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

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
```

```
29    return sum_llist
30
```

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:
```

```
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
```

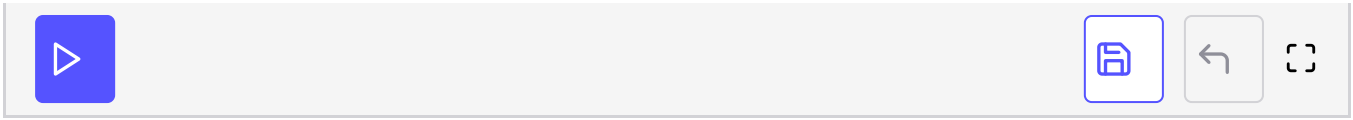
```
        curr_1.next, curr_2.next = curr_2.next, curr_1.next

    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!