

**VISVESVARAYA TECHNOLOGICAL
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**DATA STRUCTURES AAT REPORT
on
CODING CHALLENGES**
Submitted by:

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Under the Guidance of

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in partial fulfilment for the award of the degree of
BACHELOR OF ENGINEERING
In
COMPUTER SCIENCE AND ENGINEERING



B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
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B.M.S COLLEGE OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Coding Challenge 1 :

Design a stack that supports push, pop, top, and retrieving the minimum element in constant time.

Implement the MinStack class:

- MinStack() initializes the stack object.
 - void push(int val) pushes the element val onto the stack.
 - void pop() removes the element on the top of the stack.
 - int top() gets the top element of the stack.
 - int getMin() retrieves the minimum element in the stack.
- You must implement a solution with O(1) time complexity for each function.

Example 1:

Input

```
["MinStack","push","push","push","getMin","pop","top","get"]
[[],[-2],[0],[-3],[],[],[],[]]
```

Output :

```
[null,null,null,null,-3,null,0,-2]
```

Explanation :

```
MinStack minStack = new MinStack();
minStack.push(-2);
minStack.push(0);
minStack.push(-3);
minStack.getMin(); // return -3
minStack.pop();
minStack.top();   // return 0
minStack.getMin(); // return -2
```

Constraints:

- $-2^{31} \leq \text{val} \leq 2^{31} - 1$
- Methods pop, top and getMin operations will always be called on non-empty stacks.
- At most $3 * 10^4$ calls will be made to push, pop, top, and getMin.

Leetcode Link : <https://leetcode.com/problems/min-stack/description/>

Coding Challenge 2 :

You are given an array of k linked-lists lists, each linked-list is sorted in ascending order.

Merge all the linked-lists into one sorted linked-list and return it.

Example 1:

Input: lists = [[1,4,5],[1,3,4],[2,6]]

Output: [1,1,2,3,4,4,5,6]

Explanation: The linked-lists are:

```
[  
    1->4->5,  
    1->3->4,  
    2->6  
]
```

merging them into one sorted linked list:

1->1->2->3->4->4->5->6

Example 2:

Input: lists = []

Output: []

Example 3:

Input: lists = [[]]

Output: []

Constraints:

- $k == \text{lists.length}$
- $0 \leq k \leq 10^4$
- $0 \leq \text{lists}[i].length \leq 500$
- $-10^4 \leq \text{lists}[i][j] \leq 10^4$
- $\text{lists}[i]$ is sorted in **ascending order**.
- The sum of $\text{lists}[i].length$ will not exceed 10^4 .

Leetcode Link: <https://leetcode.com/problems/merge-k-sorted-lists/description/>

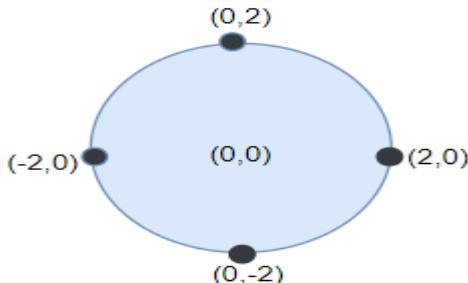
Coding Challenge 3 :

Alice is throwing n darts on a very large wall. You are given an array darts where $\text{darts}[i] = [x_i, y_i]$ is the position of the i^{th} dart that Alice threw on the wall.

Bob knows the positions of the n darts on the wall. He wants to place a dartboard of radius r on the wall so that the maximum number of darts that Alice throws lie on the dartboard.

Given the integer r, return *the maximum number of darts that can lie on the dartboard*.

Example 1:

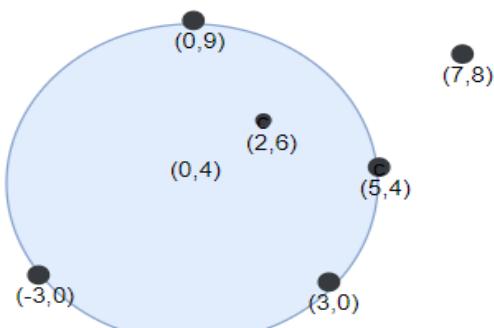


Input: darts = [[-2,0],[2,0],[0,2],[0,-2]], r = 2

Output: 4

Explanation: Circle dartboard with center in (0,0) and radius = 2 contain all points.

