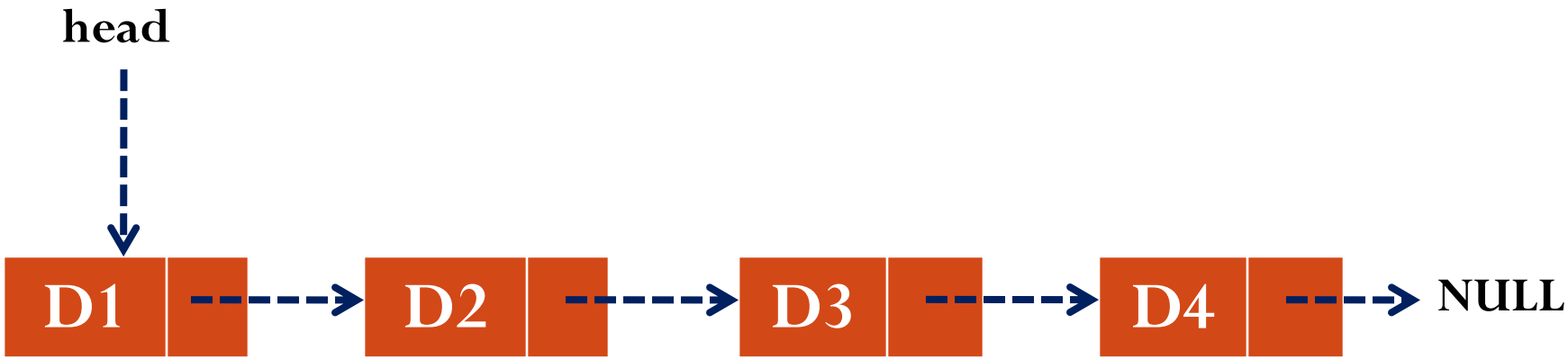
Data Structures – CST 201
Module - 3

Syllabus

- **Linked List and Memory Management**
  - Self Referential Structures
  - Dynamic Memory Allocation
  - **Singly Linked List-Operations on Linked List.**
  - Doubly Linked List
  - Circular Linked List
  - Stacks using Linked List
  - Queues using Linked List
  - Polynomial representation using Linked List
  - Memory allocation and de-allocation
    - First-fit, Best-fit and Worst-fit allocation schemes

Singly Linked List

- Each node contains only one link which points the subsequent node in the list



Node Creation

Algorithm struct node

1. Declare int data, node link

Program

```
struct node
{
        int data;
        struct node *link;
};
```

Operations on Singly Linked List

- **Traverse a list**
- **Insertion of a node into list**
  - Insert at front
  - Insert at end
  - Insert after a specified node
- **Deletion of node from list**
  - Delete from front
  - Delete from end
  - Delete from any position
- **Copy a linked list to make duplicate**
- **Merging two linked list into larger list**
- **Searching for an element in a list**

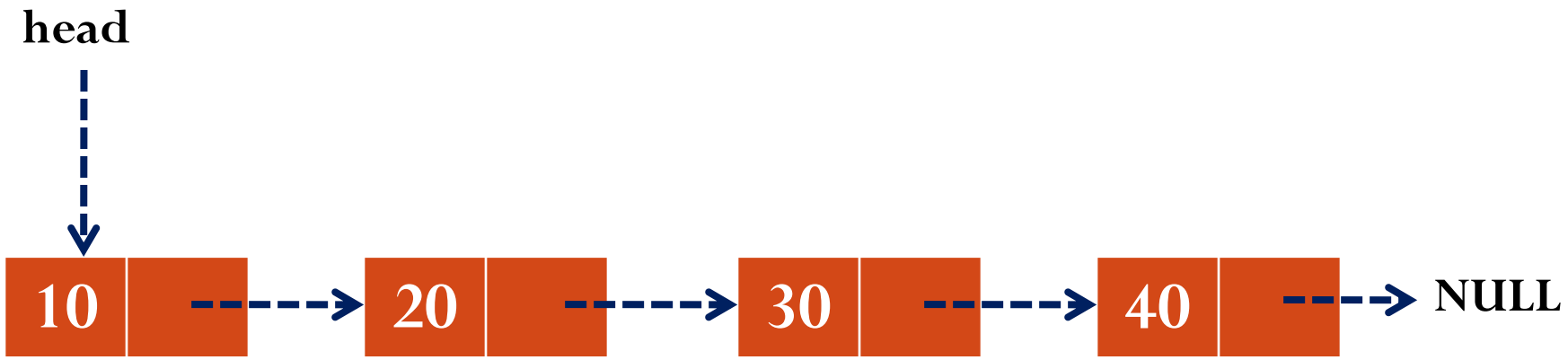
Traversal

- Visit every node in the list starting from the first node to the last one

Traversal ~ Algorithm

Algorithm Traversal(head)

1. ptr = head
2. while ptr!=NULL do
    1. Print ptr→data
    2. ptr = ptr→link



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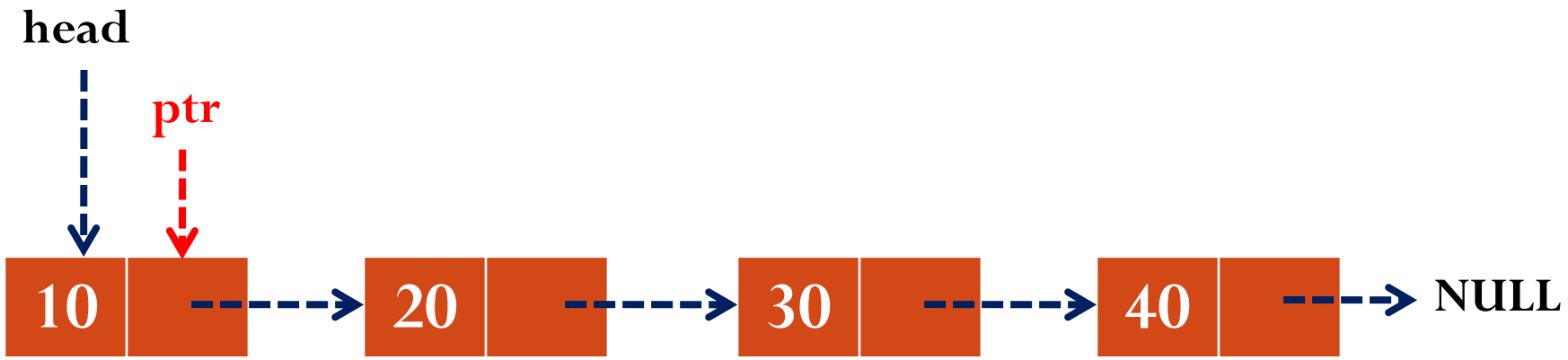

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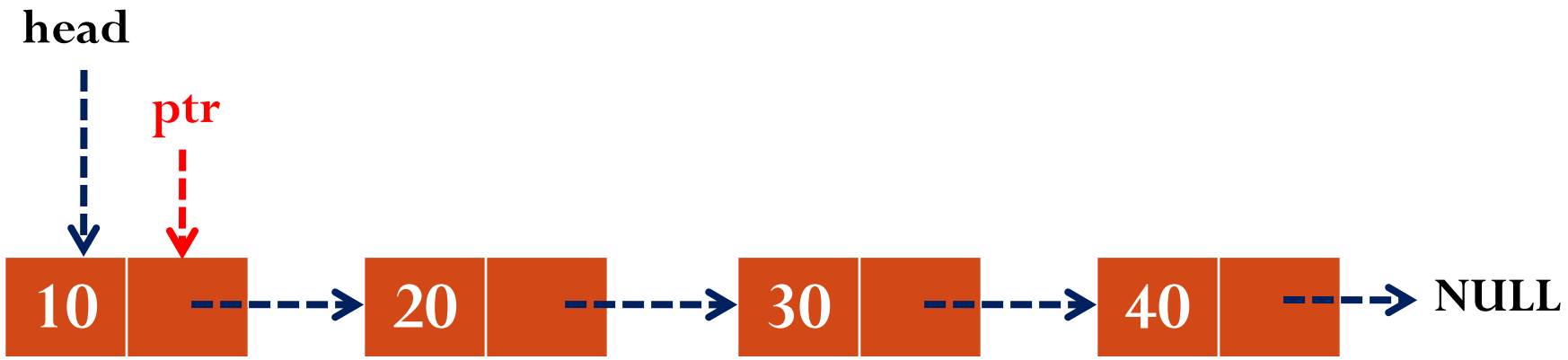

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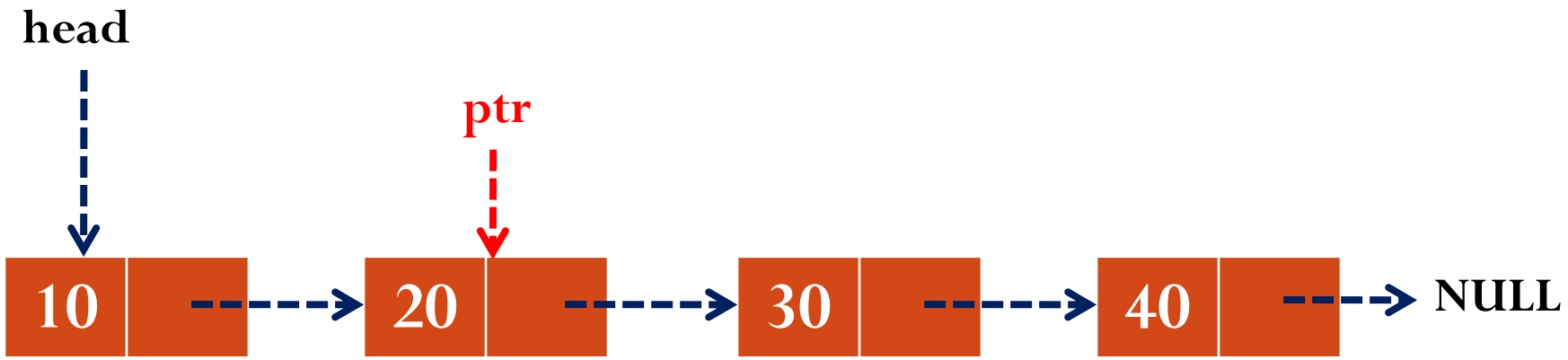

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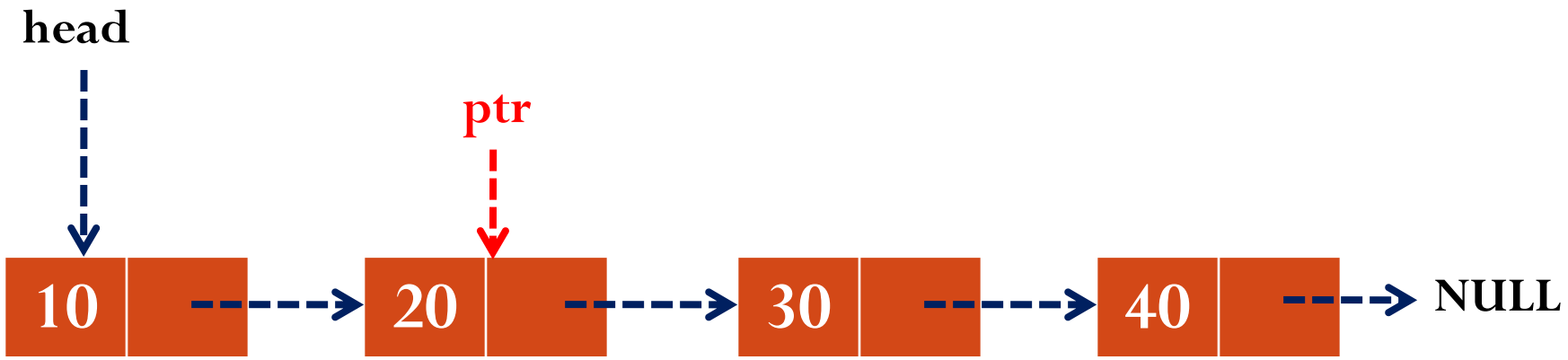

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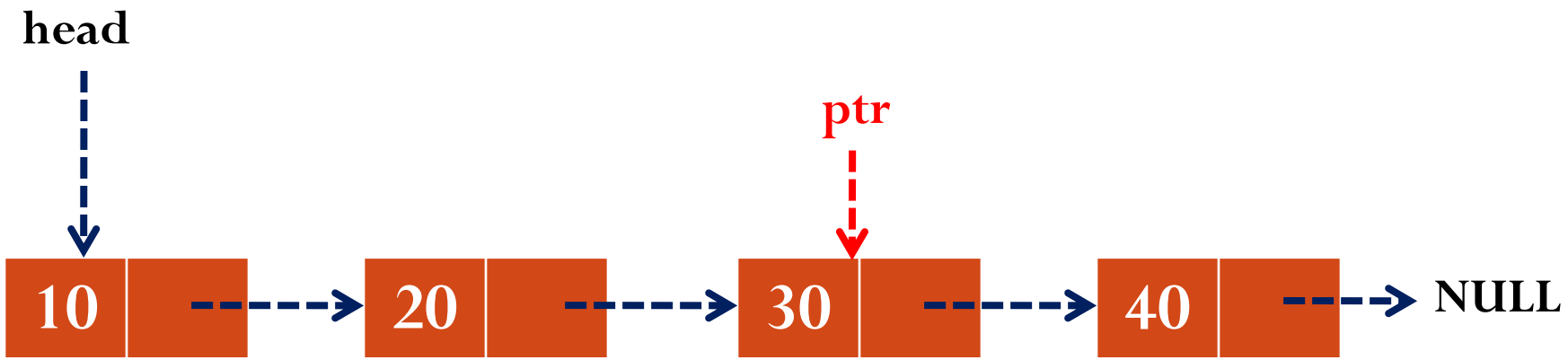

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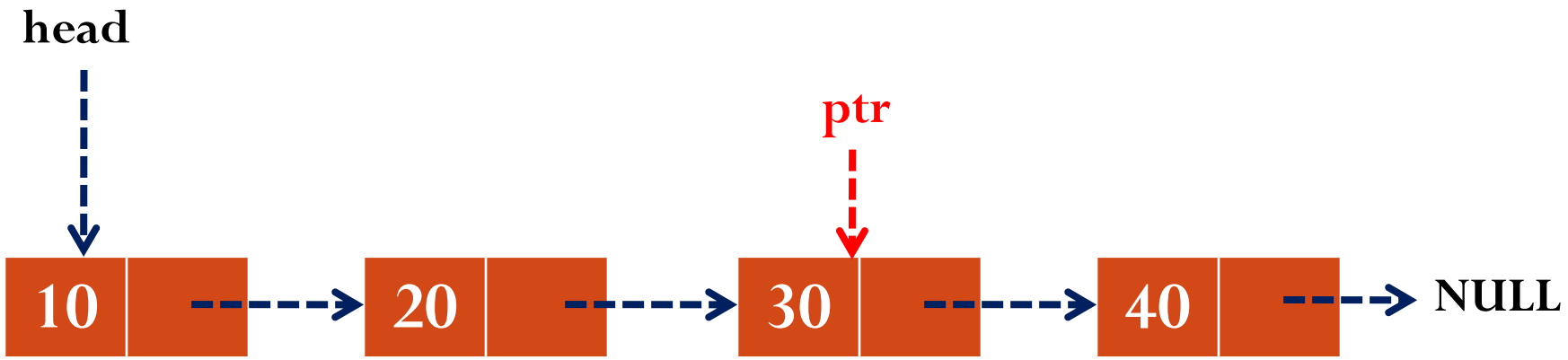

