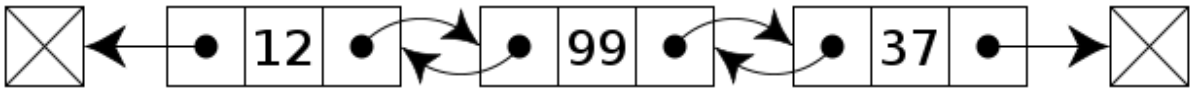
Double Link List

In computer science, a **doubly-linked list** is a linked data structure that consists of a set of sequentially linked records called nodes. Each node contains two fields, called *links*, that are references to the previous and to the next node in the sequence of nodes. The beginning and ending nodes' **previous** and **next** links, respectively, point to some kind of terminator, typically a sentinel node or null, to facilitate traversal of the list. If there is only one sentinel node, then the list is circularly linked via the sentinel node. It can be conceptualized as two singly linked lists formed from the same data items, but in opposite sequential orders.



The two node links allow traversal of the list in either direction. While adding or removing a node in a doubly-linked list requires changing more links than the same operations on a singly linked list, the operations are simpler and potentially more efficient (for nodes other than first nodes) because there is no need to keep track of the previous node during traversal or no need to traverse the list to find the previous node, so that its link can be modified.

CODES(C)

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node
{
    struct node *previous;
    int data;
    struct node *next;
}*head, *last;

void insert_begning(int value)
{
   struct node *var,*temp;
    var=(struct node *)malloc(sizeof(struct node));
    var->data=value;
    if(head==NULL)
    {
       head=var;
       head->previous=NULL;
       head->next=NULL;
       last=head;
    }
    else
    {
       temp=var;
       temp->previous=NULL;
       temp->next=head;
       head->previous=temp;
       head=temp;
    }
}

void insert_end(int value)
{
    struct node *var,*temp;
    var=(struct node *)malloc(sizeof(struct node));
          var->data=value;
    if(head==NULL)
    {
        head=var;
```

```
        head->previous=NULL;
        head->next=NULL;
        last=head;
    }
    else
    {
       last=head;
       while(last!=NULL)
       {
          temp=last;
          last=last->next;
       }
    last=var;
    temp->next=last;
    last->previous=temp;
    last->next=NULL;
    }
}

int insert_after(int value, int loc)
{
    struct node *temp,*var,*temp1;
    var=(struct node *)malloc(sizeof(struct node));
    var->data=value;
       if(head==NULL)
    {
         head=var;
         head->previous=NULL;
         head->next=NULL;
    }
    else
    {
         temp=head;
         while(temp!=NULL && temp->data!=loc)
         {
              temp=temp->next;
         }
         if(temp==NULL)
         {
             printf("\n%d is not present in list ",loc);
         }
         else
         {
```

```
            temp1=temp->next;
            temp->next=var;
            var->previous=temp;
           var->next=temp1;
            temp1->previous=var;
            }
      }
      last=head;
      while(last->next!=NULL)
      {
            last=last->next;
      }
}
int delete_from_end()
{
      struct node *temp;
      temp=last;
      if(temp->previous==NULL)
      {
            free(temp);
            head=NULL;
            last=NULL;
            return 0;
      }
      printf("\nData deleted from list is %d \n",last->data);
      last=temp->previous;
      last->next=NULL;
      free(temp);
      return 0;
}

int delete_from_middle(int value)
{
    struct node *temp,*var,*t, *temp1;
    temp=head;
    while(temp!=NULL)
    {
        if(temp->data == value)
        {
            if(temp->previous==NULL)
            {
                free(temp);
                head=NULL;
```

