DOMAIN WINTER CAMP

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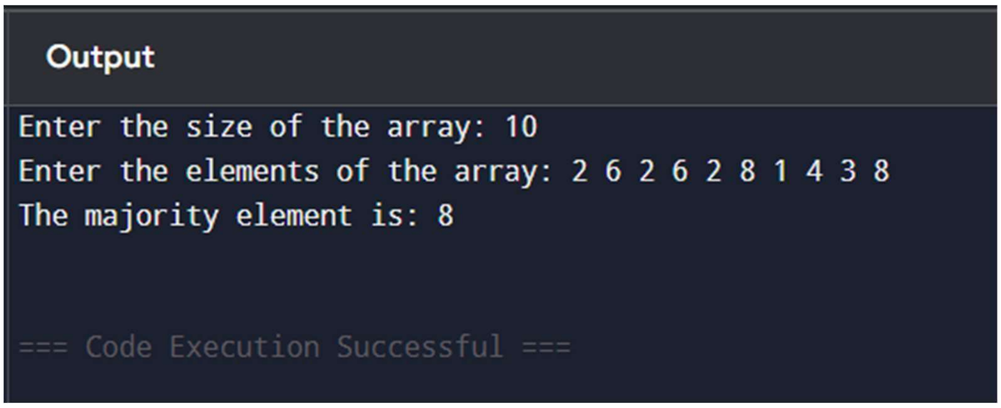
DAY-2

Q.1. Given an array nums of size n, return the majority element.The majority element is the element that appears more than ⌊n / 2⌋ times. You may assume that the majority element always exists in the array.

Program Code:-

```
#include <iostream>

using namespace std;

int majorityElement(int nums[], int n) {

    int candidate = nums[0];

    int count = 1;

    for (int i = 1; i < n; i++) {

        if (nums[i] == candidate) {

            count++;

        } else {
            count--;

        }

        if (count == 0) {

            candidate = nums[i];

            count = 1;

        }

    }

    return candidate;

}

int main() {

    int n;

    cout << "Enter the size of the array: ";

    cin >> n;

    int* nums = new int[n];  // Dynamically allocating memory for the array

    cout << "Enter the elements of the array: ";

    for (int i = 0; i < n; i++) {

        cin >> nums[i];

    }
    int result = majorityElement(nums, n);

    cout << "The majority element is: " << result << endl;

    delete[] nums;  // Deallocate the memory

    return 0;

}
```

Output:-



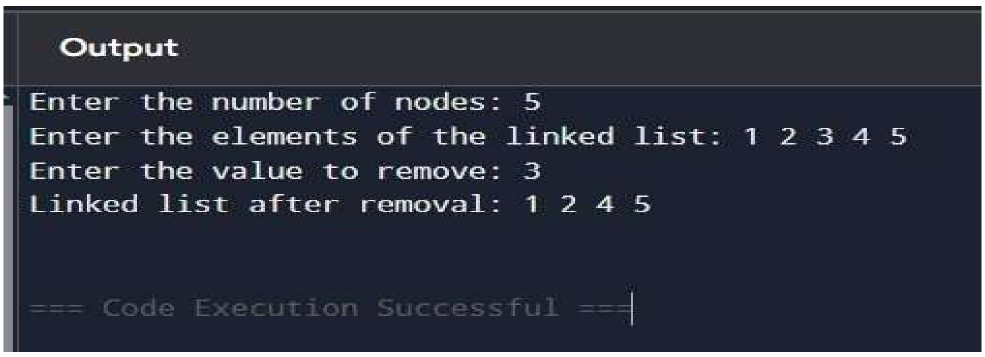
```
Enter the size of the array: 10
Enter the elements of the array: 2 6 2 6 2 8 1 4 3 8
The majority element is: 8


=== Code Execution Successful ===
```

Q.2. Given the head of a linked list and an integer val, remove all the nodes of the linked list that has Node.val == val, and return *the new head*.

