Answer Key:

Final Exam, Version 3
CSci 127: Introduction to Computer Science
Hunter College, City University of New York

23 May 2022

1. (a) Fill in the code below to produce the Output on the right:

```
workdays = "Monday?Tuesday?Wednesday?Thursday?"
summer_months = "*June*July*August*"
long_weekend = "Friday_Saturday_Sunday"
seasons = "+Spring+Summer+Fall+Winter"
```

i.

```
print( □ ], □ ])
```

Answer Key:

```
print(seasons[1:7],workdays[7:14])
```

ii.

```
days = long_weekend[ □ ].split( □ )

print("Our weekend has", len( □ ),"days.")
```

Answer Key:

```
days = long_weekend[:].split(’_’)
print("Our weekend has", len(days), "days.")
```

iii.

```
for d in □

    print(□ )
```

Answer Key:

```
       for d in days:
            print(d.upper())
```

(b) Consider the following shell commands:

```
$ pwd
/Users/guest
$ ls
bronx.png  circuit.txt   nand.txt  nyc.png    temp
```

i. What is the output for:

```
$ mkdir logic
$ mv *txt logic
$ ls
```

Answer Key:

```
bronx.png    logic  nyc.png    temp
```

ii. What is the output for:

```
$ cd logic
$ ls
```

Answer Key:

```
circuit.txt   nand.txt
```

iii. What is the output for:

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

Answer Key:

```
/Users/guest/temp
```

2. (a) Select the correct option.

Answer Key:

i. What color is tina? `tina.color(1.0,0.0,1.0)`
□ black □ red □ white □ gray **X** purple

ii. Select the SMALLEST Binary number:
□ 1011 □ 1101 □ 1111 **X** 1010 □ 1110

iii. Select the LARGEST Hexadecimal number:
□ AA □ BA **X** DC □ CC □ CD

iv. What is the binary number equivalent to decimal 14?
□ 1011 □ 1101 □ 1111 □ 1010 **X** 1110

v. What is the hexadecimal number equivalent to decimal 170?
X AA □ BA □ DC □ CC □ CD

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

```
nums = [ 23, 45, 76, 23, 98, 45 , 11, 4, 33, 29, 5, 66]
```

i. **Answer Key:**

```
for i in range( 3,                    10 ):
print(nums[i], end=" ")
```

Output:

```
23 98 45 11 4 33 29
```

ii. **Answer Key:**

```
for j in range( 1,12,4 ):
  print(nums[j], end=" ")
```

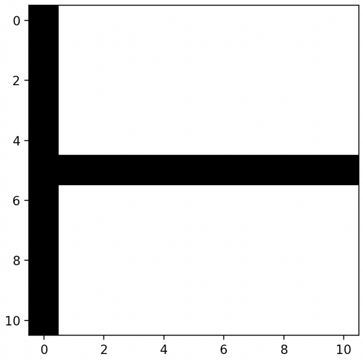
Output:

```
45 45 29
```

iii. **Answer Key:**

```
import numpy as np
import matplotlib.pyplot as plt
img = np.ones( (11,11,3) )
img[ 5 , : , :]  = 0
# black row
img[ : , 0 , :]  = 0
# black column
plt.imshow(im)
plt.show()
```

Output:



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

i.

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

Answer Key:

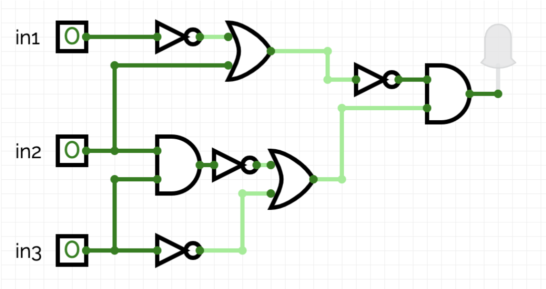
```
out = True
```

ii.

```
in1 = True
in2 = False
in3 = ( not in1 ) or ( not in2 )
out = (not in1 or not in2) and (not in2 and in3)
```

Answer Key:

```
out = True
```

iii. 

