Answer Key:

Row:	Seat:

Final Exam F22 V1

CSci 127: Introduction to Computer Science

Hunter College, City University of New York

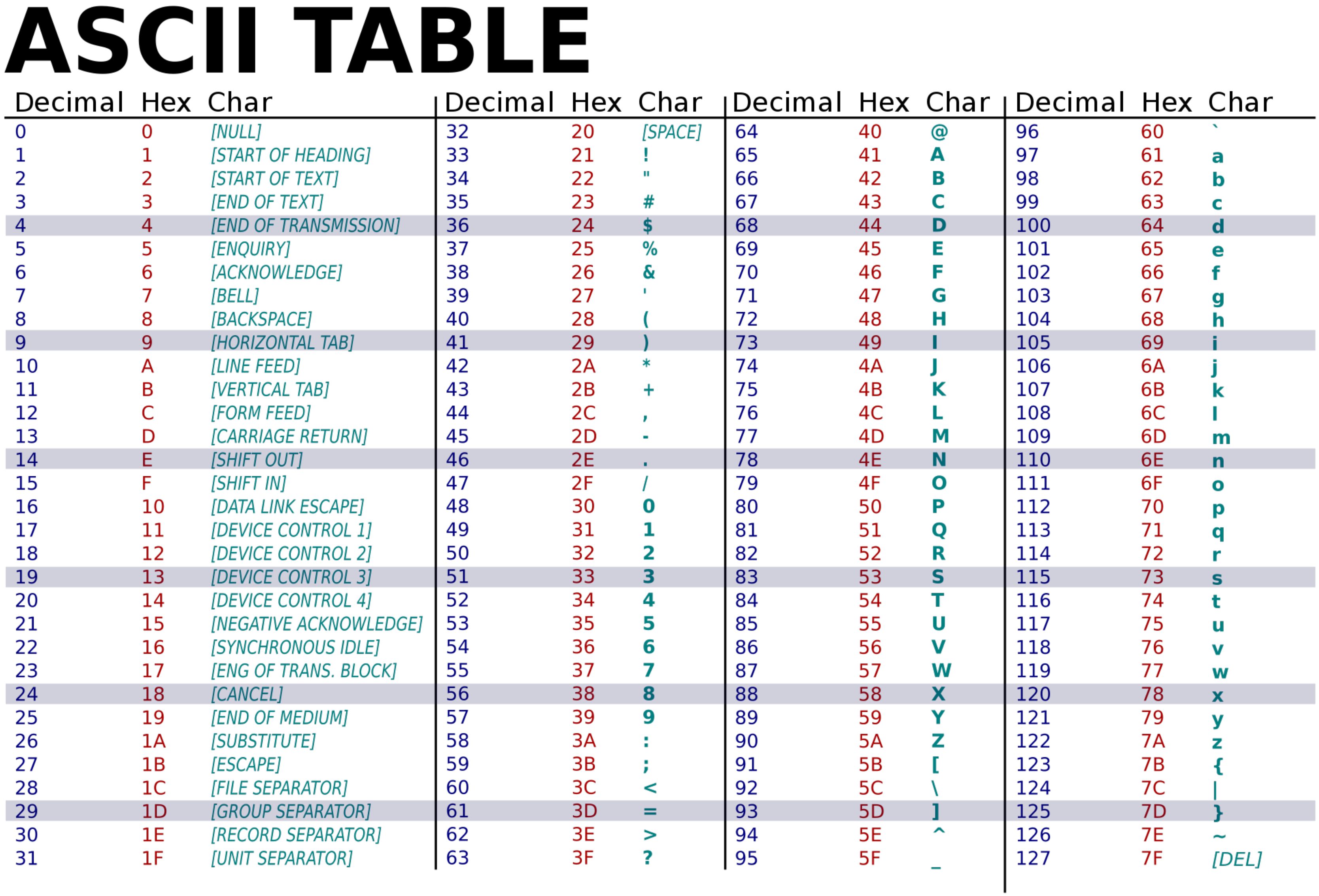
December 16, 2022

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.**

Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures.

