

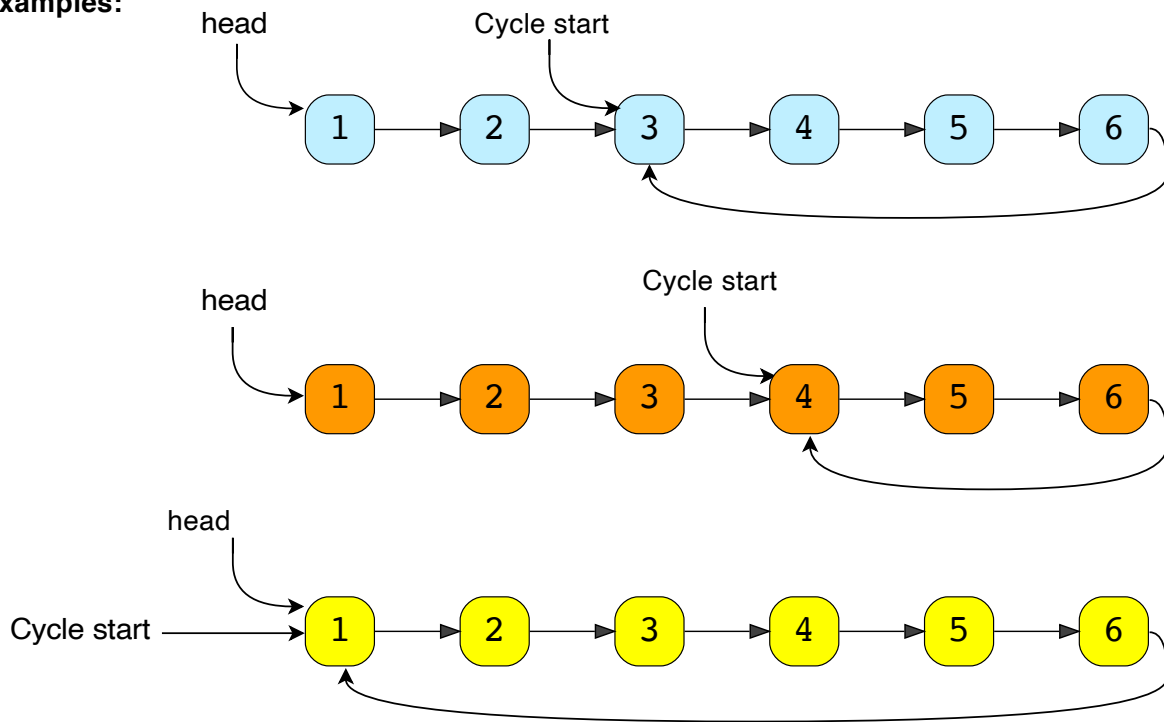
Start of LinkedList Cycle (medium)

We'll cover the following ^

- Problem Statement
- Try it yourself
- Solution
 - Code
 - Time Complexity
 - Space Complexity

Problem Statement#

Given the head of a **Singly LinkedList** that contains a cycle, write a function to find the **starting node of the cycle**.

Examples:

Try it yourself#

Try solving this question here:

Java

Python3

JS

C++

```
1 class ListNode {
2     int value = 0;
3     ListNode next;
4
5     ListNode(int value) {
6         this.value = value;
7     }
8 }
9
10 class LinkedListCycleStart {
11
```



```
13 public static ListNode findCycleStart(ListNode head) {  
14     // TODO: Write your code here  
15     return head;  
16 }  
17 public static void main(String[] args) {  
18     ListNode head = new ListNode(1);  
19     head.next = new ListNode(2);  
20     head.next.next = new ListNode(3);  
21     head.next.next.next = new ListNode(4);  
22     head.next.next.next.next = new ListNode(5);  
23     head.next.next.next.next.next = new ListNode(6);  
24  
25     head.next.next.next.next.next.next = head.next.next;  
26     System.out.println("LinkedList cycle start: " + LinkedListCycleStart.  
27  
28     head.next.next.next.next.next.next = head.next.next.next;
```

Run

Save

Reset



Solution#

If we know the length of the **LinkedList** cycle, we can find the start of the cycle through the following steps:

1. Take two pointers. Let's call them `pointer1` and `pointer2`.
2. Initialize both pointers to point to the start of the LinkedList.
3. We can find the length of the LinkedList cycle using the approach discussed in LinkedList Cycle

(<https://www.educative.io/collection/page/5668639101419520/5671464854355968/6556337280385024>). Let's assume that the length of the cycle is 'K' nodes.

