Machine Learning Workshop 1 – CSE 2793

MINOR ASSIGNMENT-1: BASIC ELEMENTS OF PYTHON PROGRAMMING

Q 01 Evaluate the following expressions:

```
(x<y) or (not(z==y) and (z<x))
a. x=0, y=6, z=10
b. x=1, y=1, z=1
```

Q 02 Evaluate the following expressions involving arithmetic operators:

```
a. -7*20+8/16*2+54
b. 7**2//9%3
c. (7-4*2)*10-25*8//5
d. 5%10+10-25*8//5
e. 'hello'*2-5
```

Q 03 Evaluate the following expressions involving relational and logical operators:

```
a. 'hi' > 'hello' and 'bye' < 'Bye'
b. 'hi' > 'hello' or 'bye' < 'Bye'
c. 7 > 8 or 5 < 6 and 'I am fine > 'I am not fine'
d. 10 !=9 and 29 >= 29
e. 10 !=9 and 29 >= 29 and 'hi' > 'hello' or 'bye' < 'Bye' and 7 <= 2.5
```

Q 04 Evaluate the following expressions involving arithmetic, relational and logical operators:

```
a. 5 % 10 + 10 < 50 and 29 >= 29
b. 7 ** 2 <= 5 // 9 % 3 or 'bye' < 'Bye'
c. 5 % 10 < 8 and -25 > 1 * 8 // 5
d. 7 ** 2 // 4 + 5 > 8 or 5 != 6
e. 7/4 < 6 and 'I am fine > 'I am not fine'
f. 10 + 6 * 2 ** 2 != 9//4-3 and 29 >= 29/9
g. 'hello' * 5 > 'hello' or 'bye' < 'Bye'
```

Q 05 Evaluate the following expressions involving bitwise operators:

```
a. 15 & 22
b. 15 | 22
c. -15 & 22
d. -15 | 22
e. ~ 15
f. ~ 22
g. ~ -20
h. 15^22
i. 8 << 3
j. 40 >> 3
```

Q 06 What output will be displayed when the following commands are executed in Python shell in sequence:

```
a. >>> a = 6
   >>> a == 6
   >>> a < 5.9
   >>> a > 5.9
```

```
b. >>> b = 7
   >>> b / 6
   >>> b // 6
   >>> b / 4
   >>> b % 4
   >>> b % 7
   >>> b * 2
   >>> b ** 2
```

Q 07 Construct logical expressions for representing the following conditions:

a. Marks scored should be greater than 300 and less than 400.

b. Whether the value of grade is an uppercase letter.

c. The post is engineer and experience is more than four years.

Q 08 Write Python statements for the following equations:

a. $root1 = \frac{-b+\sqrt{b^2-4ac}}{2a}$

b. $result1 = \frac{2xy-9y}{2xy^4} - \frac{4yx^2}{2y}$

c. $result2 = 2\cos(0.5(x+y))\cos\big(0.5(x-y)\big) + e^x - 1 - \frac{x}{4} + \tan(x) + \log(v)$

Q 09 How does the effect of the following two statements differ?

```
a. x += x + 10
b. x = x + 10
```

Q 10 Write a program that asks the user to enter the width and length of a room. Once these values have been read, your program should compute and display the area of the room. The length and the width will be entered as floating-point numbers. Include units in your prompt and output message; either feet or meters, depending on which unit you are more comfortable working with.

Q 11 An online retailer sells two products: widgets and gizmos. Each widget weighs 75 grams. Each gizmo weighs 112 grams. Write a program that reads the number of widgets and the number of gizmos from the user. Then your program should compute and display the total weight of the parts.

Q 12 Write a program that determines how quickly an object is travelling when it hits the ground. The user will enter the height from which the object is dropped in meters (m). Because the object is dropped its initial speed is 0 m/s. Assume that the acceleration due to gravity is 9.8 m/s^2. You can use the formula $v_f = \sqrt{v_i^2 + 2ad}$ to compute the final speed, v_f, when the initial speed, v_i, acceleration, a, and distance, d, are known.

