                cout << "X";
            else
                cout << "O";
        }
        cout << endl;
    }
    return 0;
}
```

Answer Key:

```
X
XO
XOX
XOXO
```

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

```
#Python Loops, V1
for i in range(25,101,25):
    print(i+1, i+2)
```

Answer Key:

```
//C++ Loop, V1
#include <iostream>
using namespace std;
int main()
{
    for(int i=25; i<101; i+=25)
        cout<< i+1 << " " << i+2 << " " << endl;
    return 0;
}
```

(b) The number of Instagram monthly active users grew from ∼130 million in 2013 to ∼1000 million (1 billion) in 2019. The average annual growth rate can then be estimated as

$$\text{avgGrowth} = \frac{\%\text{growth}}{\text{number-of-years}} = \frac{100 \cdot \frac{1000-130}{130}}{2019-2013} = 134\%$$

We can thus estimate the average annual growth: **avgGrowth = 134%**.

Write a **complete C++ program** that asks the user for a year greater than 2013 (assume user complies) and prints the estimated number (in millions) of monthly active Instagram users in that year.

Answer Key:

```
//Instagram monthly active users V1
#include <iostream>
using namespace std;
int main()
{
    double past = 130;
    double avgGrowth = past * 1.34;
    int year = 0;

    cout << "Please enter a year between 2013 and 2018: ";
    cin >> year;

    double users = (past + (avgGrowth * (year-2013)))/12;

    cout << "The number of Social Network monthly users in ";
    cout << year << " is approximately " << users;
    cout << " billions" << endl;

    return 0;
}
```