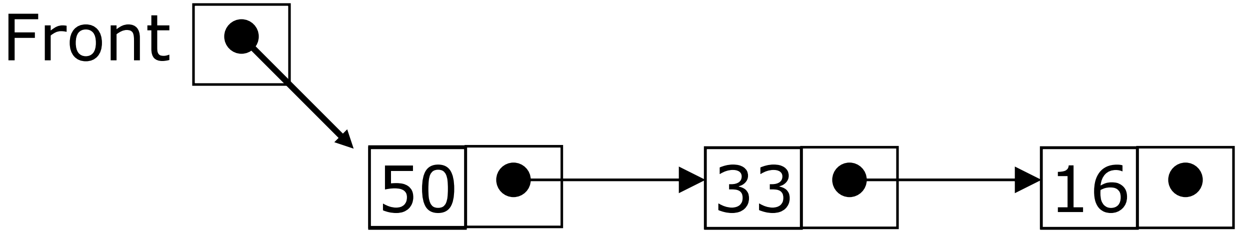
LINKED LISTS

Recap

- Creating a node of the linked list
- Adding the first node of the list
- Insertion – front, end
- Deletion – front, end
- Linked list traversal
    - Insertion at a specific place
    - Deletion of a specific node
    - Counting the nodes
    - Printing the list
- Recursion and Linked lists

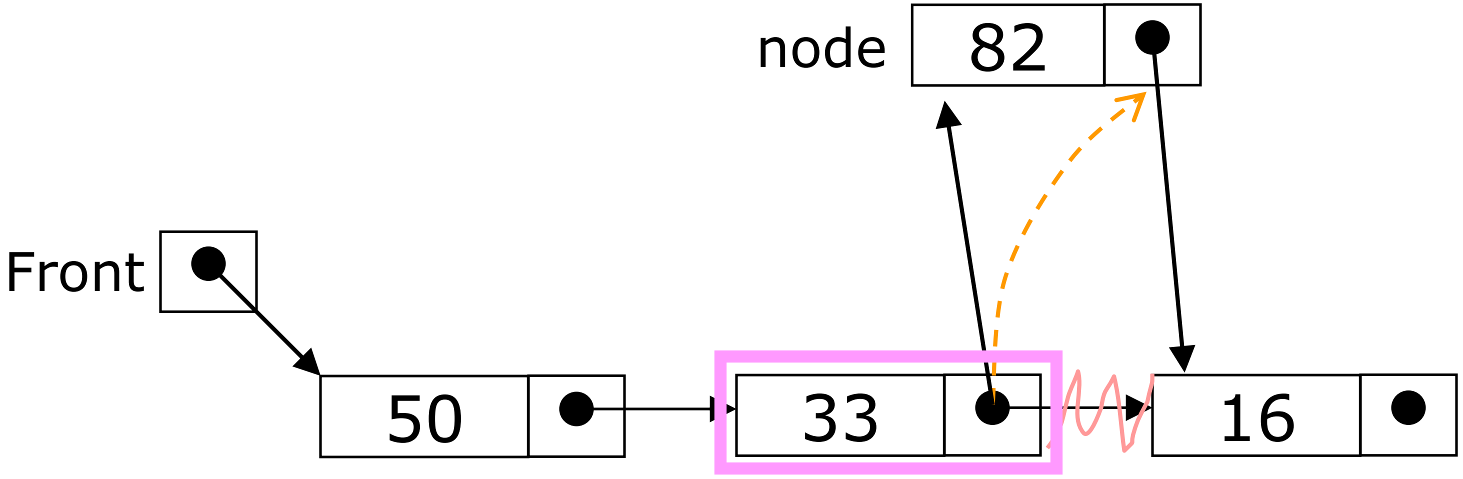
Inserting a node at a specific position in the List

- Assume node 50 is at position 1. Suppose we wanted to insert a node containing value 82 at position 3, that means after node containing 33.
- This would involve breaking the list and setting two links to new values.



- First form a new node with value 82 (and pointing to null).
- Reach position 2. Get link of 33 and use it to set link of 82, so that 82 and 16 get linked. Next set link of 33 to address of new node 82.

