

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

Polynomial Representation using Linked List

- General form of a polynomial

$$a_n x^n + a_{n-1} x^{n-1} + \dots + a_0 x^0$$

- A node represents a single term in the polynomial

Coeff	Expo	Link
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- Number of nodes required = number of terms in the polynomial

Polynomial Representation using Linked List

- Example: $5x^3+4x^2-3x+7$



Operations on Polynomial

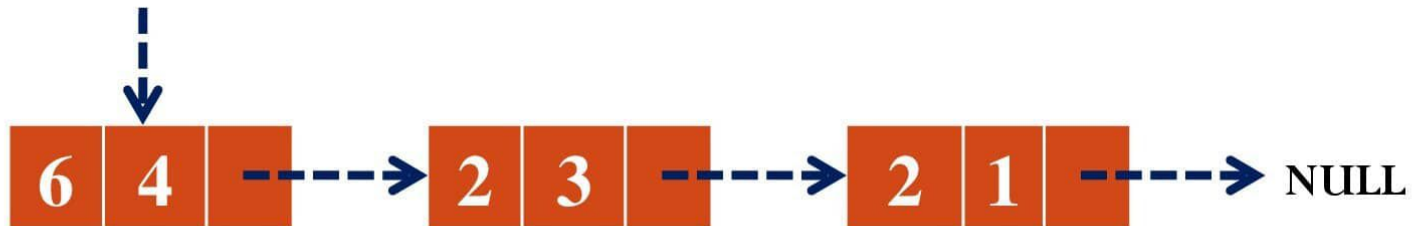
- Polynomial Addition
- Polynomial Multiplication

Polynomial Addition

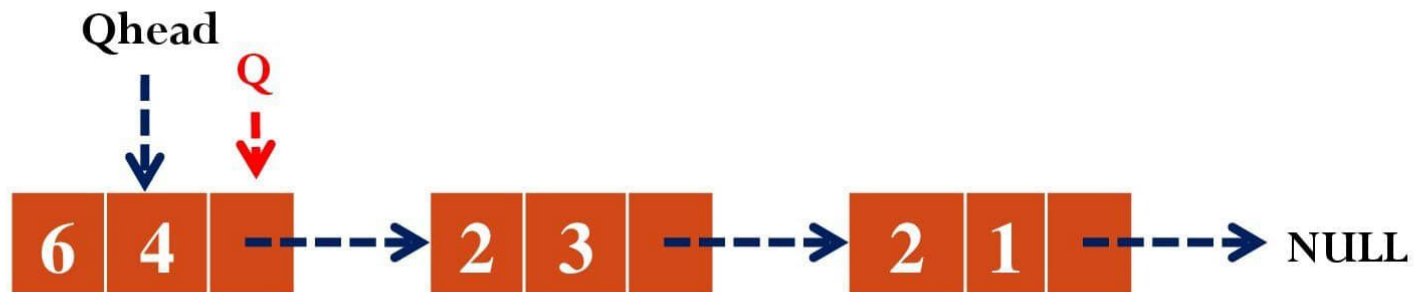
Phead



Qhead



Polynomial Addition

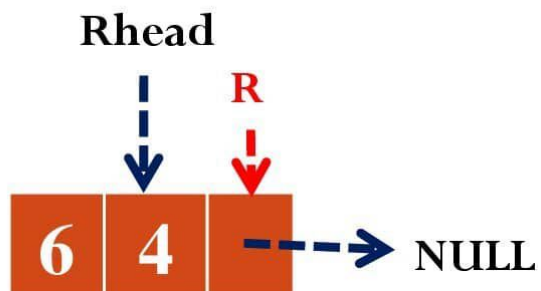
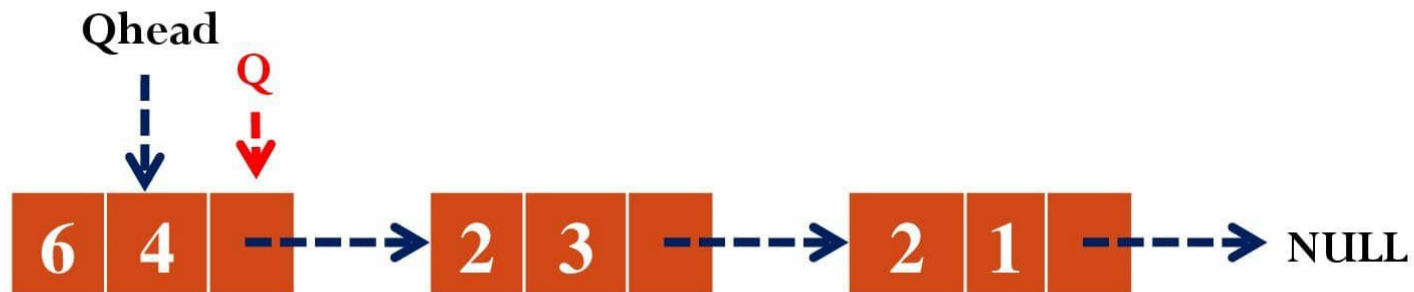


Rhead

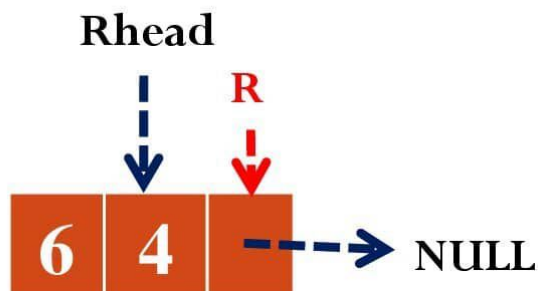
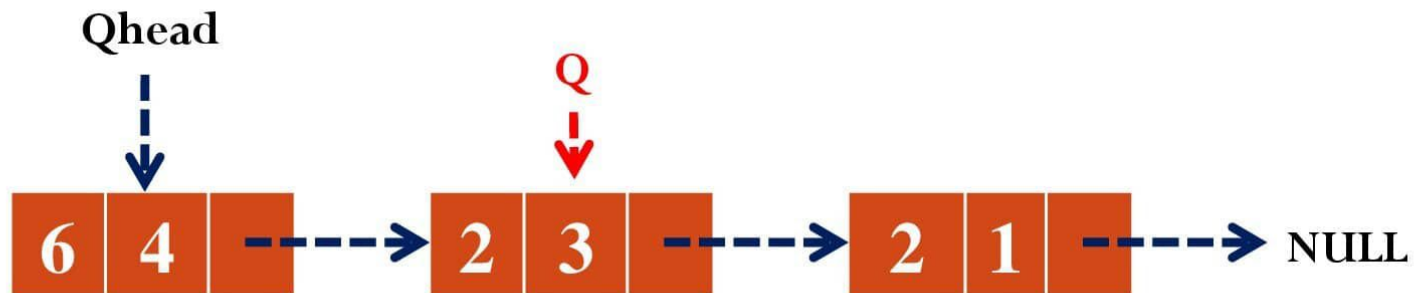


NULL

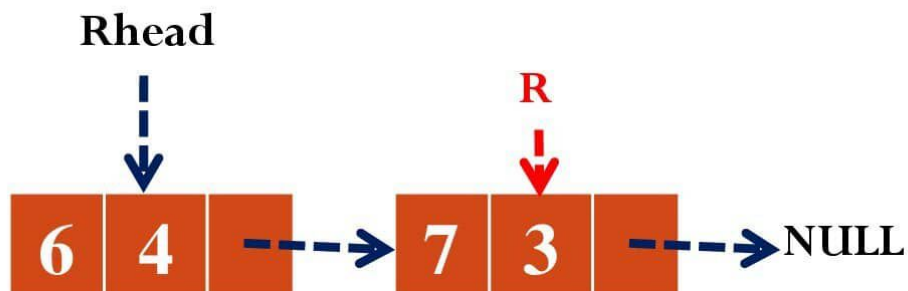
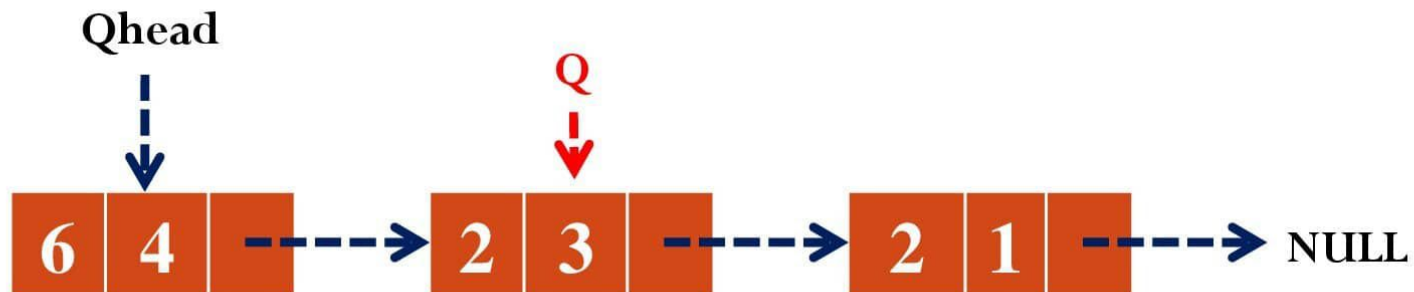
Polynomial Addition



Polynomial Addition



Polynomial Addition

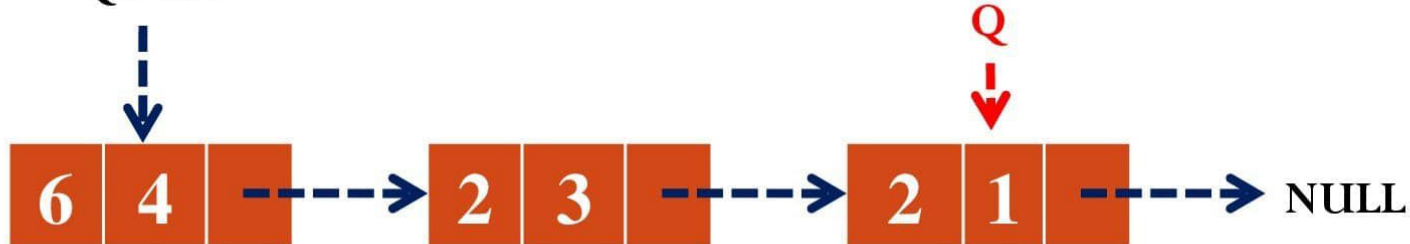


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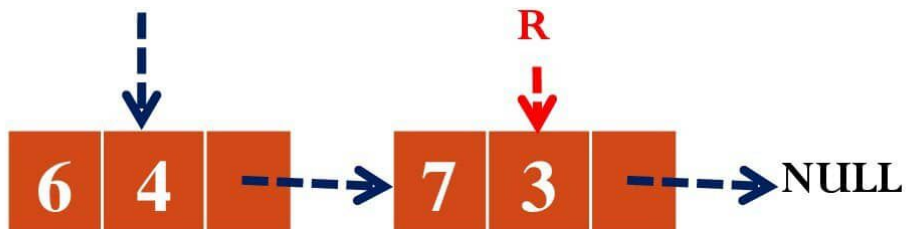
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Qhead



Rhead

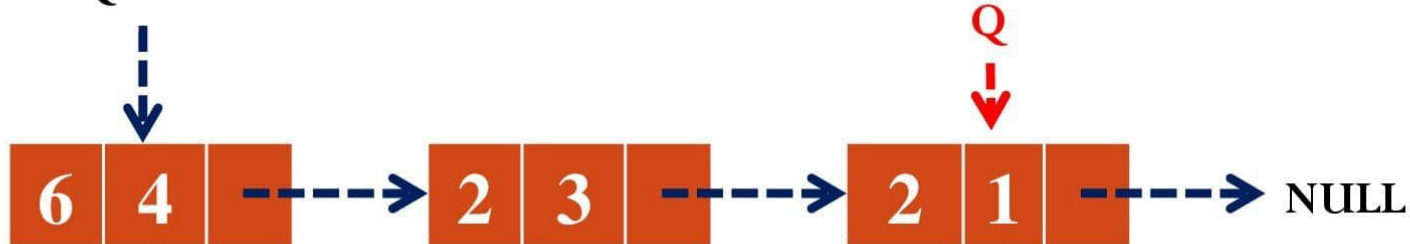


Polynomial Addition

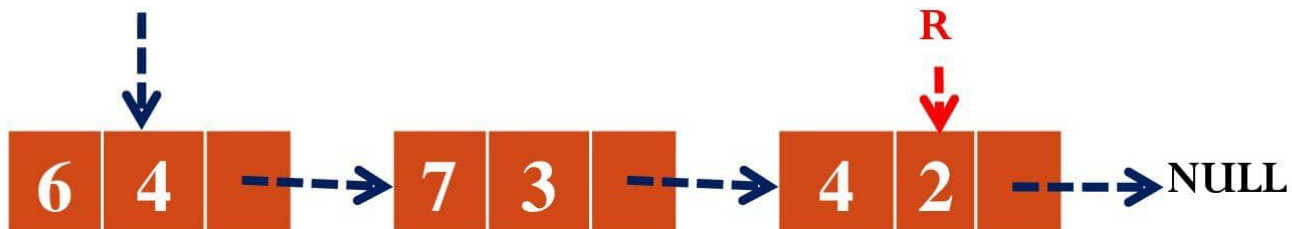
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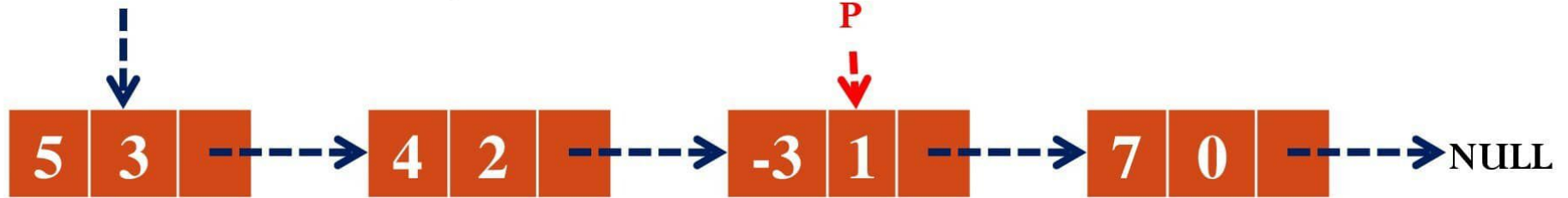


