

# Indian Institute of Technology Jodhpur

## CS121 Data Structures and Algorithms

1. There is a straight highway with villages alongside the highway. The highway is represented as an integer axis, and the position of each village is identified with a single coordinate. There are no two villages in the same position. The distance between two positions is the absolute value of the difference of their coordinates.

Post offices will be built in some, but not necessarily all of the villages. A village and the post office in it have the same position. For building the post offices, their positions should be chosen so that the total sum of all distances between each village and its nearest post office is minimum.

You are to write an algorithm which, given the positions of the villages and the number of post offices, computes the least possible sum of all distances between each village and its nearest post office.

2. In the knapsack problem we are given a set of  $n$  items, where each item  $i$  is specified by a size  $s_i$  and a value  $v_i$  both integers. We are also given a size bound  $S$  (the size of our knapsack). The goal is to find the subset of items of maximum total value such that sum of their sizes is at most  $S$  (they all fit into the knapsack).
3. Write an Insertion Sort algorithm for integer key values. However, here's the catch: The input is a stack (not an array), and the only variables that your algorithm may use are a fixed number of integers and a fixed number of stacks. The algorithm should return a stack containing the records in sorted order (with the least value being at the top of the stack). Your algorithm should be  $O(n^2)$  in the worst case.