Inserting after (animation)



Find the node you want to insert after

First, copy the link from the node that's already in the list

Then, change the link in the node that's already in the list

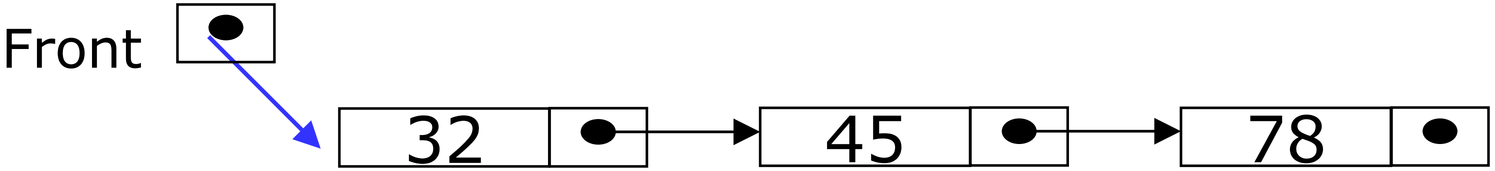
Inserting a node at a specific position in the List

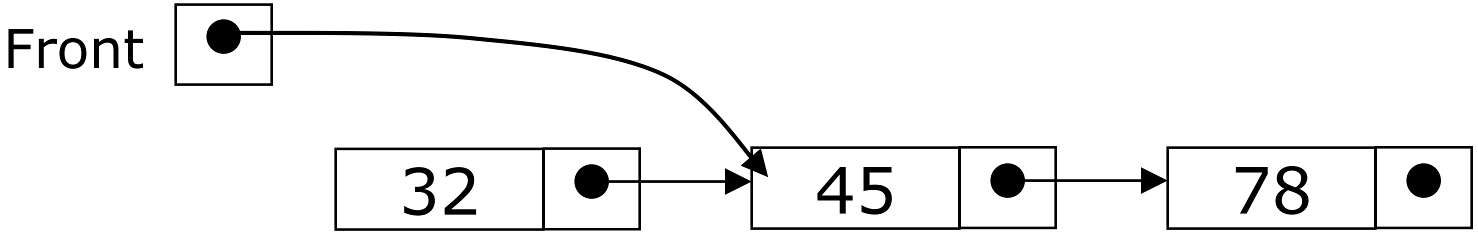
- Position of first node is assumed 1.
-
```
public void insertAtPos(int val , int pos)        {
        Node nptr = new Node(val, null);
        Node ptr = front;
        pos = pos - 1 ;
        for (int i = 1; i < size; i++)                {
            if (i == pos)                    {
                Node tmp = ptr.getLink() ;
                ptr.setLink(nptr);
                nptr.setLink(tmp);
                break;
            }
            ptr = ptr.getLink();
        }
```

Deletion in Linked Lists

Deleting the first node

- To delete the first element, change the link in the header



- 

```
Node ptr = Front.getLink();
 Front = ptr;
```

Deleting the last node

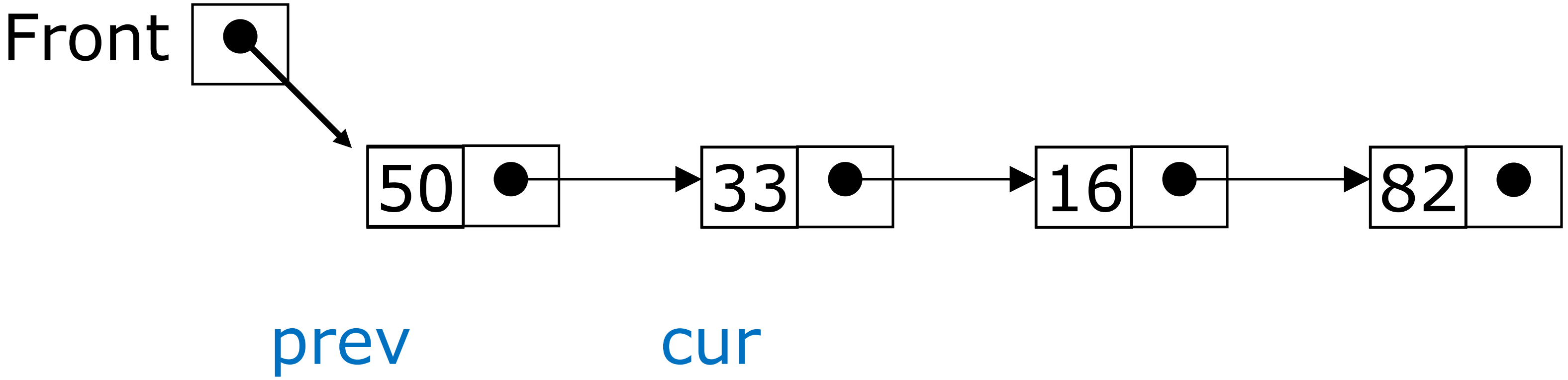
- Set pointer prev (previous node) to first node of the list.
- Set pointer cur (current node) to second node of the list.
- Traverse the list till cur reaches the last node
- set link for prev to null, so that last node is not reachable.

```
Node prev = Front;
Node cur = Front.getLink();
while ( cur.getLink() != null) {
     prev = cur;
     cur = cur.getLink();
 }
 prev.setLink(null);
```

Add code to handle single node in the list.

