

Google

3 Rounds - All Design and Algorithms

OS/networks/dbms were not asked. The faster you code, more questions will be asked. (speed is imp)

Round1 : (Time 45 mins/ 40 mins interview 5 mins Q and A)

q1: John Appleseed has a locker which requires a 4 digit(0-10) combination key. The problem with the locker is you can enter a string of numbers of any length and at any point of time, if 4 consecutive numbers form the key, lock will be opened. Analyze such a string length. (best and worst cases). Write a code to generate the large string that opens the locker.

a1: I started discussing the De Bruyn Sequence (AGT course). He asked me if a De Bruyn kind of string always exists. Then i gave a backtracking code to generate the string (using a hash table). We had a detailed discussion on hash table implementation, collisions etc. Now can you do this without Hash table. I gave the next permutation approach.

q2: Which Google product do you like?

a2: GMail. We discussed why gmail and he asked me 5 points to improve gmail, etc.

q3: Do you know that Google News was designed in 2004. Design Google News for 2014.

a3: I talked about clustering (K-means, Agglomerative clustering). I suggested better hierarchical clustering in Google News. We talked about UI tweaks in mobile google news platform, importance of trending topics etc.

q4:

Round2 : (Time 45 mins/ 40 mins interview 5 mins Q and A)

q1: We talked about a Chinese reinvention of the game Reversi. Almost the same rules as the traditional reversi. Code the Reversi solver.

a1: Used backtracking and Graph search algorithms. Write test cases for your code. Where does it fail? What can we do about it?

q2: BFS vs DFS

a2: Indepth analysis of BFS and DFS. I also talked a little about forward, backward, cross and tree edges, Uniform Cost Search ( from AI).

q3: At this point we talked about my Graph Theory internship. I was asked to find the diameter of a tree without finding the tree's height

a3: Do BFS twice to get the trees diameter (CLRS question). We talked about Chordal Graphs(my intern topic)

q4:

Round3 : (Time 45 mins/ 40 mins interview 5 mins Q and A)

q1: Design an API for LRU policy. If you do not know, he will explain LRU .

a1: I have used a DLL with Hash Table. Apparently Silberschatz OS book does it in a better way using circular linked lists. Get your API correct. Handle edge cases.

q2: There are 4 bins where coins of differing values are stacked on top of each other. You are given the values of these coins and the number of coins in each bin. Take N coins (in total) from the four bins maximizing the sum of the values of the coins selected. (Why four bins -- This is just to put a constraint that you can only pick the top coin from every bin. It's not a bag)

a2: I tried a dynamic programming approach but I couldn't solve it.

q3: Given a tree find all common/similar subtrees.

a3: Lengthy discussion of hashing. Sum paths to nodes etc. Coded both approaches.

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#### Interview 1

Q1 Given a set of intervals  $[S_i, E_i]$  for  $i = 1..n$ . and a target interval  $t = [s, e]$ . Find the minimum subset of interval which fully cover the target interval.

Q2. Given a dictionary. Find a pair of word which are non conflicting and have maximum optimization value. A pair of words are conflicting if they have a common letter and a optimization value of a word is the product of the letters numerical value.

#### Interview 2

Q1 Find the first repeating number from a stream of numbers.

#### Interview 3

Q1. Variation of Subset sum problem

Q2. Given a set of matching pair eg  $\{ \{a, b\}, \{a, c\}, \{z, d\} \}$  and a string. Find whether the string is balanced or not. eg abaczd and azacdb is balanced according to the above matching pair set. It is a generalized parenthesis matching problem.

#### Interview 4

Q1. You have a stream of stock value of a company coming every second and you have to display the present value of the stock, maximum/ minimum price of the stock till now. But due to some error in the network, sometimes it may happen that the previous (not immediate previous, any previous value) value of stock that you got is wrong.

Formally you have three events as follows

presentValue(time t) : return the stock value at time t

changeValue(time pt) : return the correct value of stock at time pt ( $<$  current time)

Write the handler for the above events

Q2. **Given a set of horizontal or vertical lines segments in 2D plane. Find the number of squares formed by the set.**

Round 1 : [Duration 45 minutes]

Interviewer : Given two linked list, head at MSD (Most significant digit). add them and return head at MSD.

Me: Reversed them and add them.

Interviewer : You can not modify head pointers

Me: after 5 min, I can do it recursively[Just a tukka], wasn't sure about it :P

Interviewer: But that will take  $O(n)$  space in the stack.

Me: Yes

Interviewer: Do it with  $O(n)$  time and  $O(1)$  space.

Me: thought 10 mins, didn't get anything.

Interviewer: Lets solve a problem, Given a number in the form of linked list with head at MSD and add 1 to the number.[ Asked by them in intern interview of my ICPC team mate Shubhang].

I gave complete solution of this problem.

Interviewer : Now use it to solve the problem.

Me: Thought 5 min, didn't get anything.

Interviewer: Gave a hint

After that I solved the problem.

Round 2: [45 minutes]

2 Simple problems, gave solutions instantaneously and coded them as well.

1. Given  $N$  number of intervals, and a target intervals, two intervals can be merged if they intersect. like  $[2,10]$  and  $[10, 12]$  or  $[2,7]$  and  $[4,11]$  can be merged. Merge minimum number of intervals such that after merging them, we get an interval. which contains target interval inside it. e.g.  $[3,12]$  contains  $[2,12]$  and  $[5,10]$  inside it.