Example 2:



Input: darts = [[-3,0],[3,0],[2,6],[5,4],[0,9],[7,8]], r = 5

Output: 5

Explanation: Circle dartboard with center in (0,4) and radius = 5 contain all points except the point (7,8).

Constraints:

- $1 \leq \text{darts.length} \leq 100$
- $\text{darts}[i].length == 2$
- $-10^4 \leq x_i, y_i \leq 10^4$
- All the darts are unique
- $1 \leq r \leq 5000$

Leetcode Link: <https://leetcode.com/problems/maximum-number-of-darts-inside-of-a-circular-dartboard/description/>

Coding Challenge 4:

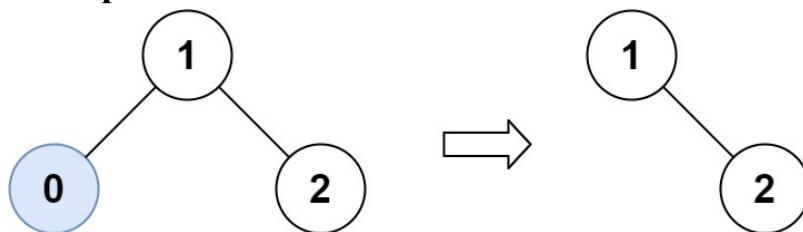
Given the root of a binary search tree and the lowest and highest boundaries as low and high, trim the tree so that all its elements lies in [low, high].

Trimming the tree should **not** change the relative structure of the elements that will remain in the tree (i.e., any node's descendant should remain a descendant).

It can be proven that there is a **unique answer**.

Return *the root of the trimmed binary search tree*. Note that the root may change depending on the given bounds.

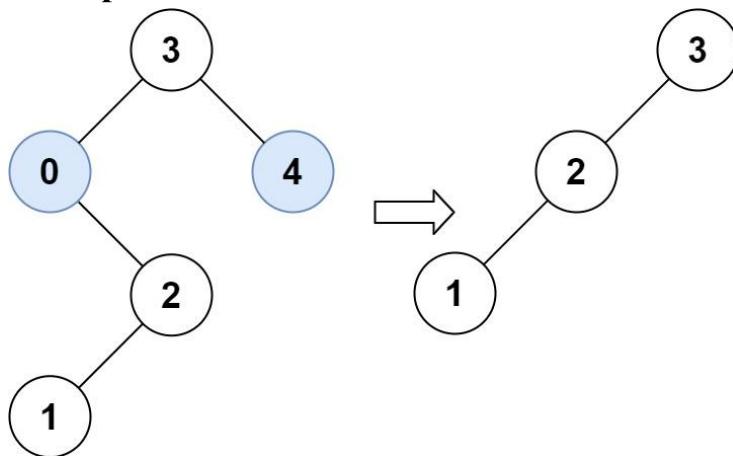
Example 1:



Input: root = [1,0,2], low = 1, high = 2

Output: [1,null,2]

Example 2:



Input: root = [3,0,4,null,2,null,null,1], low = 1, high = 3

Output: [3,2,null,1]

Constraints:

- The number of nodes in the tree is in the range $[1, 10^4]$.
- $0 \leq \text{Node.val} \leq 10^4$
- The value of each node in the tree is **unique**.
- $0 \leq \text{low} \leq \text{high} \leq 10^4$

Leetcode link : <https://leetcode.com/problems/trim-a-binary-search-tree/description/>

Coding Challenge 5 :

An array is **squareful** if the sum of every pair of adjacent elements is a **perfect square**.

Given an integer array `nums`, return *the number of permutations of `nums` that are squareful*.

Two permutations `perm1` and `perm2` are different if there is some index `i` such that `perm1[i] != perm2[i]`.

Example 1:

Input: `nums = [1,17,8]`

Output: 2

Explanation: `[1,8,17]` and `[17,8,1]` are the valid permutations.

