

FINAL EXAM, VERSION 3
CSCI 127: Introduction to Computer Science
Hunter College, City University of New York

December 18, 2023

Exam Rules

- Show all your work. Your grade will be based on the work shown.
- The exam is closed book and closed notes.
- When taking the exam, you may have with you pens, pencils, and an 8 1/2" x 11" piece of paper filled with notes, programs, etc.
- You may not use a computer, calculator, tablet, smart watch, or other electronic device.
- Do not open this exam until instructed to do so.

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I understand that all cases of academic dishonesty will be reported to the Dean of Students and will result in sanctions.

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EmpID:

Signature:

ASCII TABLE

Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char
0	0	[NULL]	32	20	[SPACE]	64	40	@	96	60	`
1	1	[START OF HEADING]	33	21	!	65	41	A	97	61	a
2	2	[START OF TEXT]	34	22	"	66	42	B	98	62	b
3	3	[END OF TEXT]	35	23	#	67	43	C	99	63	c
4	4	[END OF TRANSMISSION]	36	24	\$	68	44	D	100	64	d
5	5	[ENQUIRY]	37	25	%	69	45	E	101	65	e
6	6	[ACKNOWLEDGE]	38	26	&	70	46	F	102	66	f
7	7	[BELL]	39	27	'	71	47	G	103	67	g
8	8	[BACKSPACE]	40	28	(	72	48	H	104	68	h
9	9	[HORIZONTAL TAB]	41	29	)	73	49	I	105	69	i
10	A	[LINE FEED]	42	2A	*	74	4A	J	106	6A	j
11	B	[VERTICAL TAB]	43	2B	+	75	4B	K	107	6B	k
12	C	[FORM FEED]	44	2C	,	76	4C	L	108	6C	l
13	D	[CARRIAGE RETURN]	45	2D	-	77	4D	M	109	6D	m
14	E	[SHIFT OUT]	46	2E	.	78	4E	N	110	6E	n
15	F	[SHIFT IN]	47	2F	/	79	4F	O	111	6F	o
16	10	[DATA LINK ESCAPE]	48	30	0	80	50	P	112	70	p
17	11	[DEVICE CONTROL 1]	49	31	1	81	51	Q	113	71	q
18	12	[DEVICE CONTROL 2]	50	32	2	82	52	R	114	72	r
19	13	[DEVICE CONTROL 3]	51	33	3	83	53	S	115	73	s
20	14	[DEVICE CONTROL 4]	52	34	4	84	54	T	116	74	t
21	15	[NEGATIVE ACKNOWLEDGE]	53	35	5	85	55	U	117	75	u
22	16	[SYNCHRONOUS IDLE]	54	36	6	86	56	V	118	76	v
23	17	[ENG OF TRANS. BLOCK]	55	37	7	87	57	W	119	77	w
24	18	[CANCEL]	56	38	8	88	58	X	120	78	x
25	19	[END OF MEDIUM]	57	39	9	89	59	Y	121	79	y
26	1A	[SUBSTITUTE]	58	3A	:	90	5A	Z	122	7A	z
27	1B	[ESCAPE]	59	3B	;	91	5B	[	123	7B	{
28	1C	[FILE SEPARATOR]	60	3C	<	92	5C	\	124	7C	|
29	1D	[GROUP SEPARATOR]	61	3D	=	93	5D	]	125	7D	}
30	1E	[RECORD SEPARATOR]	62	3E	>	94	5E	^	126	7E	~
31	1F	[UNIT SEPARATOR]	63	3F	?	95	5F	_	127	7F	[DEL]

(Image from wikipedia commons)

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

i. `banana = "xyyzzBaaabbBbccc"`
`print(banana.count("b"))`

Output:

3

ii. `B = banana.split("B")`
`print(B[0])`

Output:

xyyzzz

iii. `up = B[-1].upper()`
`print(up)`

Output:

BCCC

iv. `for c in up:`
`print(c.lower())`

Output:

b
c
c
c

(b) Consider the contents of the current directory:

`banana.txt banana.py carrot.csv clementine.py dragonfruit`

i. What is the output for:

`$ ls *r*`

Output:

Carrot.csv
dragonfruit

ii. What is the output for:

`$ mv *.py ./dragonfruit`
`$ ls`

Output:

banana.txt
Carrot.csv
dragonfruit

iii. What is the output for:

`$ ls -l | grep "banana" | wc -l`

Output:

1

2. (a) Select the correct option.
- What color is tina after this command? `tina.color("#008800")`
 black red white gray green
 - Select the LARGEST binary number:
 1011 1101 0111 1010 1001
 - Select the LARGEST hexadecimal number:
 FD EA EF FC CD
 - What is the binary number equivalent to decimal 12?
 1011 0001 1100 0111 1110
 - What is the hexadecimal number equivalent to decimal 36?
 34 22 24 2B CD
- (b) Fill in the code below to make an image in which a pixel is green if it has an entry of 35 or greater in the array `elevations`. Otherwise, the pixel should be colored blue.

```
# Takes elevation data of NYC and displays storm surge map
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]):
```

```
        if elevations[row, col] >= 35:
            floodMap[row, col, 1] = 1.0
        else:
            floodMap[row, col, 2] = 1.0
```

