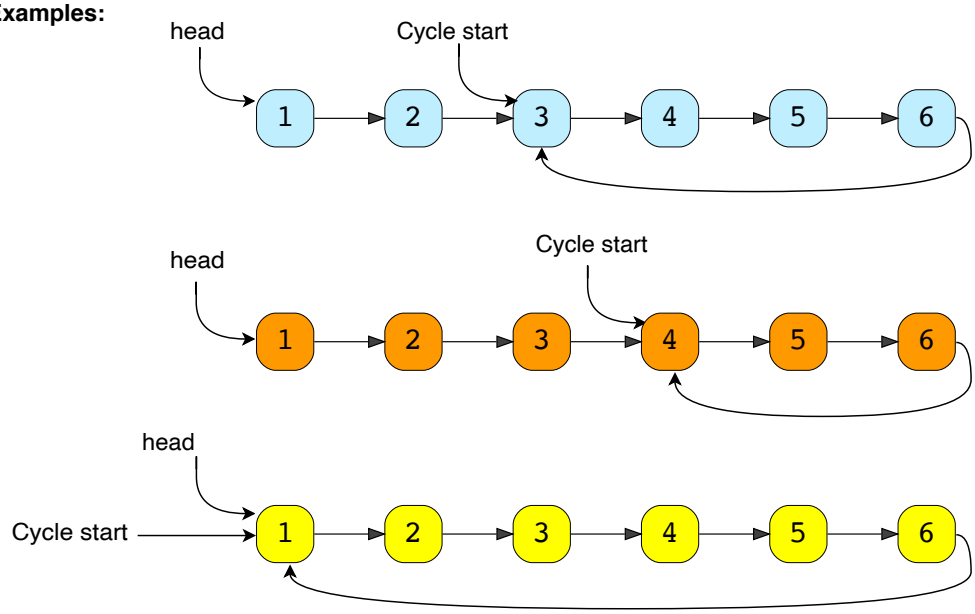
Start of LinkedList Cycle (medium)

We'll cover the following

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:

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```
from __future__ import print_function


class Node:
  def __init__(self, value, next=None):
    self.value = value
    self.next = next

```

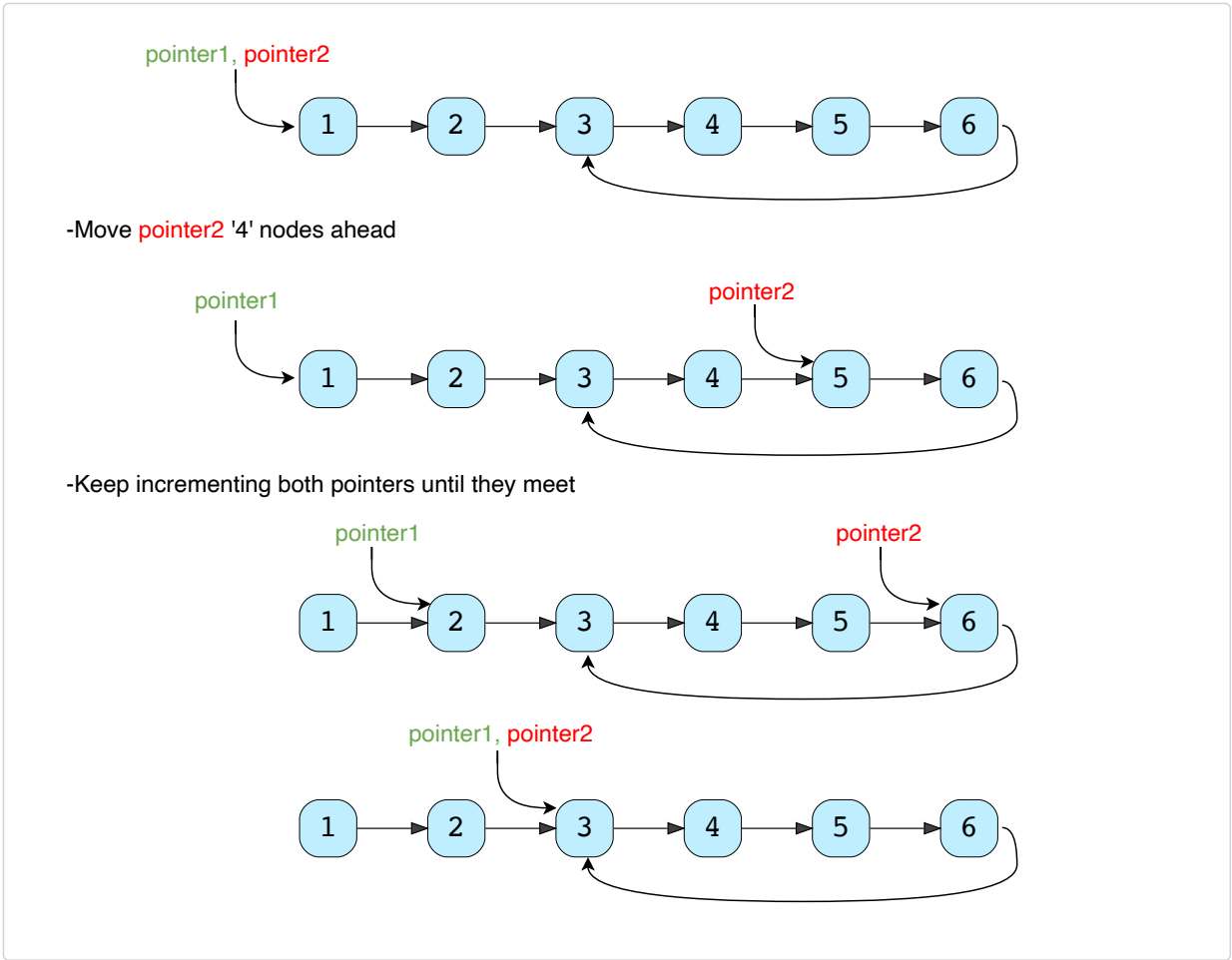
```
  def print_list(self):
    temp = self
    while temp is not None:
      print(temp.value, end='')
      temp = temp.next
    print()


def find_cycle_start(head):
  # TODO: Write your code here
  return head


def main():
  head = Node(1)
  head.next = Node(2)
  head.next.next = Node(3)
  head.next.next.next = Node(4)
  head.next.next.next.next = Node(5)
  head.next.next.next.next.next = Node(6)
```

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.
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:

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```
    cycle_length -= 1
  # increment both pointers until they meet at the start of the cycle
  while pointer1 != pointer2:
    pointer1 = pointer1.next
    pointer2 = pointer2.next
  return pointer1


def main():
  head = Node(1)
  head.next = Node(2)
  head.next.next = Node(3)
  head.next.next.next = Node(4)
  head.next.next.next.next = Node(5)
  head.next.next.next.next.next = Node(6)

  head.next.next.next.next.next.next = head.next.next
  print("LinkedList cycle start: " + str(find_cycle_start(head).value))

```

```
  head.next.next.next.next.next.next = head.next.next.next
  print("LinkedList cycle start: " + str(find_cycle_start(head).value))

  head.next.next.next.next.next.next = head
  print("LinkedList cycle start: " + str(find_cycle_start(head).value))


main()

```

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 $O(1)$.

Back

LinkedList Cycle (easy)

Next

Happy Number (medium)

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