An Introduction to Data Structures

The LinkedList

The Linked List - LinkedList Basics

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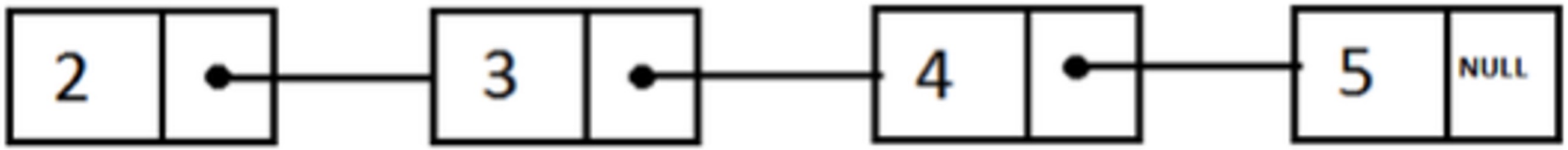

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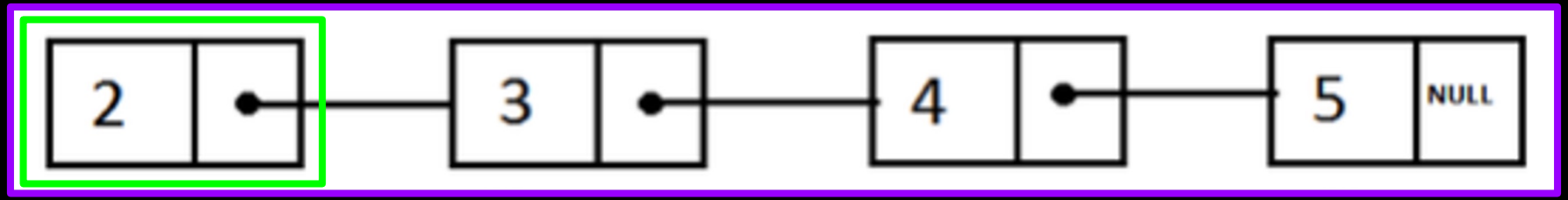

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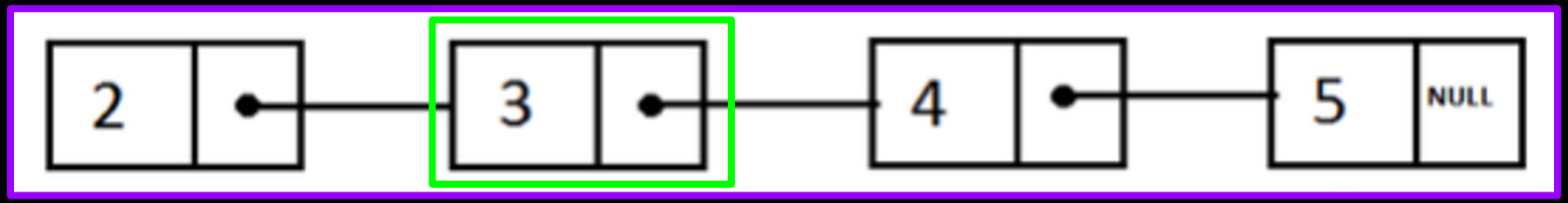

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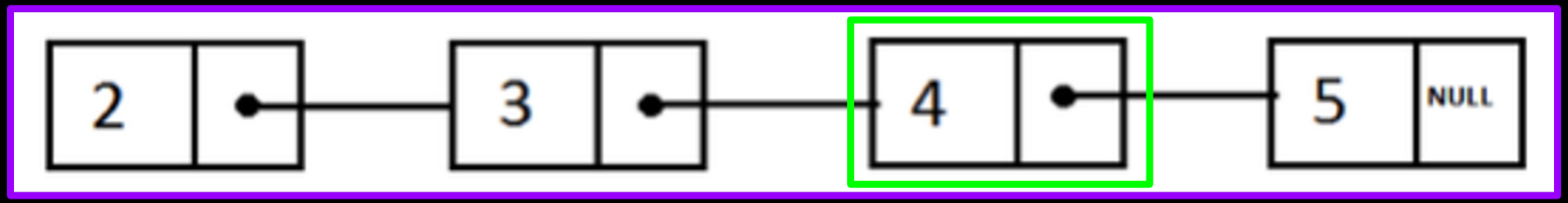

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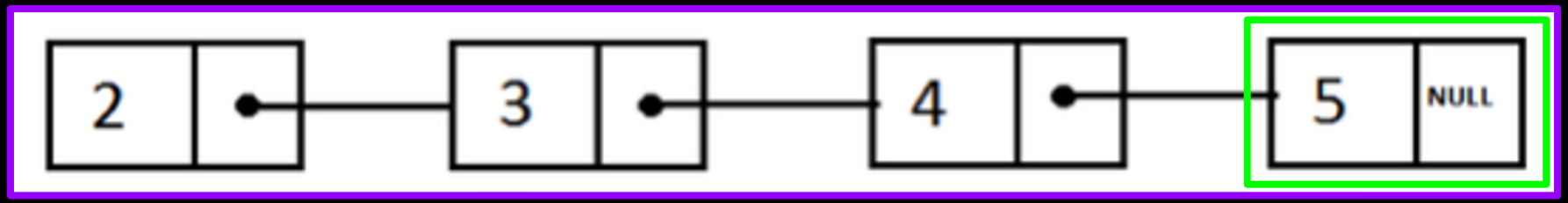

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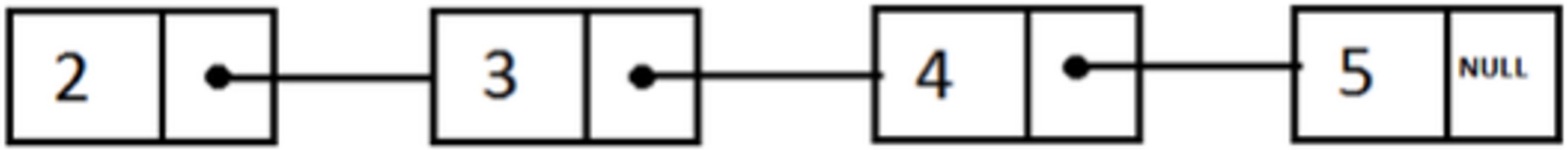

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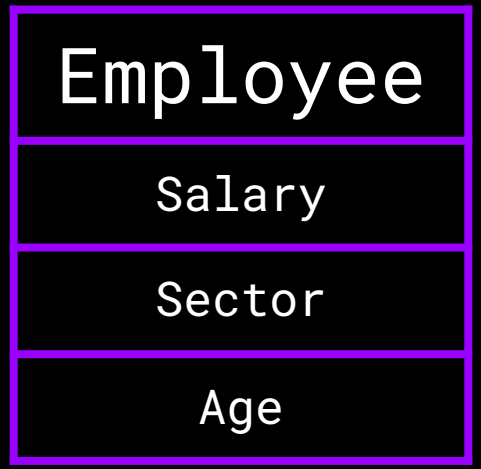

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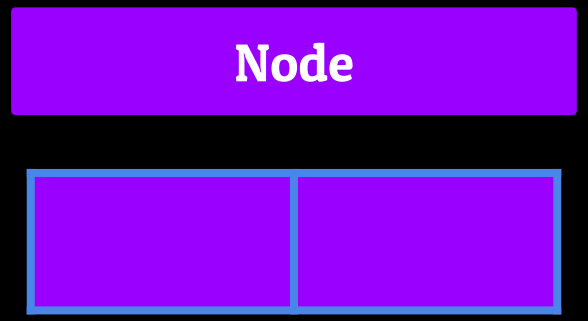

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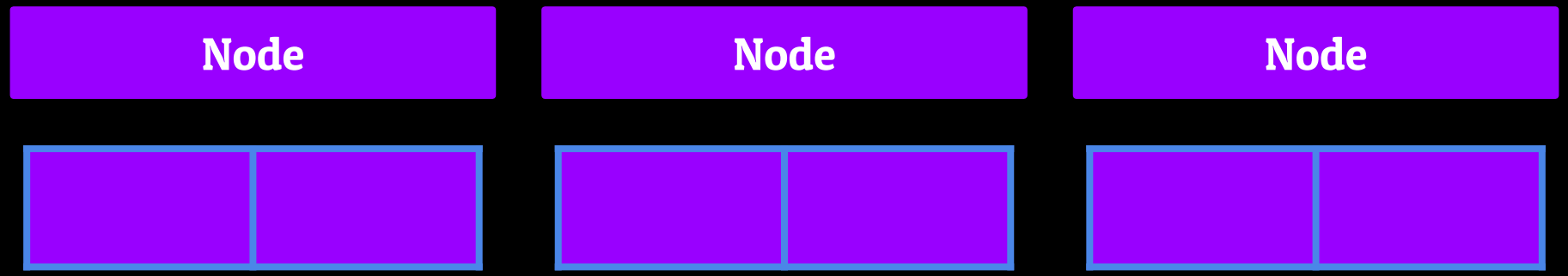

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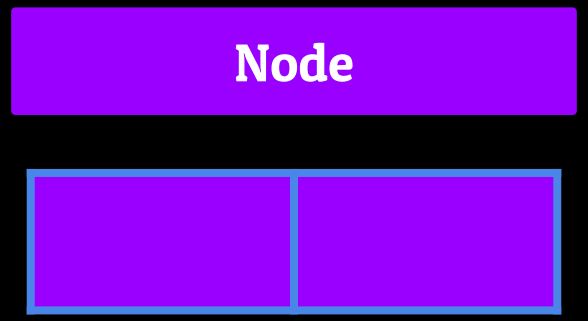

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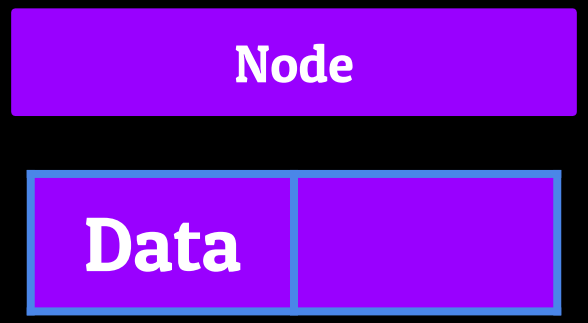

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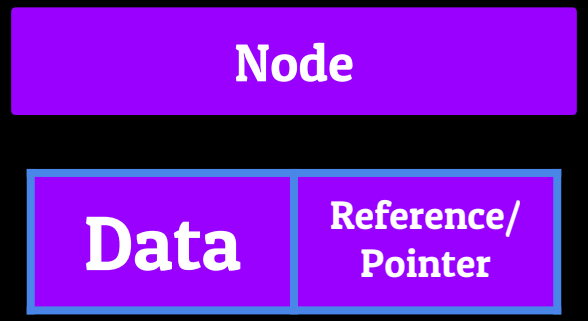

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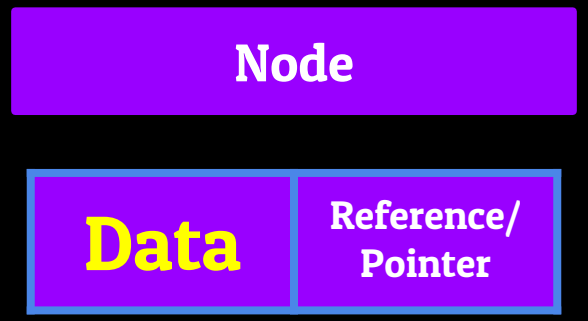

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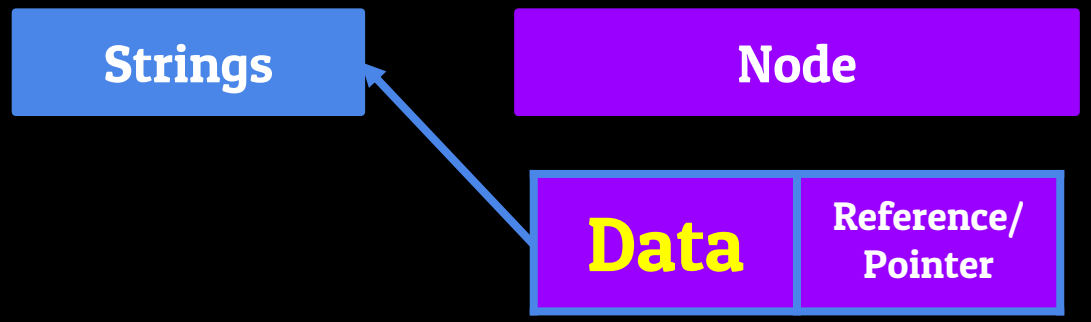

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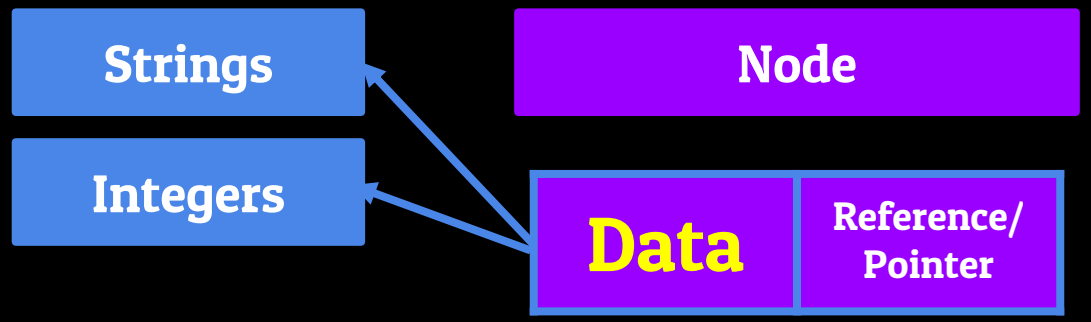

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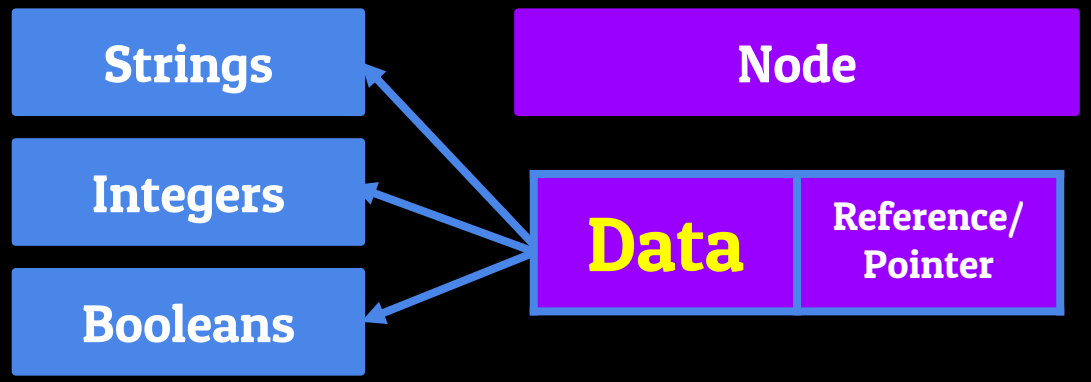

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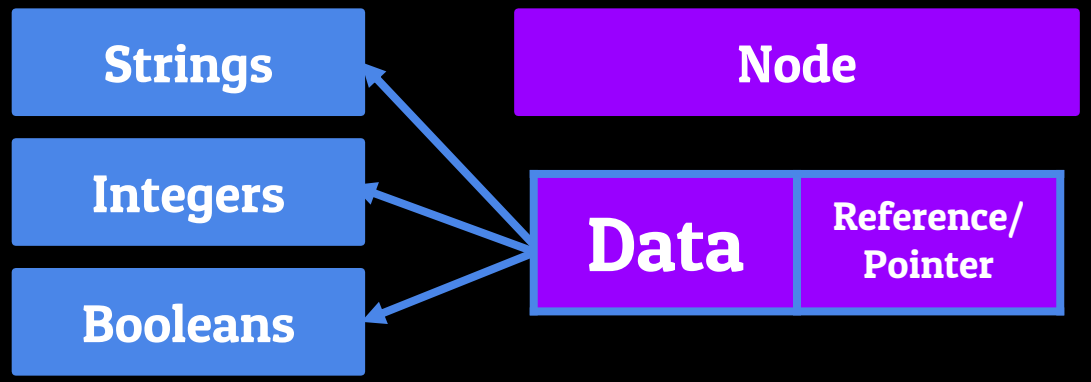

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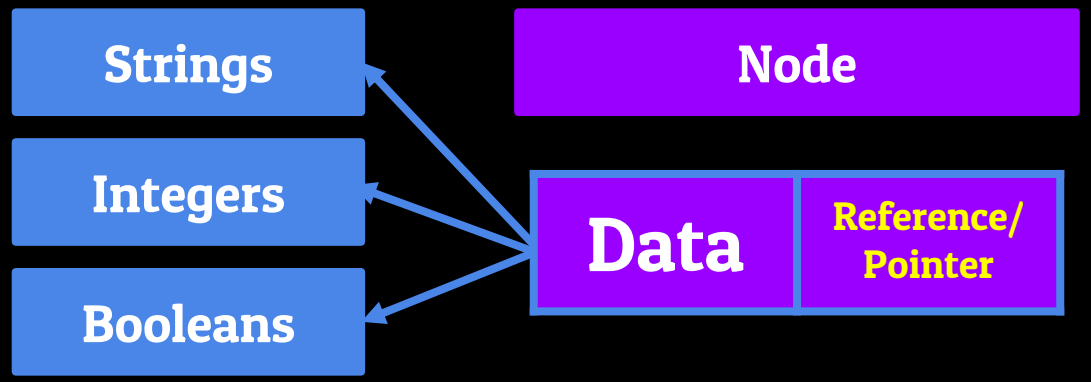

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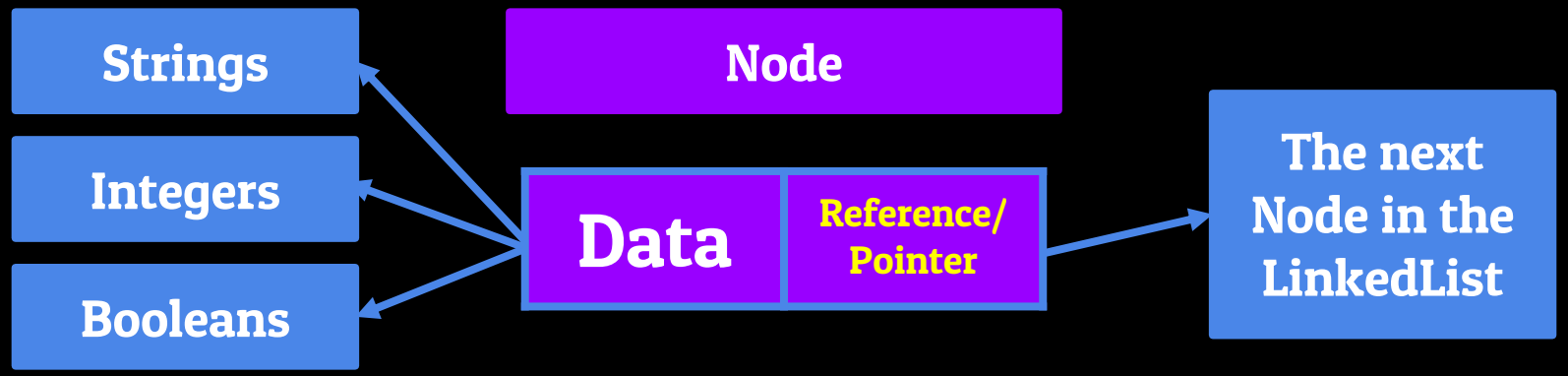

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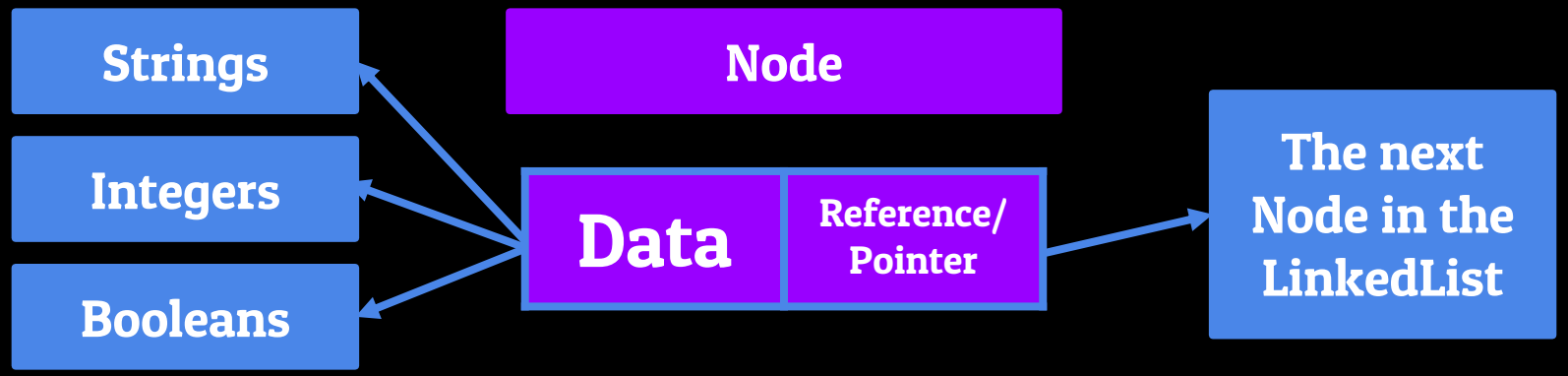

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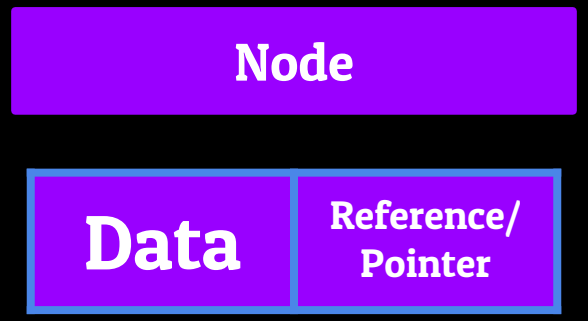

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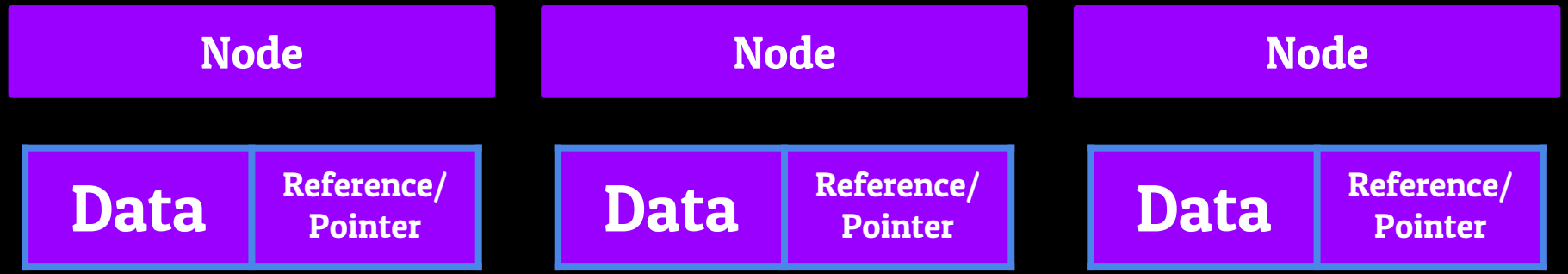

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Linked List

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Head Node

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Data	Reference/ Pointer

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Head Node

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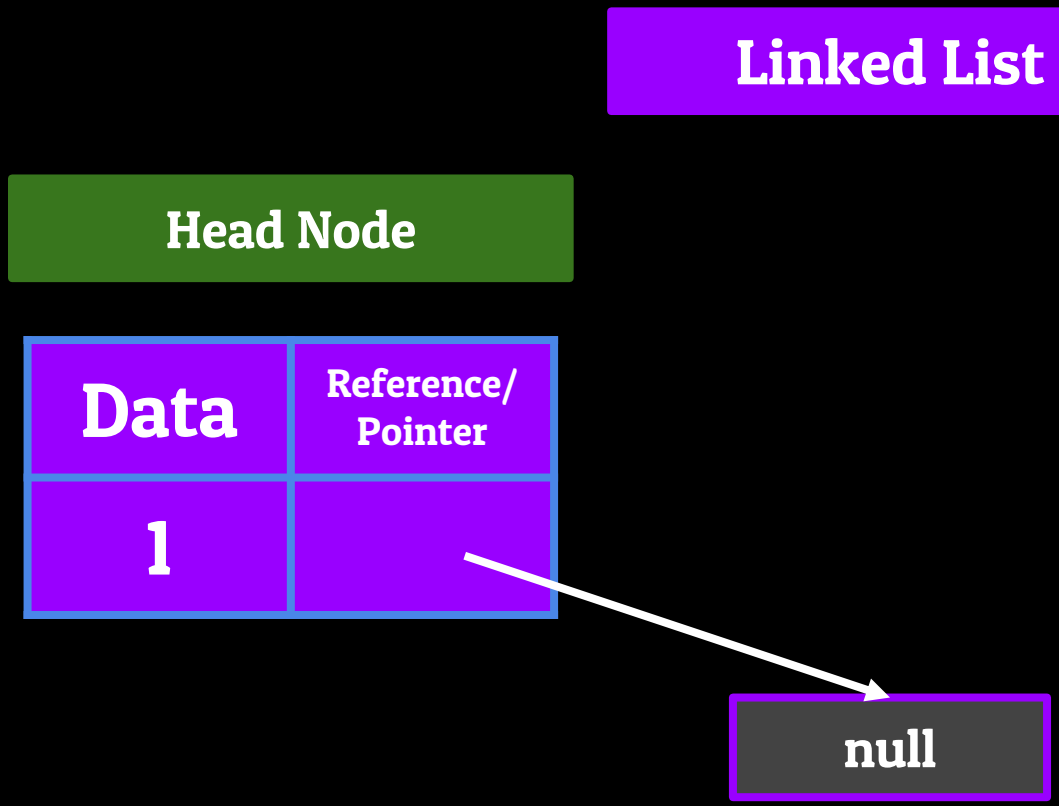

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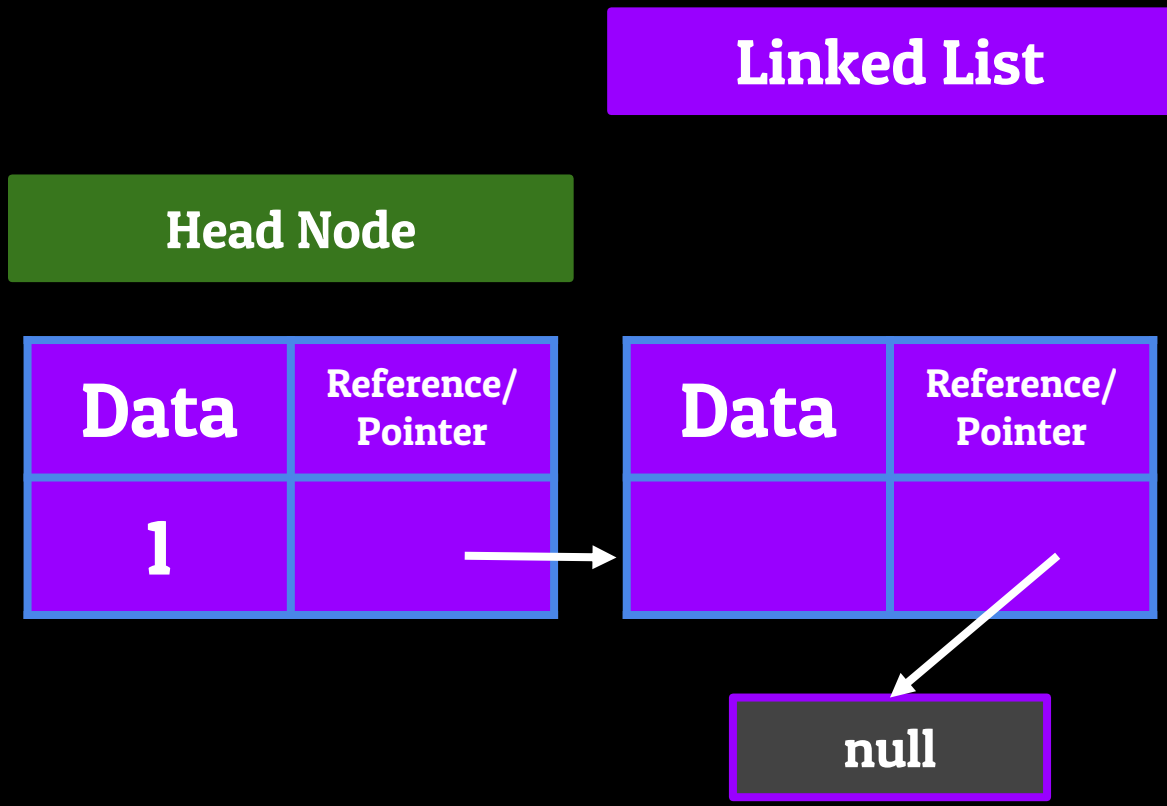

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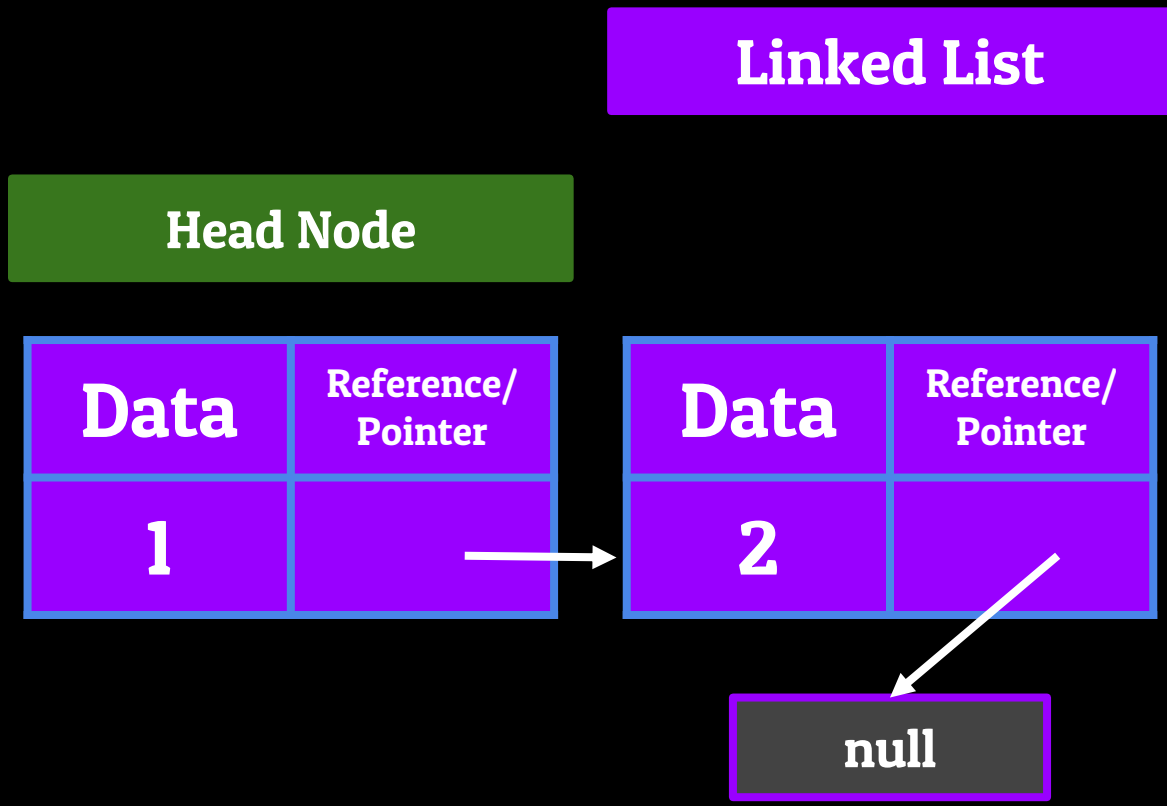