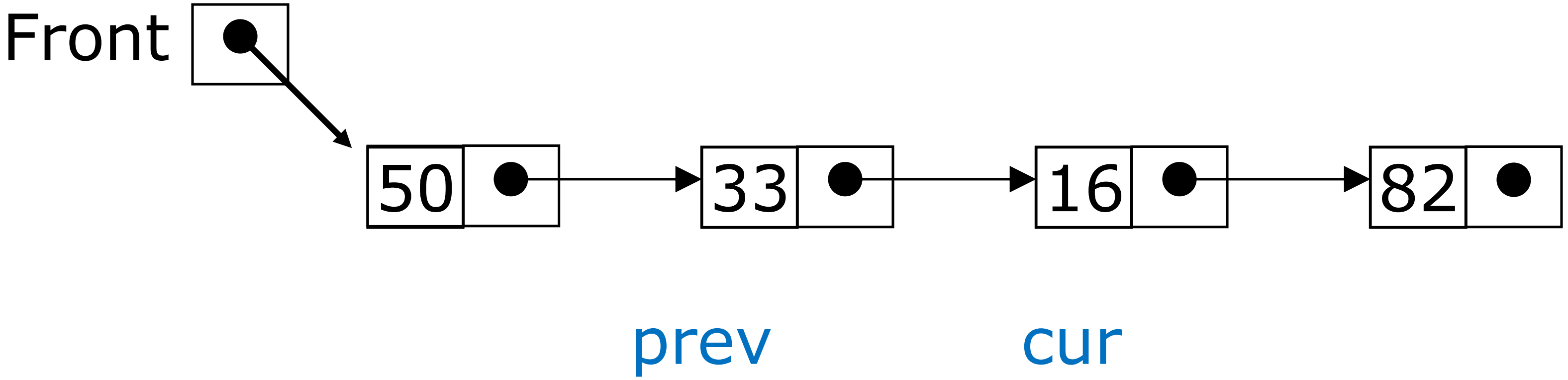
Traversing list with 2 pointers

- :



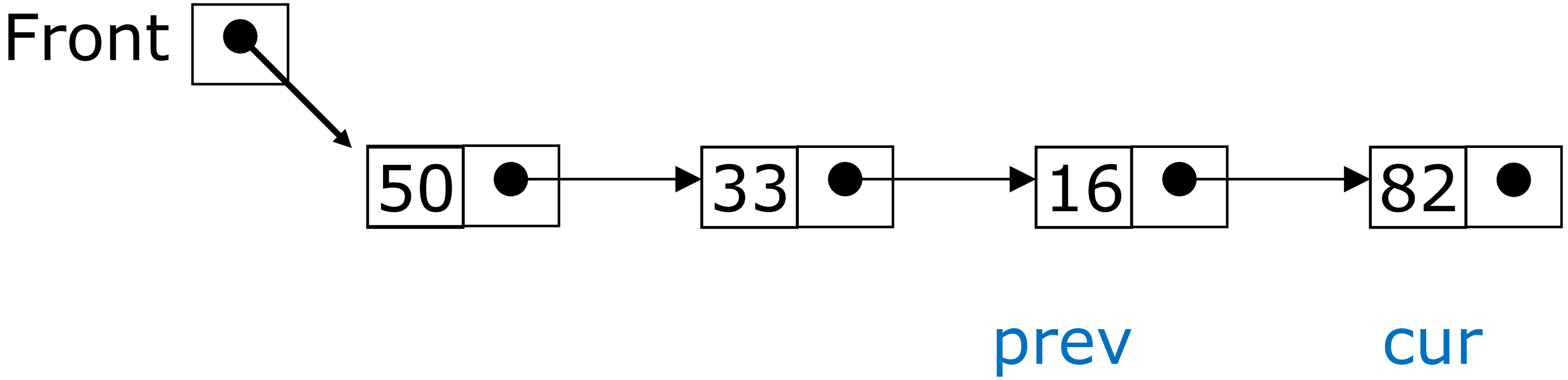
Traversing list with 2 pointers

- :