```
            last=NULL;
            return 0;
        }
        else
        {
            var->next=temp1;
            temp1->previous=var;
            free(temp);
            return 0;
        }
    }
    else
    {
        var=temp;
        temp=temp->next;
        temp1=temp->next;
    }
  }
  printf("data deleted from list is %d",value);
}

void display()
{
   struct node *temp;
   temp=head;
   if(temp==NULL)
    {
      printf("List is Empty");
    }
   while(temp!=NULL)
   {
       printf("-> %d ",temp->data);
       temp=temp->next;
   }
}

int main()
{
  int value, i, loc;
  head=NULL;
  printf("Select the choice of operation on link list");
  printf("\n1.) insert at begning\n2.) insert at at\n3.) insert at middle");
  printf("\n4.) delete from end\n5.) reverse the link list\n6.) display list\n7.)exit");
```

```
while(1)
{
    printf("\n\nenter the choice of operation you want to do ");
    scanf("%d",&i);
    switch(i)
    {
        case 1:
        {
         printf("enter the value you want to insert in node ");
         scanf("%d",&value);
         insert_begning(value);
         display();
         break;
         }
         case 2:
         {
         printf("enter the value you want to insert in node at last ");
         scanf("%d",&value);
         insert_end(value);
         display();
         break;
         }
         case 3:
         {
         printf("after which data you want to insert data ");
         scanf("%d",&loc);
         printf("enter the data you want to insert in list ");
         scanf("%d",&value);
         insert_after(value,loc);
         display();
         break;
         }
         case 4:
         {
         delete_from_end();
         display();
         break;
         }
         case 5:
         {
         printf("enter the value you want to delete");
         scanf("%d",value);
         delete_from_middle(value);
```

```
                display();
                break;
                }
                case 6 :
                {
                display();
                break;
                }
                case 7 :
                {
                    exit(0);
                    break;
                }
            }
    }
    printf("\n\n%d",last->data);
    display();
    getch();
}
```

CODES(JAVA)

```
import java.util.Scanner;
```

```
/*  Class Node  */
class Node
{
    protected int data;
    protected Node next, prev;

    /* Constructor */
    public Node()
    {
        next = null;
        prev = null;
        data = 0;
    }
    /* Constructor */
    public Node(int d, Node n, Node p)
    {
        data = d;
        next = n;
        prev = p;
    }
    /* Function to set link to next node */
    public void setLinkNext(Node n)
    {
        next = n;
    }
    /* Function to set link to previous node */
    public void setLinkPrev(Node p)
    {
        prev = p;
    }
```

```
    /* Funtion to get link to next node */
    public Node getLinkNext()
    {
        return next;
    }
    /* Function to get link to previous node */
    public Node getLinkPrev()
    {
        return prev;
    }
    /* Function to set data to node */
    public void setData(int d)
    {
        data = d;
    }
    /* Function to get data from node */
    public int getData()
    {
        return data;
    }
}

/* Class linkedList */
class linkedList
{
    protected Node start;
    protected Node end ;
    public int size;

    /* Constructor */
```

```
public linkedList()
{
    start = null;
    end = null;
    size = 0;
}
/* Function to check if list is empty */
public boolean isEmpty()
{
    return start == null;
}
/* Function to get size of list */
public int getSize()
{
    return size;
}
/* Function to insert element at begining */
public void insertAtStart(int val)
{
    Node nptr = new Node(val, null, null);
    if(start == null)
    {
        start = nptr;
        end = start;
    }
    else
    {
        start.setLinkPrev(nptr);
        nptr.setLinkNext(start);
        start = nptr;
```

```
    }
    size++;
}
/* Function to insert element at end */
public void insertAtEnd(int val)
{
    Node nptr = new Node(val, null, null);
    if(start == null)
    {
        start = nptr;
        end = start;
    }
    else
    {
        nptr.setLinkPrev(end);
        end.setLinkNext(nptr);
        end = nptr;
    }
    size++;
}
/* Function to insert element at position */
public void insertAtPos(int val , int pos)
{
    Node nptr = new Node(val, null, null);
    if (pos == 1)
    {
        insertAtStart(val);
        return;
    }
    Node ptr = start;
```

