UCS 1312 Data Structures Lab
A3: Applications of types of linked lists - CLL, DLL, CDLL

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Best Practices to be adapted

Modular design and coding using versions
Verification of algorithm using Hand-trace
Test case design
Avoiding global variables

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Write algorithms for all the operations and applications in question 1 and 2 and trace them with an example. Inspect the steps using the diagrammatic representation of the list.

1. Create an ADT for a Circular linked list (CLL) of integers where CLL is a pointer to the last node. (CO1, K3)

a) Add the following operations:
   insertFirst(CLL, item), insertLast(CLL, item), deleteFirst(CLL), deleteLast(CLL)
b) Write an application for the following that uses CLL
   I. *rotate(CLL,direction, count)* that rotates the integers in the list by left or right (direction is -1 for left; +1 for right) by *count* number of positions.
   II. display(CLL) that displays the integers in the CLL
c) Demonstrate the CLL operations and applications with suitable test cases

2. Create an ADT for a doubly linked list (DLL) of integers where DLL is a pointer to the first node of the DLL. (CO1, K3)

a) Add the following operations:
   insertFirst(DLL, item), insertLast(DLL, item), deleteFirst(DLL), deleteLast(DLL)
b) Write an application for the following that uses DLL
   I. display(DLL) that displays the integers in the DLL
   II. shift(DLL, direction, count) that rotates the integers in the list by left or right (direction is -1 for left; +1 for right) by *count* number of positions.
   III. Demonstrate the DLL operations and applications with suitable test cases

3. The Josephus Problem (CO1,K5)

A group of soldiers are surrounded by an overwhelming enemy force. There is no hope for victory without reinforcement, but there is a single horse available for escape. The soldiers agree to a pact to determine which one of them is to escape and summon help. They stand in a circle and each one chooses a positive integer. One of their names and a positive integer ‘n’ are chosen. Starting with the person whose name is chosen; they count around the circle clockwise and eliminate the nth person. The positive integer which that person chose is then used to continue the count, but this time in the anticlockwise direction. Each time that a person is eliminated, the number the person chosen is used to determine the next person to be eliminated and the direction of traversal is opposite to that of the previous one. i.e. the counting alternates between clockwise and anticlockwise direction

For example, suppose that the 5 soldiers are A, B, C, D, and E. They chose integers 4,5,6,7, and 8 respectively. The name C and integer 2 are initially chosen. Then the order in which the soldiers are eliminated from the circle is D, A, B, and E leaving C as the last one and C will be signaled to escape.

What to deliver?

1. Write an algorithm for the above problem and implement the algorithm in C. Decide a suitable data structure. Trace the algorithm diagrammatically.
2. Write the ADT for your data structure with suitable operations in a header file.
3. Implement the application separately, making use of the ADT.
4. Write more test cases and test your program.
5. Design a user-friendly interface

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