

Object Oriented Programming (Lab)

BSIT - Fall 2024

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Lab - 3

The objective of this lab is to:

To understand and utilize the concept of arrays (1D and 2D) along with the previous concepts.

ALERT!

1. This is an individual lab. You are **strictly NOT allowed to collaborate** with others, share screens, or communicate answers in any form.
2. Use of **AI tools (e.g., ChatGPT, Copilot, etc.)** is **strictly prohibited**. Any AI-generated content will be treated as academic dishonesty.
3. Anyone caught in the act of **cheating would be awarded a 0** in this Lab.
4. **MAKE SURE TO VALIDATE WHERE EVER YOU TAKE INPUT FROM THE USER<** OTHERWISE MARKS SHALL BE DEDUCTED.

Task 01

(4 marks)

Find Missing Number

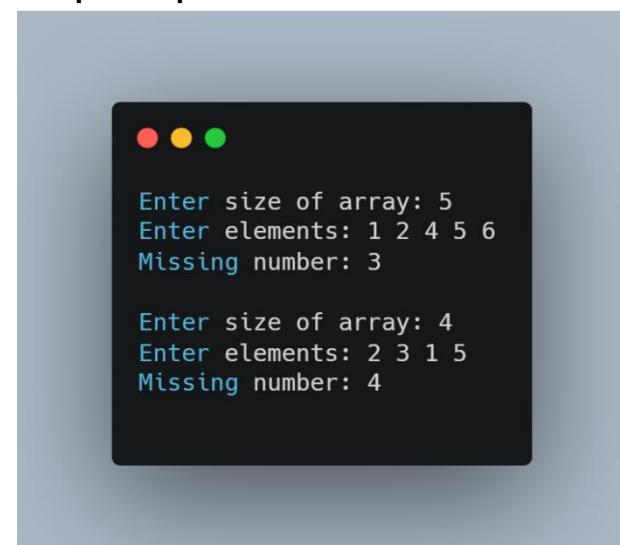
Problem:

You are given an array of size n containing distinct integers from 1 to n+1, but one number is missing. Find and print the missing number.

Function Prototype:

int findMissing(int arr[], int n);

Sample Output:



```
● ● ●
Enter size of array: 5
Enter elements: 1 2 4 5 6
Missing number: 3

Enter size of array: 4
Enter elements: 2 3 1 5
Missing number: 4
```

Task 02

(8 marks)

Cinema Ticket Booking

Problem:

A cinema hall has a seating chart of size 4×4 . Each seat in the chart is represented as either 0 for an empty seat or 1 for a booked seat. At the beginning of the program, some of the seats should be randomly marked as booked using the `rand()` function.

You are required to write a **function**

```
void bookSeat(int seats[][][4], int  
&row, int &col);
```

This function should take the position of a seat (row and column) as input. If the input is invalid (that is, the row or column is not between 0 and 3), then both row and column should be set to -1. If the seat is empty, the function should mark it as booked and return the updated row and column through reference parameters. If the seat is already booked, the function should return -1, -1 to indicate failure.

Sample Output:

```
● ● ●  
Cinema Booking System  
Enter row (0-3): 1  
Enter col (0-3): 2  
Seat booked successfully at (1,2).  
  
Cinema Booking System  
Enter row (0-3): 0  
Enter col (0-3): 0  
Sorry! Seat (0,0) is already booked.  
  
Cinema Booking System  
Enter row (0-3): 4  
Enter col (0-3): 2  
Invalid input! Row and Column must be between 0 and 3.
```

Task 03

(6 marks)

Caesar Cipher with Character Array

Problem:

Write a program that takes a string (character array) and an integer k.

Shift every alphabet in the string forward by k positions in the alphabet (wrapping around if needed).

Preserve case (uppercase stays uppercase, lowercase stays lowercase). Non-alphabetic characters remain unchanged.

