DATA STRUCTURES

Doubly Linked List / Two-Way Linked List

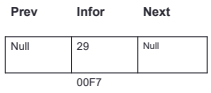
By
Zainab Malik

Content

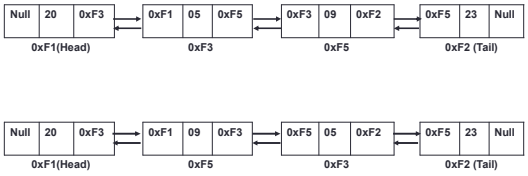
- Introduction to Doubly Linked List (DLL)
  - Properties of DLL
  - Operations of DLL
  - Advantages/Disadvantages of DLL
  - Applications of DLL

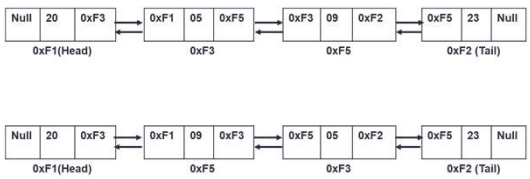
Doubly Linked List (DLL)

- In a doubly linked list, also called two-way list, each node is divided into three parts:
  - The first part, called previous pointer, contains the address of the preceding element in the list
  - The second part contains the information of the element.
  - The third part, called next pointer, contains the address of the succeeding element in the list



Doubly Linked List





Operations on Doubly Linked List (DLL)

- Traversing
- Searching
- Insertion
  - AddToHead
  - AddToTail
  - AddAfterGivenElement
  - AddBeforeGivenElement
- Removal
  - RemoveFromHead
  - RemoveFromTail
  - RemoveGivenItem

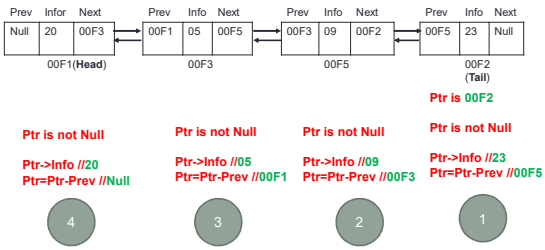
7

Traversing & Searching in DLL

- Traversing and searching procedure is exactly same as in SLL
- However, we can traverse in reverse direction too i.e. from tail to head
  - ReverseTraversal()
    - Case1: list is empty
      - Display message "No element to traverse"
    - Case 2:
      1. Set ptr at tail
      2. Repeat steps 3-4 while (ptr!=0)
      3. Print Info of current ptr
      4. Move ptr to its previpus node (ptr=ptr->prev)
      5. Exit

8

reverseTraversing(list)



9

Insertion in Doubly Linklist

- AddToHead
- AddToTail (Your Task)
- AddAfterGivenElement
- AddBeforeGivenElement (Your Task)

10

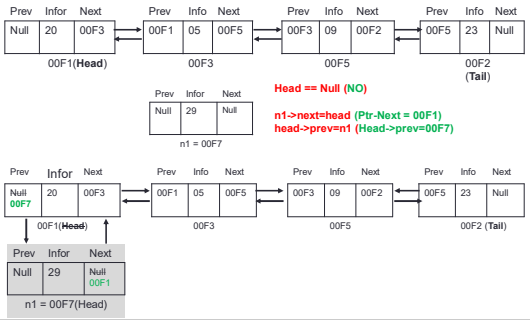
Insertion-AddtoHead(list, element)

1. Set n1=address of newly constructed Node
2. Set n1->prev=Null
3. Set n1->info=element
4. Set n1->next=Null
5. If (head=Null) then
6. Set head=tail=n1
7. else
8. Set n1->next=head
9. Set head->prev=n1
10. set Head=n1
11. Endif
12. Exit

11

addToHead(list,element)

element=29



12

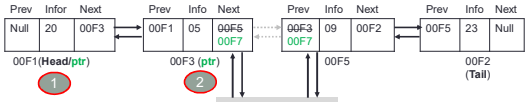
Insertion-AddAfter (list,existing, element)

- Case1:List is Empty
  - Display message ("there is no existing element in the list")
- Case 2:List is not empty and the exiting is found at tail
  - Call addToTail function
- Case 3:List is not empty and existing can be somewhere after head
  1. Create a new node as n1
  2. Set ptr=head
  3. Repeat step 4 While (ptr->info != existing && ptr!=null)
  4. Ptr=ptr->next
  5. If(ptr->info == existing)
  6. Set n1->next=ptr->next
  7. Set n1->prev=ptr
  8. Set ptr->next=n1
  9. Set n1->next->prev=n1
  10. Else
  11. Display message ("existing not found")