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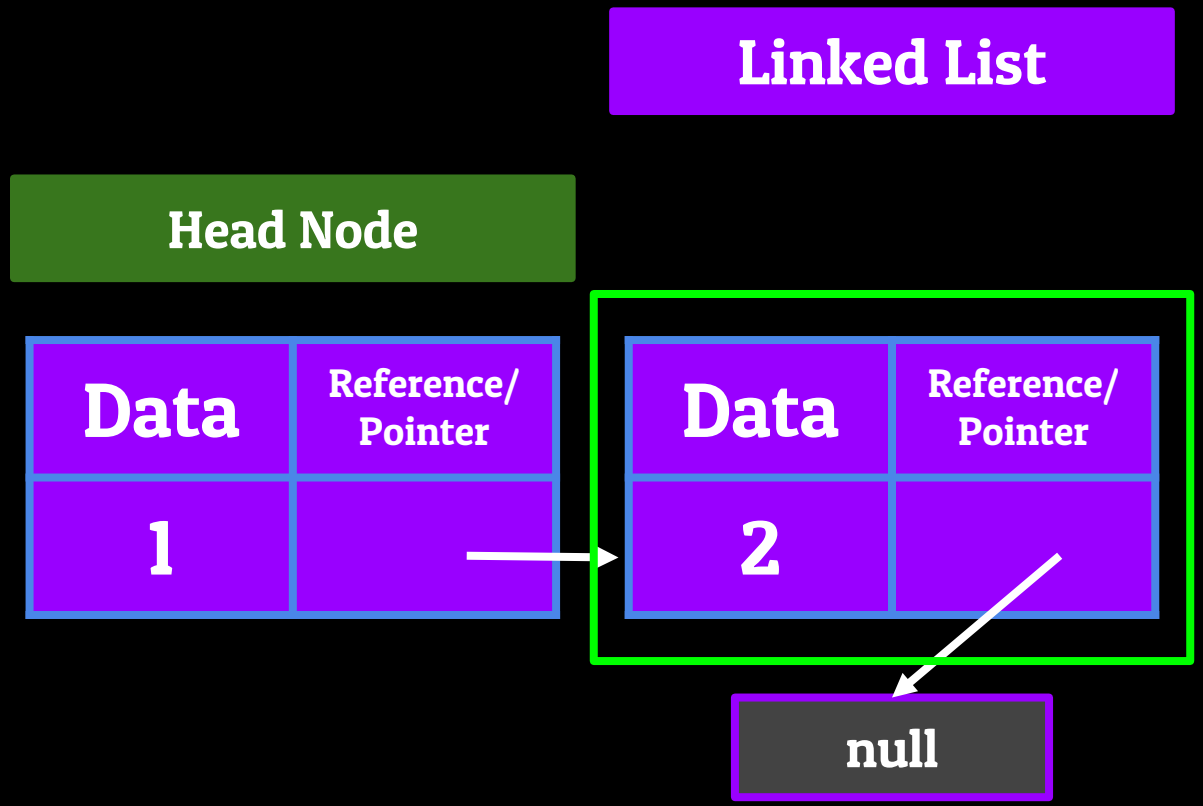

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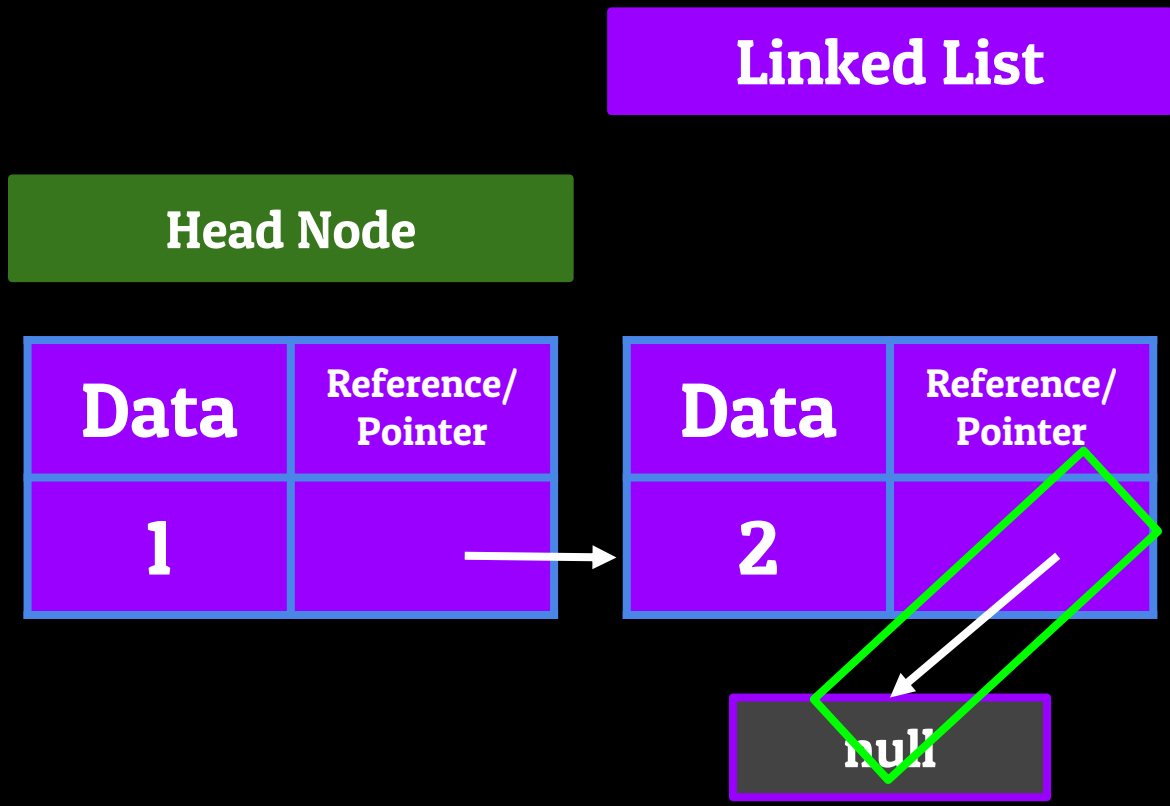

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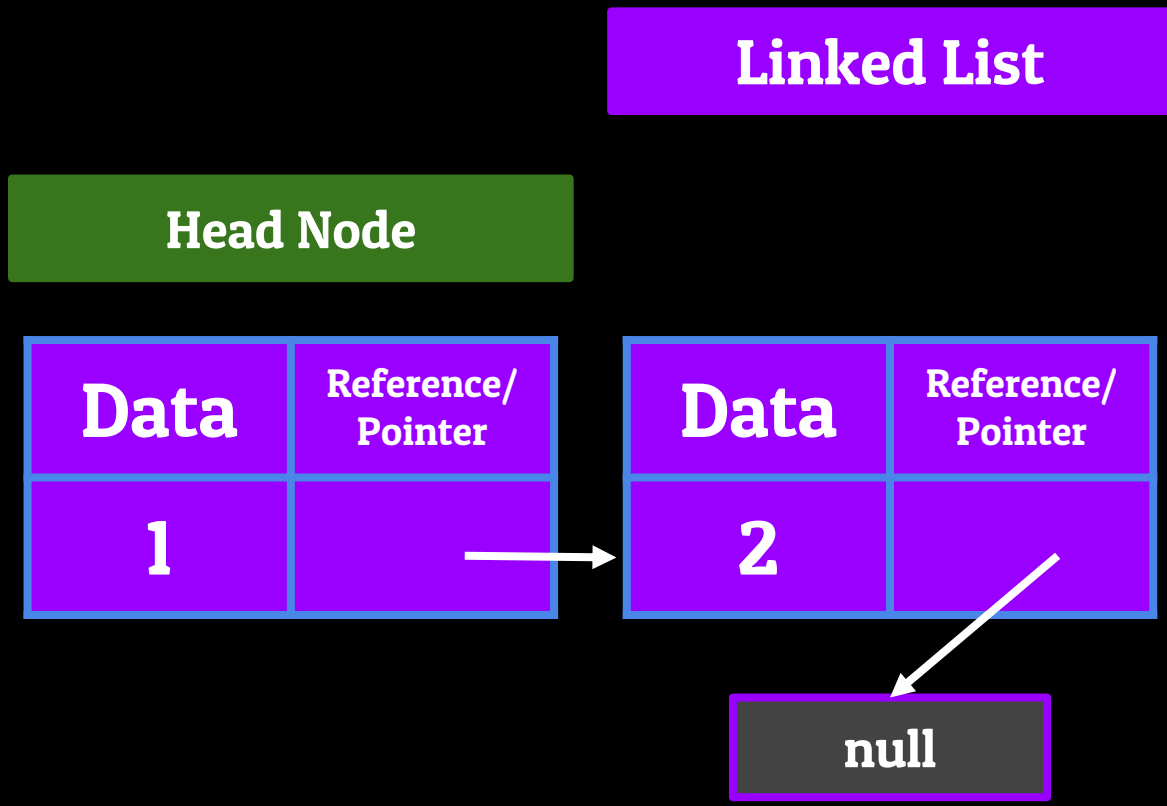

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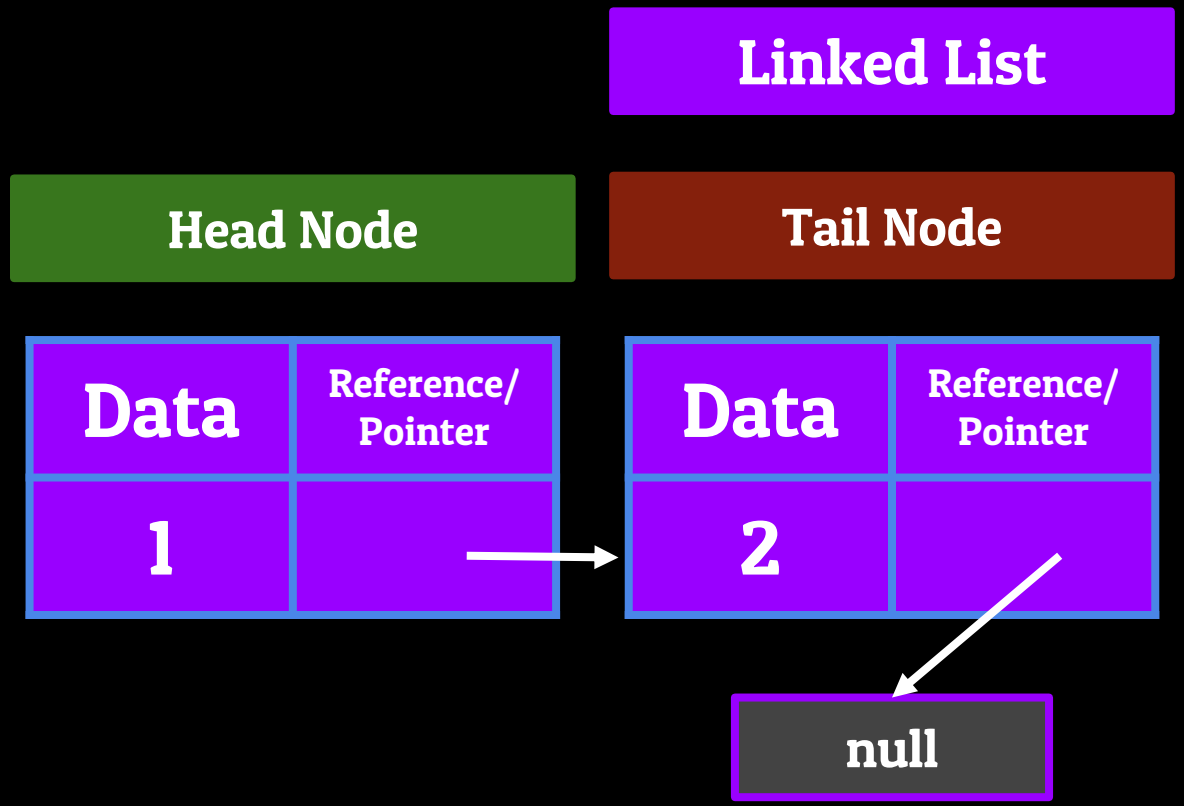

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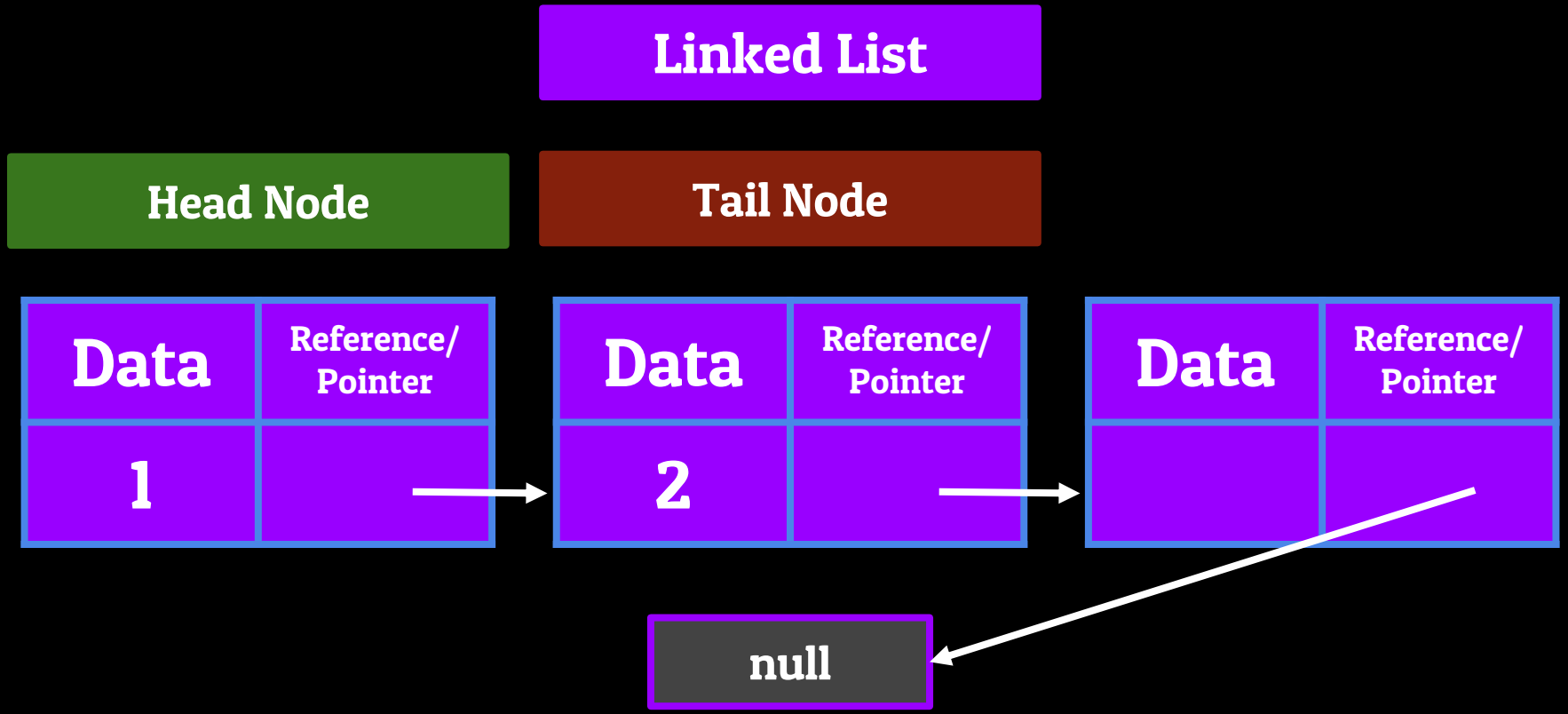

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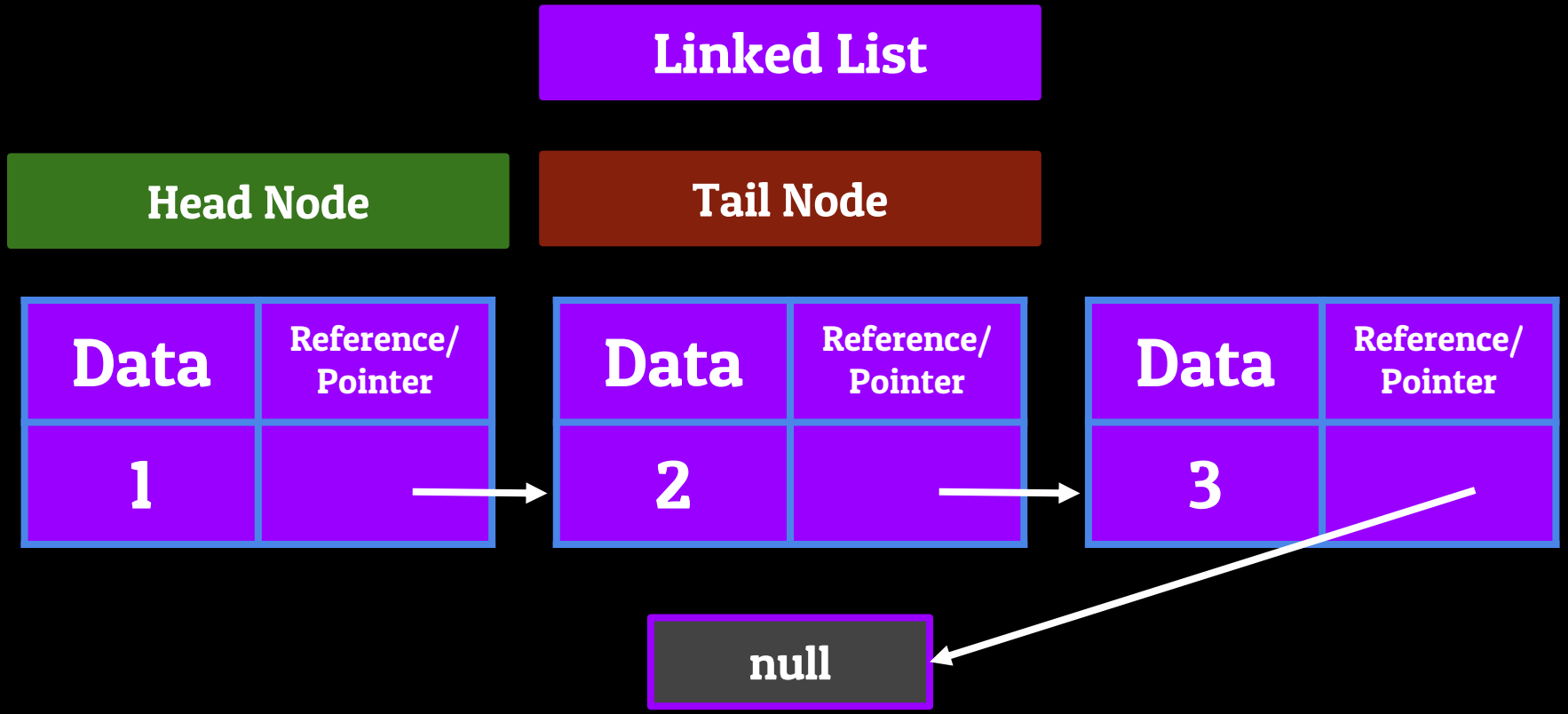

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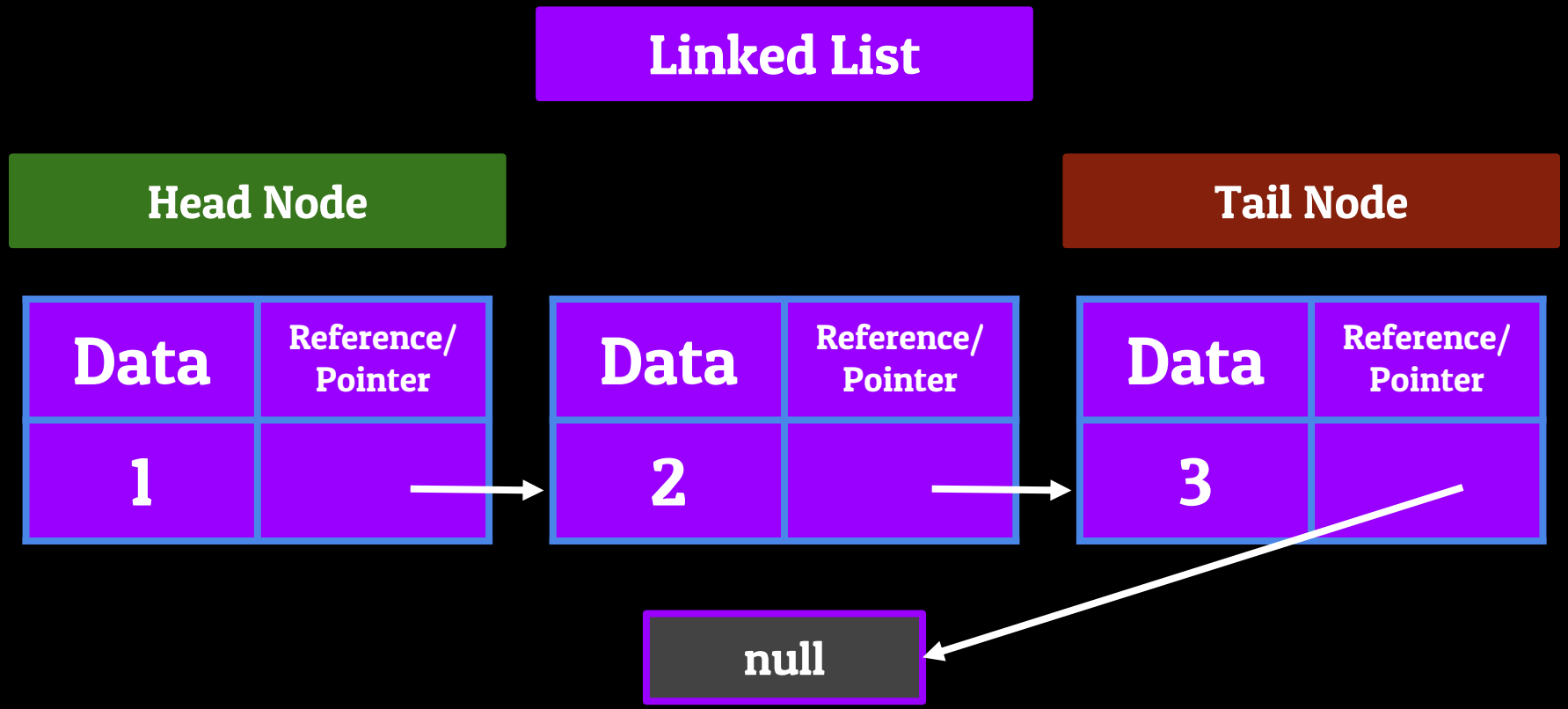

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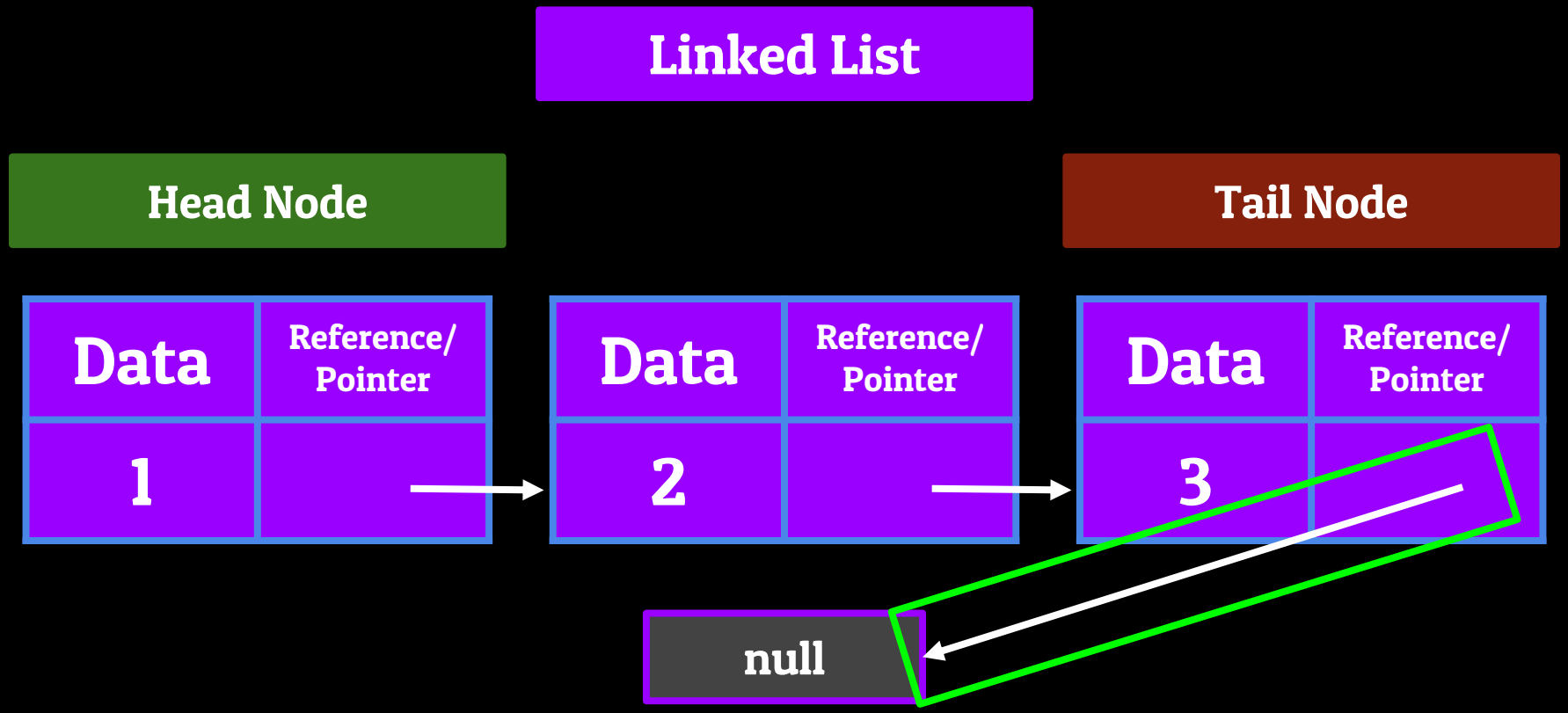

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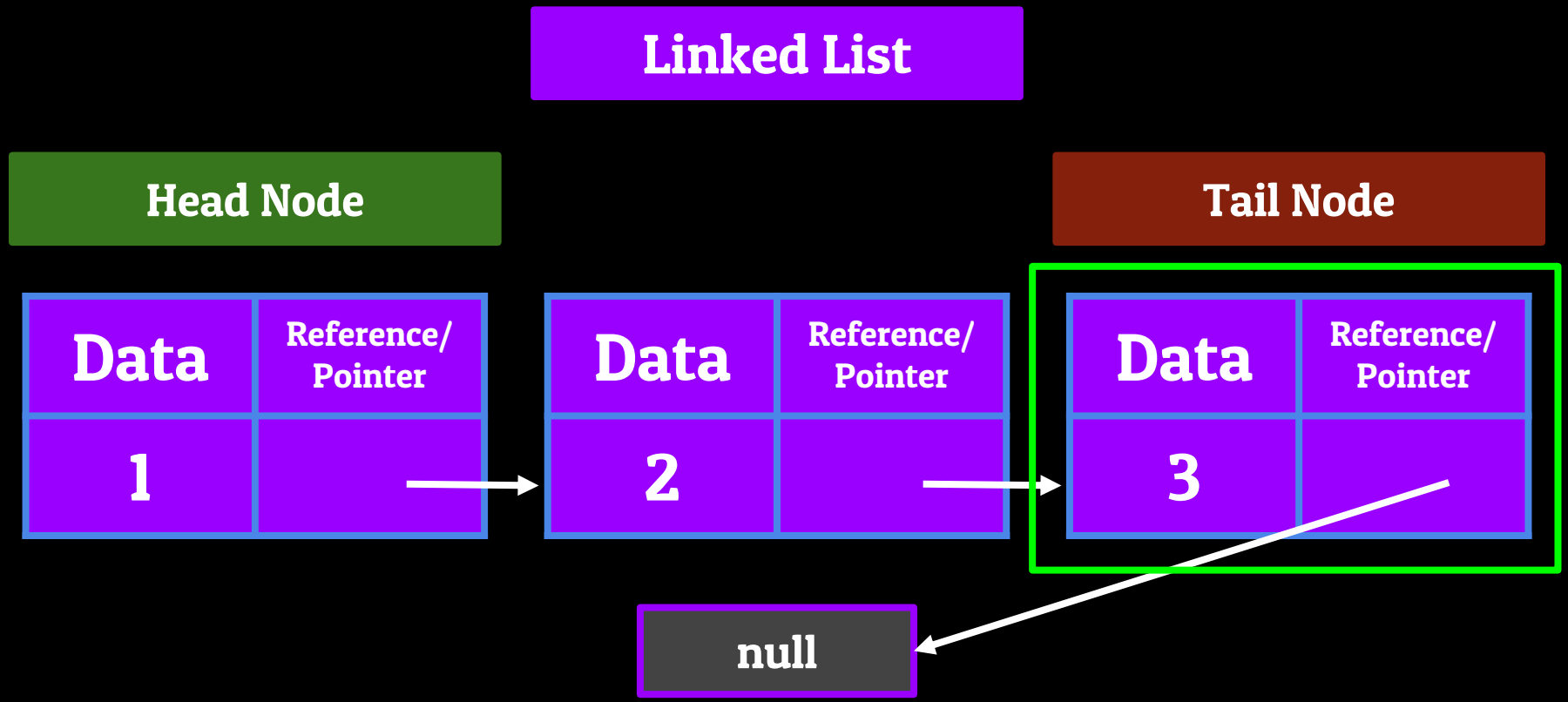