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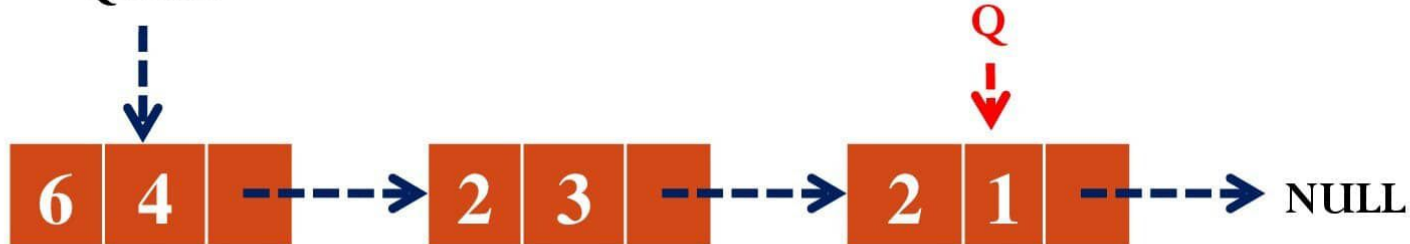


Polynomial Addition

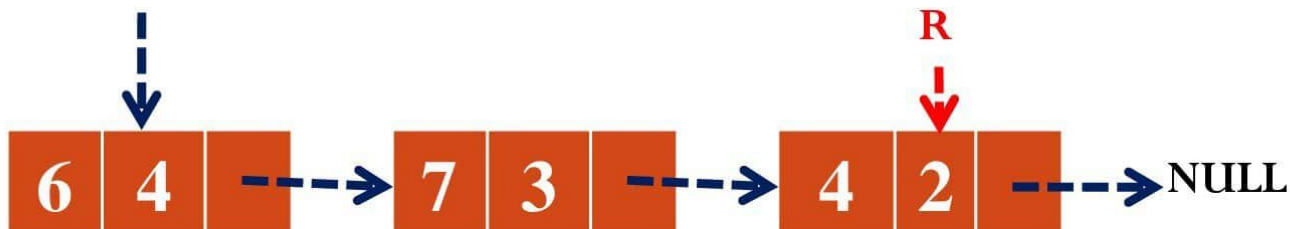
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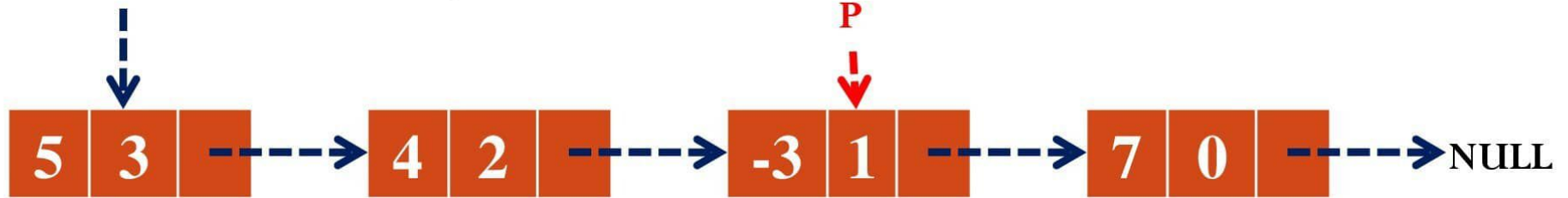


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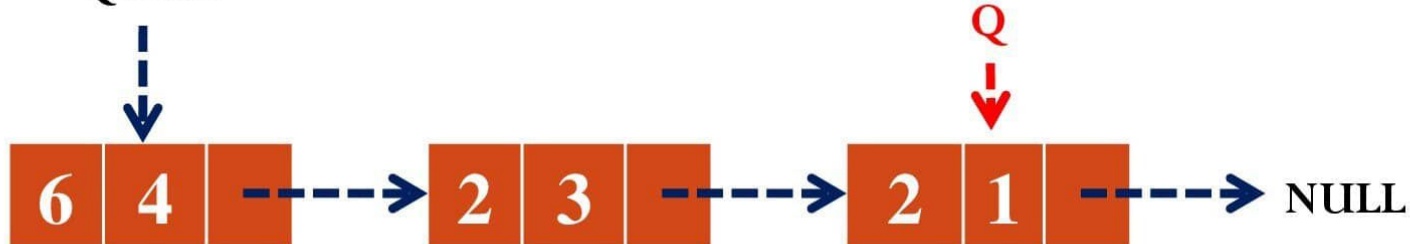


Polynomial Addition

Phead



Qhead



Rhead

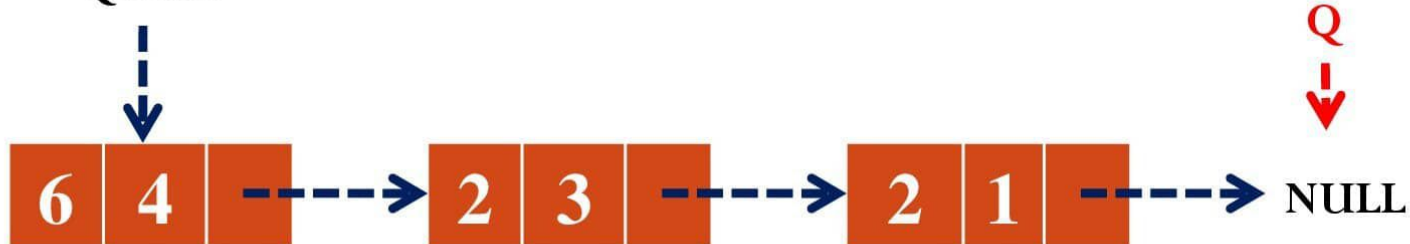


Polynomial Addition

Phead



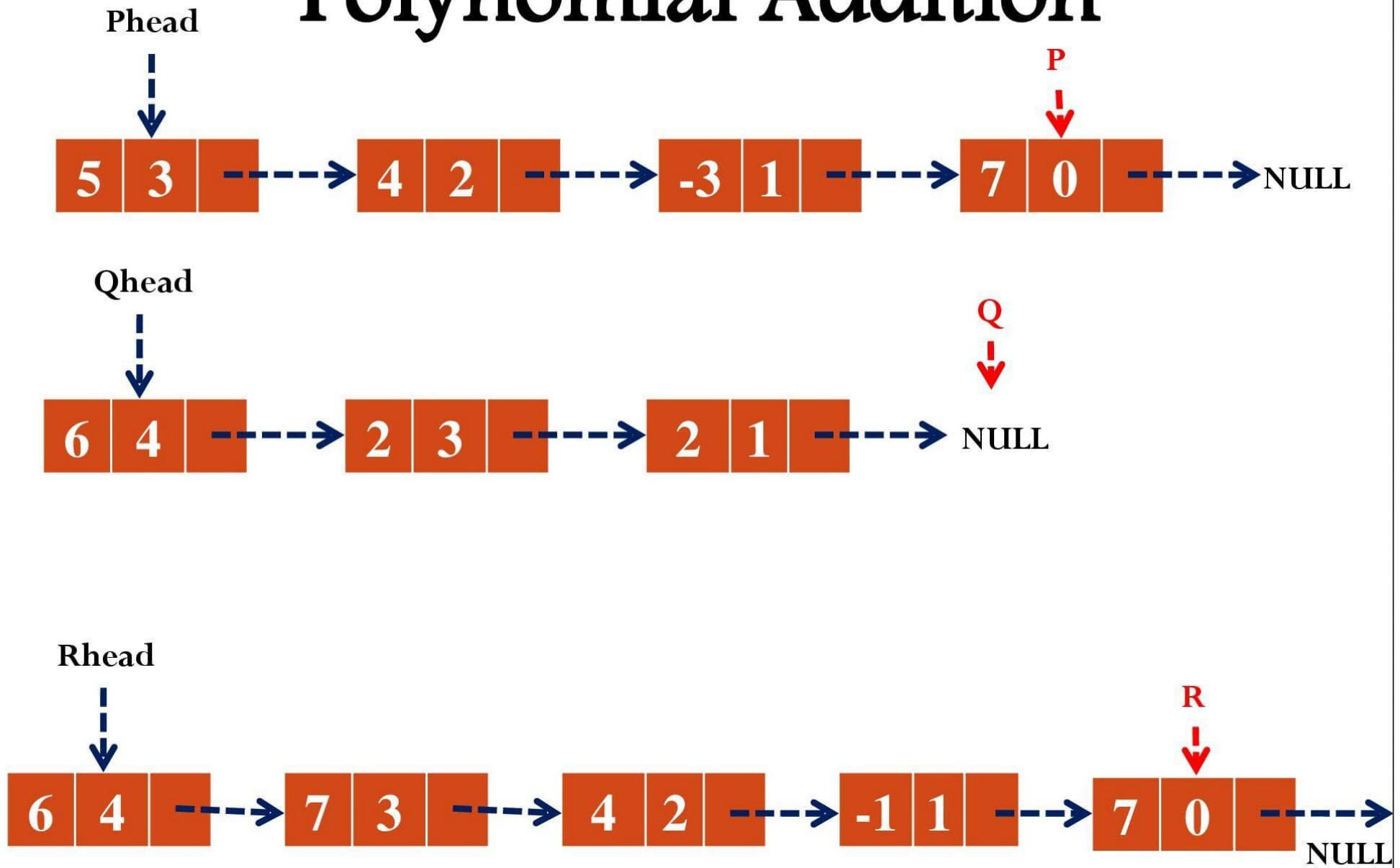
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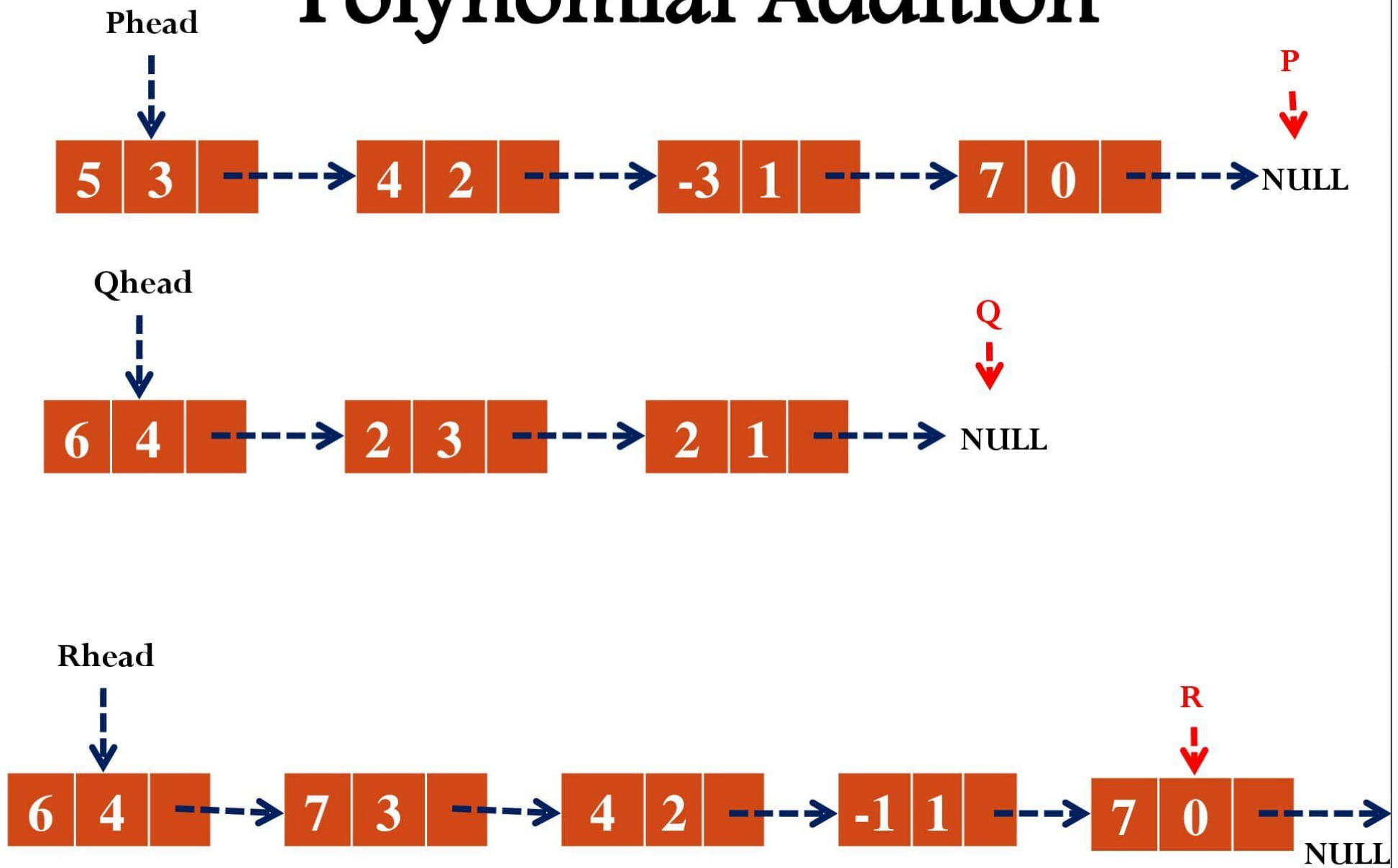
Rhead



Polynomial Addition



Polynomial Addition



Polynomial Addition ~ Algorithm

Algorithm AddPoly(Phead, Qhead)

1. $P = Phead$
2. $Q = Qhead$
3. $Rhead = NULL$
4. While $P \neq NULL$ and $Q \neq NULL$ do
 1. Create a node new
 2. If $P \rightarrow Expo = Q \rightarrow Expo$ then
 1. $new \rightarrow Coeff = P \rightarrow Coeff + Q \rightarrow Coeff$
 2. $new \rightarrow Expo = P \rightarrow Expo$
 3. $new \rightarrow Link = NULL$
 4. $P = P \rightarrow Link$
 5. $Q = Q \rightarrow Link$

2. Else If $P \rightarrow \text{Expo} > Q \rightarrow \text{Expo}$ then
 1. $\text{new} \rightarrow \text{Coeff} = P \rightarrow \text{Coeff}$
 2. $\text{new} \rightarrow \text{Expo} = P \rightarrow \text{Expo}$
 3. $\text{new} \rightarrow \text{Link} = \text{NULL}$
 4. $P = P \rightarrow \text{Link}$
3. Else
 1. $\text{new} \rightarrow \text{Coeff} = Q \rightarrow \text{Coeff}$
 2. $\text{new} \rightarrow \text{Expo} = Q \rightarrow \text{Expo}$
 3. $\text{new} \rightarrow \text{Link} = \text{NULL}$
 4. $Q = Q \rightarrow \text{Link}$
4. If $\text{Rhead} = \text{NULL}$ then
 1. $\text{Rhead} = R = \text{new}$
5. Else
 1. $R \rightarrow \text{Link} = \text{new}$
 2. $R = \text{new}$