Q 13 Write a program that reads a four-digit integer from the user and displays the sum of its digits. For example, if the user enters 3141 then your program should display 3 + 1 + 4 + 1 = 9.

Q 14 Write a program that reads three integers from the user and displays them in sorted order (from smallest to largest). Use the `min` and `max` functions to find the smallest and largest values. The middle value can be found by computing the sum of all three values, and then subtracting the minimum value and the maximum value.

Q 15 Create a program that reads duration from the user as number of days, hours, minutes, and seconds. Compute and display the total number of seconds represented by this duration.

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MINOR ASSIGNMENT-2: CONDITIONAL STATEMENTS

Q 01 Write a Python program to input the height of the person and check if the height of the person is greater than or equal to 6 feet then print the message "**`The person is tall`**".

Q 02 Write a Python program to input the mark of a student and check if the student mark is greater than or equal to 40, then it generates the following message.

"**`Congratulations! You have passed the exam.`**"

Otherwise, the output message is

"**`Sorry! You have failed the exam.`**"

Q 03 Input an integer through the keyboard. Write a Python program to find out whether it is an odd number or even number.

Q 04 Any character is entered through the keyboard; write a Python program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol. The following table shows the range of ASCII values for various characters.

```
Characters ASCII Values
      A - Z: 65 - 90
      a - z: 97 - 122
      0 - 9: 48 - 57
      Special symbols: 0 - 47, 58 - 64, 91 - 96, 123 - 127
```

Q 05 The two roots of a quadratic equation $ax^2 + bx + c = 0$ can be obtained using the following formula:

$$root_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \qquad root_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

$b^2 - 4ac$ is called the discriminant of the quadratic equation. If it is positive, the equation has two real roots. If it is zero, the equation has one root. If it is negative, the equation has no real roots.

Write a Python program that prompts the user to enter values for a, b, and c and displays the result based on the discriminant. If the discriminant is positive, display two roots. If the discriminant is 0, display one root. Otherwise, display "**`The equation has no real roots`**".

Here are some sample runs.

```
Enter a, b, c: 1.0 3 1
The equation has two roots -0.381966 and -2.61803

Enter a, b, c: 1 2.0 1
The equation has one root -1

Enter a, b, c: 1 2 3
The equation has no real roots
```

Q 06 You can use Cramer's rule to solve the following 2 X 2 system of linear equation:

$$ax + by = e$$
$$cx + dy = f$$
$$x = \frac{ed - bf}{ad - bc}$$
$$y = \frac{af - ec}{ad - bc}$$

Write a Python program that prompts the user to enter $a, b, c, d, e,$ and f and displays the result. If $ad - bc$ is 0, report that "`The equation has no solution.`"
Sample lines of output:

```
Enter a, b, c, d, e, f: 9.0 4.0 3.0 -5.0 -6.0 -21.0
x is -2.0 and y is 3.0

Enter a, b, c, d, e, f: 1.0 2.0 2.0 4.0 4.0 5.0
The equation has no solution
```

Q 07 Write a Python program that takes the x – y coordinates of a point in the Cartesian plane and prints a message telling either an axis on which the point lies or the quadrant in which it is found.
Sample lines of output:

```
(-1.0, -2.5) is in quadrant III
(0.0, 4.8) is on the y-axis
```

Q 08 If the ages of Rahul, Ayush and Ajay are input through the keyboard, write a Python program to determine the elder among them.

Q 09 Write a Python program that randomly generates an integer between 1 and 12 and displays the English month name January, February… December for the number 1, 2… 12, accordingly.

Q 10 Write a Python program that prompts the user to enter an integer for today's day of the week (Sunday is 0, Monday is 1… and Saturday is 6). Also prompt the user to enter the number of days after today for a future day and display the future day of the week.
Here is a sample run:

```
Enter today's day: 1
Enter the number of days elapsed since today: 3
Today is Monday and the future day is Thursday

Enter today's day: 0
Enter the number of days elapsed since today: 31
Today is Sunday and the future day is Wednesday
```

Q 11 The body mass index (BMI) is commonly used by health and nutrition professionals to estimate human body fat in populations. It is computed by taking the individual's weight (mass) in kilograms and dividing it by the square of their height in meters. i.e.

$$Metric: BMI = \frac{Weight(Kg)}{\left(Height(m)\right)^2}$$

Write a Python program by using some if statements to show the category for a given BMI.