4. Move `pointer2` ahead by 'K' nodes.

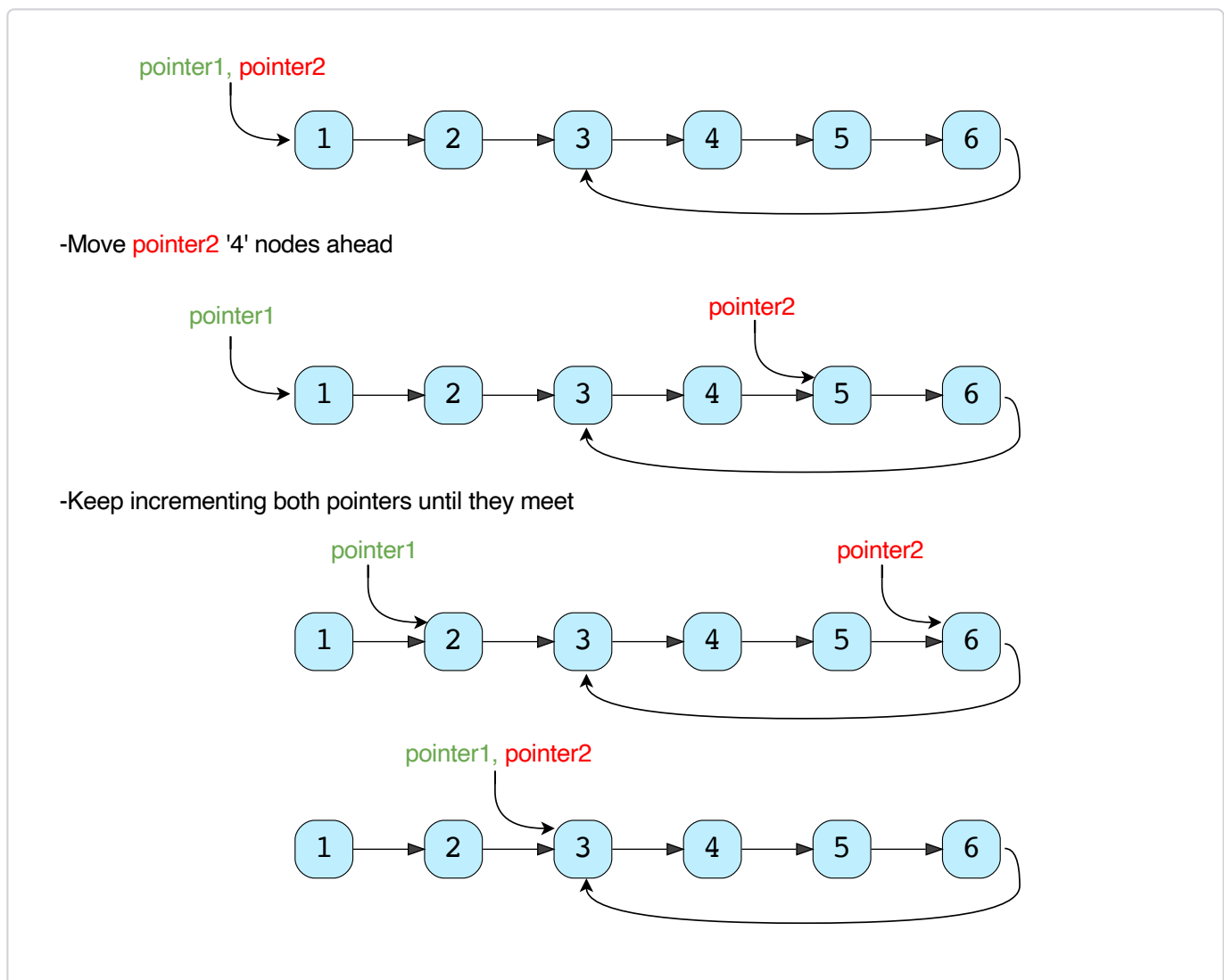


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5. Now, keep incrementing `pointer1` and `pointer2` until they both meet.
6. As `pointer2` is 'K' nodes ahead of `pointer1`, which means, `pointer2` must have completed one loop in the cycle when both pointers meet. Their meeting point will be the start of the cycle.





Let's visually see this with the above-mentioned Example-1:



We can use the algorithm discussed in LinkedList Cycle (<https://www.educative.io/collection/page/5668639101419520/5671464854355968/6556337280385024>) to find the length of the cycle and then follow the above-mentioned steps to find the start of the cycle.

Code#

Here is what our algorithm will look like:

 Java	 Python3	 C++	 JS
--	---	---	--

```
1  class ListNode {
2      int value = 0;
3      ListNode next;
4
5      ListNode(int value) {
6          this.value = value;
7      }
8  }
9
10 class LinkedListCycleStart {
11
12     public static ListNode findCycleStart(ListNode head) {
13         int cycleLength = 0;
14         // find the LinkedList cycle
15         ListNode slow = head;
16         ListNode fast = head;
17         while (fast != null && fast.next != null) {
18             fast = fast.next.next;
19             slow = slow.next;
20             if (slow == fast) { // found the cycle
21                 cycleLength = calculateCycleLength(slow);
22                 break;
23             }
24         }
25     }
```

```
26     } return findStart(head, cycleLength);  
27  
28
```

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Time Complexity#

As we know, finding the cycle in a LinkedList with 'N' nodes and also finding the length of the cycle requires $O(N)$. Also, as we saw in the above algorithm, we will need $O(N)$ to find the start of the cycle. Therefore, the overall time complexity of our algorithm will be $O(N)$.

Space Complexity#

The algorithm runs in constant space $O(1)$.

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