5. While $P \neq \text{NULL}$ do
 1. Create a node new
 2. $\text{new} \rightarrow \text{Coeff} = P \rightarrow \text{Coeff}$
 3. $\text{new} \rightarrow \text{Expo} = P \rightarrow \text{Expo}$
 4. $\text{new} \rightarrow \text{Link} = \text{NULL}$
 3. If $\text{Rhead} = \text{NULL}$ then
 1. $\text{Rhead} = \text{R} = \text{new}$
 4. Else
 1. $\text{R} \rightarrow \text{Link} = \text{new}$
 2. $\text{R} = \text{new}$
 5. $P = P \rightarrow \text{Link}$

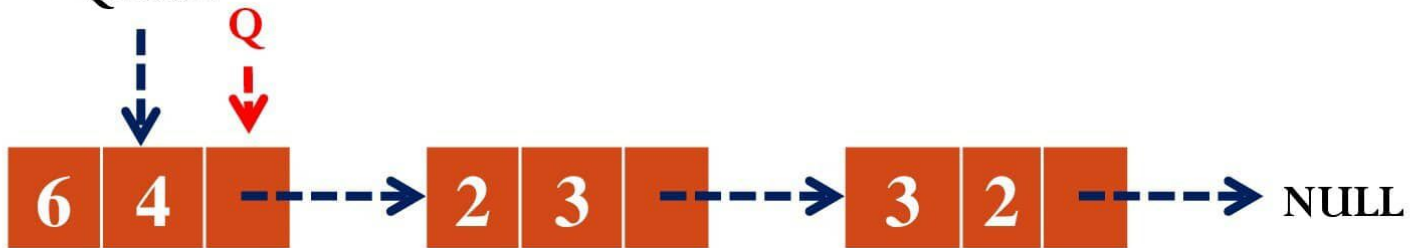
6. While $Q \neq \text{NULL}$ do
 1. Create a node new
 2. $\text{new} \rightarrow \text{Coeff} = Q \rightarrow \text{Coeff}$
 3. $\text{new} \rightarrow \text{Expo} = Q \rightarrow \text{Expo}$
 4. $\text{new} \rightarrow \text{Link} = \text{NULL}$
 3. If $\text{Rhead} = \text{NULL}$ then
 1. $\text{Rhead} = \text{R} = \text{new}$
 4. Else
 1. $\text{R} \rightarrow \text{Link} = \text{new}$
 2. $\text{R} = \text{new}$
 5. $Q = Q \rightarrow \text{Link}$

Polynomial Multiplication

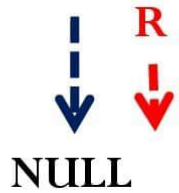
Phead



Qhead



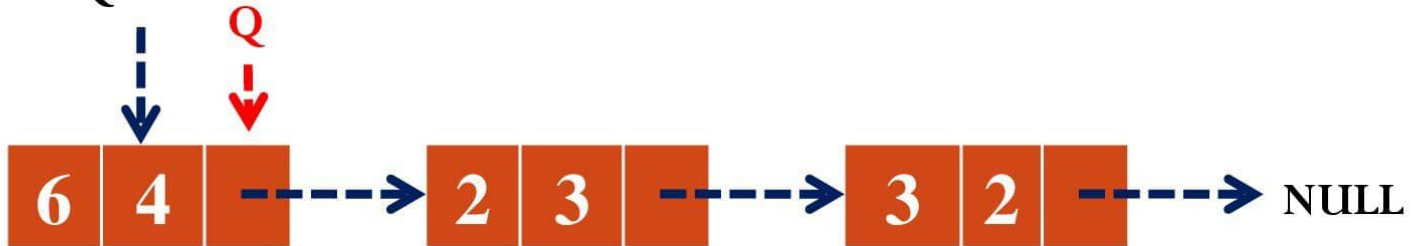
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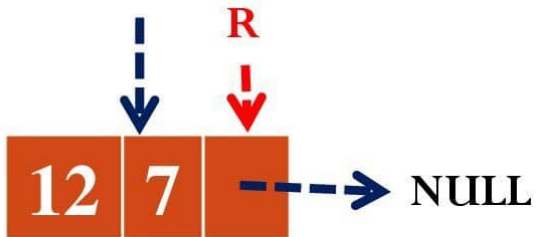
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Qhead



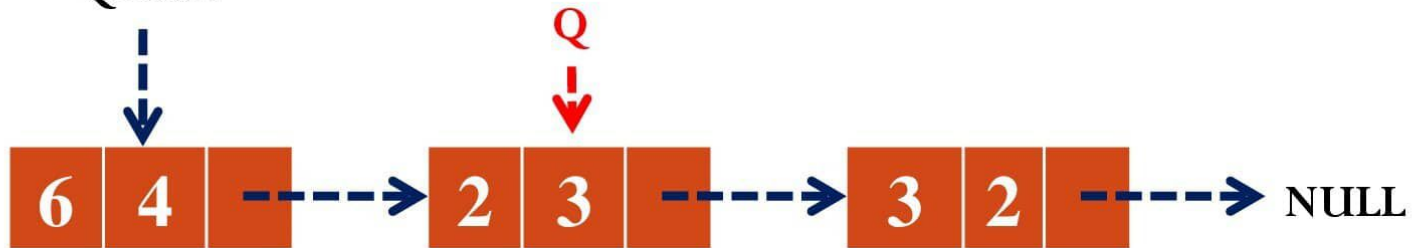
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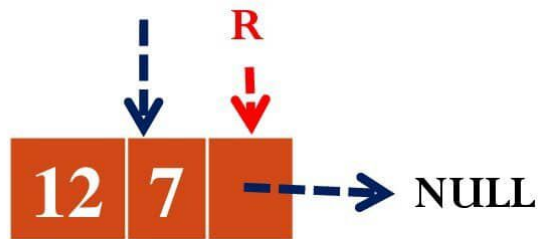
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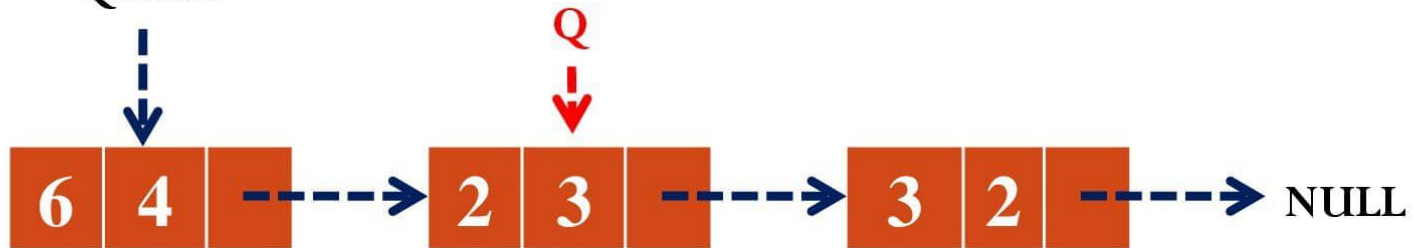
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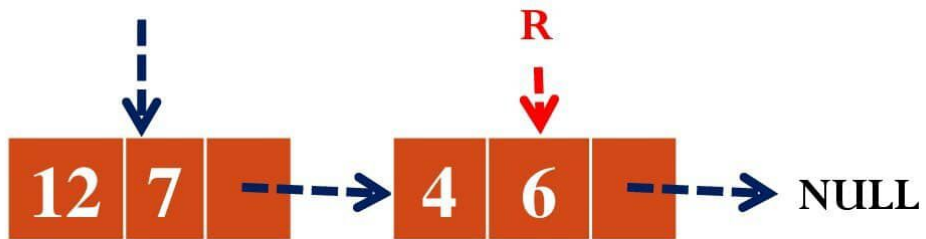
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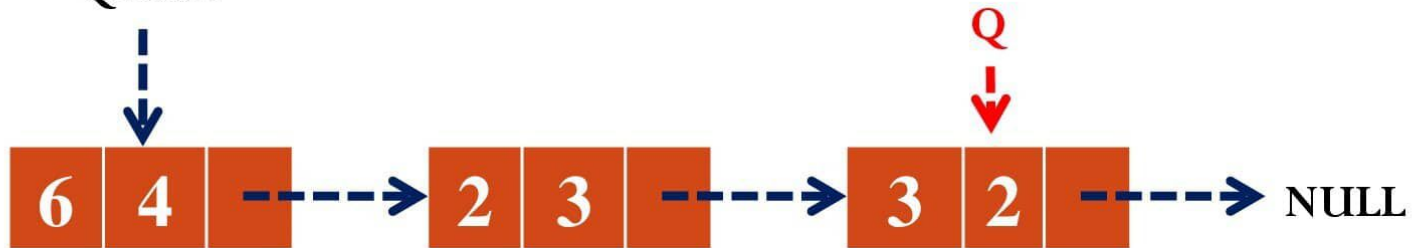
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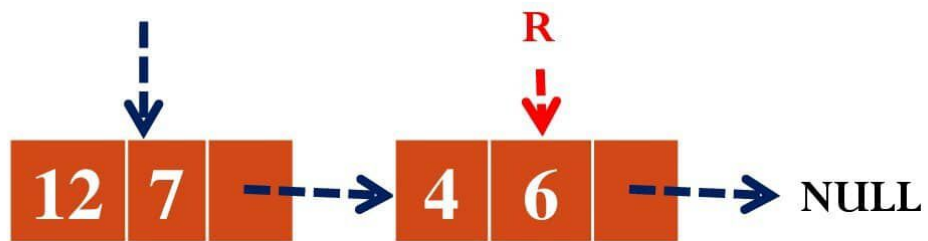
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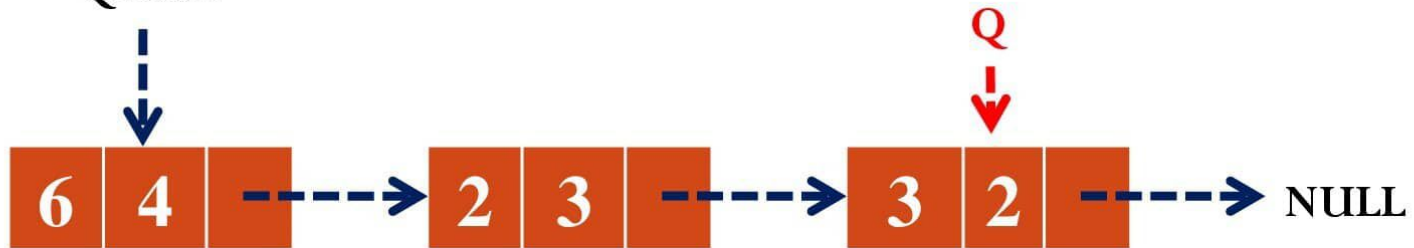
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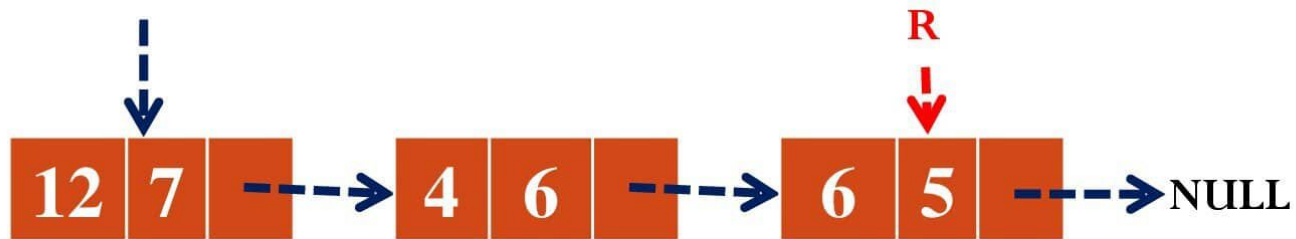
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Qhead