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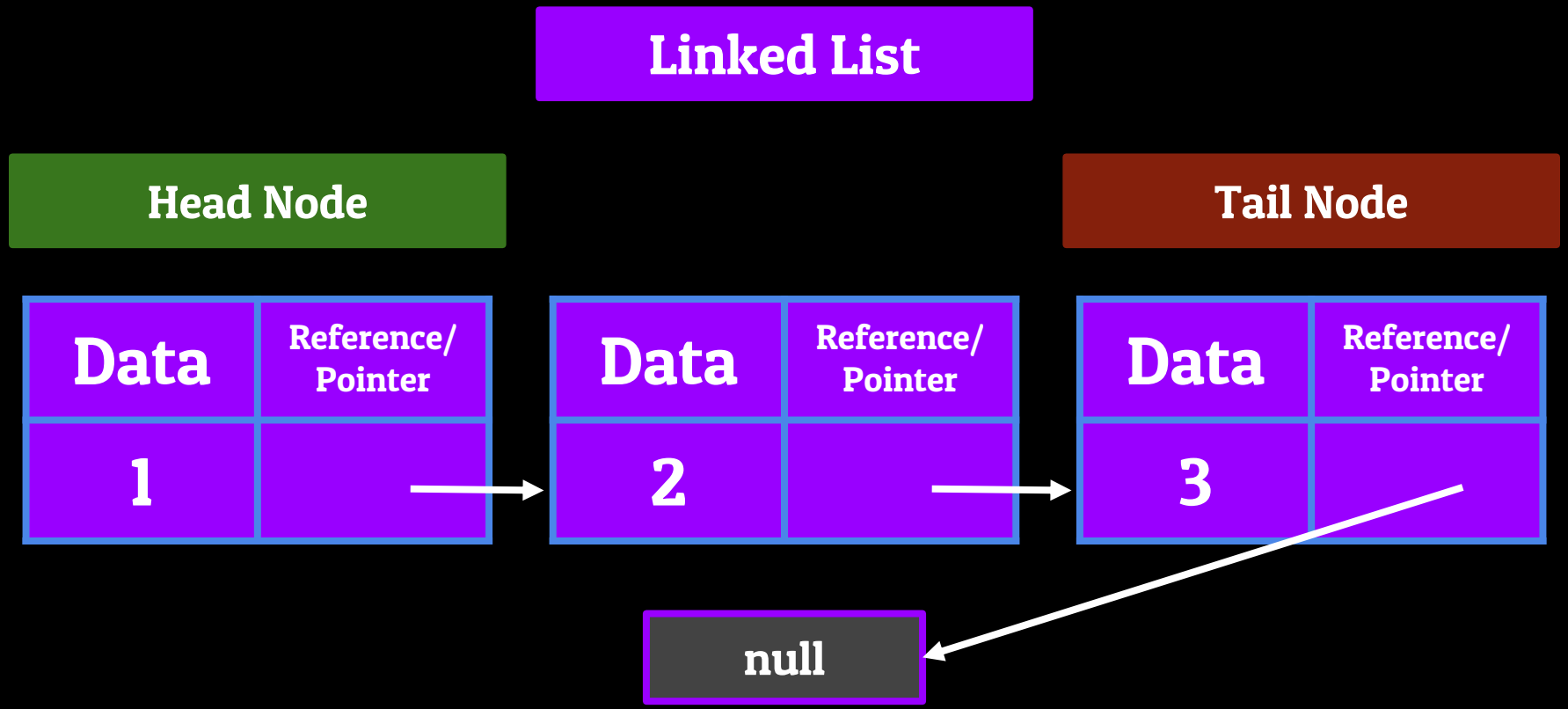

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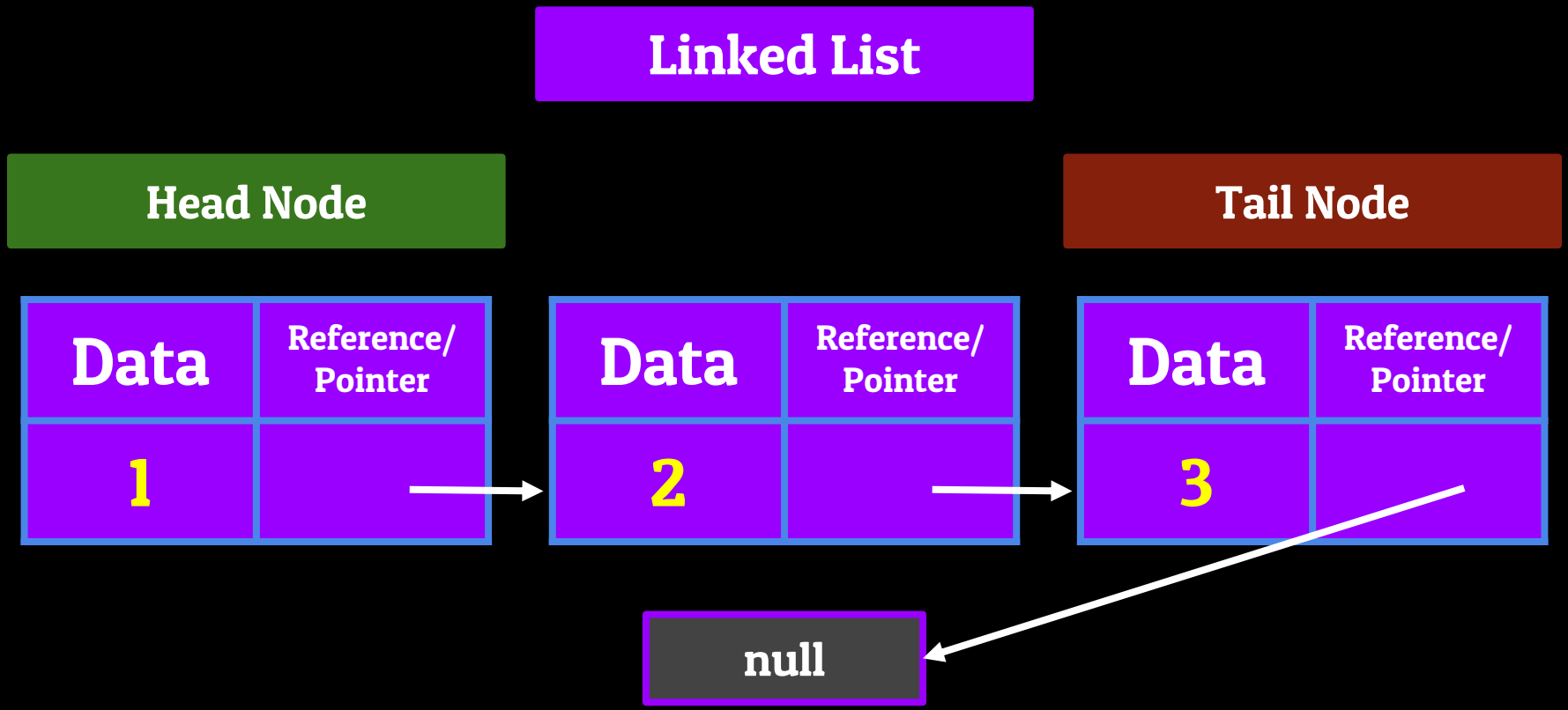

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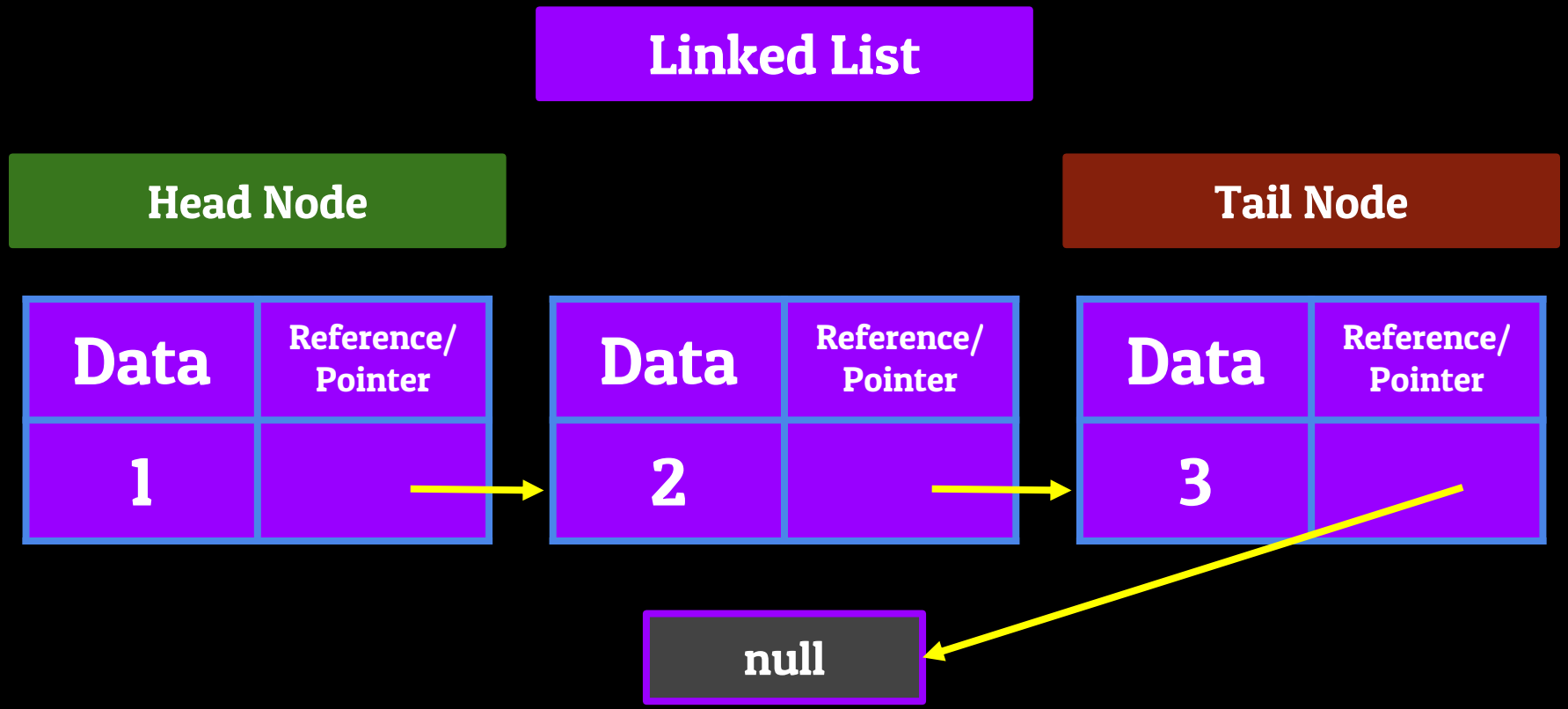

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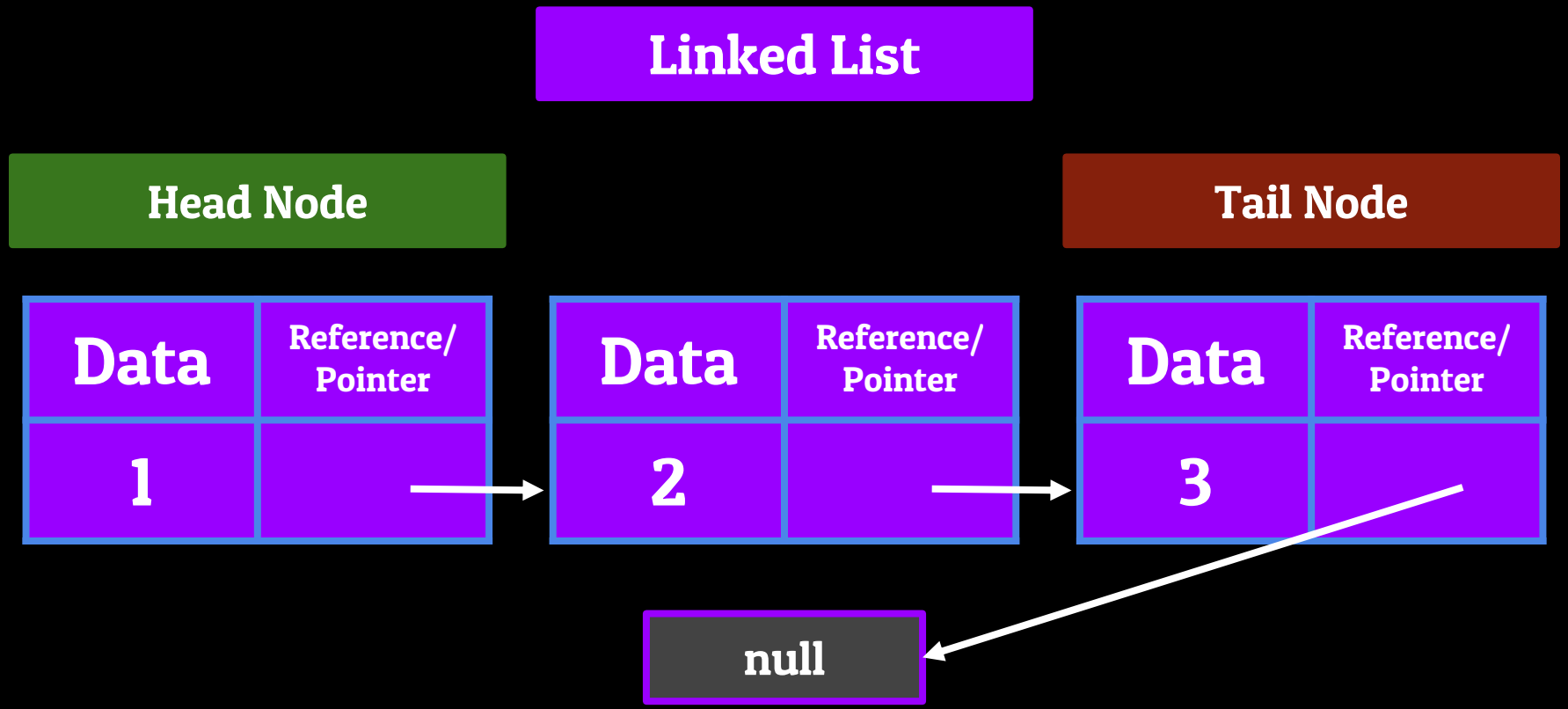

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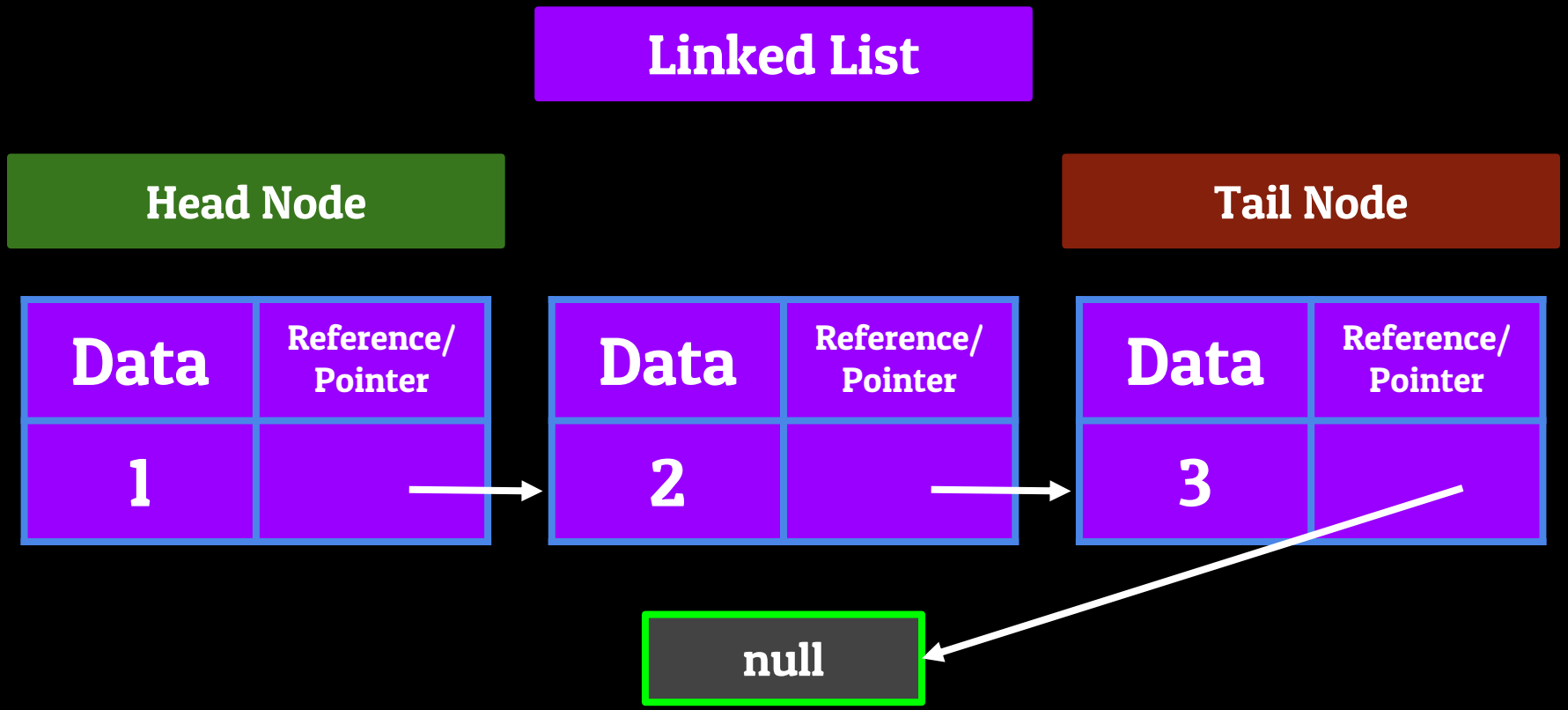

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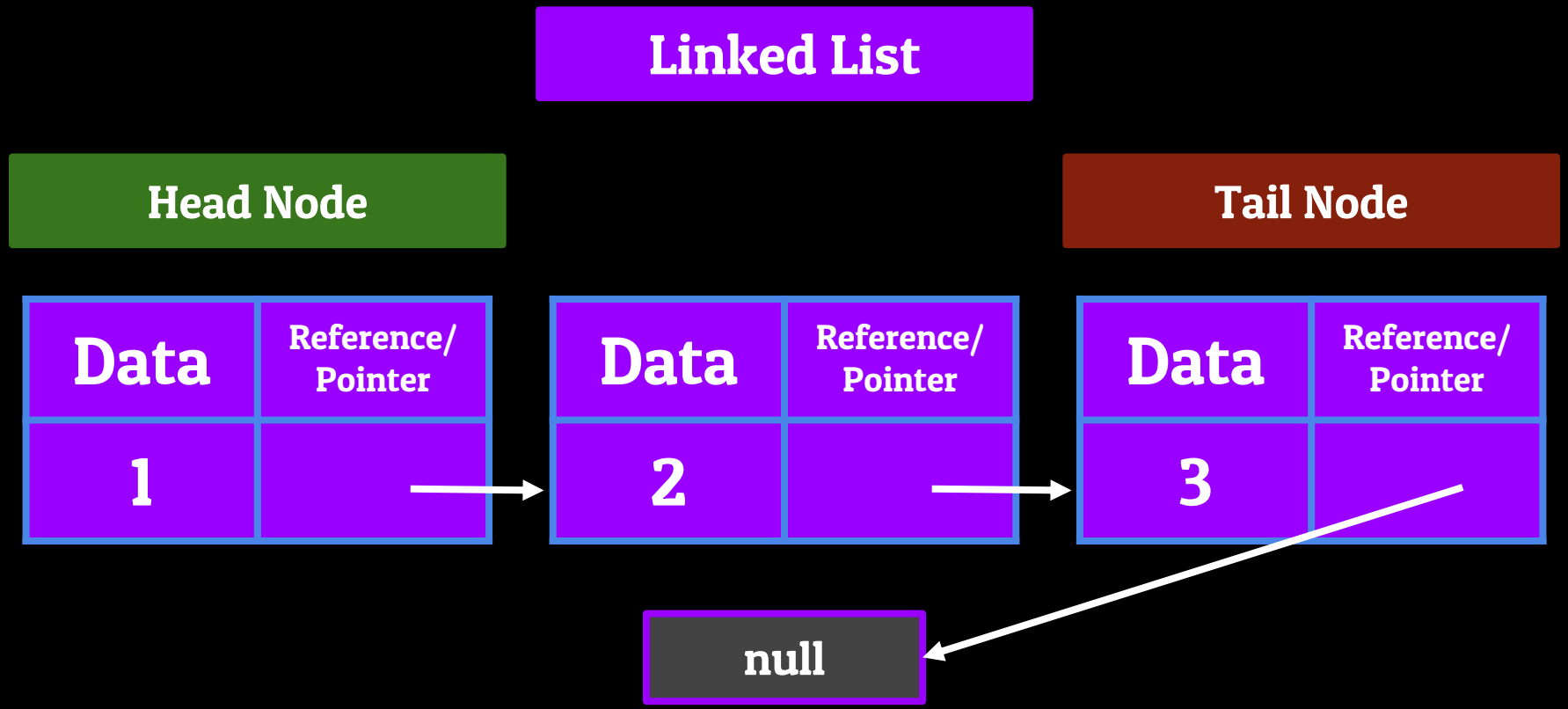

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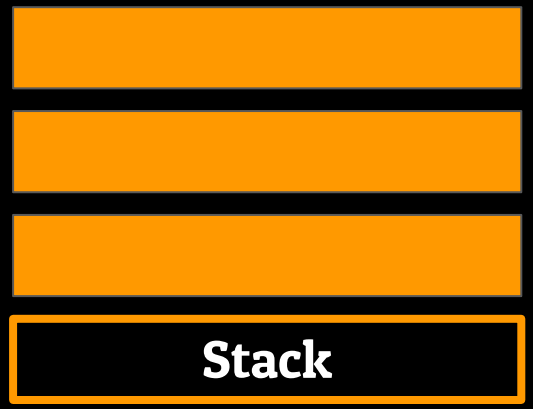

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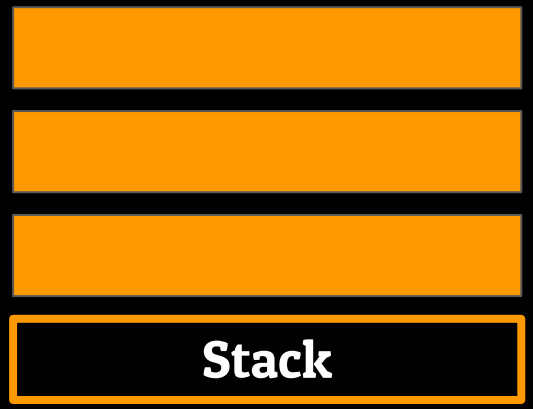
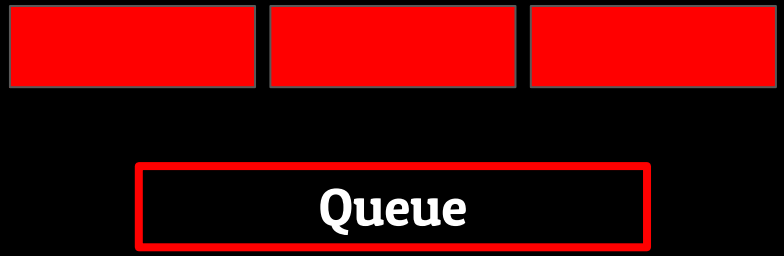
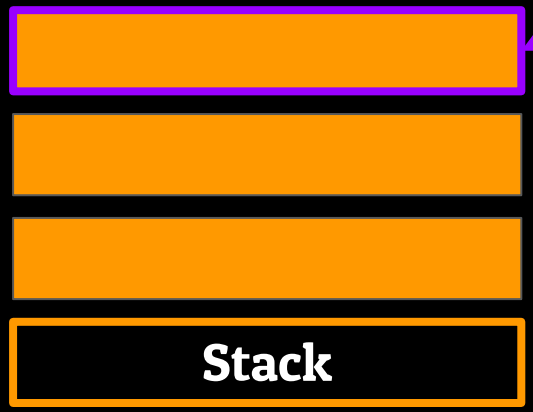
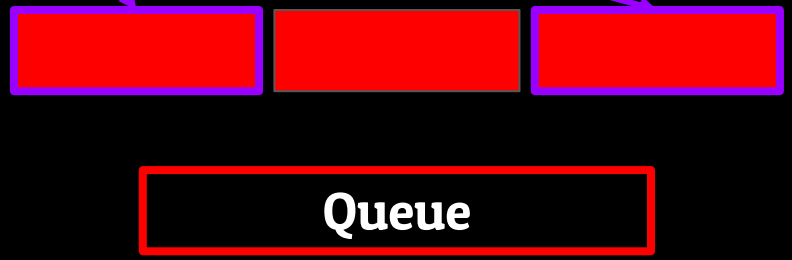




The Linked List - Adding and Removing Information

Data can only flow in and out of a few specified points





The Linked List - Adding and Removing Information

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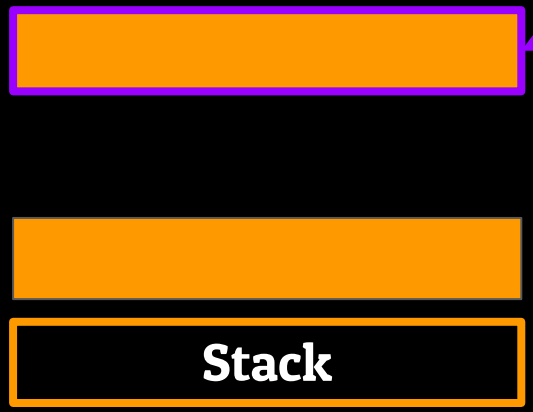

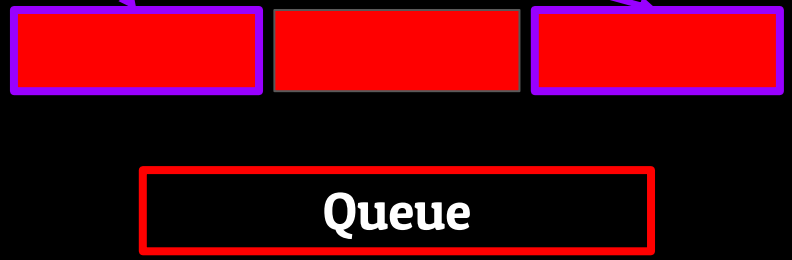

The Linked List - Adding and Removing Information

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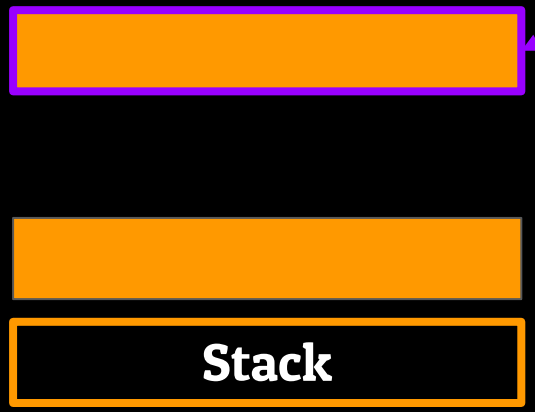
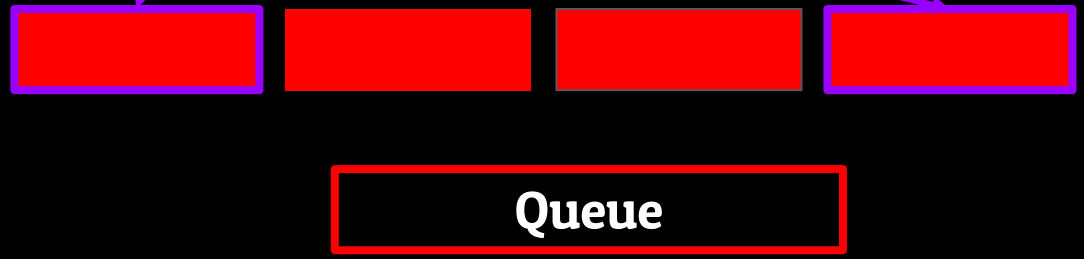
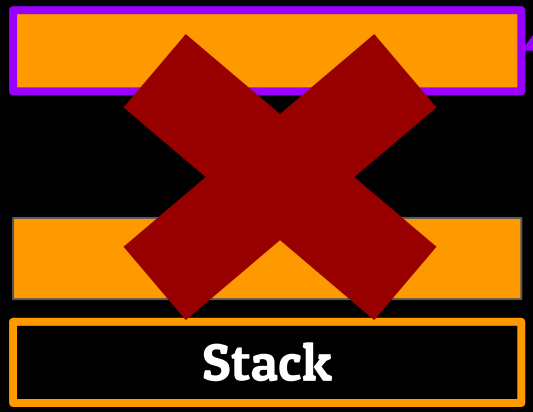
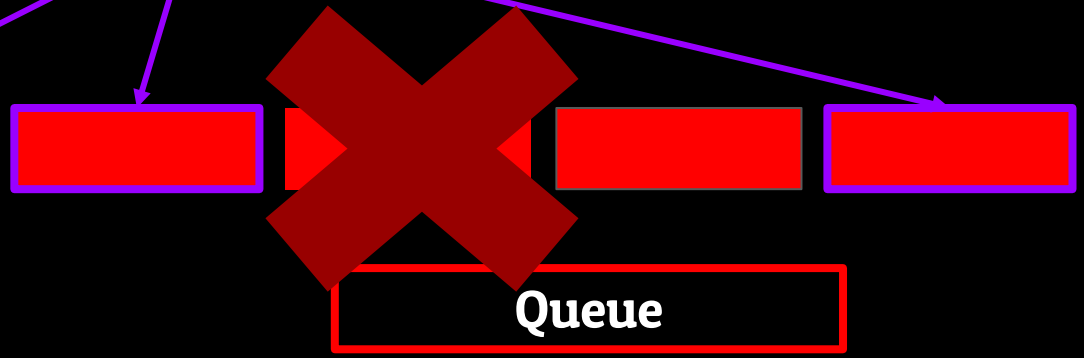