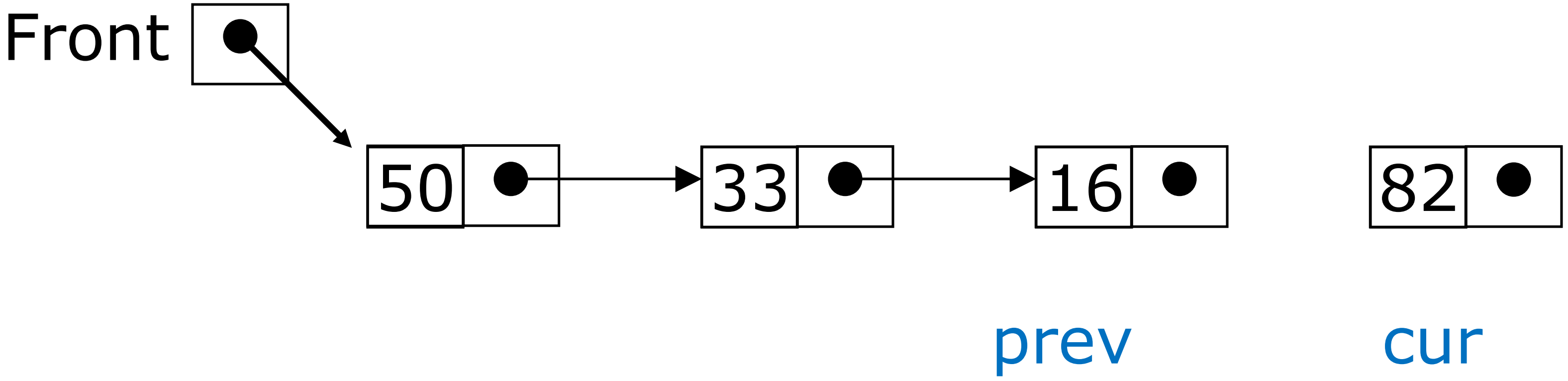
Traversing list with 2 pointers

- now cur points to last node and prev points to last but one node



Traversing list with 2 pointers

- set link of last but one node to null, so that the last node is not reachable (gets deleted)



Deleting a node containing data d

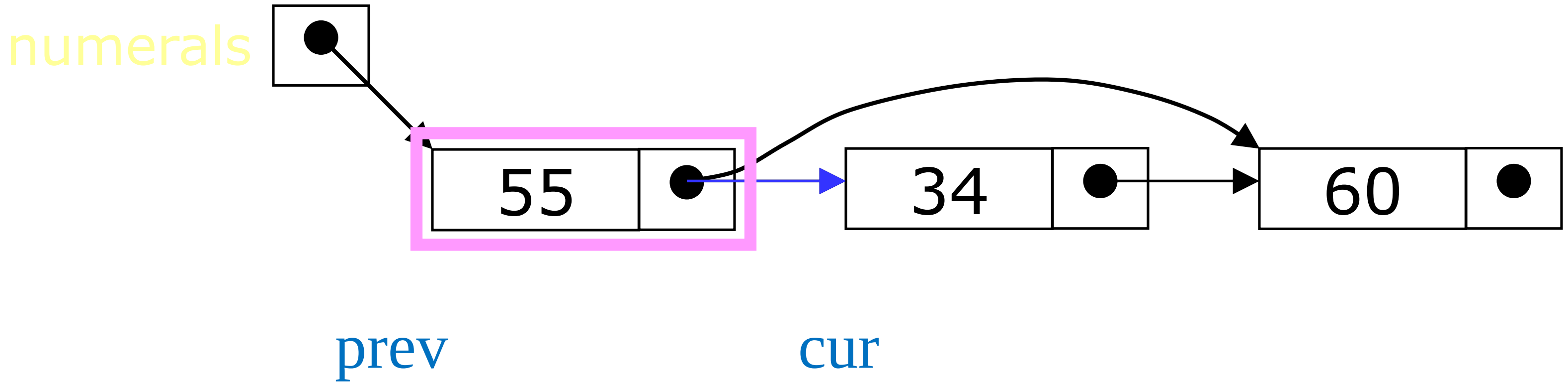
- Set pointer prev (previous node) to first node of the list.
- Set pointer cur (current node) to second node of the list.
- Traverse the list till cur reaches the node to be deleted.
- Set link for prev to next node of cur so that current node is not reachable.

```
if (Front.getData == d) Front = Front.getLink();
else {
    Node prev = Front;
    Node cur = Front.getLink();
    while ( cur.getData() != d) {
            prev = cur;
        cur = cur.getLink();
    }
    prev.setLink(cur.getLink());
 }
```