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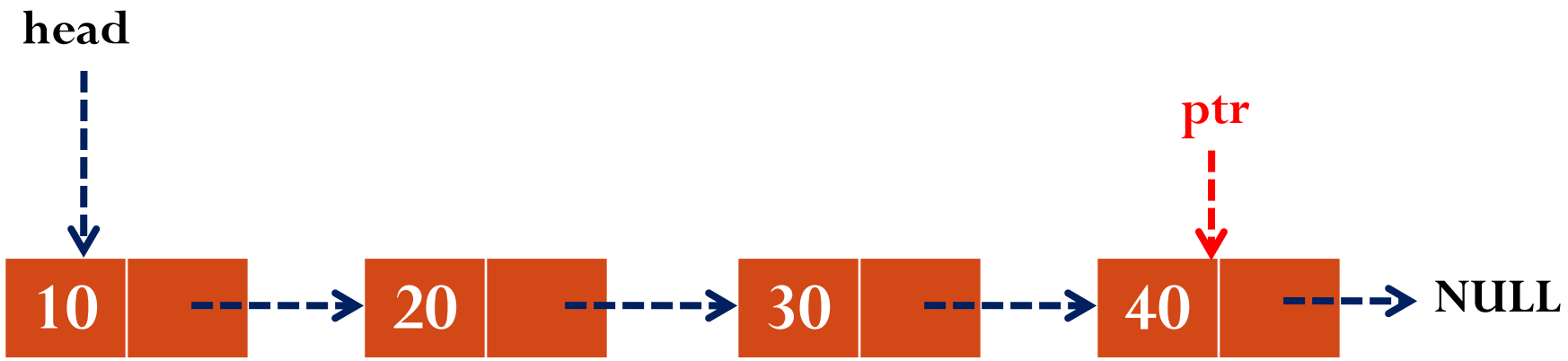

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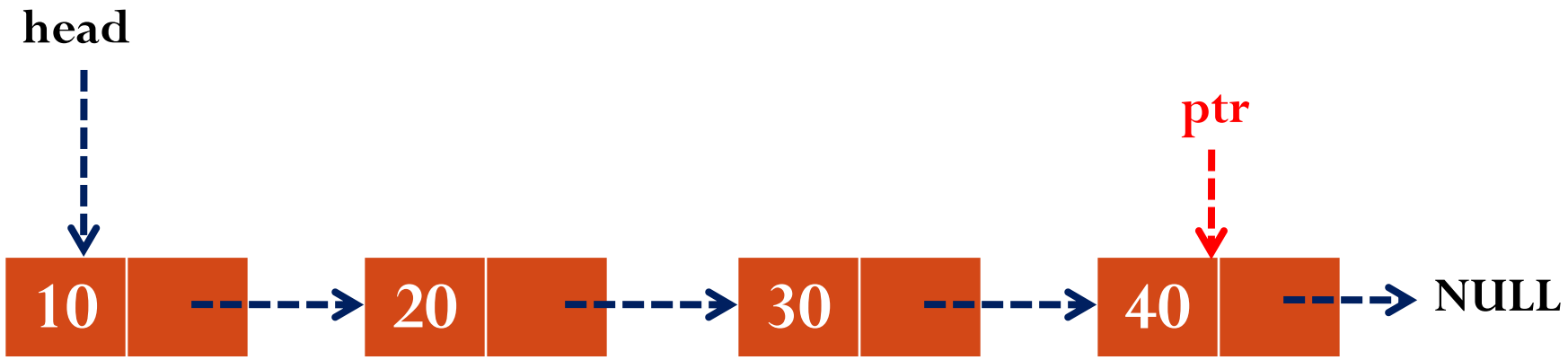

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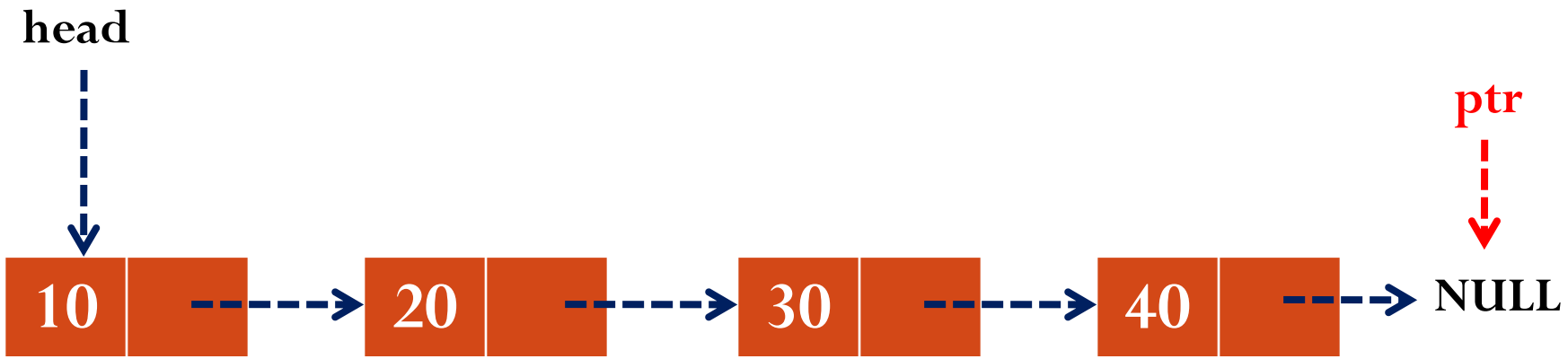

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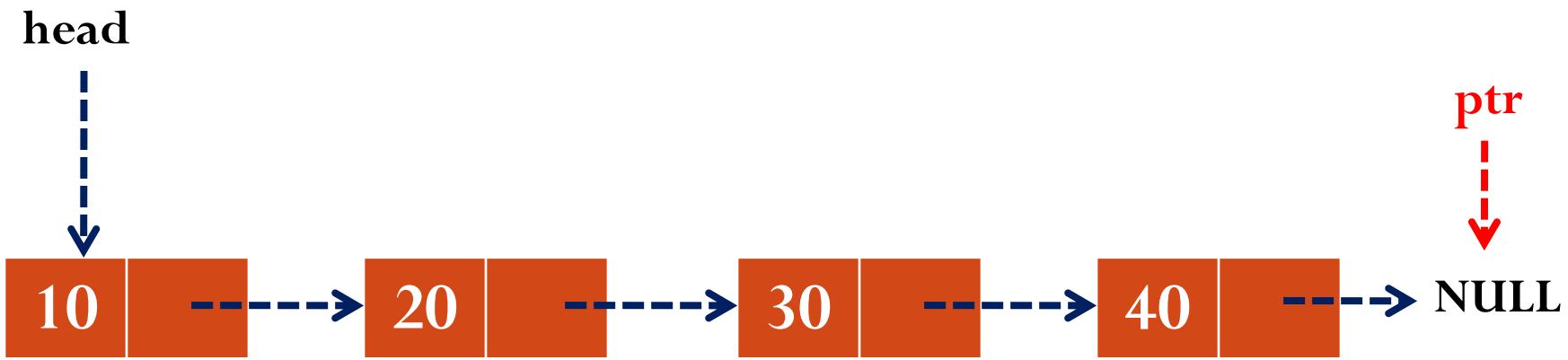


Insertion

1. Insert at Front
2. Insert at End
3. Insert after a specified node

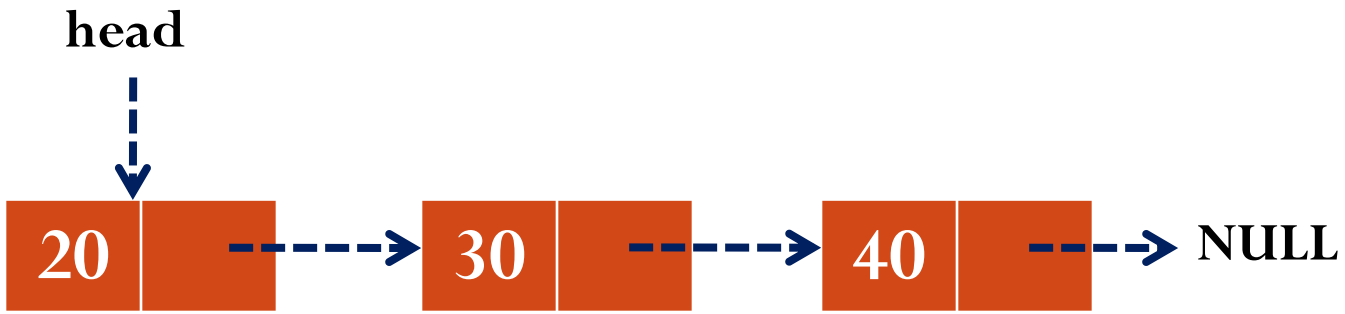
Insertion

1. **Insert at Front**
2. Insert at End
3. Insert after a specified node

Insert at Front ~ Algorithm

Algorithm Insert_Front(head, x)

1. Create a node new
2. new→data=x
3. new→link=head
4. head=new



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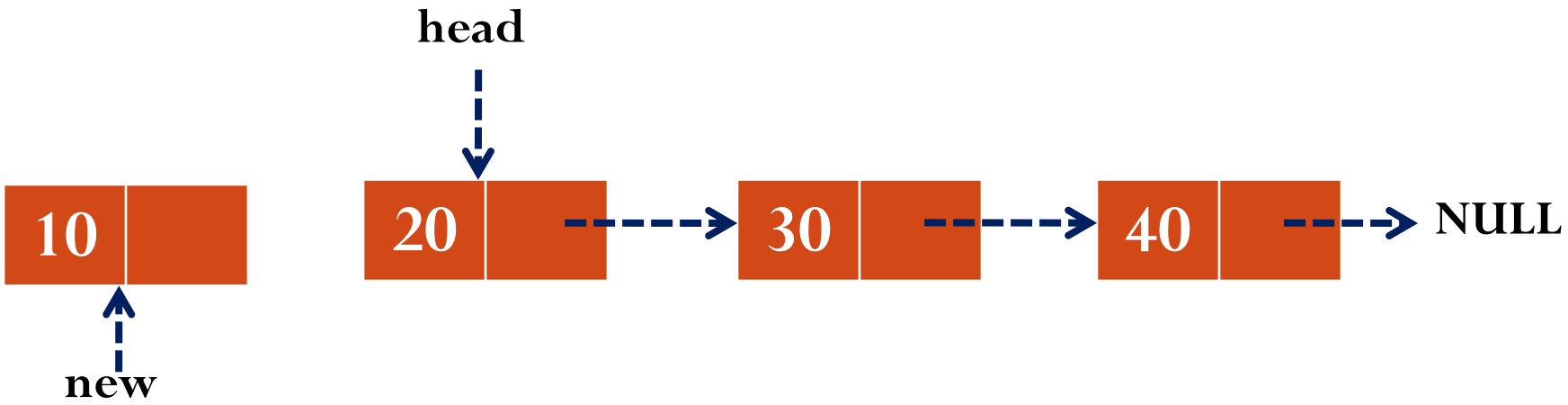

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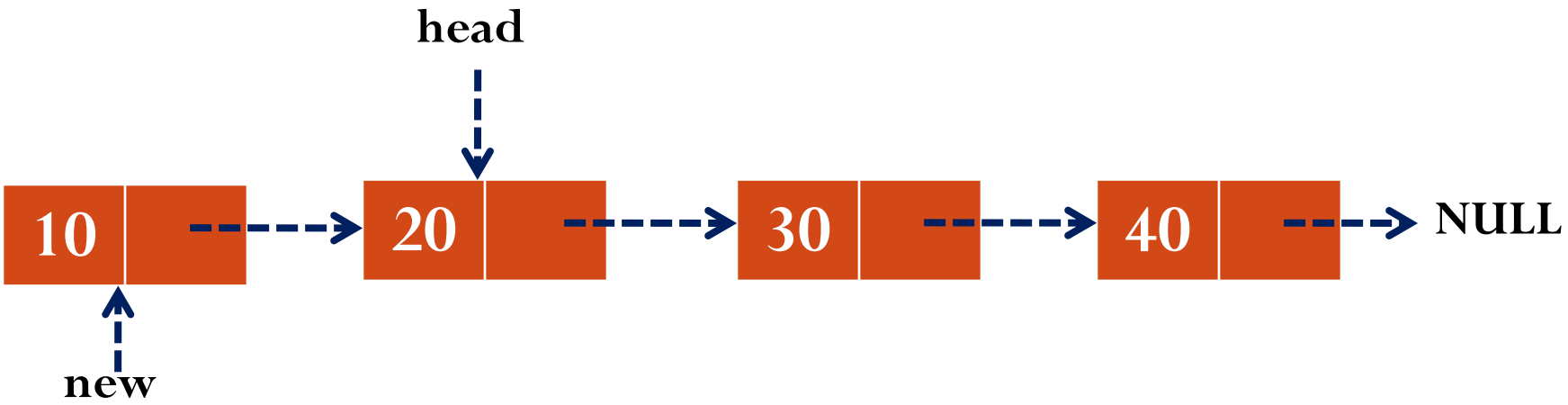

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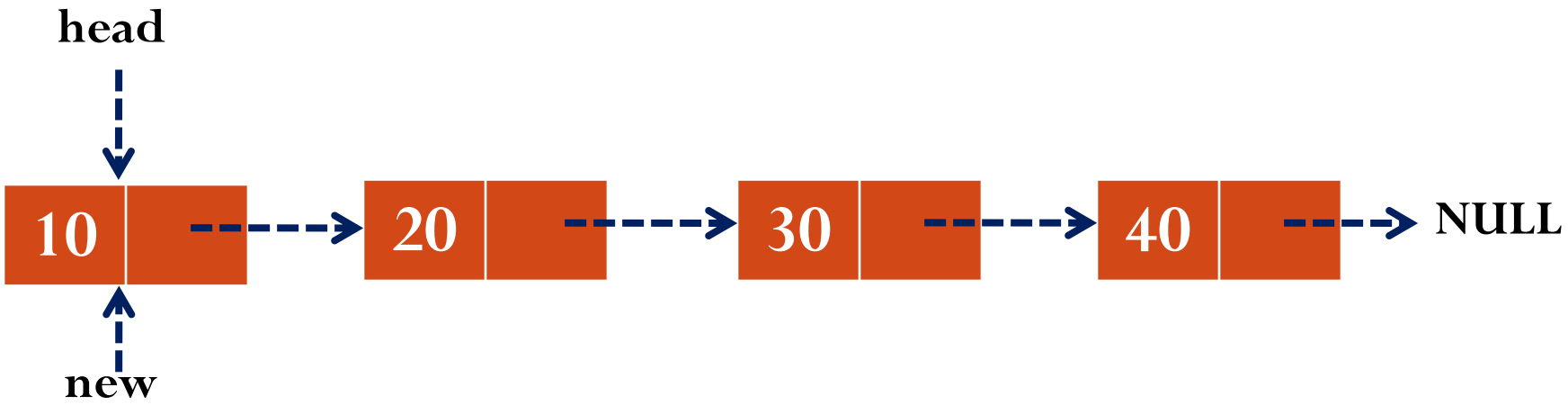

Insertion

1. Insert at Front
2. **Insert at End**
3. Insert after a specified node

Insert at End - Algorithm

Algorithm Insert_End(head, x)

