# Final Exam, Version 1

## CSCI 127: Introduction to Computer Science
## Hunter College, City University of New York

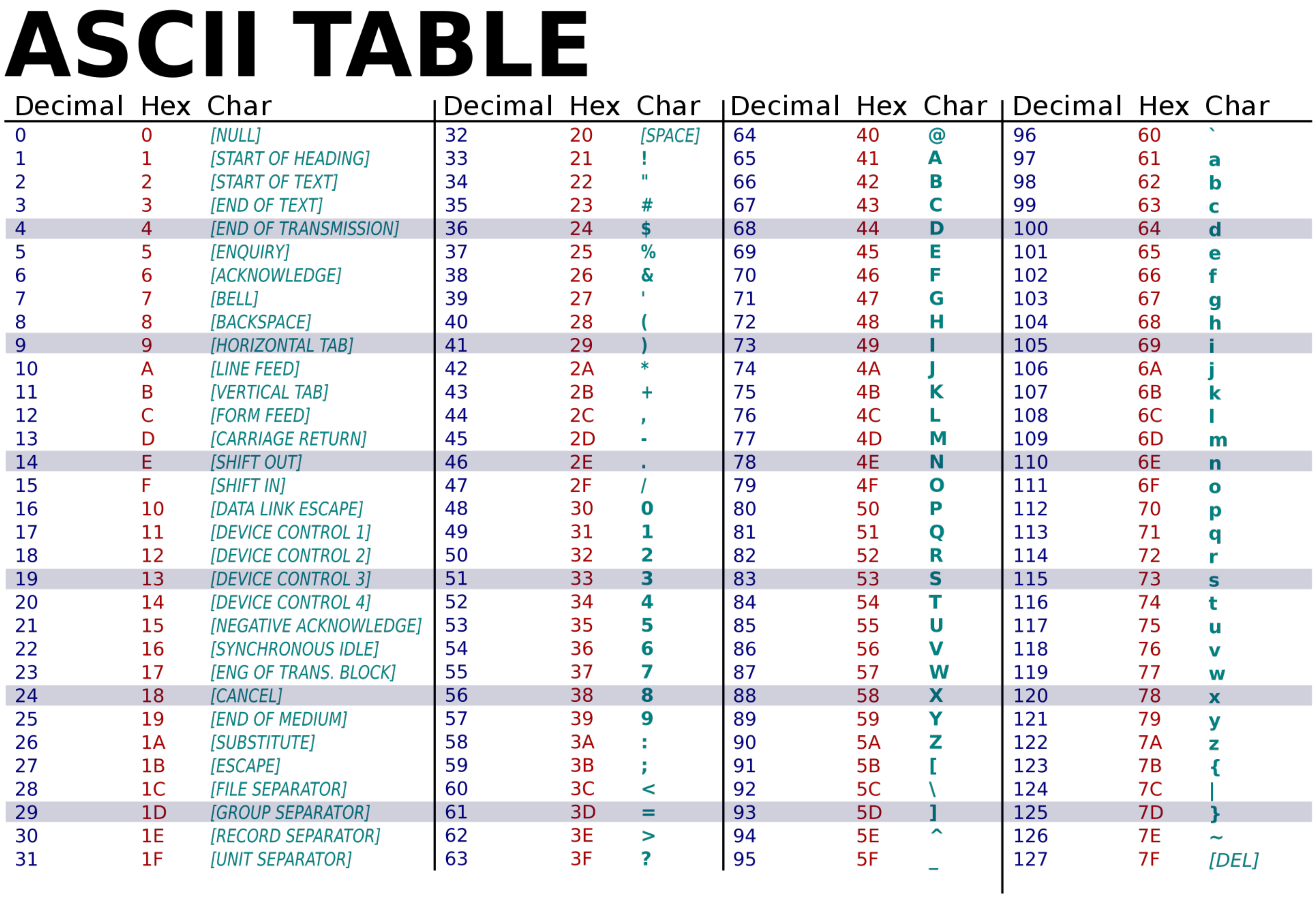
December 12, 2023

## 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.

*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: MelissA Lynch |
| 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 = "xxyyzzBaaabbBbccc"
print(banana.count("b"))
```

**Output:**

