

**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**  
**HYDERABAD**  
**CAMPUS,**  
**Data Structures and Algorithms**  
**CS F211 / IS F211**

**Homework Assignment – 4**

1. These days lot of e-commerce websites have an option of sorting things by a field or an attribute. Consider you are looking for a **Book** whose fields or attributes are book name, author name, edition, isbn no, price, publication. You will be having an array of Book of size  $n$  and you have to sort the array according to price. Define a structure for the Book with relevant fields mentioned and sort the array on basis of price using Merge-Sort.  $1 \leq n \leq 1000$
2. These days lot of e-commerce websites have an option of sorting things by a field or an attribute. Consider you are looking for a **Book** whose fields or attributes are book name, author name, edition, isbn no, price, publication, publication year. You will be having an array of Book of size  $n$  and you have to sort the array according to price. Define a structure for the Book with relevant fields mentioned and sort the array on basis of book name using Quick-Sort.  $1 \leq n \leq 1000$
3. These days lot of e-commerce websites have an option of sorting things by a field or an attribute. Consider you are looking for a **Book** whose fields or attributes are book name, author name, edition, isbn no, price, publication, publication year. You will be having an array of Book of size  $n$  and you have to sort the array according to price. Define a structure for the Book with relevant fields mentioned and sort the array on basis of publication year using Insertion-Sort.  $1 \leq n \leq 1000$
4. The election in the state of Gotham is nearing. Several candidates are contesting to be the mayor of the town. The big day finally arrives and the votes are taken. The ex-mayor asks you (since you are a responsible citizen with coding skills) to find the winner of election. You are given input array  $A[0 \dots n-1]$  where each element represents the vote in the election. Assume that each vote is an integer representing the ID of the chosen candidate. Help ex-mayor in deciding who wins the election by outputting the ID of the winner candidate. Assume only one winner be there. Solve it in  $O(n \log n)$   
[the student has to find the no. Which repeats the most no. Of times.]
5. Sam thinks he know binary search too well. But his friend already has a challenge for him. His friend gives him an ascending order sorted array which had been rotated clockwise about a pivot which is unknown to you beforehand. So for instance, 1 2 3 4 5 might become 3 4 5 1 2.

His friend challenges Sam to find a given key in  $O(\log n)$  time. Help Sam in completing the challenge.

6. There are  $n$  person playing a game. Each person owns some money which is displayed by them. And you are watching them as a spectator suddenly thought of an amount  $X$  and want to check if any two person combined sum of money is equal to this amount  $X$  or not? You have to answer Yes or No in  $O(n \log n)$ . Assume money to be an integer

**Input Format:**

$n$   $X$

$n$  integer's separated by space

**Sample Input:**

6 10

1 5 4 19 10 6

**Sample Output:**

Yes

**Explanation:** there exist two values 4 and 6 such that  $4 + 6 = 10$

7. Write a program that converts upper case to lower or lower case to upper in given file (file.txt), depending on the name it is invoked with in the command line. (think `argv[0]`)

e.g.

\$ ./toupper file.txt

Converts to upper case

\$ ./tolower file.txt

Converts to lower case

8. Your friend recently learnt to make android apps. He made a word puzzle app. Given a word  $w$ , the puzzle app gives string  $s$  lexicographically greater than  $w$ . In case of multiple answers, the app outputs the lexicographically smallest one among them. If no answer exists, 'game terminated!' is printed. Your friend asks you to check if the outputs are correct. You decide not to see his code and write your own code to verify his app's results. Your code takes no. of test cases and prints the lexicographically higher word for each input.

**Eg:**

**Sample input**

5

ab

bb

hefg

dhck

dkhc

**Sample output**

```
ba
game terminated!
hegf
dhkc
hcdk
```

9. There are **n** person in a village. Each person own some cows which is distinct for every body and is known to you. You want to check how many triplets of 3 people are there for whom cow possessed by one person is equal to sum of cows possessed by 2 other person. In a way you have to find the total number of triplets (i,j,k) such that  $cows[i] = cows[j] + cows[k]$  and  $i \neq j \neq k$ . Solve this problem in  $O(n^2)$
10. Write a program to reverse the order of words in a sentence. Take the sentence is given as an array of characters in the program itself. The array itself must be changed with the order of words reversed. Don't use any extra array. Assume there are no leading or trailing spaces in the sentence.  
e.g.  
array "Data structures and Algorithms" should become  
"Algorithms and structures Data".
11. Write a program to generate 1000, 100000, 100000, 200000, 500000, and 1000000 numbers randomly (use `srand()` and `rand()`) and sort them using the following algorithms
  - a. Insertion sort
  - b. Bubble sort
  - c. Merge sort
  - d. Quick sortMeasure the time taken to run each of the above algorithm and print it (use `time()` and `clock()` functions)