Subject: Algorithm and Data Structure Assignment 3

Solve the assignment with following thing to be added in each question.

- -Program
- -Flow chart
- -Explanation
- -Output
- -Time and Space complexity

Submission Date: 3/10/2024

- 1. Implement a singly linked list with basic operations: insert, delete, search.
 - Test Case 1:

Input: Insert 3 \rightarrow Insert 7 \rightarrow Insert 5 \rightarrow Delete 7 \rightarrow Search 5

Output: List = [3, 5], Found = True

• Test Case 2:

Input: Insert $9 \rightarrow$ Insert $4 \rightarrow$ Delete $4 \rightarrow$ Search 10

Output: List = [9], Found = False

- 2. Reverse a singly linked list.
 - Test Case 1:

Input: List = [1, 2, 3, 4, 5]

Output: List = [5, 4, 3, 2, 1]

• Test Case 2:

Input: List = [10, 20, 30]

Output: List = [30, 20, 10]

- 3. Detect a cycle in a linked list.
 - Test Case 1:

Input: List = $[1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 3 \text{ (cycle)}]$

Output: Cycle Detected

Test Case 2:

Input: List = $[6 \rightarrow 7 \rightarrow 8 \rightarrow 9]$

Output: No Cycle

- 4. Merge two sorted linked lists.
 - Test Case 1:

Input: List1 = [1, 3, 5], List2 = [2, 4, 6]

Output: Merged List = [1, 2, 3, 4, 5, 6]

• Test Case 2:

Input: List1 = [10, 15, 20], List2 = [12, 18, 25]

Output: Merged List = [10, 12, 15, 18, 20, 25]

5. Find the nth node from the end of a linked list.

Test Case 1:

Input: List = [10, 20, 30, 40, 50], n = 2

Output: 40
• Test Case 2:

Input: List = [5, 15, 25, 35], n = 4

Output: 5

6. Remove duplicates from a sorted linked list.

• Test Case 1:

Input: List = [1, 1, 2, 3, 3, 4] Output: List = [1, 2, 3, 4]

• Test Case 2:

Input: List = [7, 7, 8, 9, 9, 10] Output: List = [7, 8, 9, 10]

7. Implement a doubly linked list with insert, delete, and traverse operations.

• Test Case 1:

Input: Insert $10 \rightarrow$ Insert $20 \rightarrow$ Insert $30 \rightarrow$ Delete 20

Output: List = [10, 30]

• Test Case 2:

Input: Insert $1 \rightarrow$ Insert $2 \rightarrow$ Insert $3 \rightarrow$ Delete 1

Output: List = [2, 3]

8. Reverse a doubly linked list.

• Test Case 1:

Input: List = [5, 10, 15, 20] Output: List = [20, 15, 10, 5]

• Test Case 2:

Input: List = [4, 8, 12] Output: List = [12, 8, 4]

9. Add two numbers represented by linked lists.

• Test Case 1:

Input: List1 = $[2 \rightarrow 4 \rightarrow 3]$, List2 = $[5 \rightarrow 6 \rightarrow 4]$ (243 + 465)

Output: Sum List = $[7 \rightarrow 0 \rightarrow 8]$

Test Case 2:

Input: List1 = $[9 \rightarrow 9 \rightarrow 9]$, List2 = [1] (999 + 1)

Output: Sum List = $[0 \rightarrow 0 \rightarrow 0 \rightarrow 1]$

10. Rotate a linked list by k places.

Test Case 1:

Input: List = [10, 20, 30, 40, 50], k = 2 Output: List = [30, 40, 50, 10, 20]

• Test Case 2:

Input: List = [5, 10, 15, 20], k = 3 Output: List = [20, 5, 10, 15]

11. Flatten a multilevel doubly linked list.

Test Case 1:

Input: List = $[1 \rightarrow 2 \rightarrow 3, 3 \rightarrow 7 \rightarrow 8, 8 \rightarrow 10 \rightarrow 12]$

Output: Flattened List = $[1 \rightarrow 2 \rightarrow 3 \rightarrow 7 \rightarrow 8 \rightarrow 10 \rightarrow 12]$

Test Case 2:

Input: List = $[1 \rightarrow 2 \rightarrow 3, 2 \rightarrow 5 \rightarrow 6, 6 \rightarrow 7 \rightarrow 9]$

Output: Flattened List = $[1 \rightarrow 2 \rightarrow 5 \rightarrow 6 \rightarrow 7 \rightarrow 9 \rightarrow 3]$

12. Split a circular linked list into two halves.

• Test Case 1:

Input: Circular List = $[1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 6 \rightarrow (back to 1)]$

Output: List1 = $[1 \rightarrow 2 \rightarrow 3]$, List2 = $[4 \rightarrow 5 \rightarrow 6]$

• Test Case 2:

Input: Circular List = $[10 \rightarrow 20 \rightarrow 30 \rightarrow 40 \rightarrow (back to 10)]$

Output: List1 = $[10 \rightarrow 20]$, List2 = $[30 \rightarrow 40]$

13. Insert a node in a sorted circular linked list.

• Test Case 1:

Input: Circular List = $[10 \rightarrow 20 \rightarrow 30 \rightarrow 40 \rightarrow (back to 10)]$, Insert 25

Output: Circular List = $[10 \rightarrow 20 \rightarrow 25 \rightarrow 30 \rightarrow 40 \rightarrow (back to 10)]$

• Test Case 2:

Input: Circular List = $[5 \rightarrow 15 \rightarrow 25 \rightarrow (back to 5)]$, Insert 10

Output: Circular List = $[5 \rightarrow 10 \rightarrow 15 \rightarrow 25 \rightarrow (back to 5)]$

14. Check if two linked lists intersect, and find the intersection point if they do.

• Test Case 1:

Input: List1 = $[1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5]$, List2 = $[6 \rightarrow 7 \rightarrow 4 \rightarrow 5]$

Output: Intersection Point = 4

• Test Case 2:

Input: List1 = $[10 \rightarrow 20 \rightarrow 30 \rightarrow 40]$, List2 = $[15 \rightarrow 25 \rightarrow 35]$

Output: No Intersection

15. Find the middle element of a linked list in one pass.

• Test Case 1:

Input: List = [1, 2, 3, 4, 5]

Output: Middle = 3

Test Case 2:

Input: List = [11, 22, 33, 44, 55, 66]

Output: Middle = 44