CDC Problem Set (2021 Internship Tests)

Google

Two medium-hard algorithmic problems to be done in 60 minutes. The difficulty of the problems varies from one contestant to another. One thing to note is that Google loves dynamic programming problems.

First Problem

Given a grid G with n rows and m columns, each cell contains an integer. In one move, we can move from cell (i_1, j_1) to (i_2, j_2) if $|i_1 - i_2| + |j_1 - j_2| \leq p$, where p is the number of unique prime factors of integer $G[i_1][j_1]$. This moves costs $\left\lfloor \sqrt{G[i_1][j_1]} \right\rfloor$. Find the minimum cost path from the top-left cell to bottom right cell.

Constraints

$$1 \leq n, m \leq 10^3$$

$$1 \leq G[i][j] \leq 10^6$$

Hint

Notice that upper-bound on p is 7.

Second Problem

Given a string S, find number of triplets $\langle (i_1, j_1), (i_2, j_2), (i_3, j_3) \rangle$ with $i_1 \leq j_1 < i_2 \leq j_2 < i_3 \leq j_3$ such that substrings $S[i_1, j_1]$, $S[i_2, j_2]$ and $S[i_3, j_3]$ are palindromes.

Constraints

$$1 \leq |S| \leq 10^3$$

Microsoft ML

There were three sections. Total time was 120 minutes. Only Python was allowed.

First Section

We were required to implement TFIDF (detailed mathematical description was given in the problem) using nltk and numpy.

Second Section

We were required to manipulate training data so as to get a better accuracy using sklearn's LinearSVC model. There were certain thresholds on the desired accuracy and crossing each threshold contributed to the score.

Third Section

10 MCQs on fundamentals of machine learning and 2 MCQs on SQL.

Microsoft SW

Two easy algorithmic problems to be solved in 85 minutes.

First Problem

Given an array A, find number of subarrays whose average sum is K.

Constraints

$$1 \leq |A| \leq 5 \times 10^5$$

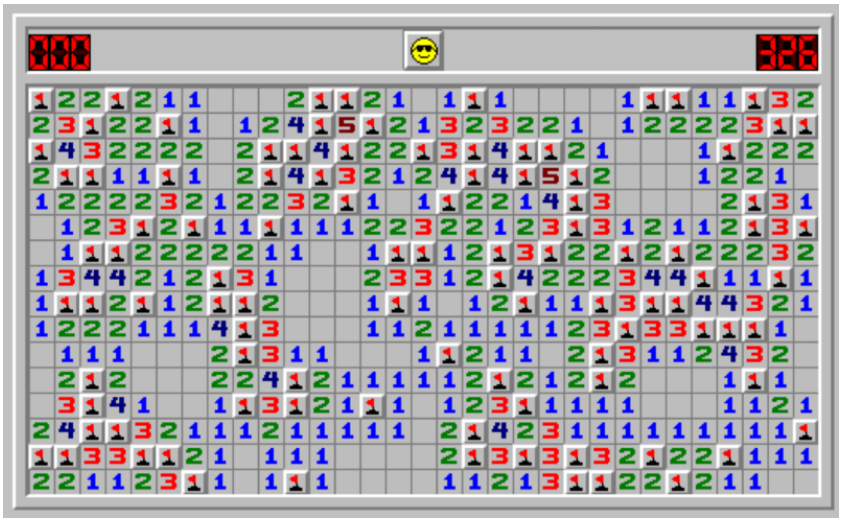
$$-10^9 \leq A[i], K \leq 10^9$$

Second Problem

Minesweeper: Given an $n \times n$ grid and position of bombs in the grid, print the grid as it would appear in Minesweeper game. Instead of flags, use B for the bombs and empty cells would contain 0.

Constraints

$$1 \leq n \leq 10^3$$



DE Shaw

This test was different in structure as compared to other tests. Each problem had its own time limit and they were sequential. One easy algorithmic problem to be done in 25 minutes. Two medium algorithmic problems to be done in 35 minutes each.

First Problem

Given three bags X, Y and Z containing n_X, n_Y and n_Z balls each. Each ball has an integer on it. Count the number of ways you can choose three balls (one from each bag) such that the sum of integers over the chosen balls is a multiple of 7.

