



DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY  
(MA39203)

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Indian Institute of Technology, Kharagpur

Assignment : 03  
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**You must solve Question 1 and 2 first. Otherwise, you will not be evaluated for the other questions.**

1. Write a program to implement the Randomized Quick Sort algorithm. Do not use any extra space except the (recursion call) stack space.

**Example:** Input:  $N = 4$ ,  $\text{array}[] = \{3, 4, 6, 2\}$  Output: 2, 3, 4, 6

2. The median of an array of size  $n$  is defined as the middle element when  $n$  is odd and the average of the middle two elements when  $n$  is even. Write a program to find the median of an integer array that runs in **average** case time complexity  $O(n)$ .

**Example 1:** Input:  $\text{arr}[] = \{6, 3, 7\}$  Output: 6

**Example 2:** Input:  $\text{arr}[] = \{4, 2, 1, 3\}$  Output: 2.5

3. Given two **sorted** arrays **arr1**[] and **arr2**[] of size  $m$  and  $n$  respectively, find the median of the two sorted arrays.

**Example 1:** Input:  $m = 2$ ,  $\text{arr1}[] = \{1, 3\}$ ,  $n = 1$ ,  $\text{arr2}[] = \{2\}$  Output: 2

Explanation: merged array is [1, 2, 3] and median is 2.

**Example 2:** Input:  $m = 2$ ,  $\text{arr1}[] = \{1, 2\}$ ,  $n = 2$ ,  $\text{arr2}[] = \{3, 4\}$  Output: 2.5

Explanation: merged array is [1, 2, 3, 4] and median is 2.5

4. A Chef has prepared a feast with  $N$  dishes for you. You are also given an array  $A$  of size  $N$ , where  $A[i]$  represents the happiness you get by eating the  $i$ -th dish. You will eat all the dishes in a series of steps. In each step, you pick a non-empty subset of the remaining dishes and eat them. The happiness you get from eating these dishes is the size of the subset multiplied by the sum of the individual happiness from the dishes in the subset. You want to maximize the total happiness you get from the entire feast, which is the sum of happiness in each step.

**Example 1:** Input:  $N = 3$ ,  $A[] = \{-8, 0, -2\}$  Output: -10

Explanation: You can eat the first dish in the first step, the second dish in the second step and the third dish in the third step; total happiness =  $1*(-8) + 1*0 + 1*(-2) = -10$

**Example 2:** Input:  $N = 3$ ,  $A[] = \{2, 3, 1\}$  Output: 18

You can eat all three dishes in a single step; total happiness =  $3*(1+2+3)=18$