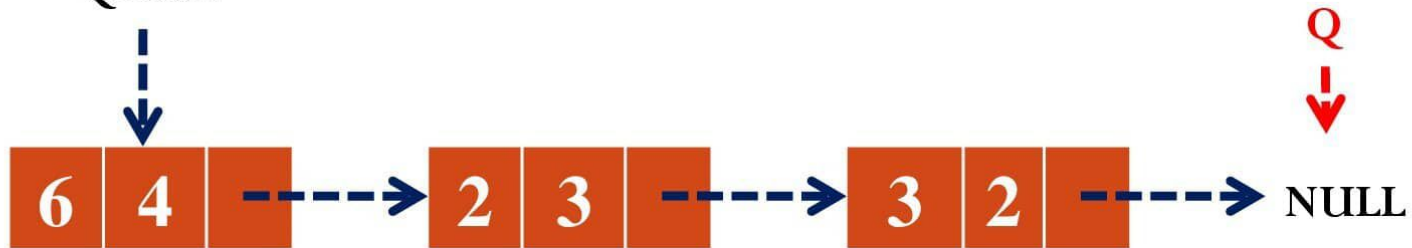
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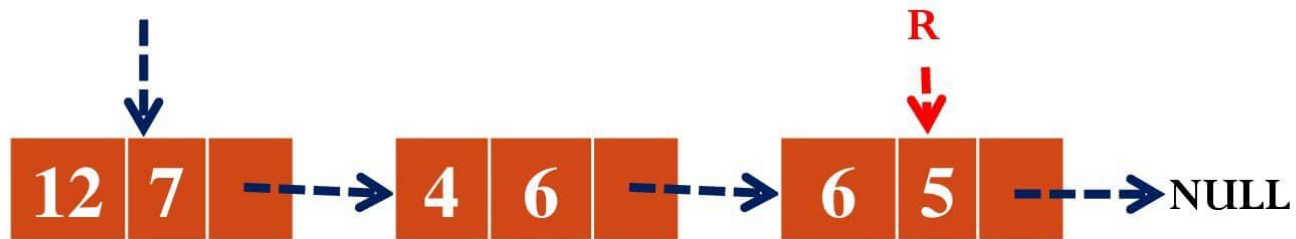
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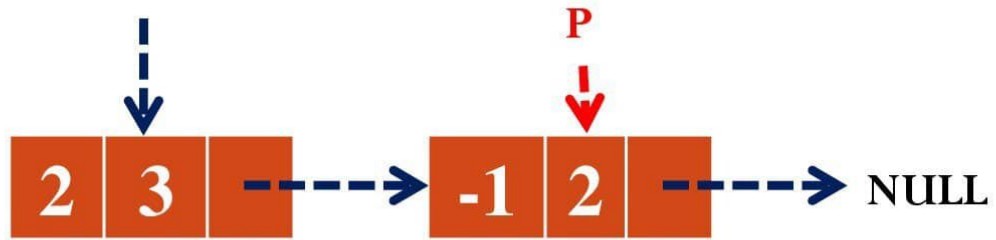
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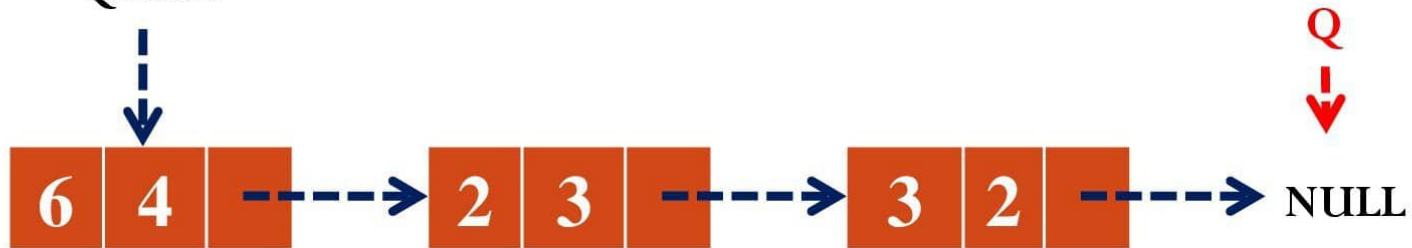
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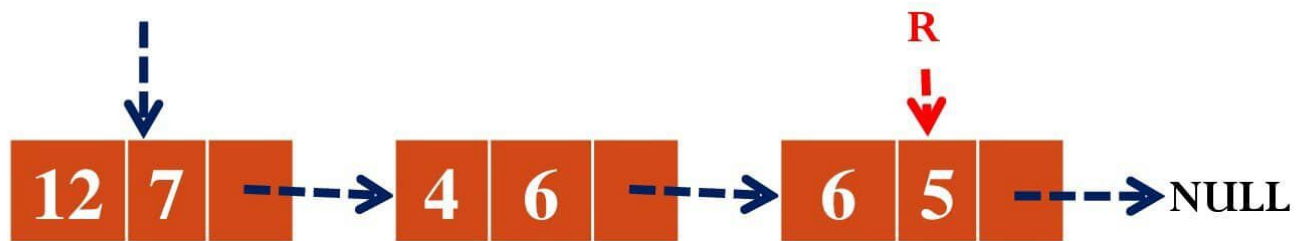
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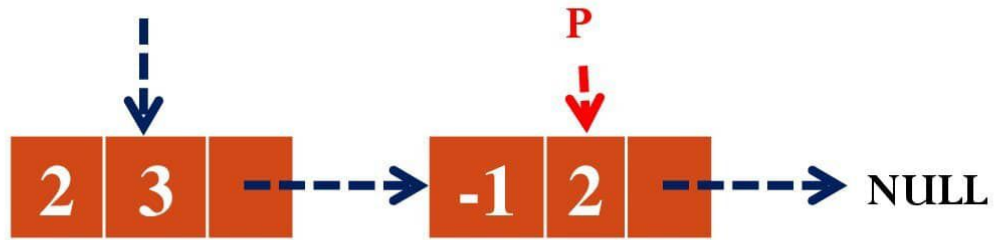
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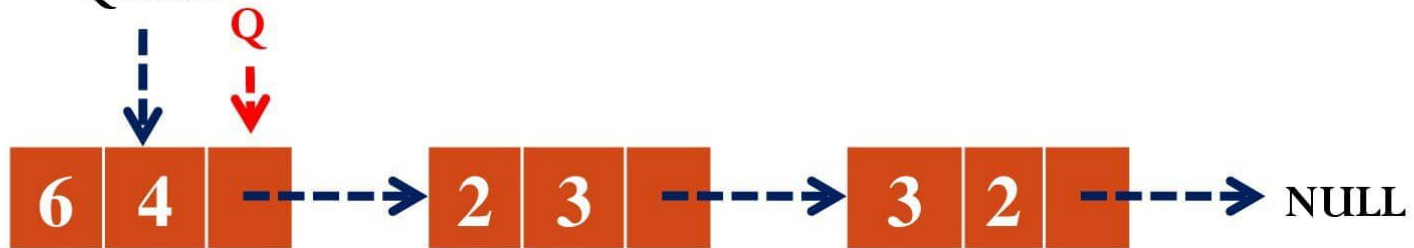
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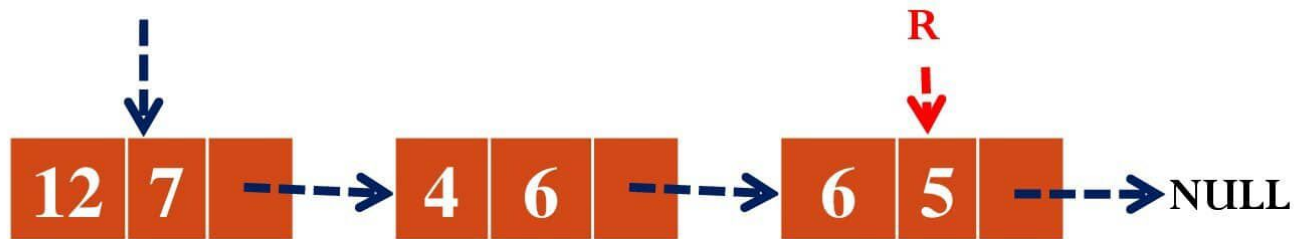
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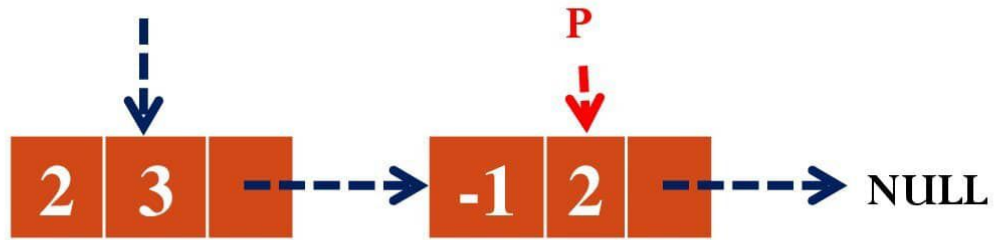
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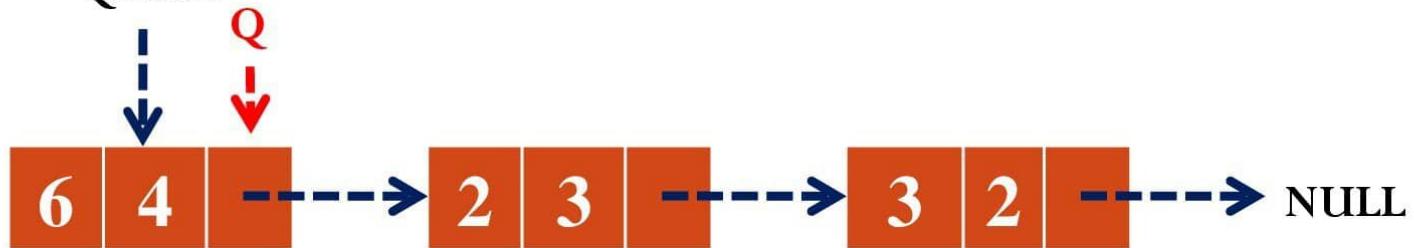
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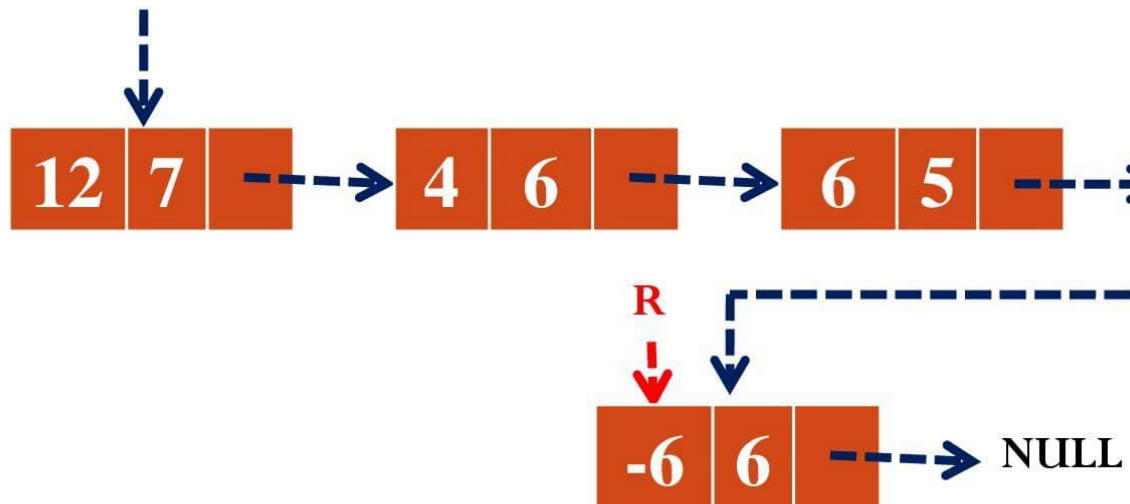
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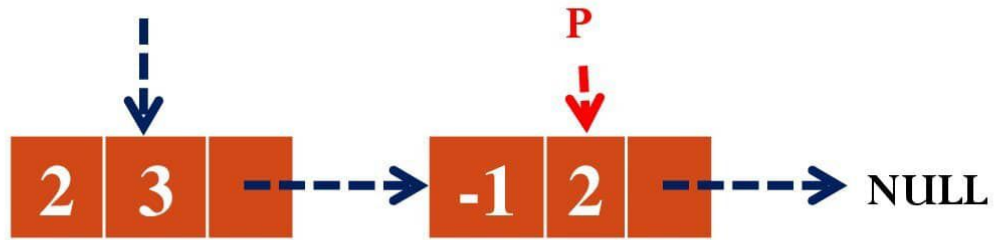
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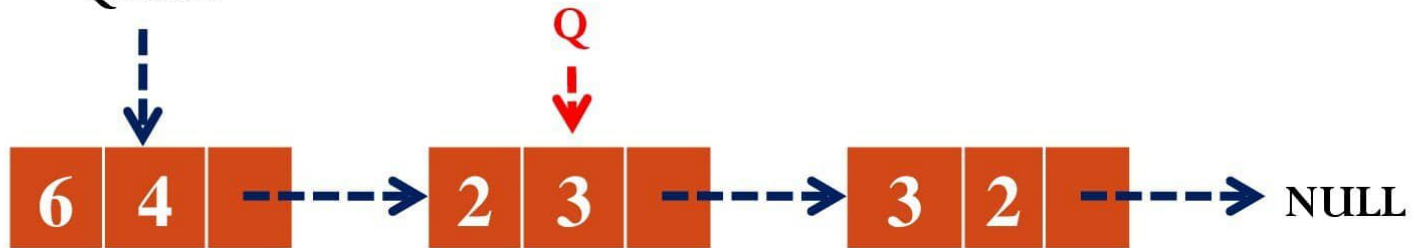
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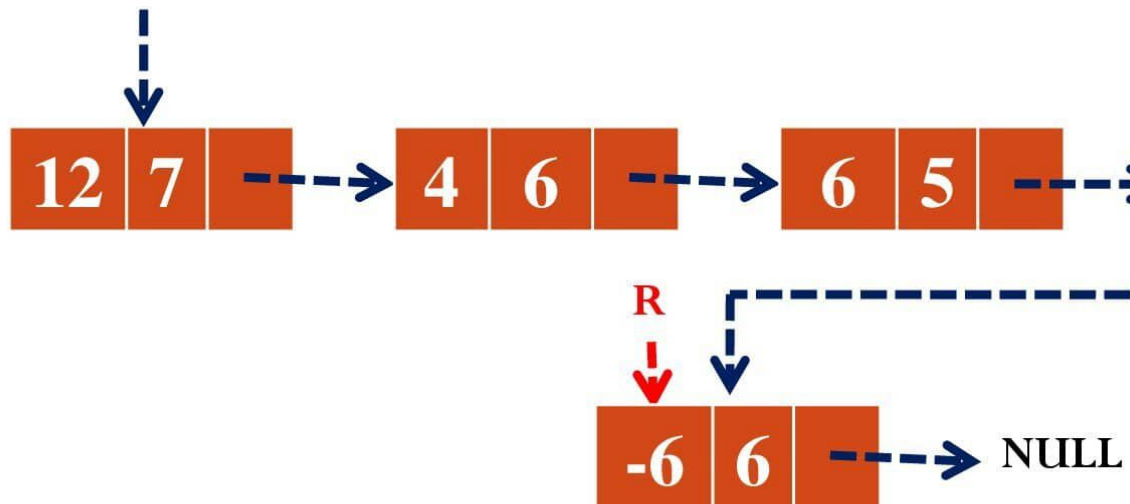
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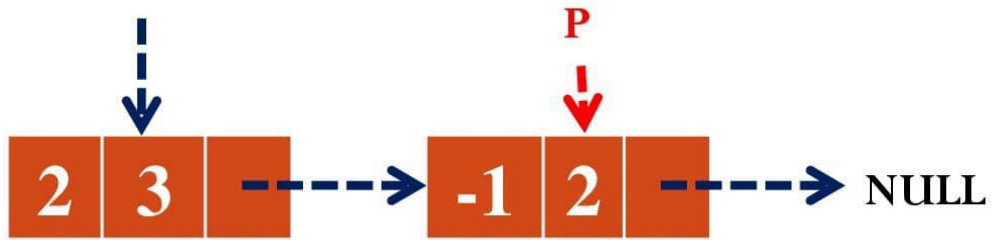