1. Create a node new
2. new→data=x
3. new→link=NULL
4. ptr=head
5. If ptr=NULL then
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6. Else
    1. While(ptr→link!=NULL) do
        1. ptr=ptr→link
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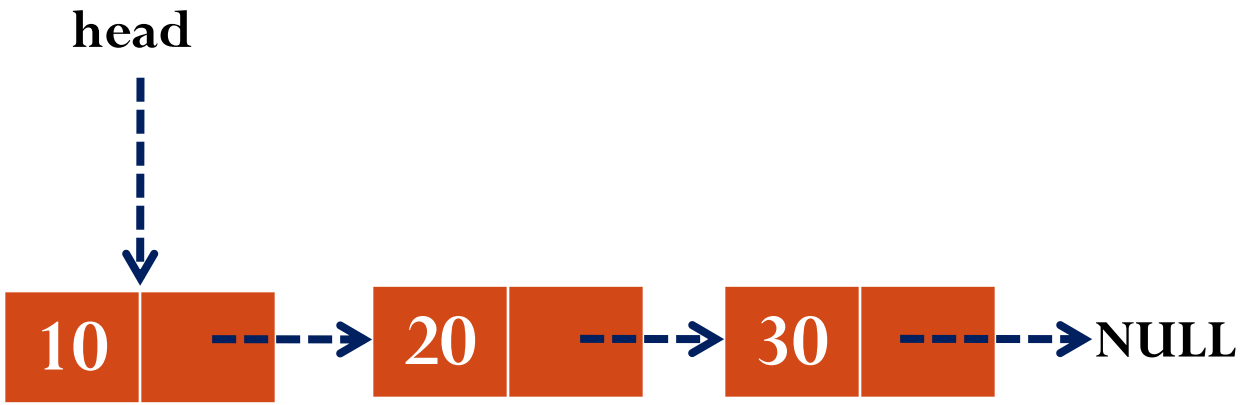

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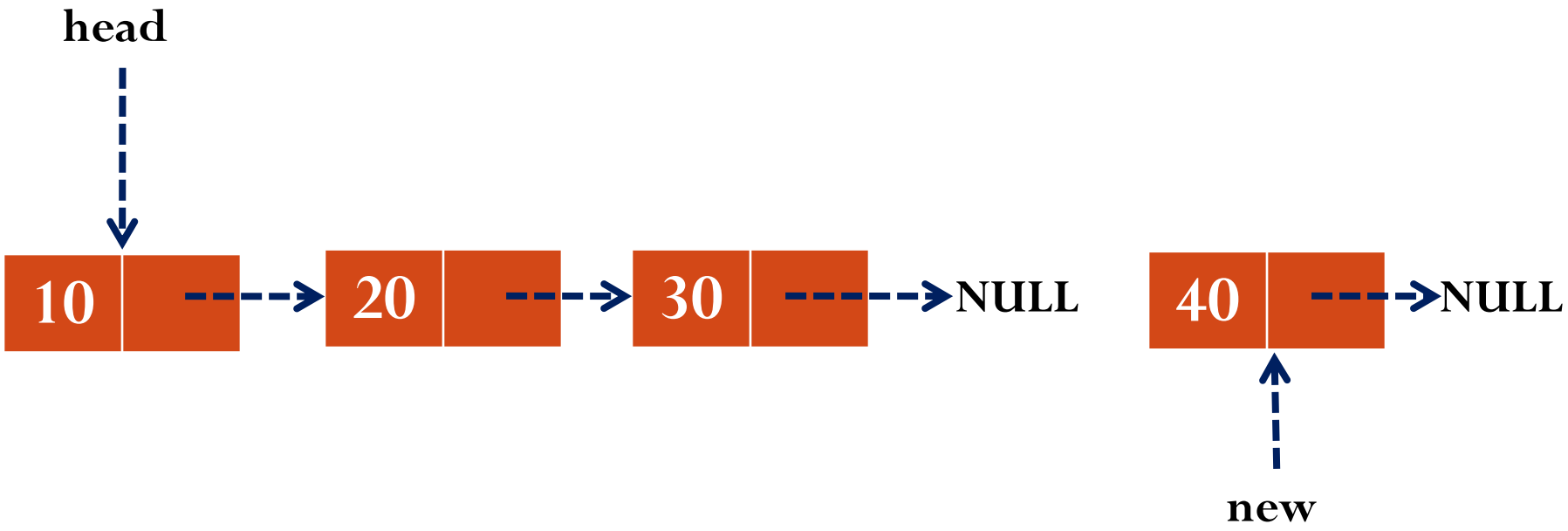

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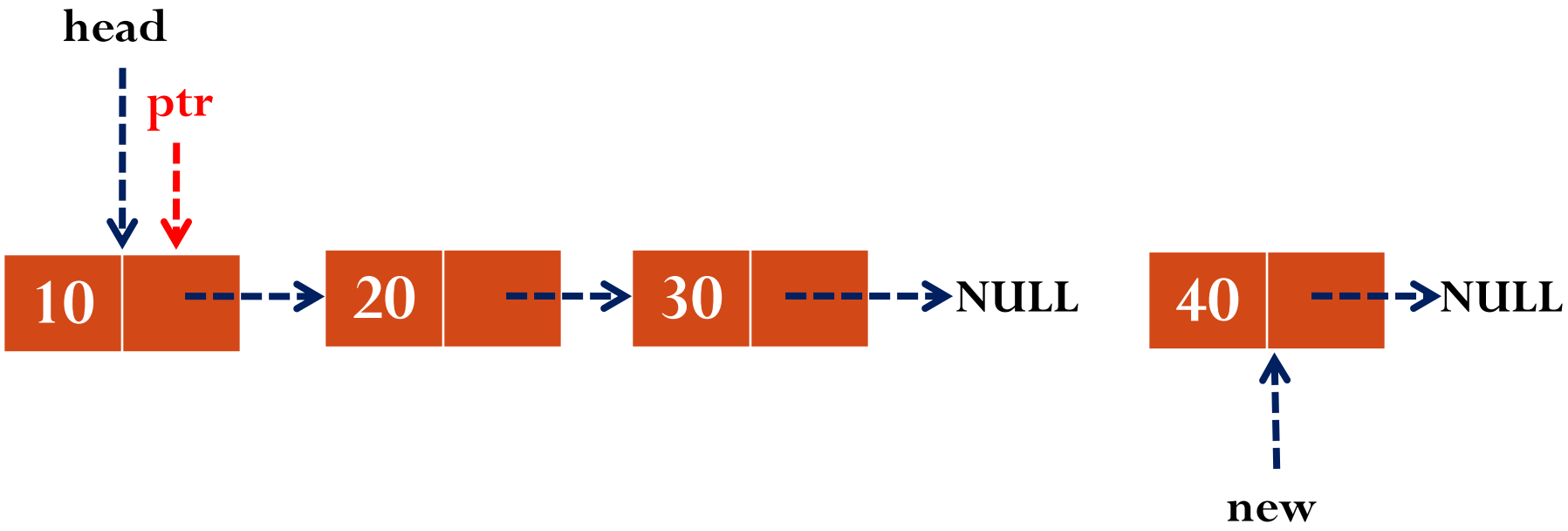

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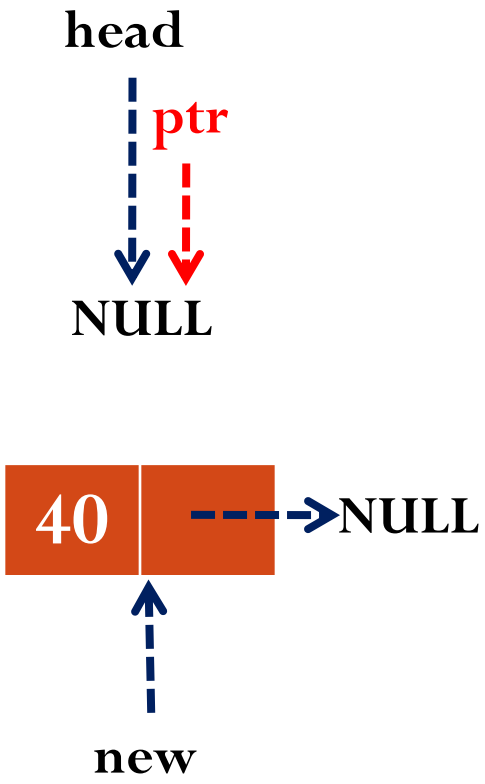

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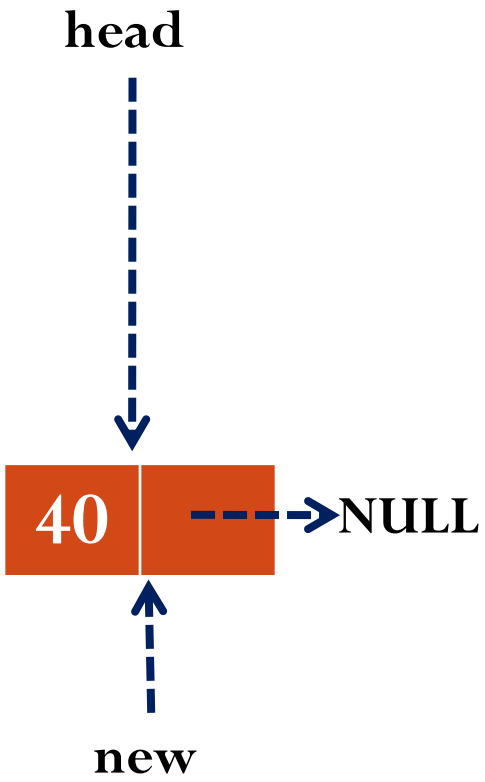

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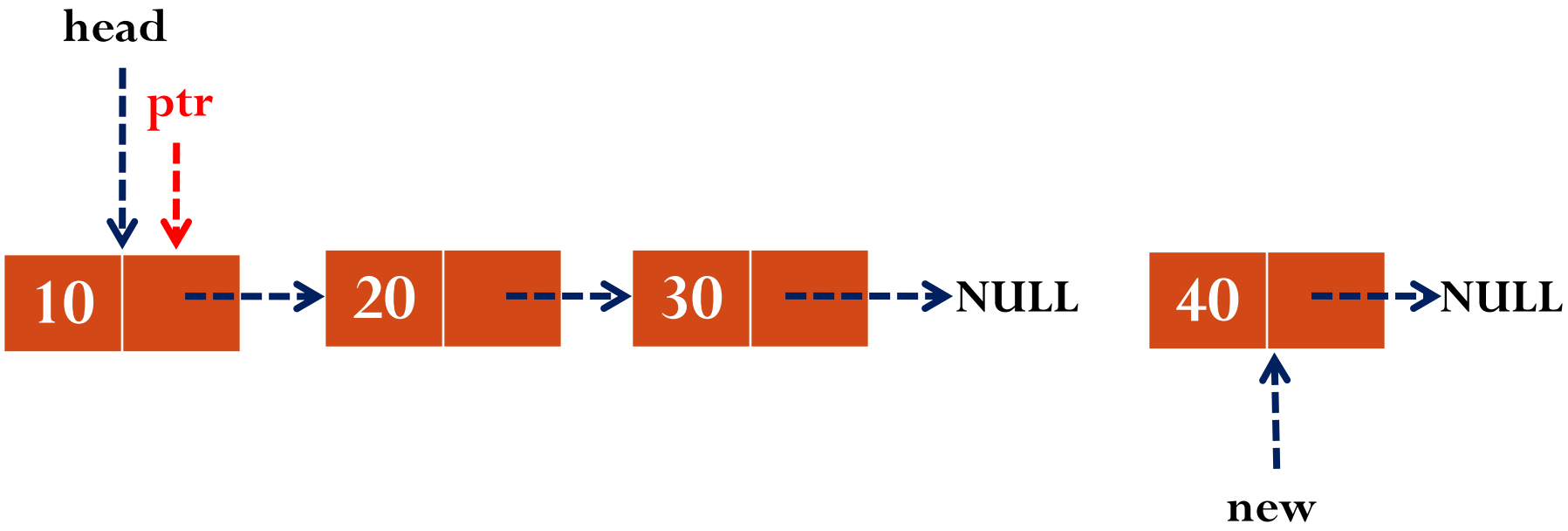

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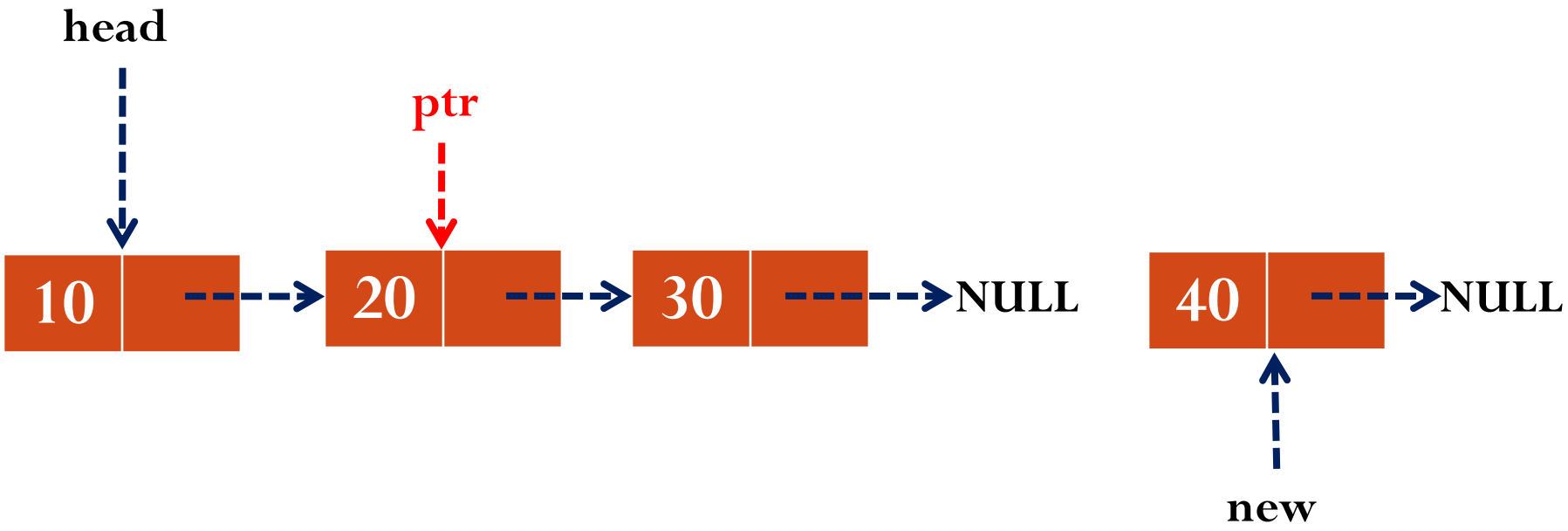
Insert at End



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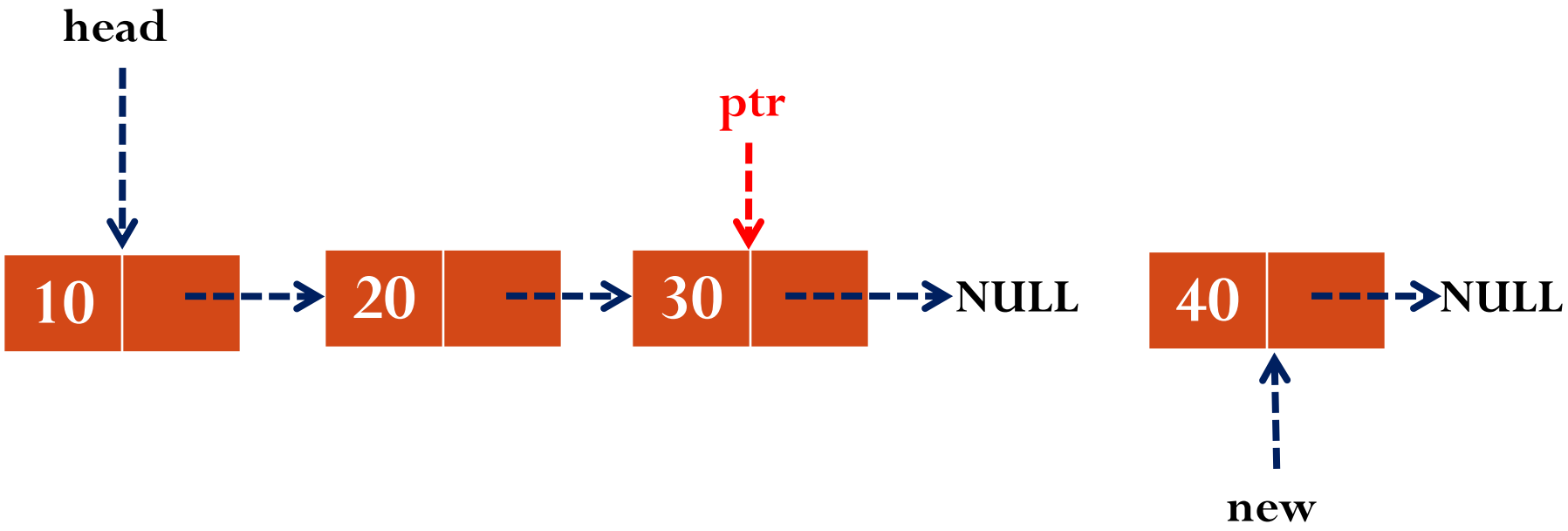

