Experiment-3

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Semester: 6th **Date of Performance: 30/01/2025**
Subject Name: AP Lab II **Subject Code: 22ITT-314**

Problem-1

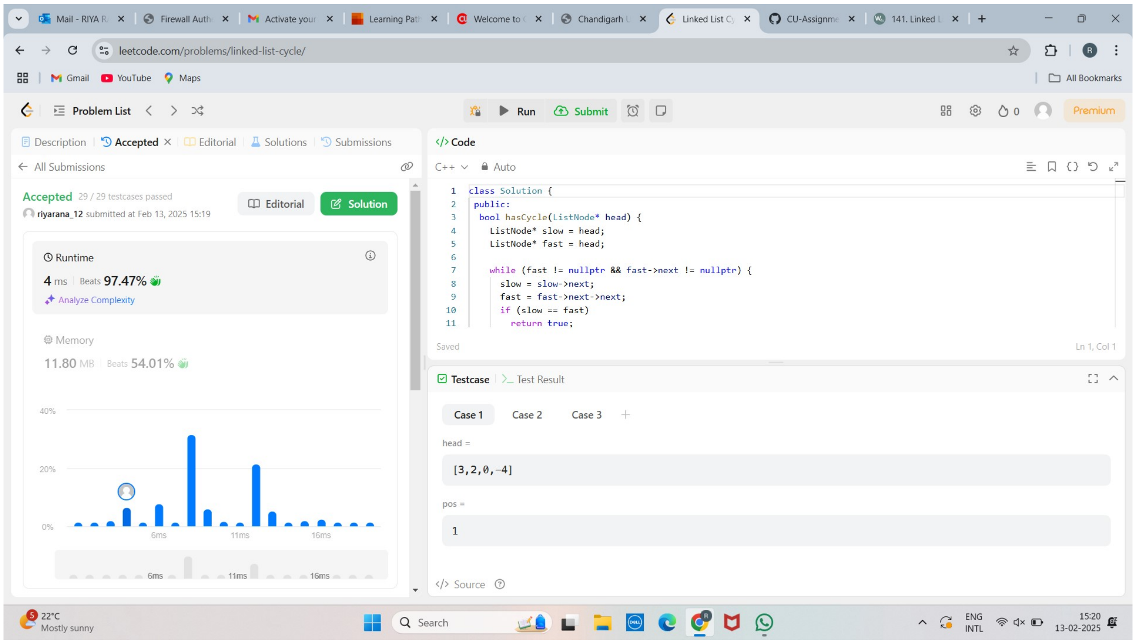
1. **Aim:** Detect a cycle in a linked list.

2. **Objective:** Given head, the head of a linked list, determine if the linked list has a cycle in it. There is a cycle in a linked list if there is some node in the list that can be reached again by continuously following the next pointer. Internally, pos is used to denote the index of the node that tail's next pointer is connected to.

3. **Implementation/Code:**

```
class Solution {
 public:
  bool hasCycle(ListNode* head) {
    ListNode* slow = head;
    ListNode* fast = head;

    while (fast != nullptr && fast->next != nullptr) {
      slow = slow->next;
      fast = fast->next->next;
      if (slow == fast)
        return true;
    }

    return false;
  }
};
```

4. Output:


leetcode.com/problems/linked-list-cycle/

Accepted 29 / 29 testcases passed
riyarana_12 submitted at Feb 13, 2025 15:19

Runtime
4 ms | Beats 97.47%

Memory
11.80 MB | Beats 54.01%

```
class Solution {
 public:
  bool hasCycle(ListNode* head) {
    ListNode* slow = head;
    ListNode* fast = head;

    while (fast != nullptr && fast->next != nullptr) {
      slow = slow->next;
      fast = fast->next->next;
      if (slow == fast)
        return true;
```

Saved
Ln 1, Col 1

Testcase | Test Result

Case 1 Case 2 Case 3

head =
[3,2,0,-4]