Example 2:

Input: `nums = [2,2,2]`

Output: 1

Constraints:

- $1 \leq \text{nums.length} \leq 12$
- $0 \leq \text{nums}[i] \leq 10^9$

Leetcode Link : <https://leetcode.com/problems/number-of-squareful-arrays/description/>

Challenge 1:

Code

Testcase > Test Result

Case 1 +

```
["MinStack","push","push","push","getMin","pop","top","getMin"]
```

```
[],[-2],[0],[-3],[],[],[],[]
```

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Code

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Case 1

Input

```
["MinStack","push","push","push","getMin","pop","top","getMin"]
```

```
[],[-2],[0],[-3],[],[],[],[]
```

Output

```
[null,null,null,null,-3,null,0,-2]
```

Expected

```
[null,null,null,null,-3,null,0,-2]
```

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Challenge 2 :

</> Code

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Case 1 Case 2 Case 3

Input

```
lists =  
[]
```

Output

```
[]
```

Expected

```
[]
```



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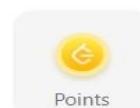
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Case 1 Case 2 Case 3

Input

```
lists =  
[[[]]]
```

Output

```
[]
```

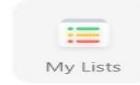
Expected

```
[]
```



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Case 1 Case 2 Case 3

Input

```
lists =  
[[1,4,5],[1,3,4],[2,6]]
```

Output

```
[1,1,2,3,4,4,5,6]
```

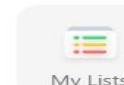
Expected

```
[1,1,2,3,4,4,5,6]
```

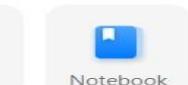


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Challenge 3:

</> Code

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Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
darts =  
[[-2,0],[2,0],[0,2],[0,-2]]
```

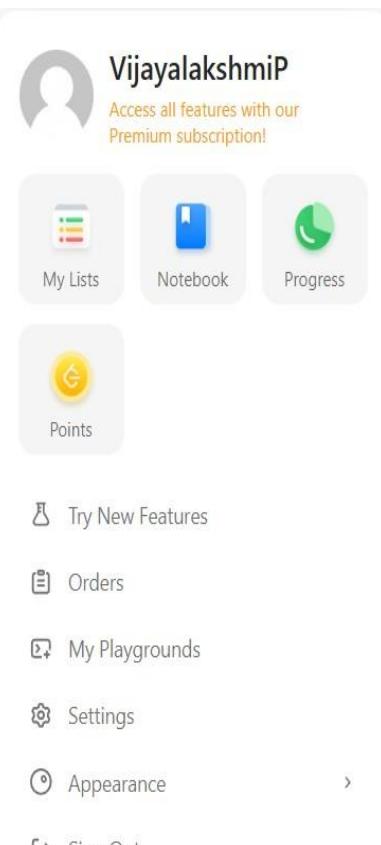
r =
2

Output

```
4
```

Expected

```
4
```



</> Code

Testcase | Test Result

Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
darts =  
[[-3,0],[3,0],[2,6],[5,4],[0,9],[7,8]]
```

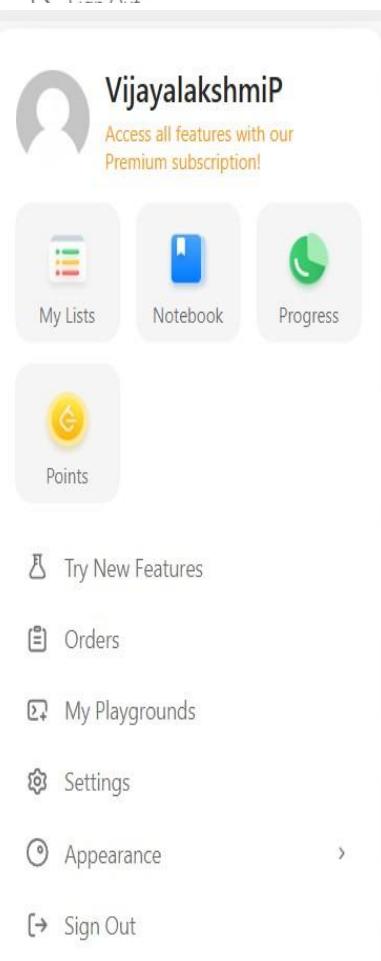
r =
5

Output

```
5
```

Expected

```
5
```



Challenge 4 :