2. Given  $S$  strings, find maximum product of the length of two string such that they do not share any character.

For example. ["dog", "cad", "apple", "map"] answer will be 15,  $\text{length}(\text{"dog"}) \times \text{length}(\text{"apple"})$

He said to me that problem can be solved in  $O(n^2 \times \text{max\_length\_of\_string})$  using naive way. So I didn't have to change the complexity. I just to do some optimization.

Round 3: [45 minutes]

Interviewer : If you know solution to some problem, tell me and we will solve some another problem.

Me : cool

Interviewer : Write a code to find intersection of two quad-trees?

I saw the problem on quad-tree one day before interview and couldn't solve it, so I said yes I know the problem. So that he may skip it.

Interviewer: Ok lets solve it again

Me: :( So as I didn't know it, I said I read about it in Computational geometry, Please explain quad-tree.

Interviewer : Gave complete explanation.

I solved it. Was pretty simple.

Interviewer : Gave a case, where my code was going to give wrong answer.

I modified the code a bit. Now everything looked fine to me.

Interviewer : Write test case and run ur code.

I wrote and ran it. It was fine.

Interviewer : Write test case for this problem.

I write many test case few were small edge case , and few were large random cases.

Interviewer : But you can not test big case as u don't know the real answer.

Me : I am considering that I have a correct solution of the problem.

Interviewer : But that is always not possible in real world.

Me : But we can always write a brute force checker.

Interviewer : Do you have anything to ask?

Me : Nothing right now.

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we have a random list of people. each person knows his own height and the number of tall people in front of him. write a code to make the equivalent queue.

for example :

input: <"Height", "NumberOfTall", "Name">,  
<6,2, "A">,<1,4, "B">,<11,0, "C">,<5,1, "D">,<10,0, "E">,<4,0, "F">

output: "F", "E", "D", "C", "B", "A" --> end of queue

## **SOME MORE QUESTIONS - date - 13 jan 2015**

### **First Interview**

**1) Add one to a linked list(in one pass).**

**2) Given a class with two methods**

**Class nextString{**

**bool hasNext;**

**string getNextString;**

**}**

**implement the two methods, where the given initial string is a binary string with some '?'**

**characters in between, which can be substituted by either '0' or '1'. Everytime getNextString is**

**called a new string should be returned(never repeated) substituting the initial string's wildcard**

**characters. Eg: 1?0?1111?0? is given initially, one possible string returned could be**

**11011111001. There is no required order of the returned strings. You can not store the strings**

**you have returned previously.**

**hasNext method should return whether any new string is possible or not.**

### **Second Interview**

**1) Given a number, express in minimum number of terms of sum of squares i.e.**

**$x = a_1^2 + a_2^2 + \dots + a_n^2$ , minimise  $n$ , and return  $n$ .**

2) Maximum contiguous sum in an array(Kadane's algorithm)

3) Spiral order printing of matrix

4) Given a database and a cache(any type of cache you can choose), how do you implement the system where the user's request is always served from the cache and never from the database directly. He was expecting data structures I would use. He grilled me over how hashmap is implemented at the very basic level when I said that I would use hashmap.

PS: He made me code just the first one out of these questions :P

#### Interview 1

1) Given a set of intervals queries will be like given a point find the number of intervals this point belongs to. He expected a near about  $O(1)$  algo basically wanted to use map.

2) Even values at even positions and odd values at odd positions. Even sorted among themselves and odd among themselves. Find a value.

3) Given a graph find any local minima.

#### Interview 2

1) Given two graphs form a new graph which is addition of these two.

2) Design question : design a leaderboard to handles queries like player with this rank and update score of this player.

1) Given a string, count the total number of palindromic substrings in it.

$O(n^2)$  time.  $O(1)$  space.

2) Given a  $N \times N$  grid and a position  $(X, Y)$  of a man on it. He is allowed to take  $K$  steps in any of the 4 directions. If he steps out of the grid, he dies. Find the probability that the man survives after  $K$  steps. (PS. The steps taken are unbiased i.e doesn't depend upon where he is standing).

3) Given a doubly linked list of size  $m$  and a set of  $n$  random pointers to the list ( $n \ll m$ ).

Find the number of connected components in the list.

4) Given a string  $S$  of digits, find the next higher palindrome.

eg. Given  $S = 20$ , ans = 22

$S = 121$ , ans = 131.

Complexity:  $O(n)$  where  $n$  is the size of the string.

5) Given an array of integers, find any one local minima.  $O(\log n)$  required.

1) Given 2 integers, one as string and other as int. Return their sum.

2) Given  $n$  numbers, find all triplets (all 3 in Arithmetic progression)

3) Given 3 arrays (all are sorted arrays of length  $n$  each)

4) Given array of  $2n$  numbers from  $1$  to  $n$  (each element occurs 2 times in array). Return a permutation of array in which each element  $e$  is adjacent to other instance of  $e$  by swapping elements.

5) Given an array  $A$  of  $n$  elements return array of  $n$  elements whose  $i$ th element is

$\text{Result}[i] = \text{Sum of all } A[j] \text{ (} j \text{ from } 0 \text{ to } i-1 \text{) which are less than } A[i]$

Interview 1

1. There are 2 types of characters

1 byte character which contains value between 0 to 127.

2 byte character which has 2 bytes. First byte contains value between 128-255 and second byte has value between 0 to 255.

Given an array of bytes and an index  $k$ , tell whether index  $k$  is the start of a character?