Deleting a specific element

```
prev.setLink(cur.getLink());
```

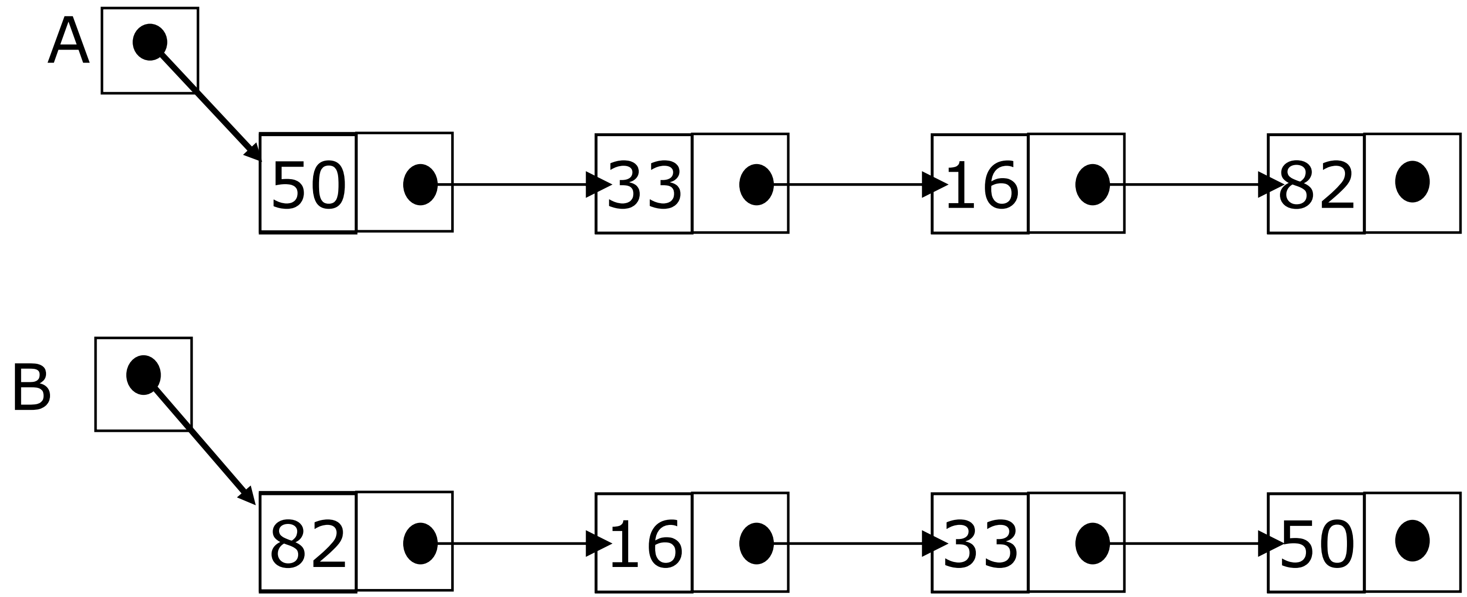
- To delete a node, change the link in its previous node



Reversing a Linked List

Creating another list with reversed contents

- Read contents from list A, and add them to front of list B.



Create a list B which is reverse of list A

```
ptr = A;
B = null;
while (ptr  != null)
{
    int d = ptr.getData();
    Node nptr = new Node ( d, null);
    nptr.setLink(B);
    B = nptr;
    ptr = ptr.getLink();
 }
```

Reverse a Linked list in place

- You need to use 3 pointers: prev, cur, next
- Start with pointing cur to first node, and prev = null.
- Traverse the list in a while loop
  1. Set next to cur.link
  2. Set cur link to address of prev node
  3. Set prev to cur
  4. Set cur to next
- When loop is over, return prev node

Code for List Reversal

```
public static ReverseList (Node cur){
    Node prev = null;
    Node next = null;
    while (cur != null) {
        next = cur.getLink();
        cur.setLink(prev);
        prev = cur;
        cur = next;
    }
    return prev;
}
```

Recursive Function to Reverse a Linked List

- The base case is the empty list, or having a single node , when the Front (head) can be returned. The continuation case calls the function with node next to the head.

```
public static Node Reverse (Node head); {
    if (head == null || head.getLink == null)
          return head;
    Node next = head.getLink;
    head.getLink = null;
    Node rest = Reverse(next);
    next.setLink(head);
    return rest;
}
```

Exercises

- Create a list with each node containing name of student and his CGPA.
- Given the above list, find the name of the student having the highest CGPA.
- Given a list, create two lists with alternate elements of first list.
- Append a list at end of another list.
- Check if two lists are identical
- Given two lists, create a new lists taking corresponding elements from the two lists.