</> Code

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Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
root = [3,0,4,null,2,null,null,1]
```

low = 1

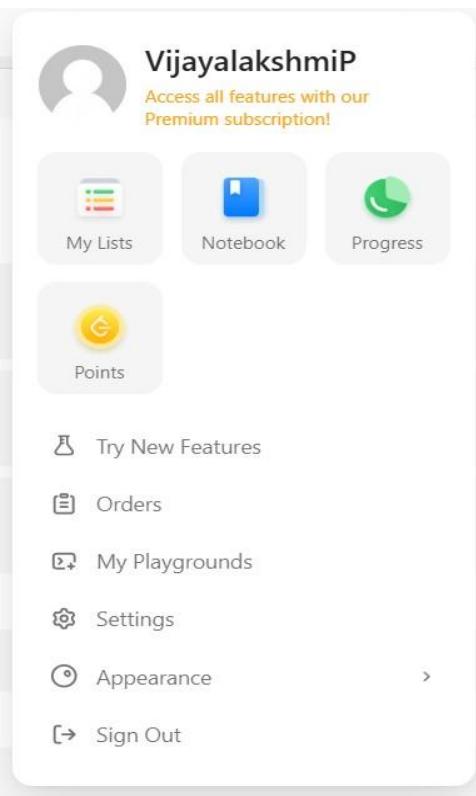
high = 3

Output

```
[3,2,null,1]
```

Expected

```
[3,2,null,1]
```



</> Code

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Case 1 Case 2

Input

```
root = [1,0,2]
```

low = 1

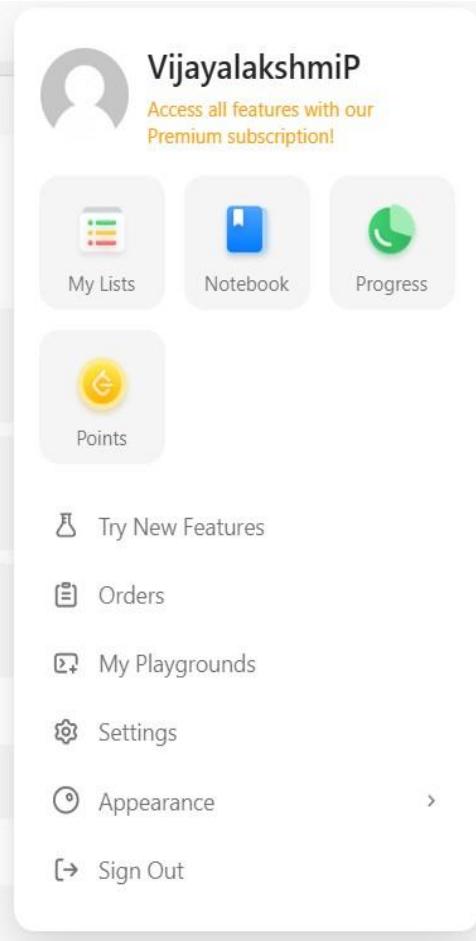
high = 2

Output

```
[1,null,2]
```

Expected

```
[1,null,2]
```



Challenge 5:

</> Code

Testcase | Test Result

Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
nums =
```

```
[2,2,2]
```

Output

```
1
```

Expected

```
1
```

</> Code

Testcase | Test Result

Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
nums =
```

```
[1,17,8]
```

Output

```
2
```

Expected

```
2
```



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1 . Min Stack

```
typedef struct {  
    int s[30000];  
    int min[30000];  
    int top;  
} MinStack;
```

```
MinStack* minStackCreate() {  
    MinStack* obj = (MinStack*)malloc(sizeof(MinStack));  
    obj->top = -1;  
    return obj;  
}
```

```
void minStackPush(MinStack* obj, int val) {  
    obj->top++;  
    obj->s[obj->top] = val;  
    if (obj->top == 0)  
        obj->min[obj->top] = val;  
    else  
        obj->min[obj->top] = val < obj->min[obj->top - 1] ? val : obj->min[obj->top - 1];  
}
```

```
void minStackPop(MinStack* obj) {  
    obj->top--;  
}
```

```
int minStackTop(MinStack* obj) {  
    return obj->s[obj->top];  
}
```

```
int minStackGetMin(MinStack* obj) {  
    return obj->min[obj->top];  
}  
void minStackFree(MinStack* obj) {  
    free(obj);  
}
```

2. Merge k Sorted List

