160. Intersection of Two Linked Lists

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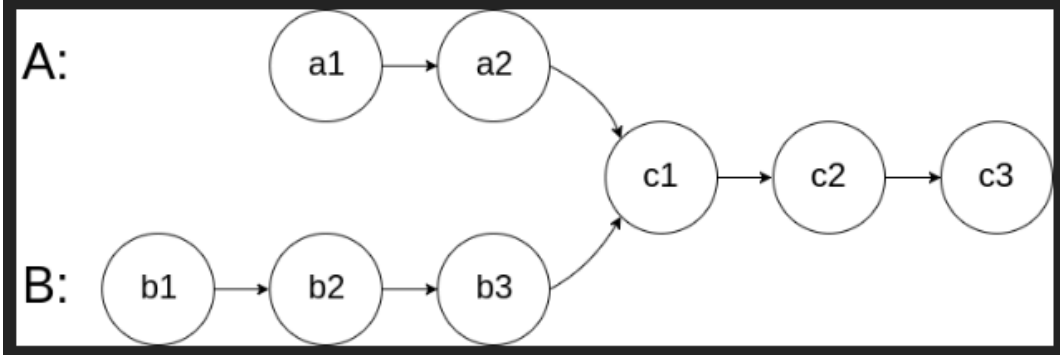
Given the heads of two singly linked-lists `headA` and `headB`, return *the node at which the two lists intersect*. If the two linked lists have no intersection at all, return `null`.

For example, the following two linked lists begin to intersect at node `c1`:



The test cases are generated such that there are no cycles anywhere in the entire linked structure.

Note that the linked lists must **retain their original structure** after the function returns.

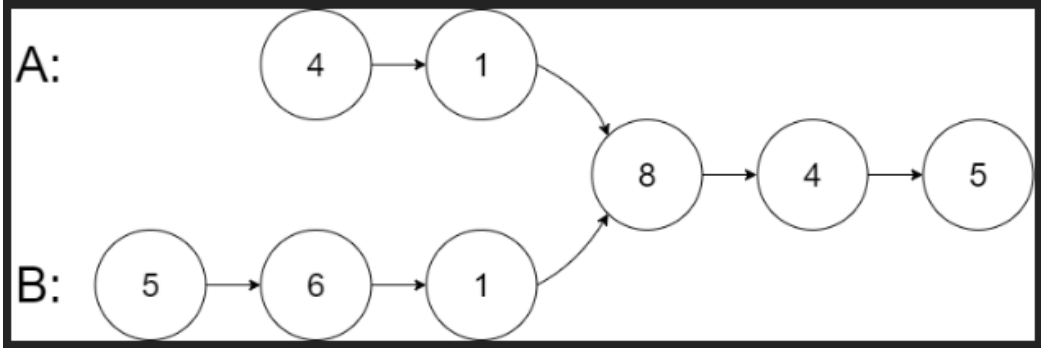
Custom Judge:

The inputs to the **judge** are given as follows (your program is **not** given these inputs):

- `intersectVal` - The value of the node where the intersection occurs. This is `0` if there is no intersected node.
- `listA` - The first linked list.
- `listB` - The second linked list.
- `skipA` - The number of nodes to skip ahead in `listA` (starting from the head) to get to the intersected node.
- `skipB` - The number of nodes to skip ahead in `listB` (starting from the head) to get to the intersected node.

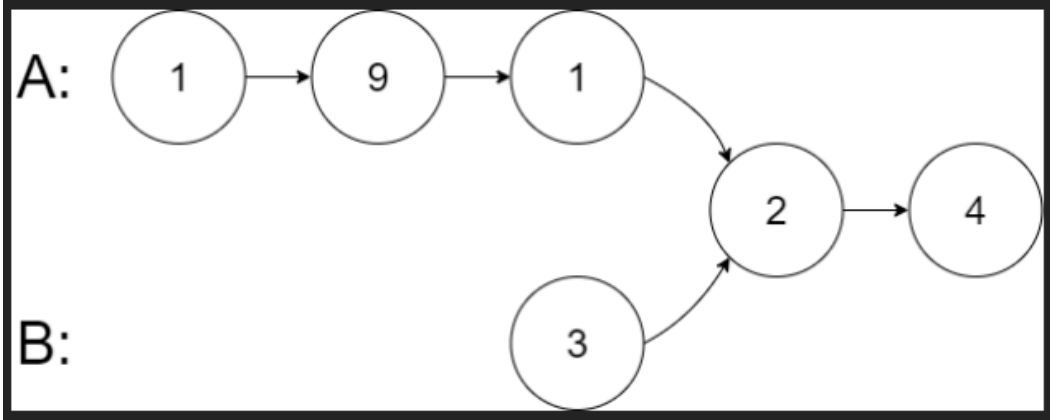
The judge will then create the linked structure based on these inputs and pass the two heads, `headA` and `headB` to your program. If you correctly return the intersected node, then your solution will be **accepted**.