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

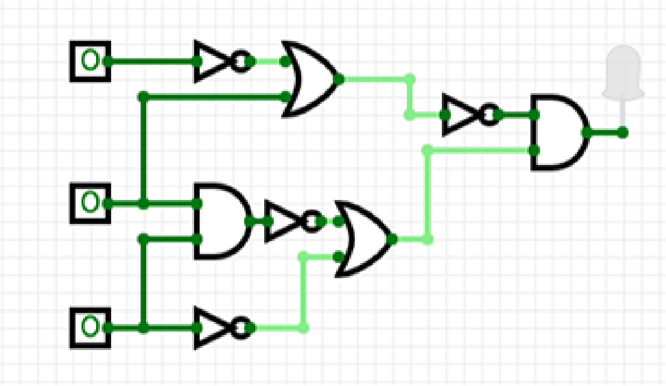
Answer Key:

```
out = True
```

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

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

Answer Key:



4. Consider the following functions:

```
def whoop(n, smile):
   for i in range(1,n+1):
      screech(i, smile)
      print()
```

```
def screech(i, smirk):
    for j in range(i):
      print(smirk, end='  ')


def main():
      whoop(3, '^_^')
```

(a) What are the formal parameters for `screech()`?

Answer Key: i, smirk

(b) What are the actual parameters for `whoop()`?

Answer Key:

```
3, '^_^'
```

(c) How many calls are made to `screech()` after calling `main()`?

Answer Key: 3

(d) What is the output after calling `main()`?

Output:

Answer Key:

```
^_^
^_^  ^_^
^_^  ^_^  ^_^
```

5. Design an algorithm that asks the user for the name of an image file and the quarter ['TL', 'TR', 'BL', 'BR'] they wish to "black-out", where 'TL' stands for Top Left, 'BL' stands for Bottom Right and so on. The algorithm then saves a new image where that quarter of the image is black. The name of the new image is 'XXblack.png' where XX is replaced by one of ['TL', 'TR', 'BL', 'BR'] that the user entered. You must write detailed **pseudocode** as a precise list of steps that completely and precisely describe the algorithm.

Libraries (if any):

Answer Key: pyplot and numpy

Input:

Answer Key: The file name and the quarter

Output:

Answer Key: An image where the corresponding quarter is black

Principal Mechanisms (select all that apply):

Answer Key: ☐ Search ☐ Single Loop ☐ Nested Loop **X**Conditional (if/else) statement
XIndexing / Slicing ☐ `split()` **X**`input()`

Process (as a concise and precise LIST OF STEPS / pseudocode):
(Assume libraries, if any, have already been imported.)

Answer Key:

(a) Ask the user for the name of an image file

(b) Ask the user for the name of a quarter, one of ['TL', 'TR', 'BL', 'BR']

(c) Use pyplot to read the image into a numpy array and give it a name, say `img`

(d) Use `img.shape` to find the height and width of the image, with `height = img.shape[0]` and `width = img.shape[1]`

(e) Use conditionals (if/elif/else statements) to determine which quarter should be black and use slices to set the color of that quarter to black

   i. `if quarter == 'TL', img[ :  height//2, :  width // 2, :  ]  = 0`

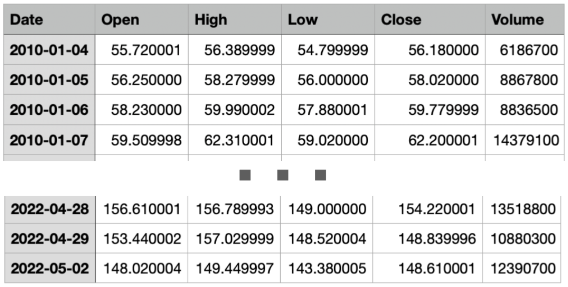
   ii. `elif quarter == 'BL', img[ height//2 :  , :  width // 2, :  ]  = 0`

   iii. `elif quarter == 'TR', img[ :  height//2, width // 2 :  , :  ]  = 0`

   iv. `else, img[ height//2 :  , width // 2 :  , :  ]  = 0`

(f) use pyplot to save the image to a file with name quarter + "black.png", `plt.iamsave( quarter + "black.png", img)`

6. Consider `boeing.csv` from the "Military Stocks during Russia-Ukraine War " dataset from kaggle, reporting the Boeing Company's stock prices (in USD $) from January 2010 to May 2022 **Each row in the dataset corresponds to the stock values for one day of trading**. A snapshot of the data is given in the image below:



Date	Open	High	Low	Close	Volume
2010-01-04	55.720001	56.389999	54.799999	56.180000	6186700
2010-01-05	56.250000	58.279999	56.000000	58.020000	8867800
2010-01-06	58.230000	59.990002	57.880001	59.779999	8836500
2010-01-07	59.509998	62.310001	59.020000	62.200001	14379100
■ ■ ■					
2022-04-28	156.610001	156.789993	149.000000	154.220001	13518800
2022-04-29	153.440002	157.029999	148.520004	148.839996	10880300
2022-05-02	148.020004	149.449997	143.380005	148.610001	12390700