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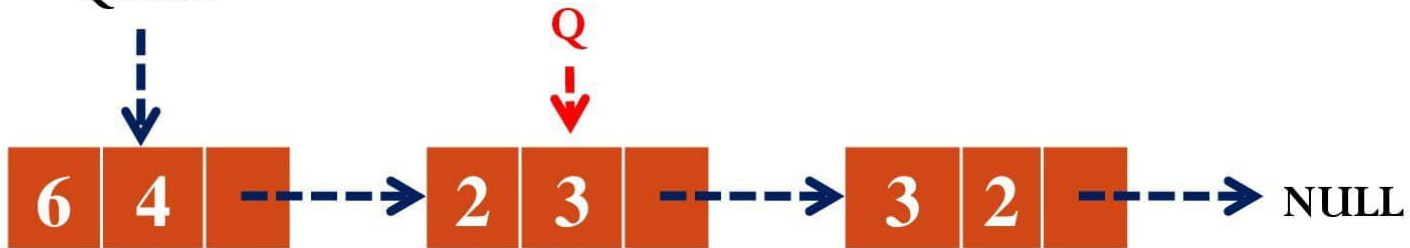
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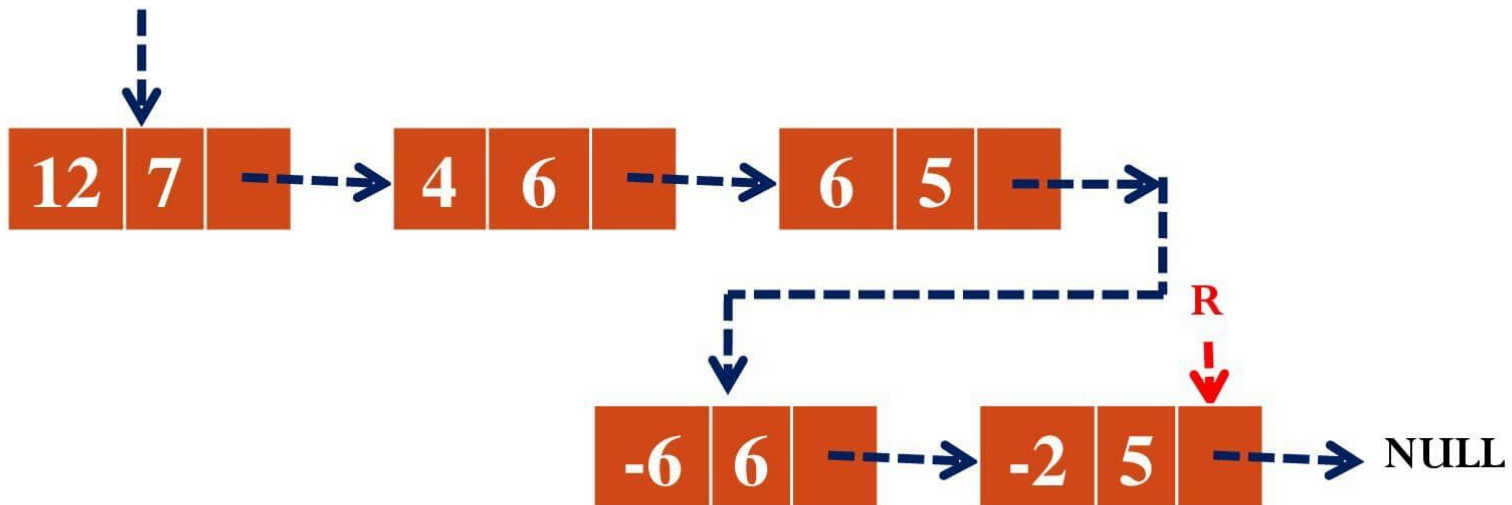
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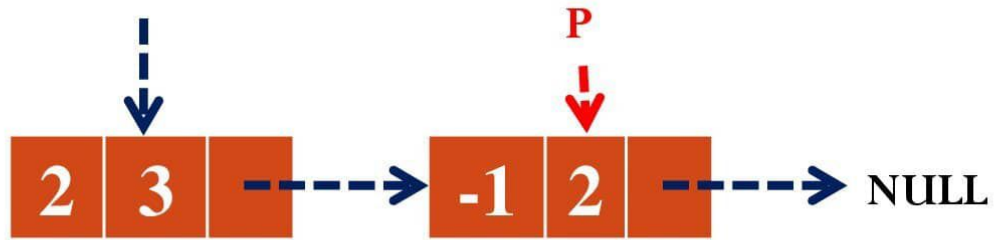
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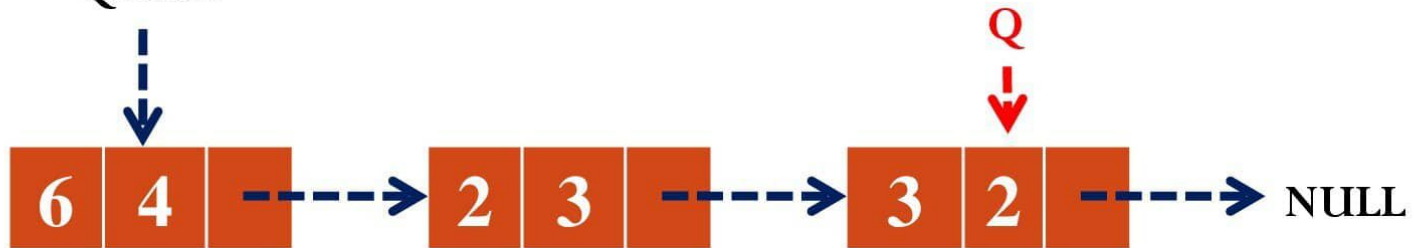
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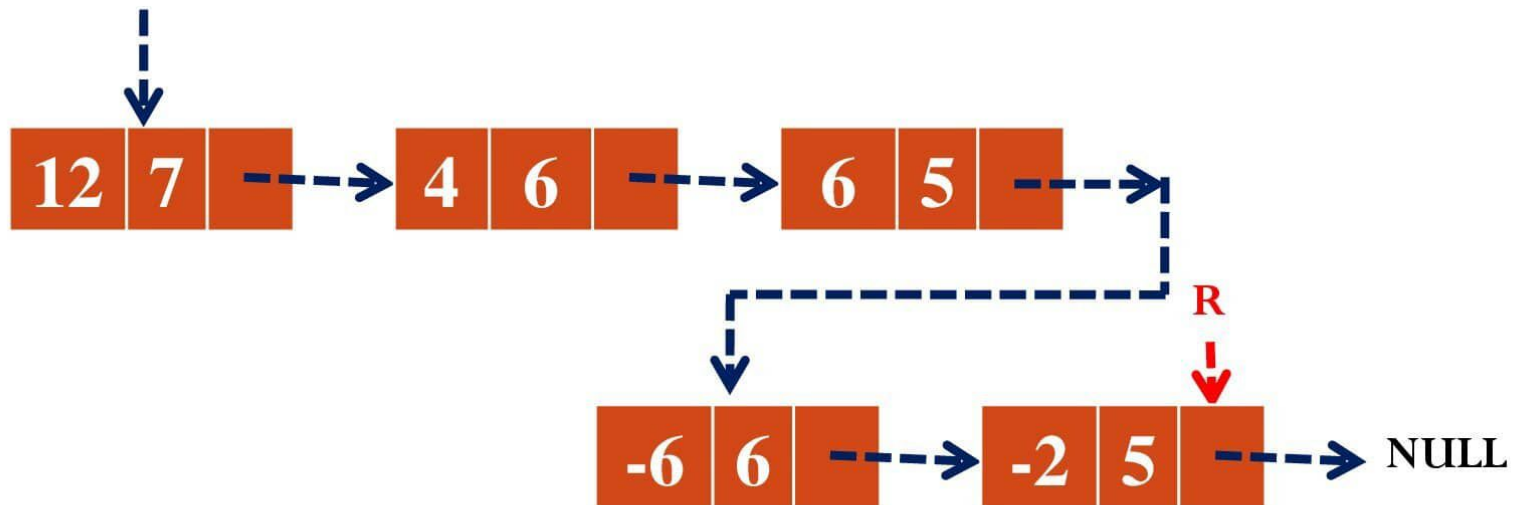
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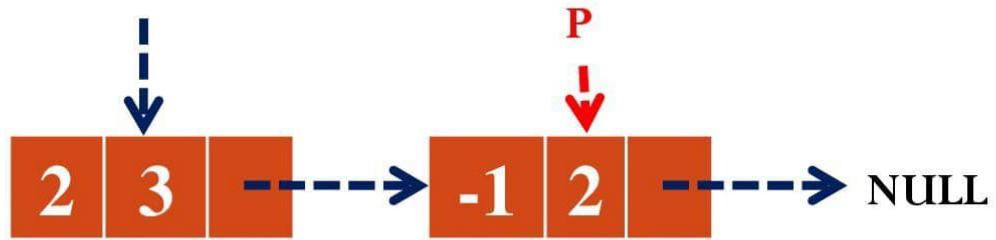
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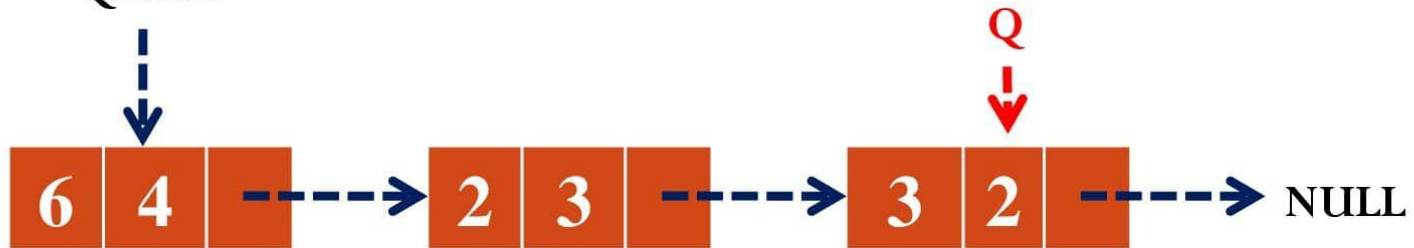
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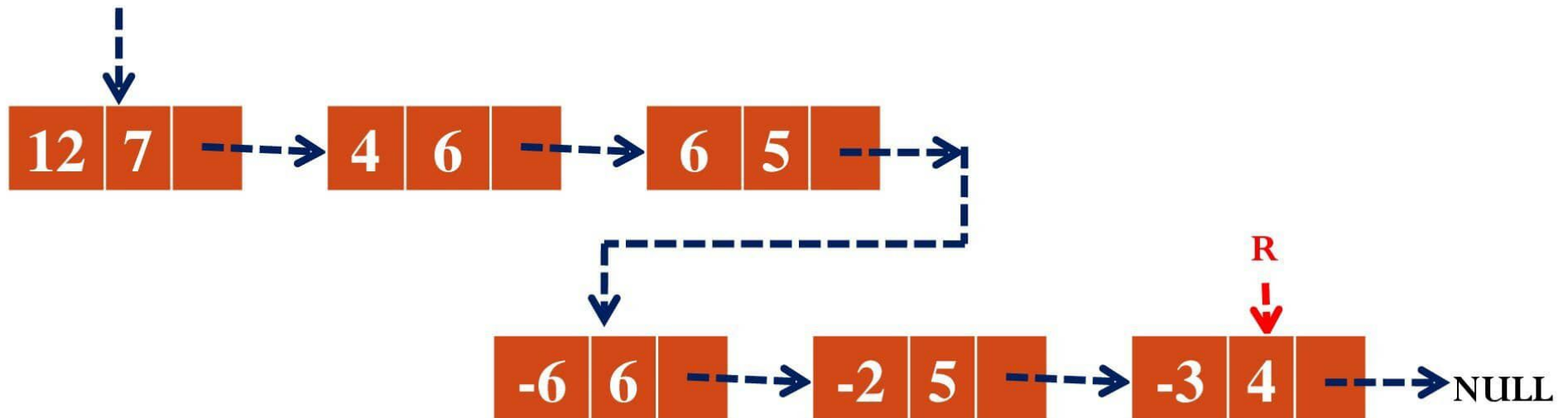
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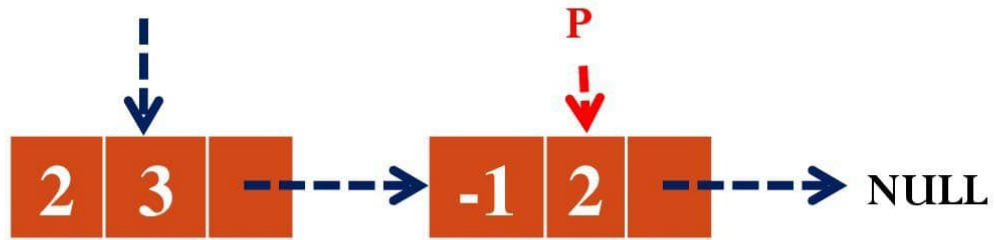
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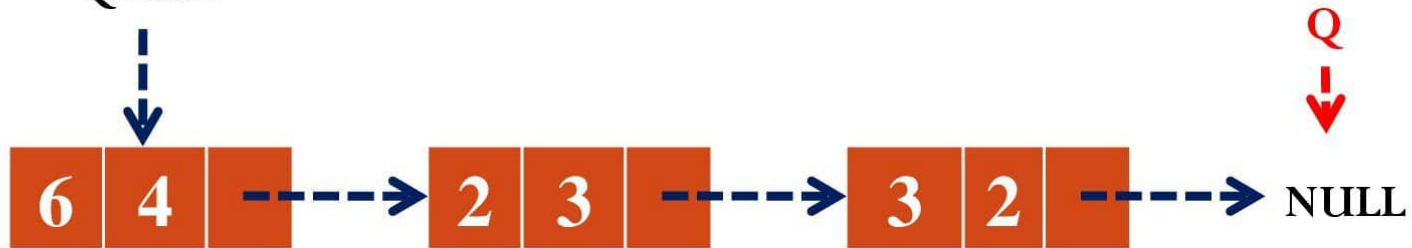
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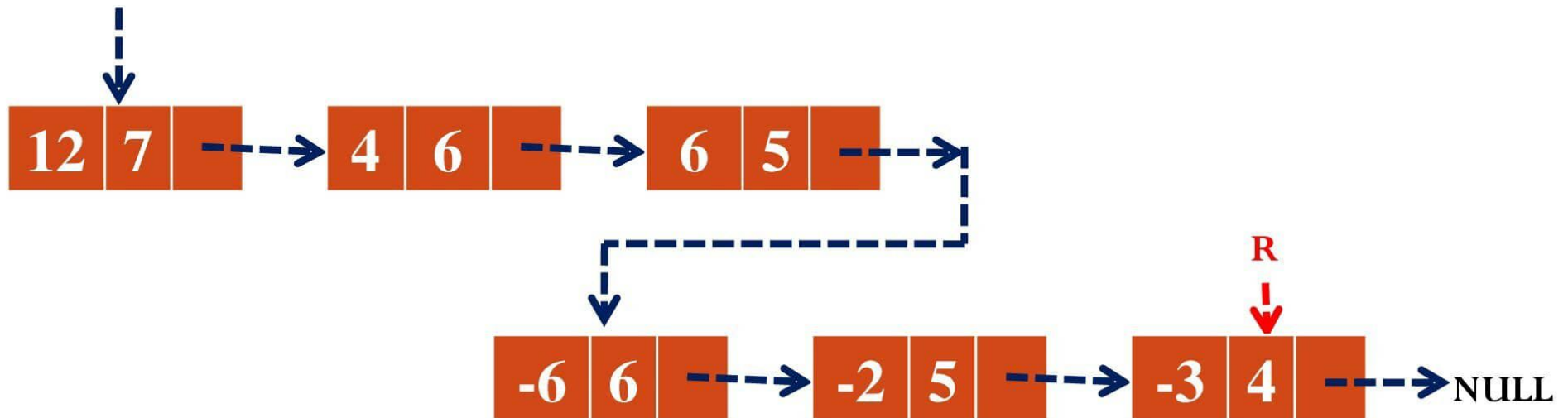
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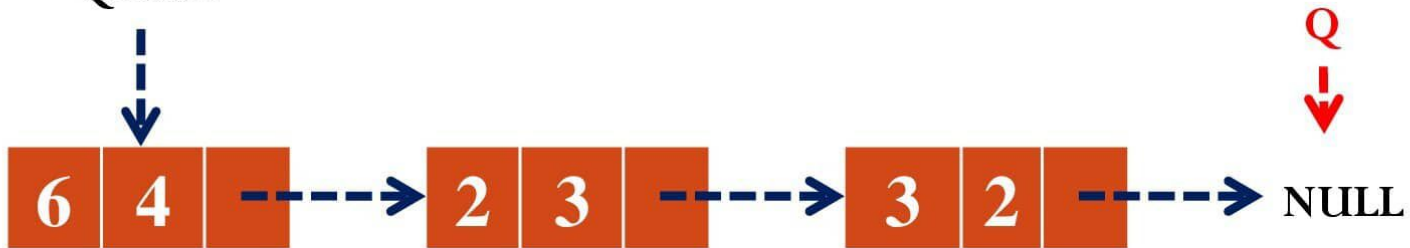
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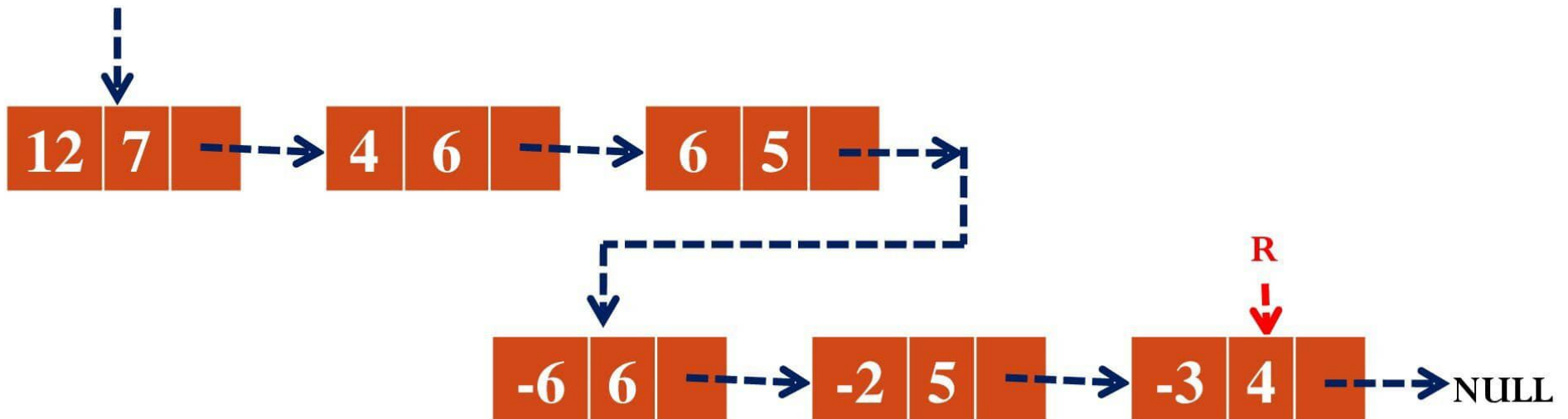
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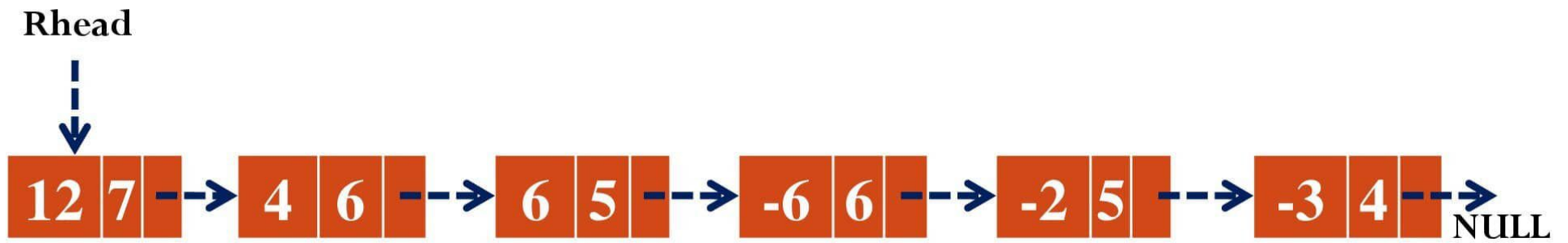