```
3
```

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

**Output:**

```
xx yy zz
```

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.

   i. What color is tina after this command? `tina.color("#888888")`
   □ black □ red □ white ■ gray □ green

   ii. Select the LARGEST Binary number:
   □ 1011 □ 1101 □ 0111 □ 1010 ■ 1110

   iii. Select the LARGEST Hexadecimal number:
   ■ FD □ EA □ EF □ FC □ CD

   iv. What is the binary number equivalent to decimal 7?
   □ 1011 □ 0001 □ 1100 ■ 0111 □ 1110

   v. What is the hexadecimal number equivalent to decimal 34?
   □ 34 ■ 22 □ 24 □ 2B □ CD

   (b) Fill in the code below to make an image in which a pixel is red if it has an entry of 50 or greater in the array `elevations`. Otherwise, the pixel should be colored green.

```
# 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] >= 50 :
      Flood Map [row,col, 0] = 1.0
else :
      flood Map [rows col, 1] = 1.0
```

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

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

i.

```
in1 = False
in2 = False
out = in1 or in2
```

out = False

ii.

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

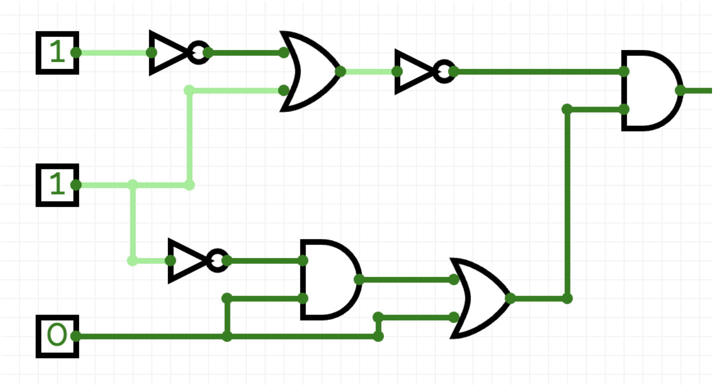
out = True

iii.

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

out = True

iv.

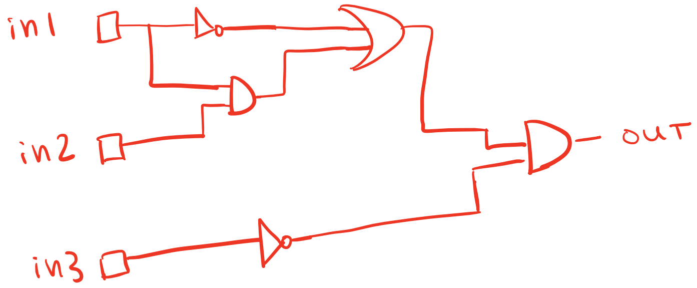


```
in1 = True
in2 = True
in3 = False
```

out = False

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

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

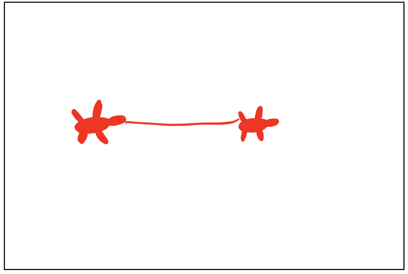


4. (a) Draw the output for the function calls:

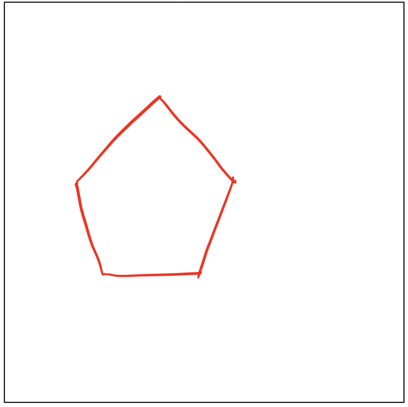
```
import turtle
tess = turtle.Turtle()
tess.shape("turtle")

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 + "H"
     return send

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

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

i. When the user enters: `aa`?