Fill in the Python program below:

Answer Key:

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

#Prompt user for input file name:
fin = input("Please enter the name of the Boeing stocks csv file: ")

#Read input data into data frame:
boeing = pd.read_csv(fin)

#Print the average opening value
print(boeing["Open"].mean())

#Print the lowest closing value
print( boeing["Close"].min())

#Create a new column called "Range" that computes
#the difference between the highest and lowest value of the stock
boeing["Range"] = boeing["High"] - boeing["Low"]

#Plot the newly computed range against the date
boeing.plot(x="Date", y="Range")
plt.show()
```

7. Fill in the following functions that are part of a program that averages the color in an image:

    - `getData()`: asks the user for the name of an image file and returns a numpy array of the pixels
    - `getAvg()`: computes and returns the average (r, g, b) values in img
    - `avgImg()`: returns an image of size rows, cols, with color r, g, b

Answer Key:

```
import numpy as np

def getData():
     """
     Asks the user for the name of an image file
     Returns a numpy array of the pixels
     """
     inF = input('Enter name of image file ')
     img = plt.imread(inF)
     return(img)

def getAvg(img):
     """
     Computes and returns the average (r, g, b) values in img
```

```
        """
        r = img[:,:,0].mean()
        g = img[:,:,1].mean()
        b = img[:,:,2].mean()
        return(r, g, b)


    def avgImg(rows, cols, r, g, b):
        """
        Creates and returns an image of size rows, cols, with color r, g, b

        """
        avg_img = np.zeros([rows, cols, 3])
        avg_img[:,:,0] = r
        avg_img[:,:,1] = g
        avg_img[:,:,2] = b

        return avg_img
```

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

   Answer Key:

   ZZZZZZZZZ

   (b) Modify the program to print out ”ZYXWV”. Shade in the box for each line that needs to be changed and rewrite the instruction below, or add instructions where necessary.

Answer Key:

```
#Loop through characters
ADDI $sp, $sp, -6      # Set up stack
ADDI $s3, $zero, 1      # Store 1 in a register
ADDI $t0, $zero, 90      # Set $t0 at 90 (Z)
ADDI $s2, $zero, 6      # Use to test when you reach 6
SETUP: SB $t0, 0($sp)     # Next letter in $t0
ADDI $sp, $sp, 1          # Increment the stack
ADDI $s3, $s3, 1          # Increment the counter by 1
BEQ $s3, $s2, DONE        # Jump to done if $s3 == 6
ADDI $t0, $t0, -1         # Decrement the letter (added instruction)
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, -5      # 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. Fill in the C++ programs below to produce the Output on the right.

```
    #include <iostream>
    using namespace std;
    int main()
    {
(a)     for( □ ; i <=15;  □ ){
           cout << i-1 << endl;
        }
        return 0;
    }
```

Answer Key:

```
for( int i = 4; i <=15; i +=2)
#include <iostream>
using namespace std;
int main()
{
     int n=12, m=-5;

(b)     while(n+m □ ){
            cout << n << " " << m << endl;
            n-=2;
            m++;
        }
        return 0;
    }
```

Answer Key:

```
while(n+m > 0)
```

```
#include <iostream>
using namespace std;
int main(){
for ( □ ){
```

Answer Key:

```
for(int i = 8; i > 2; i--)
```

(c)
```
    for( □ ){
```

Answer Key:

```
for(int j = 0; j <= i; j++)
```

```
            cout << i << j-i << " ";
        }
        cout << endl;
    }
    return 0;
}
```

10. (a) Write a **complete C++ program** that repeatedly asks the user for two integers until their sum is even, then it outputs the sum:

Answer Key:

```
#include <iostream>
using namespace std;

int main()
{
    int num1=0, num2=0;
    do{
        cout << "Please enter an integer: ";
        cin >> num1;
        cout << "Please enter another integer: ";
        cin >> num2;

    }while((num1+num2)%2!=0);

    cout << "The sum is " << num1+num2 << endl;
    return 0;
}
```

(b) Write a **complete C++ program** that asks the user for an amount and computes the number of years it takes to triple the amount, if it is subject to an increase of 5% each year.

Answer Key:

```
#include <iostream>
using namespace std;

int main()
{
    float amount = 0.0;
    int year = 0;

    cout << "Please enter an mount: ";
    cin >> amount;
    int tripled_amount = amount*3;
    while(amount < tripled_amount){
        amount = amount + amount*0.05;
        year +=1;
        cout << year << " " << amount << endl;
    }

    cout << "It took " << year << " years to triple your amount to " << amount << endl
    return 0;
}
```

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