The Linked List - Adding and Removing Information

Data can only flow in and out of a few specified points





The Linked List - Adding and Removing Information

The Linked List - Adding and Removing Information

Data can flow in and out of any point of a LinkedList

The Linked List - Adding and Removing Information

Data can flow in and out of any point of a LinkedList

Add to Head

Remove from Head

The Linked List - Adding and Removing Information

Data can flow in and out of any point of a LinkedList

Add to Head

Add to the Middle

Remove from Head

Remove from the Middle

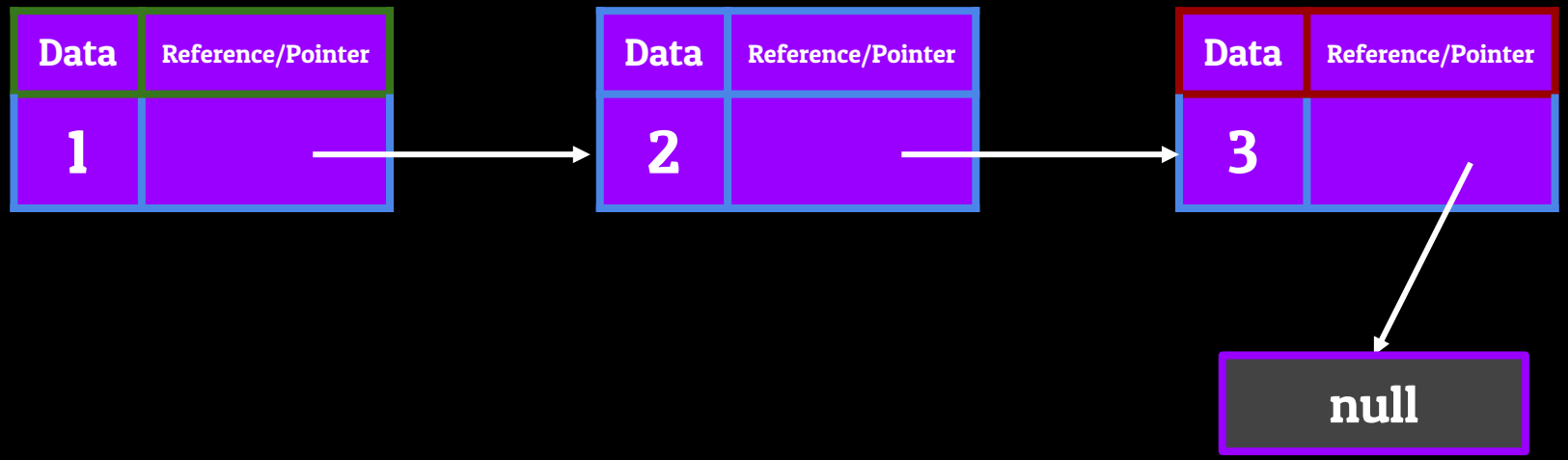
The Linked List - Adding and Removing Information

Data can flow in and out of any point of a LinkedList

Add to Head	Add to the Middle	Add to Tail
Remove from Head	Remove from the Middle	Remove from Tail

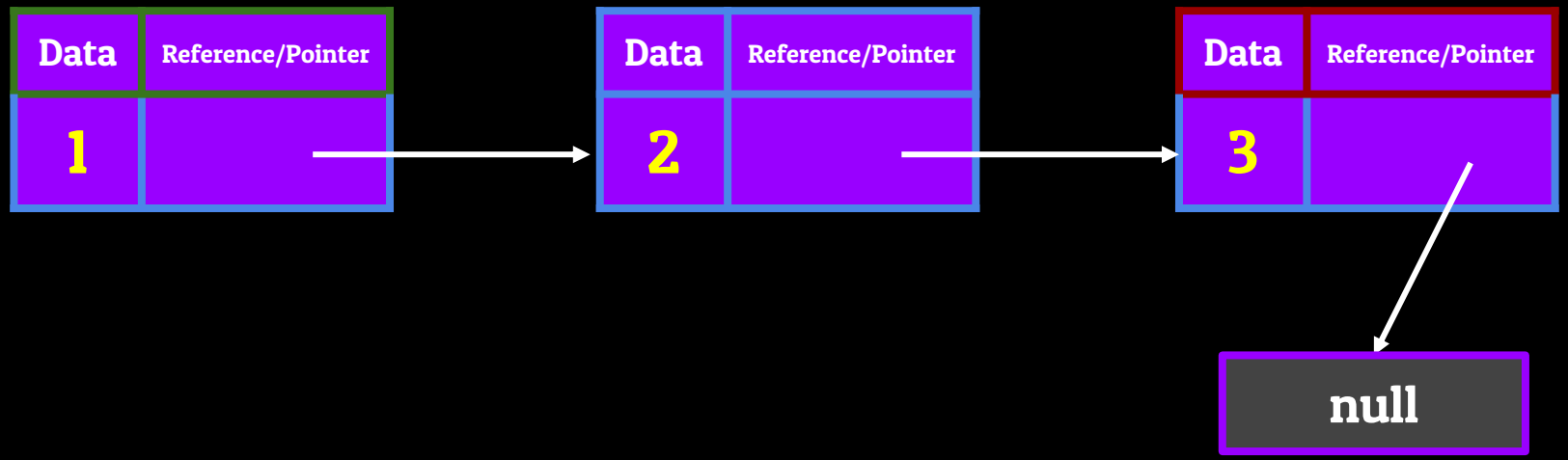
The Linked List - Adding and Removing Information

Data can flow in and out of any point of a LinkedList



The Linked List - Adding and Removing Information

Data can flow in and out of any point of a LinkedList



The Linked List - Adding and Removing Information

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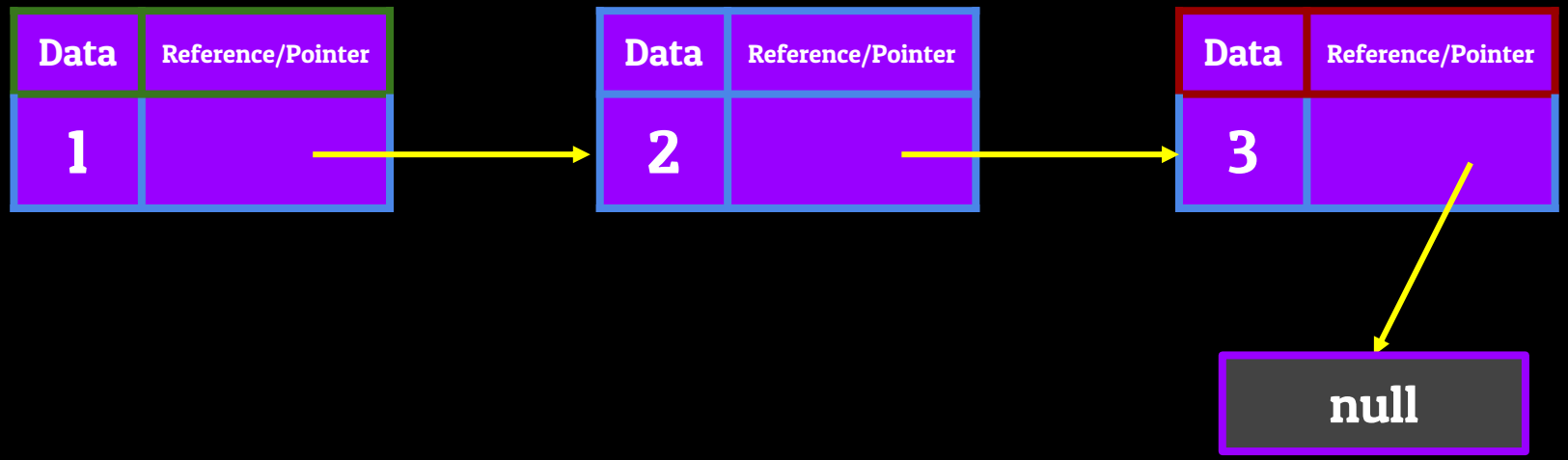

The Linked List - Adding and Removing Information

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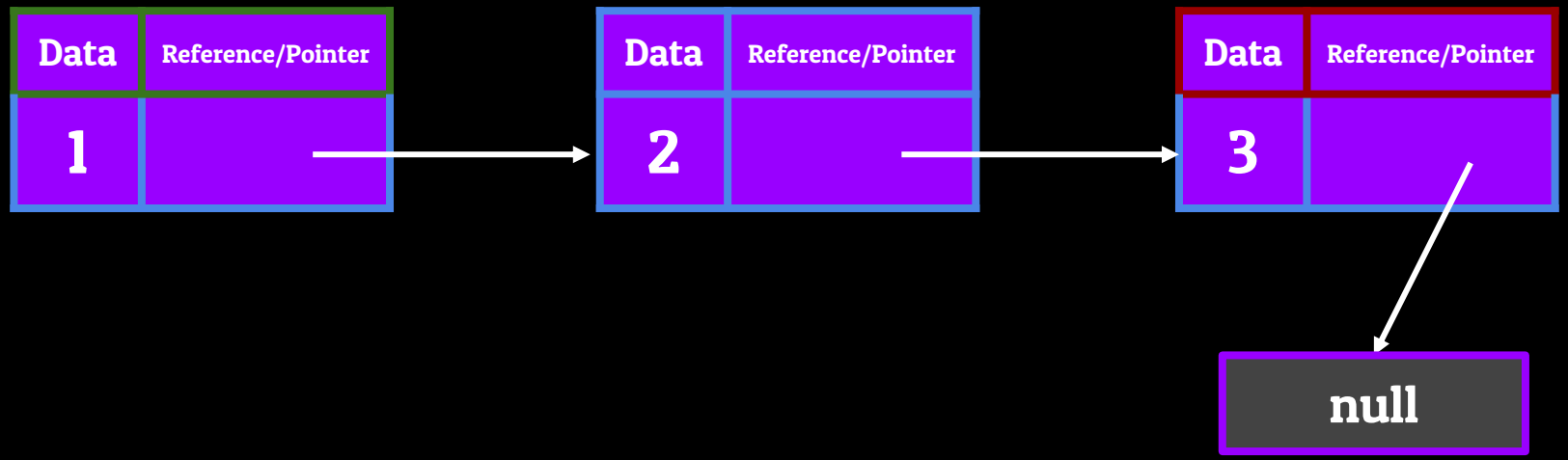

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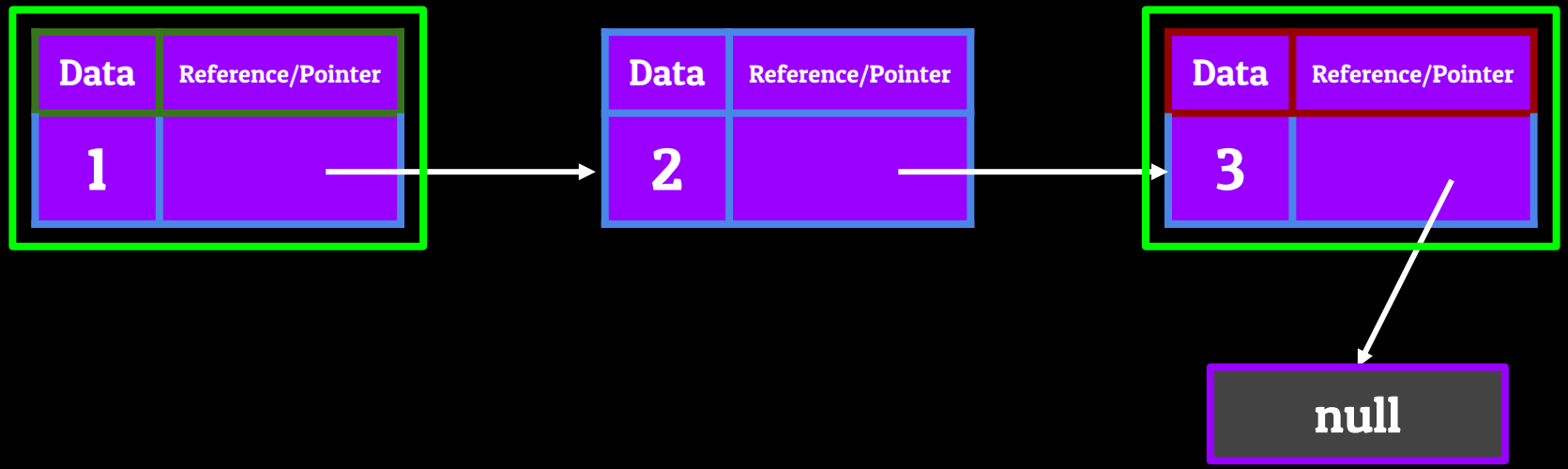

The Linked List - Adding and Removing Information

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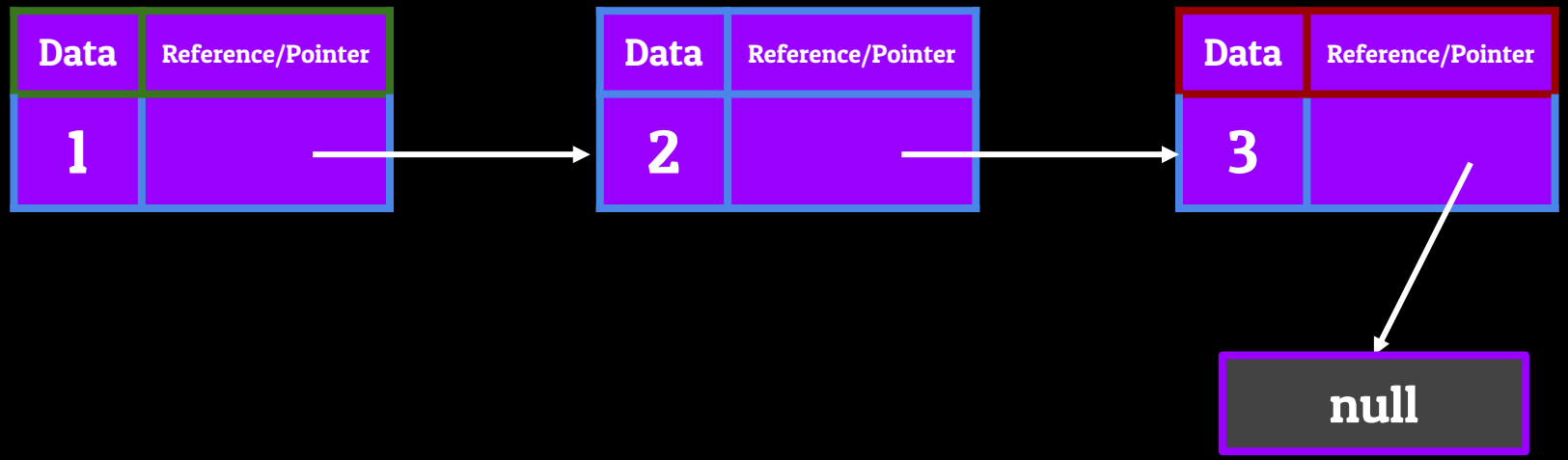

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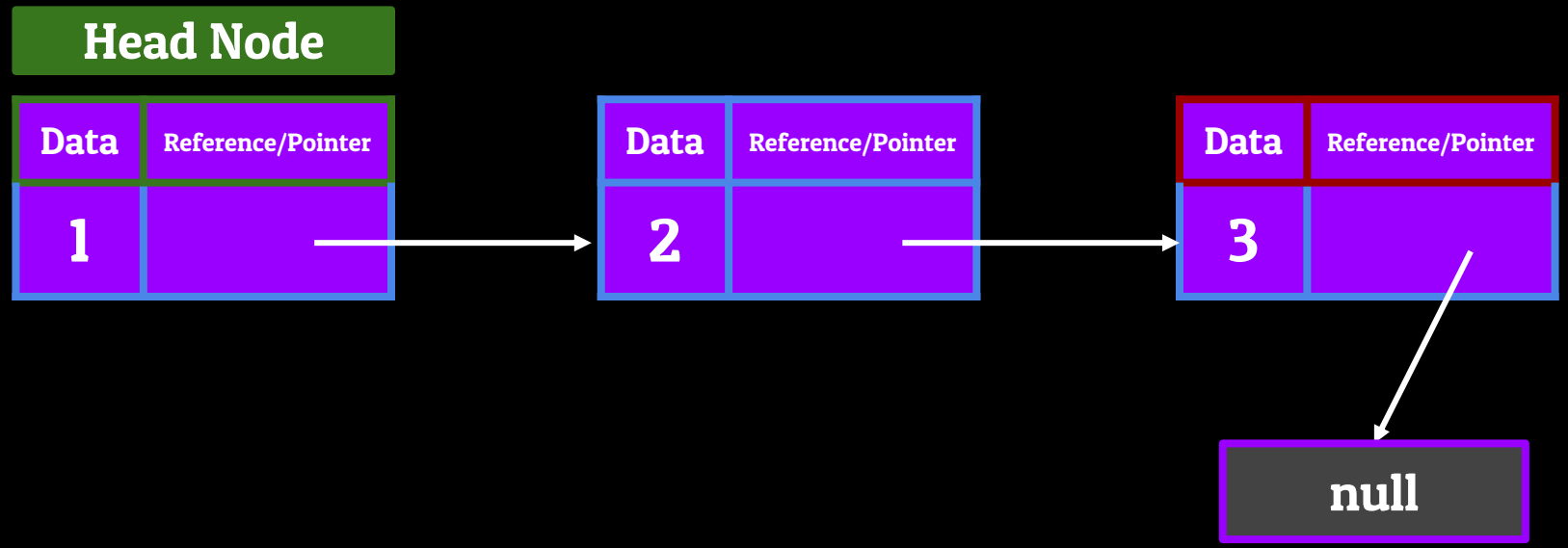
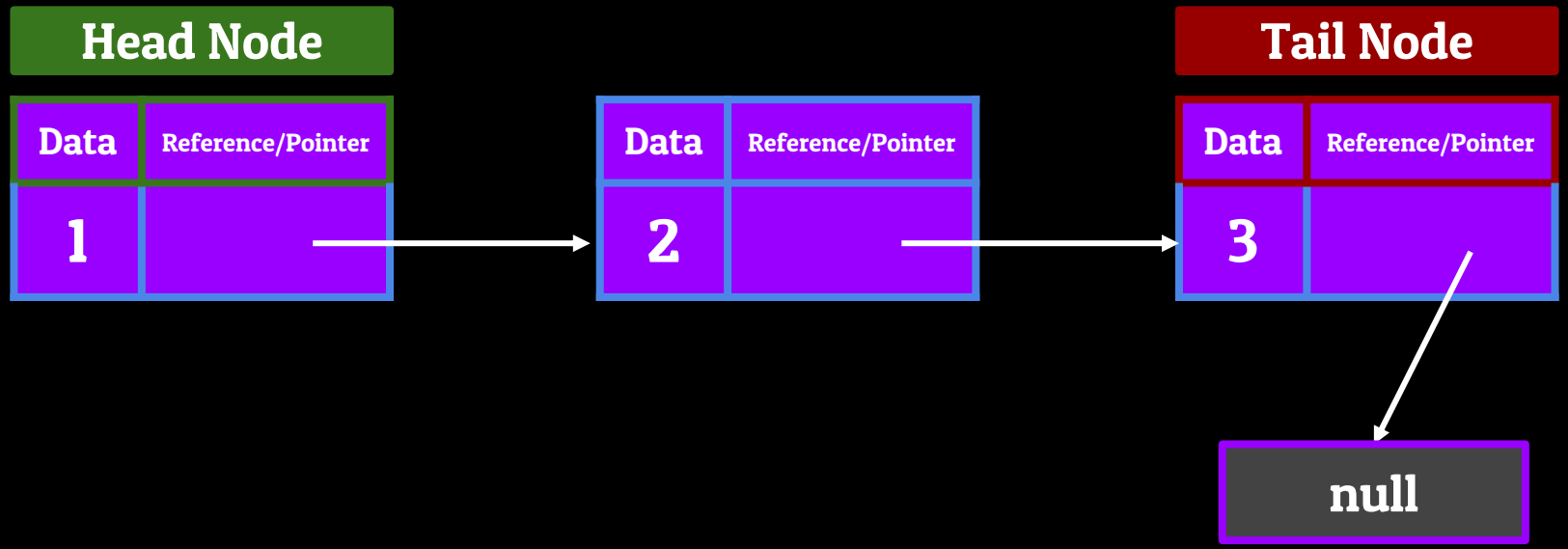


The Linked List - Adding and Removing Information

Data can flow in and out of any point of a LinkedList



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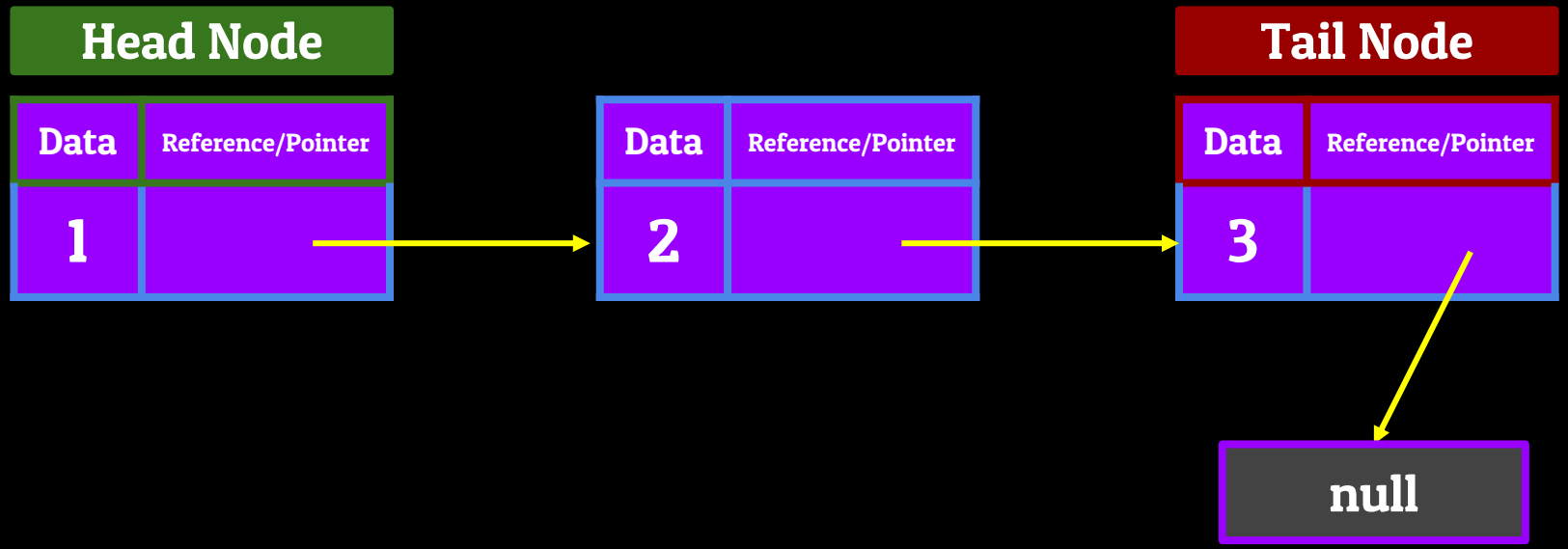
Data can flow in and out of any point of a LinkedList



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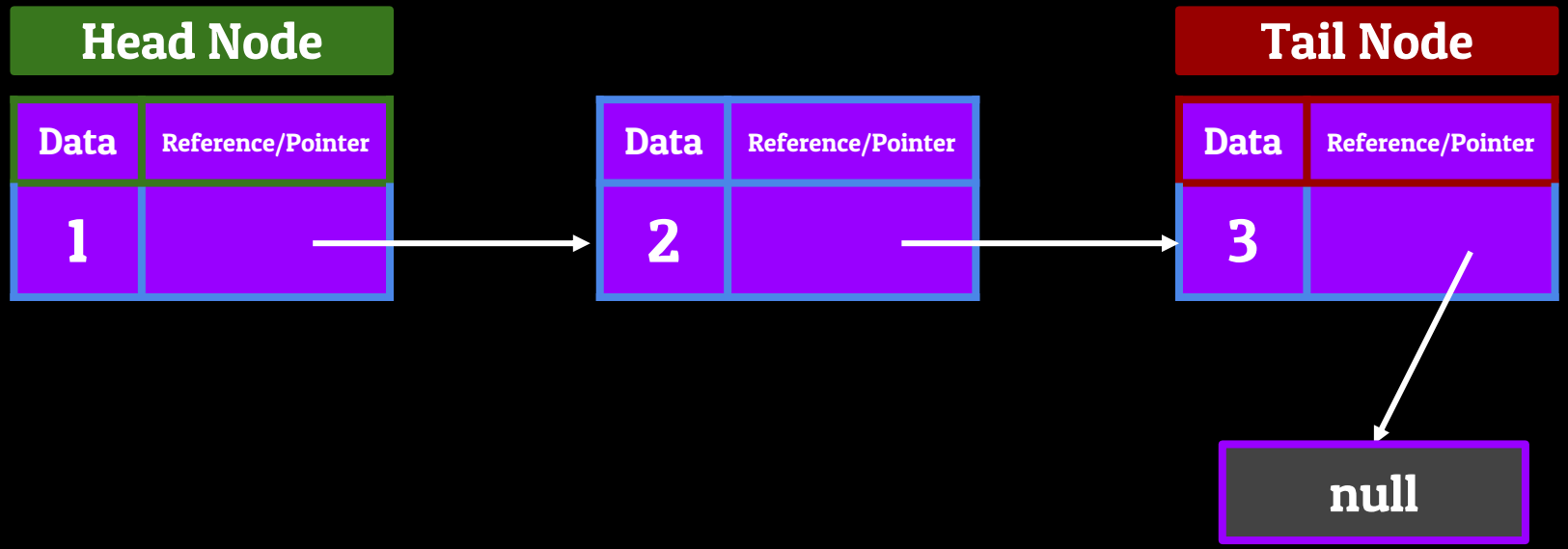
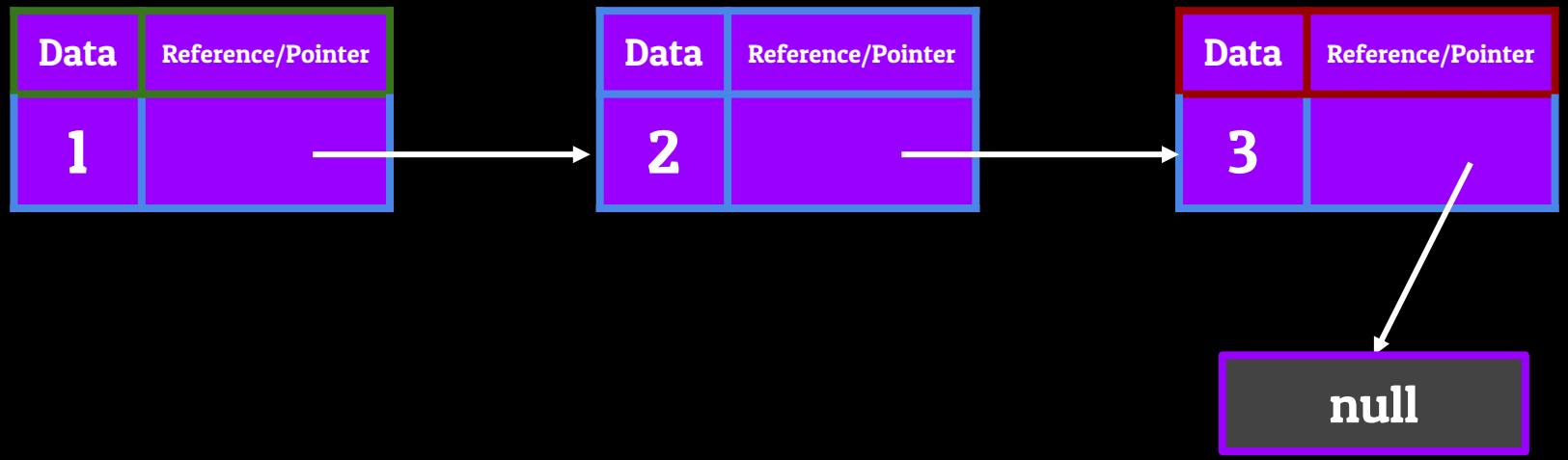
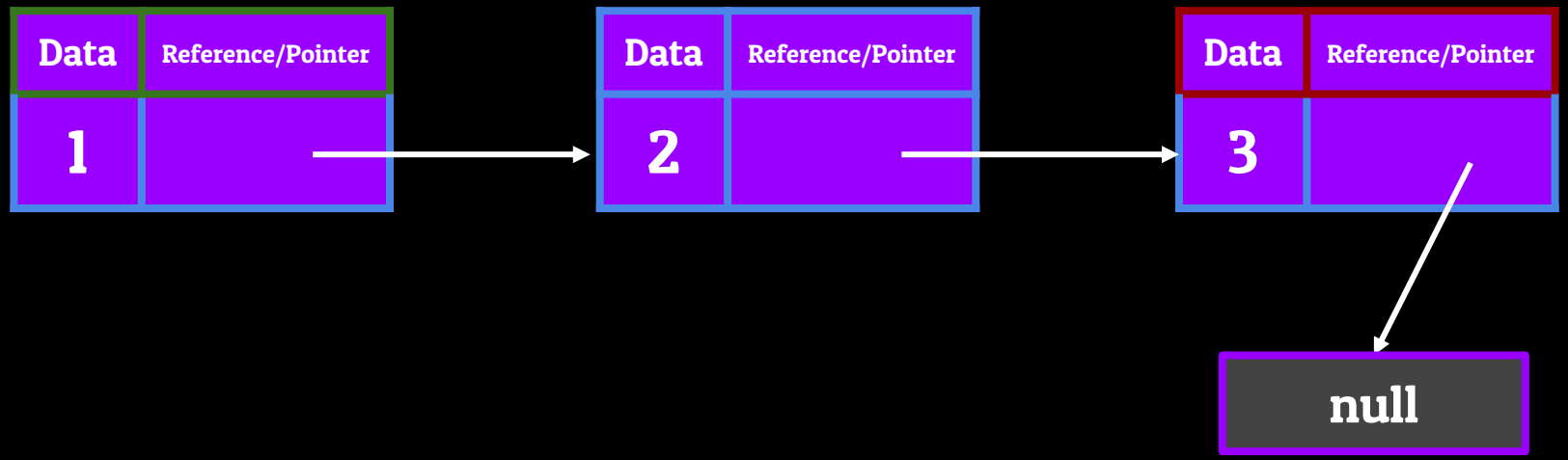