Program Code:-

```
#include <iostream>

using namespace std;

struct ListNode {

    int val;

    ListNode* next;

    ListNode(int x) : val(x), next(nullptr) {}
};

ListNode* removeElements(ListNode* head, int val) {

    ListNode* dummy = new ListNode(0);

    dummy->next = head;

    ListNode* current = dummy;


    while (current->next != nullptr) {

        if (current->next->val == val) {

            current->next = current->next->next;

        } else {

            current = current->next;

        }

    }


    ListNode* newHead = dummy->next;

    delete dummy;

    return newHead;

}
```

```
void printList(ListNode* head) {
    while (head != nullptr) {
        cout << head->val << " ";
        head = head->next;
    }
    cout << endl;
}

int main() {
    int n, val;
    cout << "Enter the number of nodes: ";
    cin >> n;
    ListNode* head = nullptr;
    ListNode* tail = nullptr;
    cout << "Enter the elements of the linked list: ";
    for (int i = 0; i < n; i++) {
        int nodeVal;
        cin >> nodeVal;
        ListNode* newNode = new ListNode(nodeVal);
        if (head == nullptr) {
            head = newNode;
            tail = newNode;
        } else {
            tail->next = newNode;
            tail = newNode;
        }
    }
    cout << "Enter the value to remove: ";
    cin >> val;
    head = removeElements(head, val);
    cout << "Linked list after removal: ";
    printList(head);
    return 0;
}
```
Output:-



Output

```
Enter the number of nodes: 5
Enter the elements of the linked list: 1 2 3 4 5
Enter the value to remove: 3
Linked list after removal: 1 2 4 5


=== Code Execution Successful ===
```

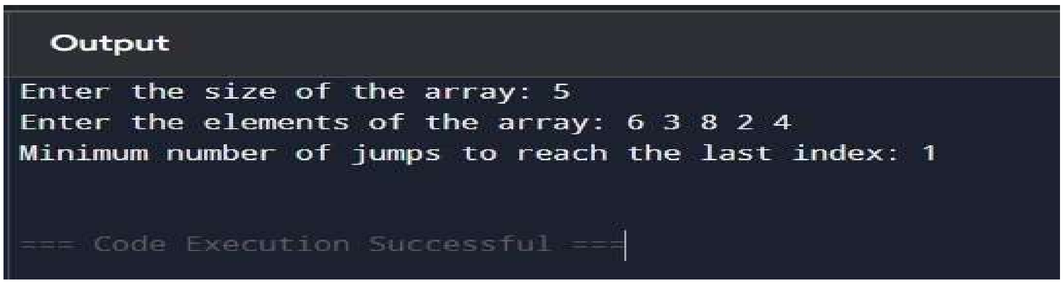
Q.3. You are given a 0-indexed array of integers nums of length n. You are initially positioned at nums[0]. Each element nums[i] represents the maximum length of a forward jump from index i. In other words, if you are at nums[i], you can jump to any nums[i + j] where:0 <= j <= nums[i] and i + j < n

Return the minimum number of jumps to reach nums[n - 1]. The test cases are generated such that you can reach nums[n - 1].

Program Code:-

```
#include <iostream>

using namespace std;

int minJumps(int nums[], int n) {

   if (n <= 1) return 0;

   int jumps = 0;

   int currentEnd = 0;

   int currentFarthest = 0;

   for (int i = 0; i < n - 1; i++) {

      currentFarthest = max(currentFarthest, i + nums[i]);

      if (i == currentEnd) {

         jumps++;

         currentEnd = currentFarthest;

         if (currentEnd >= n - 1) break;

      }}
```

```
    return jumps;
}
int main() {
    int n;
    cout << "Enter the size of the array: ";
    cin >> n;
    int* nums = new int[n];
    cout << "Enter the elements of the array: ";
    for (int i = 0; i < n; i++) {
        cin >> nums[i];
    }
    int result = minJumps(nums, n);
    cout << "Minimum number of jumps to reach the last index: " << result << endl;
    delete[] nums;
    return 0;
}
```
Output:-



```
Enter the size of the array: 5
Enter the elements of the array: 6 3 8 2 4
Minimum number of jumps to reach the last index: 1


=== Code Execution Successful ===
```

Q.4. You are given a rows x cols matrix grid representing a field of cherries where grid[i][j] represents the number of cherries that you can collect from the (i, j) cell.