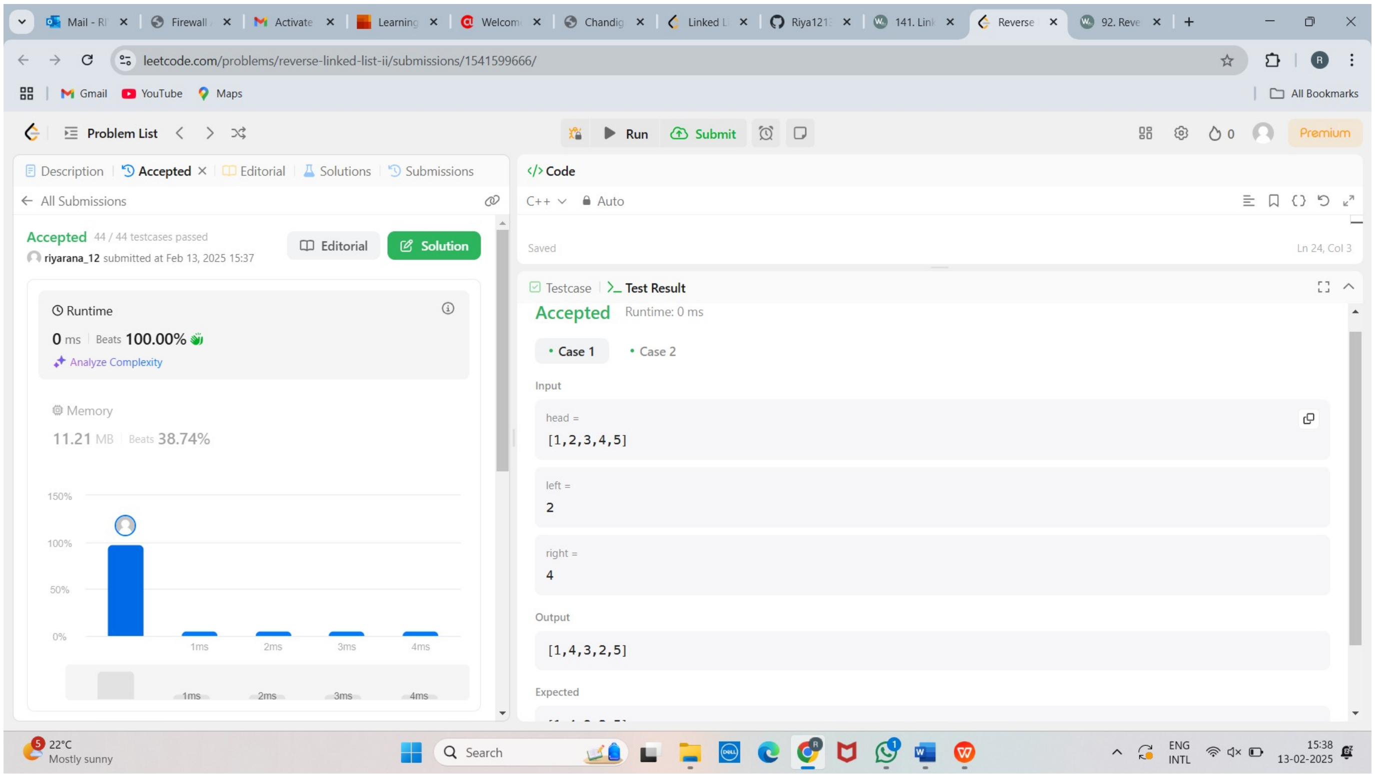
pos =
1

Problem-2

1. **Aim:** Reverse linked list 2
2. **Objective**: Given the head of a singly linked list and two integers left and right where left <= right, reverse the nodes of the list from position left to position right, and return the reversed list.
3. **Implementation/Code:**

```
class Solution {
 public:
  ListNode* reverseBetween(ListNode* head, int left, int right) {
    if (left == 1)
      return reverseN(head, right);

    head->next = reverseBetween(head->next, left - 1, right - 1);

    return head;
  }

 private:
  ListNode* reverseN(ListNode* head, int n) {
    if (n == 1)
      return head;

    ListNode* newHead = reverseN(head->next, n - 1);
    ListNode* headNext = head->next;
    head->next = headNext->next;
    headNext->next = head;

    return newHead;
  }
};
```

