

Course Code: CS2001/AI	Course Name: Data Structures
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Instructions:

- Please return the question paper.
- Please read each question completely before answering it. There are **3 questions and 2 pages**
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement in the question paper.
- Show all steps clearly.

Time: 60 minutes.

Max Marks: 20 points

Question 1: Sorting and Searching (CLO: 1)

5 points

Shaheen Real Estate Agency is one of the authorized dealers of New-Malir housing society. The society contains multiple blocks of houses. Each block contains **N** houses of equal in size. Shaheen agency got the license to sale the houses of only **1** block of the society. Luckily all the houses are sold to the **N** no of different families in a week. Initially at the booking, they were randomly allocating the house from **1 to N**. But according to the rules of society, every family allotted a house must have a neighboring family with less no of family members to its left.

You need to design an algorithm to solve the issue and re-shuffle them according to the rule of the society.

Question 2: Stacks and Queues (CLO: 3)

7.5 points

Suppose there are four friends (A, B, C, D) playing a card game. The game is being played with a deck of 100 cards, ranging from numbers 1-100. Card numbers are not repeated, i.e., there is only one card for each number. These cards are randomly shuffled and maintained in a pile.

The game works as follows:

- In each iteration, each friend (A, B, C, D) picks a card from the deck and place it on the table. Each player only picks the topmost card. That is, players are not allowed to select a card.
- In this manner, there are four cards placed on the table in each iteration.
- The player who has placed the highest card in the iteration wins the round and put all the cards in his/her pile.
- In this manner four individual piles are being maintained, i.e., for each player.
- For 100 cards, there are 25 rounds (iterations).
- At the end of the game, the player with highest number of cards in his/her pile wins the game.

Simulate the game by writing an efficient code using your knowledge of data structures.

Question 3: Binary Search Trees (CLO:2)

7.5 points

Given a binary tree (not necessarily a BST) as input. Write a function that calculates the number of subtrees in the given binary tree that are valid Binary Search Trees.

Example:

The following binary tree contains 4 valid BSTs (3 leaf nodes and 1 subtree)