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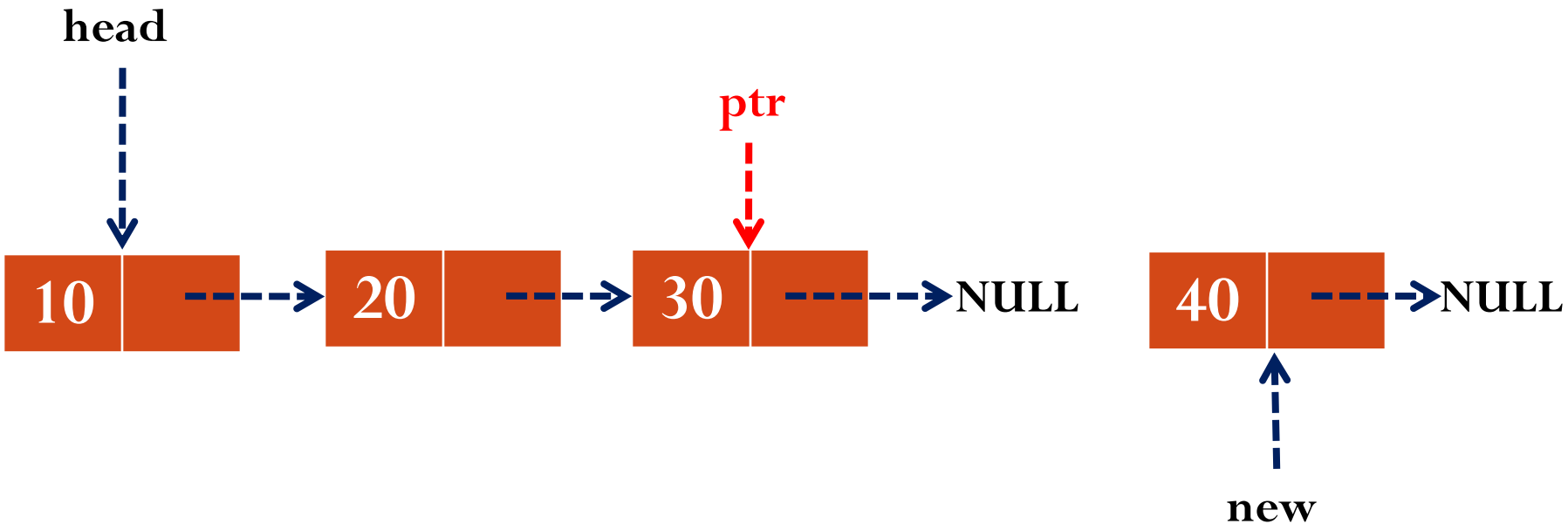

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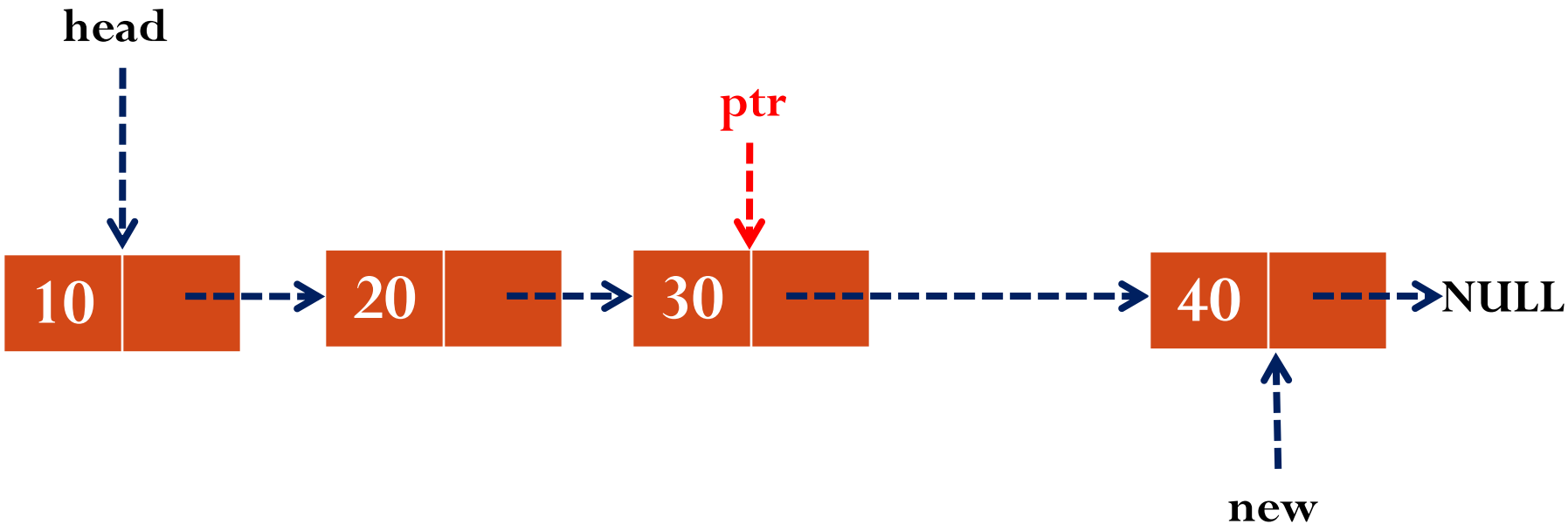

Insert at End - Algorithm

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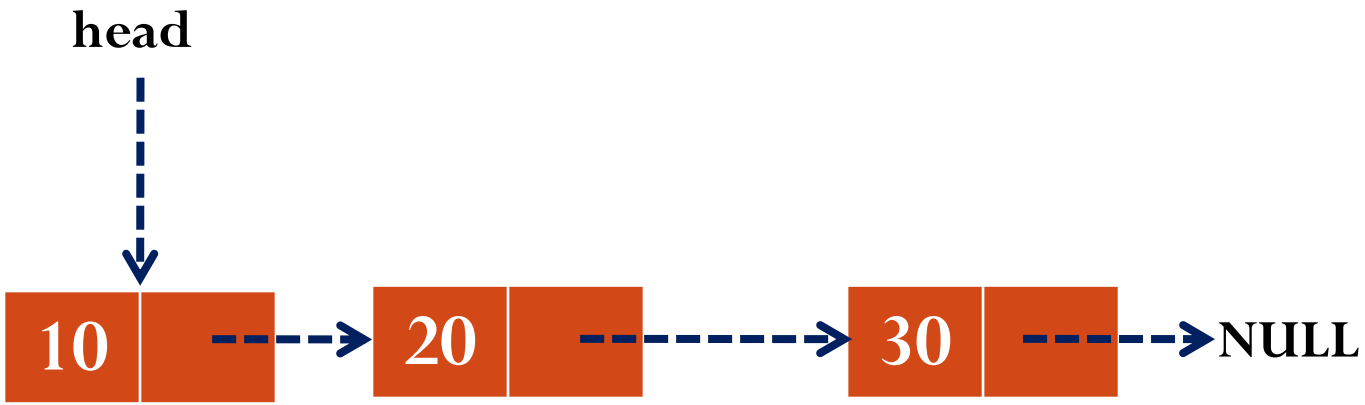
3. new→link=NULL
4. ptr=head
5. If ptr=NULL then
    1. head=new
6. Else
    1. While(ptr→link!=NULL) do
        1. ptr=ptr→link
    2. ptr→link=new

Insertion

1. Insert at Front
2. Insert at End
3. **Insert after a specified node**

Insert after a specified node 20



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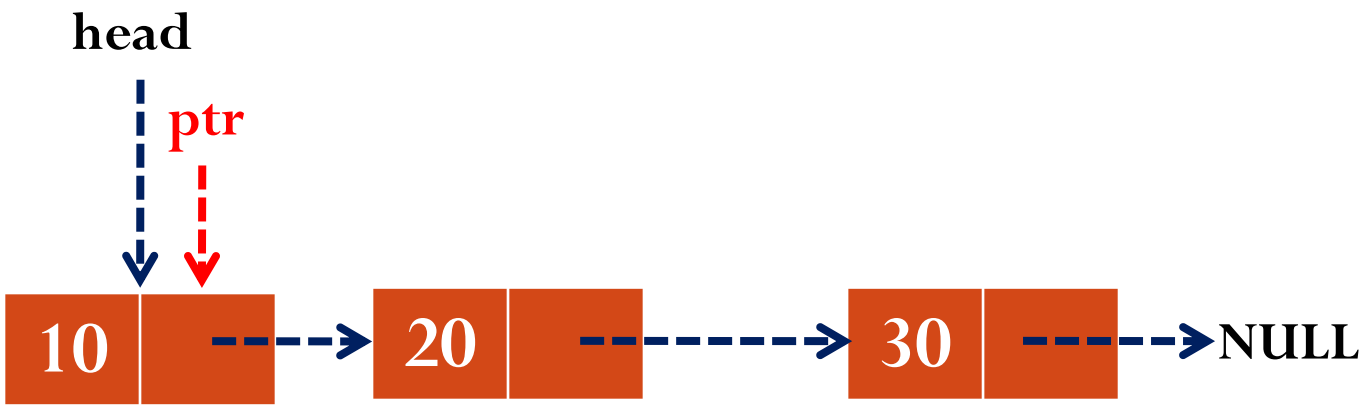
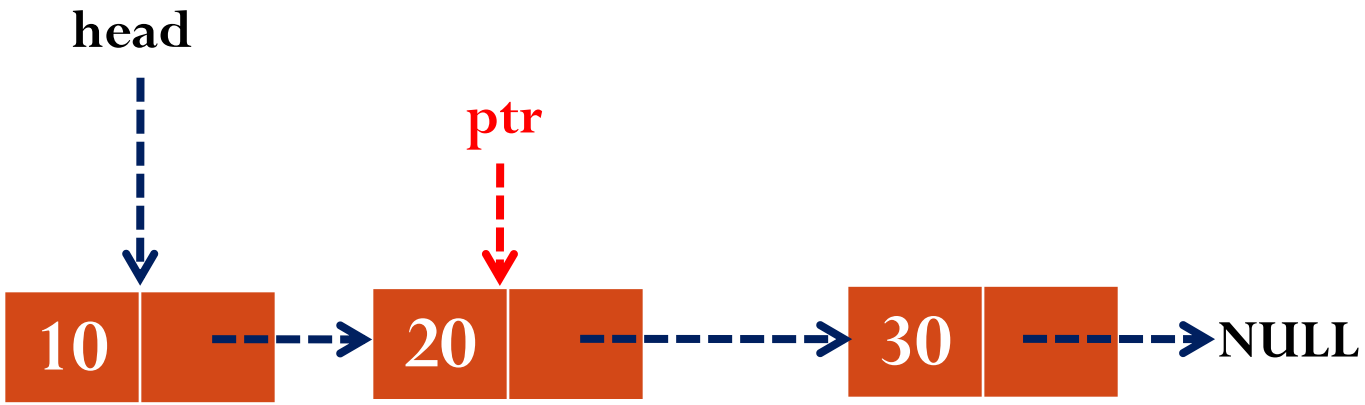
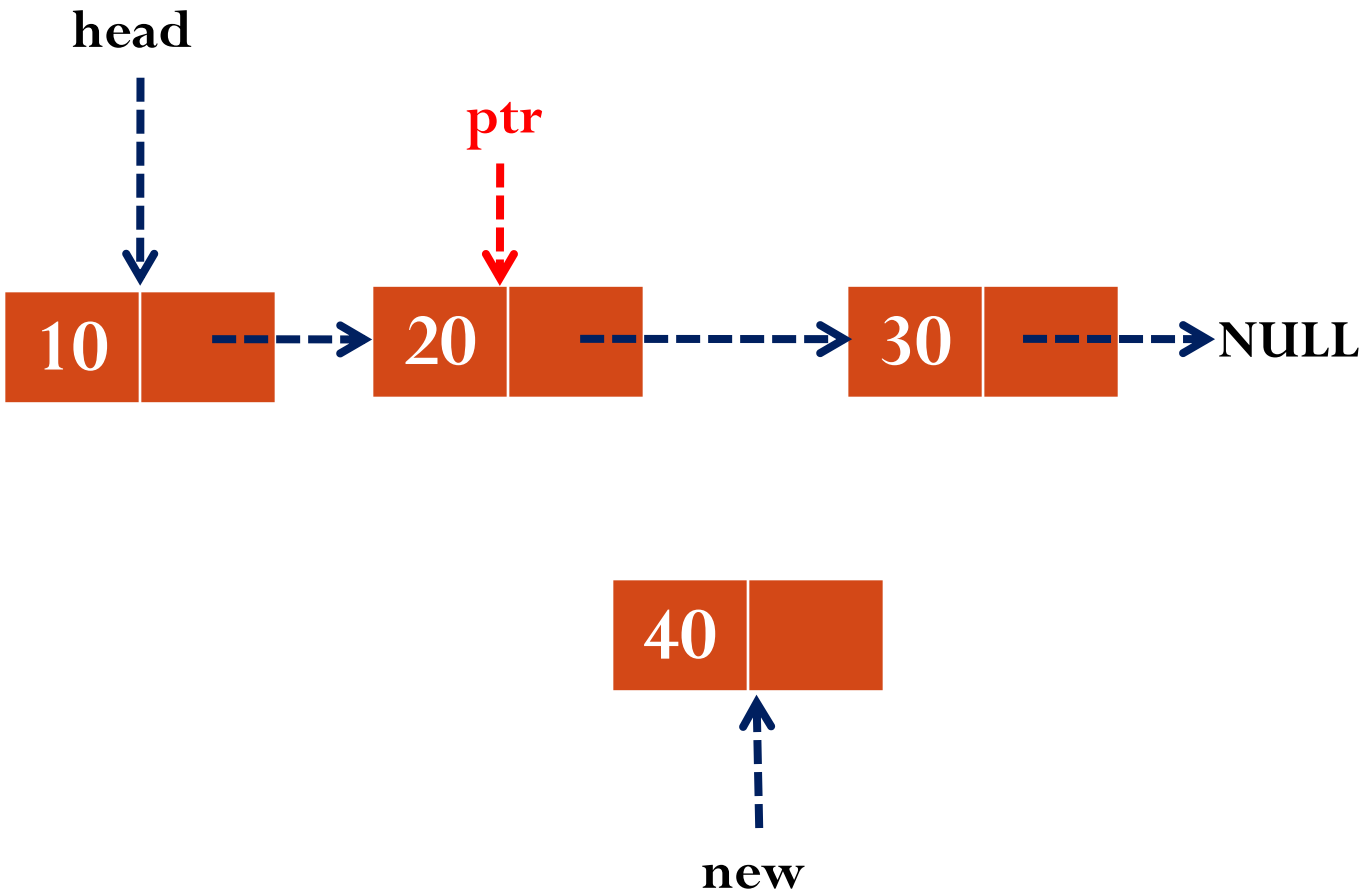