I understand that all cases of academic dishonesty will be reported to the Dean of Students and will result in sanctions.	
Name:	
EmpID:	□□□□□□□□
Email:	
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) Fill in the code below to produce the output on the right:

```
languages = "Python&C++&Java&MIPS"
```

i.

```
cpp = languages[ ]
print(cpp)
```

Output:

```
C++
```

Answer Key:

```
cpp = languages[7:10]
or
cpp = languages[-13:-10]
```

ii.

```
python_mips =
for s in python_mips:
    print( )
```

Output:

```
python
mips
```

Answer Key:

```
python_mips = languages.split('&')[0::3]
for s in python_mips:
    print(s.lower())
```

(b) Consider the following shell commands:

```
$ pwd
/usr/john/cs127
$ ls
airbab.csv houses.csv p1_hello.py p2_flower.py  programs
```

i. What is the output for:

```
$ rm airbab.csv
$ mkdir data
$ mv *.csv data
$ ls
```

Output:

Answer Key:

```
data p1_hello.py p2_flower.py  programs
```

ii. What is the output for:

Output:

```
$ cd data
$ pwd
```

Answer Key:

```
/usr/john/cs127/data
```

iii. What is the output for:

```
$ ls | grep csv | wc -l
```

Output:

Answer Key:

```
1
```

2. (a) Select the color corresponding to the rgb values below:

i. `rgb = (0, 255, 255)`
□ black □ red □ cyan □ gray □ purple

ii. `rgb = "#009900"`
□ red □ green □ blue □ black □ white

iii. `What is rgb values for yellow?`
□ 0, 0, 1 □ 0, 1, 1 □ 1, 0, 0 □ 1, 0, 1 □ 1, 1, 0

iv. What is the binary number equivalent of decimal number 50?

`Decimal 50 = Binary`

v. What is the Decimal number equivalent to Hexadecimal 2F?

`Hexadecimal 2F = Decimal`

Answer Key:

i. `rgb = (0, 255, 255)`
□ black □ red **X** cyan □ gray □ purple

ii. `rgb = "#009900"`
□ red **X** green □ blue □ black □ white

iii. `What is rgb values for yellow?`
□ 0, 0, 1 □ 0, 1, 1 □ 1, 0, 0 □ 1, 0, 1 **X** 1, 1, 0

iv. What is the binary number equivalent of decimal number 20?

```
2   | 50
    +---
  2 | 25    0
    +---
  2 | 12    1
    +---
  2 |  6    0
    +---
  2 |  3    0
    +---
  2 |  1    1
    +---
       0    1
```

`Decimal 50 = Binary`

1	**1**	**0**	**0**	**1**	**0**

v. What is the Decimal number equivalent to Hexadecimal 2F?
Hexadecimal 2F = 2 * 16 + F = 2 * 16 + 15 = 47

4	**7**

(b) Given the list `fruits` below, fill in the code to produce the Output on the right:

```
fruits = ['apple', 'bananna', 'coconut', 'dragon fruit', 'elderberry']
```

i.

```
for j in range( □ ):
    print(fruits[□])
```

Output:

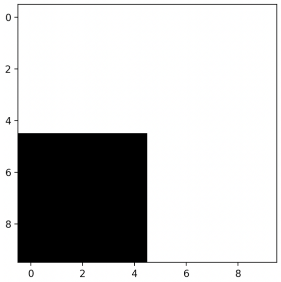
```
apple
coconut
elderberry
```

Answer Key:

```
fruits = ['apple', 'bananna', 'coconut', 'dragon␣fruit', 'elderberr

for j in range(0, 5, 2):
    print(fruits[j])
```

```
import numpy as np
import matplotlib.pyplot as plt
img = np.ones( (10,10,3) )
img[□ , □ ] = 0
plt.imshow(img)
plt.show()
```

Output:



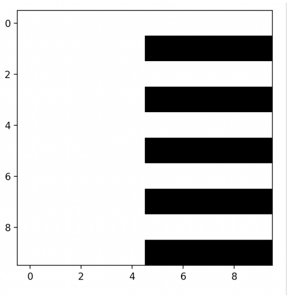
ii.