The Linked List - Adding and Removing Information



The Linked List - Adding and Removing Information

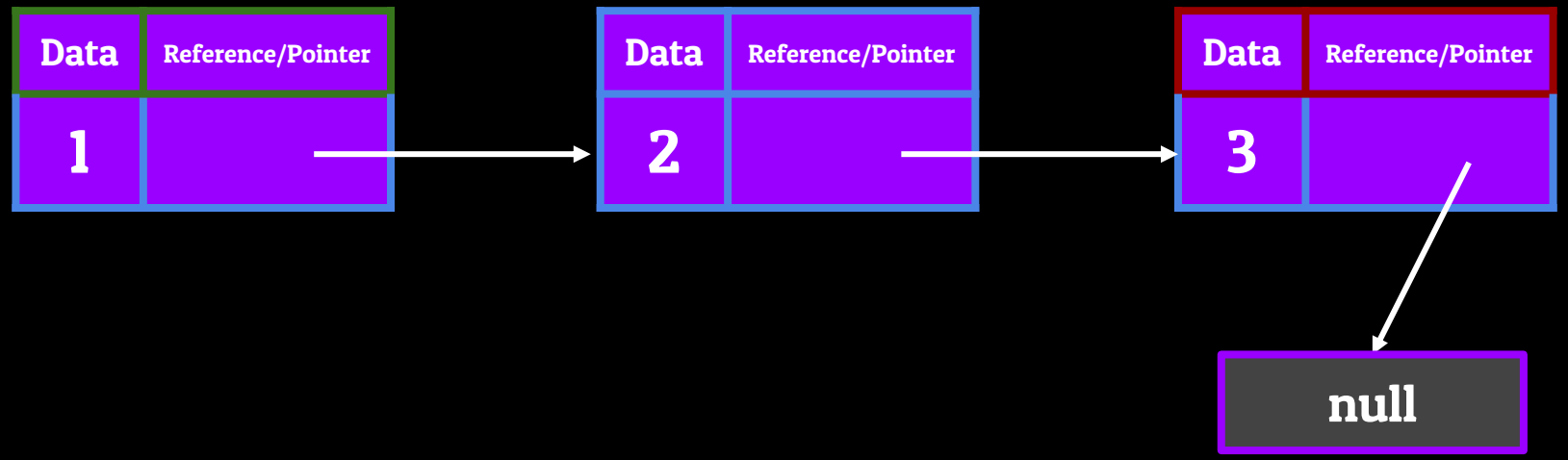
Adding to the Head of a LinkedList



The Linked List - Adding and Removing Information

Adding to the Head of a LinkedList

Make that new Node's pointer point to the current Head of the LinkedList



The Linked List - Adding and Removing Information

Adding to the Head of a LinkedList

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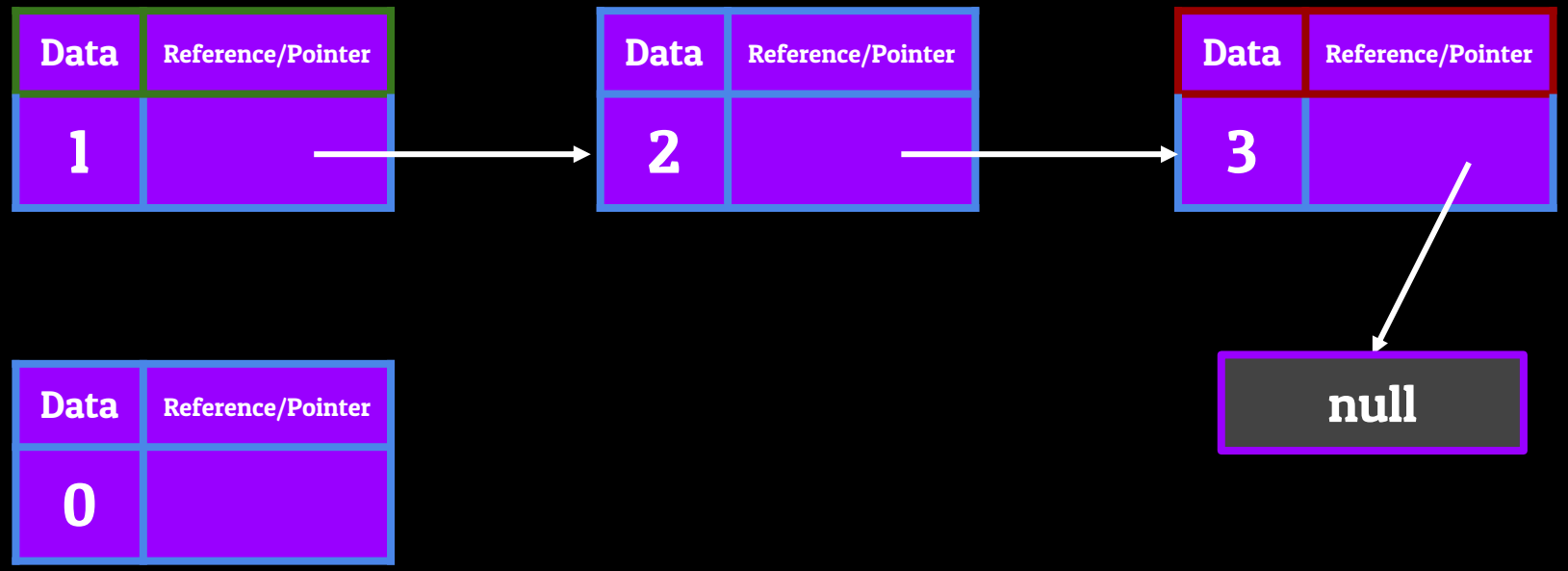

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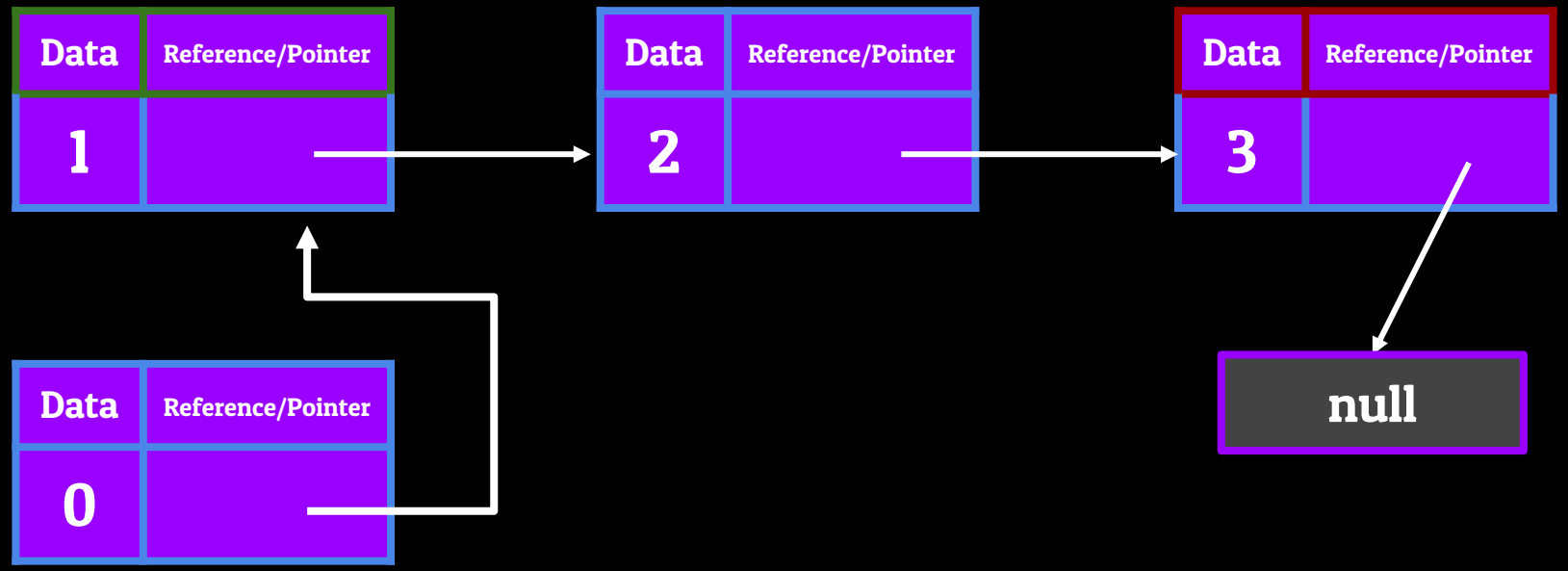
Adding to the Head of a LinkedList

Make that new Node's pointer point to the current Head of the LinkedList



The Linked List - Adding and Removing Information

Adding to the Head of a LinkedList

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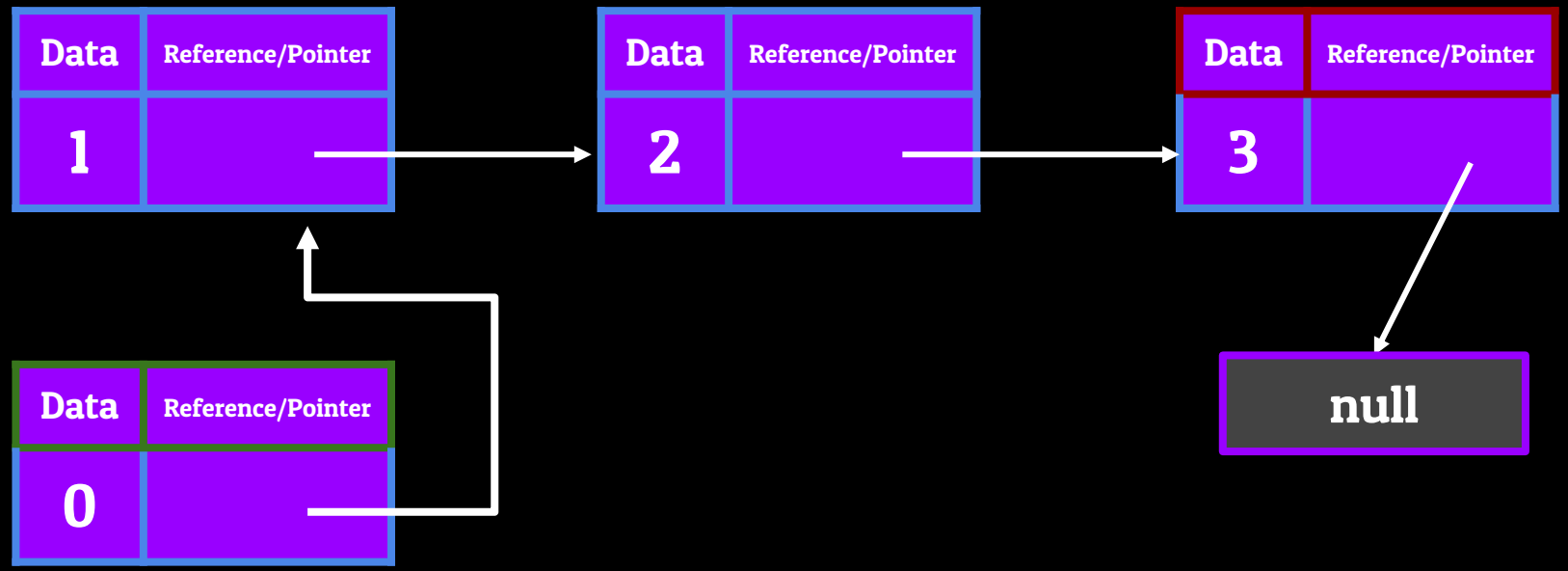

The Linked List - Adding and Removing Information

Adding to the Head of a LinkedList

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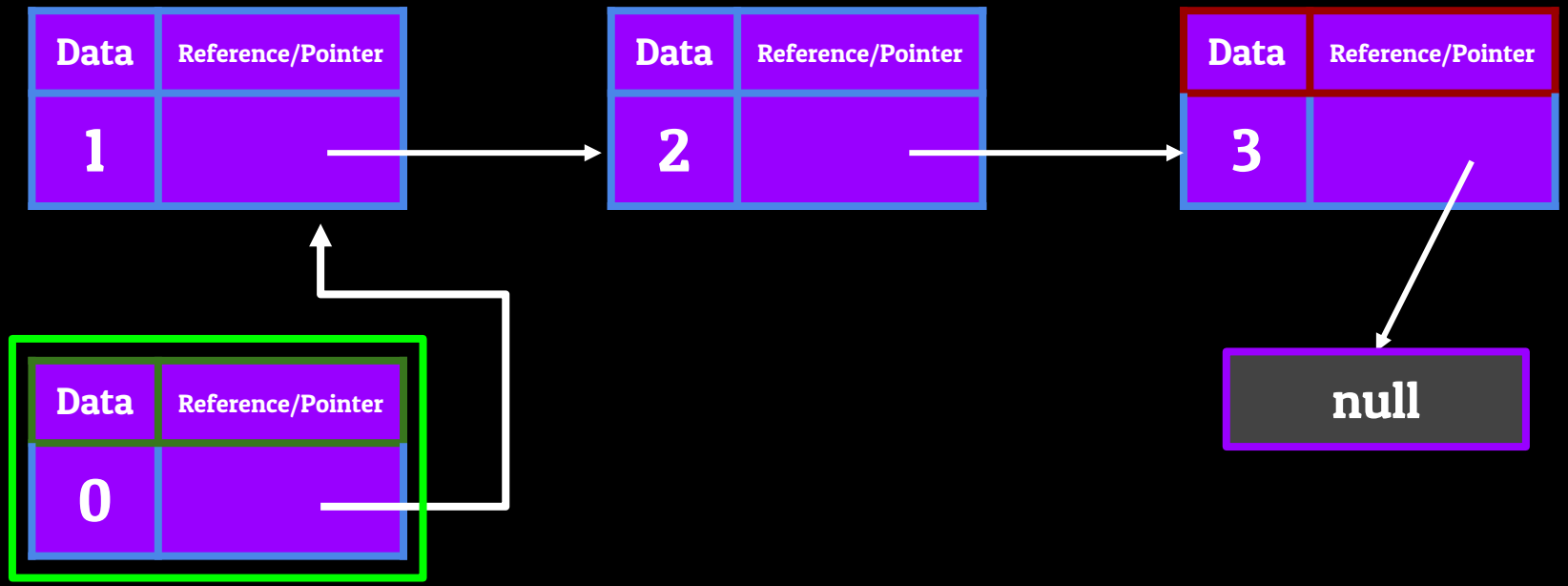

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Adding to the Head of a LinkedList

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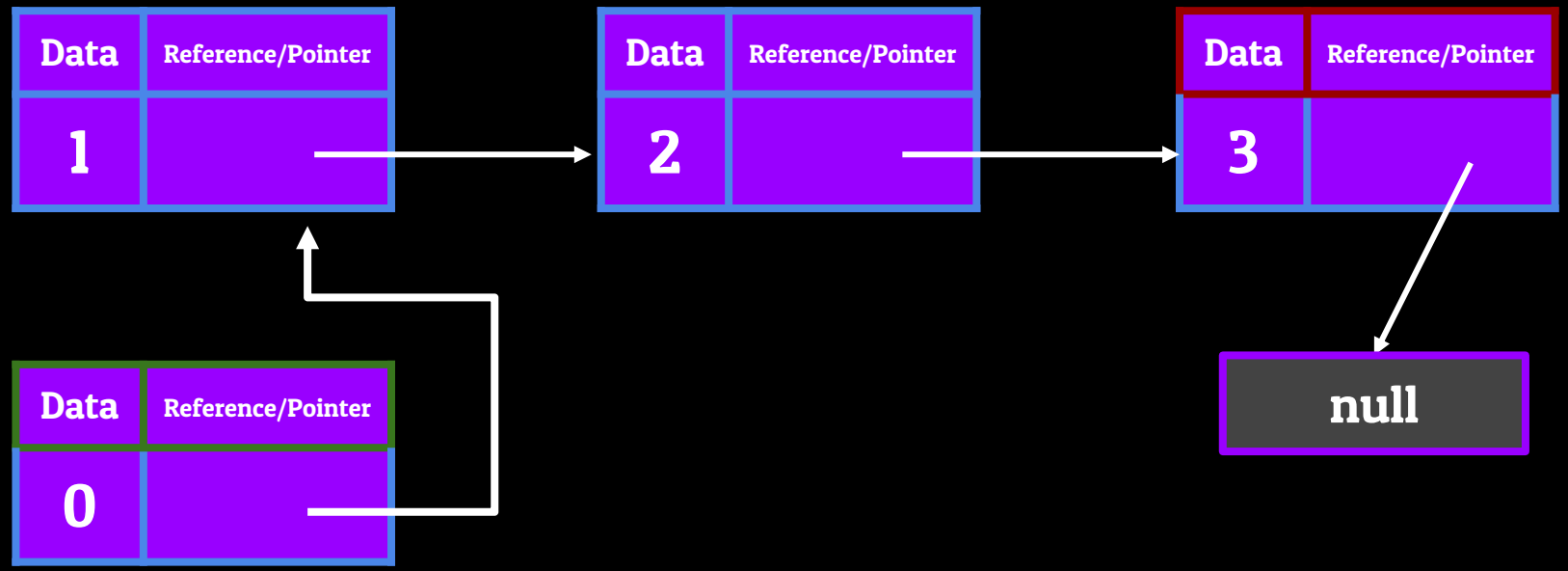
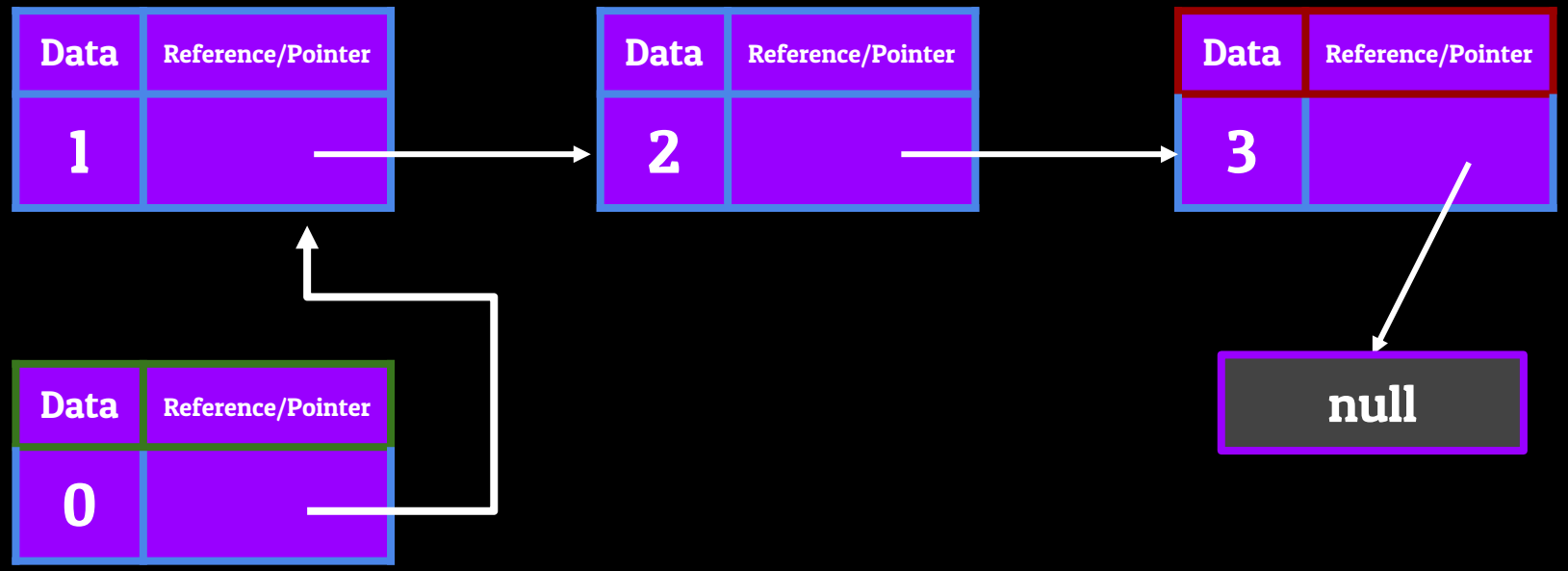
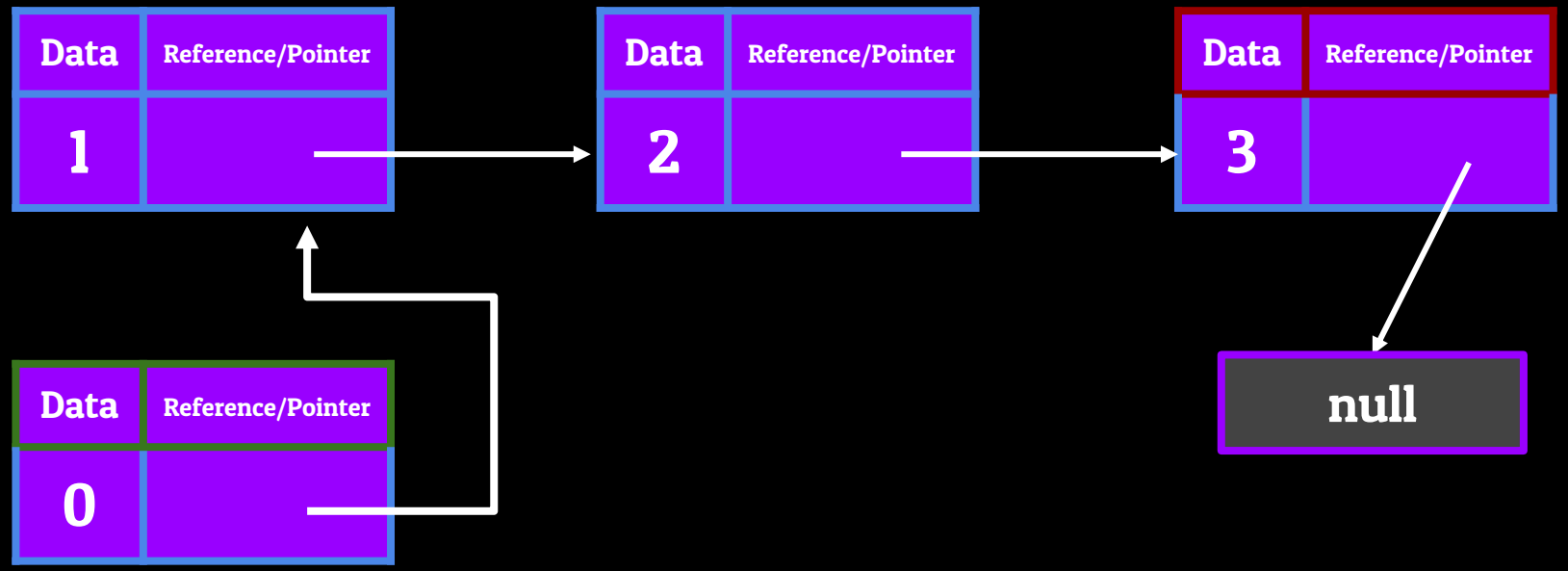


The Linked List - Adding and Removing Information



The Linked List - Adding and Removing Information

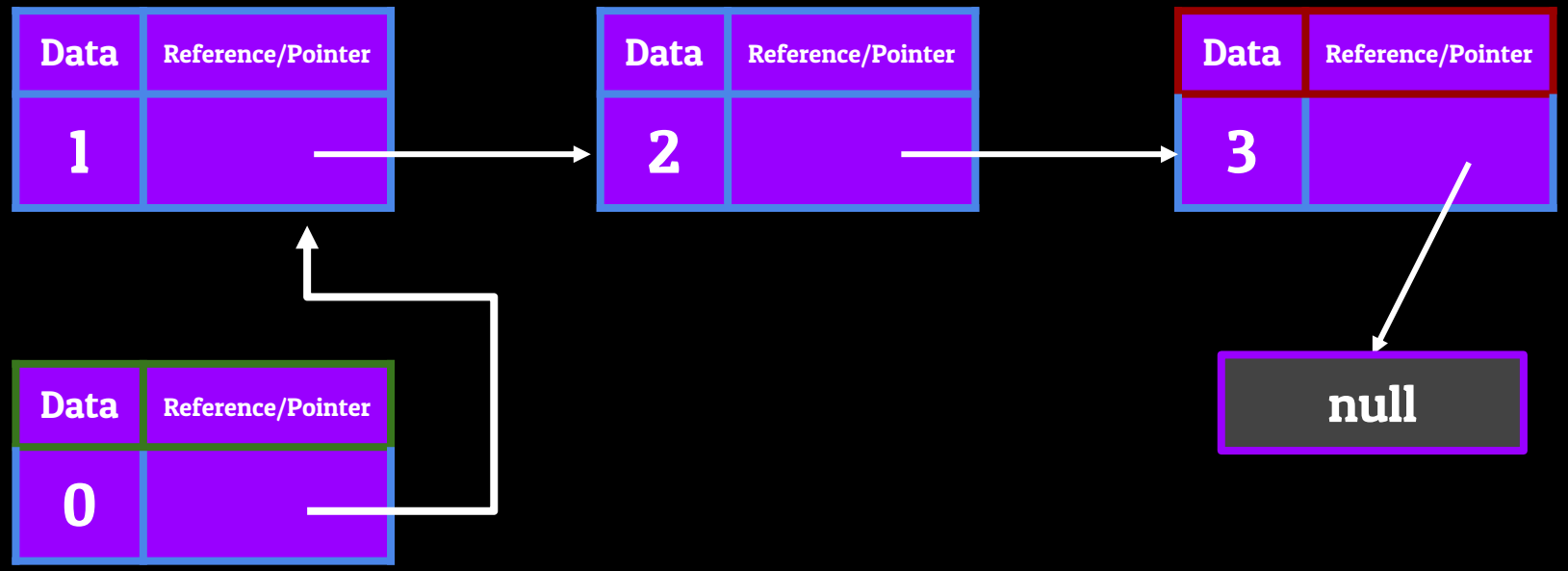
Removing from the Head of a LinkedList



The Linked List - Adding and Removing Information

Removing from the Head of a LinkedList

Set the Head Node's pointer to a null value



The Linked List - Adding and Removing Information

Removing from the Head of a LinkedList

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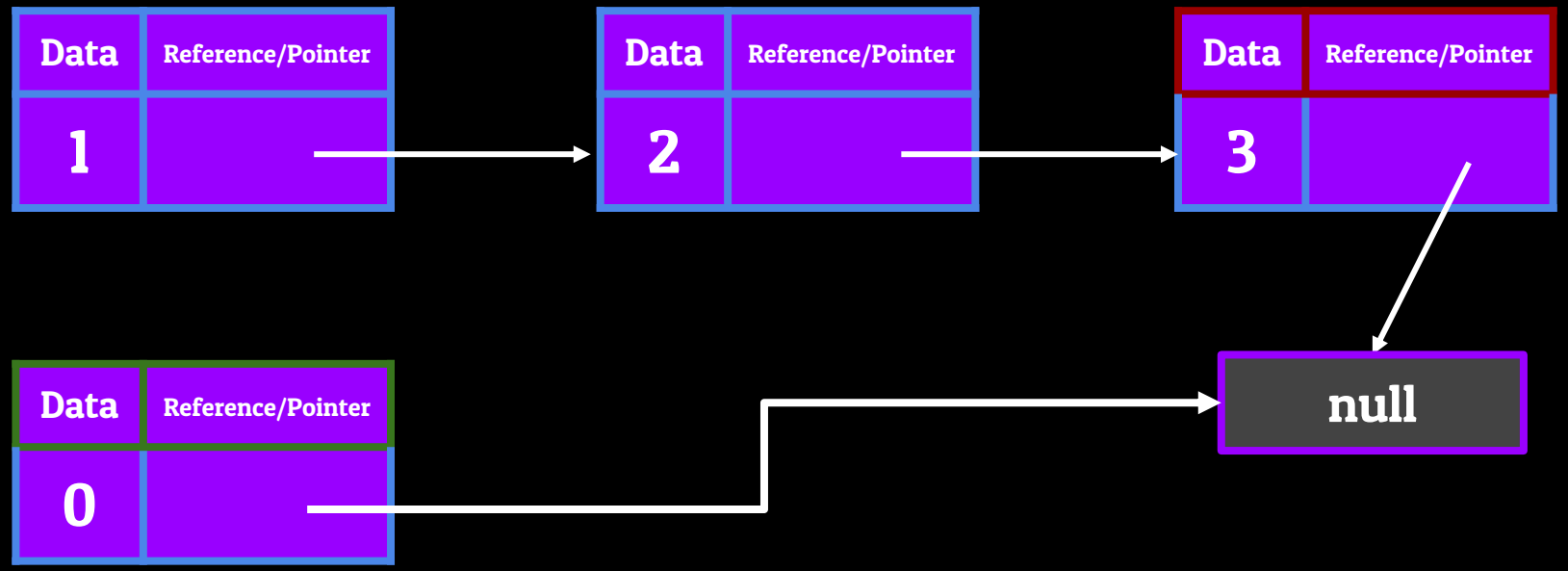

The Linked List - Adding and Removing Information

Removing from the Head of a LinkedList

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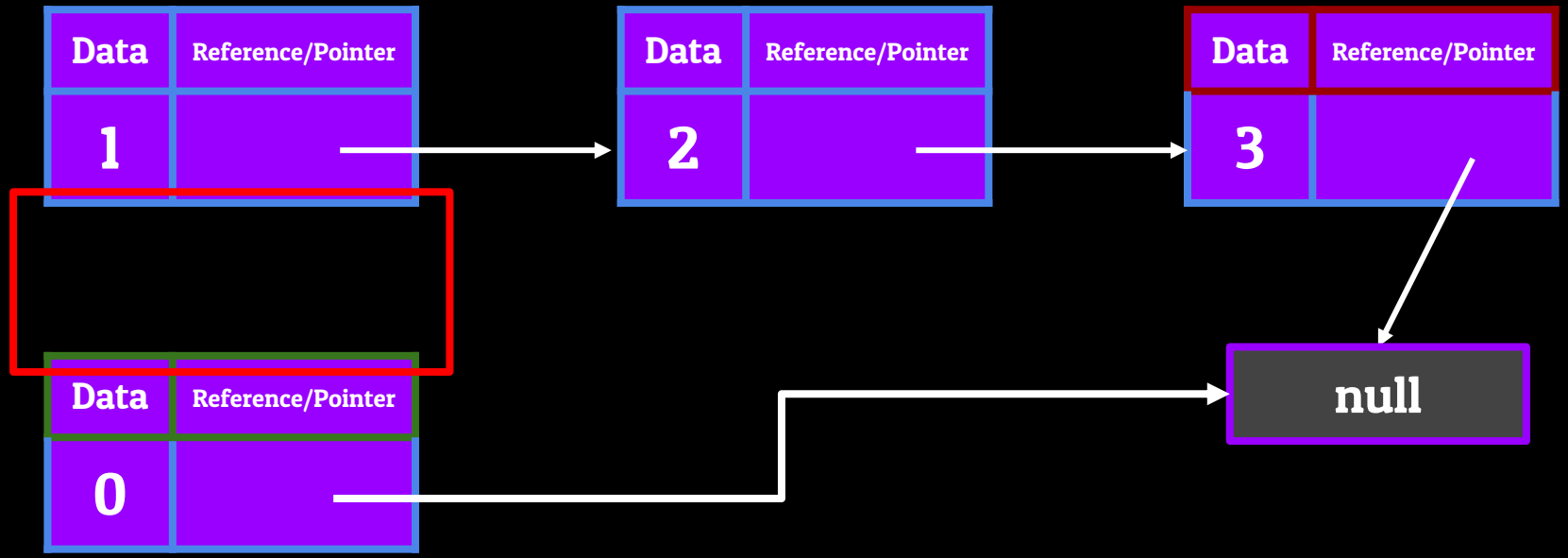