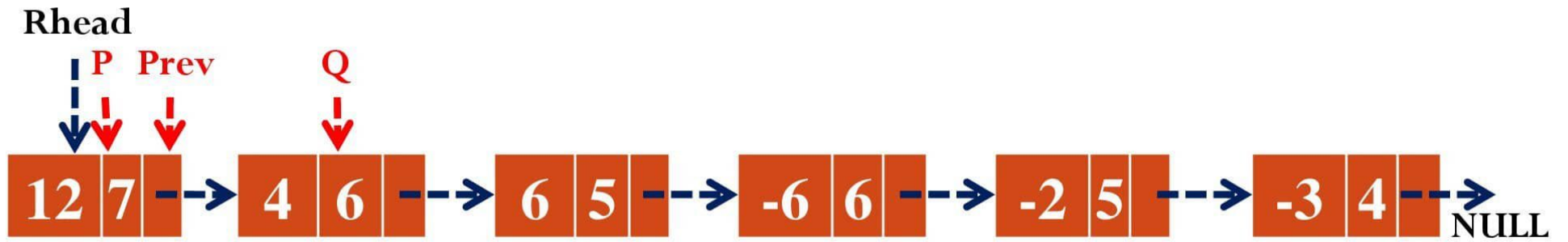
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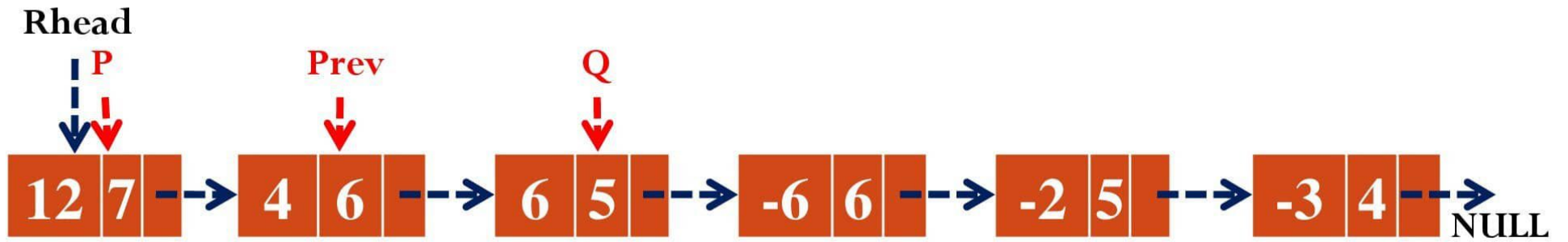