4. Output:



leetcode.com/problems/reverse-linked-list-ii/submissions/1541599666/

Accepted 44 / 44 testcases passed
riyarana_12 submitted at Feb 13, 2025 15:37

Runtime
0 ms | Beats 100.00%

Memory
11.21 MB | Beats 38.74%

Accepted Runtime: 0 ms

Case 1 Case 2

Input

head =
```
[1,2,3,4,5]
```

left =
```
2
```

right =
```
4
```

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

Expected

Problem-3

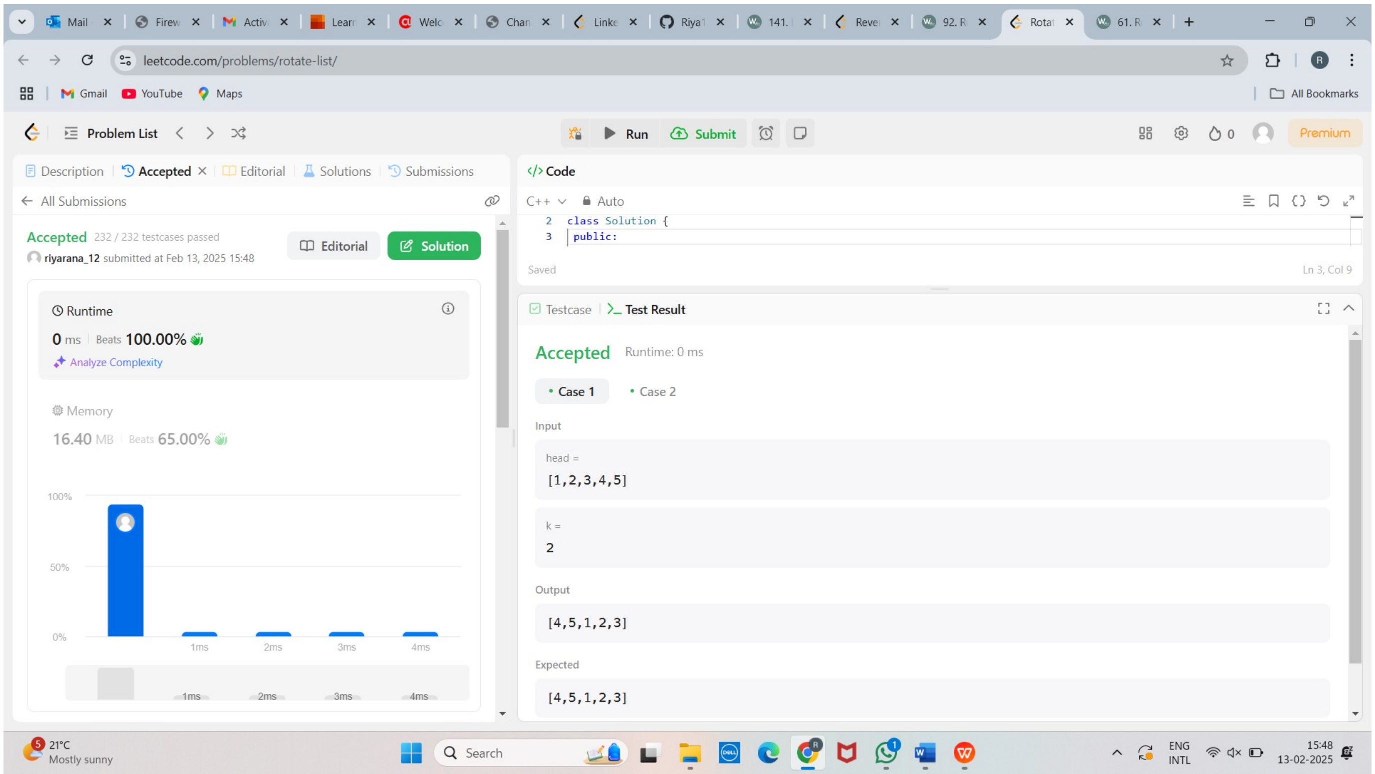
1. **Aim:** Rotate a list

2. **Objective:** Given the head of a linked list, rotate the list to the right by k places.

3. **Code:**

```
class Solution {

 public:

  ListNode* rotateRight(ListNode* head, int k) {
    if (!head || !head->next || k == 0)
      return head;

    ListNode* tail;
    int length = 1;

    for (tail = head; tail->next; tail = tail->next)
      ++length;
    tail->next = head;  // Circle the list.

    const int t = length - k % length;
    for (int i = 0; i < t; ++i)
      tail = tail->next;
    ListNode* newHead = tail->next;
    tail->next = nullptr;

    return newHead;
  }
};
```