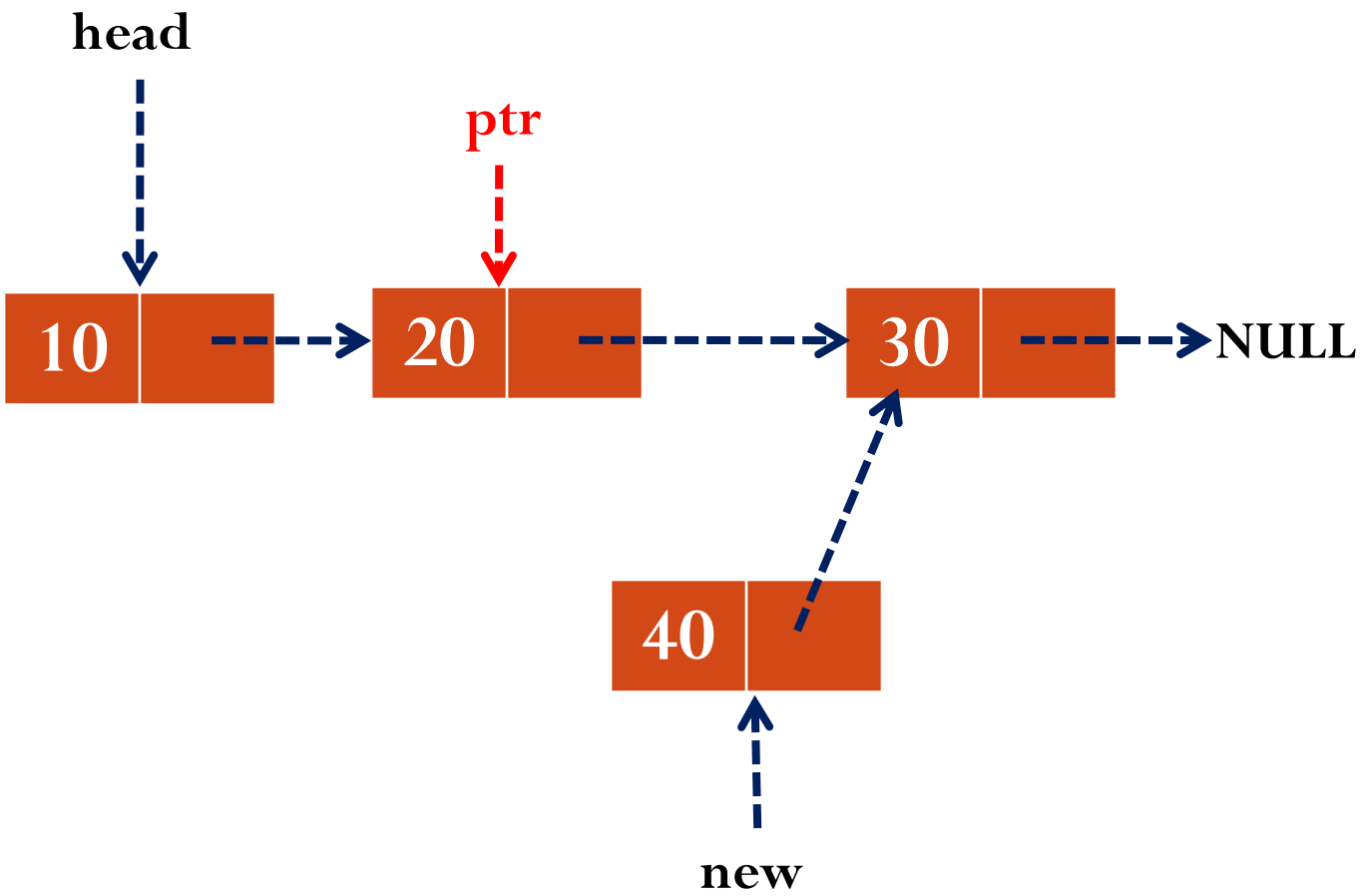
Insert after a specified node 20



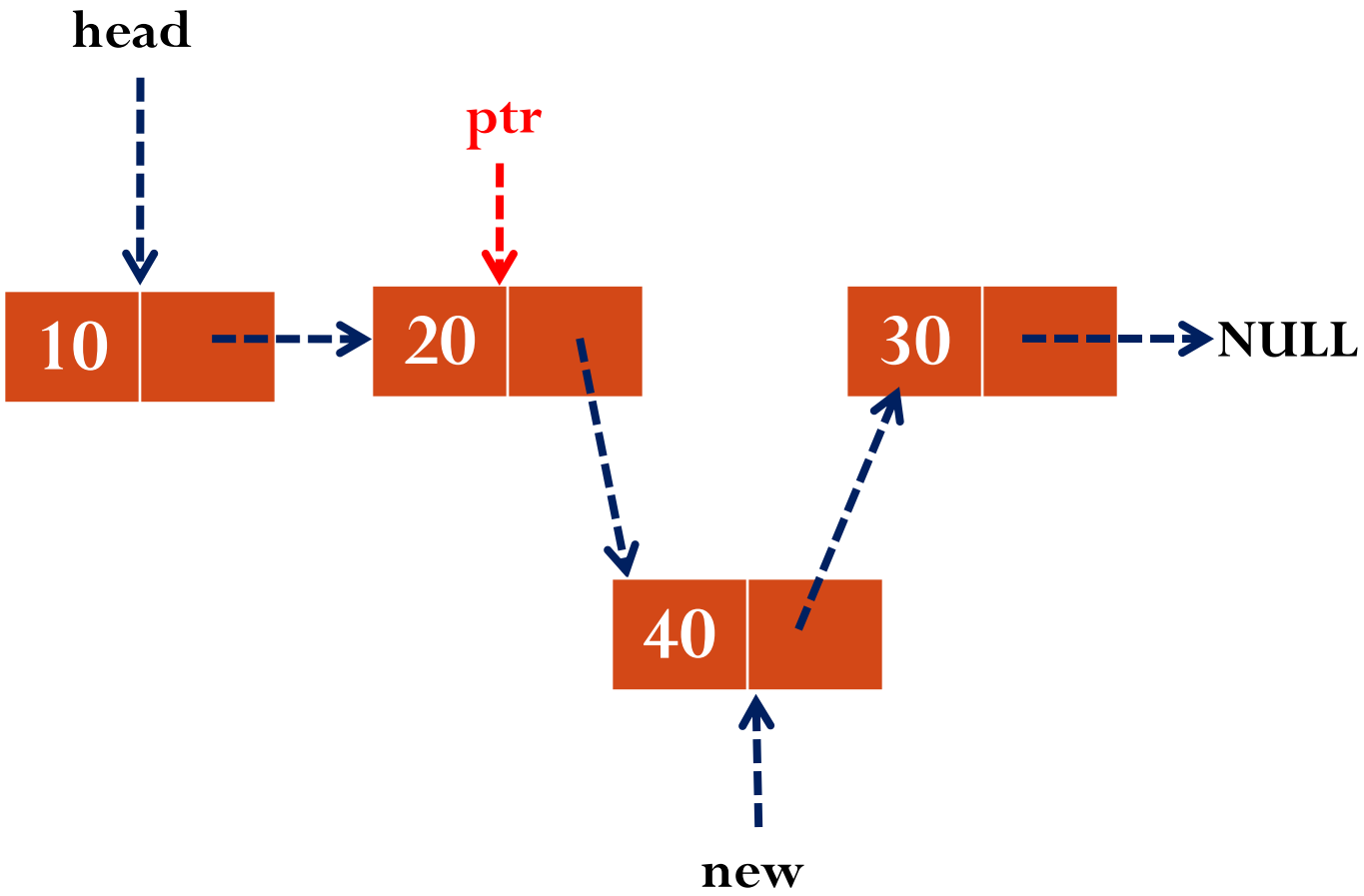
Insert after a specified node 20



Insert after a specified node 20



Insert after a specified node 20



Insert after a specified node - Algorithm

Algorithm Insert_After(head, key, x)

1. ptr=head
2. while(ptr→data!=key and ptr→link!=NULL) do
    1. ptr=ptr→link
3. If ptr→data!=key then
    1. Print “Search failed. Insertion is not possible”
4. Else
    1. Create a node new
    2. new→data=x
    3. new→link=ptr→link
    4. ptr→link = new

Deletion

1. Delete from Front
2. Delete from End
3. Delete a specified node

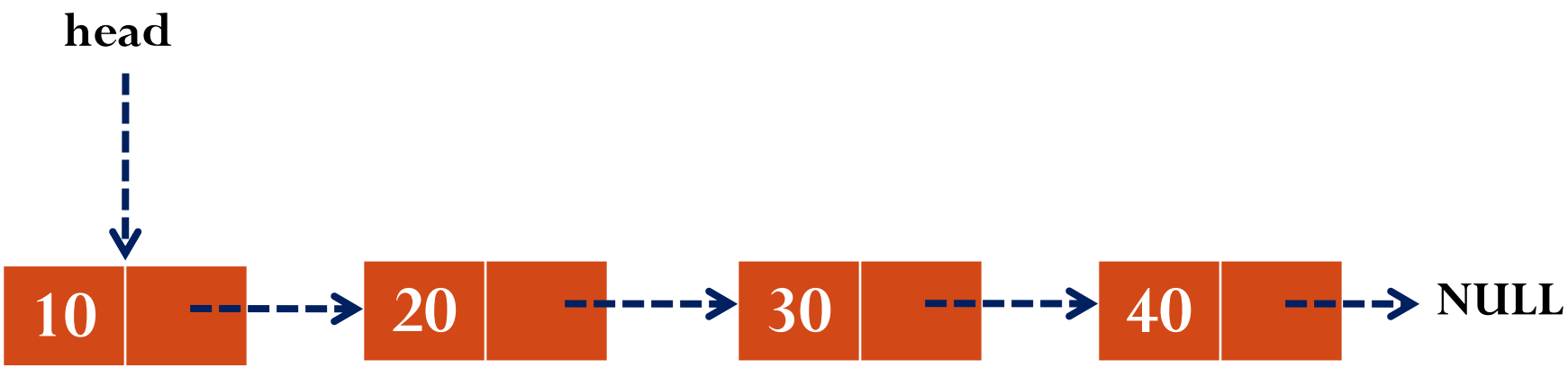
Deletion

1. **Delete from Front**
2. Delete from End
3. Delete a specified node

Delete from Front~ Algorithm

Algorithm Delete_Front(head)

1. If head ==NULL then
    1. Print “List is empty”
2. Else
    1. head=head→link



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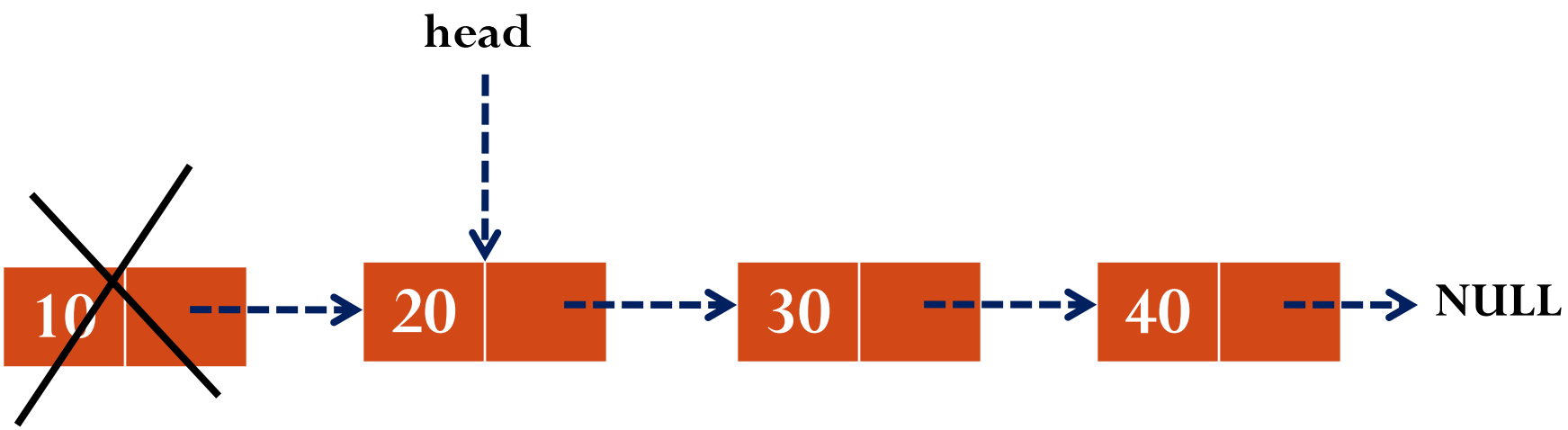


Deletion

1. Delete from Front
2. **Delete from End**
3. Delete a specified node

Delete from End

- **Three cases**

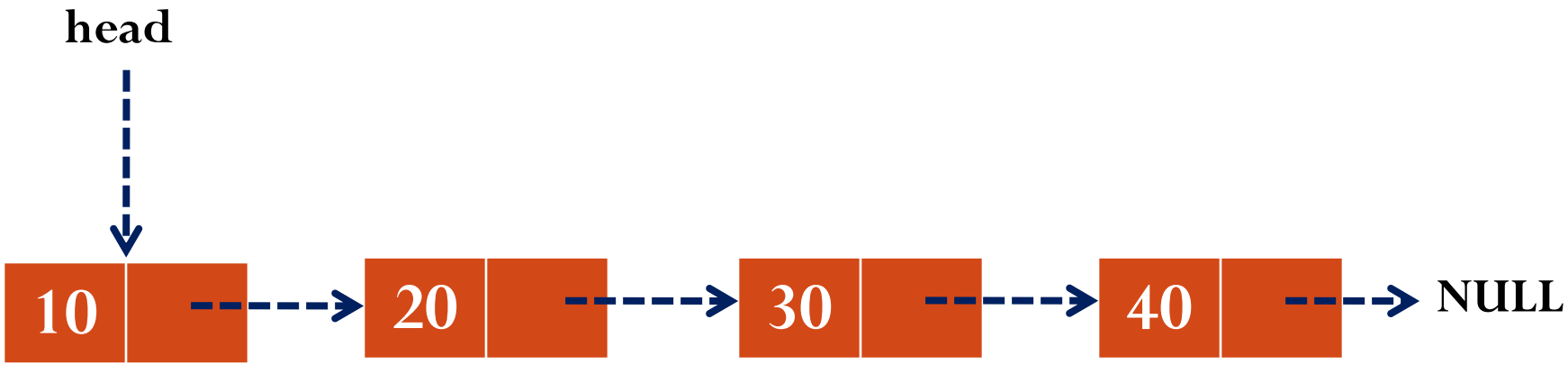
1. List is empty
2. Only one element in the list
3. All other cases

Delete from End~ Algorithm

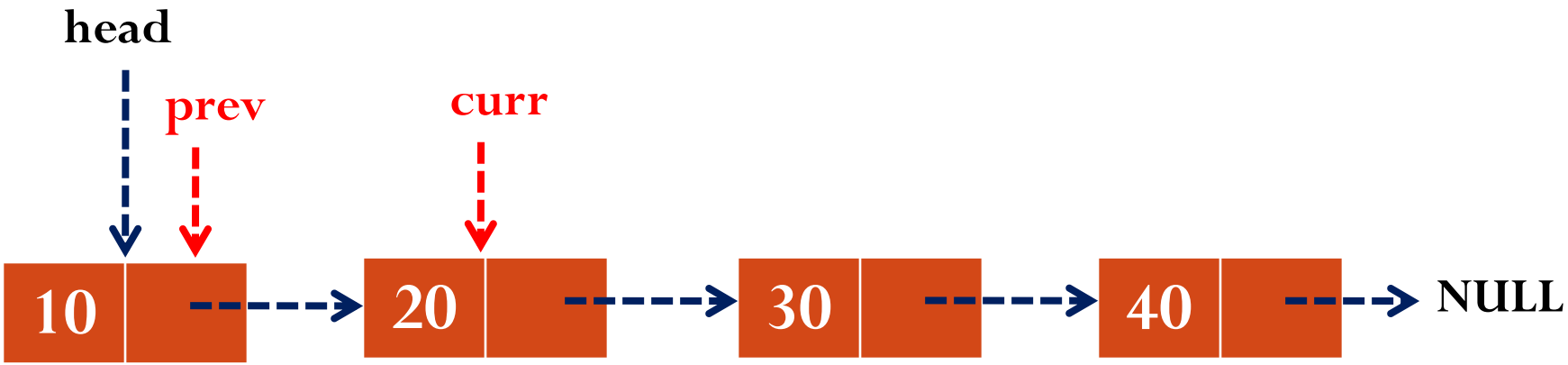
Algorithm Delete_End (head)