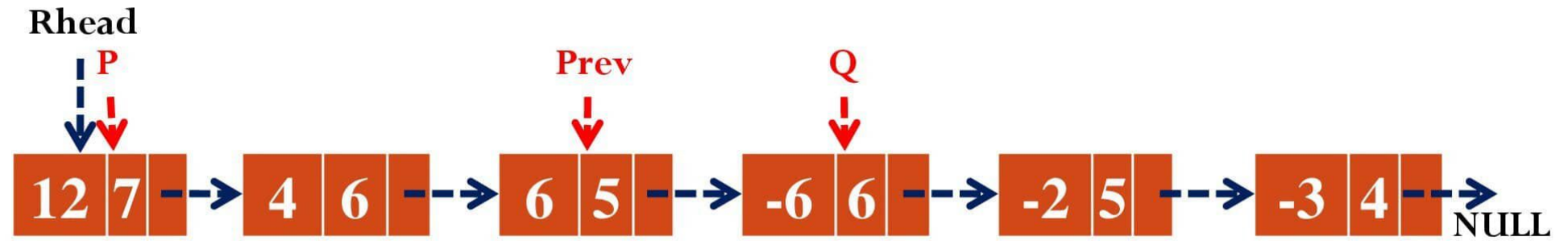
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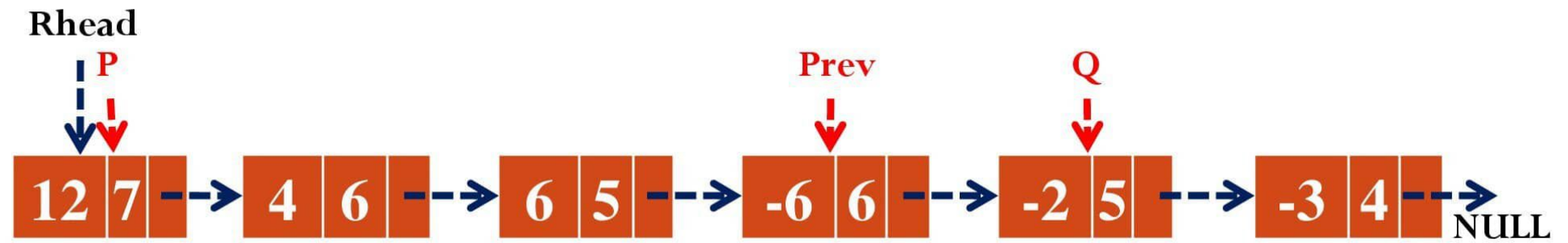