The Linked List - Adding and Removing Information

Removing from the Head of a LinkedList

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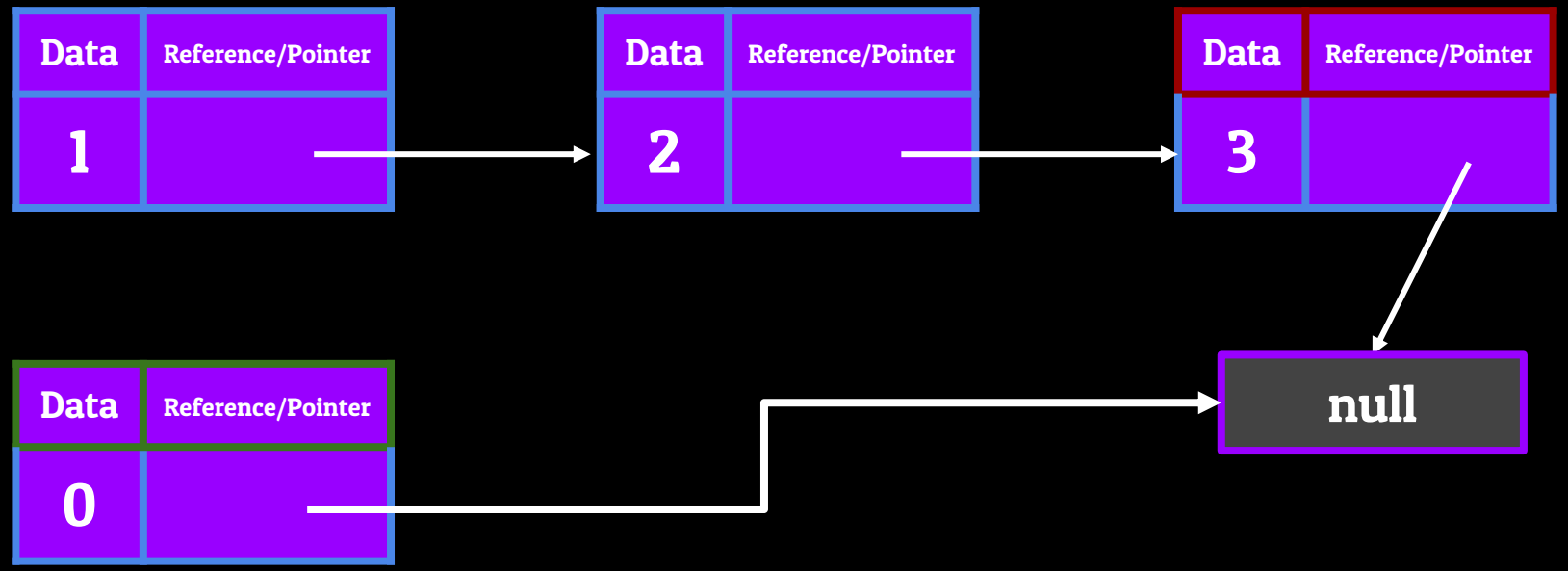

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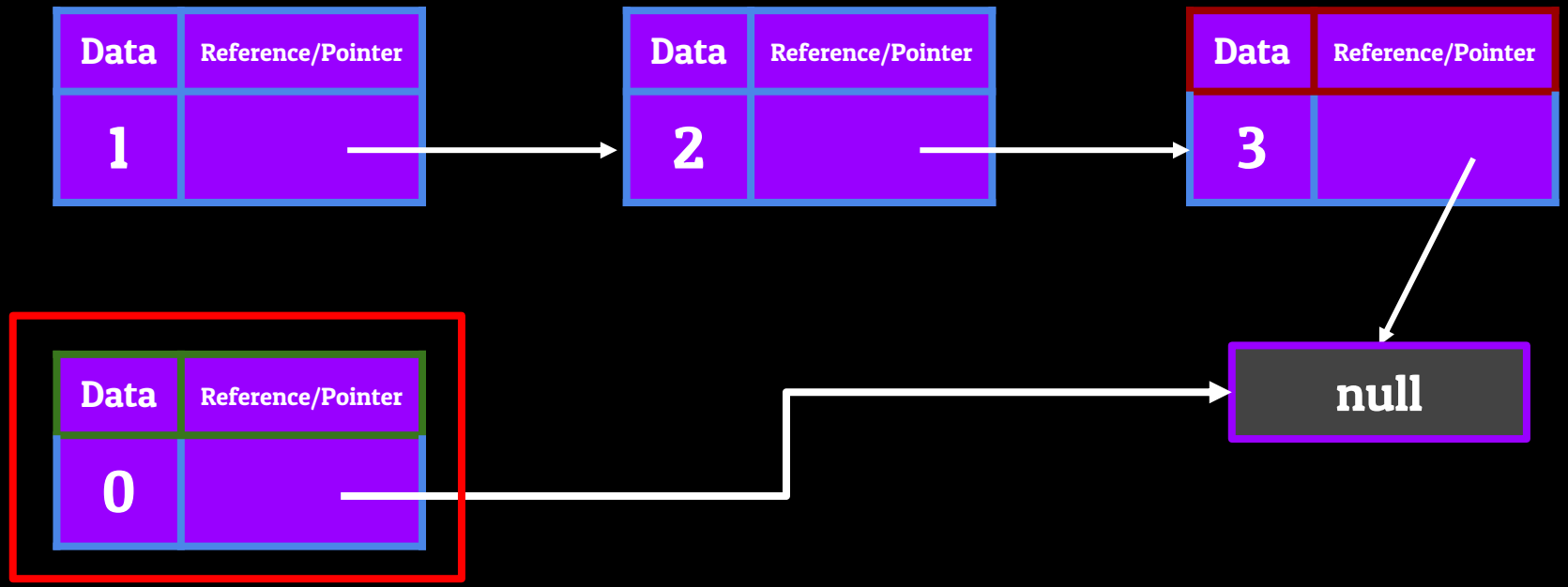

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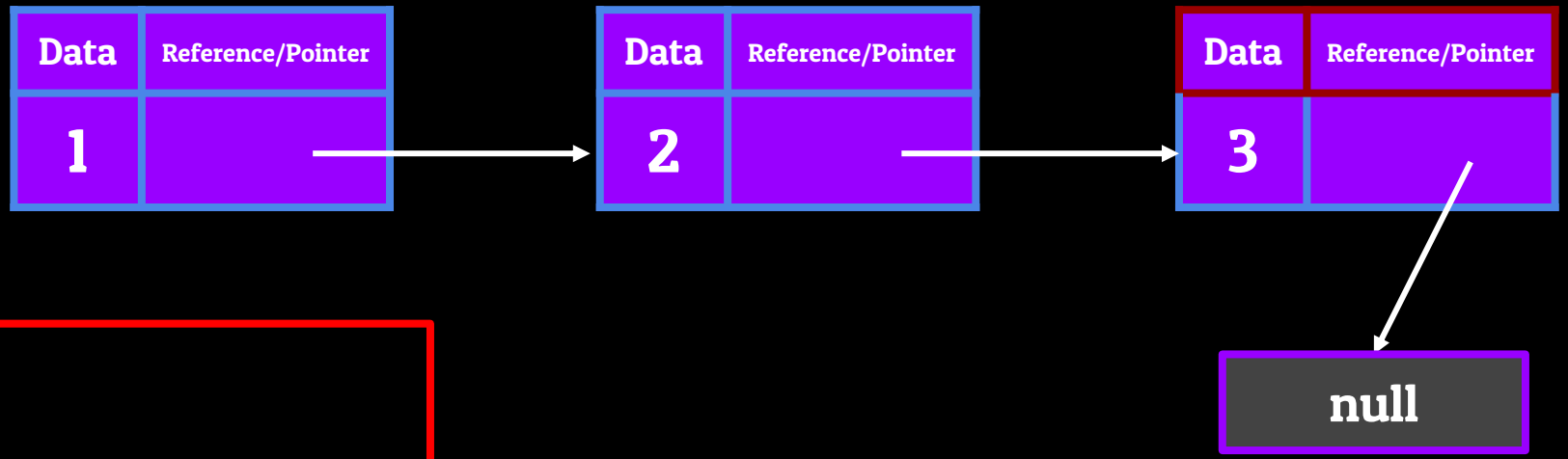

The Linked List - Adding and Removing Information

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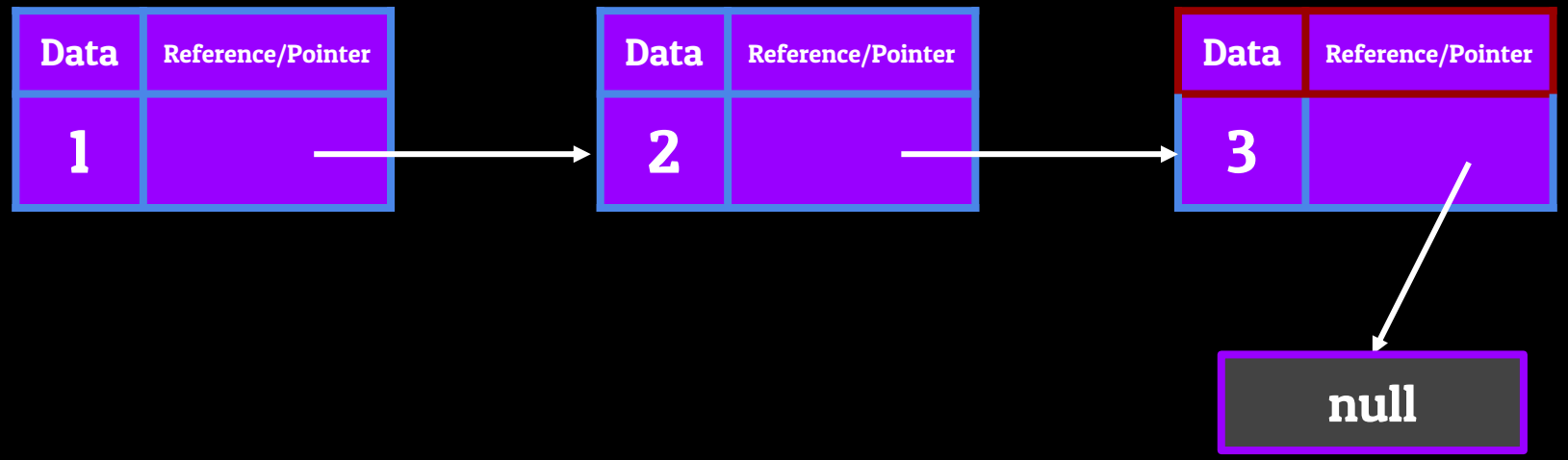

The Linked List - Adding and Removing Information

Removing from the Head of a LinkedList

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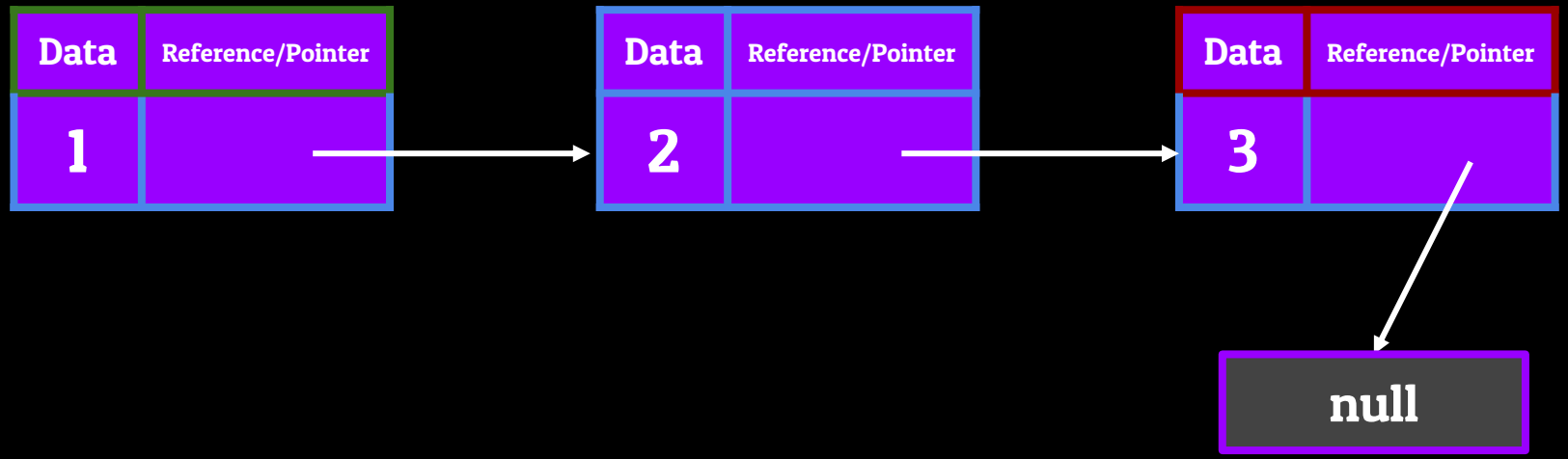
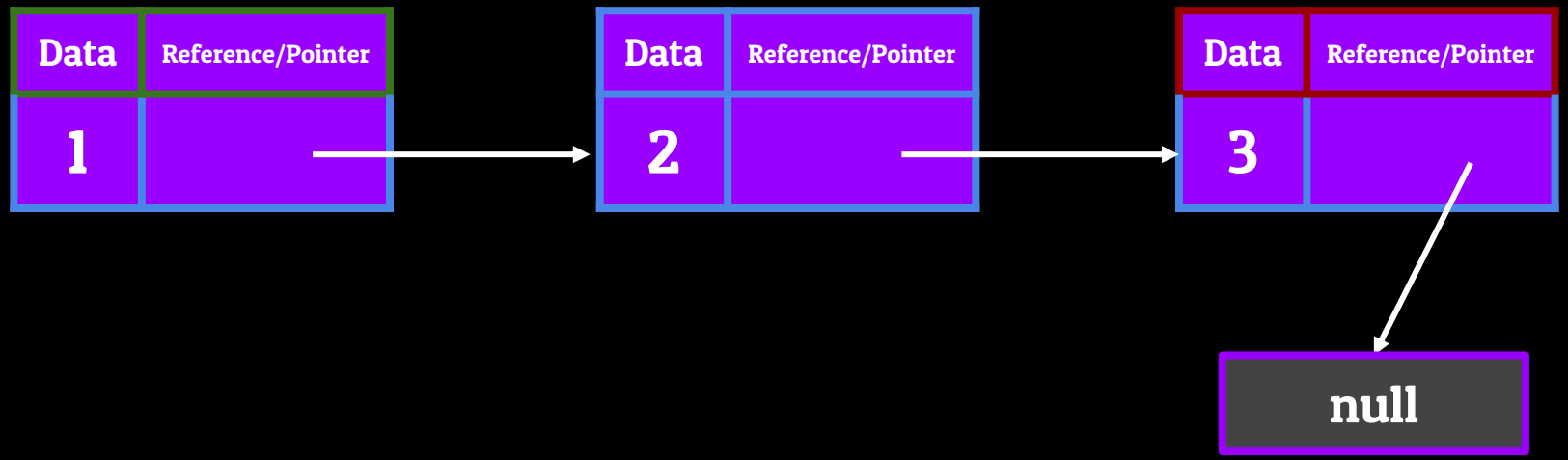


The Linked List - Adding and Removing Information

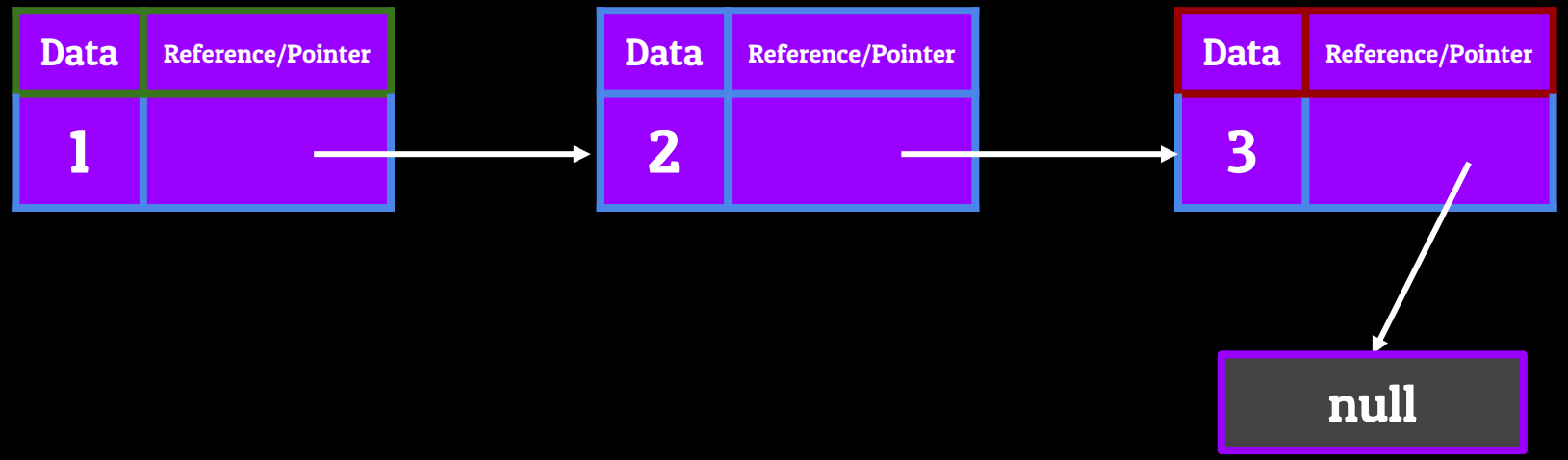
Adding a Node to the Middle of a LinkedList



The Linked List - Adding and Removing Information

Adding a Node to the Middle of a LinkedList

Make the pointer of the new Node point to the Node after the location we want to insert at

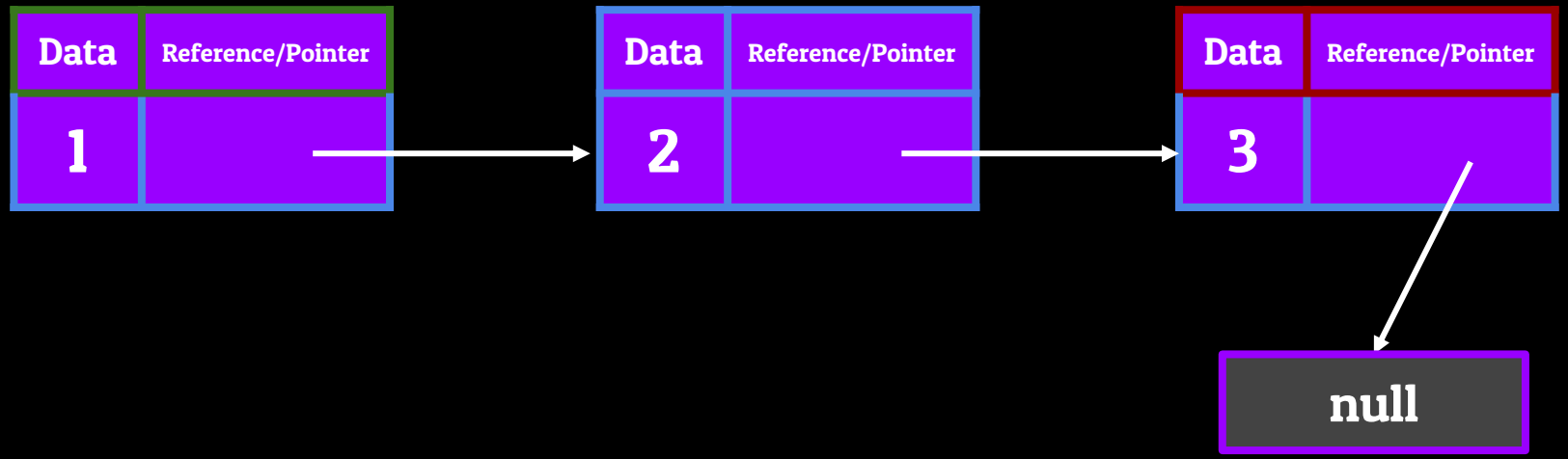


The Linked List - Adding and Removing Information

Adding a Node to the Middle of a LinkedList

Make the pointer of the new Node point to the Node after the location we want to insert at

Set the Node before the location we want to insert at to point towards the new Node



The Linked List - Adding and Removing Information

Adding a Node to the Middle of a LinkedList

Make the pointer of the new Node point to the Node after the location we want to insert at

Set the Node before the location we want to insert at to point towards the new Node

The Linked List - Adding and Removing Information

Adding a Node to the Middle of a LinkedList

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The Linked List - Adding and Removing Information

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Make the pointer of the new Node point to the Node after the location we want to insert at

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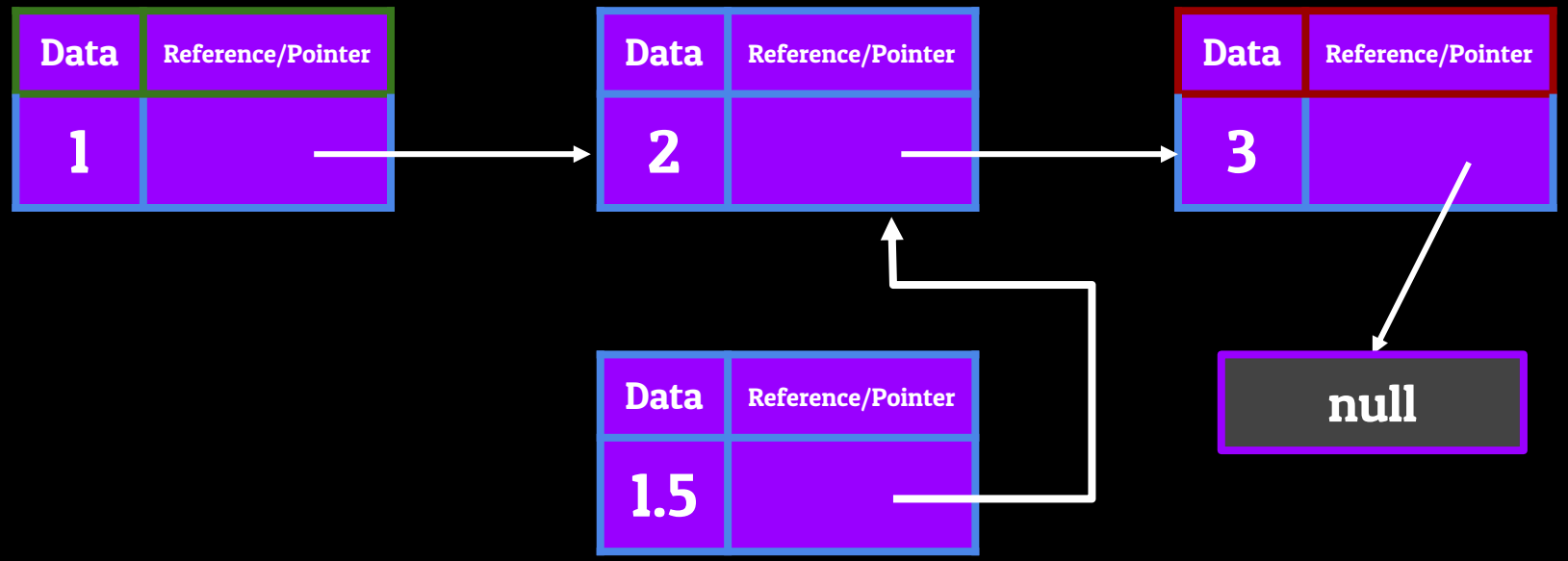
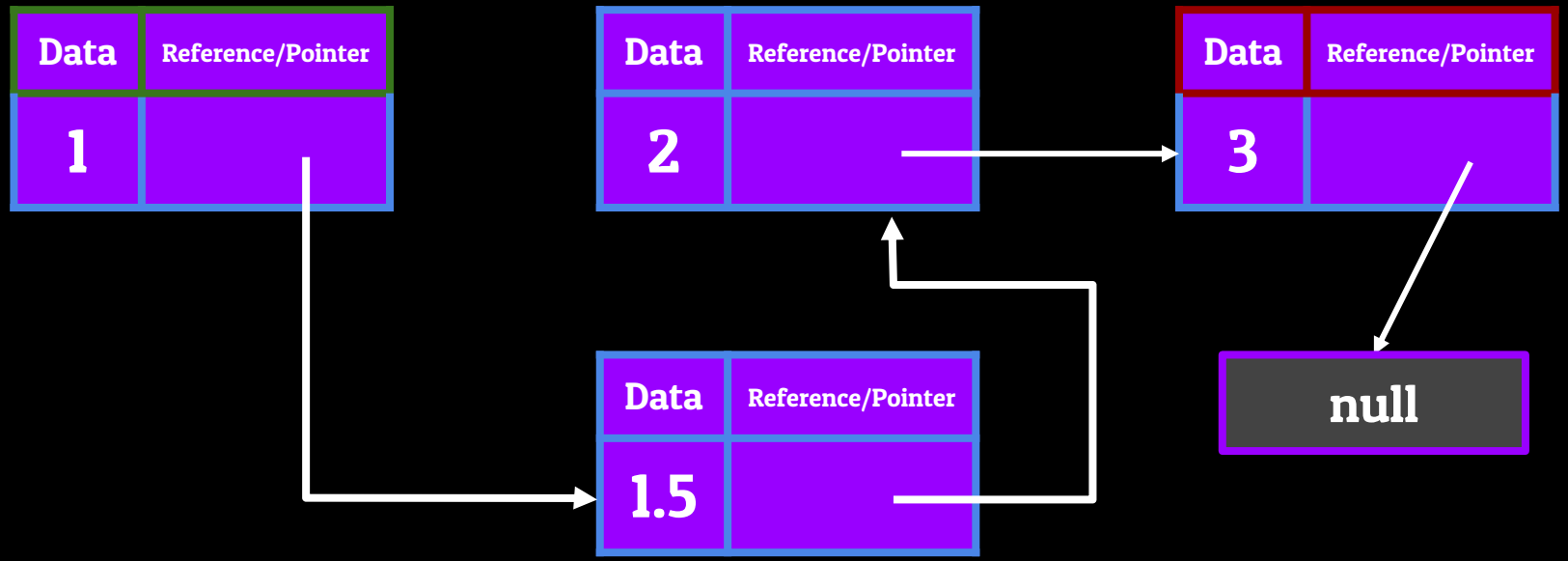


The Linked List - Adding and Removing Information

Adding a Node to the Middle of a LinkedList

Make the pointer of the new Node point to the Node after the location we want to insert at

Set the Node before the location we want to insert at to point towards the new Node

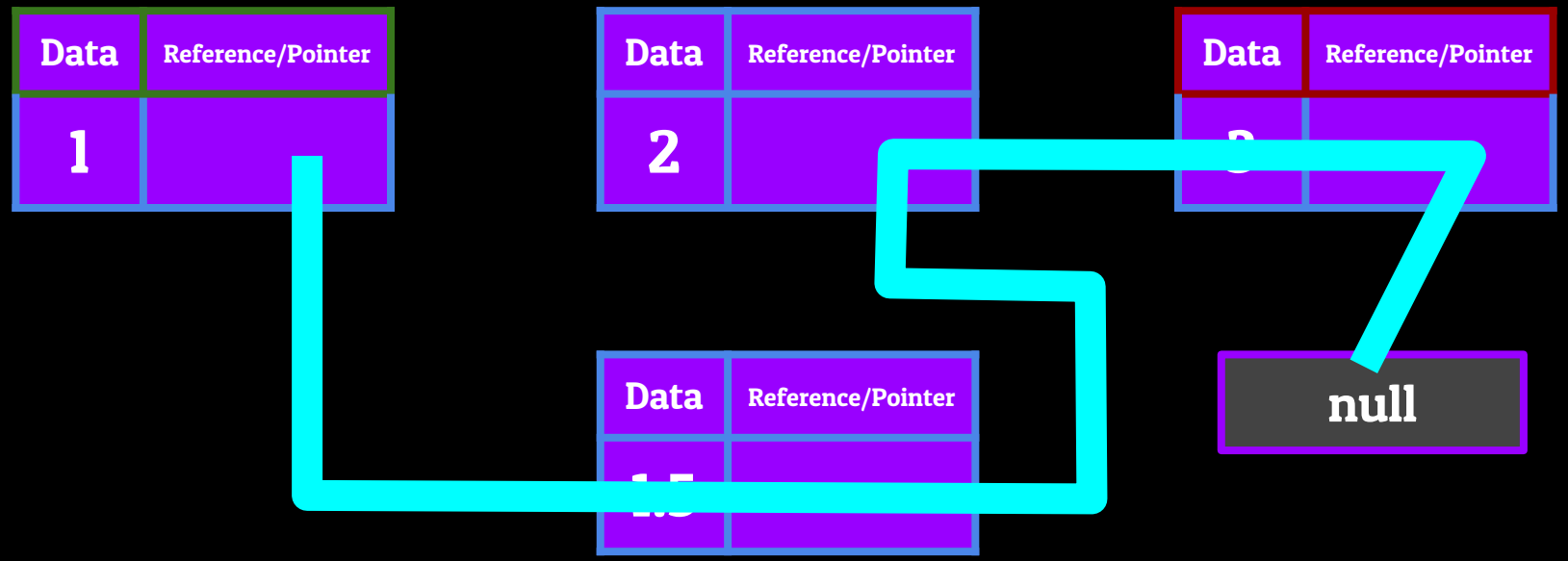


The Linked List - Adding and Removing Information

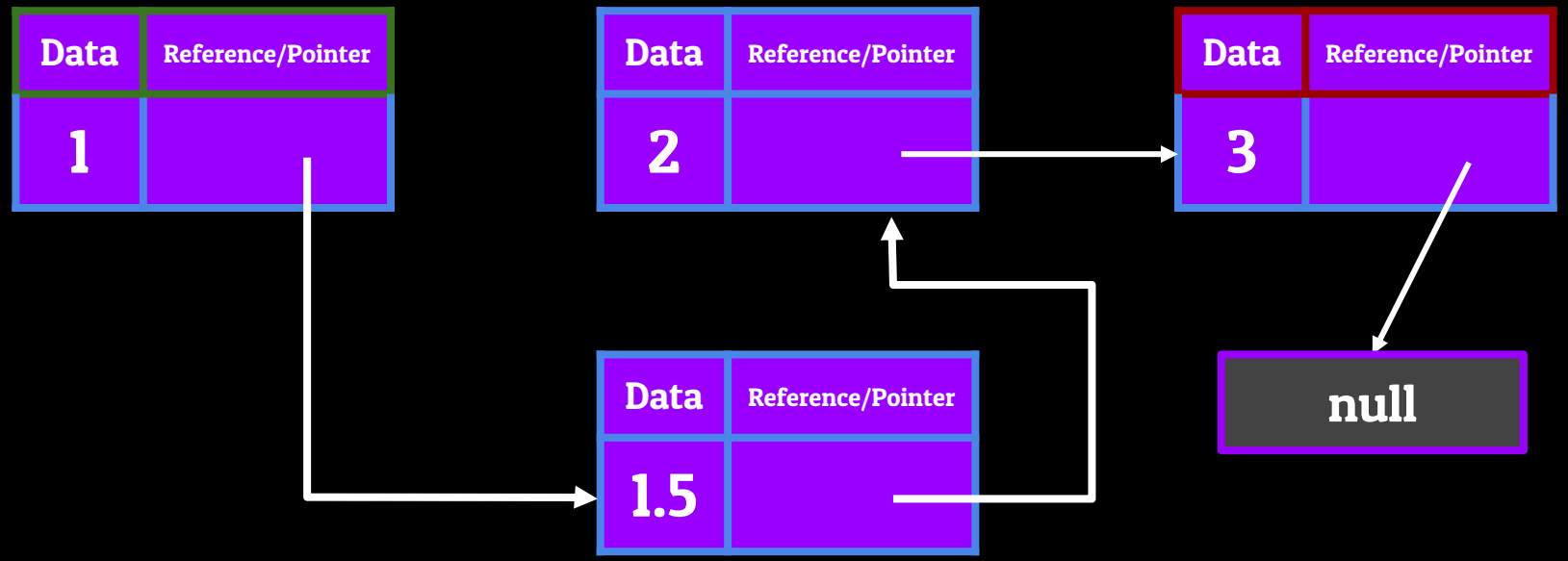
Adding a Node to the Middle of a LinkedList