You have two robots that can collect cherries for you:

Robot #1 is located at the top-left corner (0, 0), and

Robot #2 is located at the top-right corner (0, cols - 1).

Return the maximum number of cherries collection using both robots by following the rules below:

From a cell (i, j), robots can move to cell (i + 1, j - 1), (i + 1, j), or (i + 1, j + 1).

When any robot passes through a cell, It picks up all cherries, and the cell becomes an empty cell.

When both robots stay in the same cell, only one takes the cherries.

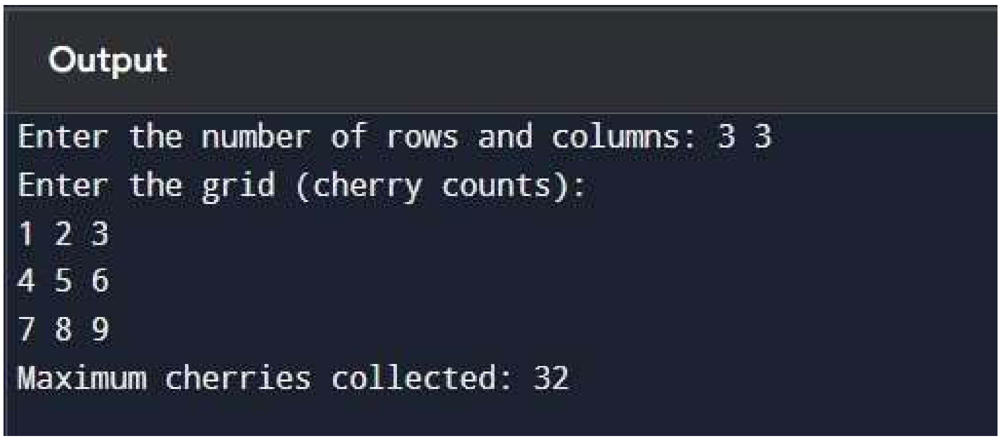
Both robots cannot move outside of the grid at any moment.

Both robots should reach the bottom row in grid.

Program Code:-

```
#include <iostream>

#include <algorithm>

using namespace std;

int maxCherries(int** grid, int rows, int cols) {

    int dp[rows][cols][cols];  // DP table to store max cherries at each step
    // Initialize the DP table with -1 for non-visited states
    for (int i = 0; i < rows; i++) {
        for (int j1 = 0; j1 < cols; j1++) {
            for (int j2 = 0; j2 < cols; j2++) {
                dp[i][j1][j2] = -1;
            }
        }
    }
    dp[0][0][cols - 1] = grid[0][0] + grid[0][cols - 1];
    for (int i = 1; i < rows; i++) {
        for (int j1 = 0; j1 < cols; j1++) {
            for (int j2 = 0; j2 < cols; j2++) {
                if (dp[i - 1][j1][j2] != -1) { // If this state was reachable from the
previous row
                    for (int dj1 = -1; dj1 <= 1; dj1++) {
                        for (int dj2 = -1; dj2 <= 1; dj2++) {
                            int newJ1 = j1 + dj1;
                            int newJ2 = j2 + dj2;

                            if (newJ1 >= 0 && newJ1 < cols && newJ2 >= 0 && newJ2 <
cols) {
                        int cherries = grid[i][newJ1] + grid[i][newJ2];
                        if (newJ1 == newJ2) cherries -= grid[i][newJ1]; // If both
robots are at the same cell, only one picks cherries
                        dp[i][newJ1][newJ2] = max(dp[i][newJ1][newJ2], dp[i -
1][j1][j2] + cherries);
                    }
                }
            }
        }
    }
  }
  }
  int maxCherries = 0;
  for (int j1 = 0; j1 < cols; j1++) {
    for (int j2 = 0; j2 < cols; j2++) {
      maxCherries = max(maxCherries, dp[rows - 1][j1][j2]);
    }
  }
```

```
    return maxCherries;
}

int main() {
    int rows, cols;
    cout << "Enter the number of rows and columns: ";
    cin >> rows >> cols;

    int** grid = new int*[rows];
    cout << "Enter the grid (cherry counts):\n";
    for (int i = 0; i < rows; i++) {
        grid[i] = new int[cols];
        for (int j = 0; j < cols; j++) {
            cin >> grid[i][j];
        }
    }

    int result = maxCherries(grid, rows, cols);
    cout << "Maximum cherries collected: " << result << endl;
    for (int i = 0; i < rows; i++) {

        delete[] grid[i];

    }

    delete[] grid;



    return 0;

}
```
Output:-



```
Output
Enter the number of rows and columns: 3 3
Enter the grid (cherry counts):
1 2 3
4 5 6
7 8 9
Maximum cherries collected: 32
```

