# Practice Lab: Data Structures

| Fundamentals – I & II | Q1 | Q2 | Q3 | Total |
|---|---|---|---|---|
| | $5 \times 4$ | $3 + 4 + 3$ | $5 + 5 + 5 + 5 + 10$ | 60 |

1. This practice lab is expected to be completed by the end of week 2 of the course.

**Topics**
**Syllabus and Fundamentals (I)**: Data Types, Structures in C/C++ and Arrays.

**Fundamentals (II)**: Functions, Array of Structures, Local and Global Variables and Arrays as global variables

**Q1)** Write separate **functions** for each of the following:

1) Sum of Arithmetic Series: $f\ (a, d, n) = S_n = \frac{N}{2}\{2a + (n-1)d\}$ (5)

2) Sum of Geometric Series: $f_r(a, r, n) = S_n = \{\begin{array}{l} \frac{a(r^n - 1)}{r-1}, if\, r > 1 \\ \frac{a(1 - r^n)}{1-r}, if\, r < 1 \end{array}$ (5)

3) Sum of an $\infty$ Geometric series $f_\infty(a, r) = S_\infty = \{\begin{array}{l} \frac{a}{1-r} if\, r < 1 \\ \frac{a}{r-1} if\, r > 1 \end{array}$ (5)

4) a function that returns a structure $Z = \{X, Y\}$, where (5)
   1) $X\ =$ Sum of Geometric Series: $f_r(a, r, n)$
   2) $Y\ =$ Sum of an $\infty$ Geometric series $f_\infty(a, r)$

**Q2)** Write a **program** that uses the functions to developed in Q1 in order to:

1) Asks the user which function he/she wants to calculate? (3)
2) Accepts from the user appropriate inputs, note that each function mentioned above may require a different set of inputs. (4)
3) Calls the requisite function to calculate the formula, prints the results and exits. (3)

**Q3)** Write a **program** that:

1) Declare a structure named 'student.' Each student should contain a name and marks of three courses, namely, {Math, Chem, Physics}. (5)
2) Make an array of structures, where the size of the array is 10. (5)
3) Initialize the names and marks of these 10 students via the user. (5)
4) Call out a function named 'calculate_average' which accepts this array of structures and evaluates and prints the respective averages of Math, Chemistry and Physics. (5)
5) Call out a function names 'bubble_sort' which accepts this array of structures and sorts and prints the student list (i.e., their names and marks) as per their names. (10)

**Rubrics**

| S. No. | Content | Meets Criteria (1) | Marks | Does not meet expectations (0) | Marks |
|---|---|---|---|---|---|
| 1 | Indentation | Perfect | 100% | Code not indented properly | 0 |
| 2 | Code works | Code compiles and executes properly for any variable sized matrices | 100% | Code has errors | Based on the code |
| 3 | Comments | Code is properly commented | 100% | Code is not properly commented. | 0 |

**Sample Output for Q3:**

Herein below you will see a sample view of the program. Items written in black is printed by the program, whereas, items marked in red are inputted by the user:

> For the following ten students - please input their names and marks in Math, Physics, Chemistry:
>
> Name 1: Zeeshan
> [1.1] Zeeshan – Math:  90
> [1.2] Zeeshan – Chemistry: 85
> [1.3] Zeeshan – Physics: 95
>
> Name 2: Ayesha
> [2.1] Ayesha – Math:  70
> [2.2] Ayesha – Chemistry: 74
> [2.3] Ayesha – Physics: 99
>
> …
>
> Name 10: Umer
> [10.1] Ayesha – Math:  95
> [10.2] Ayesha – Chemistry: 55
> [10.3] Ayesha – Physics: 98
>
> The combined average of the three courses for 10 students is as follows:
> Math: 76.5
> Chemistry: 67.9
> Physics: 64.2
>
> Mark Sheet for Spring 2021:
> [1] Ayesha: Math (70) – Chemistry (74) – Physics (99)
> …
> [6] Umer: Math (95) – Chemistry (55) – Physics (98)
> …
> [10] Zeeshan: Math (90) – Chemistry (85) – Physics (95)