2. Given a sorted array with numbers in range 0-100. Find the missing numbers and print them in the form of intervals, separated by commas.

Eg

1 2 4 9

Return a string >

"0,3,58,10100"

## Interview 2

1. Given a list of parent ids and its corresponding list of child ids, build the tree.

1 > 2 3

3 > 4 8

4 > 5 6 7

Ids can be string, int, float, etc. And there can be any number of children for a given node.

2. There are 2 cities Hyderabad and Bangalore. A traveller travels for n days. He is in one of the cities on a given day. You are given two arrays:

$H[n]$  > Amount person earns on ith day in Hyd.

$B[n]$  > Amount person earns on ith day in Bang.

A person can also move from 1 city to another. It takes him 2 days to reach the other city.

One day is spent in travelling ( on that day he earns no money), and finally on the second day, he is in the other city.

Find max amount person can earn after n days. Also print the path he should take to get that max amount.

## Interview 3

1. **Given a forest of trees. The forest of trees is represented in an array. Every node in a tree has a unique integer id. Id of child node is always greater than id of parent node.**

**Eg**

**1 6**

**2 3 7 8**



4 5 9 10

Above forest has 2 trees. It will be represented in an array as (1indexing):

Idx 1 2 3 4 5 6 7 8 9 10

A[idx] 1 1 1 3 3 6 6 6 8 8

A[idx] is the parent ID of child node with ID = idx.

Now k nodes (given as input ) are deleted from some trees in the forest. If a node is deleted from a tree, then the entire subtree rooted at that node gets deleted.

You need to represent the new forest (after deleting k nodes) in the array again. Also reorder the IDs so that all the IDs are consecutive.

If node with ID 3 and 8 are deleted, the new forest will be :

1 6

2 7

After Reordering:

1 3

2 4

Final Array:

idx 1 2 3 4

A[idx] 1 1 3 3

Expected order:  $O(n)$

2. Given the starting and ending points of the building and it's heights. Eg: 1 4 5

1 is the starting point, 4 is the ending point and 5 is its height. Given such several buildings output the starting point, ending point and maximum height there.

Eg:

4

1 4 5

2 3 7

2 6 4

5 7 3

output

1 2 5

2 3 7

3 4 5

4 6 4

6 7 3

Expected order:  $O(n \log n)$

#### Interview 1

1.1. Given a set of numbers, and a random generator which generates a random float number between  $[0,1]$ . Return any permutation of those numbers.

Complexity:  $O(n)$

1.2. Given that there are  $n$  people sitting in a row, out of which more than  $n/2$  are engineers and rest are managers. If a question like "Is person on index  $i$  an engineer?" is asked to an engineer, he answers correctly(TRUE/FALSE), but when asked to manager he answers arbitrary anything. You have to find on each index if their is an engineer or manager.

Complexity:

Brute force:  $O(n*n)$

Best:  $O(n)$

#### Interview 2

2.1. I don't remember the exact question, but I just answered DFS and he said, lets move to

the second question.

2.2 This question is pretty big.

Part 1: Given  $N$  stations in a row and  $M$  station masters ( $M \leq N$ ). Arrange station masters on different stations, such that maximum difference between two station masters should be minimum.

Part 2: Now station masters are initially standing at some positions. You have to move them and bring them to positions "such that maximum difference between two station masters should be minimum", But as there could be many formations for the same maximum difference, answer the formation which requires minimum movement of station masters.

Part 3: Everything same as part 2, but now station masters can only move  $K$  steps from their original position.

Interview 1

1. Longest increasing subsequence in 2d grid, you can search in all the 4 directions up, down, left and right. //  $O(N^2)$

2. Design Question (Networks)

Interview 2

1. In a grid, all the blocks have either green color and blue color, green standing for land, blue for water, asked me to find no of islands in the grid, (will be solved using connected components)

2. Given  $n$  2d points, find how many maximum points can lie on a single line.

Shukla Off Campus

1. Find the largest substring in a string which doesn't contain more than 2 unique characters.

2. Addition of 2 numbers represented by strings.

3. Find all triplets in a vector that are in AP.

4. Given a big string and a lot of small strings, write a method to test if the small strings are a subsequence of the big one.

5. Given 2 sets, A and B, find  $A \cap B$  and  $B \cap A$

6. Finding the longest path in a DAG

7. Implement iterator of iterators (involves bit explanation but was quite easy)

8. Find triplet such that  $a+b+c \leq x$

9. Find a number which occurs more than  $n/4$  times in a sorted array.  $O(\log n)$

10. Longest path between any two nodes in a linear graph.

11. Maximum occurring number in BST.

12. Alien Dictionary.

13. Queue question that was also asked in PPO interview.

14. External Merging of files.

Sudhanshu Off Campus

1. Connected components + Knapsack => basically, given N people, who have groups amongst them and the groups can only go together, find the maximum people you can send to a picnic.

2. DAG mein longest path nikalo. Where each node can have only one outgoing edge.

3.  $A = xyz$ .  $B = xzyxyy$ .  $A^k = x..k \text{ times}, y..k \text{ times}, z..k \text{ times}$  etc. Find the largest K such that  $A^k$  is a subset of B.

4. Find the maximum occurring element in a BST.

5) Find all triplets such that sum is  $\leq N$ .

6. Alien dictionary problem. Isko optimize karne ko kaha tha, ab tak samajh nahi aaya kaise karu.

7. People in a queue wala.

8. Iterator for the power set of a given set. You can't store the previous state. Isme push\_back use kiya tha toh woh interviewer ne hatane ko kaha.

