

FINAL EXAM, VERSION 4
CSci 127: Introduction to Computer Science
Hunter College, City University of New York

24 January 2019

Answer Key:

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

```
i. s = "elion,gertrude;cohn,mildred;petters,arlie"  
   a = s[-5:]  
   print(a.upper())
```

Answer Key:

ARLIE

```
ii. names = s.split(';')  
    print(names[-1])
```

Answer Key:

petters,arlie

```
iii. b,c = names[0],names[1]  
     print(c[:4])
```

Answer Key:

cohn

```
iv. for n in names:  
     w = n.split(',')  
     print(w[1],w[0])
```

Answer Key:

```
henriette avram
mary dolciani
mina rees
```

(b) Consider the following shell commands:

```
$ ls
nyc.csv p40.py p41.py p55.cpp trees.csv
```

i. What is the output for:

```
$ ls *.py
```

Answer Key:

```
p40.py p41.py
```

ii. What is the output for:

```
$ ls *.py | wc -l
```

Answer Key:

```
2
```

iii. What is the output for:

```
$ mkdir pythonProgs
$ mkdir biopy
$ ls py* | wc -l
```

Answer Key:

```
3
```

2. (a) For each row below containing a binary, decimal, and hexadecimal number, check the **largest value** in the row (or “All Equal” if all three entries have the same value):

	Binary:	Decimal:	Hexadecimal:	All Equal
a)	11	3	3	All Equal
b)	100	10	11	<i>All Equal</i>
c)	1111	30	13	<i>All Equal</i>
d)	100001	32	20	<i>All Equal</i>
e)	11111111	255	FC	<i>All Equal</i>

- (b) Fill in the code below to make an image in which a pixel is red if it has an entry of 0 in the array `elevations`. Otherwise, the pixel should be colored purple.

```
# Takes elevation data of NYC and displays coastlines
import numpy as np
import matplotlib.pyplot as plt
elevations = np.loadtxt('elevationsNYC.txt')
#Base image size on shape (dimensions) of the elevations:
mapShape = elevations.shape + (3,)
floodMap = np.zeros(mapShape)

for row in range(mapShape[0]):
    for col in range(mapShape[1]):
```

Answer Key:

```
        if elevations[row,col] == 0:
            #Coastline:
            floodMap[row,col,0] = 1.0      #Set the red channel to 100%
        else:
            #Everyone else
            floodMap[row,col,0] = 1.0      #Set the blue channel to 100%
            floodMap[row,col,2] = 1.0      #Set the blue channel to 100%

#Save the image:
plt.imshow('floodMap.png', floodMap)
```

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

```
in1 = False
i. in2 = True
out = in1 or in2
```

Answer Key:

out = True

in1 = False

ii. in2 = True

out = in1 or (in2 and not in1)

Answer Key:

out = False

in1 = False

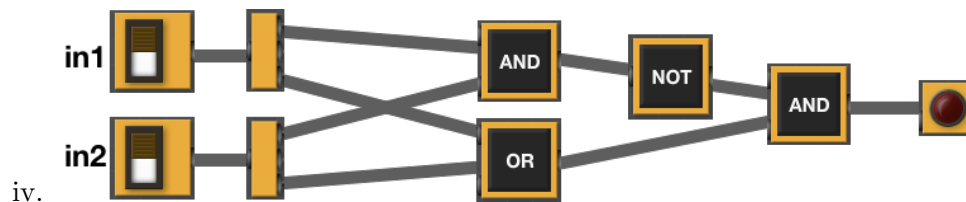
iii. in2 = False or not in1

in3 = in1 or in2

out = in1 and not in3

Answer Key:

out = False



in1 = False

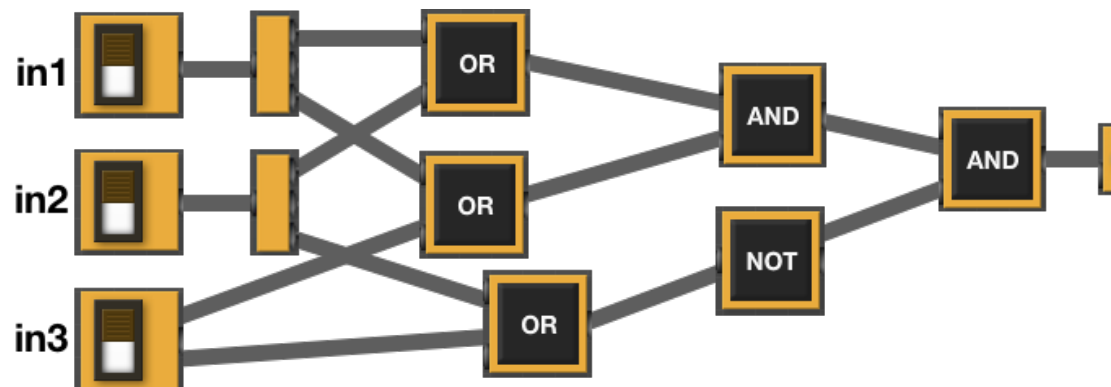
in2 = True

Answer Key:

out = True

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

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



Answer Key:

4. (a) For the following code:

```
def v4(bryan, esteban):
    if bryan < esteban:
        return esteban
    else:
        return 0

def startV4(jakub):
    mohammed = 5
    kaiya = 10
    jasmeet = v1(jakub-mohammed,kaiya)
    return jasmeet
```

- i. What are the formal parameters for `v4()`:

Answer Key:

bryan, esteban

- ii. What are the formal parameters for `startV4()`:

Answer Key:

jakub

- iii. What does `startV4(8)` return:

Answer Key:

0

- (b) Given the function definition:

```
def sorted(ls):
    for i in range(4):
        print(ls)
        for j in range(3):
            if ls[j] > ls[j+1]:
                ls[j],ls[j+1] = ls[j+1],ls[j]
```

- i. What is the output for `sorted([4,3,-1,0])`?

Answer Key:

ls[0]	ls[1]	ls[2]	ls[3]
4	3	-1	0
3	-1	0	4
-1	0	3	4
-1	0	3	4

- ii. What is the output for `sorted(["Parakram","Michael","Camryn","Brian"])`?

Answer Key:

ls[0]	ls[1]	ls[2]	ls[3]
"Parakram"	"Michael"	"Camryn"	"Brian"
"Michael"	"Camryn"	"Brian"	"Parakram"
"Camryn"	"Brian"	"Michael"	"Parakram"
"Brian"	"Camryn"	"Michael"	"Parakram"

5. Design an algorithm that finds all internships in the current NYC Job Postings using NYC OpenData. Specify the inputs and outputs for your algorithm and give the design in pseudocode. In your pseudocode, specify any libraries that you would need for your design.

Job ID	Agency	Posting T	# O	Business Title	Civil Service	Title Code	Level	Job Category	Full-	Salary Range	Salary Range
246814	DEPT OF INFO	External	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	100000	130000
246814	DEPT OF INFO	Internal	1	Senior Architect Cloud Infrastructure D	SENIOR IT AF	6800	0	Information	F	100000	130000
247320	DEPT OF ENVI	Internal	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering	F	52000	52000
247320	DEPT OF ENVI	External	2	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering	F	52000	52000
269885	DEPT OF ENVI	External	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering	F	52000	52000
269885	DEPT OF ENVI	Internal	1	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering	F	52000	52000
285120	NYC HOUSINC	External	1	Deputy Director for Engineering	ADMINISTRA	10015	M3	Engineering	P	115000	130000
285120	NYC HOUSINC	Internal	1	Deputy Director for Engineering	ADMINISTRA	10015	M3	Engineering	P	115000	130000
287202	DEPT OF ENVI	External	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering	F	52000	52000
287202	DEPT OF ENVI	Internal	4	MECHANICAL ENGINEERING INTERN	MECHANICA	20403	0	Engineering	F	52000	52000

Input:

Answer Key: The name of the CSV file and the zip code

Output:

Answer Key: All trees (either rows or Job ID) of jobs containing “intern”.

Process:

Answer Key:

- (a) Import pandas.
 - (b) Ask user for file name.
 - (c) Open the file as a dataframe.
 - (d) Select all the rows (or Job ID's) where that contain “intern” in the Business Title.
 - (e) Print out selected rows or Job ID's).
6. Fill in the Python program that will read:
- prompt the user for the name of a CSV file,
 - prompt the user for the name of two columns in that CSV file, and
 - print out the maximum value of the first column.
 - displays a scatter plot of the two columns entered

```
#P6,V4: prints max of 1st column in a CSV file & makes scatter plot
```

```
#Import the libraries for data frames and displaying images:
```

```
#Prompt user for file name:
```

```
#Prompt user for 2 column names:
```

```
df = pd.read_csv(fileName)
```

```
#Compute maximum value of the column:
```

```
print("Maximum of first column is ", M)
```

```
#Display a scatter plot of first column versus second column:
```

Answer Key:

```
#P6,V4: prints max of 1st column in a CSV file & makes scatter plot
```

```
#Import the libraries for data frames and displaying images:
```

```
import pandas as pd
```

```
import matplotlib.pyplot as plt
```

```

#Prompt user for file name:
fileName = input('Enter file name: ')

#Prompt user for column name:
col1 = input('Enter column name: ')
col2 = input('Enter column name: ')

df = pd.read_csv(fileName)

#Compute maximum value of the first column:
M = df[col1].max()
print("Maximum is ", M)

#Display a scatter plot of first column versus second column:
df.plot.bar(x = col1, y = col2)
plt.show()

```

7. Complete the following program, by writing the functions:

- `getInput()`: returns the number of turtles the user entered
- `setUpTurtles()`: creates and returns a list of turtles, and
- `stamp()`: makes each turtle in the list stamp.