4. Output:



Accepted 232 / 232 testcases passed

riyarana_12 submitted at Feb 13, 2025 15:48

Runtime

0 ms | Beats 100.00%

Memory

16.40 MB | Beats 65.00%

```
class Solution {
public:
```

Accepted Runtime: 0 ms

Case 1 Case 2

Input

head =

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

k =

```
2
```

Output

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

Expected

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

Problem-4

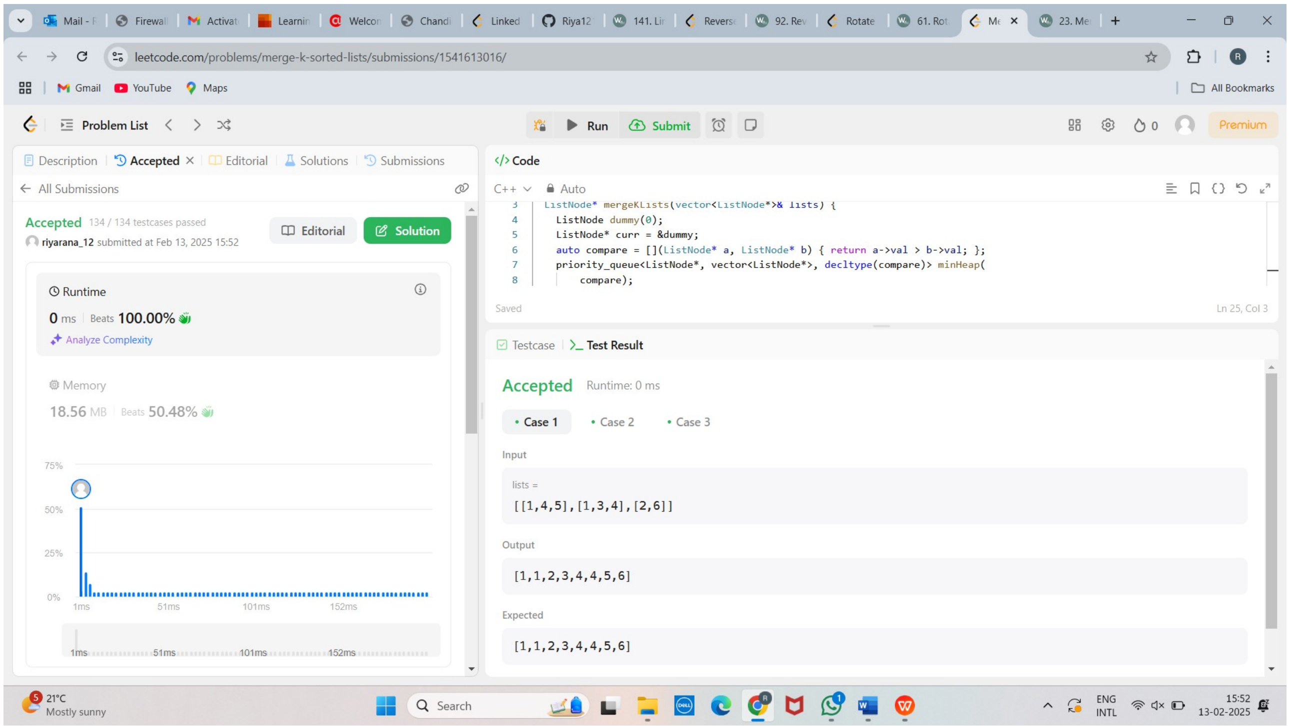
1. **Aim:** Merge k sorted lists

2. **Objective**: 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.

3. **Implementation/Code:**

```
class Solution {
 public:
  ListNode* mergeKLists(vector<ListNode*>& lists) {
    ListNode dummy(0);
    ListNode* curr = &dummy;
    auto compare = [](ListNode* a, ListNode* b) { return a->val > b->val; };
    priority_queue<ListNode*, vector<ListNode*>, decltype(compare)> minHeap(
        compare);

    for (ListNode* list : lists)
      if (list != nullptr)
        minHeap.push(list);

    while (!minHeap.empty()) {
      ListNode* minNode = minHeap.top();
      minHeap.pop();
      if (minNode->next)
        minHeap.push(minNode->next);
      curr->next = minNode;
      curr = curr->next;
    }

    return dummy.next;
  }
};
```

4. Output:



leetcode.com/problems/merge-k-sorted-lists/submissions/1541613016/

Accepted 134 / 134 testcases passed
riyarana_12 submitted at Feb 13, 2025 15:52

Runtime
0 ms | Beats 100.00%

Memory
18.56 MB | Beats 50.48%

Code — C++

```
ListNode* mergeKLists(vector<ListNode*>& lists) {
  ListNode dummy(0);
  ListNode* curr = &dummy;
  auto compare = [](ListNode* a, ListNode* b) { return a->val > b->val; };
  priority_queue<ListNode*, vector<ListNode*>, decltype(compare)> minHeap(
      compare);
```