9. External merge sort of distributed files=> N servers; each has log files which store logs by timestamp. kisi K length ki window mein kitni queries aa rhi hai yeh answer krna hai.

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## MAHAVIR

1.1. Given a set of numbers, and a random generator which generates a random float number between [0,1]. Return any permutation of those numbers.

Complexity:  $O(n)$

1.2. Given that there are n people sitting in a row, out of which more than  $n/2$  are engineers and rest are managers. If a question like "Is person on index i an engineer?" is asked to an engineer, he answers correctly(TRUE/FALSE), but when asked to manager he answers arbitrary anything. You have to find on each index if their is an engineer or manager.

Complexity:

Brute force:  $O(n*n)$

Best:  $O(n)$

2.1. I don't remember the exact question, but I just answered DFS and he said, lets move to the second question.

2.2 This question is pretty big.

Part1: Given N stations in a row and M station masters ( $M \leq N$ ). Arrange station masters on different stations, such that maximum difference between two station masters should be minimum.

Part2: Now station masters are **initially standing at some positions**. You have to move them and bring them to positions "such that maximum difference between two station masters should be minimum", But as their **could be many formations** for the same maximum difference, answer the formation which requires minimum movement of station masters.

Part3: Everything same as part2, but now station masters can only move K steps from their original position.

Google ques collection:

Placement Interview 1 Google :

Q1. Find the local minimum in an array ?

Q2. Find local minimum in 2D grid ?

Q3. Find local minimum in 2D grid using best complexity ?

Code the above solution (only high level code)

Placement Interview 2 Google :

Q1. Find if an array contains an equilibrium index. Equilibrium Index : Sum on the left of the index is equal to the sum in the right side of the index.

Code it ?

Without using extra space ,  $O(1)$  space is allowed ?

Q2. Suppose there is a camera whose field of view is  $F$  degrees and you are with this camera in a ground. There are many trees in the ground. Find the maximum number of trees that can be covered in his field of view.

Code it !

Q3. Suppose the Q2 where the number of trees are very very large , i.e. you cannot store all trees in the physical memory. So device an approximation algorithm for finding the solution to Q2 and suppose you can store trees in any segments

Placement Interview 3 Google :

Design Problem :

Design a cab and consumer system where the user can download the app in his mobile and cab people can download the app in his mobile and you need to discuss and design the model with the interviewer . Interaction with the interviewer is important.

Code on Google Docs for all the problems.

**Tushar (got mtv offer)**

Round 1.

First it started with a basic introduction and question regarding my internship along with a project discussion. This was a sort of an ice breaker which went on for only about 5 minutes.

Q1. Two numbers are represented in the form of an array with each array index storing a digit of the number with MSB at 0th index. Write a function which takes these 2 arrays as inputs and returns a new array which contains the sum of the 2 numbers stored in a resultant array. This ques was basically meant for testing corner cases.

Q2. Given a binary tree (not a BST) , convert it into a singly linked list such that the order of the elements in the linked list is the zigzag representation of the tree. The left pointer of the treenode is converted to next pointer of linked list and right pointer is changed to null. Write a function which takes a pointer to root as input and returns the pointer to the head of the linked list. Note that this should be done inplace.

I was asked to code both these ques. This round went on for abt 45-50 mins.

Round 2.

Q1. Suppose you are working at the Google Datacenter ( was happy to hear this :P) . Jobs arrive and leave at the datacenter from time to time. Each job has 3 properties associated with it

Start Time, End time and Ram usage.

Now at any particular instant of time (in this case it was in units of seconds of the day), we want to query the maximum ram usage among the jobs running at that particular instant of time. Write a routine that will do this efficiently.

After I coded this ques, she changed the ques as follows.

Suppose I want to print a calendar of the RAM usage, i.e. show intervals in which a specific amount of RAM is the maximum used. Write a routine to perform this task.

Example.

Job	Start	End	Ram
1	2	7	8
2	3	4	9
3	7	9	10

Then the calendar is as follows.

2-2	8
3-4	9
5-6	8
7-9	10

This is the output of the above example.

Round 3.

We have a list of class schedules in the form of start and end times, and one classroom. The aim is to maximise the number of classes that can take place in this classroom.

Suppose you have a document and a list of words ( 3 in my case for simplicity ). We have to find the smallest snippet window in the document, i.e the smallest window in which all 3 words occur. The window length is specified in terms of number of words in the window.

Given a linked list with next and arbitrary pointers, clone it. I told him I had seen this ques before. He still asked me for the approach which I was able to explain.

Create a fair spin lock for threads. This lock shud ensure that the order in which the threads enter the critical section is the same as that in which they entered the entry section. I was expected to write the code for the entry and exit section. Only one atomic operation. i.e atomic increment is available.

Write code for Reader Writer Problem using the above fair spin lock.

Round 4.

Given a string, find the number of palindromic substrings. He only expected an  $O(n^2)$  time and constant space soln. I was asked to code it.

Given a string of A,B and C find the number of substrings which dont have all 3 letters present in the substring. I was expected to give a linear time soln and was also asked to code it.

In this round I was asked to write all my code on the whiteboard unlike the previous rounds which were on the Google Docs.

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prashant

First Round:

1. Encode a tree into a string format such that the tree can be constructed back form the string encoding. Also encoding should be efficient both time and space wise.
2. Given a regular expression containing only characters a-z, A-Z, and wild cards( . and \*) and a string. Write a function which tells whether the given string follows the given regular expression or not.