13

Insertion-AddAfter (list,existing, element)

existing=05 and element=29 (illustrating case 3 only)



1. Create a new node as n1
2. Set ptr=head
3. Repeat step 4 While (ptr->info != existing && ptr!=null)
4. Ptr=ptr->next
5. If(ptr->info == existing)
6. Set n1->next=ptr->next //00F5
7. Set n1->prev=ptr //00F3
8. Set ptr->next=n1// 00F7
9. Set n1->next->prev=n1//00F7

14

Deletion in Doubly Linklist

- RemoveFromHead
- RemoveFromTail (Your Task)
- RemoveGivenItem

15

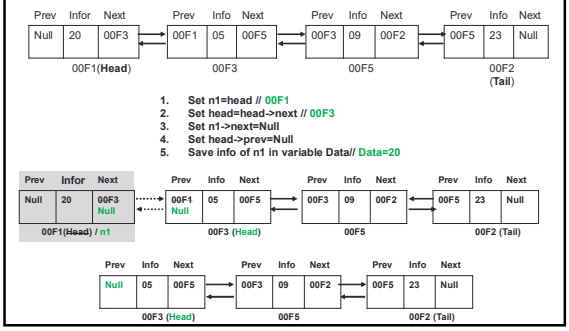
Deletion-removeFromHead(list)

1. Case 1: List is empty
2. Display message “Nothing to delete”
3. Case 2: List is not empty
4. Set n1=head
5. Set head=head->next //head=n1->next
6. Set n1->next=Null
7. Set head->prev=Null
8. Save info of n1 in variable Data
9. Delete n1
10. return Data
11. Exit

16

removeFromHead(list,element)

(illustrating Case 2 only)



17

Deletion-RemoveGivenItem(list, item)

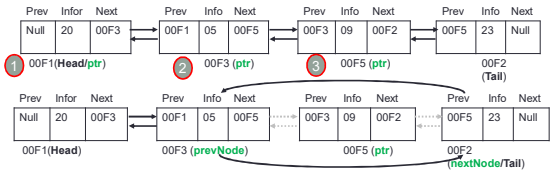
- Case 1:List is Empty
  - Display message (“there is no existing element in the list to remove”)
- Case 2: Element found at head
  - Call removeFromHead
- Case 3: Element found at tail
  - Call removeFromTail
- Case 4: Element may be Somewhere in between

1. Set ptr=head
2. Repeat step 3 while (ptr->next!=Null && ptr->info!= item)
3. Ptr=ptr->next
4. If (ptr->info=item)
5. Set nextNode=ptr->next
6. Set prevNode=ptr->prev
7. prevNode->next=nextNode
8. nextNode->prev=prevNode
9. Set ptr->prev=Null
10. Set ptr->next=Null
11. Delete ptr

18

Deletion-RemoveGivenItem(list, item)

(item= 09 illustrating Case 3 only)



1. Set ptr=head
2. Repeat step 3 while (ptr->next !=Null && ptr->info != item)
3. Ptr=ptr->next
4. If (ptr->info=item)
5. Set nextNode=ptr->next //00F2
6. Set prevNode=ptr->prev // 00F3
7. prevNode->next=nextNode // 00F2
8. nextNode->prev=prevNode //00F3
9. Set ptr->prev=Null
10. Set ptr->next=Null
11. Delete ptr // delete 00F5

19

Advantages of Singular LinkedList

- **ADVANTAGE :-**

1. We can traverse in both direction i.e. from starting to end & as well as from end to starting.
2. It is easy to reverse the linked list.
3. If we are at a node, then we can go at any node. But in linked list, it is not possible to reach the previous node.

20

Disadvantages of Singular LinkedList

DISADVANTAGE :-

- It requires more space per space per node because extra field is required for pointer to previous node.
- Insertion and Deletion take more time than linear linked list because more pointer operations are required than linear linked list.

21

Applications

- Image viewer – Previous and next images are linked, hence can be accessed by next and previous button.
- Previous and next page in web browser – We can access previous and next url searched in web browser by pressing back and next button since, they are linked as linked list.
- Music Player – Songs in music player are linked to previous and next song. you can play songs either from starting or ending of the list.

22

Thank You