

# LINKED LIST

# Problem – 206. Reverse Linked List

Easy

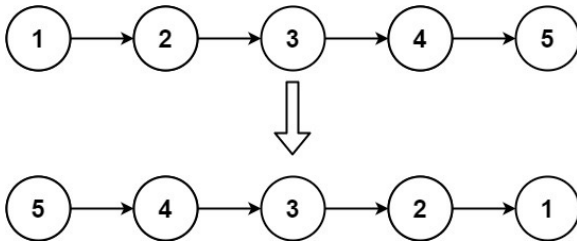


LeetCode

[leetcode.com/problems/reverse-linked-list](https://leetcode.com/problems/reverse-linked-list)

## Problem

- This is a classic problem
- Given a singly linked list, reverse its order



# Solution – 206. Reverse Linked List

Easy



LeetCode

[leetcode.com/problems/reverse-linked-list](https://leetcode.com/problems/reverse-linked-list)

## Solution

- Use recursive approach
- Looking at the pseudo-code, this recursion will return the last node:

```
reverseList(head) {  
    if (!head->next) return head  
    node = reverseList(head->next);  
    return node  
}
```

- From end to beginning, each head will be a node in the list
- Therefore, you can change this node by setting a new head:

```
head->next->next = head;  
head->next = nullptr;
```

# Code – 206. Reverse Linked List

Easy



LeetCode

[leetcode.com/problems/reverse-linked-list](https://leetcode.com/problems/reverse-linked-list)

**Code** Time:  **$O(n)$**  Space:  **$O(1)$**

```
ListNode* reverseList(ListNode* head) {  
    if (!head->next) return head;  
    ListNode* node = reverseList(head->next);  
    head->next->next = head;  
    head->next = nullptr;  
    return node;  
}
```

# Problem – 141. Linked List Cycle

Easy



LeetCode

[leetcode.com/problems/linked-list-cycle](https://leetcode.com/problems/linked-list-cycle)

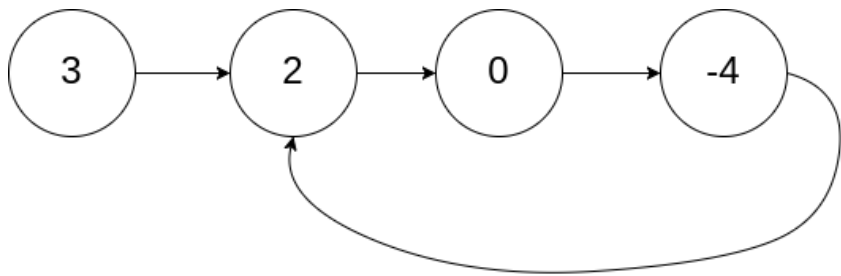
## Problem

- You are given the head of a linked list
- Return **true** if there is a cycle, false otherwise

- **Example:**

In the image below, there is a cycle (-4 to 2)

**Output:** true



# Solution – 141. Linked List Cycle

Easy



LeetCode

[leetcode.com/problems/linked-list-cycle](https://leetcode.com/problems/linked-list-cycle)

## Solution

- Have two pointers: fast and slow
- Slow will go over each item in the linked list
- Fast will go twice as fast as slow (`fast = fast->next->next`)
- If fast reach at the end, there is no cycle
- If fast encounter slow, there is a cycle, return true

# Code – 141. Linked List Cycle

Easy



LeetCode

[leetcode.com/problems/linked-list-cycle](https://leetcode.com/problems/linked-list-cycle)

**Code** Time: **O(n)** Space: **O(1)**

```
bool hasCycle(ListNode *head) {
    if (!head || !head->next) return false;
    ListNode* slow = head;
    ListNode* fast = head;
    while (fast && fast->next) {
        slow = slow->next;
        fast = fast->next->next;
        if (slow == fast) return true;
    }
    return false;
}
```

# Problem – 21. Merge Two Sorted Lists

Easy

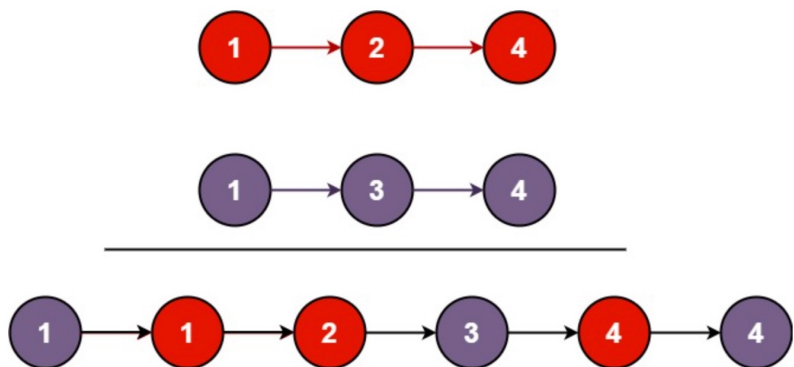


LeetCode

[leetcode.com/problems/merge-two-sorted-lists](https://leetcode.com/problems/merge-two-sorted-lists)

## Problem

- You are given the head of two linked lists (list1 and list2)
- Merge the two lists into one **sorted** list





# Solution – 21. Merge Two Sorted Lists

Easy



LeetCode

[leetcode.com/problems/merge-two-sorted-lists](https://leetcode.com/problems/merge-two-sorted-lists)

## Solution

- Recursively explore the two lists. Base case:

```
if (!list1) return list2;
```

```
if (!list2) return list1;
```