Second Round:



1. First he explained to me what is UTF encoding. Then he asked to me write a function which given a string checks that the string is a valid UTF encoding or not.
2. This was a standard question on data structures. You are given a lot of phone numbers say 10 digit. And you need to store them efficiently (space wise) and then carry three operations on it.
  - a. Mark a number that it is used.
  - b. Check whether a number if free or used.
  - c. Find a free number.All to be done time efficiently. Suggest a data structure for this problem.

Third Round:

1. Given a string, return the length of the maximum length substring which is made by only 2 characters.
2. Then write test cases for above problem.
3. Given a string containing only 0, 1 and ? Generate all the strings replacing ? by 0 and then by 1.

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priyank

Round1

Implement the following API for displaying rank table in a competitive programming.

1. Participant Joins
2. Participant Drops (Unregisters from current ongoing competition)
3. Top 5 (overall)
4. Participant Submits (update score, etc)
5. Get current rank of participant

1. A two player game. Two stacks of n and m coins.

Available options for player :

1. Take as many from one stacks
2. Take equal from both stacks.

Player who picks last loses.

Round 2

1. Add a large number represented by array with an unsigned integer.
2. Find the occurrences of anagrams of a small string S, in a large text T. Optimize so that program is not dependent on character set. Device a way in which traversing of hashmap is not required.

Round 3

1. A wooden log is given and an array of cuts is given. You have to cut at all the marked cut points. The cost of doing a cut is proportional to the current length of the log.
2. Print all the interleaving of two strings. Ex. "AB", "CD" – {ABCD, ACBD, ACGB, etc}  
Do not care about duplicates.

Round 4

1. Permute a given array of numbers so that they follow zig zag order. Ex 1 2 3 -> 1 3 2
2. Implement incrementByOne function for a linked list. Do not use recursion.
3. Given a tour path(static) ( a sequence of cities he will travel delhi->bangy->chennai) .  
And given the list of fligh start and end times for each station, find the best tour path for a given passenger. ( best == so that he reaches the destination earliest)

Do some preprocessing, so that you can answer queries for each customer given their start time for the first airport.

<http://stackoverflow.com/questions/17562089/how-to-count-number-of-requests-in-last-second-minute-and-hour>

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1st Interview :

1. You are given a number in the formed of a linked list as given below :

eg. 1 -> 2 -> 3 -> 4 represents the number 1234

You have to increment the number by 1 i.e. you have to change the number in the linked list to 1235. The number in the list can be arbitrarily large.

2. What is a Binary Search Tree ? Given a binary Search Tree and a value as N. You have to find out the number in the BST nearest to this number N i.e. with the minimum modulus of difference value.

## 2nd Interview

1. You are given a Binary Search Tree and a sum value S. You have to find out the pair of numbers in the binary search Tree whose sum is equal to S.

2. You are given an array of numbers

a1 , a2, a3, a4, a5,.....

you have to sort the array in the following form.

a1 <=a2 >= a3 <= a4 >= a5.

After giving the correct answer justify the correctness of the solution.

## 3rd Interview (Onsite)

1. Given a string S1 and other string S2. Your function should return true if S2 is anagram to any substring in S1.

Code the most optimal solution reached.

2. Given N-1 distinct integers from 1 to N. Find the missing integer.

Modified : Given N-2 distinct integers from 1 to N. Find the missing integer.

Code the most efficient solution obtained.

## 4th Interview (Onsite)

1. Print all valid Open Close braces strings of length N.

Code the solution

2. Given a list of equivalence relations. Find the number of disjoint sets from the relations.

3. Design Question : You are given two RAMs full of billions of numbers (Very less extra space available) . These two RAMs are present in a data center and are connected by a Network. You are to sort the numbers as follows :

First and second RAMS are fully sorted in increasing order and the last element of the first RAM (means the largest element) is less than the first element of the 2nd RAM(means the smallest element). As the RAMs are connected through the network you can swap elements between the RAMs.

Give an efficient algorithm for the task.

Similarly do the following type of sorting when there are 4 RAMs.

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allaudin :

[https://docs.google.com/document/d/1rYmdlfevp9LZshA7bSbmVZ1qvxyNDMPmMznStl5\\_yH0/edit](https://docs.google.com/document/d/1rYmdlfevp9LZshA7bSbmVZ1qvxyNDMPmMznStl5_yH0/edit)

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- 1a. Choose a subset of  $k$  numbers from an array of  $n$  numbers... fairly
- 1b. what if  $n$  is not known, i.e its a stream of numbers
2. Given a BST, find a maximum size chunk of same numbers
3. Given  $2n$  points on a circle, find the number of ways in which chords can be drawn with no intersection (not even on the ends)
4. Given a permutation array, find the number of times it has to be applied on an array to get back the original array.
5. Design Question: Tic Tac Toe
6. Gray Code design and proof of formula.
- 7.. Project related questions

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Round 1:

1. Given a  $m \times n$  matrix, and each cell is filled by only 2 colors. you are given a cell  $(i, j)$ , you need to find the perimeter of the connected component defined by the color of cell  $(i, j)$
2. Design Question: Build a system to distribute mobile numbers to several mobile companies. The constraint is given any number your system should be able to tell in  $O(1)$  to which company it belongs to. In addition to it implement the functions below:
  - i. `bool check_if_no_is_free(int n, int company)`
  - ii. `int assign_no(int n, int company)`
  - iii. `int generate_a_new_no(int company)`
3. General discussion on projects

Round 2:

1. Generate gray code no using the mirroring approach
2. Find all the pythagorean triplets in an array.

Round 3:

1. Given  $2n$  points on a circle, find the no of ways of drawing  $n$  non intersecting chords.
2. pretty printing of binary trees

Round 4:

1. Design question: Given a set of attributes  $(s_1, \dots, s_n)$ , we can sort a structure at any step using any of the attribute  $s_i$ , Give its data structure to insert, delete, and give the next no by the chosen attribute  $s_i$ .