BMI	Category
Less than 18.5	underweight
18.5 to 24.9	normal weight
25.0 to 29.9	overweight
30.0 or more	obese

Q 12 Write a Python program that prompts the user to enter the month and year and displays the number of days in the month. For example, if the user entered month 2 and year 2012, the program should display that February 2012 had 29 days. If the user entered month 3 and year 2015, the program should display that March 2015 had 31 days.

Q 13 Write a Python program that plays the popular scissors-rock-paper game. (A scissor can cut a paper, a rock can knock a scissor, and a paper can wrap a rock.) The program randomly generates a number 0, 1, or 2 representing scissor, rock, and paper. The program prompts the user to enter a number 0, 1, or 2 and displays a message indicating whether the user or the computer wins, loses, or draws.

Here are sample runs:

```
scissor (0), rock (1), paper (2): 1
The computer is scissors. You are rock. You won

scissor (0), rock (1), paper (2): 2
The computer is paper. You are paper too. It is a draw
```

Q 14 Write a Python program that prompts the user to enter an integer and determines whether it is divisible by 5 and 6, whether it is divisible by 5 or 6, and whether it is divisible by 5 or 6, but not both.

Here is a sample run of this program:

```
Enter an integer: 10
Is 10 divisible by 5 and 6? False

Is 10 divisible by 5 or 6? true
Is 10 divisible by 5 or 6, but not both? True
```

Q 15 Write a Python program which displays an appropriate name for a person, using a combination of nested ifs and compound conditions. Ask the user for a gender, first name, last name and age. If the person is female and 20 or over, ask if she is married. If so, display "Mrs." in front of her name. If not, display "Ms." in front of her name. If the female is under 20, display her first and last name. If the person is male and 20 or over, display "Mr." in front of his name. Otherwise, display his first and last name. Note that asking a person if they are married should only be done if they are female and 20 or older, which means you will have a single if and else nested inside one of your if statements.

Here is a sample run of this program:

```
What is your gender (M or F): F
First name: Gita
Last name: Pattanayak
Age: 32
Are you married, Gita (y or n)? y
Then I shall call you Mrs. Gita Pattanayak.
```

```
What is your gender (M or F): F
First name: Anjali
Last name: Mishra
Age: 48
Are you married, Anjali(y or n)? n
Then I shall call you Ms. Anjali.

What is your gender (M or F): M
First name: Ashok
Last name: Mohanty
Age: 23
Then I shall call you Mr. Ashok.

What is your gender (M or F): M
First name: Rahul
Last name: Pati
Age: 15
Then I shall call you Rahul Pati.
```

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MINOR ASSIGNMENT-3: FUNCTIONS AND LOOPS

Q 01 Write function **`calc_primes_up_to(max_value)`** to compute all prime numbers up to a given value. As a reminder, a prime number is a natural number greater than 1 and exclusively divisible by itself and by 1.
Check your algorithm with the following values:

Input	Result
15	[2, 3, 5, 7, 11, 13]
25	[2, 3, 5, 7, 11, 13, 17, 19, 23]
50	[2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47]

Q 02 Create function **`calc_checksum(digits)`** that performs the following position-based calculation for the checksum of a number of any length given as a string, with the n digits modeled as z_1 to z_n:

$$z_1 z_2 z_3 \dots z_n \Rightarrow (1 * z_1 + 2 * z_2 + 3 * z_3 + \cdots + n * z_n)\%10$$

Check your algorithm with the following values:

Input	Sum	Result
"11111"	1 + 2 + 3 + 4 + 5 = 15	15 % 10 = 5
"87654321"	8 + 14 + 18 + 20 + 20 + 18 + 14 + 8 = 120	120 % 10 = 0

Q 03 Compute all combinations of the values a, b, and c (each starting from 1 and less than 100) for which the following formula holds:

$$a^2 + b^2 = c^2$$

Bonus:

Reduce the running time of $O(n^3)$ to $O(n^2)$.

