

Row:	SEAT:

FINAL EXAM, VERSION 2
CSci 127: Introduction to Computer Science
Hunter College, City University of New York
 16 December 2019

Exam Rules

- Show all your work. Your grade will be based on the work shown.
- The exam is closed book and closed notes with the exception of an 8 1/2" x 11" piece of paper filled with notes, programs, etc.
- When taking the exam, you may have with you pens and pencils, and your note sheet.
- You may not use a computer, calculator, tablet, phone, earbuds, 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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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:

```
pioneers = "Easley;Annie/Wilkes;Mary Ann/Goldberg;Adele"  
i. print(pioneers.count('A'))  
   print(pioneers[-5:].upper())
```

Output:

```
names = pioneers.split('/')  
ii. m = names[1]  
    print(m[7:])
```

Output:

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

Output:

- (b) Consider the following shell commands:

```
$ pwd  
/Users/login/hwk  
$ ls  
tickets.csv p30.py p40.py nyc.csv
```

- i. What is the output for:

```
$ mkdir csci127  
$ mv *csv csci127  
$ ls
```

Output:

- ii. What is the output for:

```
$ cd csci127  
$ ls | grep nyc
```

Output:

- iii. What is the output for:

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

Output:

2. (a) Consider the code:

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

- i. After the command: `thomasH.color("#000000")`, what color is `thomasH`?
 black green white gray purple
- ii. After the command: `thomasH.color("#00BC00")`, what color is `thomasH`?
 black green white gray purple

iii. Fill in the code below to change `thomasH` to be the color white:

```
thomasH.color("#       ")
```

iv. Fill in the code below to change `thomasH` to be the brightest red:

```
thomasH.color("#       ")
```

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

- i. for i in range():
 print(i, end=" ")

Output:

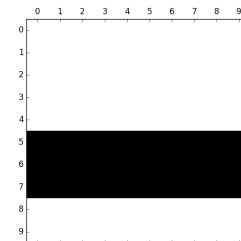
```
0 1 2 3 4
```

- ii. for j in range(, ,):
 print(i, end=" ")

Output:

```
1 2 3 4 5
```

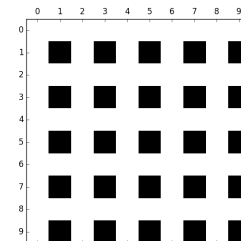
Output:



- iii.

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

Output:



- iv.

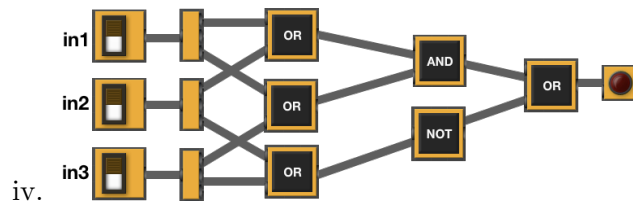
```
import numpy as np
import matplotlib.pyplot as plt
im = np.ones( (10,10,3) )
im[1:: , 1:: , :] = 0
plt.matshow(im)
plt.show()
```

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

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

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

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



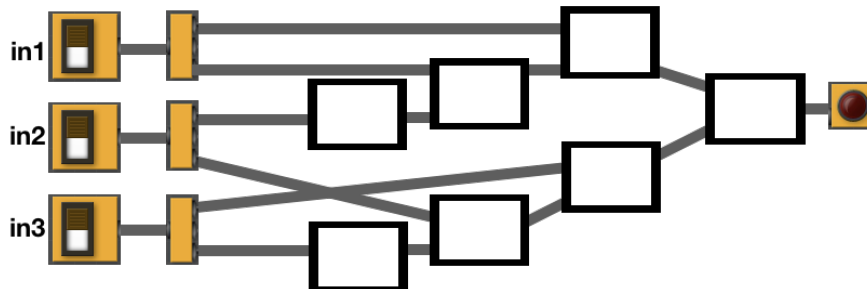
iv. in1 = False True False
in2 = False
in3 = True

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

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

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

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



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

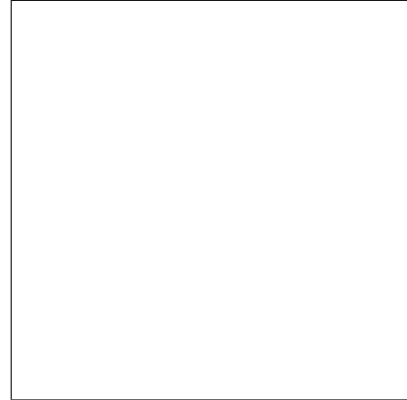
```

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

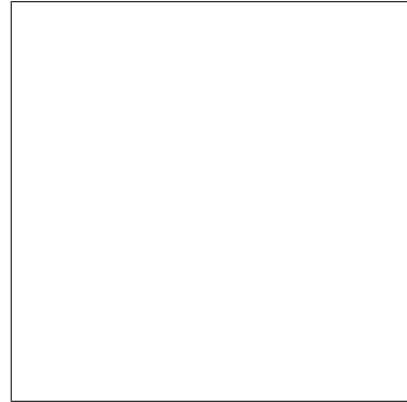
4: def ramble(ty, dist, stamp):
5:     if dist > 10:
6:         for i in range(3):
7:             ty.left(120)
8:             ty.forward(dist)
9:             ramble(ty,dist//2,stamp)
10:    elif stamp:
11:        for i in range(3):
12:            ty.forward(20)
13:            ty.stamp()
14:    else:
15:        ty.forward(20)