Constraints

$$1 \leq n_X, n_Y, n_Z \leq 10^5$$

Integer written on each ball fits in 32-bit signed integer.

Hints

Think about taking counts of balls with the given residue (mod 7).

Second Problem

Given an array A of size n, what is the probability of choosing a non-empty subsequence such that bitwise AND, OR and XOR of all elements in the subsequence are equal. If the probability is $^{p}/_{q}$, return $pq^{-1} \pmod{10^9 + 7}$.

Constraints

$$1 \leq n \leq 3 \times 10^5$$

$$0 \leq A[i] \leq 10^9$$

Hints

AND, OR and XOR of any subsequence are equal if and only if all the elements in the subsequence are equal and size of the subsequence is odd (subsequences with 0s are exception).

Third Problem

Given an array A containing 9 elements and an integer X. You have to find the largest number that can be generated using A and X using following steps:

Choose any index (1-based indexing) of A such that $A[i] \leq X$ holds. Say, we choose index k. Then, we can append the digit k to the number and continue this process on $X - A[i]$. In the end, we have to completely exhaust X, i.e., $X = 0$ should hold in the last iteration (if it doesn't hold for any possible choice, then the required number doesn't exist and 0 should be returned).

Constraints

$$1 \leq A[i], X \leq 1000$$

Tower Research

This test contained MCQs + algorithmic problems. MCQs were in the domain of Computer Networks, Operating Systems and basic DSA. There were 4 easy algorithmic problems.

First Problem

The problem is exact copy of https://www.interviewbit.com/problems/gas-station/ with same constraints.

Second Problem

Given a source coordinate (x, y) and target coordinate (a, b). Determine if you can reach from source to target using following moves:

1. $(x, y) \rightarrow (x + y, y)$
2. $(x, y) \rightarrow (x, x + y)$

Constraints

$$1 \leq x, y, a, b \leq 1000$$

Hints

It can be solved using DFS/BFS and an observation that you can only move rightwards/upwards, so prune the cases which are crossing the boundary of rectangle defined by (x, y) and (a, b).

Third Problem

There is a jail represented by the external walls which resembles a $(m + 1) \times (n + 1)$ rectangle, containing equally-spaced n internal walls in vertical direction and m internal walls in horizontal direction. We call a region bounded by the walls a hole. Initially, each hole has dimension 1×1. One prisoner is trying to escape the jail and in turn removes specific indices of internal walls both in horizontal and vertical directions described by the set H and V respectively. Given H and V, find the maximum area of hole in the final configuration.

Constraints

$$1 \leq n, m \leq 10^5$$

Fourth Problem

Given an array A of size n and an integer w. Find the maximum of minimums for each possible contiguous segment of size w.

Constraints

$$1 \leq n \leq 10^5$$

$$1 \leq w \leq n$$

Hints This problem is a classic application of min-queue data structure.

Goldman Sachs

There were 5 sections: Basic coding section, advanced coding section, CS fundamentals section, quant section and HR section. Negative marking for incorrect response in MCQs. Total time was 135 minutes. Similar in structure to DE Shaw test.

Basic Coding Section

Contained 2 very easy implementation problems. First question was like given the three co-ordinates of an isosceles triangle, print its area and perimeter. Second question contained string manipulation and sorting. 30 minutes were allotted to this section.

Advanced Coding Section

1 medium-hard dynamic programming question. 45 minutes were allotted to this section.

Given a $N \times 3$ grid ($1 \leq N \leq 1000$) containing integer values, you have K ($1 \leq K \leq 1000$) tiles of dimension 2×1. Each tile can be placed either vertically or horizontally. You have to place the tiles on the grid in a way such that sum of integers on the covered cells is maximized. Tiles shouldn't overlap with each other.

CS Fundamentals (MCQs)

Contained 2 PDS-level questions, 2 OOPs (in Java) questions and other questions were related to Operating Systems and Networks.

Quant Section (MCQs)

Contained basic-to-advanced level combinatorics. Also had questions related to trigonometry, half-life and area under the curve.

HR Section

There were two essay-type behavioral questions.