1. If head = NULL then
    1. Print “List is Empty”
2. Else if head→link=NULL then
    1. head=NULL
3. Else
    1. prev = head
    2. curr = head→link
    3. while curr→link !=NULL do
        1. prev = curr
        2. curr = curr→link
    4. prev→link=NULL

Delete from End



Delete from End



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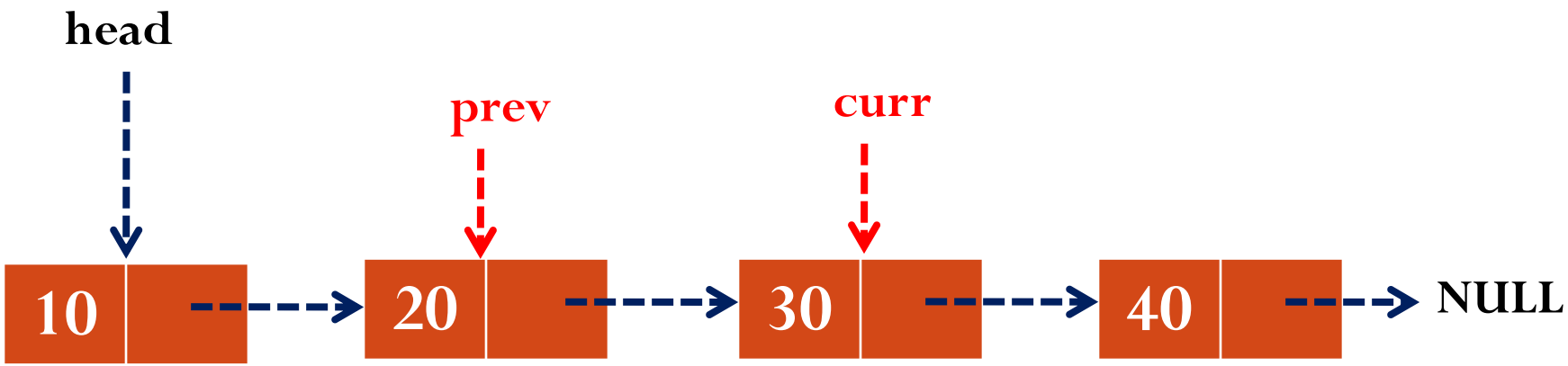

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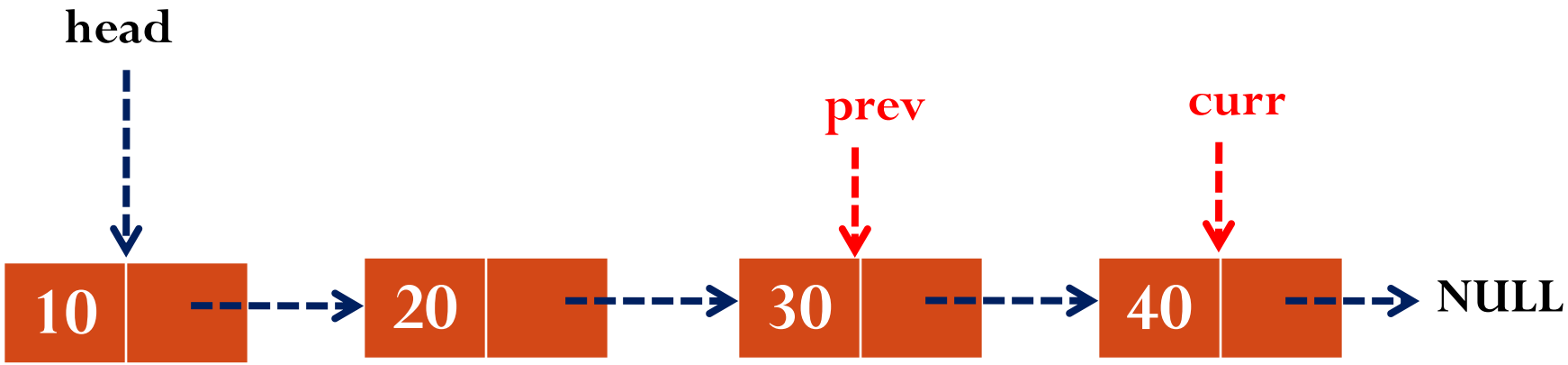
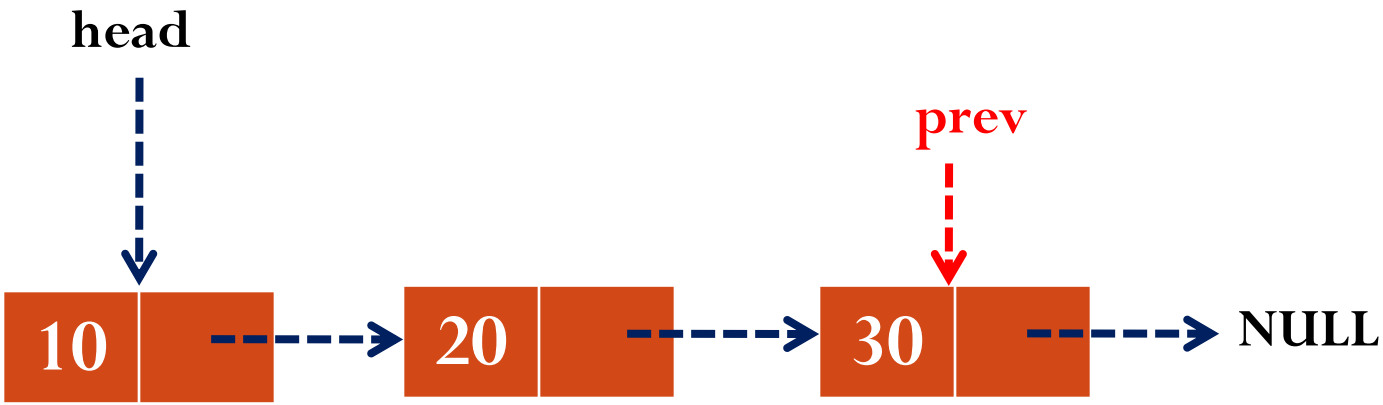


Delete from End



Delete from End~ Algorithm

Algorithm Delete_End (head)

1. If head = NULL then
    1. Print “List is Empty”
2. Else if head→link=NULL then
    1. head=NULL
3. Else
    1. prev = head
    2. curr = head→link
    3. while curr→link !=NULL do
        1. prev = curr
        2. curr = curr→link
    4. prev→link=NULL

Deletion

1. Delete from Front
2. Delete from End
3. **Delete a specified node**

Delete specified node

Three cases

1. List is empty
2. The search data present in the first node
3. All other cases

Delete specified node- Algorithm

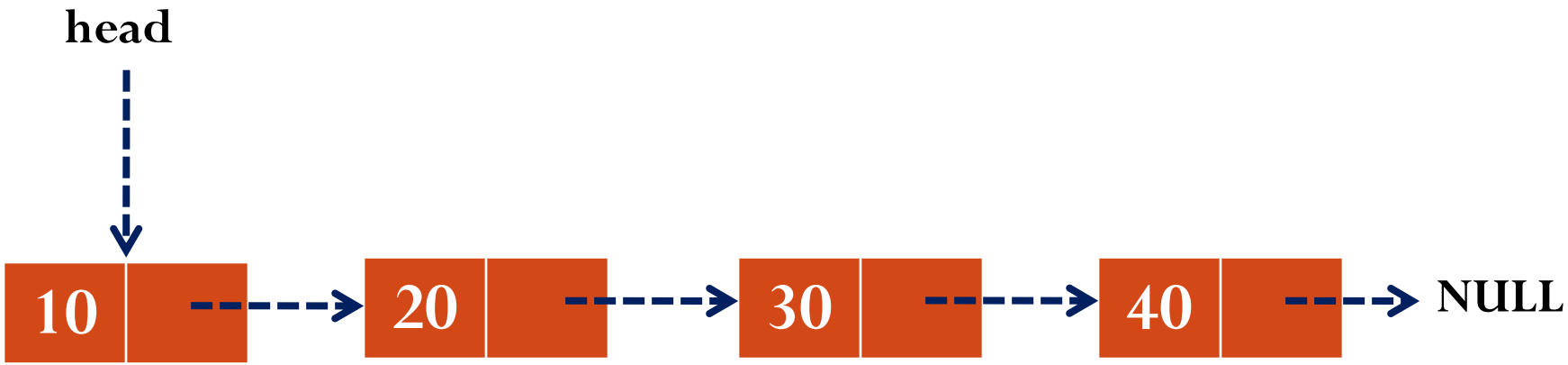
Algorithm Delete_Any(head, key)

1. If head=NULL then
    1. Print "List is Empty"
2. Else if head→data = key then head=head→link
3. Else
    1. prev=head
    2. curr=head
    3. while curr→data != key and curr→link != NULL do
        1. prev = curr
        2. curr = curr→link
    4. If curr→data != key then
        1. Print "Search key not found"
    5. Else prev→link = curr→link

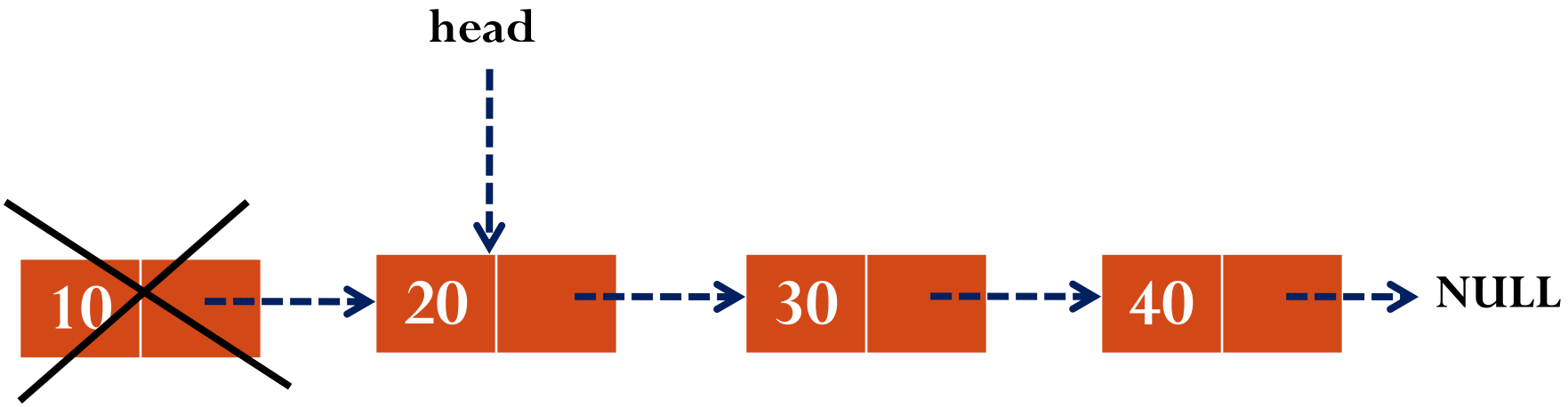
Delete specified node

The search data present in the first node

Delete Node 10



Delete Node 10

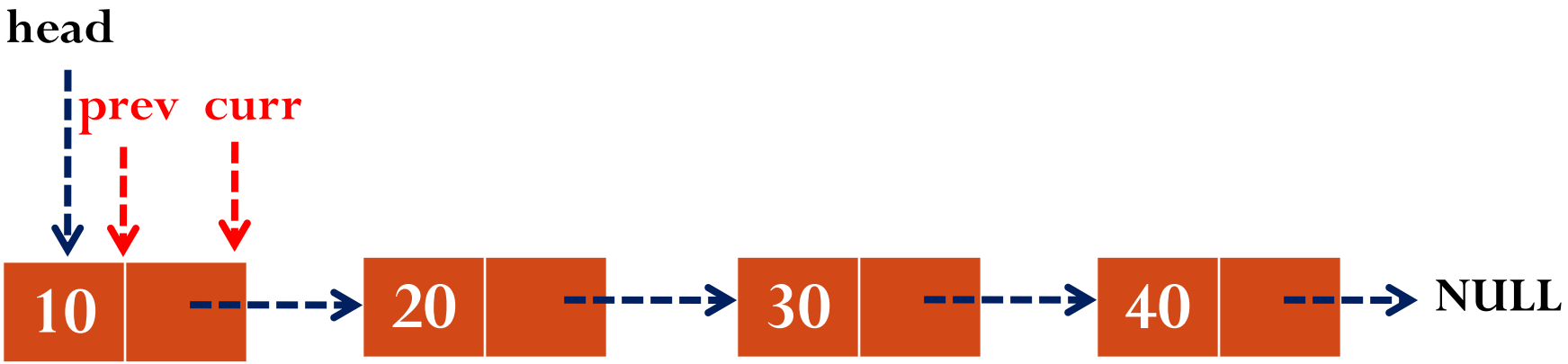


Delete specified node- Algorithm

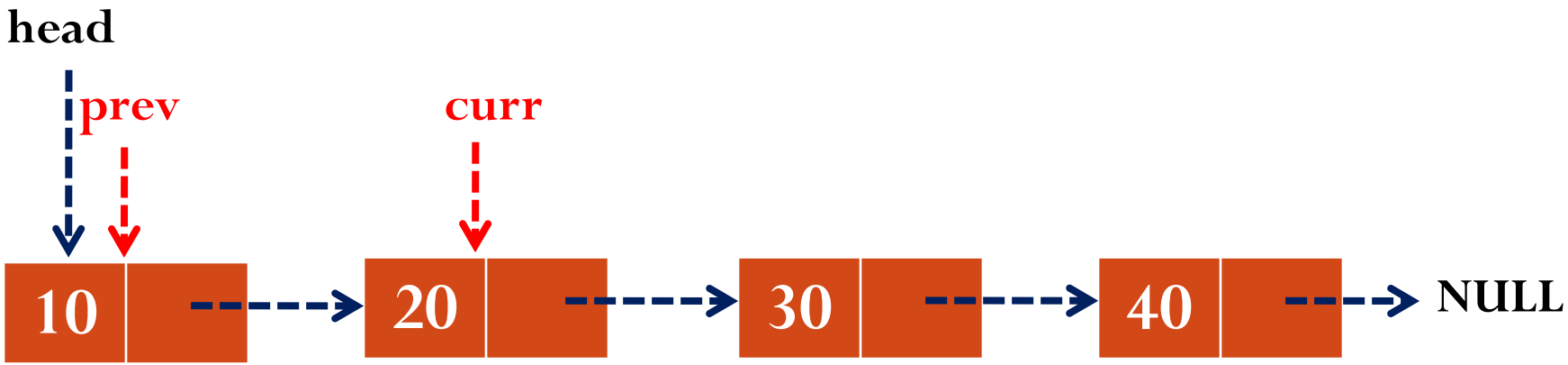
Algorithm Delete_Any(head, key)

1. If head=NULL then
    1. Print "List is Empty"
2. Else if head→data = key then head=head→link
3. Else
    1. prev=head
    2. curr=head
    3. while curr→data != key and curr→link != NULL do
        1. prev = curr
        2. curr = curr→link
    4. If curr→data != key then
        1. Print "Search key not found"
    5. Else prev→link = curr→link