Make the pointer of the new Node point to the Node after the location we want to insert at

Set the Node before the location we want to insert at to point towards the new Node

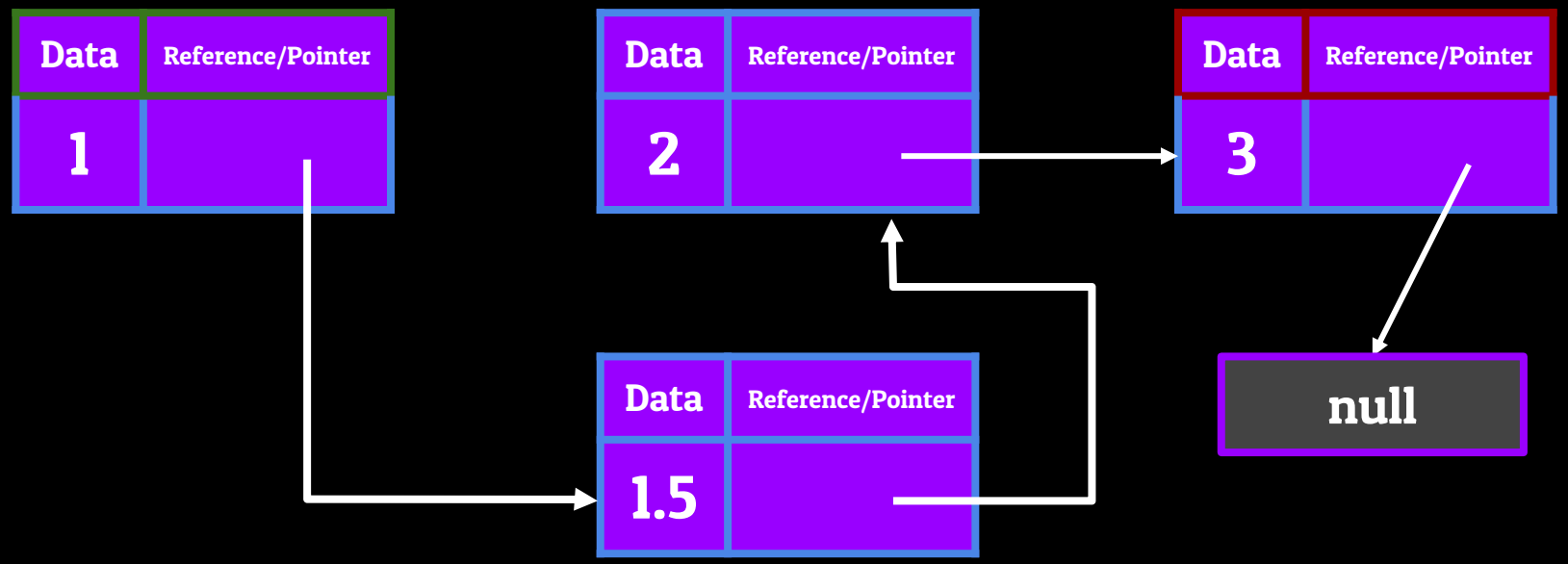


The Linked List - Adding and Removing Information



The Linked List - Adding and Removing Information

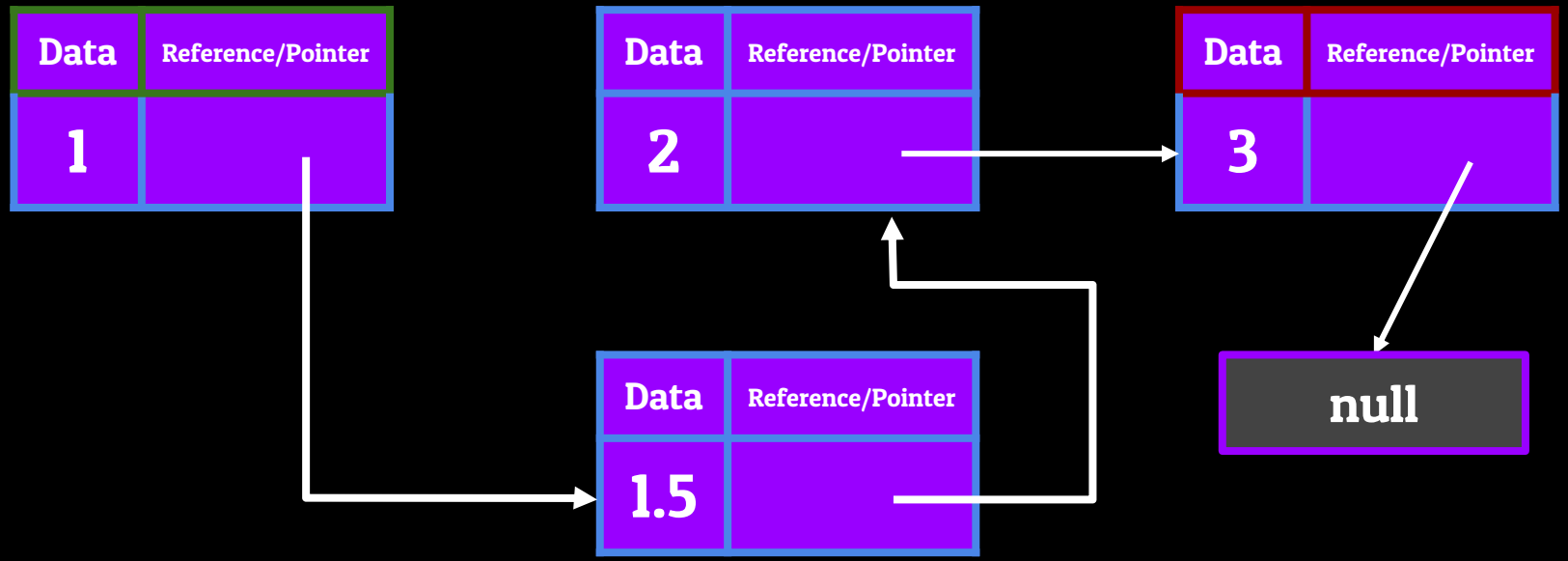
Removing a Node from the middle of a LinkedList



The Linked List - Adding and Removing Information

Removing a Node from the middle of a LinkedList

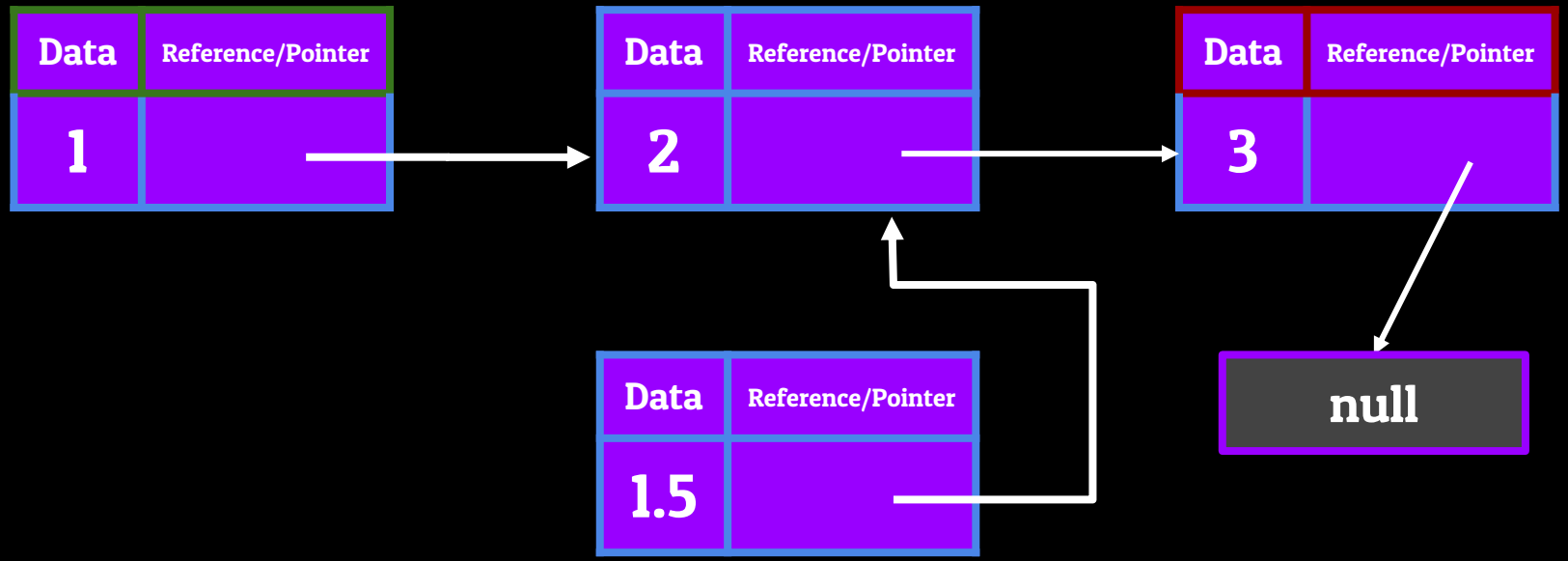
Make the pointer of the Node previous to the one we're removing, to now point to the Node after the one we're removing



The Linked List - Adding and Removing Information

Removing a Node from the middle of a LinkedList

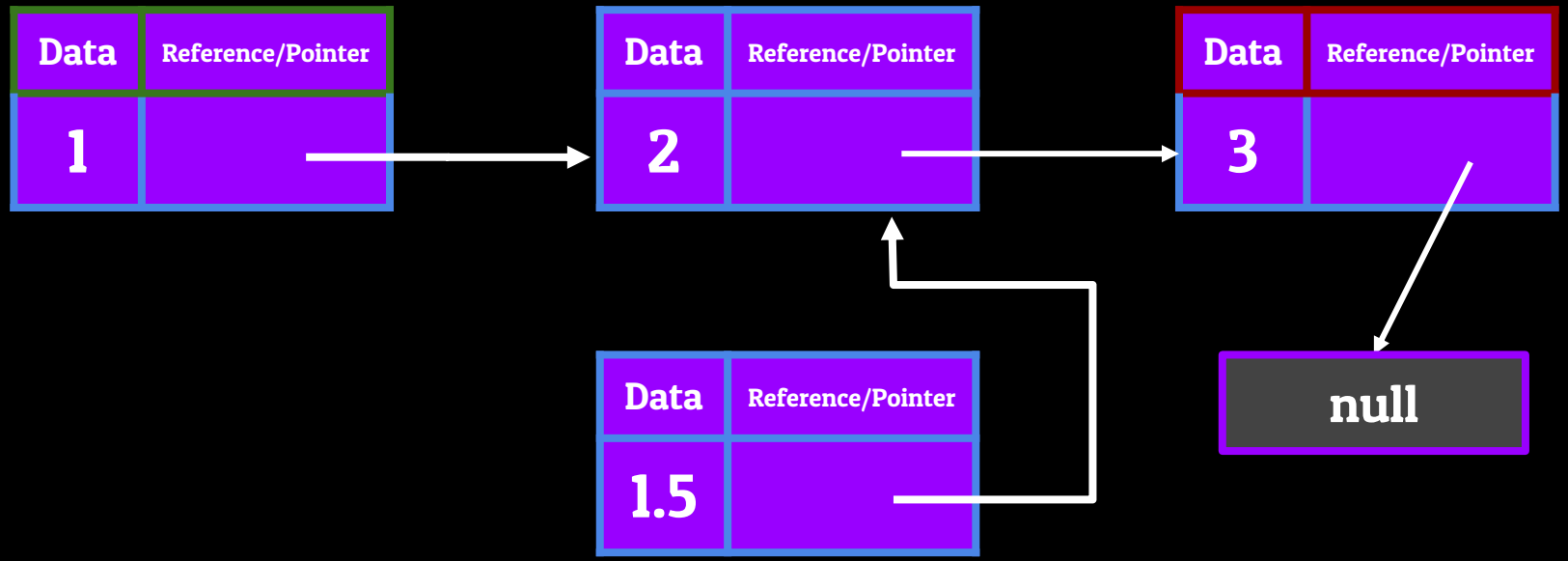
Make the pointer of the Node previous to the one we're removing, to now point to the Node after the one we're removing



The Linked List - Adding and Removing Information

Removing a Node from the middle of a LinkedList

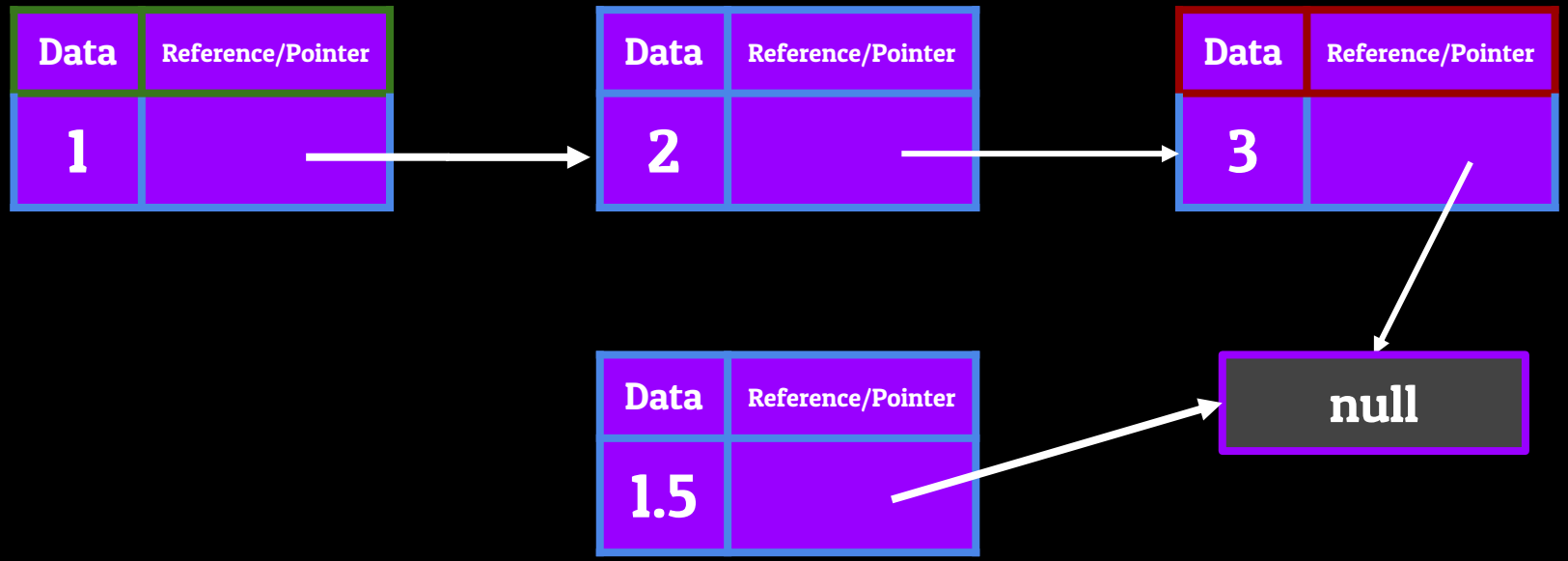
Make the pointer of the Node previous to the one we're removing, to now point to the Node after the one we're removing



The Linked List - Adding and Removing Information

Removing a Node from the middle of a LinkedList

Make the pointer of the Node previous to the one we're removing, to now point to the Node after the one we're removing



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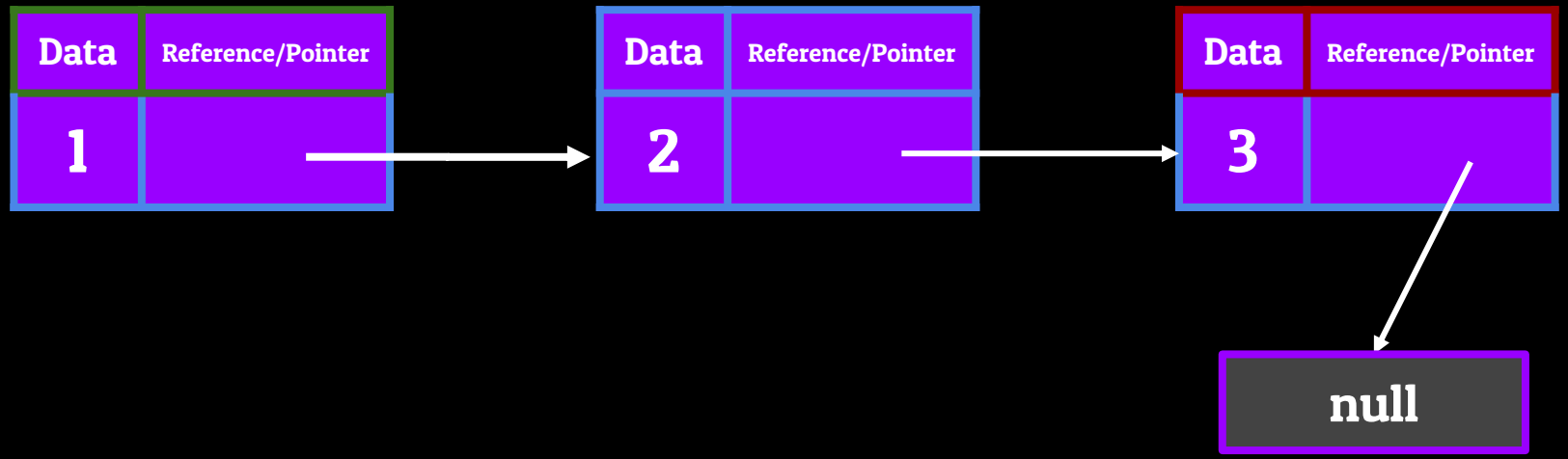
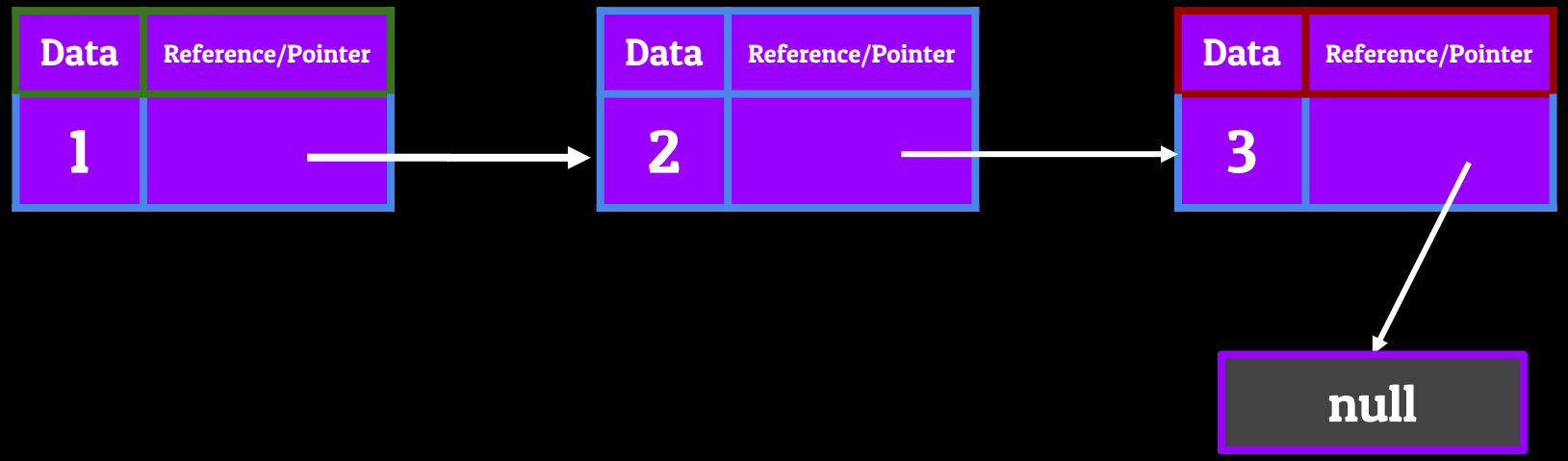
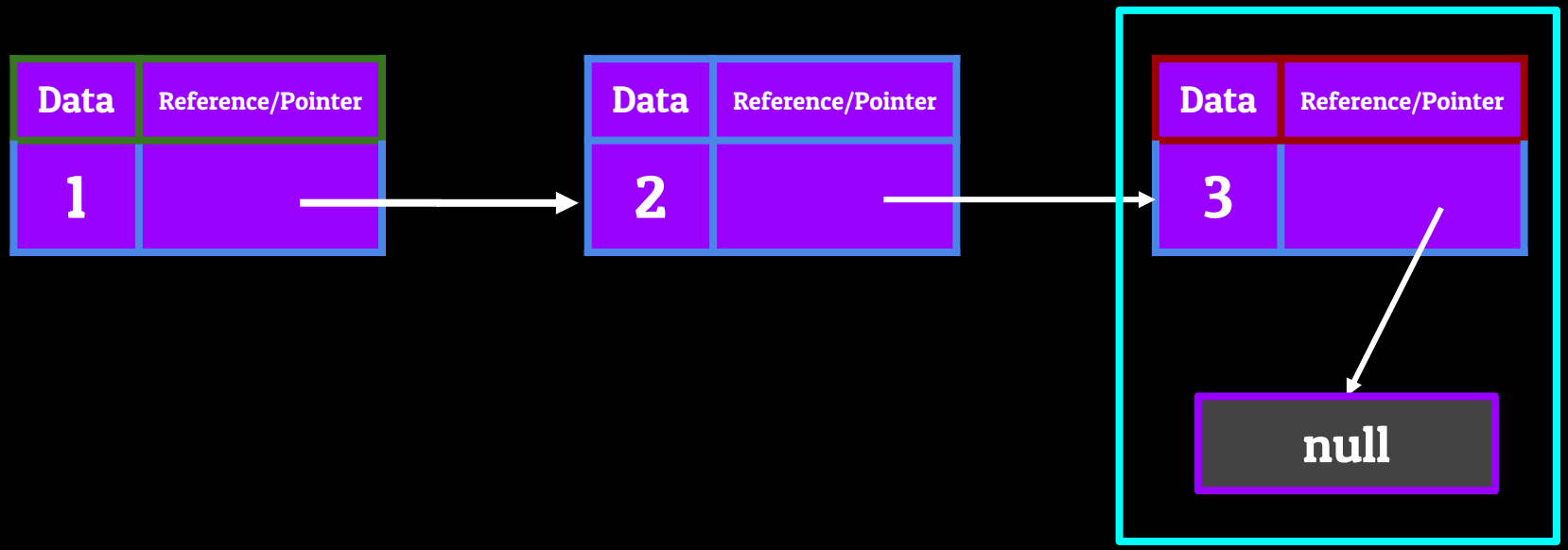


The Linked List - Adding and Removing Information

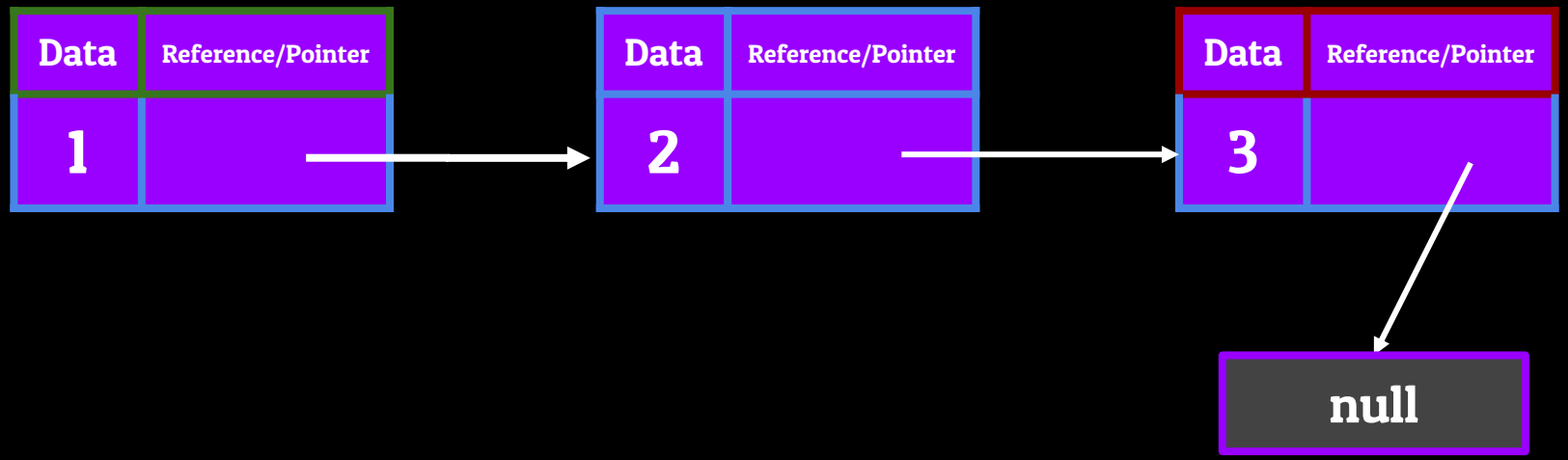


The Linked List - Adding and Removing Information



The Linked List - Adding and Removing Information

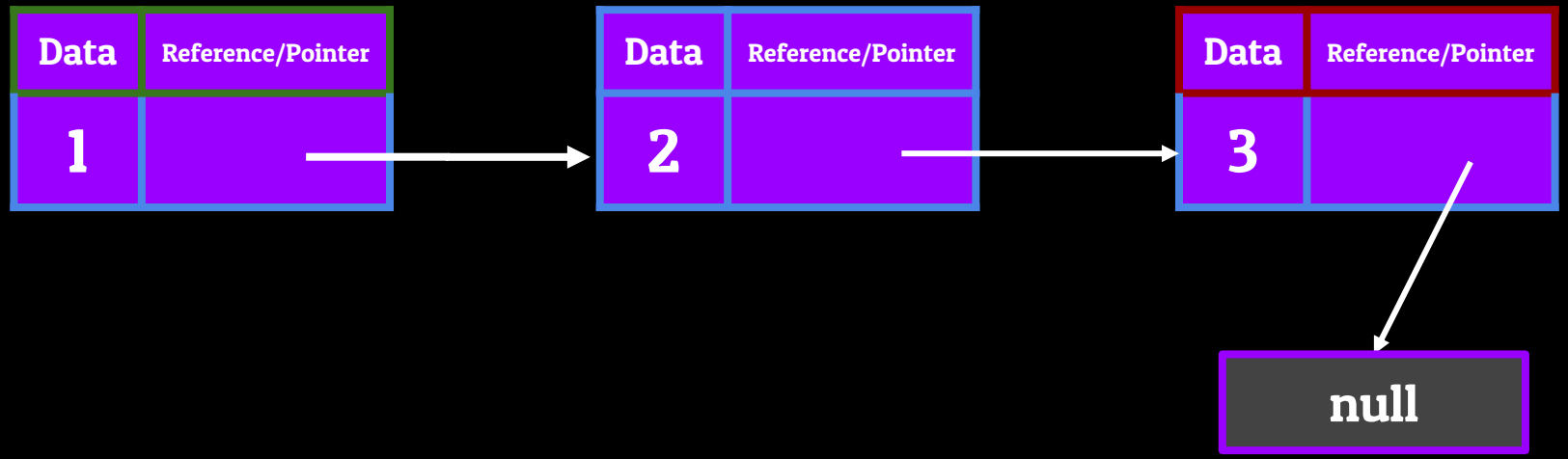
Adding to the Tail of a LinkedList



The Linked List - Adding and Removing Information

Adding to the Tail of a LinkedList

Make the current tail point towards the new Node you want to add



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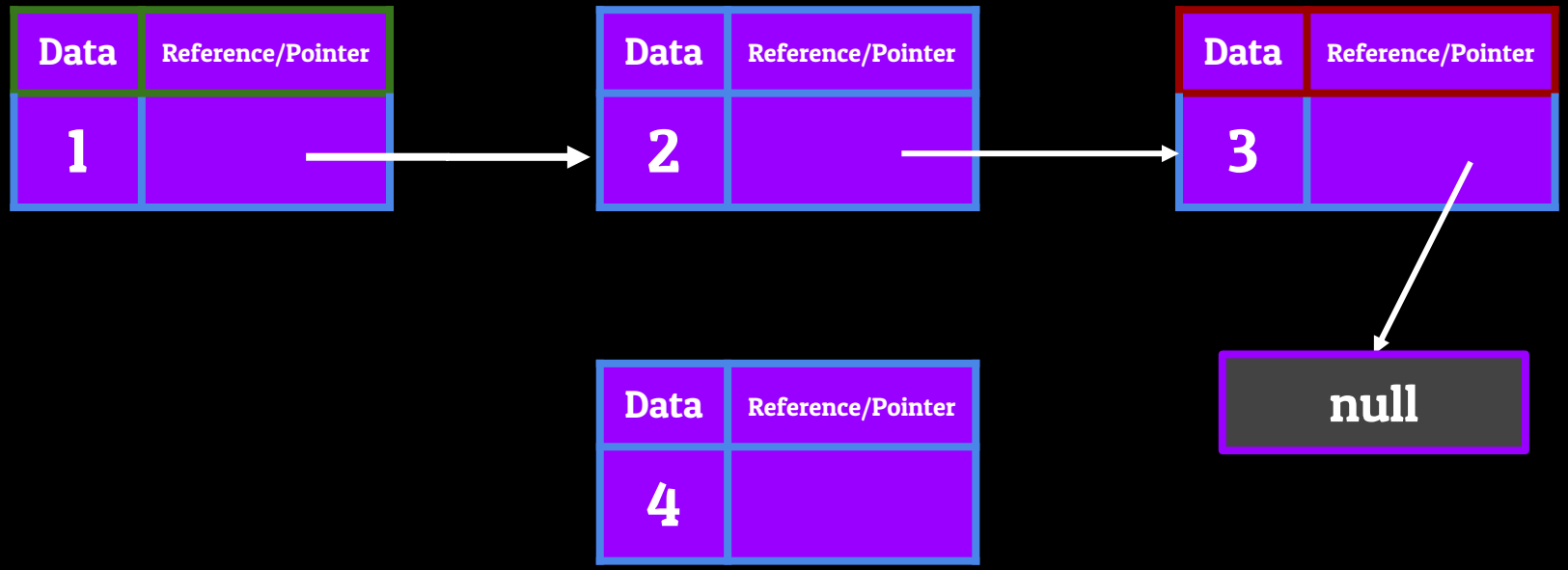