```

i. `ramble(tom,8,False)`



ii. `ramble(tom,100,True)`



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

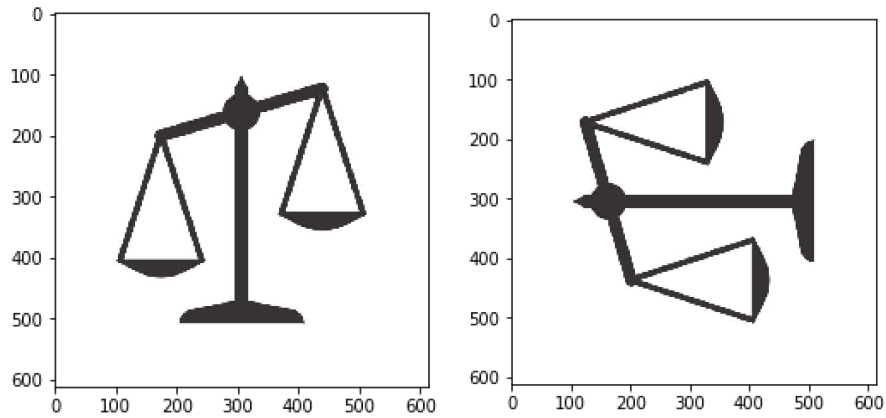
(c) If you call `ramble(tom,8,False)`, which branches of the function are tested (check all that apply):

- The block of code at Lines 6-9.
- The block of code at Lines 11-13.
- The block of code at Line 15.
- None of these blocks of code (lines 6-9, 11-13, 15) are visited from this invocation (call).

(d) If you call `ramble(tom,100,True)`, which branches of the function are tested (check all that apply):

- The block of code at Lines 6-9.
- The block of code at Lines 11-13.
- The block of code at Line 15.
- None of these blocks of code (lines 6-9, 11-13, 15) are visited from this invocation (call).

5. Design an algorithm that rotates an image by 90 degrees to the left. For simplicity, you may assume a square image (i.e. same height and length)



Libraries:

Input:

Output:

Process (as a list of steps):

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:

```
#P6,V2: extracts trolls with highest number of tweets
#Import the libraries for data frames and plotting data:
```

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

```
csvFile = 
```

```
#Read input data into data frame:
```

```
trolls = 
```

```
#Count the number of tweets for each author/troll:
```

```
frequentTrolls = 
```

```
#Print the top 10 authors/trolls with largest number of tweets
```

```
print(frequentTrolls[  :  ] )
```

```
#Generate a bar plot of the top 10 authors/trolls with largest number of tweets
```

```
frequentTrolls.
```

```
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 very dark. A pixel is very dark if the red, green, and blue values are **all** less than 10%.

```
#Import the packages for images and arrays:
```

```
#Ask user for image name and read into img:
```

```
#Get height and width:
```

```
#Initialize counter:
```

```
#Loop through all the pixels & update count if very dark:
```

```
#Compute and print fraction:
```

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

Output:

- (b) Modify the program to print out 100 copies of the letter 'Z'. Shade in the box for each line that needs to be changed and rewrite the instruction below.

- ADDI \$sp, \$sp, -11 # Set up stack
- ADDI \$s3, \$zero, 1 # Store 1 in a registrar
- ADDI \$t0, \$zero, 90 # Set \$t0 at 90 (Z)
- ADDI \$s2, \$zero, 10 # Use to test when you reach 10
- SETUP: SB \$t0, 0(\$sp) # Next letter in \$t0
- ADDI \$sp, \$sp, 1 # Increment the stack
- SUB \$s2, \$s2, \$s3 # Decrease the counter by 1
- BEQ \$s2, \$zero, DONE # Jump to done if \$s2 == 0
- 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, -10 # 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 Adele Goldberg
#include <iostream>
using namespace std;
int main()
{
    cout << "Don't ask whether\nyou ";
    cout << "can do something, \nbut";
    cout << " how to do it.";
    cout << endl << "A.G.";
    return 0;
}
```

(a)

Output:

```
#include <iostream>
using namespace std;
int main()
{
    double num = 0;
    double weight = 0;
    while (weight < 100) {
        cout <<"Please enter weight\n";
        cin >> weight;
        num++;
    }
    cout << num << endl;
    return 0;
}
```

(b)

Input: 50,75,150 Output:

```
#include <iostream>
using namespace std;
int main(){
    int i, j;
    for (i = 4; i > 0; i--){
        for (j = 0; j < i; j++){
            if(j % 2 == 0)
                cout << "0";
            else
                cout << "X";
        }
        cout << endl;
    }
    return 0;
}
```

(c)

Output:

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

```
#Python Loops, V2
for i in range(1,20,4):
    print('*'+i,'*')
```

```
//include library and namespace
```

```
//function signature
```

```
{
    //loop line
```

```
    //loop body
```

```
    //return
```

```
}
```

- (b) The number of Twitter monthly active users grew from ~ 10 million in 2010 to ~ 68 million in 2019. The average annual growth rate can then be estimated as

$$\text{avgGrowth} = \frac{\% \text{growth}}{\text{number-of-years}} = \frac{100 \cdot \frac{68-10}{10}}{2019 - 2010} = 64.4\%$$

We can thus estimate the average annual growth: **avgGrowth = 64.4%**.

Write a **complete C++ program** that asks the user for a year greater than 2010 (assume user complies) and prints the estimated number (in millions) of Twitter users in that year.

```
//include library and namespace
```

```
//function signature
```

```
{
```

```
  //initialize variables
```

```
  //obtain input
```

```
  //calculate users
```

```
  //output users
```

```
  //return
```

```
}
```