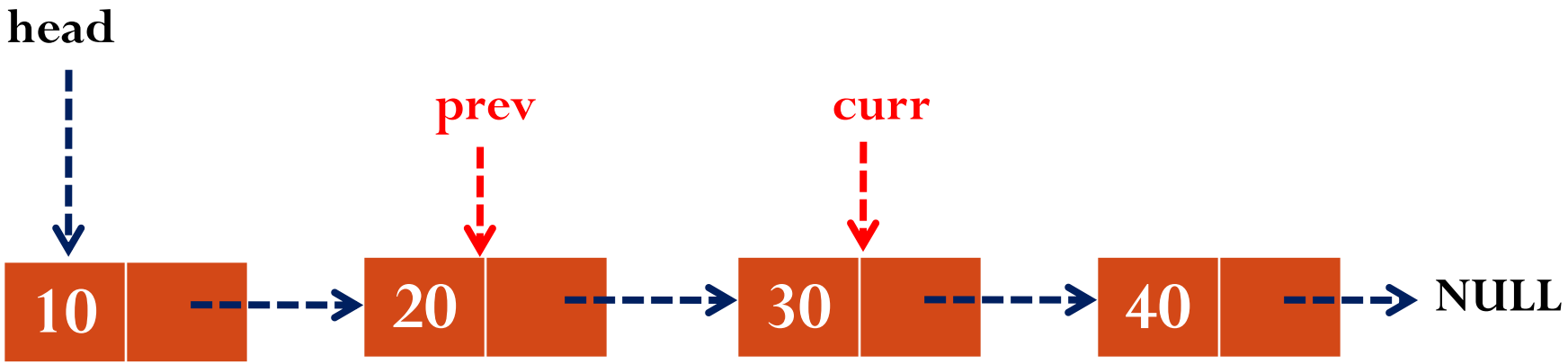
Delete Node 30



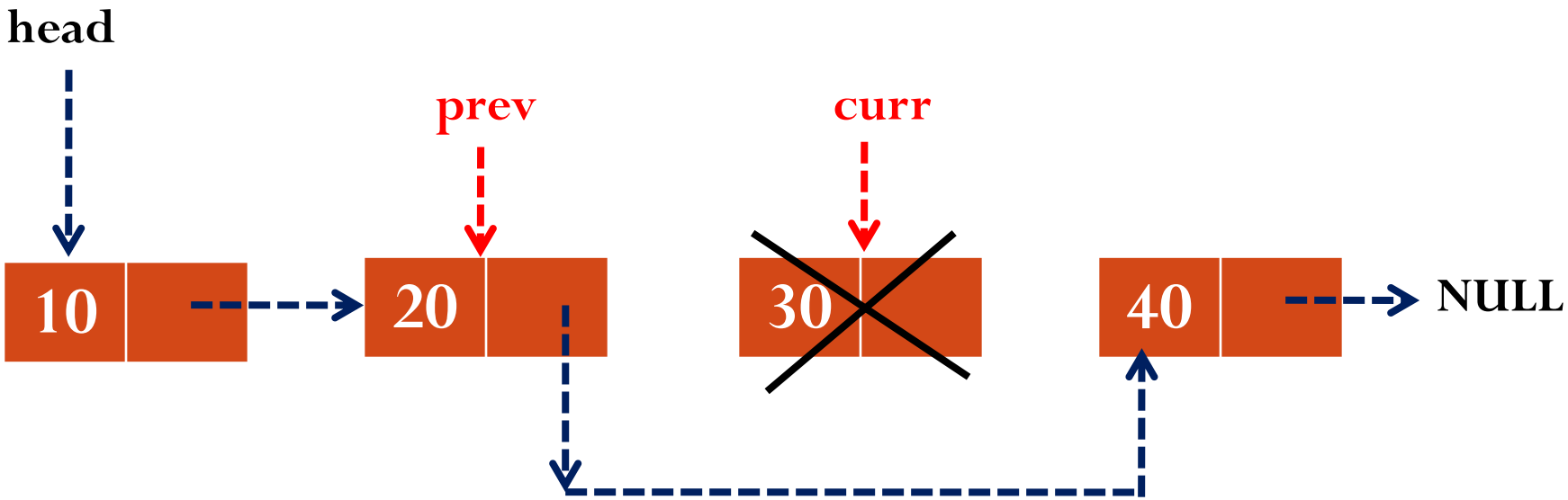
Delete Node 30



Delete Node 30



Delete Node 30

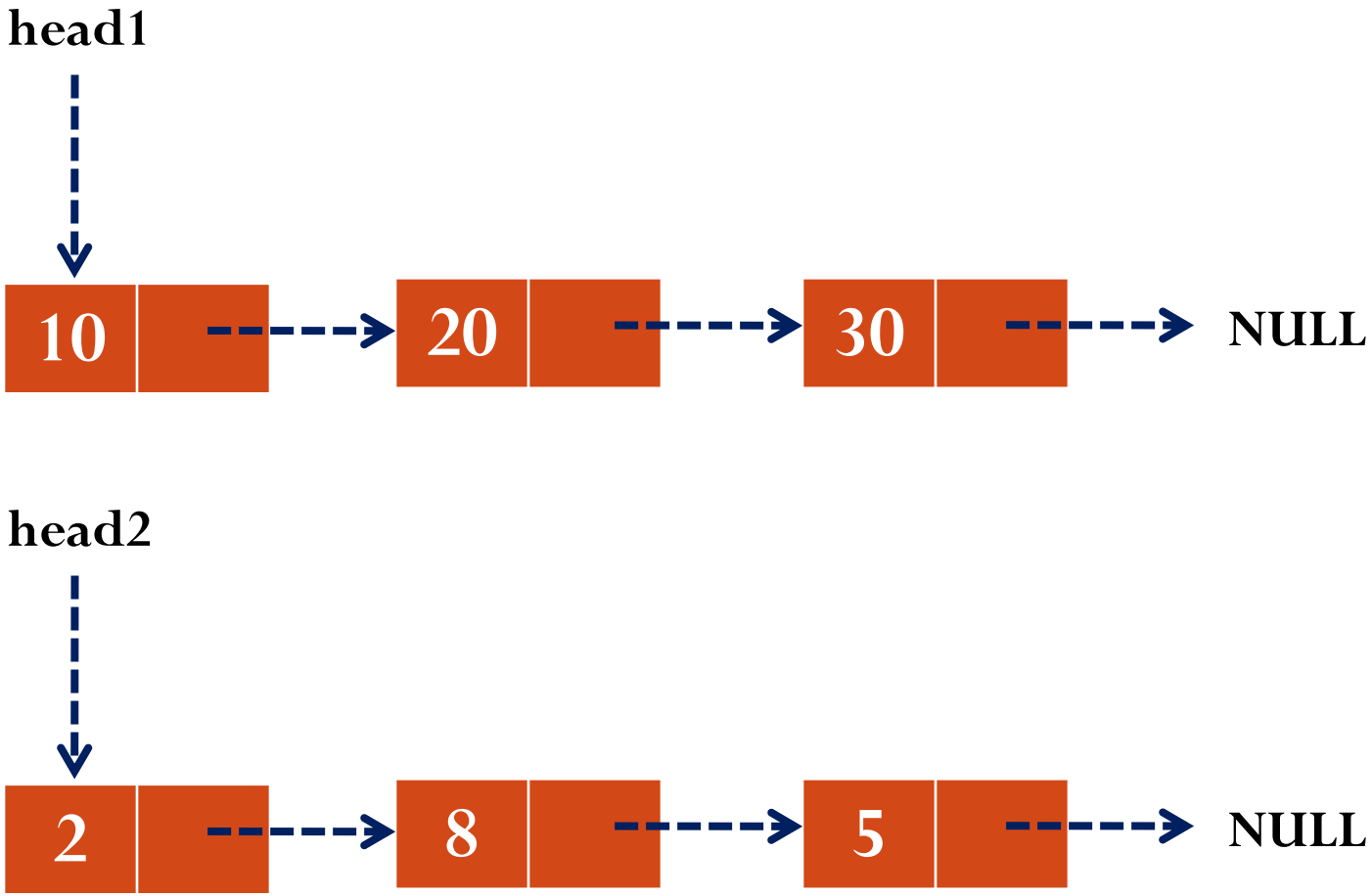


Delete specified node- Algorithm

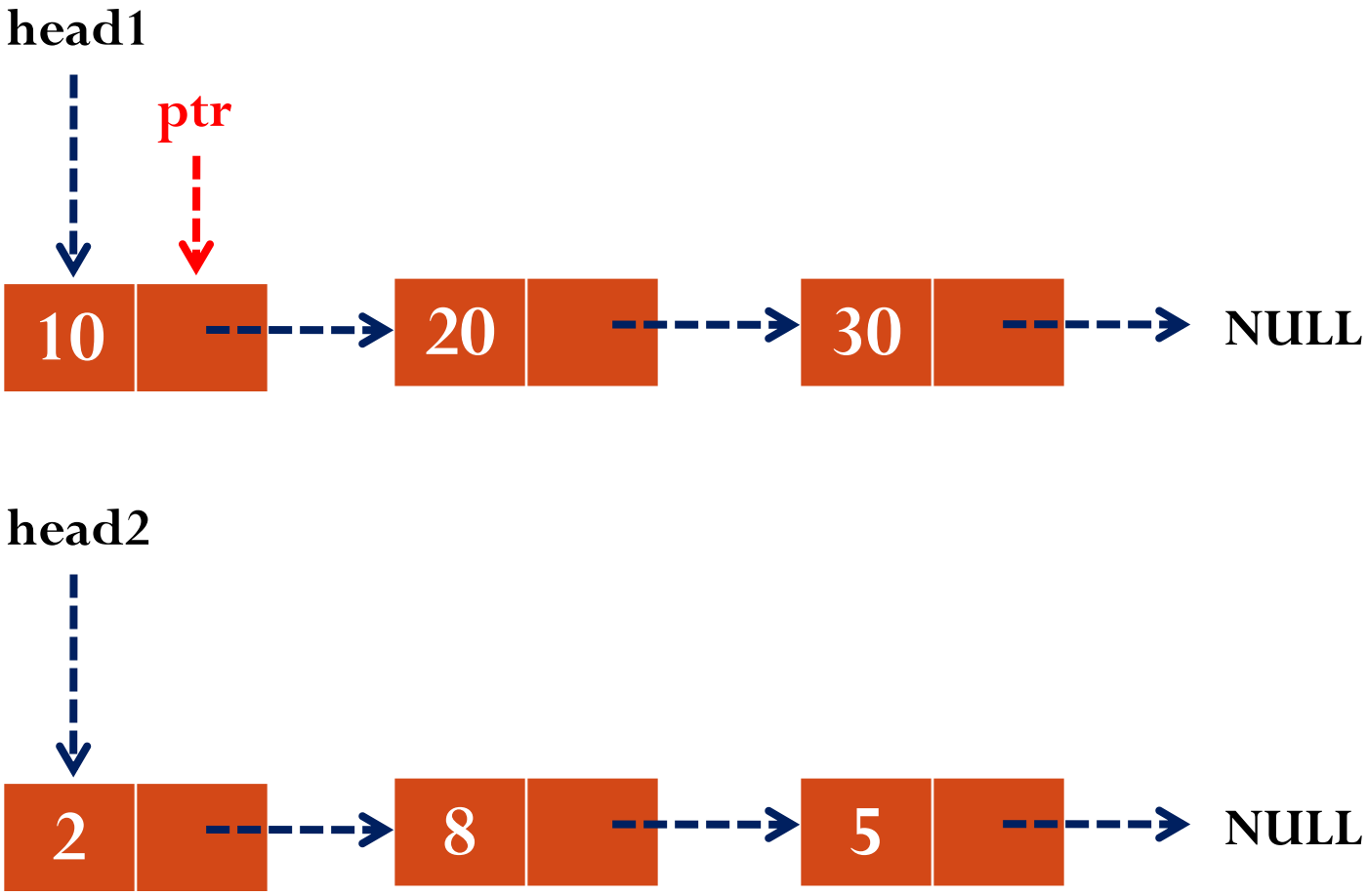
Algorithm Delete_Any(head, key)

1. If head=NULL then
    1. Print "List is Empty"
2. Else if head→data = key then head=head→link
3. Else
    1. prev=head
    2. curr=head
    3. while curr→data != key and curr→link != NULL do
        1. prev = curr
        2. curr = curr→link
    4. If curr→data != key then
        1. Print "Search key not found"
    5. Else prev→link = curr→link