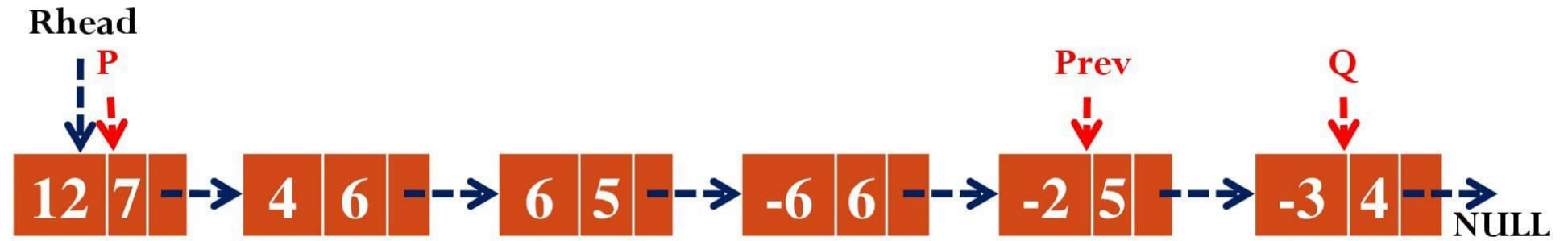


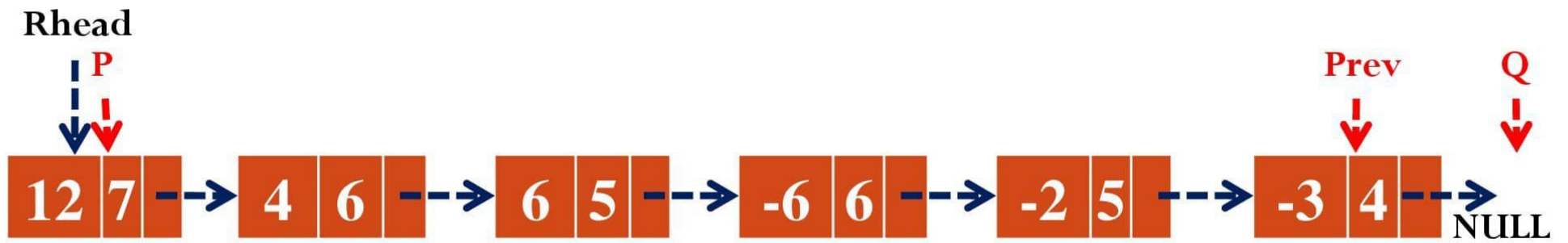


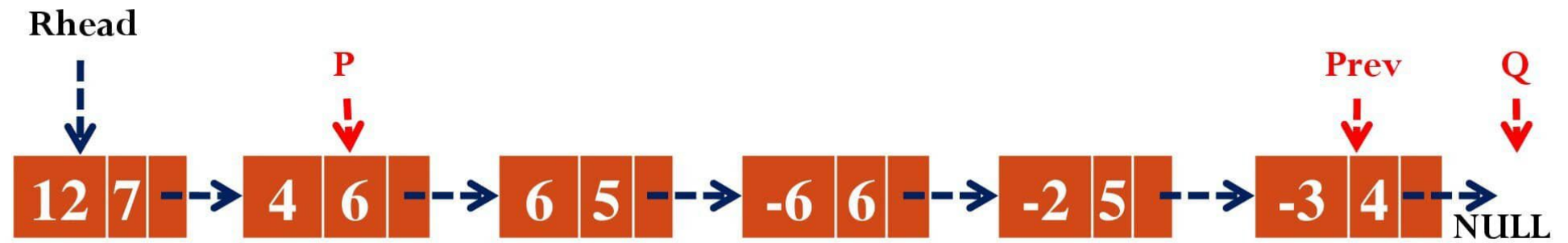


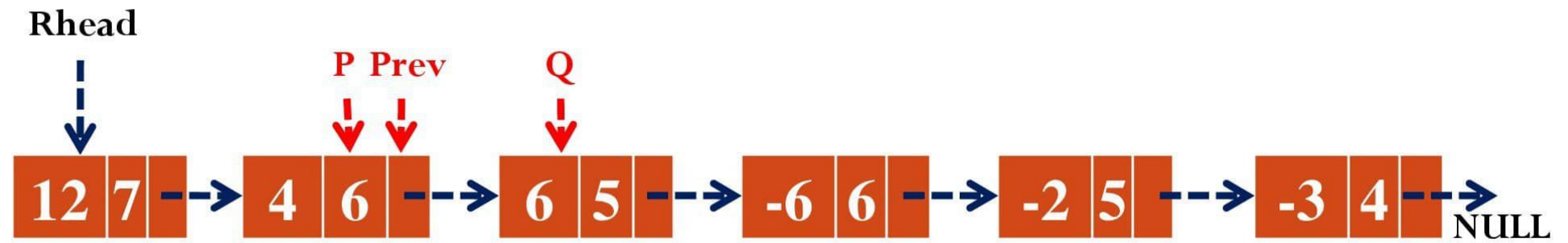


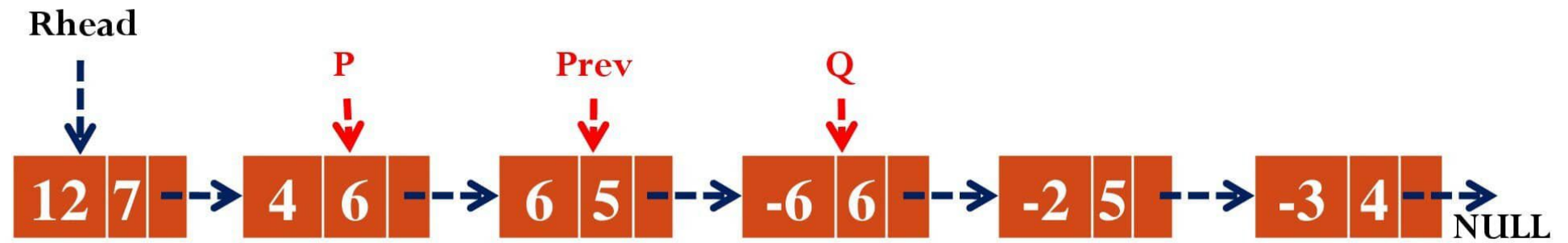


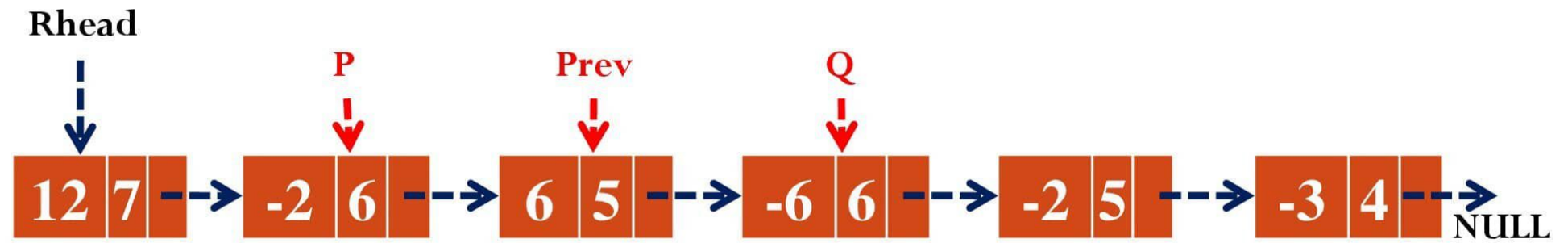


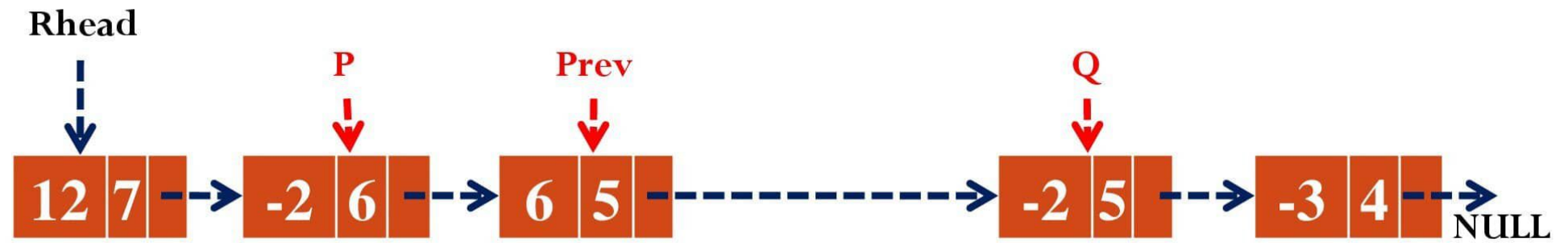


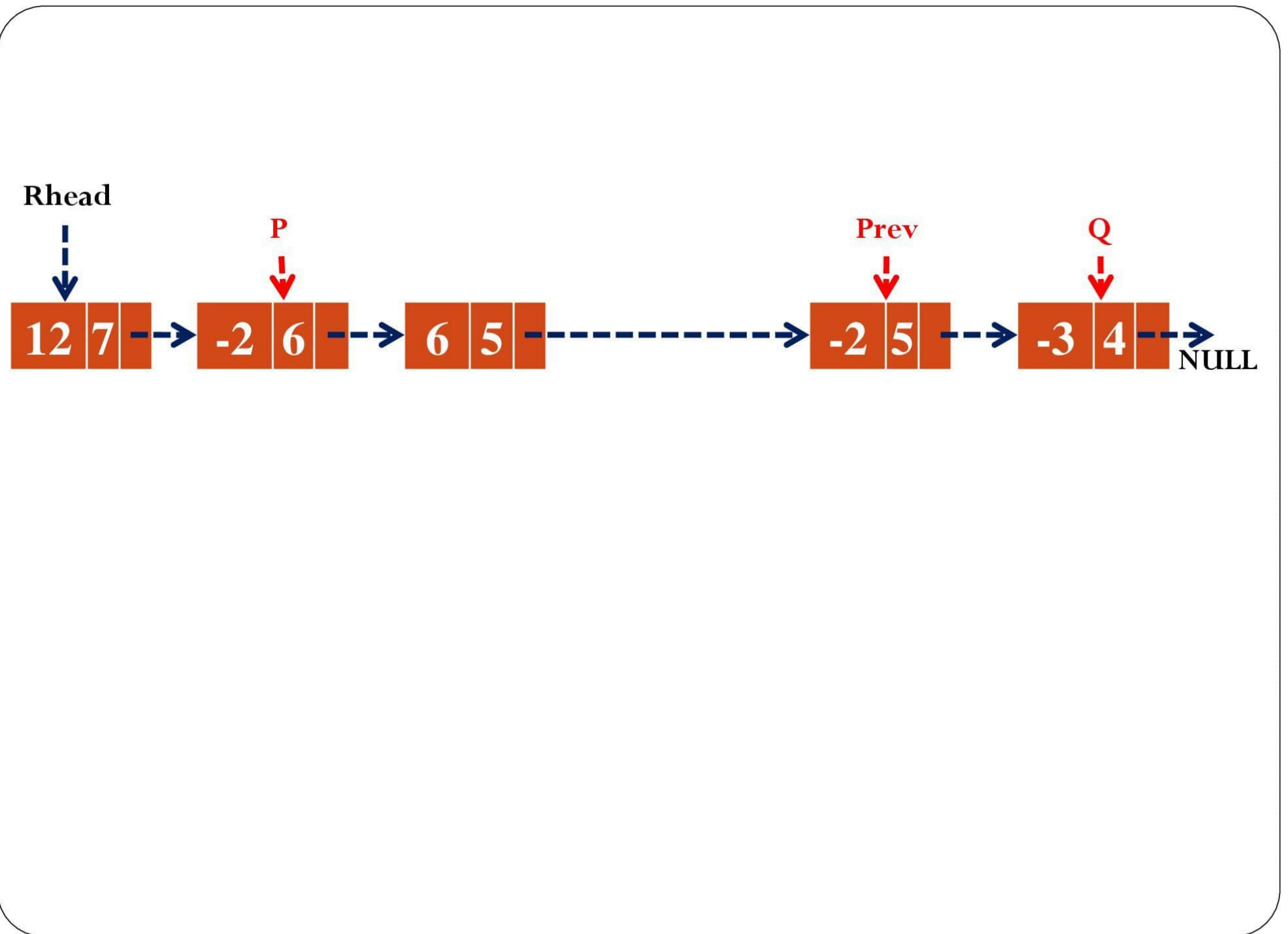


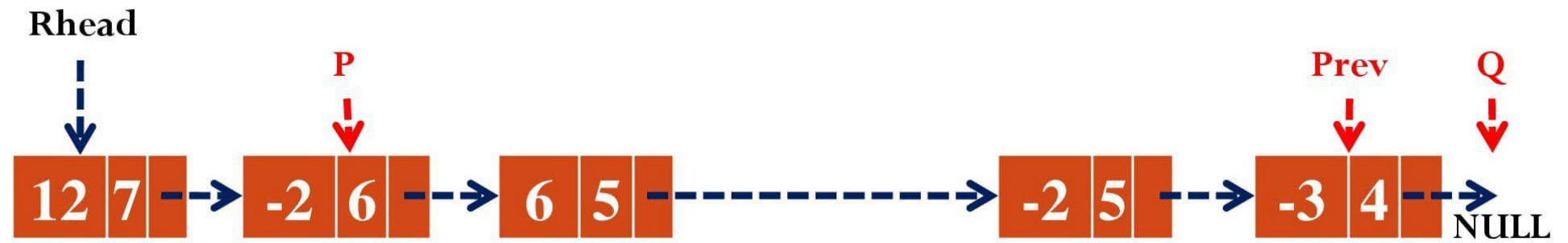


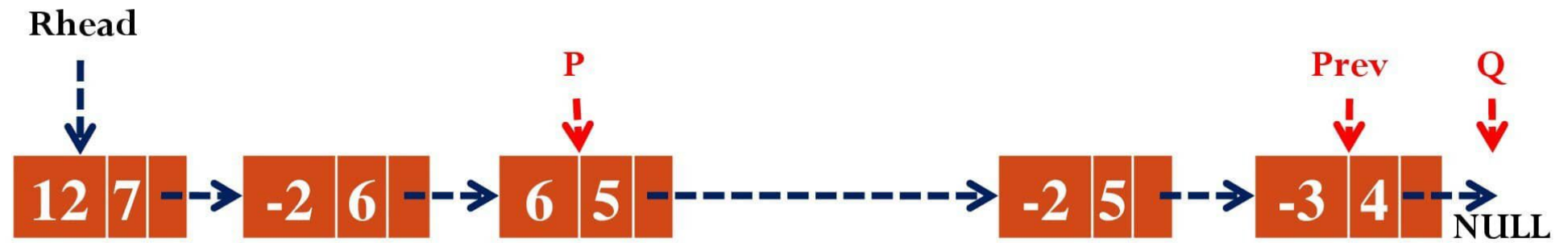


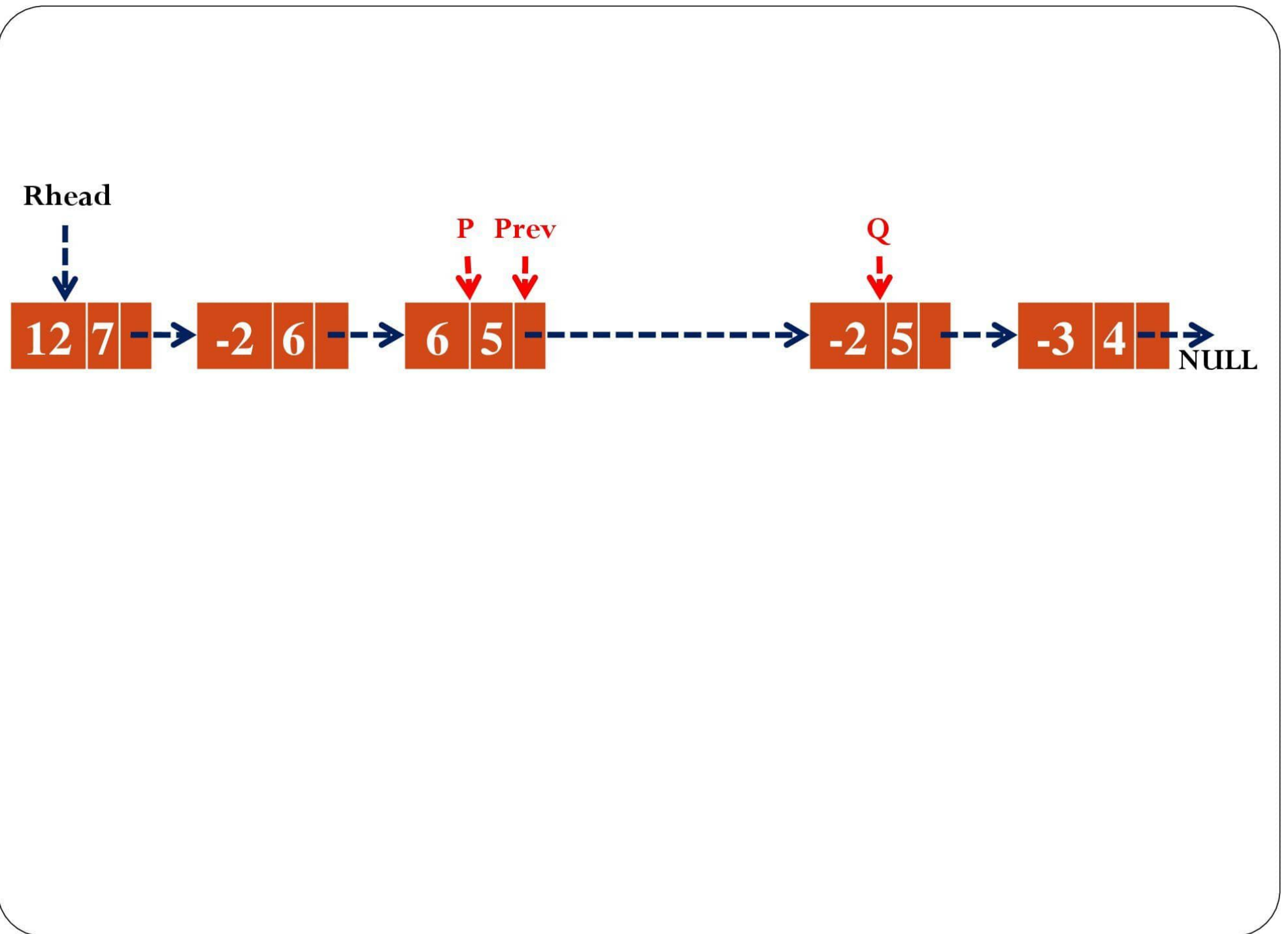


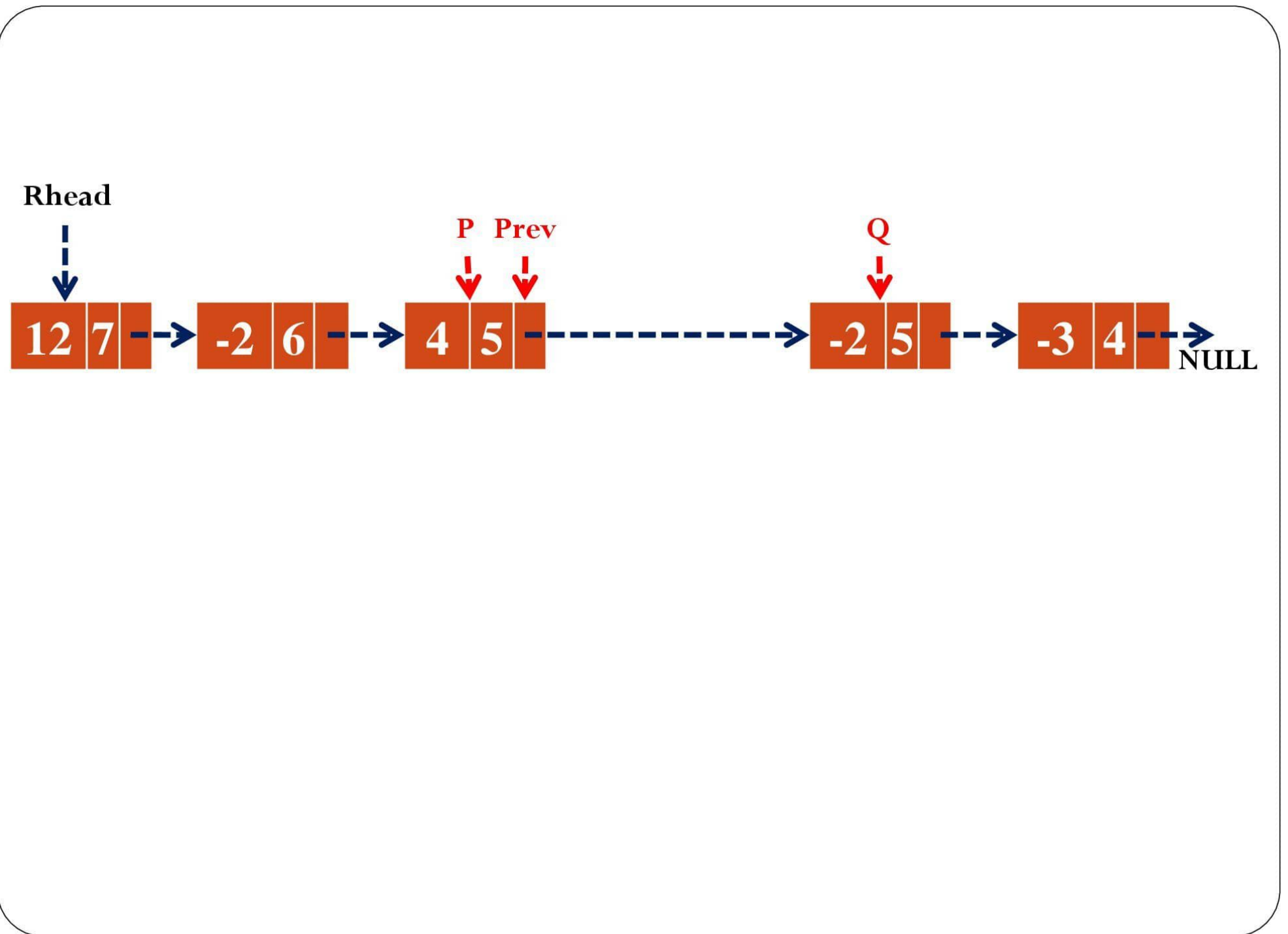




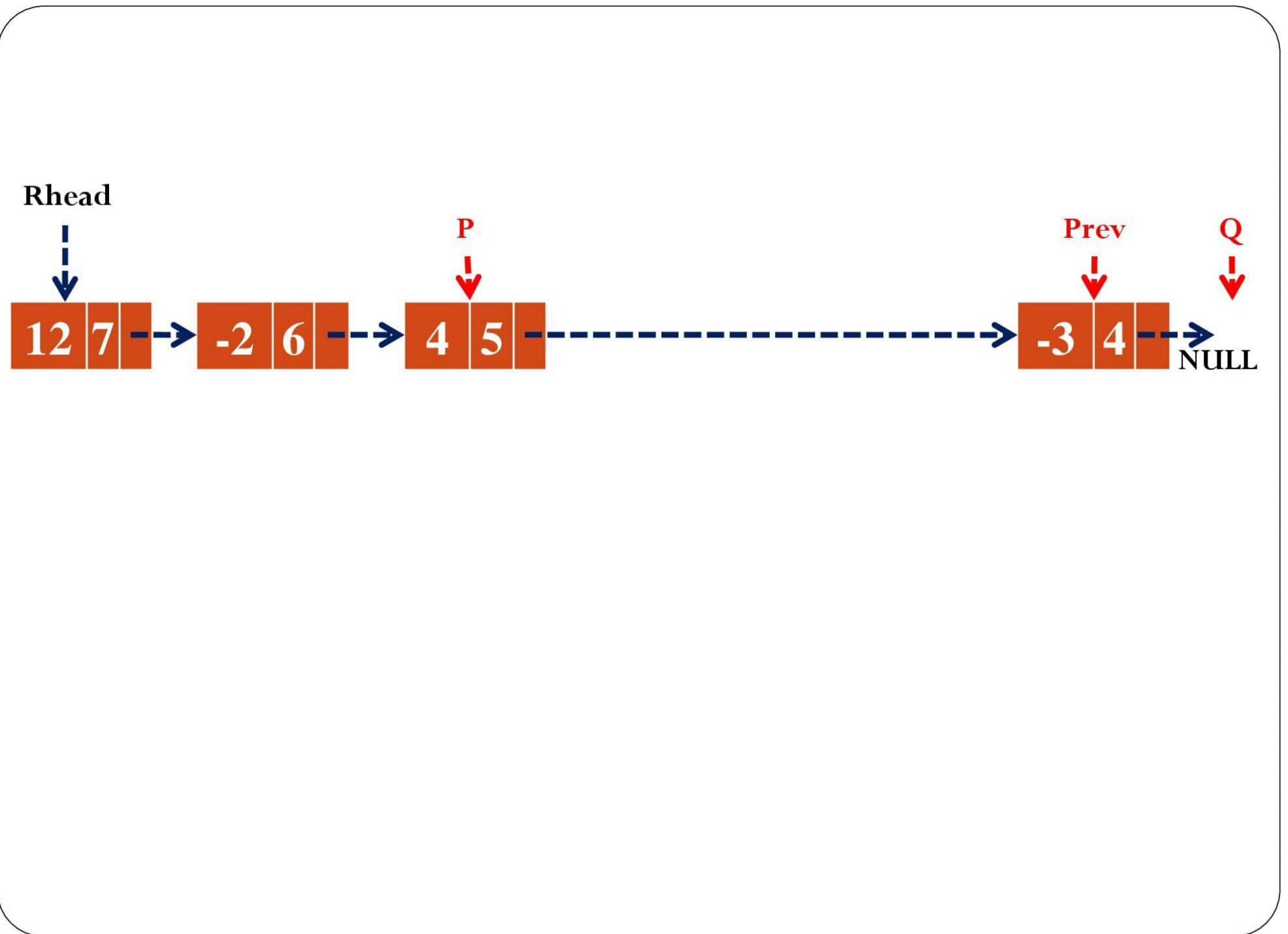


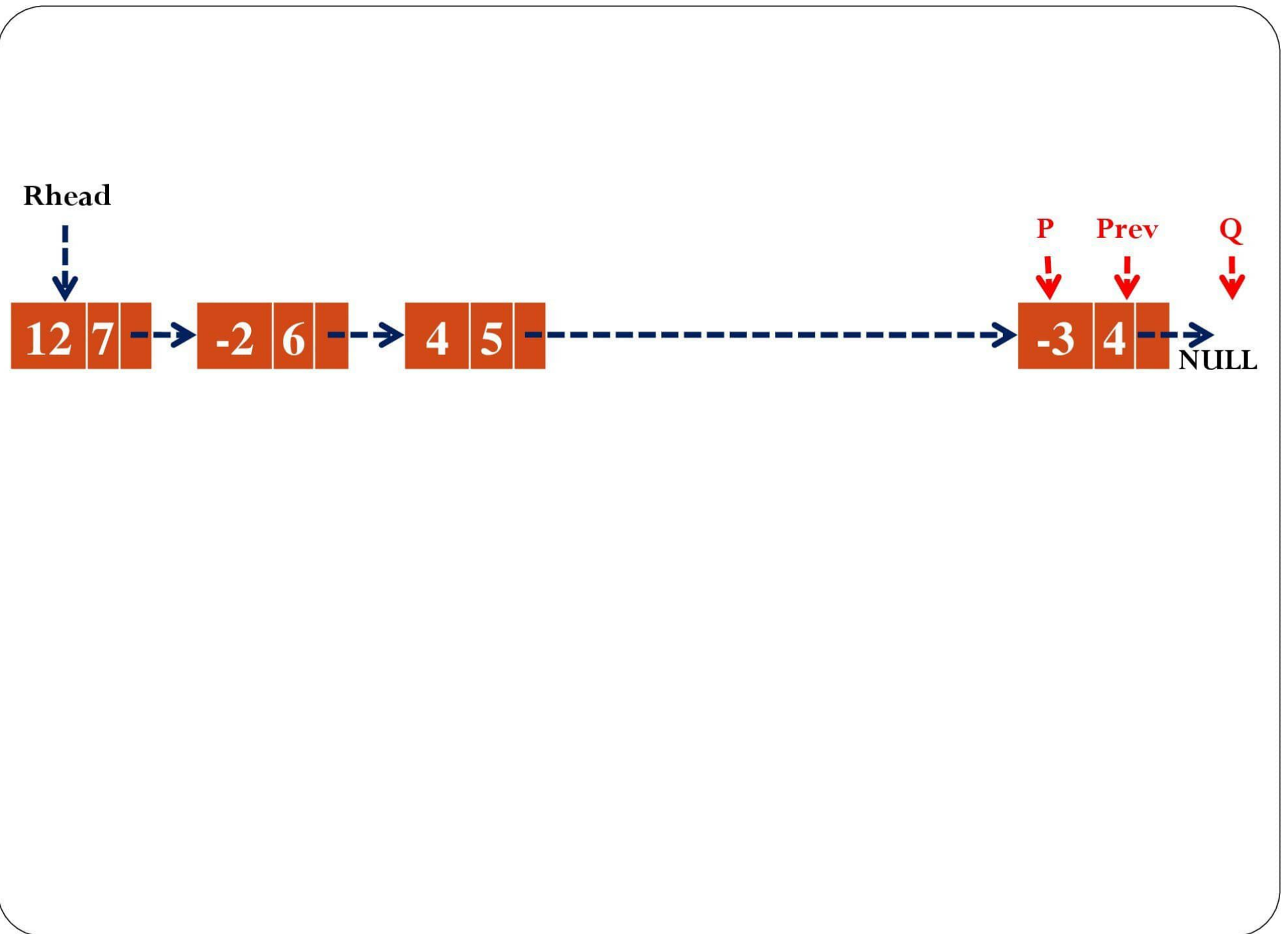


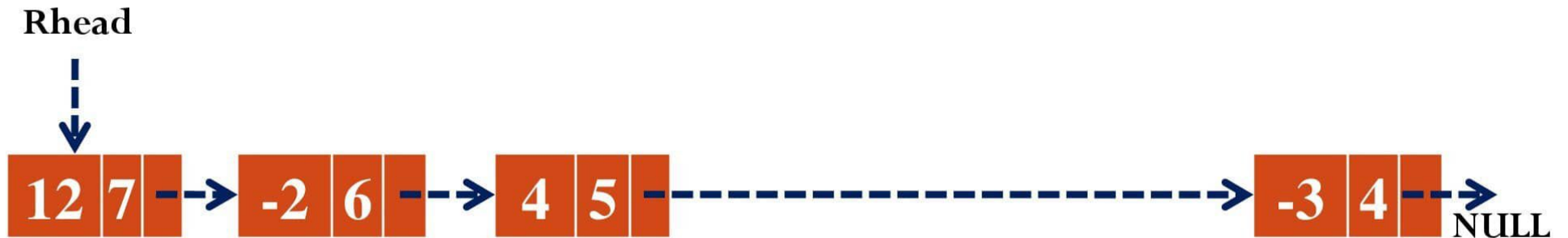












$$12x^7 - 2x^6 + 4x^5 - 3x^4$$

Polynomial Multiplication ~ Algorithm

Algorithm MulPoly(Phead, Qhead)

1. $P = Phead$ $Q = Qhead$ $Rhead = NULL$
2. While $P \neq NULL$ do
 1. While $Q \neq NULL$ do
 1. Create a node new
 2. $new \rightarrow Coeff = P \rightarrow Coeff \times Q \rightarrow Coeff$
 3. $new \rightarrow Expo = P \rightarrow Expo + Q \rightarrow Expo$
 4. $new \rightarrow Link = NULL$
 5. If $Rhead = NULL$ then $Rhead = R = new$
 6. Else
 1. $R \rightarrow Link = new$
 2. $R = new$
 7. $Q = Q \rightarrow Link$
 2. $P = P \rightarrow Link$
 3. $Q = Qhead$

3. $P = Rhead$
4. While $P \neq NULL$ do
 1. $prev = P$
 2. $Q = P \rightarrow Link$
 3. While $Q \neq NULL$ do
 1. If $P \rightarrow Expo = Q \rightarrow Expo$ then
 1. $P \rightarrow Coeff = P \rightarrow Coeff + Q \rightarrow Coeff$
 2. $Prev \rightarrow Link = Q \rightarrow Link$
 3. $Free(Q)$
 4. $Q = prev \rightarrow Link$
 2. Else
 1. $prev = Q$
 2. $Q = Q \rightarrow Link$
 4. $P = P \rightarrow Link$