```
struct ListNode* mergeTwo(struct ListNode* a, struct ListNode* b) {
    struct ListNode dummy;
    struct ListNode* t = &dummy;
    dummy.next = NULL;
    while (a && b) {
        if (a->val < b->val) {
            t->next = a;
            a = a->next;
        } else {
            t->next = b;
            b = b->next;
        }
        t = t->next;
    }
    t->next = a ? a : b;
    return dummy.next;
}

struct ListNode* mergeKLists(struct ListNode** lists, int listsSize) {
    if (listsSize == 0) return NULL;
    int interval = 1;
    while (interval < listsSize) {
        for (int i = 0; i + interval < listsSize; i += interval * 2) {
            lists[i] = mergeTwo(lists[i], lists[i + interval]);
        }
        interval *= 2;
    }
    return lists[0];
}
```

3. Maximum Number of Darts inside of circular Dartboard

```
#include <math.h>
int numPoints(int** darts, int dartsSize, int* dartsColSize, int r) {
    if (dartsSize == 0) return 0;
    int ans = 1;
    double R = (double)r;
    for (int i = 0; i < dartsSize; i++) {
        for (int j = i + 1; j < dartsSize; j++) {
            double x1 = darts[i][0], y1 = darts[i][1];
            double x2 = darts[j][0], y2 = darts[j][1];
            double dx = x2 - x1, dy = y2 - y1;
            double d = sqrt(dx * dx + dy * dy);
            if (d > 2 * R) continue;
            double mx = (x1 + x2) / 2.0;
            double my = (y1 + y2) / 2.0;
            double h = sqrt(R * R - (d / 2) * (d / 2));
            double ux = -dy / d;
            double uy = dx / d;

            double cx1 = mx + ux * h;
            double cy1 = my + uy * h;
            double cx2 = mx - ux * h;
            double cy2 = my - uy * h;

            int c1 = 0, c2 = 0;
            for (int k = 0; k < dartsSize; k++) {
                double px = darts[k][0], py = darts[k][1];
                if ((px - cx1) * (px - cx1) + (py - cy1) * (py - cy1) <= R * 1e-6)
                    c1++;
                if ((px - cx2) * (px - cx2) + (py - cy2) * (py - cy2) <= R * R + 1e-6)
                    c2++;
            }
            if (c1 > ans) ans = c1;
            if (c2 > ans) ans = c2;
        }
    }
    return ans;
}
```

4. Trim A Binary Search Tree

```
struct TreeNode* trimBST(struct TreeNode* root, int low, int high) {  
    if (root == NULL) return NULL;  
    if (root->val < low) return trimBST(root->right, low, high);  
    if (root->val > high) return trimBST(root->left, low, high);  
    root->left = trimBST(root->left, low, high);  
    root->right = trimBST(root->right, low, high);  
    return root;  
}
```

5. Number Of Squareful Arrays

```
#include <math.h>

int isSquare(int x) {
    int r = (int)(sqrt(x) + 0.5);
    return r * r == x;
}

void dfs(int* nums, int numsSize, int* used, int prev, int depth, int* count) {
    if (depth == numsSize) {
        (*count)++;
        return;
    }
    for (int i = 0; i < numsSize; i++) {
        if (used[i]) continue;
        if (i > 0 && nums[i] == nums[i - 1] && !used[i - 1]) continue;
        if (prev != -1 && !isSquare(prev + nums[i])) continue;
        used[i] = 1;
        dfs(nums, numsSize, used, nums[i], depth + 1, count);
        used[i] = 0;
    }
}

int cmp(const void* a, const void* b) {
    return (*(int*)a - *(int*)b);
}

int numSquarefulPerms(int* nums, int numsSize) {
    qsort(nums, numsSize, sizeof(int), cmp);
    int used[12] = {0};
    int count = 0;
    dfs(nums, numsSize, used, -1, 0, &count);
    return count;
}
```

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Department of Computer Science and Engineering



This is to certify that the Lab work entitled "**DATA STRUCTURES**" carried out by **VIJAYALAKSHMI PADANAD (1BMCS25456-T)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2025-2026. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab - **(23CS3PCDST)** work prescribed for the said degree.

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