```
    for (int i = 2; i <= size; i++)
    {
        if (i == pos)
        {
            Node tmp = ptr.getLinkNext();
            ptr.setLinkNext(nptr);
            nptr.setLinkPrev(ptr);
            nptr.setLinkNext(tmp);
            tmp.setLinkPrev(nptr);
        }
        ptr = ptr.getLinkNext();
    }
    size++ ;
}
/* Function to delete node at position */
public void deleteAtPos(int pos)
{
    if (pos == 1)
    {
        if (size == 1)
        {
            start = null;
            end = null;
            size = 0;
            return;
        }
        start = start.getLinkNext();
        start.setLinkPrev(null);
        size--;
        return ;
```

```
    }
    if (pos == size)
    {
        end = end.getLinkPrev();
        end.setLinkNext(null);
        size-- ;
    }
    Node ptr = start.getLinkNext();
    for (int i = 2; i <= size; i++)
    {
        if (i == pos)
        {
            Node p = ptr.getLinkPrev();
            Node n = ptr.getLinkNext();

            p.setLinkNext(n);
            n.setLinkPrev(p);
            size-- ;
            return;
        }
        ptr = ptr.getLinkNext();
    }
}
/* Function to display status of list */
public void display()
{
    System.out.print("\nDoubly Linked List = ");
    if (size == 0)
    {
        System.out.print("empty\n");
```

```
            return;
        }
        if (start.getLinkNext() == null)
        {
            System.out.println(start.getData() );
            return;
        }
        Node ptr = start;
        System.out.print(start.getData()+ " <-> ");
        ptr = start.getLinkNext();
        while (ptr.getLinkNext() != null)
        {
            System.out.print(ptr.getData()+ " <-> ");
            ptr = ptr.getLinkNext();
        }
        System.out.print(ptr.getData()+ "\n");
    }
}

/* Class DoublyLinkedList */
public class DoublyLinkedList
{
    public static void main(String[] args)
    {
        Scanner scan = new Scanner(System.in);
        /* Creating object of linkedList */
        linkedList list = new linkedList();
        System.out.println("Doubly Linked List Test\n");
        char ch;
        /*  Perform list operations  */
```

```
do
{
    System.out.println("\nDoubly Linked List Operations\n");
    System.out.println("1. insert at begining");
    System.out.println("2. insert at end");
    System.out.println("3. insert at position");
    System.out.println("4. delete at position");
    System.out.println("5. check empty");
    System.out.println("6. get size");

    int choice = scan.nextInt();
    switch (choice)
    {
    case 1 :
        System.out.println("Enter integer element to insert");
        list.insertAtStart( scan.nextInt() );
        break;
    case 2 :
        System.out.println("Enter integer element to insert");
        list.insertAtEnd( scan.nextInt() );
        break;
    case 3 :
        System.out.println("Enter integer element to insert");
        int num = scan.nextInt() ;
        System.out.println("Enter position");
        int pos = scan.nextInt() ;
        if (pos < 1 || pos > list.getSize() )
            System.out.println("Invalid position\n");
        else
            list.insertAtPos(num, pos);
```

```
            break;
        case 4 :
            System.out.println("Enter position");
            int p = scan.nextInt() ;
            if (p < 1 || p > list.getSize() )
                System.out.println("Invalid position\n");
            else
                list.deleteAtPos(p);
            break;
        case 5 :
            System.out.println("Empty status = "+ list.isEmpty());
            break;
        case 6 :
            System.out.println("Size = "+ list.getSize() +" \n");
            break;
        default :
            System.out.println("Wrong Entry \n ");
            break;
        }
        /*  Display List  */
        list.display();
        System.out.println("\nDo you want to continue (Type y or n) \n");
        ch = scan.next().charAt(0);

      } while (ch == 'Y'|| ch == 'y');
   }
}
```