Test Result

Accepted Runtime: 0 ms

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]
```

Problem-5

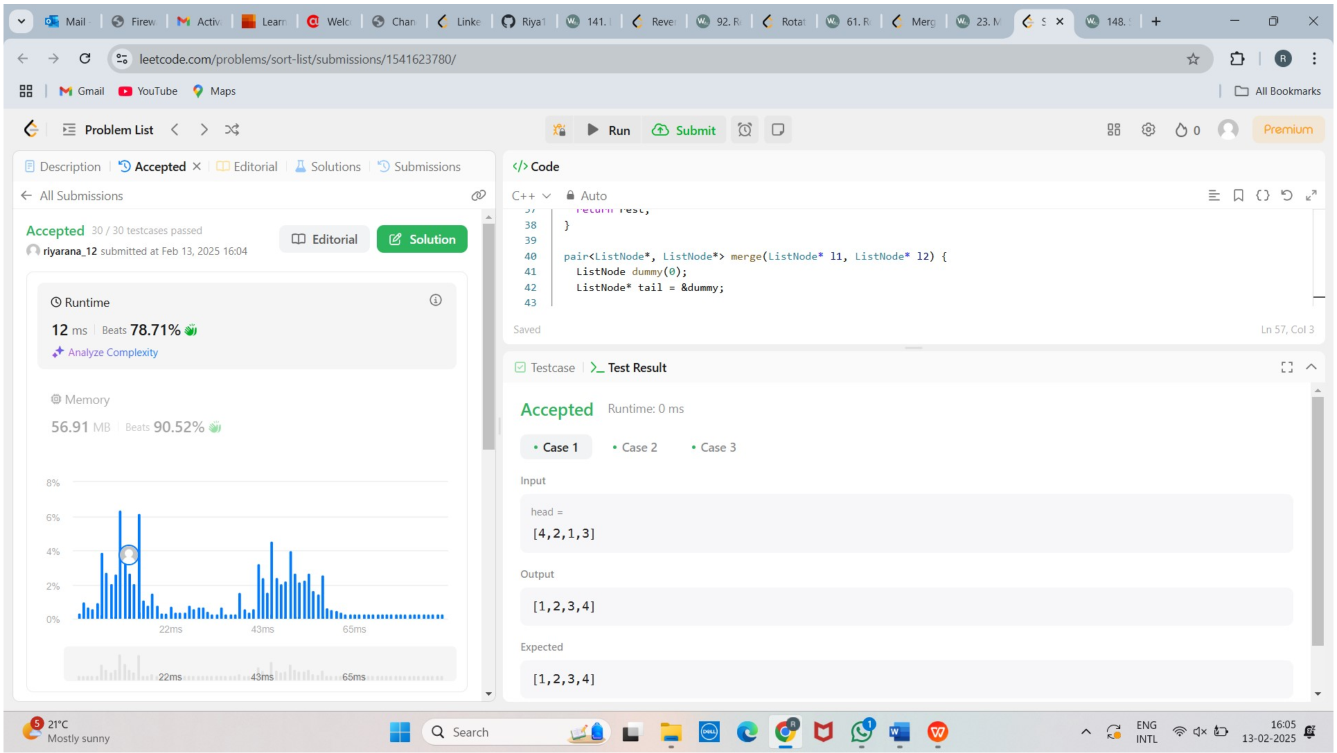
1. Aim: Sort List

2. Objective: Given the head of a linked list, return the list after sorting it in ascending order.

3. Implementation/Code:

```
class Solution {
 public:
  ListNode* sortList(ListNode* head) {
    const int length = getLength(head);
    ListNode dummy(0, head);

    for (int k = 1; k < length; k *= 2) {
      ListNode* curr = dummy.next;
      ListNode* tail = &dummy;
      while (curr != nullptr) {
        ListNode* l = curr;
        ListNode* r = split(l, k);
        curr = split(r, k);
        auto [mergedHead, mergedTail] = merge(l, r);
        tail->next = mergedHead;
        tail = mergedTail;
      }
    }

    return dummy.next;
  }
 private:
  int getLength(ListNode* head) {
    int length = 0;
    for (ListNode* curr = head; curr; curr = curr->next)
      ++length;
    return length;

  }
  ListNode* split(ListNode* head, int k) {
    while (--k && head)
      head = head->next;

    ListNode* rest = head ? head->next : nullptr;
    if (head != nullptr)
      head->next = nullptr;
    return rest;

  }

  pair<ListNode*, ListNode*> merge(ListNode* l1, ListNode* l2) {
    ListNode dummy(0);
    ListNode* tail = &dummy;

    while (l1 && l2) {
      if (l1->val > l2->val)
        swap(l1, l2);
      tail->next = l1;
      l1 = l1->next;
      tail = tail->next;
    }

    tail->next = l1 ? l1 : l2;
    while (tail->next != nullptr)
      tail = tail->next;

    return {dummy.next, tail};

  }
};
```

4. Output:



Accepted 30 / 30 testcases passed
riyarana_12 submitted at Feb 13, 2025 16:04

Runtime
12 ms | Beats 78.71%
Analyze Complexity

Memory
56.91 MB | Beats 90.52%

```
    return rest;
}

pair<ListNode*, ListNode*> merge(ListNode* l1, ListNode* l2) {
  ListNode dummy(0);
  ListNode* tail = &dummy;

```

Saved   Ln 57, Col 3

Accepted Runtime: 0 ms

Case 1 Case 2 Case 3

Input

head =

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

Output

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

Expected

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