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One was finding the  $k$ th number in  $O(n)$  simple quick select.

another based on majority element

One was based on some tree traversal based on some zig zag order

one was associated with bfs/dfs for finding perimeter of a connected area in a 2d grid

one was on strings !

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one was a normal dp, one was a simple problem on linked list, then another reqd topological sorting, 2 problems reqd to construct trees from traversals, one problem was a simple binary search

They asked me following problems:

round 1:

1. Given a max heap of  $N$  nodes. Find maximum  $k$  nodes. They require  $O(k \log k)$  solution.
2. Given a string of characters, find longest substring containing only 2 unique characters.

round 2:

Asked me about one of my projects.

then a problem, they told me about mirroring property, to find gray code of an integer. Write code to find gray code of  $N$  using mirroring property.

round 3:

1. Given a dictionary, the string of shorter length comes before the string of longer length, and if two lengths are equal, lexicographically smaller string comes before other. Given a string, find the rank of the string.

2. A binary tree is to be printed on the screen. The screen is in the form of coordinates with top left coordinate being 0,0. The binary tree printed on the screen should look like a binary tree, i.e.

- each column should have only one node of binary tree,
- the nodes of right subtree of a node should have larger x coordinate relative to the node.
- the nodes of left subtree of a node should have smaller x coordinate relative to the node.

You have a function which can assign to coordinate of a screen a node of binary tree in  $O(1)$  time.

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chinese dictionary

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Round1 (Angrez)

Solve the expression  $a+b*c+d$  giving preference to  $*$  and also evaluate from left to right .all of a b are

single digit.

Abcd 123456 -> ab2c3d456

Find the closest point to a point in a BST.

Round 2 (good guy from HYD )

Find next permutation

Check whether the graph is bipartite (2 colorable)

Quad Trees (binary images) a node can be mixed that have four children atleast one of which white and

one is black or a complete black node in which case it will not have any child.

Now find the overlay of these images. (or with black=1) check for boundary case when combining BBWW

and WWBB that the parent node will change from mixed to a single colored.

Round 3 (Piyush)

Given n points (n very large)  $c1$ =no of points in the first quad  $c2$  = second quad

Given  $X_{ij}$  reflect points  $i-j$  along  $x$  axis and correspondingly for  $y$ . give series of  $x_{ij}$  and  $y_{ij}$  find the final count of  $c_1, c_2, c_3, c_4$ .

I gave a  $n^{1.5}$  algo (topcoder) then he wanted to remove the dependency on  $n$  so gave the method of

linked list where we calculate the list based on interval  $i-j$ s

Design the ball game as some blocks were unreachable we could have optimized on the no of nodes that

we need to have in the graph.

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1. Given a grid of alphabets you have to search for a word but you can take 90 degree turns in the grid (any turn allowed) (and you can't repeat the same location)

2. You have a dictionary and you know the alphabets but you don't know the order of the alphabets i.e. you don't know that  $a$  comes before  $b$  and so on. You have to figure out the alphabet order from the dictionary

3. 1. You have an array and you have to sort it such that when you read the numbers from left to right you have the largest possible number

4. given some intervals sorted by start time and a new interval you have to merge them (the intervals are non overlapping) ( $\log n$  time : corner cases)

5. He asked this puzzle (I didn't know it then but I guess it's a famous puzzle) there are 25 horses and 5 tracks

6. you can represent an image as a quad tree. every node will have 4 children. suppose the image is completely black.

it is represented by 1 black node. if it is completely white - 1 white node and if mixed it is represented by a mixed node with 4 children each of which is the quad tree for each quadrant of the image and the Q is to implement overlay of 2 images

that is if you place 1 image on top of the other (imagine an x-ray)

if a pixel is white for both images you see white but if either pixel is black you see black so get the quad tree for the overlayed image if both are mixed recurse on subtrees

if one is white and one is mixed

copy the mixed

subtree

and if one is black and one is mixed then you get black

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First Round:

1. Encode a tree into a string format such that the tree can be constructed back from the string

encoding. Also encoding should be efficient both time and space wise.

2. Given a regular expression containing only characters a-z, A-Z, and wild cards( . and \*) and a

string. Write a function which tells whether the given string follows the given regular expression

or not.

Second Round:

1. First he explained to me what is UTF encoding. Then he asked to me write a function which given a string checks that the string is a valid UTF encoding or not.

2. This was a standard question on data structures. You are given a lot of phone numbers say 10 digit. And you need to store them efficiently (space wise) and then carry three operations on it.

a. Mark a number that it is used.

b. Check whether a number is free or used.

c. Find a free number.

All to be done time efficiently. Suggest a data structure for this problem.

