CSE 312 Midterm III (Lab Exam)

Olcay Taner YILDIZ

I. Gas Shortage (20 points)

You are given a set of cities, along with the pattern of highways between them, in the form of an undirected graph G = (V, E). Each stretch of highway $e \in E$ connects two of the cities, and you know its length in miles, l_e. You want to get from city s to city t. There's one problem: your car can only hold enough gas to cover L miles. There are gas stations in each city, but not between cities. Therefore, you can only take a route if every one of its edges has length $l_e \leq L$. Given the limitation on your car's fuel tank capacity, show how to determine in linear time whether there is a feasible route from s to t.

A. Input

The first line of the input consists of two integers (V, E) number of vertices and number of edges in the graph respectively. The second line of the input consists of three integers (s, t, L) index of the first city, index of the second city and number of miles. After those two lines, there is a line for each edge, where the edge is defined with three numbers, starting vertex, ending vertex, length of the edge in miles.

B. Sample Input

```
3 3
0 1 12
0 2 8
0 1 16
1 2 9
```

C. Output

If there is a feasible route, print 'feasible', otherwise print 'infeasible'.

D. Sample Output

```
feasible
```

II. Serve customers (20 points)

A server has n customers waiting to be served. The service time required by each customer is known in advance: it is t_i minutes for customer i. So if, for example, the customers are served in order of increasing i, then the ith customer has to wait $\sum_{j=1}^{i} t_j$ minutes. We wish to minimize the total waiting time

$$T = \sum_{i=1}^{n} (time\ spent\ waiting\ by\ customer\ i) \quad (1)$$

Give an efficient algorithm ($n \log n$) for computing the optimal order in which to process the customers.

A. Input

The first line of the input consists of a single integer n giving the number of customers. Second line consists of service times of customers.

B. Sample Input

```
4
2 3 1 4
```

C. Output

Write the minimum total waiting time.

D. Sample Output

```
20
```

III. Maximum subsequence sum (20 points)

A contiguous subsequence of a list S is a subsequence made up of consecutive elements of S. For instance, if S is

$$5, 15, -30, 10, -5, 40, 10 \quad (2)$$

then 15, -30, 10 is a contiguous subsequence but 5, 15, 40 is not. Give a linear time algorithm that finds the contiguous subsequence of maximum sum. For the preceding example, the answer would be 10, -5, 40, 10, with a sum of 55. (Hint: For each $j \in 1, 2, \ldots, n$, consider contiguous subsequences ending exactly at position j.)

A. Input

The first line of the input consists of a single integer N giving the size of the array. Second line consists of the array elements.

B. Sample Input

```
7
5 15 -30 10 -5 40 10
```

C. Output

Maximum contiguous subsequence sum.

D. Sample Output

```
55
```