APT Portfolio SW

Three algorithmic problems to be solved in 100 minutes.

First Problem

Consider a double ended queue data structure Q that stores elements in non-decreasing order. To add any new element x in Q, you can remove elements from either end, insert x and then insert back the previously removed elements. After adding x in Q, non-decreasing order must be maintained. Each insert and remove operations 1 second. Given empty Q and a stream of integers of length n, find minimum time required to add all the integers in Q.

Constraints

$$1 \leq n \leq 10^5$$

$$-10^9 \leq x \leq 10^9$$

Second Problem

Design a stack data structure that supports following operation:

1. Push x
2. Pop
3. Add i v: Add v to each of the bottom i elements of the stack

Given a set of operations S, print the top element of the stack after performing each operation (print EMPTY if the stack is empty at any moment).

Constraints

$$-10^9 \leq x, v \leq 10^9$$

$$1 \leq |S| \leq 10^5$$

Third Problem

The problem is exact copy of https://www.interviewbit.com/problems/unique-paths-in-a-grid/ with same constraints

APT Portfolio ML

Two sections: Coding section and quant. Total time was 120 minutes. Only Python/Go/R available for programming.

Coding Section

There were three easy-medium coding questions.

First Problem

An array is almost-sorted, if we can remove at most one element from the array to make it a sorted (increasing). Given an array of size n ($1 \leq n \leq 10^5$), find the minimum number of deletions to make it almost-sorted.

Second Problem

(Cartilage Recycling Problem) You have n cartilages and c dollars initially. Let r be the recycle reward and p be the perk cost. For each cartilage, you can one of the two things:

1. Recycle it, this will get you r dollars
2. Get a perk item in exchange of one cartilage and p dollars

Find the maximum number of perk items you can collect.

Constraints

$$0 \leq n, c, r, p \leq 10^9$$

Third Problem

Through the description was bit-lengthy, it all came down to find the decimal equivalent of given gray decimal n ($1 \leq n \leq 10^{15}$).

Quant Section

The section contained easy-medium quant MCQs, along with 2 SQL MCQs.

Adobe

Adobe opened for three profiles: Product Intern, Research Intern and MDSR Intern. All the profiles had a common test comprising of 4 sections: Coding, Programming Fundamentals, Aptitude and Linear Algebra. Total time was 120 minutes.

Coding Section

Two easy-medium algorithmic problems.

First Problem

Given an integer array A of size n, an integer x, and a query array Q of size m. You need to return a vector B of size m such that B_i is the index of Q_i-th occurrence of x in A. Note that $B_i = -1$ if $Q_i < 1$ or $Q_i > A.count(x)$.

Constraints

$$1 \leq n, m \leq 10^5$$

$$0 \leq x, A_i, Q_i \leq 10^9$$

Second Problem

Given an array A of non-negative integers of size n and an integer X, find the subset sum of A, say S, such that $S \leq X$ and $X - S$ is minimal possible.

Constraints

$$1 \leq n \leq 42$$

$$0 \leq A_i, X \leq 10^9$$

Hints

This problem can be solved using Meet in the Middle technique.

Programming Fundamentals Section

This section contained 4 PDS-level MCQs on C/C++.

Aptitude Section

This section contained 8 MCQs based on logical reasoning, probability and combinatorics. You can practice such questions on https://www.brainstellar.com/**.**

Linear Algebra Section

This section had 5 MCQs on Linear Algebra basics. This would be an easy section if you have done Linear Algebra / Matrix Algebra course. Questions were related to application of characteristic polynomial of square matrices, dot product and properties of eigen-values (like eigenvalues of B and $A^{-1}BA$ are same).

Alphagrep Securities

Alphagrep opened for two profiles: SWE and Quant. Both profiles had a common test. There were two sections: MCQs and Coding. Total time was 90 minutes. The test was similar to DE Shaw in structure.

MCQs Section

There were 42 MCQs to be attempted in 15 minutes. The questions were related to DSA and OOPs.

Coding Section

There were 4 easy-medium algorithmic problems to be solved in 75 minutes.