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

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

in1 = False

i. in2 = False

out = in1 or in2

out =

in1 = True

ii. in2 = False

out = not in1 or (in2 and not in1)

out =

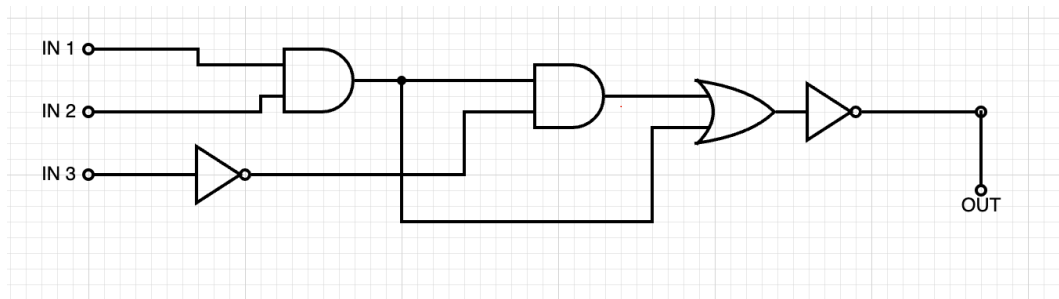
in1 = True

iii. in2 = False or not in1

in3 = in1 and in2

out = in1 or not in3

out =



iv.

in1 = True

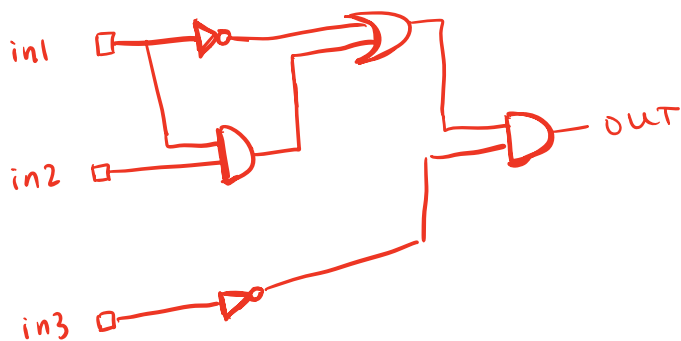
in2 = False

in3 = False

out =

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

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

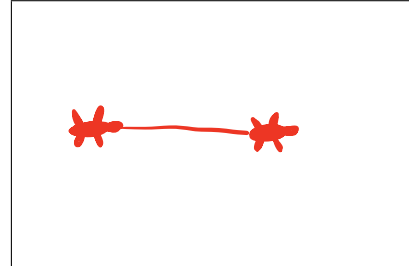


4. (a) Draw the output for the function calls:

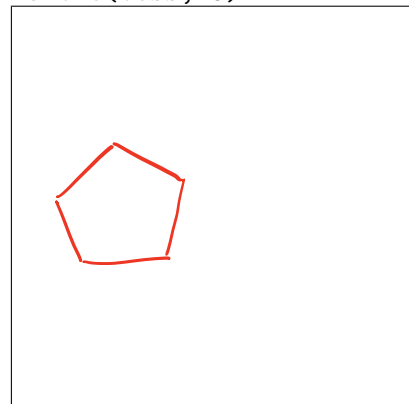
```
import turtle
tess = turtle.Turtle()
tess.shape("turtle")

def ramble(t, side):
    if side == 0:
        t.stamp()
        t.forward(50)
        t.stamp()
    else:
        for i in range(side):
            t.forward(50)
            t.left(360/side)
```

- i. `ramble(tess, 0)`



- ii. `ramble(tess, 5)`



- (b) What is the output:

```
#Another mystery program...
def mystery(num):
    send = chr(num)
    if num < ord("d"):
        send = send + "Y"
    return send

def enigma(letters):
    data = ""
    for x in letters:
        n = ord(x)
        c = "B"
        if n > 100:
            c = mystery(n)
        data = data + c
    return data

word = input("Enter a word: ")
s = enigma(word)
print(s)
```

- i. When the user enters: aa?

Output:

BB

- ii. When the user enters: cab?

Output:

BBB

- iii. When the user enters: alice?