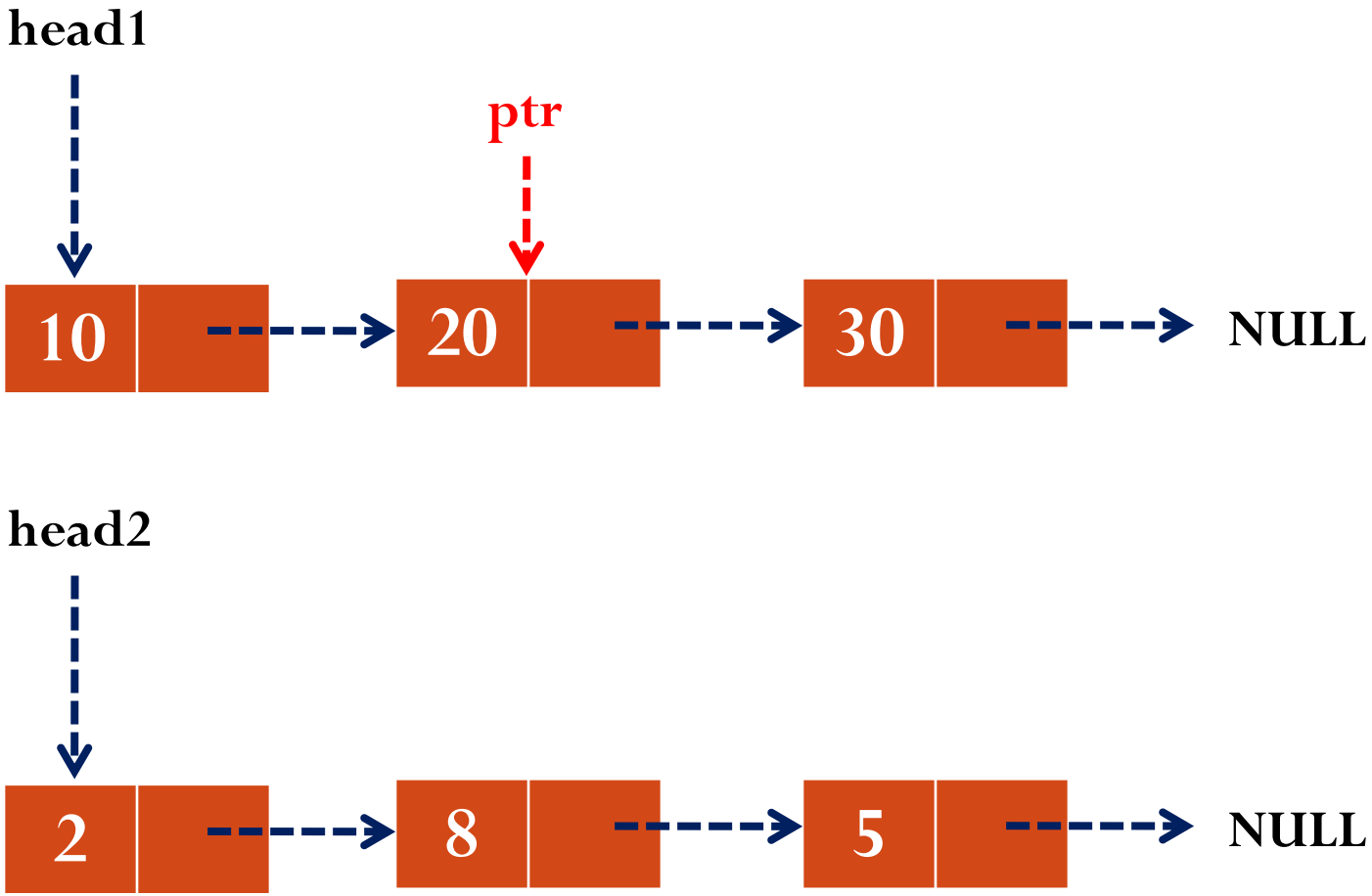
Merge



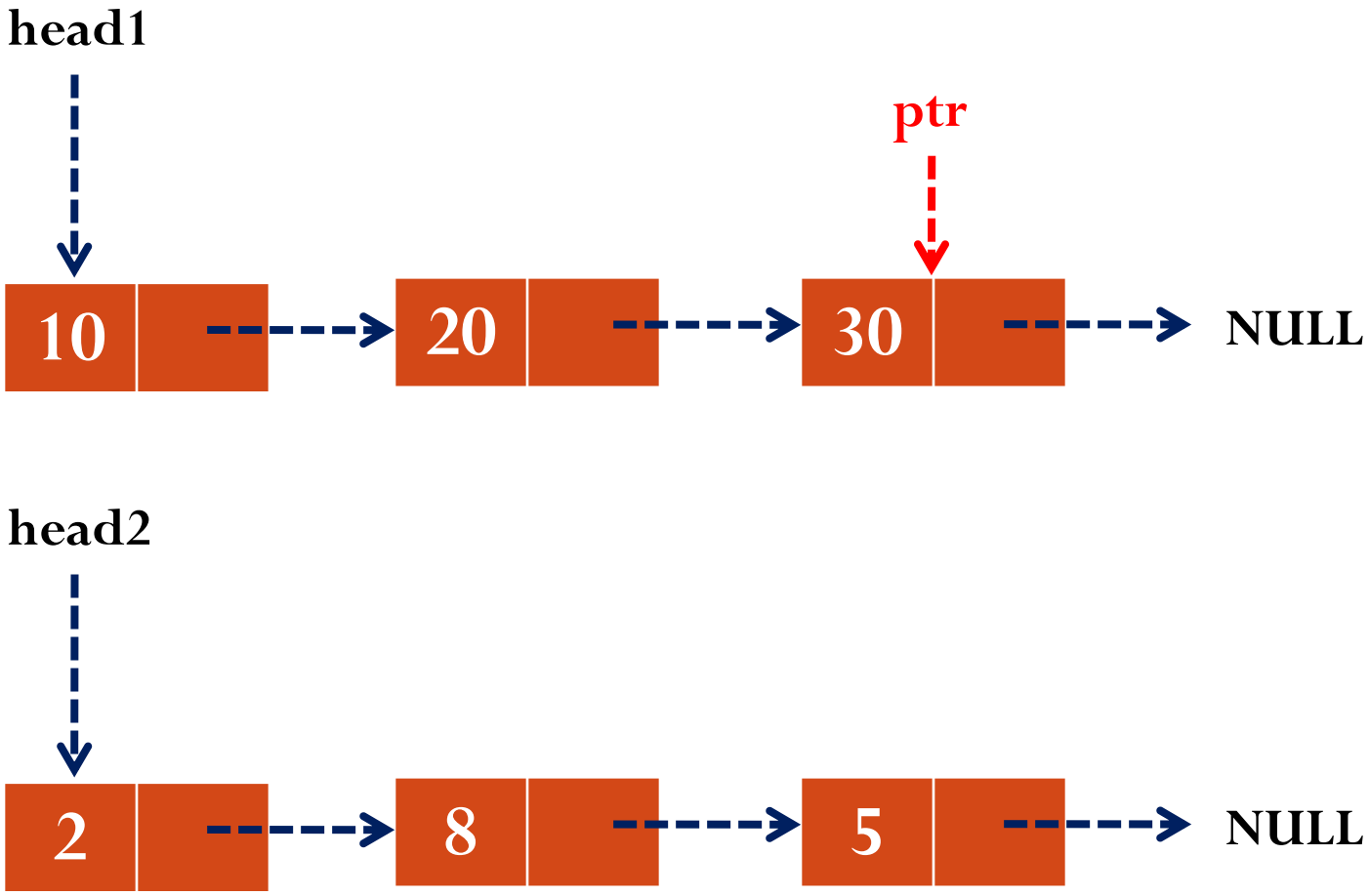
Merge



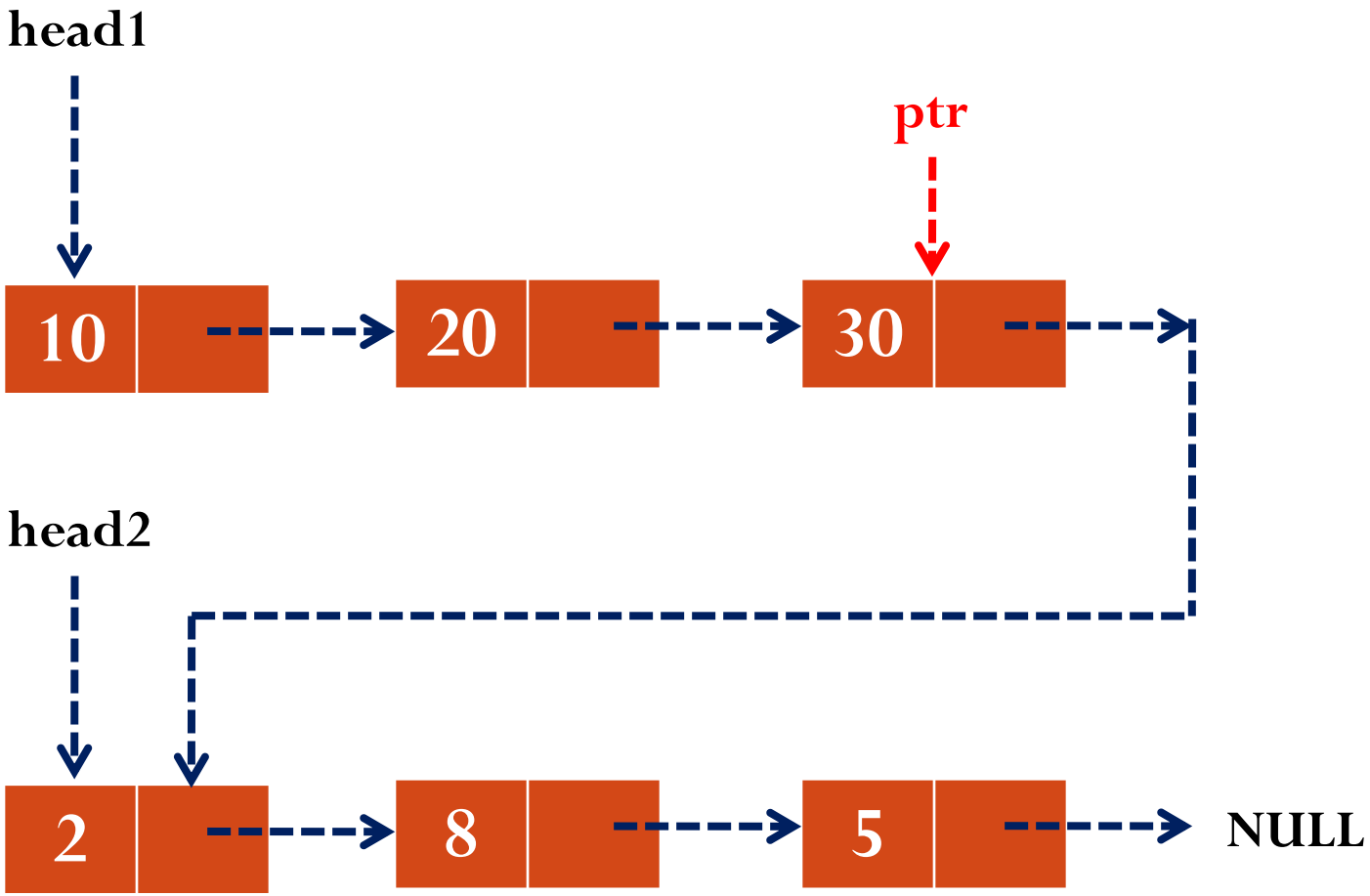
Merge



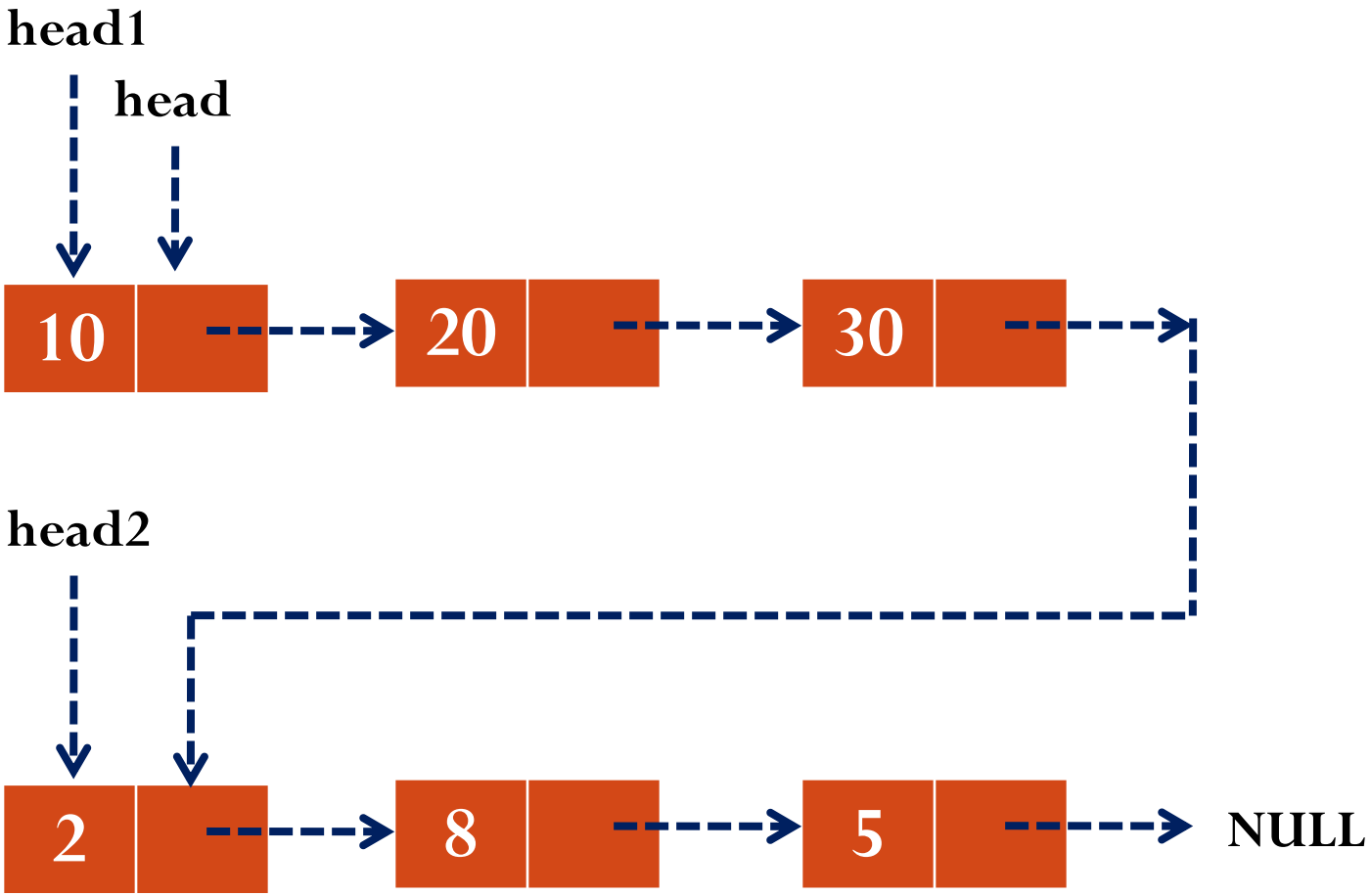
Merge



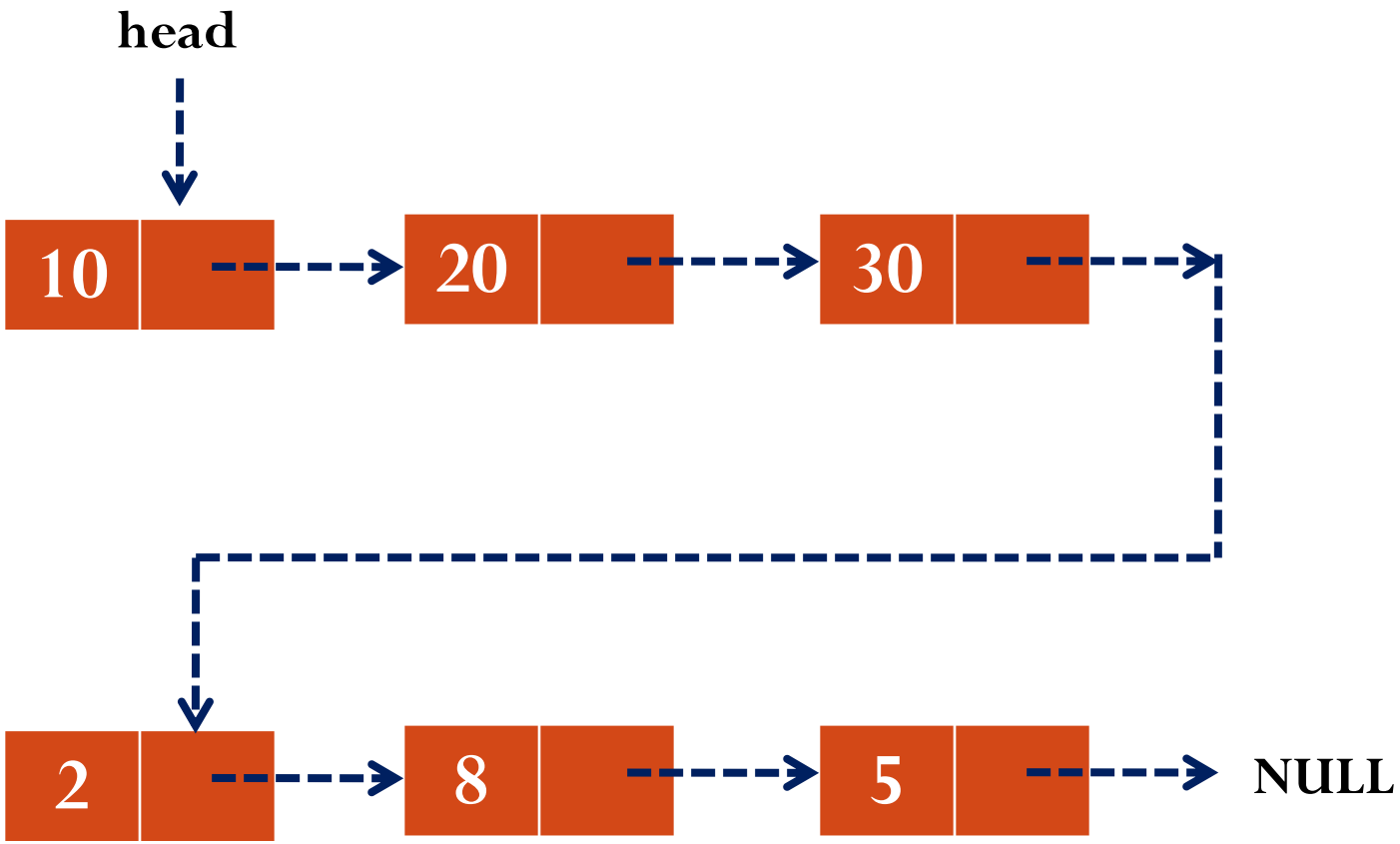
Merge



Merge



Merge



Merge ~ Algorithm

Algorithm Merge(head1, head2)

1. ptr = head1
2. while ptr→link !=NULL then
    1. ptr = ptr→link
3. ptr →link = head2
4. head=head1