

Birla Institute of Technology and Science, Pilani Second
Semester 2017-2018, DSA (CS F211)

Lab Assignment #10

1. **Closest Pair of Points:** Given a set of points in a plane, your task is to find the two closest points in it.

Input:

N – number of points

N lines of x and y coordinates

Output:

Two closest points' coordinates. (x1, y1) and (x2, y2)

Time Complexity: $O(N \log N)$

Sample Input:

```
5
0 0
1 1
5 6
10 20
10 50
```

Sample Output:

```
0 0
1 1
```

2. Given an array count the number of times a smaller number appears after a larger one.

Input:

N – number of elements in the array

The array of elements

Output:

M – the number of swaps

Time Complexity: $O(N \log N)$

Sample Input:

```
5
1 20 6 4 5
```

Sample Output:

```
5
```

Explanation: (20,6) (20,4) (20,5) (6,4) (6,5) are the pairs which are not in correct order.

3. Given two sorted arrays of same size, find the median of the array which would form when these arrays would be merged in sorted order. Since, the number of elements would be even, return the floor of the average of the two middle numbers.

Input:

N – size of the arrays

Two arrays of size N

Output:

The median

Time Complexity: $O(\log N)$

Sample Input:

4

1 9 32 51

5 12 24 45

Sample Output:

18

Explanation: average of 12 and 24: 18.

4. **Strassen's Matrix Multiplication:** The brute force matrix multiplication algorithm can be tweaked a bit to improve the time complexity. Use Strassen's algorithm to optimize multiplication of two square matrices.

<https://www.geeksforgeeks.org/strassens-matrix-multiplication/>

Input:

N – size of the square matrix

Two square matrices of size N X N

Output:

Result of multiplication

Time Complexity: $O(n^{\log 7})$

Sample Input:

3

1 2 3

3 2 1

1 2 3

4 5 6

6 5 4

4 6 5

Sample Output:

28 33 29

28 31 31

28 33 29

5. Given a chess board of size N X N, you have to place N Queens in it such that none of them are in attacking position with respect to each other.

Input:

N – size of the chessboard.

Output:

N X N matrix containing 0s and 1s. 0 – empty box. 1 – queen is placed in that box

Sample Input:

4

Sample Output:

0 1 0 0

0 0 0 1

1 0 0 0

0 0 1 0

NOTE: There can be multiple correct answers.

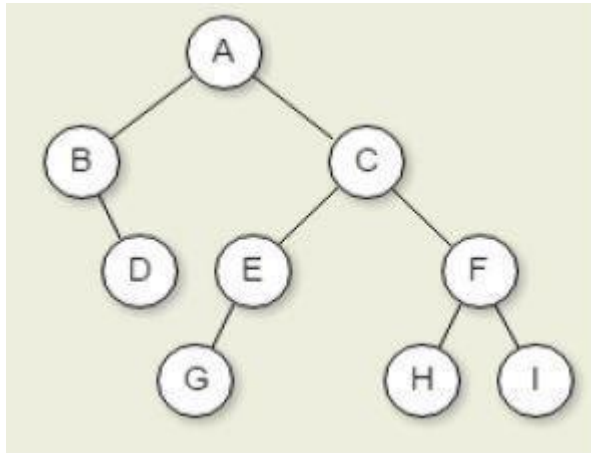
6. You are given in-order and post-order of a tree in form of character arrays. Using these two, you need to construct the tree from it. After constructing the tree print the pre-order of the tree.

Ex:

In-order: BDAGECHF I

Post-order: DBGEHIFCA

For this, constructed tree is:



Pre-order: ABDCEGFHI

7. You will be provided with N numbers and also Q Queries. Assume the N numbers to be A1, A2, A3, A4, AN. In each query you will be given two Numbers U and V. You have to find the smallest integer Y such that $1 \leq Y < 2^{31}$ and the value of f (U, V, Y) is as maximum as possible. f (U, V, Y) is defined as follows.

$$f(U, V, Y) = (A_U \text{ xor } Y) + (A_{U+1} \text{ xor } Y) + \dots + (A_V \text{ xor } Y).$$

Input:

N Q

N space separated integers denoting array A

Q lines where each line consists of two integers U and V

Output:

For each query output the value of Y

Constraints:

$$1 \leq N \leq 10^5$$

$$1 \leq Q \leq 10^5$$

$$0 \leq A_i < 2^{31} \text{ for each valid } i$$

Sample Input:

```

5 3
20 11 18 2 13
1 3
3 5
2 4
  
```

Sample Output:

```

2147483629
2147483645
2147483645
  
```

8. You are given a string s . Now if it is not a palindrome you have to split it into palindromes in such a way that their concatenation gives s . Also Splitting has to be done in such a way that minimum number of palindromes are formed.

Sample Input-1:

MALAYALAM

Sample Output-1:

1, MALAYALAM

Sample Input-2:

WHAATRAALOL

Sample Output-2:

7, W, H, AA, T, R, AA, LOL

Explanation:

After Splitting, strings are $W + H + AA + T + R + AA + LOL = WHATRAALOL$

9. A majority element in an array $A[]$ of size n is an element that appears more than $n/2$ times (and hence there is at most one such element). Write a function which takes an array and emits the majority element (if it exists), otherwise prints NONE in $O(n)$ as follows:

Constraints: $-10^9 < A_i < 10^9$

Example:

Input1:

9

3 3 4 2 4 4 2 4 4

Output1: 4

Input2:

9

3 3 3 4 2 4 4 2 4

Output2: NONE

10. Given a string s of length n which contains all lower case characters, find a permutation P such that the output string t written in that order gives out a palindrome. If not possible, print -1. That is, $t[i] = s[P_i]$.

Input:

n – size of string

String

Output:

Permutation

Constraints: $n < 10^5$. Time taken < 2 seconds

Sample Input:

3

baa

Sample Output:

2 1 3

Sample Input:

3

abc

Sample Output:

-1

Explanation:

baa can be permuted as aba and the permutation of characters is 2 1 3. abc cannot be written as a palindrome.

NOTE:

There can be multiple correct answers for this question.