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Solution Review: Find Middle Node of a Linked List

This review provides a detailed analysis of the different ways to solve the Find the Middle Value in a Linked List challenge.

We'll cover the following

Solution #1: Brute Force Method

main.py

LinkedList.py

Node.py

```

def find_mid(lst):
    if lst.is_empty():
        return None

    node = lst.get_head()
    mid = 0
    if lst.length() % 2 == 0:
        mid = lst.length()//2
    else:
        mid = lst.length()//2 + 1
```

```

    for i in range(mid - 1):
        node = node.next_element

    return node.data


lst = LinkedList()
lst.insert_at_head(22)
lst.insert_at_head(21)
lst.insert_at_head(10)
lst.insert_at_head(14)
lst.insert_at_head(7)

lst.print_list()
print(find_mid(lst))

```

This is the simplest way to go about this problem. We traverse the whole list to find its length. The middle position can be calculated by halving the length.

Note: For odd lengths, the middle value would be,

```
mid = length/2 + 1
```

Then, we iterate till the middle index and return the value of that node.

Time Complexity

The algorithm makes a linear traversal over the list. Hence, the time complexity is *O(n)*.

Solution #2: Two Pointers

main.py

LinkedList.py

Node.py

```python
from LinkedList import LinkedList
from Node import Node
def find_mid(lst):
  if lst.is_empty():
    return -1
  current_node = lst.get_head()
  if current_node.next_element == None:
    #Only 1 element exist in array so return its value.
    return current_node.data

  mid_node = current_node
  current_node = current_node.next_element.next_element
  #Move mid_node (Slower) one step at a time
  #Move current_node (Faster) two steps at a time
  #When current_node reaches at end, mid_node will be at the middle
  while current_node:
    mid_node = mid_node.next_element
    current_node = current_node.next_element
    if current_node:
      current_node = current_node.next_element
  if mid_node:
    return mid_node.data
  return -1

lst = LinkedList()
lst.insert_at_head(22)
lst.insert_at_head(21)
lst.insert_at_head(10)
```

This solution is more efficient as compared to the brute force method. We will use two pointers which will work simultaneously.

Think of it this way:

- The **fast** pointer moves two steps at a time till the end of the list
- The **slow** pointer moves one step at a time
- when the **fast** pointer reaches the end, the **slow** pointer will be at the middle

Using this algorithm, we can make the process faster because the calculation of the length and the traversal till the middle are happening side-by-side.

Time Complexity

We are traversing the linked list at twice the speed, so it is certainly faster. However, the bottleneck complexity is still *O(n)*.

The linked lists we have seen so far had unique values, but what if a list contains duplicates? We'll learn more about this in the next lesson.

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