Third Round:

1. Given a string, return the length of the maximum length substring which is made by only 2 characters.



2. Then write test cases for above problem.

3. Given a string containing only 0, 1 and ? Generate all the strings replacing ? by 0 and then by 1.

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If a person dials a sequence of numbers on the telephone what possible words/strings can be formed from the letters

We are given 4 numbers say  $n_1, n_2, n_3, n_4$ . We can place them in any order and we can use mathematical operator  $+, -, *, /$  in between them to have final result as 24. Write an algorithm for this, it will take 4 numbers and return false or true whether final result 24 is possible with any combination.

Pretend there is a robot that has to navigate a maze ( $N \times M$ ). The robot can only move down or right and the maze can contain walls. Write an algorithm to determine the number of paths the robot can take.

If a person dials a sequence of numbers on the telephone, what possible words/strings can be formed from the letters associated with those numbers?

Given a file containing 4,300,000,000 integers, how can you find one that appears at least twice

A is an array of size  $2n$  such that first  $n$  elements are integers in any order and last  $n$  elements are characters.

i.e.  $A = \{i_1 i_2 i_3 \dots i_n c_1 c_2 c_3 \dots c_n\}$

then we have to rearrange the elements such that final array is

$A = \{i_1, c_1, i_2, c_2, \dots, i_n, c_n\}$

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siddhartha banerjee

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MUDIT BHARGAVA

----- Round 1 -----

\* In an ongoing topcoder contest we need to be able to fetch the rank of any given candidate at any point of time. We also should be able to get the list of top 5 w/o linked list on candidates at any point of time.

Candidates can move up the rank ladder by submitting questions or even can be removed from the ranking if they chose to drop out mid contest. Discussion on approach ... no code required

\* adding of two linked list in  $O(1)$  space. MSB at the head of the linked list (with code).

----- Round 2 -----

\* implement a power set iterator

\* find an anagram of string T in string S

----- Round 3 -----

\* dependency problem ... topological sort

\* given a BST find the summ of all the nodes in the range of  $[l, r]$

----- Round 4 -----

\* given an array of numbers, print the condensed range of missing numbers ....

eg arr -> [3,4,45,67,68]

ans -> 0-2,5-44,46-66,69-99

[ handling of all possible border cases was required ]

\* given a byte array which contains only 2 byte and 1 byte elements such that

1 byte -> 0-127

2 byte [first byte] -> 128-255

2 byte [second byte] -> 0-255

given a byte no k, find out of that byte belongs to 1 byte type or 2 byte type

----- Round 5 -----

\* a few questions, suggestions and possible improvements on my intern project

\* given onion prices per kg in an array .... find the most amount of money you can make by doing N transactions .... you can hold only 1 kg at a time ... with code ...

----- THE END -----

## Aishvarya

1. Wiggle sort
  2. Binary search on array (lower bound)
  3. Implement stack with O(1) getMin() method
  4. How would you design a system to deploy a binary across a cluster of computers? (15 minutes)
  5. How do you produce high quality software in C++? (14 minutes)
  6. How would you design a URL shortener service like [tinyurl.com](http://tinyurl.com)? (11 minutes)  
(The previous interviewer indicated that he had strong coding skills, so I should focus on design and SW engineering. Thus, I didn't ask any coding questions.)
  7. Partial products. (in an array return multiplication of all numbers except ith term...(one way is to do by multiplying all numbers and dividing it by ith term...tell another way)).
  8. Next Node in the in-order traversal (given parent pointer also)
  9. validate an UTF8 string
  10. find the deepest leaf and the path from the root to that leaf inside a binary tree.
  11. Write a maze solver (in a maze find if you can reach from a to b).
  - 12.1 Write a function to copy a file (external merge sort)
  - 12.2 How many bytes should we copy at a time?
  - 12.3 What if we copy from one disk to another disk?
- Conversion Interviews :-
13. Number of ways you can draw n chords in a circle with 2n points such that no 2 chords intersect.
  14. Given an array and a permutation array, tell min steps in which array becomes itself again.
  15. Given a 2-d matrix with characters. Find number of occurrences of a given string (This can be tricky, few edge cases to handle like 180 degree rotation).
  16. One design question - boring they're :-/

## Vishrut

- 1) Write a function to increment number stored as an array.  
E.g., [2,7,8,9] -> [2,7,9,0]  
Starting prototype (CAN BE CHANGED AS DESIRED):  
`int* inc (int* array, int len);`
- - Discuss briefly a recent project. What role did you play on it, and what was the purpose? (HDL lab work)
- Serialize a tree with a variable number of children per node for transmission over a very low bandwidth link.
- Design a system to parse a large (tens or hundreds of GB) text file with lines like:

```
foo = 7
bar = 3
foo + 8
bar - 1
baz = 16
bar = 9
and produce summary results:
foo = 15
bar = 9
baz = 16
```

- 1) Write a breadth first graph traversal.
- 2) In a monastery there are several monks, amongst whom atleast one attains enlightenment everyday. Enlightenment manifests itself as a red mark on the forehead of a monk. The monks have no way to see their own reflection and they are forbidden from talking or gesturing to each other. All the monks meet once every morning in a single room. A monk leaves the monastery after realising that he has been enlightened. What is the algorithm that the monks use to decide that they have been enlightened.

## Yash

Q1. Return the 5th largest node in a BST

Q2. Given `ReadBlocks(start_block, block_count, buffer)`, implement `ReadData(start_addr, size, data)`

- Compute the local KxK averages of an input NxN matrix into a target matrix (image smoothing). Algorithm + Coding.