First Problem

Given a string of length n ($1 \leq n \leq 10^5$), find the number of substrings that only contain vowels and each vowel occurs at least once.

Second Problem

Given two integers A and B ($1 \leq A, B \leq 10^{12}$). Find the size of largest set of unique elements S such that following two properties hold:

1. If $x \in S$, then x is a divisor of both A and B
2. For every $x, y \in S$, $\gcd(x, y) = 1$ holds

Third Problem

Given an array A of size n, compute

$$\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} A_i \oplus A_j \ (mod\ 10^9 + 7)$$

Constraints

$$1 \leq n \leq 10^5$$

$$0 \leq A_i < 2^{60}$$

Fourth Problem

Given a string S of length n ($2 \leq n \leq 10^5$) containing only two characters: L and R. Initially, each index has exactly one robot over it. After 1 second, the robots move one index left, if the current character is L, else they move one index right. Assume that no collision happens and robots can go past one another. After 10^5 seconds, for each index i ($1 \leq i \leq n$), print the numbers of robots that are positioned at that index. It is guaranteed that S_1 = R and S_n = L.

Uber

There were 3 algorithmic problems to be solved in 60 minutes.

First Problem

Given base-2 representation of an integer as an array, return array of its base-6 representation.

Constraints

The constraints were such that you cannot use long long to store the integer. However, this has a very compact Python solution.

Second Problem

Given two unique digits x and y, find count of $n-$ digit numbers whose digit sum contains only x or y or both as its digit. As the count can be very large, return the count (mod $10^9 + 7$).

Constraints

$$1 \leq x, y \leq 9, x \neq y$$

$$1 \leq n \leq 1000$$

Third Problem

Given an array of size n and an integer k, return sum of product of its "cool" subsets. A subset is cool if it satisfies following properties:

1. Size of the subset is k
2. Count of odd integers in the subset is even

As the result can be very large, return the result (mod $10^9 + 7$).

Constraints

$$1 \leq n \leq 1000$$

$$1 \leq k \leq n$$

Instabase

Three algorithmic problems to be solved in 90 minutes. Test was conducted on HackerRank.

First Problem

Given an array A of positive integers of size n representing step length, a point T (in 2D) is reachable from point S if:

1. There exists $x = dist(T, S)$ in A which has not been used till now, or
2. There exists some point U, such that T is reachable from U and U is reachable from S

Note that we can use any A_i at most once throughout the whole journey.

Given an array Q of positive integers of size m representing distance between two points, you need to check whether you can reach from one point to other. Each case is independent.

Constraints

$$1 \leq n, m \leq 10^5$$

$$1 \leq A_i, Q_i \leq 10^9$$

Second Problem

Given an array A of size n and an integer m, find the maximum length subsequence S such that $\forall x, y \in S$, $abs(x - y)$ is a multiple of m. In case of a tie, choose the subsequence containing the minimum possible element.

Constraints

$$1 \leq n, m \leq 10^5$$

$$-10^9 \leq A_i \leq 10^9$$

Third Problem

Given two strings A and B, find the length of largest palindromic string that can be constructed from characters of two palindromic substrings, such that one palindromic substring lies in A and the other lies in B.

Constraints

$$1 \leq |A|, |B| \leq 10^5$$

Intuit

There were two shortlisting rounds.

First Round

4 easy problems to be done in 100 minutes. Test was conducted on glider.ai platform.

First Problem

A shop sells n different type of cakes, enumerated as type 1, type 2, and so on. It is known that:

1. There are $n - i + 1$ cakes of type i
2. Price of one cake of type i is c_i rupees

Calculate maximum number of cakes that can be bought using k rupees.

Constraints

$$1 \leq n \leq 10^5$$

$$1 \leq k, c_i \leq 10^9$$

Second Problem

Raju needs to sign-in to his email account. However, he has forgotten the password. He has a diary that contains n passwords $p_i, i = 1, 2, \ldots, n$ (not necessarily distinct). Now, he is going to try each of the password written in the diary to sign-in to his account. His strategy is as follows:

1. Password p_i is given higher priority than p_j, if $|p_i| < |p_j|$
2. Passwords of same length have same priority.

It is known that checking any given password takes 1 second. It is also known that after k continuous wrong tries, the system allows next entry after 5 seconds. Find the best and worst time after which Raju will have the correct password. It is guaranteed correct password is included in the list.