**Output:**

AA

ii. When the user enters: `cab`?

**Output:**

AAA

iii. When the user enters: `alice`?

**Output:**

AliAe

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

   - Ask the user for a word
   - Generate a random integer from 1 to 4 (inclusive), call it x
   - Print the user's word in reverse, with x copies of the characters on each line

   **Sample runs:**

```
Enter a word: frog                   Enter a word: frog
g                                    ggg
o                                    ooo
r                                    rrr
f                                    fff
```

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

#get user input
word = input ("Enter a word:")

#generate a random number from 1-4 inclusive
x = random.randrange (1, 5)

#loop through the input word in reverse
for i in range (len(word)-1, -1, -1):
    #prints x copies of the current character
    print(word[i]*x)
```

6. Fill in the following functions that are part of a program that analyzes star data:

   - `getData()`: asks the user for the name of the CSV file and returns a DataFrame of the contents.
   - `avgRadius(df)`: returns the average radius of a Hypergiant, and
   - `hottestStar(df)`: returns the hottest temperature in the DataFrame.

```
import pandas as pd
def getData():
     """
     Asks the user for the name of the CSV and
     Returns a dataframe of the contents.
     """
```

```
inF = input ("Enter filename:")
return  pd.read_csv (inF)
```

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

```
h = df.groupby ("Star type").get_group ("Hypergiant")
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 File name:")

#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, 2
ADD $s1, $s0, $s0
ADD $s2, $s1, $s1
ADDI $s3, $s2, 5
```

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

i. register $s1

4

ii. register $s2

8

iii. register $s3

13

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

**Output:**

LMNO

```
#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?

(a)

```
//Billy Joel
#include <iostream>
using namespace std;
int main() {
   cout << "She’ll bring\nout ";
   cout << "the best and\n";
   cout << "the worst " << endl;
   cout << "you can \nbe;";
}
```

**Output:**

```
She'll bring
out the best and
the worst
you can
be;
```

(b)

```
//Mystery C++, #2
#include <iostream>
using namespace std;
int main() {
  int sum = 3;
  while (sum < 10) {
    cout << sum;
    sum = sum + sum;
  }
}
```

**Output:**

```
36
```

(c)

```
//Mystery C++, #3
#include <iostream>
using namespace std;
int main() {
  for (int i = 0; i < 3; i++) {
    for (int j = 0; j <  4; j++) {
      if (j % 2 == 0) {
        cout << "+";
      } else {
        cout << "-";
      }
    }
    cout << endl;
  }
}
```

**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 printing 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 nonempty string: ";
     cin >> s;
 }
  cout << s ;

  return 0;
}
```

(b) Write a **complete C++ program** that prints the change in population of the state of New Jersey:

$$p \quad = \quad p + (B * p) - (D * p)$$

where $p$ is the population, $B$ is the birth rate of 58 births for every 1000 people ($\frac{58}{1000}$) each year, and $D$ is the death rate of 10.2 for every 1000 people ($\frac{10.2}{1000}$). In 2022, the population of New Jersey was 9.27 million. Your program should print expected population for the years 2022 to 2032. Each line should have: the year and the population (in millions).

```
//include library for printing and declare namespace
```

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

```
//main function signature
```

```
int main()
```

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

```
double p = 9.27;

for( int year = 2022; year <= 2032 ; year++) {
    cout << year<< "\t" << p << endl;
    p= p + (58.0 / 1000.0)*p- (10.2/1000.0)*p;
}
```

```
  return 0;
}
```