- Given a sorted array, construct a balanced BST

## Extras (asked during a conversion interview)

1. find the node with the closest value of the given node in BST (absolute difference minimum) - very easy to miss a case ! :-D
2. friends standing at integral coordinates on a grid. every intersection points in grid is hotel. All have to meet somewhere where should they meet such that the sum of distance from all other hotels is minimum?
3. Rod cutting problem - given the position of cuts you have to give order of cuts such that the cost is minimum, cost for each cut is length of rod at that time.

## Himanshu

1. Two players are playing the following game in turns . There are m white balls and n black balls on a table. A player can either remove
  - a) any number of white balls
  - b) any number of black balls
  - c) equal number of white and black balls.The player who clears the table first wins.

Given any scenario that there are x white balls and y black balls on the table and its player Z's turn. Determine his winning strategy.

2. Reverse all the words in a strings

My name is Himanshu. -> Himanshu is name My.

3. Given two numbers stored in linked lists, perform their addition.

1234 is represented as 1->2->3->4

### **Khannan**

Given some stack of coins, the 2 player game is:

each player can take all/any(>0) coins from leftmost stack

Each player plays optimally, last to pick wins.

Find Winner

Given sorted then rotated series of numbers find max/min

Given ropes of size multiples of k (unlimited in no), min pieces required to form n ropes of length m, only cut operation permitted

Sorted Array -> BST

Implement find in Integer array with difference(adj elements) = constant,

Given a 2d height map of buildings on a mountain, find the water accumulated after heavy rains

### **Asked to me**

1. Implement strcmp

2. Given a string containing many words, implement a method for mapping all words to its location in the string i.e., index of starting char and another method for looking up a word in the string and returning all the locations. Use OOPs.

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### **Asked to a friend**

One was related to rand() function

and another was finding kth largest in two sorted arrays..I solved it for without duplicates

but couldn't complete for with duplicates  
as it was tricky  
:(

Round 1 had adding two linked lists..(only the method, no code)  
printing a matrix in spiral order  
LRU cache(indirectly implied through a design question)  
Most frequently used cache  
Round 2 had [tinyurl.com](http://tinyurl.com), mostly concentrated on design  
simple coding question which involved recursion  
Round 3 had a game design which was graph theory + DP  
bringing  $O(n^4)$  to  $O(n^2)$   
and that rand() question  
Round 4 had a simultaneous BFS question  
followed by that kth largest thing

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<http://zhaonangoogole.blogspot.in/>  
  
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**BY BAJAJ**

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Onsite Round

Round 1 -

1. Given 2 sets A and B of strings, find A-B and B-A as efficiently as possible.
2. One Data Structure related problem, in which we need to show price fluctuations(i.e min price, max price, update price ..etc) of share market.

Round 2 -

1. One string of length n is given that only contains two characters I and D. I - increasing, D - decreasing.  
Find lexicographically smallest sequence of length n+1 that satisfies the condition given in string.

ex - if str[0] is I then seq[1] > seq[0], if str[1] is D then seq[2] < seq[1].  
str- given string, seq is your ans sequence

2. given some strings, group equivalent ones together. Let two strings are given A and B, they are equivalent if after rotating each character of A by some k we reach out to B.

Round 3 -

1. <http://www.spoj.com/problems/ORDERS/>

He is happy with  $n^2$  solution, but if u can optimise that would be great, i gave me  $n \log^2 n$  solution but there is one  $n \log n$  solution also exists.

2. Two strings T and S are given, find a substring in T that is an anagram of S (assume alphabet set is really big and try not to use any extra space).

Round 4-  
open ended question

Round 5-  
Design question and discussion on how google search suggestions probably work.

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Round 1  
=====

- 1) reservoir sampling.
- 2) find k mutual friends with topmost priorities..

Round 2  
=====

- 1) implement malloc() and free()
- 2) find random element in A - B. A,B are two sets of integers where B is a subset of A.

Round 3  
=====

- 1) a simple bfs based problem .
- 2) Given a graph with the condition that one node is capital node, for every other node { for all paths going from this node to capital , the total path weight must be same }  
Assign edge weights to such a graph.

#### Round 4

=====

- 1) modified Variant of subset sum problem .
- 2) open ended question - based on concurrency/parallelism.

#### Round 5

=====

- 1) given a pyramid of doors (i.e.  $i$  doors in row  $i$ ), each door can open to left or right. initially each door is configured to open to left. now once a marble is added to the door on row 1, it transfers the marble to the door to which it opens and it gets flipped, this way marble continues to reach the last floor. Now  $n$ th marble is added, find the door in the last row where it will land.
- 2) find shortest route in a grid graph with given weights.

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#### Round 1:

Both the time, it was question on tree. And the answer is level order traversal.

Q. given 2 HTML documents (in tree structure. You are free to assume the structure of the tree), check if they contain the same text. (You have to ignore formatting).

eg. `<html><p>Hello</p>/html>` is same as `<html><b>H</b><p>ello</p>/html>`

#### R2:

Last time it was related to designing a structure for maintaining leaderboard of a competition. Should support Update, GetRank functionalities.

Q. given  $n$  positions (each at some distance from origin) and  $m$  coins, maximize the minimum distance between two coins.

#### R3:

Last time it was designing a coursera like website, you have to tell data structures to use, where and how to use locks etc.

Q. It boiled down to implementing dijkstra's. Don't remember exact question.

#### R4:

Last time it was some open ended discussion

Q. Find word count all the words in a library. Boiled down to os concepts and implementing map reduce.