Answer Key:

```

#Intro Programming Lab: A program with herd of turtles
import turtle
def getInput():
    """
    Prompts & returns the number of turtles the user entered.
    """
    n = eval(input("Please enter the number of turtles: "))
    return n
def setUpTurtles(n):
    """
    Creates a list of n turtles and returns the list.
    """
    tList = []
    #Create turtles:
    for i in range(n):
        t = turtle.Turtle()
        t.shape("turtle") #Make the turtle appear turtle-shaped
        tList.append(t)
    return tList
def moveForward(tList):
    """
    Move each turtle in the list forward 30 steps.

```



```

"""
for t in tList:
    t.forward(30)
def stamp(tList):
    for t in tList:
        t.stamp()
def main():
    numTurtles = getInput()      #Ask for number of turtles
    turtleList = setUpTurtles(numTurtles) #Make a list of turtles
    for i in range(10):
        moveForward(turtleList) #Move each turtle in the list forward
        stamp(turtleList)       #Stamp where the turtle stopped
if __name__ == "__main__":
    main()

```

8. (a) What is the output for a run of this MIPS program:

```

#Loop through every other letter:
ADDI $sp, $sp, -6 # Set up stack
ADDI $t0, $zero, 97 # Start $t0 at 97 (a)
ADDI $s2, $zero, 107 # Use to test when you reach 102 (k)
SETUP: SB $t0, 0($sp) # Next letter in $t0
ADDI $sp, $sp, 1 # Increment the stack
ADDI $t0, $t0, 2 # Increment the letter
BEQ $t0, $s2, DONE # Jump to done if $t0 == 102
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, -6 # 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

```

Answer Key:

acegi

- (b) Indicate what modifications are needed to the MIPS program (repeated below) so that it prints out the first 10 lower case letters: abcdefghij ?

Answer Key: Need to change:

- the first line to have space for 11 characters (ab...j and the null to terminate).
- the corresponding line to allow 11 characters to print (i.e. `ADDI $sp, $sp, -11`).
- increment the register that's holding the letter, `t0`, by a single space (instead of 2)

The resulting program:

```

#Loop through first 10 letters:
ADDI $sp, $sp, -11 # Set up stack

```

```

ADDI $t0, $zero, 97 # Start $t0 at 97 (a)
ADDI $s2, $zero, 107 # Use to test when you reach 107 (k)
SETUP: SB $t0, 0($sp) # Next letter in $t0
ADDI $sp, $sp, 1 # Increment the stack
ADDI $t0, $t0, 1 # Increment the letter
BEQ $t0, $s2, DONE # Jump to done if $t0 == 107
J SETUP # If not, jump back to SETUP for loop
DONE: ADDI $t0, $zero, 0 # Null to end the string
SB $t0, 0($sp) # Add null to stack
ADDI $sp, $sp, -11 # 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?

```

//Lyrics by Lopez & Lopez
#include <iostream>
using namespace std;
int main()
{
(a) cout << "It's funny how some ";
    cout << "distance\nMakes";
    cout << "everything seem small";
    cout << endl;
    return(0);
}

```

Answer Key:

```

It's funny how some distance
Makes everything seem small

//More Elsa
#include <iostream>
using namespace std;
int main()
{
(b) int count = 2;
    while (count > 0) {
        cout <<"Let it go, ";
        count--;
    }
    cout << "\nCan't hold it ";
    cout << "back anymore\n";
    return(0);
}

```

Answer Key:

Let it go, let it go.
Can't hold it back anymore

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

Answer Key:

```
-*-*-
*-*-*
*-*-*
*-*-*
*-*-*
```

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

```
#Python Loop, V4:
for i in range(10,0,-1):
    print(i)
print('Blast off!')
```

Answer Key:

```
//C++ Loop, V1
#include <iostream>
using namespace std;
int main()
{
    int i;
    for (i = 10; i > 0; i--) {
        cout << i << endl;
    }
    cout << "Blast off!\n");
```

```
    return 0;
}
```

- (b) Write a **complete C++ program** that prints the change in population of predator and prey following the Lotka-Volterra model:

$$\begin{aligned}r &= 1.5r - .2rf \\ f &= 0.9f + .1rf\end{aligned}$$

where r is the number of prey (such as rabbits) each year and f is the number of predators (such as foxes) each year. The rabbit population increases by 50% each year, but $\frac{r f}{5}$ are eaten by foxes. The fox population decreases by 10% due to old age but increases in proportion to the food supply, $\frac{r f}{10}$. Assume that the starting population of prey (rabbits) is 1000 and starting population of predators (foxes) is 25. Your program should print for the first 10 years: the year, the number of prey and the number of predators.

Answer Key:

```
//Predator/Prey model
#include <iostream>
using namespace std;
int main()
{
    float r = 1000, f = 25;
    int year;
    cout << "Year\tPrey\tPredators\n";
    for (year = 0; year < 10; year++) {
        cout << "\t" << year << "\t" << r << "\t" << f << "\n";
        r = 1.5*r - .2*r*f;
        f = 0.9*f + .1*r*f;
    }
    return 0;
}
```