Constraints

$$1 \leq k \leq n \leq 100$$

$$1 \leq |p_i| \leq 100$$

Third Problem

Given any string S of lowercase letters, let's generate magical string T such that T is non-terminating chain of S. For example, if S = abcde, then T = abcdeabcdeabcde… Given m queries of form (L_i, R_i, c_i), print count of character c_i in the substring $T[L_i, R_i]$.

Constraints

$$1 \leq |S| \leq 10^5$$

$$1 \leq m \leq 10^5$$

$$1 \leq L_i \leq R_i \leq 10^{18}$$

Fourth Problem

The problem is exact copy of https://www.interviewbit.com/problems/invert-the-binary-tree/

Second Round

Two easy-medium algorithmic problems to be solved in 60 minutes. Test was conducted on Hackerearth.

First Problem (100 points)

There is a row of n chairs. String S represents the state of chairs.

1. S_i = X denotes that i^{th} chair is occupied by a person
2. S_i = D denotes that i^{th} chair is dirty
3. S_i = E denotes that i^{th} chair is empty

A person can move from his chair to his adjacent chair at a cost of p coins if the adjacent chair is unoccupied and is not dirty. A dirty chair can be converted into an empty chair at a cost of q coins.

Given m queries with values of p and q, determine the minimum cost to make the whole group sit together, i.e., next to each other, without having vacant chair between them for each query.

Constraints

$$1 \leq n, m \leq 10^5$$

$$0 \leq p, q \leq 10^5$$

Second Problem (50 points)

For any string s containing lowercase letters, we define $f(s)$ as the string obtained by sorting the characters of s. For example, f(bqao) = aboq.

Given an array of strings A of size n, we define string $g(A, l, r)$ as

$$g(A, l, r) = f(A[l] + A[l+1] + \cdots + A[r])$$

where + is concatenation operator and $1 \leq l \leq r \leq n$.

Given m queries of form (l, r, k), print the k^{th} character of $g(A, l, r)$ for each query. It is guaranteed that k is valid index of $g(A, l, r)$ for each query.

Constraints

$$1 \leq n, m \leq 10^5$$

$$1 \leq l \leq r \leq n$$

Sprinklr

Three algorithmic problems to be solved in 90 minutes. Test was conducted on Hackerearth.

First Problem (50 points)

Though the description was bit-lengthy, it reduced to find the number of inversions in an array A of size n.

Constraints

$$1 \leq n \leq 10^5$$

$$1 \leq A_i \leq 10^6$$

Second Problem (100 points)

There are n workers. The wage demand and skill set of each worker is given as w_i and s_i respectively. It is known that these workers work in unions, and if you want to hire any worker p, then you have to hire all the workers of the union where p belongs.

If worker p and q are in same union and worker q and r are in same union, it is assumed that p and r are also in the same union. Given m relations of type (p, q) denoting worker p and q are in same union, and budget b, find the maximal sum of skills you can hire.

Constraints

$$1 \leq n \leq 1000$$

$$0 \leq m \leq 10^5$$

$$0 \leq b \leq 10^4$$

Third Problem (75 points)

Jake found a treasure map. There are n locations in the map where coins are hidden. These n locations lie along one-way straight path and it is known that to move from location i to $i + 1$, it takes t_i seconds. There are c_i coins in each of these locations initially and each spot is initially closed. A spot will be opened as soon as Jack reaches that spot. If opened, the coins in location i increase as per following rule: Each location has an associated value d_i. Say location i is opened at $t = T_i$ seconds, then number of coins as function of time vary as follows:

$$C_i(T_i) = c_i \quad ; \quad C_i(T_i + k) = C_i(T_i + k - 1) + \max(0, c_i - kd_i)$$

Jack starts from location 1, but can end his journey at any location. Collecting coins from any location takes 1 second. Jack may choose to wait for some seconds before collecting coins from any location (as in some of locations, coins will increase with time). He can also choose to not collect any coins from some locations. Jack has total time limit of h seconds, you have to return an array of size n denoting time spent on each location such that maximum coins are collected. In case of a tie, choose that strategy that maximizes time spent in location 1. If tie still persist, maximize time spent on location 2 and so on. There are multiple test-cases q.