Example 1:



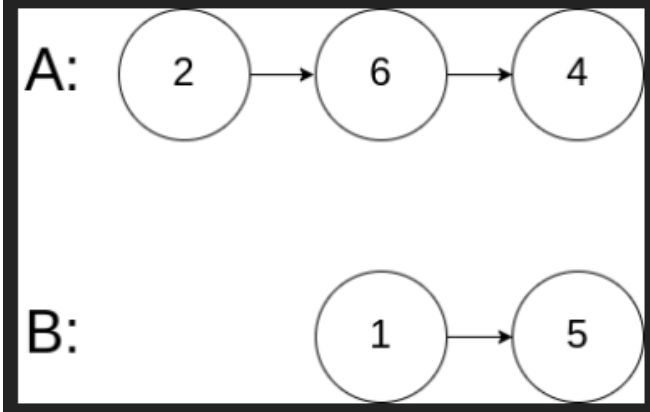
Input: intersectVal = 8, listA = [4,1,8,4,5], listB = [5,6,1,8,4,5], skipA = 2, skipB = 3
Output: Intersected at '8'
Explanation: The intersected node's value is 8 (note that this must not be 0 if the two lists intersect).
From the head of A, it reads as [4,1,8,4,5]. From the head of B, it reads as [5,6,1,8,4,5]. There are 2 nodes before the intersected node in A; There are 3 nodes before the intersected node in B.
- Note that the intersected node's value is not 1 because the nodes with value 1 in A and B (2^{nd} node in A and 3^{rd} node in B) are different node references. In other words, they point to two different locations in memory, while the nodes with value 8 in A and B (3^{rd} node in A and 4^{th} node in B) point to the same location in memory.

Example 2:




```
Input: intersectVal = 2, listA = [1,9,1,2,4], listB = [3,2,4],
skipA = 3, skipB = 1
Output: Intersected at '2'
Explanation: The intersected node's value is 2 (note that this
must not be 0 if the two lists intersect).
From the head of A, it reads as [1,9,1,2,4]. From the head of B,
it reads as [3,2,4]. There are 3 nodes before the intersected node
in A; There are 1 node before the intersected node in B.
```

Example 3:




```
Input: intersectVal = 0, listA = [2,6,4], listB = [1,5], skipA =
3, skipB = 2
Output: No intersection
Explanation: From the head of A, it reads as [2,6,4]. From the
head of B, it reads as [1,5]. Since the two lists do not
intersect, intersectVal must be 0, while skipA and skipB can be
arbitrary values.
Explanation: The two lists do not intersect, so return null.
```

Constraints:

- The number of nodes of `listA` is in the `m`.
- The number of nodes of `listB` is in the `n`.
- `1 <= m, n <= 3 * 10^4`
- `1 <= Node.val <= 10^5`
- `0 <= skipA <= m`
- `0 <= skipB <= n`
- `intersectVal` is `0` if `listA` and `listB` do not intersect.
- `intersectVal == listA[skipA] == listB[skipB]` if `listA` and `listB` intersect.

Follow up: Could you write a solution that runs in `O(m + n)` time and use only `O(1)` memory?

Python:

```
# Definition for singly-linked list.
# class ListNode:
#     def __init__(self, x):
#         self.val = x
#         self.next = None

class Solution:
    def getIntersectionNode(self, headA: ListNode, headB: ListNode) -> Optional[ListNode]:
        if not headA or not headB:
            return None

        # Two pointers
        pA, pB = headA, headB

        # Traverse both lists
        # When one pointer reaches end, move it to the other list's head
        # If they intersect, they will meet at intersection node
        # If no intersection, both will eventually become None
        while pA != pB:
```

```
            pA = pA.next if pA else headB
            pB = pB.next if pB else headA

        return pA   # Either the intersection node or None
```

JavaScript:

```
/**
 * Definition for singly-linked list.
 * function ListNode(val) {
 *     this.val = val;
 *     this.next = null;
 * }
 */

/**
 * @param {ListNode} headA
 * @param {ListNode} headB
 * @return {ListNode}
 */
var getIntersectionNode = function(headA, headB) {
    if (!headA || !headB) return null;

    let pA = headA;
    let pB = headB;

    while (pA !== pB) {
        // Move pointer forward or reset to the other list's head
        pA = pA ? pA.next : headB;
        pB = pB ? pB.next : headA;
    }

    return pA; // either intersection node or null
};
```

Java:

```
/**
 * Definition for singly-linked list.
 * public class ListNode {
 *     int val;
 *     ListNode next;
 *     ListNode(int x) {
 *         val = x;
 *         next = null;
```

```
 *     }
 * }
 */
public class Solution {
    public ListNode getIntersectionNode(ListNode headA, ListNode headB) {
        if (headA == null || headB == null) {
            return null;
        }

        ListNode a = headA;
        ListNode b = headB;

        // Traverse both lists. When one reaches the end, switch to the other list.
        while (a != b) {
            a = (a == null) ? headB : a.next;
            b = (b == null) ? headA : b.next;
        }

        // Either intersection node or null
        return a;
    }
}
```