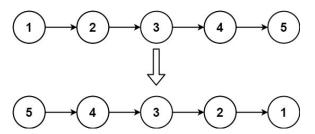
# LINKED LIST



leetcode.com/problems/reverse-linked-list

### **Problem**

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





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;
```

```
LeetCode
```

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;
```



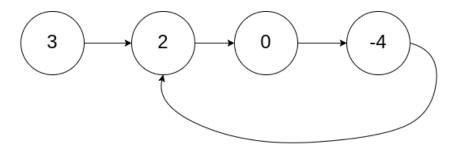
leetcode.com/problems/linked-list-cycle

#### **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



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

```
E LeetCode
```

leetcode.com/problems/linked-list-cycle

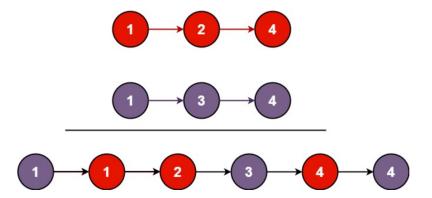
```
bool hasCycle(ListNode *head) {
   if (!head || !head->next) return false;
   ListNode* slow = head;
   ListNode* fast = head;
   while (fast && fast->next) {
      slow = slow->next;
      fast = fast->next->next;
      if (slow == fast) return true;
   }
   return false;
}
```



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



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

```
E LeetCode
```

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



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



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

```
E LeetCode
```

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* 11, ListNode* 12) {
   if (!l1) return l2;
   if (!12) return 11;
   if (l1->val < l2->val) {
        11->next = mergeTwoLists(l1->next, l2);
        return 11;
   } else {
       12->next = mergeTwoLists(12->next, 11);
        return 12;
ListNode* divideAndConquer(vector<ListNode*> lists, int left, int right) {
   if (left == right) return lists[right];
   int mid = left + (right - left) / 2;
   ListNode* 11 = divideAndConquer(lists, left, mid);
   ListNode* 12 = divideAndConquer(lists, mid + 1, right);
    return mergeTwoLists(l1, l2);
```

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



**LeetCode** 

leetcode.com/problems/remove-nth-node-from-end-of-list

### Problem Statement / Solution / Code Time: O() Space: O()

• ..

### Problem - 143. Reorder List



**LeetCode** 

leetcode.com/problems/reorder-list

### Problem Statement / Solution / Code Time: O() Space: O()

• ..

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

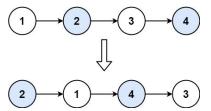
#### **Problem**

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

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

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;
}
```