Q 04 This exercise deals with three-digit Armstrong numbers. By definition, these are numbers for whose digits $x, y,$ and z from 1 to 9 satisfy the following equation:

$$x * 100 + y * 10 + z = x^3 + y^3 + z^3$$

Write function **`calc_armstrong_numbers()`** to compute all Armstrong numbers for x, $y,$ and z (each < 10).

Q 05 Two numbers n_1 and n_2 are called friends (or related) if the sum of their divisors is equal to the other number:

$$sum(divisors(n_1)) = n_2$$
$$sum(divisors(n_2)) = n_1$$

Write function **`calc_friends(max_exclusive)`** to compute all friends numbers up to a passed maximum value.

Input	Divisors
∑(*divisors*(220)) = 284	div(220) = 1, 2, 4, 5, 10, 11, 20, 22, 44, 55, 110
∑(*divisors*(284)) = 220	div(284) = 1, 2, 4, 71, 142
∑(*divisors*(1184)) = 1210	div(1184) = 1, 2, 4, 8, 16, 32, 37, 74, 148, 296, 592
∑(*divisors*(1210)) = 1184	div(1210) = 1, 2, 5, 10, 11, 22, 55, 110, 121, 242, 605

Q 06

a. Write function **`gcd(a, b)`** that computes the greatest common divisor (GCD) using iteration.
Implement the above using Euclid's algorithm, which is an iterative computation based on the following observation:
if x is greater than y, then if y divides x, the gcd of x and y is y;
otherwise,
the gcd of x and y is the same as the gcd of x % y and y.

b. Write function **`lcm(a, b)`** that computes the greatest common divisor (GCD) using iteration.

$$\text{lcm} = \frac{a * b}{\text{gcd}\ (a, b)}$$

`GCD`

Input 1	Input 2	Result
42	7	7
42	28	14
42	14	14

`LCM`

Input 1	Input 2	Result
2	7	14
7	14	14
42	14	42

Q 07 A perfect number is one whose divisors add up to the number.
Example: The first perfect number is 6, because 1, 2, and 3 are its proper divisors, and 1+2+3=6
Write a Python program that prints all perfect numbers in between 1 and 500.

Q 08 Write function **`to_binary(n)`** that iteratively converts the given positive integer into a textual binary representation. No call to **`int(x, base)`** may be used.

Input	Result
5	"101"
7	"111"
22	"10110"
42	"101010"
256	"100000000"

Q 09 Write conversions to octal and hexadecimal numbers by implementing the corresponding functions **`to_octal(n)`** and **`to_hex(n)`**. Again, no call to **`int(x, base)`** may be used.

Input	Method	Result
7	octal	"7"
8	octal	"10"
42	octal	"52"
15	hexadecimal	"F"
77	hexadecimal	"4D"

Q 10 A palindrome is a word that reads the same from the front and the back. You can extend this definition to the digits of a number. Write an iterative function `is_number_palindrome(number)` but without converting the number into a string and then using string functionalities like `[::-1]`.

Q 11 Write a Python program called `functionGrowth()` that prints a table of the values log N, N,N log N, N^2, N^3, and 2^N for N = 16, 32, 64, ..., 2048. Use tabs (`\t` characters) to line up columns.

Q 12 Write the Python programs to print the following four patterns using for loop using four different programs.

(a)	(b)	(c)	(d)
*	1	1	1
* *	1 2	2 2	2 3
* * *	1 2 3	3 3 3	4 5 6
* * * *	1 2 3 4	4 4 4 4	7 8 9 10
* * * * *	1 2 3 4 5	5 5 5 5 5	11 12 13 14 15

Q 13 Write a Python program that displays all the numbers from 100 to 1,000, ten per line, that are divisible by 5 and 6. Numbers are separated by exactly one space.

Q 14 Write a Python program to evaluate the function $sin(x)$ and $cos(x)$ as defined by the infinite series expansions.

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} \ldots$$

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} \ldots$$

The acceptable error for computation is 10^{-6}.

Q 15 Assume that x is a positive variable of type double. Write a Python program that uses the Taylor series expansion to set the value of sum to

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots\ldots$$