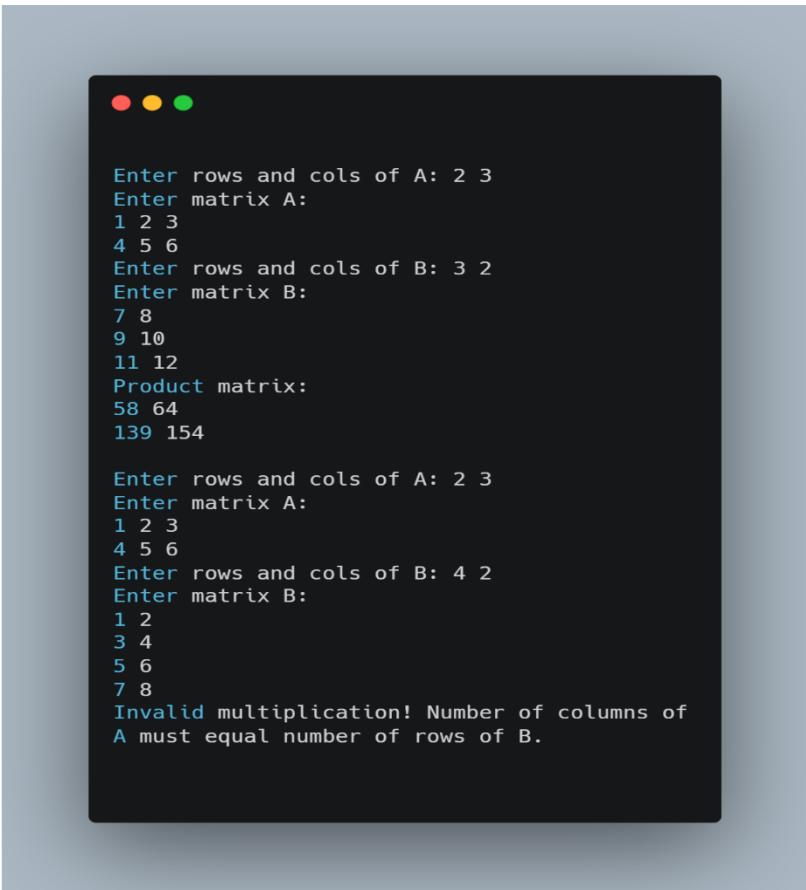
Sample Output:

```
● ● ●  
Sample Input 1:  
Enter string: Attack at Dawn!  
Enter shift value (k): 3  
Cipher text: Dwdfn dw Gdzq!  
  
Sample Input 2:  
Enter string: Zebra  
Enter shift value (k): 2  
Cipher text: Bgdtc
```

Task 04

(8 marks)

Matrix Multiplication



The screenshot shows a terminal window with two examples of matrix multiplication. In the first example, matrices A (2x3) and B (3x2) are multiplied to produce a product matrix (2x2). In the second example, attempting to multiply matrix A (2x3) by matrix B (4x2) results in an error message stating that the number of columns of A must equal the number of rows of B.

```
Enter rows and cols of A: 2 3
Enter matrix A:
1 2 3
4 5 6
Enter rows and cols of B: 3 2
Enter matrix B:
7 8
9 10
11 12
Product matrix:
58 64
139 154

Enter rows and cols of A: 2 3
Enter matrix A:
1 2 3
4 5 6
Enter rows and cols of B: 4 2
Enter matrix B:
1 2
3 4
5 6
7 8
Invalid multiplication! Number of columns of
A must equal number of rows of B.
```

Task 05

(4 marks)

Dice Game

Problem:

We want to simulate a 2-player dice game where each player rolls a dice three times. The program should use `srand(time(0))` so that the dice rolls are random every time.

You are required to write a function

```
void playTurn(int &score);
```

which rolls the dice three times, adds the dice values to the player's score using a reference parameter, and prints "Invalid dice roll!" if any value generated falls outside the range of 1 to 6 (this can happen if seeding with `srand` is skipped or the logic is incorrect). After both players finish their turns, the program should compare their scores and display the winner, or print "Draw" if the scores are equal.

```
Dice Game Start!
Player 1 rolls: 4 2 6
Player 2 rolls: 3 5 1
Player 1 Score = 12
Player 2 Score = 9
Winner: Player 1

Dice Game Start!
Player 1 rolls: 7 2 6
Invalid dice roll!
```

Task 06

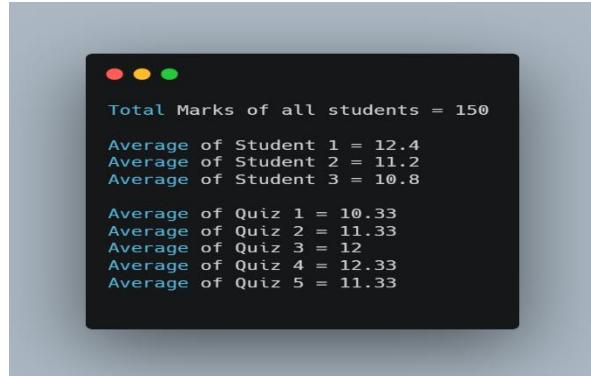
(6 marks)

Problem:

We have marks of 3 students in 5 quizzes stored in a 2D array.

You are required to write functions to:

1. Calculate the **total marks** of all students (`sum2D`)
2. Calculate the **average marks of each student** (`avgStd`)
3. Calculate the **average marks of the class per quiz** (`avgClass`)



```
Total Marks of all students = 150
Average of Student 1 = 12.4
Average of Student 2 = 11.2
Average of Student 3 = 10.8

Average of Quiz 1 = 10.33
Average of Quiz 2 = 11.33
Average of Quiz 3 = 12
Average of Quiz 4 = 12.33
Average of Quiz 5 = 11.33
```

Task 07

(6 marks)

Character Frequency Analyzer

Problem:

A teacher wants to check how many times each letter appears in a student's essay.