Constraints

$$1 \leq q \leq 5000$$

$$1 \leq n \leq 25$$

$$1 \leq h, t_i \leq 200$$

$$0 \leq c_i, d_i \leq 10^9$$

Salesforce

Three algorithmic problems to be solved in 75 minutes. Test was conducted on HackerRank.

First Problem

Given an array A of length n, find the sum of elements having maximum and second maximum occurrence. Ties are broken by comparing pair (cnt_x, x) and (cnt_y, y).

Constraints

$$1 \leq n \leq 10^5$$

$$-10^9 \leq A_i \leq 10^9$$

Second Problem

There are n dishes with t_i being the time of preparation of i^{th} dish. There are k chefs. Each chef can give at most T_i units of time for preparing dishes. Each chef will prepare only contiguous section of dishes. Note that:

1. A dish cannot be prepared partially by one chef and partially by others
2. Configuration where chef 1 prepares dish 1 and 3 but not 2 is invalid.

Find minimum time required to prepare all the dishes.

Constraints

$$1 \leq n, k \leq 10^5$$

$$1 \leq t_i, T_i \leq 10^6$$

Third Problem

Given a connected tree of n nodes rooted at node 1, each node has a binary value b_i. If b_i is 1, then some thieves are hiding in node i. A policeman is initially positioned in node 1. His task is to capture all the thieves present in the tree and then return back to node 1. He can capture a thief by visiting the node where the thief is present. It takes 1 second to move from one node to another adjacent node. Capturing a thief doesn't take any time. Find minimum time after which policeman will capture all the thieves and return back to node 1.

Constraints

$$1 \leq n \leq 10^5$$

$$b_i \in \{0, 1\}$$

JP Morgan Quant

There were two sections to be submitted in 35 minutes and 40 minutes respectively.

First Section

There were three subsections:

1. Math MCQs
2. Probability MCQs
3. Coding MCQS

There were 9 coding MCQS and 21 Math + Probability MCQs.

Coding MCQs

It contained some PDS-level questions and some basic questions regarding trees, graphs, BST, matrix multiplication, etc.

Math and Probability MCQs

It contained general questions asked for a Quant role.

Second Section

Two very easy problems.

First Problem

Given height and weight of a person, calculate BMI (formula was given).

Second Problem

Given an adjacency matrix representation of an undirected graphs, calculate number of bridges in the graph.

Hint

See this article https://cp-algorithms.com/graph/bridge-searching.html

Oracle

There were 4 sections with 100+ questions in total:

1. Comprehension and Grammar
2. Quant (contained questions on Math and Probability)
3. Aptitude (contained visual puzzles and statement-conclusion type questions)
4. CS Fundamentals (contained questions on AVL tree, OS, DBMS, Networks, etc.)

Each section had various subsections and each subsection had a specific time limit. You can take break in between attempting the subsections.

Wells Fargo

There were two sections with each section having a specific time limit:

1. Comprehension and Grammar
2. Coding question (2 problems, 60 minutes)

First Problem

Given N cities, each city has a network of n_i stores connected by m_i weighted roads. It is guaranteed each network is connected. Cost of a city is defined as sum of shortest pair of all possible pairs of stores. Return the city with k^{th} largest cost.

Constraints

Constraints were just that Floyd-Warshall algorithm will do.

Second Problem

Given an array A of n elements, beauty of a subsequence is defined as:

1. Bitwise AND of all the elements, if all the elements in subsequence are distinct
2. Zero, if some elements are repeated

Find the maximum possible beauty of any subsequence of size k.

Constraints

$$1 \leq k \leq n \leq 10^5$$

$$1 \leq A_i \leq 10^9$$

American Express

Three sections with each having its own time limit:

1. Comprehension and Grammar MCQs
2. Machine Learning MCQs (basic fundamentals)
3. Business Analytics MCQs

Section 1 was compulsory, however you can either attempt section 2 or section 3 or both.