- Compare the value of the current node of list 1 and list 2

```
if (list1->val > list2->val) { ...
```

- Set the next node of the node with the minimum value:

assume the previous condition is true, so

```
list2->next = mergeTwoLists(list1, list2->next);
```

```
return list2;
```

meaning, we want list2->next to come before list1. But we do this recursively since we need the next result

# Code – 21. Merge Two Sorted Lists

Easy



LeetCode

[leetcode.com/problems/merge-two-sorted-lists](https://leetcode.com/problems/merge-two-sorted-lists)

**Code** Time:  $O(n + m)$  Space:  $O(n + m)$  where  $n$  is the length of list1 and  $m$  is the length of list2

```
ListNode* mergeTwoLists(ListNode* list1, ListNode* list2) {
    if (!list1) return list2;
    if (!list2) return list1;

    if (list1->val < list2->val) {
        list1->next = mergeTwoLists(list1->next, list2);
        return list1;
    } else {
        list2->next = mergeTwoLists(list2->next, list1);
        return list2;
    }
}
```

# Problem – 23. Merge k Sorted Lists

Hard



LeetCode

[leetcode.com/problems/merge-k-sorted-lists](https://leetcode.com/problems/merge-k-sorted-lists)

## Problem

- You are given an **array of k linked lists**
- Each linked list is **sorted** in ascending order
- Merge all linked lists into one **sorted** linked-lists

# Solution – 23. Merge k Sorted Lists

Hard



LeetCode

[leetcode.com/problems/merge-k-sorted-lists](https://leetcode.com/problems/merge-k-sorted-lists)

## Solution

- Create a function to merge two lists
- Go over the lists and merge with each over; **or**
- Use divide and conquer to merge (more optimal)
- Divide and conquer is more efficient because it avoids merging a big list with a small one multiple times

# Code – 23. Merge k Sorted Lists

Hard



LeetCode

[leetcode.com/problems/merge-k-sorted-lists](https://leetcode.com/problems/merge-k-sorted-lists)

**Code** Time:  $O(N \log k)$  Space:  $O(\log k)$  where **N** is the total number of nodes across all lists and **k** is the number of lists

```
ListNode* mergeKLists(vector<ListNode*>& lists) {
    if (lists.empty()) return nullptr;
    return divideAndConquer(lists, 0 /* left */, lists.size() - 1 /* right */);
}

ListNode* mergeTwoLists(ListNode* l1, ListNode* l2) {
    if (!l1) return l2;
    if (!l2) return l1;

    if (l1->val < l2->val) {
        l1->next = mergeTwoLists(l1->next, l2);
        return l1;
    } else {
        l2->next = mergeTwoLists(l2->next, l1);
        return l2;
    }
}

ListNode* divideAndConquer(vector<ListNode*> lists, int left, int right) {
    if (left == right) return lists[right];

    int mid = left + (right - left) / 2;
    ListNode* l1 = divideAndConquer(lists, left, mid);
    ListNode* l2 = divideAndConquer(lists, mid + 1, right);
    return mergeTwoLists(l1, l2);
}
```

# Problem – 19. Remove Nth Node From End of List

Medium

 [leetcode.com/problems/remove-nth-node-from-end-of-list](https://leetcode.com/problems/remove-nth-node-from-end-of-list)

**Problem Statement / Solution / Code**   Time:  $O()$    Space:  $O()$

■ ...

# Problem – 143. Reorder List

Medium



LeetCode

[leetcode.com/problems/reorder-list](https://leetcode.com/problems/reorder-list)

**Problem Statement / Solution / Code**   Time:  $O()$    Space:  $O()$

■ ...

# Problem – 24. Swap Nodes in Pair

Medium

<https://leetcode.com/problems/swap-nodes-in-pairs>

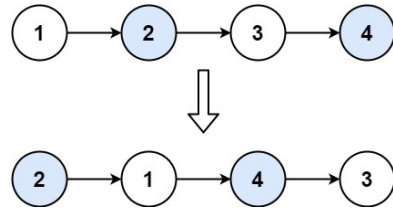
## Problem

Given a linked list, swap every two adjacent nodes and return its head. You must solve the problem without modifying the values in the list's nodes (i.e., only nodes themselves may be changed.)

### Example 1

Input: head = [1,2,3,4]

Output: [2,1,4,3]



### Example 2

Input: head = []

Output: []

Example 3:

### Example 3

Input: head = [1]

Output: [1]



# Solution – Swap Nodes in Pair

Medium

<https://leetcode.com/problems/swap-nodes-in-pairs>

```
ListNode* swapPairs(ListNode* head) {
    if (head == NULL || head->next == NULL) {
        return head;
    }
    ListNode *node = head;
    ListNode *prev = NULL;
    head = head->next;

    while (node && node->next) {
        ListNode *second = node->next;
        ListNode *next_pair = second->next;
        second->next = node;
        node->next = next_pair;
        if (prev) {
            prev->next = second;
        }
        prev = node;
        node = next_pair;
    }
    return head;
}
```

# Solution (recursive) – Swap Nodes in Pair

Medium

<https://leetcode.com/problems/swap-nodes-in-pairs>

```
ListNode* swapPairs(ListNode* head) {  
    if(!head || !head->next)  
        return head;  
    ListNode* newHead = head->next;  
    head->next = swapPairs(head->next->next);  
    newHead->next = head;  
    return newHead;  
}
```