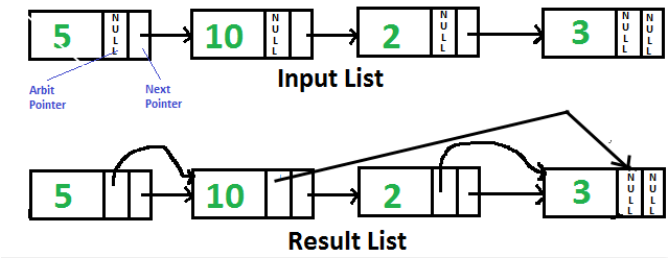
Point arbit pointer to greatest value right side node in a linked list

Given singly linked list with every node having an additional "arbitrary" pointer that currently points to NULL. We need to make the "arbitrary" pointer to greatest value node in a linked list on its right side.



We strongly recommend to minimize your browser and try this yourself first

A **Simple Solution** is to traverse all nodes one by one. For every node, find the node which has greatest value on right side and change the next pointer. Time Complexity of this solution is $O(n^2)$.

An **Efficient Solution** can work in O(n) time. Below are steps.

1. Reverse given linked list.
2. Start traversing linked list and store maximum value node encountered so far. Make arbit of every node to point to max. If the data in current node is more than max node so far, update max.
3. Reverse modified linked list and return head.

Following is C++ implementation of above steps.

```
// C++ program to point arbit pointers to highest
// value on its right
#include<bits/stdc++.h>
using namespace std;

/* Link list node */
struct Node
{
    int data;
    Node* next, *arbit;
};

/* Function to reverse the linked list */
Node* reverse(Node *head)
{
    Node *prev = NULL, *current = head, *next;
    while (current != NULL)
    {
        next  = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    return prev;
}

// This function populates arbit pointer in every
// node to the greatest value to its right.
Node* populateArbit(Node *head)
{
    // Reverse given linked list
    head = reverse(head);

    // Initialize pointer to maximum value node
    Node *max = head;
```

```
    // Traverse the reversed list
    Node *temp = head->next;
    while (temp != NULL)
    {
        // Connect max through arbit pointer
        temp->arbit = max;

        // Update max if required
        if (max->data < temp->data)
            max = temp;

        // Move ahead in reversed list
        temp = temp->next;
    }

    // Reverse modified linked list and return
    // head.
    return reverse(head);
}

// Utility function to print result linked list
void printNextArbitPointers(Node *node)
{
    printf("Node\tNext Pointer\tArbit Pointer\n");
    while (node!=NULL)
    {
        cout << node->data << "\t\t";

        if (node->next)
            cout << node->next->data << "\t\t";
        else cout << "NULL" << "\t\t";

        if (node->arbit)
            cout << node->arbit->data;
        else cout << "NULL";

        cout << endl;
        node = node->next;
    }
}

/* Function to create a new node with given data */
Node *newNode(int data)
{
    Node *new_node = new Node;
    new_node->data = data;
    new_node->next = NULL;
    return new_node;
}

/* Driver program to test above functions*/
int main()
{
    Node *head = newNode(5);
    head->next = newNode(10);
    head->next->next = newNode(2);
    head->next->next->next = newNode(3);

    head = populateArbit(head);

    printf("Resultant Linked List is: \n");
    printNextArbitPointers(head);

    return 0;
}
```

Output:

```
Resultant Linked List is:
Node    Next Pointer    Arbit Pointer
5               10              10
10              2               3
2               3               3
3               NULL            NULL
```

Recursive Solution:

We can recursively reach the last node and traverse the linked list from end. Recursive solution doesn't require reversing of linked list. We can also use a stack in place of recursion to temporarily hold nodes. Thanks to Santosh Kumar Mishra for providing this solution.

```
// C++ program to point arbit pointers to highest
// value on its right
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using namespace std;

/* Link list node */
struct Node
{
    int data;
    Node* next, *arbit;
};

// This function populates arbit pointer in every
// node to the greatest value to its right.
void populateArbit(Node *head)
{
    // using static maxNode to keep track of maximum
    // orbit node address on right side
    static Node *maxNode;

    // if head is null simply return the list
    if (head == NULL)
        return;

    /* if head->next is null it means we reached at
       the last node just update the max and maxNode */
    if (head->next == NULL)
    {
        maxNode = head;
        return;
    }

    /* Calling the populateArbit to the next node */
    populateArbit(head->next);

    /* updating the arbit node of the current
     node with the maximum value on the right side */
    head->arbit = maxNode;

    /* if current Node value id greater then
     the previous right node then  update it */
    if (head->data > maxNode->data)
        maxNode = head;

   return;
}

// Utility function to print result linked list
void printNextArbitPointers(Node *node)
{
    printf("Node\tNext Pointer\tArbit Pointer\n");
    while (node!=NULL)
    {
        cout << node->data << "\t\t";

        if(node->next)
            cout << node->next->data << "\t\t";
        else cout << "NULL" << "\t\t";
```

```
        if(node->arbit)
            cout << node->arbit->data;
        else cout << "NULL";

        cout << endl;
        node = node->next;
    }
}

/* Function to create a new node with given data */
Node *newNode(int data)
{
    Node *new_node = new Node;
    new_node->data = data;
    new_node->next = NULL;
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/* Driver program to test above functions*/
int main()
{
    Node *head = newNode(5);
    head->next = newNode(10);
    head->next->next = newNode(2);
    head->next->next->next = newNode(3);

    populateArbit(head);

    printf("Resultant Linked List is: \n");
    printNextArbitPointers(head);

    return 0;
}
```

Output:

```
Resultant Linked List is:
Node    Next Pointer    Arbit Pointer
5               10              10
10              2               3
2               3               3
3               NULL            NULL
```