Answer Key:

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

img = np.ones( (10, 10, 3) )
img[5:, :5] = 0
plt.imshow(img)
plt.show()
```

```
import numpy as np
import matplotlib.pyplot as plt
img = np.ones( (10,10,3) )
img[□ , □ ] = 0
plt.imshow(img)
plt.show()
```

Output:



iii.

Answer Key:

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

img = np.ones( (10, 10, 3) )
img[1::2, 5:] = 0
plt.imshow(img)
plt.show()
```

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

i.
```
in1 = False
in2 = True
out = not in1 or not in2
```
☐ True ☐ False

Answer Key:

```
out = True
```

ii.
```
in1 = True
in2 = True
in3 = False
out = not (in1 and not in2) and in3
```
☐ True ☐ False

Answer Key:

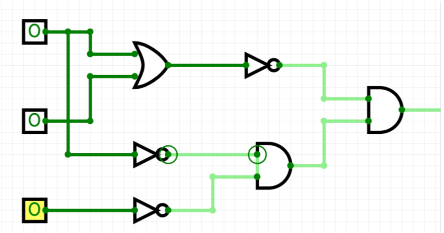
```
out = False
```

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

Answer Key:

```
out = False
```

iv.



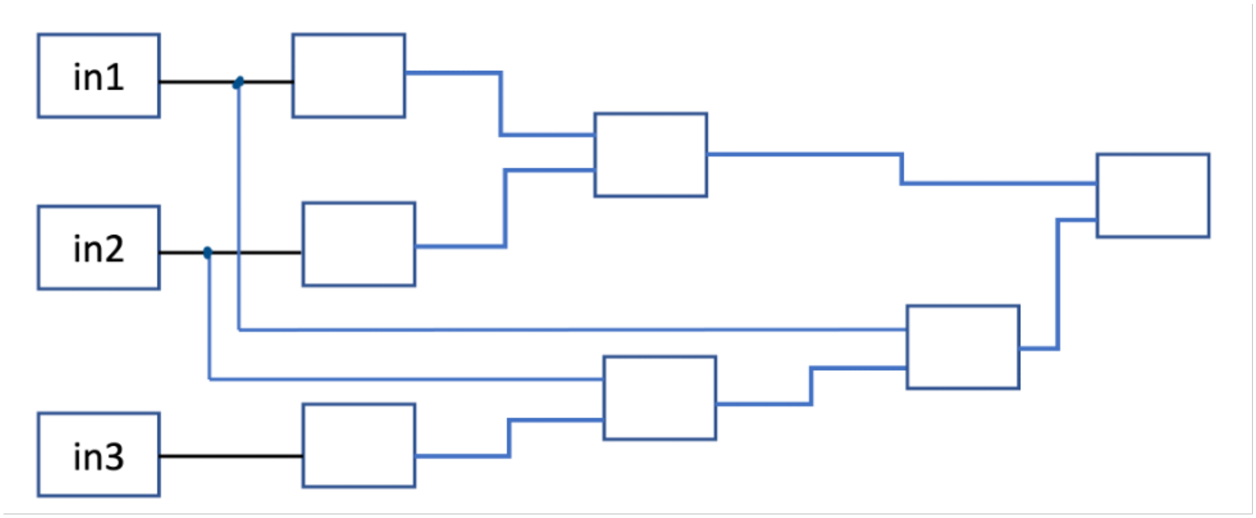
```
in1 = False
in2 = False
in3 = False
```
☐ True ☐ False

Answer Key:

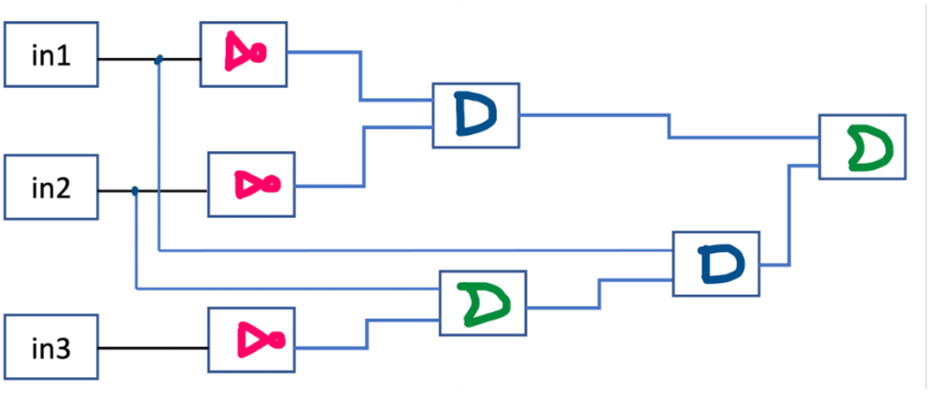
```
out = True
```

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

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



Answer Key:



4. Consider the following functions:

```
def count(mylist, target):
    num_occur = 0
    for num in mylist:
        if division(num, target):
           num_occur += 1

    return num_occur
```

```
def division(s, t):
    if t == 0:
       return False
    else: return s % t == 0

def main():
    arr = [4, 6, 5, 9, 7, 2]
    print(count(arr, 2))
```

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

Answer Key: s, t

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

Answer Key: arr, 2

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

Answer Key: 6

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

Output:

Answer Key:

```
3
```

5. Design an algorithm that asks the user for the name of a text file containing a grid of numbers and loads it into a 2D array of integers(think like an image without the color channel). The program outputs the number of all elements in the grid that are multiple of 3.

   Libraries:

   Answer Key: numpy

   Input:

   Answer Key: The name of the text file

   Output:

   Answer Key: The number of elements in the grid that are a multiple of 3. **Design Pattern:**
   □ Search □ Find Min □ Find Max □ Find All

   Answer Key: □ Search □ Find Min □ Find Max **X** Find All

   Principal Mechanisms (select all that apply):
   □ Single Loop □ Nested Loop □ Conditional (if/else) statement
   □ Indexing / Slicing □ `split()` □ `groupby()`

   Answer Key:

   □ Single Loop **X** Nested Loop **X** Conditional (if/else) statement
   XIndexing / Slicing □ `split()` □ `groupby()`

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

Answer Key:

(a) Ask the user for text file name

(b) Load data into grid.

(c) Set result to be zero.

(d) Use a nested loop to consider every element in grid, looping for rows in outer loop and columns in inner loop if the element is a multiple of 3, ie, the remainder of the number divided by 3 is zero, increase result by 1.

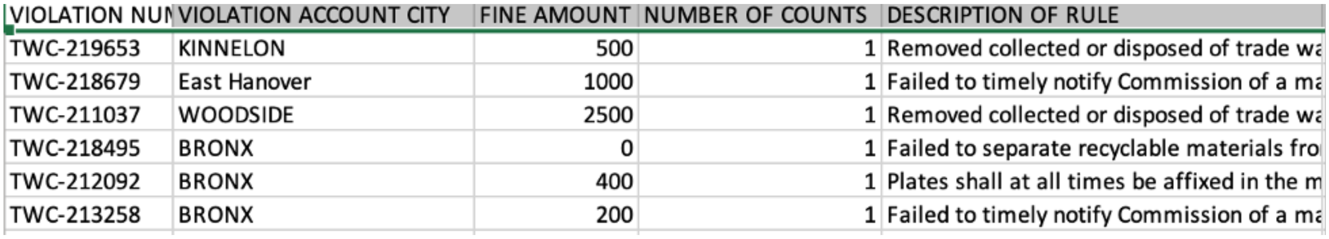
(e) Report result.

