

DOMAIN WINTER CAMP

DAY - 5

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Searching and Sorting QUESTIONS :-

Very Easy

1.Searching a Number

Given an integer k and array arr. Your task is to return the position of the first occurrence of k in the given array and if element k is not present in the array then return -1.

Note: 1-based indexing is followed here.

Solution:

```
#include <iostream>
#include <vector>
using namespace std;
int searchNumber(int k, const vector<int>& arr) {
    for (int i = 0; i < arr.size(); i++) {
        if (arr[i] == k) {
            return i + 1; // 1-based indexing
        }
    }
    return -1; // If not found
}

int main() {
    int k, n;
    cout << "Enter the size of the array: ";
    cin >> n;
    vector<int> arr(n);
    cout << "Enter the elements of the array: ";
    for (int i = 0; i < n; i++) {
        cin >> arr[i];
    }
}
```

```

    }
    cout << "Enter the number to search: ";
    cin >> k;
    int result = searchNumber(k, arr);
    cout << "Position of the first occurrence: " << result << endl;

    return 0;
}

```

Output:

```

Enter the size of the array: 5
Enter the elements of the array: 3 5 7 8 7
Enter the number to search: 7
Position of the first occurrence: 3

```

== Code Execution Successful ==

Easy

2. Minimum Number of Moves to Seat Everyone

There are n available seats and n students standing in a room. You are given an array `seats` of length n , where `seats[i]` is the position of the i th seat. You are also given the array `students` of length n , where `students[j]` is the position of the j th student.

You may perform the following move any number of times:

Increase or decrease the position of the i th student by 1 (i.e., moving the i th student from position x to $x + 1$ or $x - 1$)

Return the minimum number of moves required to move each student to a seat such that no two students are in the same seat.

Note that there may be multiple seats or students in the same position at the beginning.

Input:

```

#include <iostream>
#include <vector>
#include <algorithm>
#include <cmath> // for abs

using namespace std;

int minMovesToSeat(vector<int>& seats, vector<int>& students) {
    // Sort both vectors
    sort(seats.begin(), seats.end());
    sort(students.begin(), students.end());

    int moves = 0;
    // Calculate the total moves
    for (int i = 0; i < seats.size(); i++) {
        moves += abs(seats[i] - students[i]);
    }

    return moves;
}

int main() {
    // Example 1
    vector<int> seats1 = {3, 1, 5};
    vector<int> students1 = {2, 7, 4};
    cout << "Output: " << minMovesToSeat(seats1, students1) << endl;

    // Example 2
    vector<int> seats2 = {4, 1, 5, 9};
    vector<int> students2 = {1, 3, 2, 6};
    cout << "Output: " << minMovesToSeat(seats2, students2) << endl;

    return 0;
}

```

Output:

```

Output: 4
Output: 7

```

```

=== Code Execution Successful ===

```

Medium

3.Search in 2D Matrix.

You are given an $m \times n$ integer matrix `matrix` with the following two properties:

Each row is sorted in non-decreasing order.

The first integer of each row is greater than the last integer of the previous row.

Given an integer `target`, return `true` if `target` is in `matrix` or `false` otherwise.

You must write a solution in $O(\log(m * n))$ time complexity.

Input:

```
#include <iostream>
```

```
#include <vector>
```

```
using namespace std;
```

```
bool searchMatrix(vector<vector<int>>& matrix, int target) {
```

```
    int m = matrix.size();
```

```
    int n = matrix[0].size();
```

```
    int left = 0, right = m * n - 1;
```

```
    while (left <= right) {
```

```
        int mid = left + (right - left) / 2;
```

```
        int midValue = matrix[mid / n][mid % n]; // Map 1D index to 2D
```

```
matrix
```

```
        if (midValue == target) return true;
```

```
        else if (midValue < target) left = mid + 1;
```

```
        else right = mid - 1;
```

```
    }
```

```
    return false;
```

```
}
```

```
int main() {
```

```
    vector<vector<int>> matrix1 = {
```

```
        { 1, 3, 5, 7 },
```

```
        { 10, 11, 16, 20 },
```

```

        {23, 30, 34, 60}
    };
    int target1 = 3;
    cout << (searchMatrix(matrix1, target1) ? "true" : "false") << endl;
    vector<vector<int>> matrix2 = {
        {1, 3, 5, 7},
        {10, 11, 16, 20},
        {23, 30, 34, 60}
    };
    int target2 = 13;
    cout << (searchMatrix(matrix2, target2) ? "true" : "false") << endl;
    return 0;
}

```

Output:

```

true
false

=== Code Execution Successful ===

```

Hard

4.Sort Items by Groups Respecting Dependencies

There are n items each belonging to zero or one of m groups where $group[i]$ is the group that the i -th item belongs to and it's equal to -1 if the i -th item belongs to no group. The items and the groups are zero indexed. A group can have no item belonging to it.

Return a sorted list of the items such that:

The items that belong to the same group are next to each other in the sorted list.

There are some relations between these items where $beforeItems[i]$ is a list containing all the items that should come before the i -th item in the sorted array (to the left of the i -th item).

Return any solution if there is more than one solution and return an empty list if there is no solution.