Output:

Bl:Be

5. Fill in the Python program below. Consider the following pseudocode:

- Generate a random integer from 0 to 15 (inclusive), call it `x`
- Print the number in one's complement representation; that is, given a binary string, all 0's become 1's and all 1's become 0's
- **Example:** 0110 in one's complement representation is 1001

```
#imports the library for generating random numbers
```

```
import random
```

```
#generates a random integer from 0-15 inclusive
```

```
x = random.randrange(16)
```

```
#converts the random integer to a binary string
```

```
binary = bin(x)[2:] # sample use: bin(6)[2:] == "0110"
```

```
#stores the one's complement representation of x
```

```
result = ""
```

```
#loops through the binary string
```

```
for c in binary:
```

```
    #if the char is "0", add "1" to result
```

```
        if c == "0":
            result += "1"
```

```
    #otherwise, add "0" to result
```

```
        else:
            result += "0"
```

```
#prints x and its one's complement representation
```

```
print(x, result)
```

6. Consider the following main function that analyzes star data:

```
import pandas as pd
def main():
    stars = pd.read_csv("stars.csv")
    avgH = avgRadius(stars, "Hypergiant")
    maxTemp = hottestStar(stars)
```

Define the functions below:

```
def avgRadius(df, starType):
    """
    Takes a DataFrame and a string as input
    Returns the average radius of input value
    First, group by "Star type" then get group starType
    Get the average radius of the group by using the "Radius" column
    """
```

```
h = df.groupby("Star type").get_group(starType)
return h["Radius"].mean()
```

```
def hottestStar(df):
    """
    Takes a DataFrame as input
    Returns the maximum value in the column, "Temperature"
    """
```

```
return df["Temperature"].max()
```


7. Fill in the Python program below that asks the user for the name of a .png (image) file and **turns the right half of the image red**. The new image should then be displayed to the user.

```
#import the libraries for images
```

```
import numpy as np
import matplotlib.pyplot as plt
```

```
#get user input
```

```
infile = input("Enter filename: ")
```

```
#read the image file
```

```
img = plt.imread(infile)
```

```
#get the width of the image
```

```
width = img.shape[1]
```

```
#make a copy of the original image
```

```
img2 = img.copy()
```

```
#set the green and blue channels to 0.0
```

```
img2[:, width//2:, 1:] = 0.0
```

```
#set the red channel to 1.0
```

```
img2[:, width//2:, 0] = 1.0
```

```
#load the image into pyplot
```

```
plt.imshow(img2)
```

```
#display the image
```

```
plt.show()
```

8. (a) Consider the following MIPS program:

```

ADDI $s0, $zero, 4
ADD $s1, $s0, $s0
ADD $s2, $s1, $s1
ADDI $s3, $s2, 3

```

After the program runs, what is the value stored in:

- i. register \$s1

8

- ii. register \$s2

16

- iii. register \$s3

19

- (b) What is the output for a run of this MIPS program:

Output:

LMND

```

#Loop through four letters:
ADDI $sp, $sp, -5           # Set up stack
ADDI $t0, $zero, 76        # Start $t0 at 76 (L)
ADDI $s2, $zero, 80        # Use to test when you reach 80 (P)
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 == 80
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, -4          # 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?

```

//Heraclitus
#include <iostream>
using namespace std;
int main() {
    cout << "No man steps foot\n";
    cout << "in the same river\ntwice, ";
    cout << "for it is not the" << endl;
    cout << "same river, and he is";
    cout << "\nnot the same man;";
}

```

(a)

Output:

```

No man steps foot
in the same river
twice, for it is not the
same river, and he is
not the same man;

```

```

//Mystery C++, #2
#include <iostream>
using namespace std;
int main() {
    int sum = 5;
    while (sum < 13) {
        cout << sum;
        sum = sum + sum;
    }
}

```

(b)

Output:

```

510

```

```

//Mystery C++, #3
#include <iostream>
using namespace std;
int main() {
    for (int i = 0; i < 3; i++) {
        for (int j = 0; j < 3; j++) {
            if (j % 2 == 0) {
                cout << "+";
            } else {
                cout << "-";
            }
        }
    }
    cout << endl;
}

```

(c)

Output:

```

+ - +
+ - +
+ - +

```

10. (a) Write a **complete C++ program** that prompts the user for a string until a non-empty string is entered. The program then prints the non-empty string that was entered.

```
//include library for input/output and declare namespace
```

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

```
//main function signature
```

```
int main()
```

```
{
```

```
    //prompt user for string until non-empty string is entered
```

```
    string s = ""; //empty string
    while (s == "") {
        cout << "Enter a non-empty string: ";
        cin >> s;
    }
```

```
    //print non-empty string that was entered
```

```
    cout << s;
```

```
    return 0;
```

```
}
```

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

$$r = 2 * r - (0.25 * r) * f$$

$$f = 0.95 * f + (0.1 * r) * f$$

Assume that the starting population of prey (rabbits) is 1000 and the starting population of predators (foxes) is 100. Your program should print for the first 10 years: the year, the number of prey, and the number of predators.

```
//include library for input/output and declare namespace
```

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

```
//main function signature
```

```
int main()
```

```
{
```

```
    //calculate and print the predicted population
```

```
    double r = 1000.0;
    double f = 100.0;

    for(int i = 0; i < 10; i++) {
        cout << i << ": " << r << " " << f << endl;
        r = r * 2.0 - (r * 0.25) * f;
        f = f * 0.95 + (r * 0.1) * f;
    }
}
```

```
    return 0;
```

```
}
```