United International University
Department of Computer Science and Engineering
CSE-2218 Data Structures and Algorithms II Laboratory

Assignment **1** — Set: A — Summer 2025

Total Marks: **7.5**

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

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1. You are attending your mid-term of the course "CS101". The total marks of the exam is M and the total time is T minutes. You have to answer N questions, where the i-th question carries m_i marks and takes t_i minutes for you to answer.

   The marks you receive will be proportional to the percentage of your answer compared to the full answer. For example, if a question contains 100 marks and you complete 30% of it, you will get 30 marks.

   - Find the maximum marks you can get in this exam. Print the questions you have to answer for that.
   - Find the maximum marks you can get in this exam if you are allowed to take the same exam in a group with your one friend (as long as a question is answered, both of you get marks irrespective of who answered it) and your friend's answering capacity is exactly the same as yours.

Sample Input	Sample Output
120 20 5 20 10 20 5 30 5 30 6 20 40	Maximum 88 marks answering alone ques 3 100% done – 30 marks ques 4 100% done – 30 marks ques 2 100% done – 20 marks ques 1 40% done – 8 marks Maximum 107 marks answering with a friend

2. You are managing a multipurpose hall of your university, where seminars, lectures, and cultural events are held. N clubs have sent you booking requests for their events tomorrow. Each booking request contains the club id (c_i), the start time (s_i) and the duration (d_i) of the event.

   Approve the booking requests such that you can accommodate the maximum events tomorrow, without creating conflicts. Note that, after an event you need X hours to clean up and prepare for the next event.

Sample Input	Sample Output
4 a 2 8 b 3 4 d 8 1 c 7 1 0	Chosen clubs: b c d
4 a 2 8 b 3 4 d 8 1 c 7 1 1	Chosen clubs: b d

3. There are n boxes of n different items in a warehouse. Each box has a label that says the name (m_i), total weight (w_i) in kg, and the total value (v_i) in taka of that item (i). All items are divisible.

   Suppose, k thieves have come to steal from the warehouse, each with a knapsack of capacity W_i. Given each thief wants to maximize profit, how many thieves will be needed to empty the warehouse? Solve using a greedy algorithm.

Sample Input	Sample Output
4 silver-dust 300 4 gold-dust 2000 8 salt 80 10 sugar 89 10 2 15 15	Thief 1 profit: 2326.7 taka Thief 2 profit: 126.3 taka Total 2 thieves stole from the warehouse. Still following items are left: salt 2.0 kg 16.0 taka

4. Write a divide and conquer program that takes X and Y as input and calculates X^Y.

Sample Input	Sample Output
3 7	2187

5. Write a function `merge_sort` that sorts an array of N numbers in descending order using merge sort. Write a main program that takes N numbers as input, sorts the array, and prints the result.

Sample Input	Sample Output
4 3 7 5 -1	7 5 3 -1

6. If $i < j$ and $A[i] > A[j]$, then the pair $(A[i], A[j])$ is called an inversion of an array A.

   Write a function `count_inversion` using divide and conquer that counts the inversions in an array.

Sample Input	Sample Output
5 8 4 -1 2 5	#inversions: 6
7 1 20 6 4 5 8 4	#inversions: 10

7. Write a function `find_max_sum_subarray` that finds the maximum sum subarray of an array A of N integers using divide and conquer.

Sample Input	Sample Output
9 -2 1 -3 4 -1 2 1 -5 4	4 -1 2 1 sum 6

8. Write a recursive program to find the sum of the elements of an array of size n.

Sample Input	Sample Output
5 1 2 3 4 5	15
4 10 -2 7 5	20

9. Write a recursive program to check if a given positive integer is a palindrome or not.

Sample Input	Sample Output
121	Palindrome
123	Not Palindrome
1221	Palindrome

10. Write a recursive program to implement the Tower of Hanoi.

Sample Input	**Sample Output**
3	Move disk 1 from A to C Move disk 2 from A to B Move disk 1 from C to B Move disk 3 from A to C Move disk 1 from B to A Move disk 2 from B to C Move disk 1 from A to C

11. Sereja and Dima play a game. The players have n cards in a row, each with a distinct number. On each turn, a player takes either the leftmost or rightmost card. Both play greedily by choosing the larger available card. Sereja moves first. Print the final scores of both players.

Sample Input	**Sample Output**
4 4 1 2 10	12 5
7 1 2 3 4 5 6 7	16 12

12. A new e-mail service "Berlandesk" is going to be opened in Berland. Each time a new user wants to register, he sends a request with his name. If such a name does not exist in the database, the system inserts it and responds `OK`. If the name already exists, the system appends the smallest integer to make it unique (e.g., name1, name2, ...).

Sample Input	**Sample Output**
4 abacaba acaba abacaba acab	OK OK abacaba1 OK