Solution:

```
#include <iostream>
```

```

#include <vector>
#include <unordered_map>
#include <queue>
using namespace std;

// Helper function to perform topological sort
vector<int> topologicalSort(int n, unordered_map<int, vector<int>>& graph,
vector<int>& indegree) {
    vector<int> result;
    queue<int> q;

    // Add nodes with zero indegree
    for (int i = 0; i < n; i++) {
        if (indegree[i] == 0) q.push(i);
    }

    while (!q.empty()) {
        int node = q.front();
        q.pop();
        result.push_back(node);

        for (int neighbor : graph[node]) {
            indegree[neighbor]--;
            if (indegree[neighbor] == 0) q.push(neighbor);
        }
    }

    // If the result doesn't include all nodes, there's a cycle
    if (result.size() != n) return { };
    return result;
}

vector<int> sortItems(int n, int m, vector<int>& group,
vector<vector<int>>& beforeItems) {
    // Assign unique group IDs for items with group[i] == -1
    int groupId = m;
    for (int i = 0; i < n; i++) {
        if (group[i] == -1) group[i] = groupId++;
    }

    // Build item and group graphs
    unordered_map<int, vector<int>> itemGraph, groupGraph;
    vector<int> itemIndegree(n, 0), groupIndegree(groupId, 0);

```

```

for (int i = 0; i < n; i++) {
    for (int prev : beforeItems[i]) {
        // Build item graph
        itemGraph[prev].push_back(i);
        itemIndegree[i]++;

        // Build group graph if items belong to different groups
        if (group[prev] != group[i]) {
            groupGraph[group[prev]].push_back(group[i]);
            groupIndegree[group[i]]++;
        }
    }
}

// Perform topological sort on items and groups
vector<int> sortedItems = topologicalSort(n, itemGraph, itemIndegree);
vector<int> sortedGroups = topologicalSort(groupId, groupGraph,
groupIndegree);

if (sortedItems.empty() || sortedGroups.empty()) return { };

// Group items based on sorted groups
unordered_map<int, vector<int>> groupedItems;
for (int item : sortedItems) {
    groupedItems[group[item]].push_back(item);
}

// Combine sorted groups and their items
vector<int> result;
for (int grp : sortedGroups) {
    result.insert(result.end(), groupedItems[grp].begin(),
groupedItems[grp].end());
}

return result;
}

int main() {
    int n, m;
    cout << "Enter the number of items (n): ";
    cin >> n;
    cout << "Enter the number of groups (m): ";

```

```

cin >> m;

vector<int> group(n);
cout << "Enter the group assignment for each item (-1 for no group): ";
for (int i = 0; i < n; i++) {
    cin >> group[i];
}

vector<vector<int>> beforeItems(n);
cout << "Enter the dependencies for each item (number of dependencies
followed by the items):" << endl;
for (int i = 0; i < n; i++) {
    int count;
    cout << "Item " << i << ": ";
    cin >> count;
    beforeItems[i].resize(count);
    for (int j = 0; j < count; j++) {
        cin >> beforeItems[i][j];
    }
}

vector<int> result = sortItems(n, m, group, beforeItems);

if (result.empty()) {
    cout << "No valid order exists." << endl;
} else {
    cout << "Valid order of items: ";
    for (int item : result) {
        cout << item << " ";
    }
    cout << endl;
}

return 0;
}

```

Output:


```

Enter the number of items (n): 8
Enter the number of groups (m): 2
Enter the group assignment for each item (-1 for no group): -1 -1 1 0 0 1 0
-1
Enter the dependencies for each item (number of dependencies followed by
the items):
Item 0: 0
Item 1: 1 5
Item 2: 1 6
Item 3: 1 6
Item 4: 2 3 6
Item 5: 0
Item 6: 0
Item 7: 0
Valid order of items: 6 3 4 0 7 5 2 1

=== Code Execution Successful ===

```

Very Hard

5.Find Minimum in Rotated Sorted Array II.

Suppose an array of length n sorted in ascending order is rotated between 1 and n times. For example, the array `nums = [0,1,4,4,5,6,7]` might become:

`[4,5,6,7,0,1,4]` if it was rotated 4 times.

`[0,1,4,4,5,6,7]` if it was rotated 7 times.

Notice that rotating an array `[a[0], a[1], a[2], ..., a[n-1]]` 1 time results in the array `[a[n-1], a[0], a[1], a[2], ..., a[n-2]]`.

Given the sorted rotated array `nums` that may contain duplicates, return the minimum element of this array.

You must decrease the overall operation steps as much as possible.

Input:

```
#include <iostream>
```

```
#include <vector>
```

```
using namespace std;
```

```
int findMin(vector<int>& nums) {
    int left = 0, right = nums.size() - 1;
```

```
    while (left < right) {
```

```

    int mid = left + (right - left) / 2;

    if (nums[mid] > nums[right]) {
        // Minimum lies to the right of mid
        left = mid + 1;
    } else if (nums[mid] < nums[right]) {
        // Minimum lies to the left of or at mid
        right = mid;
    } else {
        // nums[mid] == nums[right], reduce the search space
        right--;
    }
}
return nums[left];
}

int main() {
    int n;
    cout << "Enter the number of elements: ";
    cin >> n;

    vector<int> nums(n);
    cout << "Enter the elements of the array: ";
    for (int i = 0; i < n; i++) {
        cin >> num[i];
    }

    int result = findMin(nums);
    cout << "The minimum element is: " << result << endl;

    return 0;
}

```

Output:

```

^ Enter the number of elements: 5
Enter the elements of the array: 2 2 2 0 1
The minimum element is: 0

=== Code Execution Successful ===

```