You are required to write a function

```
void charFrequency(char text[], int freq[]);
```

which counts the frequency of each alphabet character (both lowercase a-z and uppercase A-Z). All digits and special symbols should be ignored.

The program should display the frequency of only those characters that actually appear in the text. If the input text is empty, the program should display an error message. Example Console Interaction:

```
Enter text: "Hello World"
Output:
H:1
e:1
l:3
o:2
W:1
r:1
d:1

Enter text: ""
Output: Invalid! Text cannot be empty.
```

Task 08

(8 marks)

Rotate Array by k Steps

Problem

Write a program that rotates an array of size n to the right by k steps.

```
Sample Input 1:
Enter n: 7
Enter array elements: 1 2 3 4 5 6 7
Enter k: 3
Sample Output 1:
Rotated array: 5 6 7 1 2 3 4

Sample Input 2:
Enter n: 5
Enter array elements: 10 20 30 40 50
Enter k: 2
Sample Output 2:
Rotated array: 40 50 10 20 30
```

Task 09

(8 marks)

Transpose of a Matrix

Problem:

Given a matrix, find its transpose.

Transpose of a matrix is obtained by flipping rows into columns.

```
Sample Input 1:  
Enter rows and cols: 2 3  
Enter matrix:  
1 2 3  
4 5 6  
Sample Output 1:  
Transpose:  
1 4  
2 5  
3 6  
  
Sample Input 2 (Square Matrix):  
Enter rows and cols: 3 3  
Enter matrix:  
1 0 0  
0 1 0  
0 0 1  
Sample Output 2:  
Transpose:  
1 0 0  
0 1 0  
0 0 1
```

Task 10

(4 marks)

Peak Element (1D Array Search):

Problem:

An element is a “peak” if it is not smaller than its neighbors. Find and print any one peak element. (Corner elements need only one neighbor check.)

```
Sample Input 1:  
Enter n: 6  
Enter array elements: 1 3 20 4 1 0  
Sample Output 1:  
Peak element: 20  
  
Sample Input 2:  
Enter n: 4  
Enter array elements: 10 20 15 2  
Sample Output 2:  
Peak element: 20
```

Task 11

(4 marks)

Randomized Password Generator:

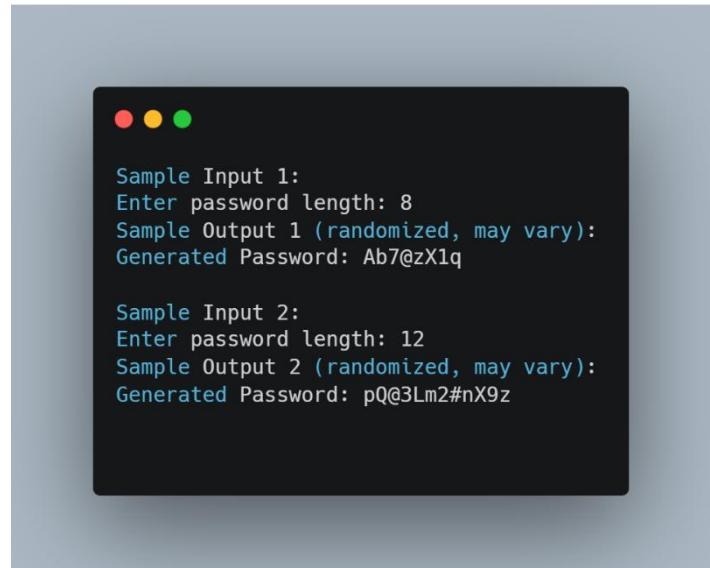
Problem:

Write a function that generates a random password of given length n using rand() and srand(). The password must contain at least:

- 1 uppercase letter
- 1 lowercase letter
- 1 digit
- 1 special character (@, #, \$, %, &)

The rest of the characters can be **randomly chosen(use of rand/srand)** from the whole pool.

(Outputs will differ each run because of rand(), but the structure — at least one from each category — stays enforced.)



```
Sample Input 1:  
Enter password length: 8  
Sample Output 1 (randomized, may vary):  
Generated Password: Ab7@zX1q  
  
Sample Input 2:  
Enter password length: 12  
Sample Output 2 (randomized, may vary):  
Generated Password: pQ@3Lm2#nX9z
```

Task 12

(5 marks)

Problem:

Write a function int merge(char result[], char str1[], char str2[], int len1, int len2); that merges two character arrays (strings) into one. The merged string should first contain all the characters of str1, followed by all the characters of str2. The function should return the total length of the merged string.

If either of the input strings is empty, the function should still work (just copy the other string). If the result array does not have enough space to store the merged string, the function should return -1 to indicate failure.



```
str1 = "Hello"  
str2 = "World"  
Merged String: HelloWorld  
Length of merged string: 10  
  
str1 = "Open"  
str2 = ""  
Merged String: Open  
Length of merged string: 4
```