An implementation of the above code is as follows (This part is **optional** and will **not** be counted towards grading).

```
#suppose airtravel.csv has the following contents.
#”Month”, ”1958”, ”1959”, ”1960”
#”JAN”,  340,  360,  417
#”FEB”,  318,  342,  391
#”MAR”,  362,  406,  419
#”APR”,  348,  396,  461
#”MAY”,  363,  420,  472
#”JUN”,  435,  472,  535
#”JUL”,  491,  548,  622
#”AUG”,  505,  559,  606
#”SEP”,  404,  463,  508
```

```
#”OCT”,  359,  407,  461
#”NOV”,  310,  362,  390
#”DEC”,  337,  405,  432

import numpy as np

grid = np.loadtxt('airtravel.csv', skiprows=1, delimiter=',', usecols=range(1
#skip the first row, which is column head
#skip the first column, since it is row head
#print(grid)

numRows = grid.shape[0]
numCols = grid.shape[1]

result = 0
for i in range(numRows):
    for j in range(numCols):
        if grid[i,j] % 3 == 0:
            result += 1

print(result)
```

6. Consider the `violations.csv` dataset that reports violations issued by Business Integrity Commission for companies operating in the trade waste industry. A snapshot given in the image below:



VIOLATION NUN	VIOLATION ACCOUNT CITY	FINE AMOUNT	NUMBER OF COUNTS	DESCRIPTION OF RULE
TWC-219653	KINNELON	500	1	Removed collected or disposed of trade wa
TWC-218679	East Hanover	1000	1	Failed to timely notify Commission of a ma
TWC-211037	WOODSIDE	2500	1	Removed collected or disposed of trade wa
TWC-218495	BRONX	0	1	Failed to separate recyclable materials fro
TWC-212092	BRONX	400	1	Plates shall at all times be affixed in the m
TWC-213258	BRONX	200	1	Failed to timely notify Commission of a ma

Fill in the Python program below:

```
#Read input data into data frame:

df = 
```

```
#Print the maximum value in column 'NUMBER OF COUNTS'.
```

```
#Groups the data by 'VIOLATION ACCOUNT CITY' to extract data in WOODSIDE.

woodside = 
```

```
#Print the average of FINE AMOUNT in Woodside.
```

```
#Find out the most common THREE rules violated.
#Hint: look at 'DESCRIPTION OF RULE' and value_counts method.
```

Answer Key:

```
#To test, download https://data.cityofnewyork.us/Business/BIC-Issued-Violation
#shorten the file name as violations.csv.
import pandas as pd

df = pd.read_csv("violations.csv")
print(df["NUMBER_OF_COUNTS"].max())
woodside = df.groupby("VIOLATION_ACCOUNT_CITY").get_group("WOODSIDE")
print(woodside['FINE_AMOUNT'].mean())
print(df["DESCRIPTION_OF_RULE"].value_counts()[:3])
```

7. Complete the following code.

   Define `reverse` function, for a string, return its reversed version. For example, the return of reverse(”abc”) is ”cba”.

   Define `isPalindrome` function, if the given string is a palindrome, that is, the string read the same from left to right and from right to left, return true, otherwise, return false. For example, isPalindrome(”abc”) returns false, but isPalindrome(”aba”) returns true.

Answer Key:

```
def reverse(mystr):
    result = ""
    for c in mystr:
        result = c + result

    return result

def reverse2(mystr): #a simpler implementation of reverse a string using slici
    return mystr[-1::-1]

def isPalindrome(mystr):
    return mystr == reverse2(mystr)

def main():
    mylist = ["madam", "abc", "aba"]
    for elm in mylist:
        if isPalindrome(elm):
            print(elm)

if __name__ == '__main__':
   main()
```

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

Output:

Answer Key:

```
fedcba
```

(b) Modify the program to print out behk. Shade in the box for each line that needs to be changed and rewrite the instruction below. Warning: you need to modify from the above code. Need to use j and beq commands.

```
□ ADDI $sp, $sp, -7 # Set up stack

□ ADDI $t0, $zero, 102 # Set $t0 at 102 ('f')

□ 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 $s2, $s2, -1 # Decrement the counter by 1

□ ADDI $t0, $t0, -1 # Decrement the letter by 1

□ BEQ $s2, $zero, DONE # Jump to DONE if s2 == 0

□ J SETUP # Else, jump back to SETUP

□ 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`

□ `syscall                   # Print to the log`

Answer Key:

```
ADDI $sp, $sp, -5                   # Set up stack
ADDI $t0, $zero, 98                      # Set $t0 at 98 ('b')
ADDI $s2, $zero, 4                           # Use to test when you reach 4
SETUP: SB $t0, 0($sp)               # Next letter in $t0
ADDI $sp, $sp, 1                             # Increment the stack
ADDI $s2, $s2, -1                            # Decrement the counter by 1
ADDI $t0, $t0, 3                    # Increase the letter by 3
BEQ $s2, $zero, DONE                # Jump to DONE if s2 == 0
J SETUP                                      # Else, jump back to SETUP
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
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()
{

    for(int i = 3; i <= □ ; □ ){

       cout << i*2  << endl;
    }
    return 0;
}
```

Answer Key:

(a)

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

int main()
{
    for (int i = 3; i <= 6; i++)
    //Warning: do not add ; right after for-head,
    //or the loop body is empty.
    //That is,
    //the following writing is WRONG
    //for (int i = 3; i <= 6; i++) ;
    //We say, each statement in C++ ends with ;
    //we do not say, each line in C++ ends with ;
    {   //this pair of curly braces can be omitted,
        //since the loop body has only statement
        cout << i * 2 << endl;
    }

    return 0;
}
```

Output:

```
6
8
10
12
```

(b)

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

int main()
{
    for (int i = 1; i <= 3; i++)
    {
        for (int j = 0; j < i; j++)
            cout << "*#";
        cout << endl;
    }

    return 0;
}
```

Output:

□

Answer Key:

```
*#
*#*#
*#*#*#
```

(c)

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

    for (int i = 5; □ ; □ ) {

         cout << i << endl;
    }
    return 0;
}
```

Output:

```
5
3
1
```

Answer Key:

```
i >= 1 or
i > 0
```

A complete C++ code is as follows.

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

int main()
{
    //for (int i = 5; i > 0; i-=2) //also work
    for (int i = 5; i >= 1; i-=2)
    {   //This pair of curly braces can be omitted
        //since loop body has only one statement.
        cout << i << endl;
    }

    return 0;
}
```

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

```
num = 0
while num <= 0:
    num = int(input("Enter␣a␣positive␣integer:␣"))

print("num␣=", num)
```

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

□

```
//main function signature
```

□

```
{
  //initialization
```

□

```
  //loop line
```

□

```
  //loop body
  {
```

□

```
  }
  //return
```

□

```
}
```

Answer Key:

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

int main()
{
    int num = 0;
    while (num <= 0)
    {
        cout << "Enter a positive integer: ";
        cin >> num;
    }

    cout << "num = " << num << endl;

    return 0;
}
```

(b) Declare variables for miles and kilometers. Declare variable for choice. If choice is 1, then enter number of miles, and convert it to kilometers and print the result out. Otherwise, enter number of kilometers, and convert it to miles and print the result out.

1 mile = 1.6 kilometers 1 kilometer = 1 / 1.6 mile

Some sample input/output is as follows.

```
Enter a choice: 1
Enter number of miles: 2
2 miles = 3.2 kilometers

Enter a choice: 2
Enter number of kilometers: 5
5 kilometers = 3.125 miles
```

Just finish the code in main function. No need to write include library and main function signature and return statement.

```
//declare variables miles and kms (for kilometers).
```

```
//declare and obtain input for variable choice.
```

```
//Write if-statement when choice is 1:
//input miles, convert to kms (kilometers), and output result.
```

```
//Write else-statement: input kms (kilometers), convert to miles, and output result
```

Answer Key:

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

int main()
{
    //declare variables for miles and kms.
    double miles;
    double kms;

    //declare and input for variable choice
    int choice;
    cout << "Enter a choice: ";
    cin >> choice;

    //when choice is 1
    if (choice == 1)
    {
        cout << "Enter number of miles: ";
        cin >> miles;
        kms = miles * 1.6;
        cout << miles << " miles = " << kms << " kms" << endl;
    }
    else //when choice is not 1
    {
        cout << "Enter number of kilometers: ";
        cin >> kms;
        miles = kms / 1.6;
        cout << kms << " kilometers = " << miles << " miles" << endl;

    }
    return 0;
}
```

SCRATCH PAPER

SCRATCH PAPER