Solution Review: Sum Two Linked Lists

This lesson contains the solution review for the challenge of summing two linked lists.

WE'LL COVER THE FOLLOWING

- Implementation
- Explanation

In this lesson, we investigate how to sum two singly linked lists. Check out the code below, after which, we will do a line by line analysis of it.

Implementation

```
def sum_two_lists(self, llist):
  p = self.head
  q = llist.head

  sum_llist = LinkedList()

  carry = 0
  while p or q:
      if not p:
          i = 0
      else:
          i = p.data
      if not q:
          j = 0
      else:
          j = q.data
      s = i + j + carry
      if s >= 10:
          carry = 1
          remainder = s % 10
          sum_llist.append(remainder)
      else:
          carry = 0
          sum_llist.append(s)
      if p:
          p = p.next
      if q:
          q = q.next
  return sum_llist
```

Explanation

First of all, we initialize `p` and `q` to point to the heads of each of the two linked lists (**lines 2-3**). On **line 5**, we declare `sum_llist` and initialize it to a linked list. The data values of `sum_llist` will represent the final sum at the end of this method. `carry` is initialized to `0` on **line** 7 and it will help us in evaluating the sum.

With the help of `p` and `q`, we set up a `while` loop which will run until both `p` and `q` equal `None`. On **lines 9-16**, we have handled the cases if either `p` or `q` equal `None`. If `p` or `q` equal `None`, we set `i` or `j` to `0` accordingly. In the other case where `p` and `q` are not equal to `None`, we use the data values of the node they are pointing to and store the data values in variables `i` and `j`. We are using `i` to represent the current digit picked from the first linked list and `j` to represent the current digit picked from the second one.

Once we get the values in `i` and `j`, we evaluate the sum on **line 17** by adding `i`, `j`, and `carry` and storing the sum in variable `s`. Note that `carry` will be `0` in the first iteration. After calculating the sum, we check if that sum is greater than or equal to `10` on **line 18**. If `s` is greater than or equal to `10`, we set `carry` to `1` (**line 19**) and calculate the `remainder` using the modulus operator on **line 20**. Now we append `remainder` to the final linked list (`sum_llist`) on **line 20**. On the other hand, if `s` is less than `10`, then there is no carry (`carry = 0`), and we append `s` to `sum_llist`. These steps are almost the same as we perform the arithmetic operation of addition. On **line 25-28**, we update `p` and `q` to their next nodes if they are not already `None`.

`sum_llist` is returned from the end of the method and contains the sum of the two linked lists we had at the start.

The `sum_two_lists` has been made part of the `LinkedList` class. You can run it and verify our solution!

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


class LinkedList:
    def __init__(self):
        self.head = None
```

```
    def print_list(self):
        cur_node = self.head

        while cur_node:
            print(cur_node.data)
            cur_node = cur_node.next

    def append(self, data):
        new_node = Node(data)

        if self.head is None:
            self.head = new_node
            return

        last_node = self.head
        while last_node.next:
            last_node = last_node.next
        last_node.next = new_node

    def prepend(self, data):
        new_node = Node(data)

        new_node.next = self.head
        self.head = new_node

    def insert_after_node(self, prev_node, data):

        if not prev_node:
            print("Previous node does not exist.")
            return

        new_node = Node(data)

        new_node.next = prev_node.next
        prev_node.next = new_node

    def delete_node(self, key):

        cur_node = self.head

        if cur_node and cur_node.data == key:
            self.head = cur_node.next
            cur_node = None
            return

        prev = None
        while cur_node and cur_node.data != key:
            prev = cur_node
            cur_node = cur_node.next

        if cur_node is None:
            return

        prev.next = cur_node.next
        cur_node = None

    def delete_node_at_pos(self, pos):
        if self.head:
            cur_node = self.head

            if pos == 0:
                self.head = cur_node.next
```

```
            cur_node = None
            return

        prev = None
        count = 1
        while cur_node and count != pos:
            prev = cur_node
            cur_node = cur_node.next
            count += 1

        if cur_node is None:
            return

        prev.next = cur_node.next
        cur_node = None

    def len_iterative(self):

        count = 0
        cur_node = self.head

        while cur_node:
            count += 1
            cur_node = cur_node.next
        return count

    def len_recursive(self, node):
        if node is None:
            return 0
        return 1 + self.len_recursive(node.next)

    def swap_nodes(self, key_1, key_2):

        if key_1 == key_2:
            return

        prev_1 = None
        curr_1 = self.head
        while curr_1 and curr_1.data != key_1:
            prev_1 = curr_1
            curr_1 = curr_1.next

        prev_2 = None
        curr_2 = self.head
        while curr_2 and curr_2.data != key_2:
            prev_2 = curr_2
            curr_2 = curr_2.next

        if not curr_1 or not curr_2:
            return

        if prev_1:
            prev_1.next = curr_2
        else:
            self.head = curr_2

        if prev_2:
            prev_2.next = curr_1
        else:
            self.head = curr_1

        curr_1.next, curr_2.next = curr_2.next, curr_1.next
```

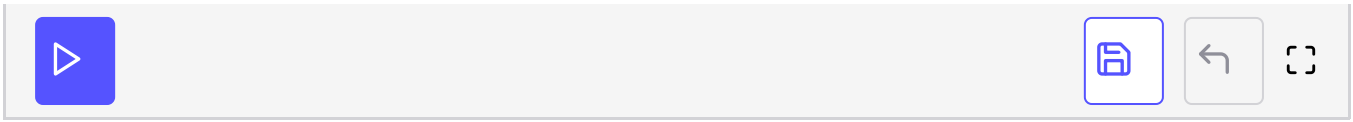
```
    def print_helper(self, node, name):
        if node is None:
            print(name + ": None")
        else:
            print(name + ":" + node.data)