Q.5. You are given an integer array jobs, where jobs[i] is the amount of time it takes to complete the ith job.There are k workers that you can assign jobs to. Each job should be assigned to exactly one worker. The working time of a worker is the sum of the time it takes to complete all jobs assigned to them. Your goal is to devise an optimal assignment such that the maximum working time of any worker is minimized.

Return the minimum possible maximum working time of any assignment

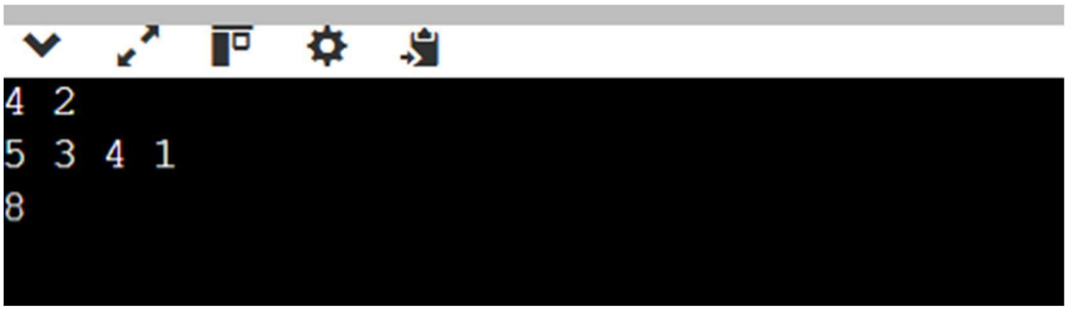
```
}
```

Program Code:-

```
#include <iostream>

#include <numeric>

#include <algorithm>

using namespace std;

bool canAssignJobs(int jobs[], int n, int k, int max_time) {

   int workers = 1, current_time = 0;

   for (int i = 0; i < n; i++) {

      if (current_time + jobs[i] > max_time) {

         workers++;

         current_time = jobs[i];

         if (workers > k) return false;

      } else {

         current_time += jobs[i];

      }

   }


   return true;

}
```

```
int minimumTimeRequired(int jobs[], int n, int k) {
    int left = *max_element(jobs, jobs + n);
    int right = accumulate(jobs, jobs + n, 0);
    while (left < right) {
        int mid = left + (right - left) / 2;
        if (canAssignJobs(jobs, n, k, mid)) {
            right = mid;
        } else {
            left = mid + 1;
        }
    }
    return left;
}
int main() {
    int n, k;
    cin >> n >> k;
    int jobs[n];
    for (int i = 0; i < n; i++) {
        cin >> jobs[i];
    }

    int result = minimumTimeRequired(jobs, n, k);

    cout << result << endl;

    return 0;

}
```

Output:-



```
4 2
5 3 4 1
8
```