    def reverse_iterative(self):

        prev = None
        cur = self.head
        while cur:
            nxt = cur.next
            cur.next = prev

            self.print_helper(prev, "PREV")
            self.print_helper(cur, "CUR")
            self.print_helper(nxt, "NXT")
            print("\n")

            prev = cur
            cur = nxt
        self.head = prev

    def reverse_recursive(self):

        def _reverse_recursive(cur, prev):
            if not cur:
                return prev

            nxt = cur.next
            cur.next = prev
            prev = cur
            cur = nxt
            return _reverse_recursive(cur, prev)

        self.head = _reverse_recursive(cur=self.head, prev=None)

    def merge_sorted(self, llist):

        p = self.head
        q = llist.head
        s = None

        if not p:
            return q
        if not q:
            return p

        if p and q:
            if p.data <= q.data:
                s = p
                p = s.next
            else:
                s = q
                q = s.next
            new_head = s
        while p and q:
            if p.data <= q.data:
                s.next = p
                s = p
                p = s.next
```

```
            else:
                s.next = q
                s = q
                q = s.next
        if not p:
            s.next = q
        if not q:
            s.next = p
        return new_head

    def remove_duplicates(self):

        cur = self.head
        prev = None

        dup_values = dict()

        while cur:
            if cur.data in dup_values:
                # Remove node:
                prev.next = cur.next
                cur = None
            else:
                # Have not encountered element before.
                dup_values[cur.data] = 1
                prev = cur
            cur = prev.next

    def print_nth_from_last(self, n, method):
        if method == 1:
            #Method 1:
            total_len = self.len_iterative()
            cur = self.head
            while cur:
                if total_len == n:
                   #print(cur.data)
                    return cur.data
                total_len -= 1
                cur = cur.next
            if cur is None:
                return

        elif method == 2:
            # Method 2:
            p = self.head
            q = self.head

            count = 0
            while q:
                count += 1
                if(count>=n):
                    break
                q = q.next

            if not q:
                print(str(n) + " is greater than the number of nodes in list.")
                return

            while p and q.next:
                p = p.next
                q = q.next
            return p.data
```

```
    def rotate(self, k):
        if self.head and self.head.next:
            p = self.head
            q = self.head
            prev = None
            count = 0

            while p and count < k:
                prev = p
                p = p.next
                q = q.next
                count += 1
            p = prev
            while q:
                prev = q
                q = q.next
            q = prev

            q.next = self.head
            self.head = p.next
            p.next = None

    def count_occurences_iterative(self, data):
        count = 0
        cur = self.head
        while cur:
            if cur.data == data:
                count += 1
            cur = cur.next
        return count

    def count_occurences_recursive(self, node, data):
        if not node:
            return 0
        if node.data == data:
            return 1 + self.count_occurences_recursive(node.next, data)
        else:
            return self.count_occurences_recursive(node.next, data)

    def is_palindrome_1(self):
        # Solution 1:
        s = ""
        p = self.head
        while p:
            s += p.data
            p = p.next
        return s == s[::-1]

    def is_palindrome_2(self):
        # Solution 2:
        p = self.head
        s = []
        while p:
             s.append(p.data)
             p = p.next
        p = self.head
        while p:
            data = s.pop()
            if p.data != data:
                return False
            p = p.next
```

```
        return True

    def is_palindrome_3(self):
        if self.head:
            p = self.head
            q = self.head
            prev = []

            i = 0
            while q:
                prev.append(q)
                q = q.next
                i += 1
            q = prev[i-1]

            count = 1

            while count <= i//2 + 1:
                if prev[-count].data != p.data:
                    return False
                p = p.next
                count += 1
            return True
        else:
            return True

    def is_palindrome(self,method):
        if method == 1:
            return self.is_palindrome_1()
        elif method == 2:
            return self.is_palindrome_2()
        elif method == 3:
            return self.is_palindrome_3()

    def move_tail_to_head(self):
        if self.head and self.head.next:
            last = self.head
            second_to_last = None
            while last.next:
                second_to_last = last
                last = last.next
            last.next = self.head
            second_to_last.next = None
            self.head = last

    def sum_two_lists(self, llist):
        p = self.head
        q = llist.head

        sum_llist = LinkedList()

        carry = 0
        while p or q:
            if not p:
                i = 0
            else:
                i = p.data
            if not q:
                j = 0
            else:
                j = q.data
            s = i + j + carry
```

```
            if s >= 10:
                carry = 1
                remainder = s % 10
                sum_llist.append(remainder)
            else:
                carry = 0
                sum_llist.append(s)
            if p:
                p = p.next
            if q:
                q = q.next
        sum_llist.print_list()


# 3 6 5
#   4 2
# ------
#
llist1 = LinkedList()
llist1.append(5)
llist1.append(6)
llist1.append(3)

llist2 = LinkedList()
llist2.append(8)
llist2.append(4)
llist2.append(2)

print(365 + 248)
llist1.sum_two_lists(llist2)
```



I hope you were able to enjoy and understand this challenge. By now, you'll have a firm grasp on the problems concerning singly linked lists. In the next chapter, we are going to explore another type of linked list: Circular Linked List. See you there!