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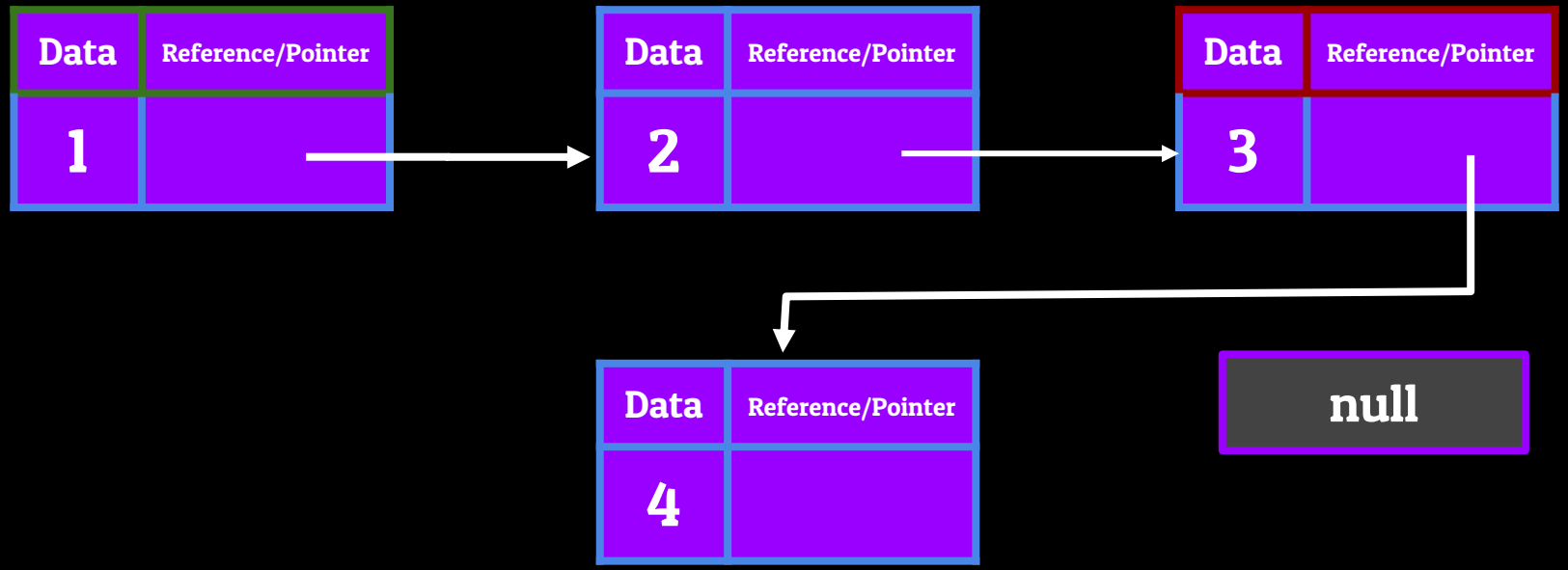

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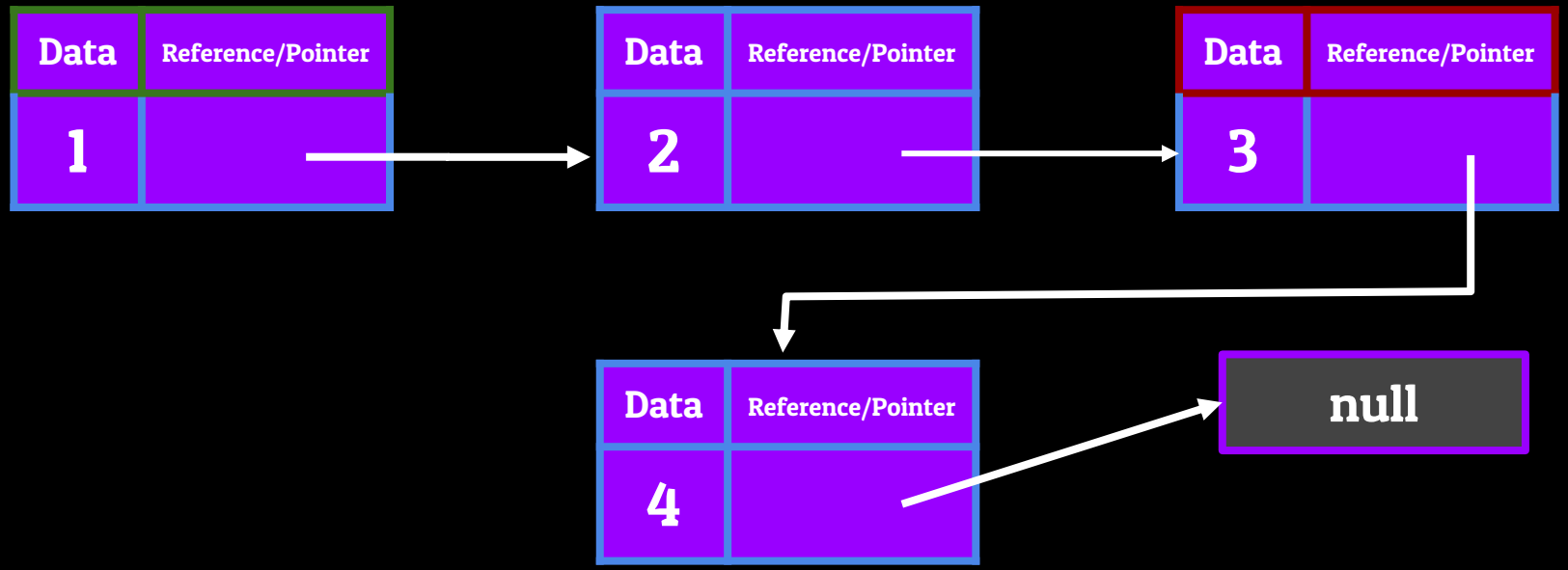

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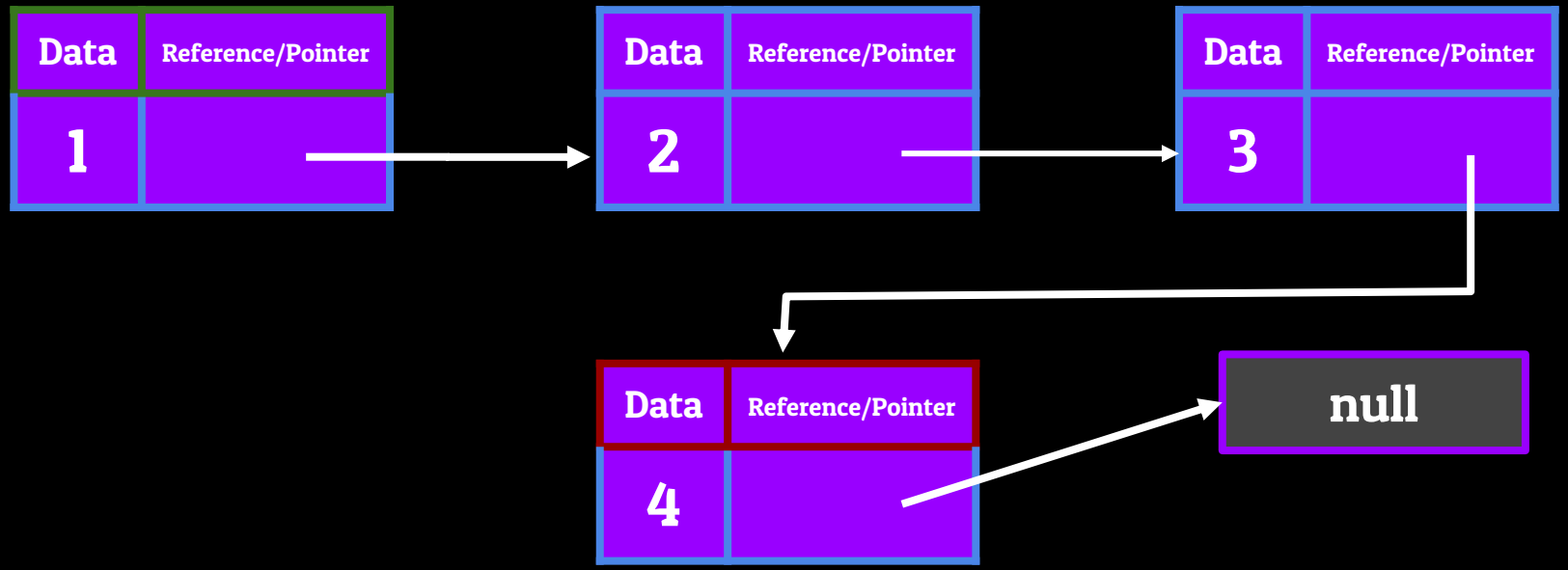

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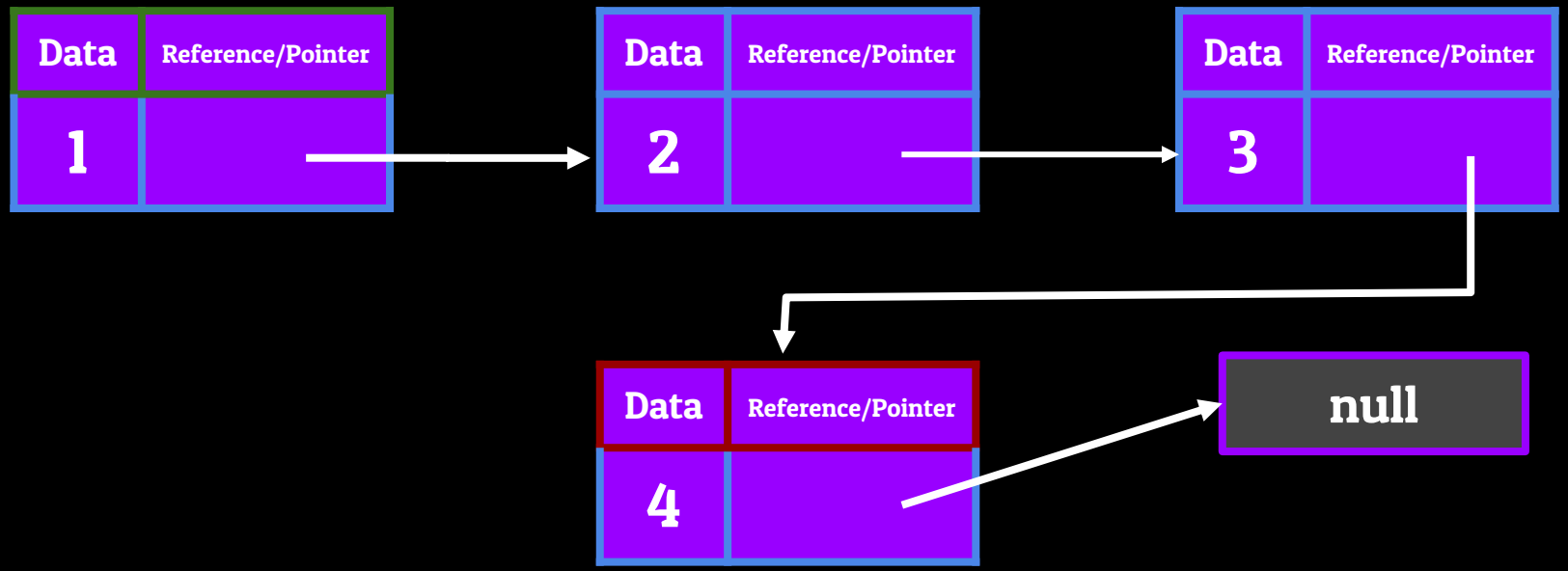
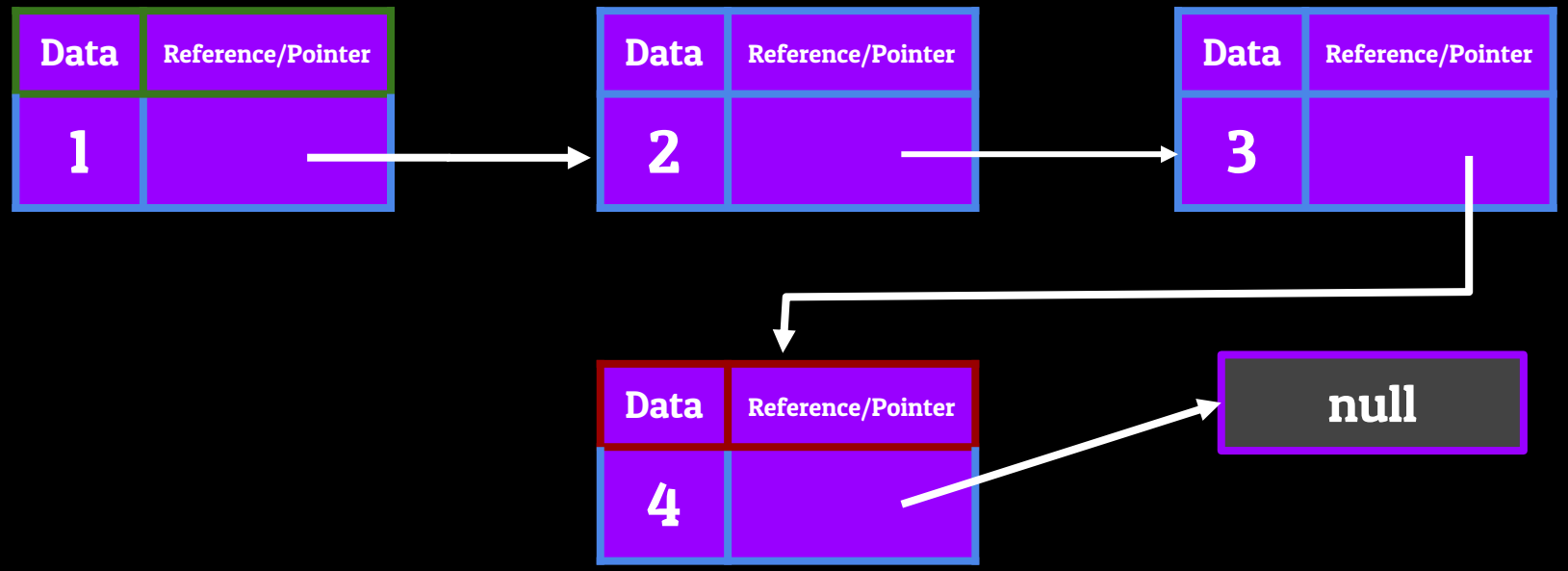


The Linked List - Adding and Removing Information

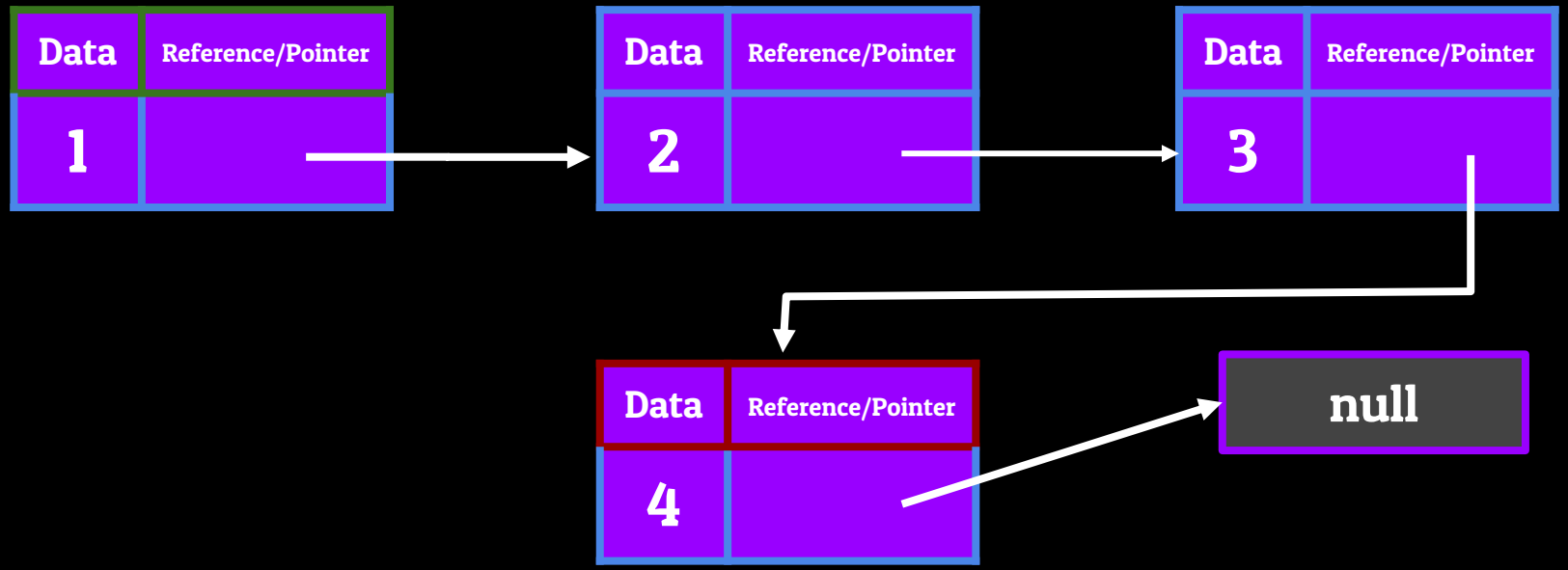
Removing from the Tail of a LinkedList



The Linked List - Adding and Removing Information

Removing from the Tail of a LinkedList

Set the previous tail to point towards a null value instead of the current tail



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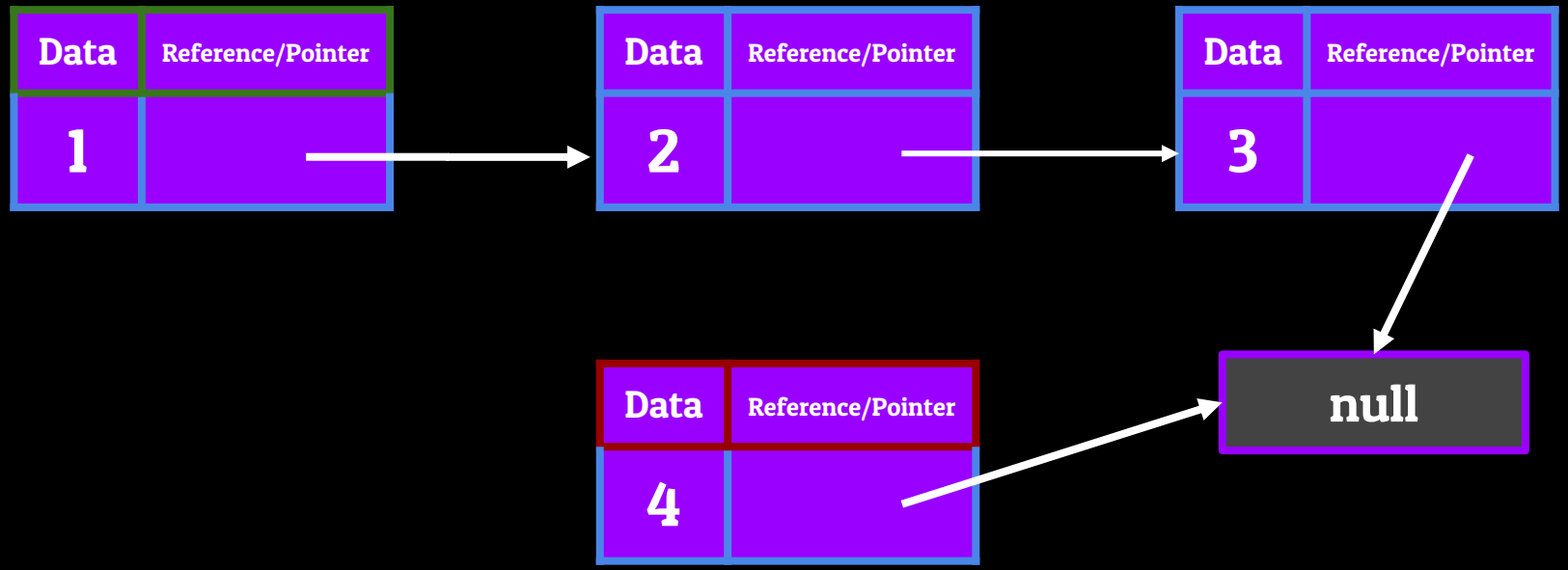

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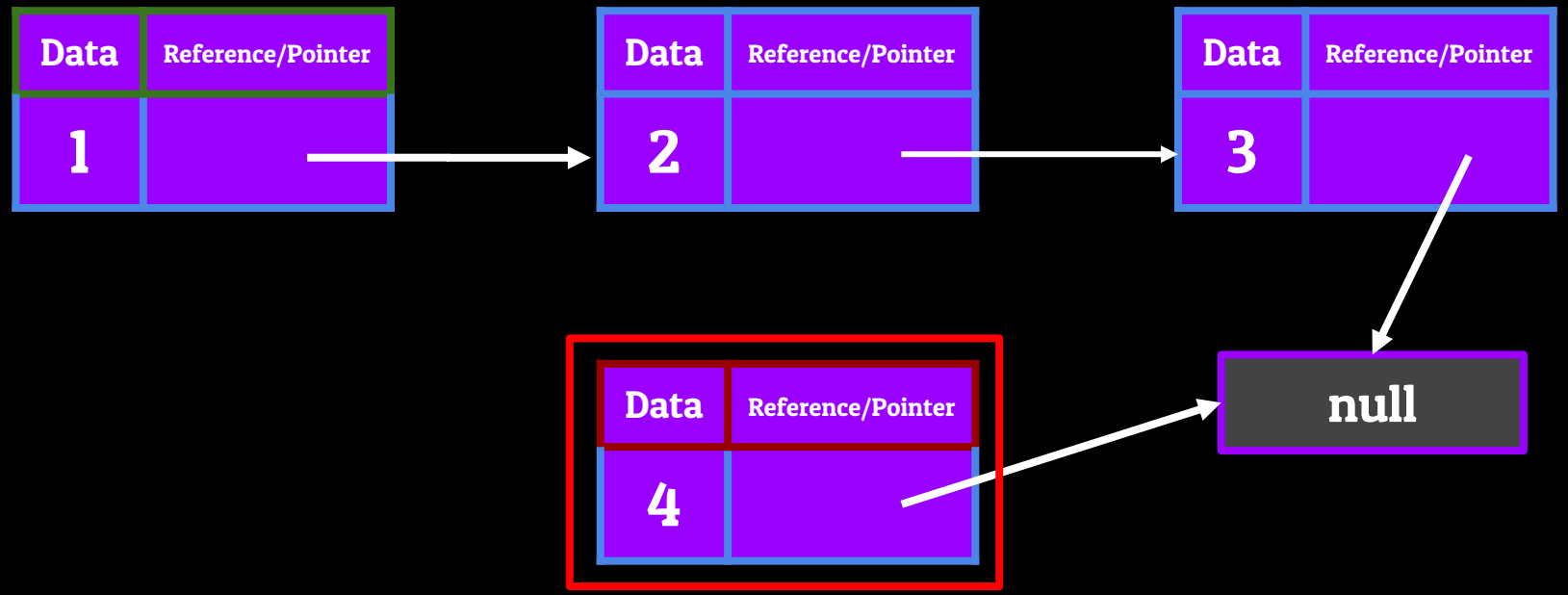

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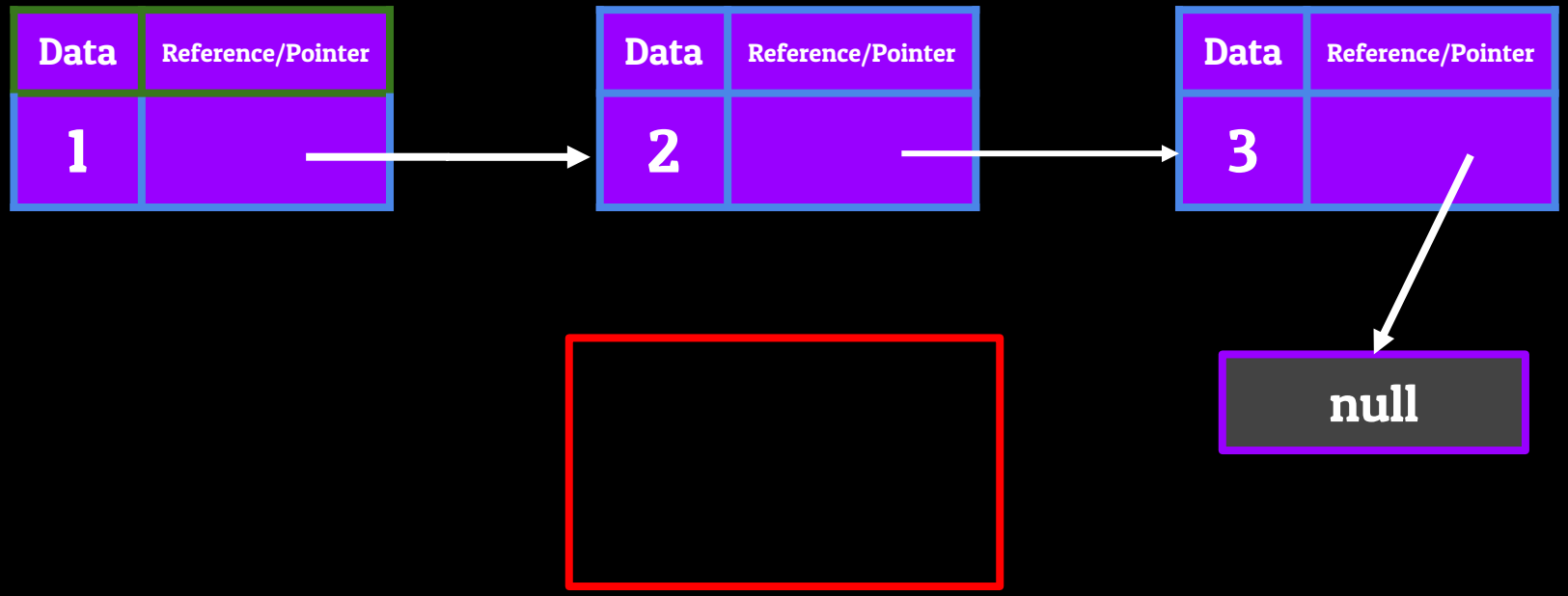

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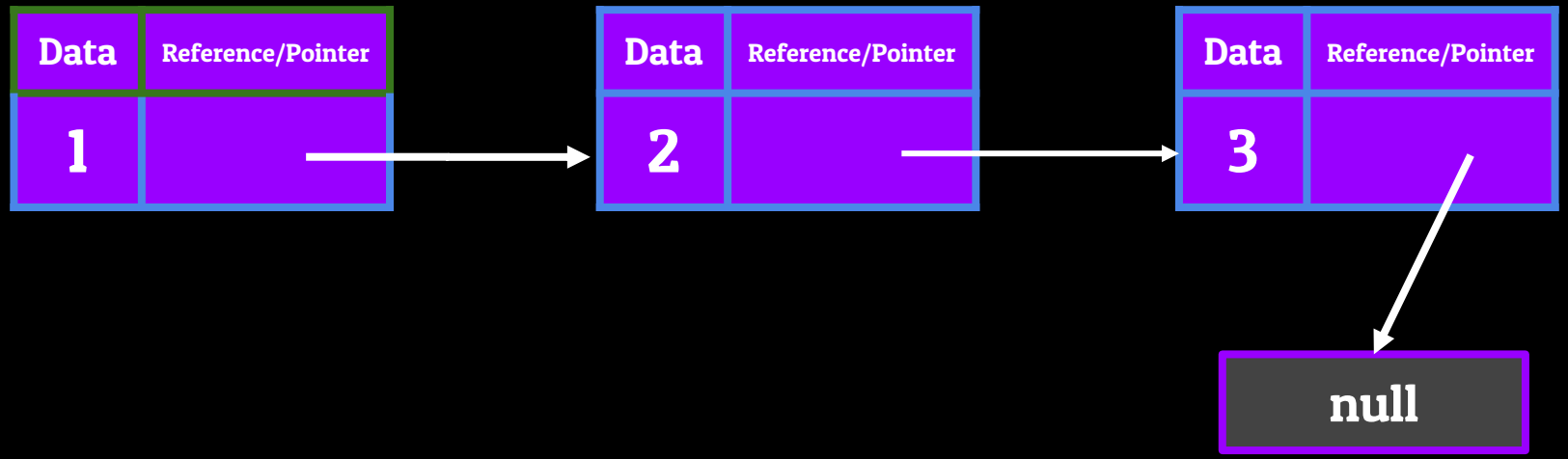

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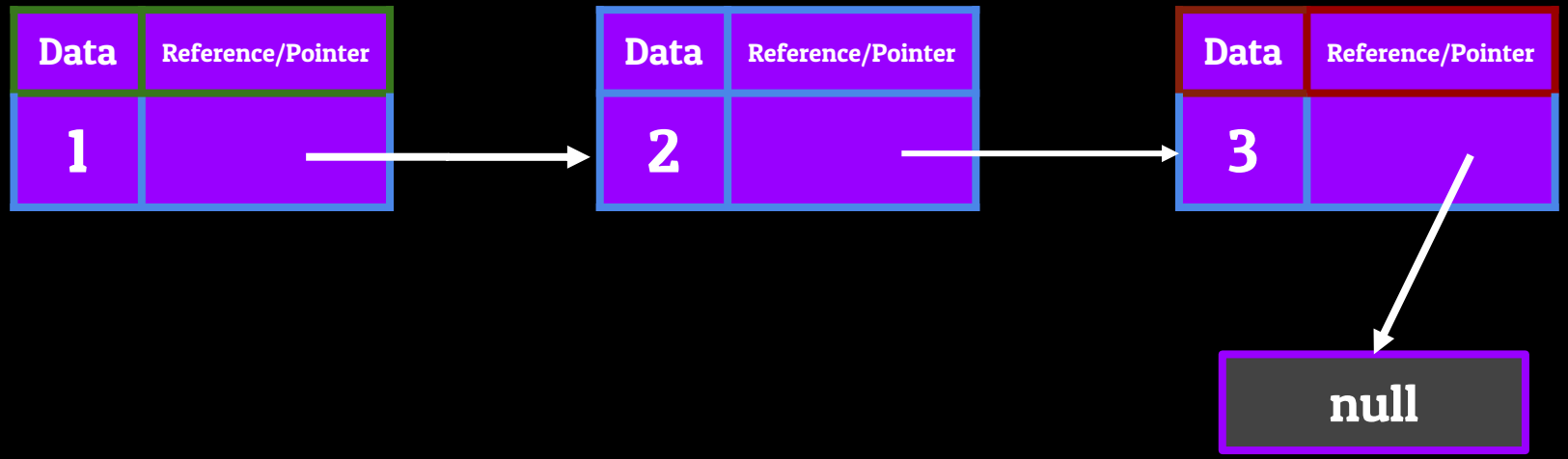


The LinkedList - Time Complexity Equations

The LinkedList - Time Complexity Equations

Accessing

The LinkedList - Time Complexity Equations

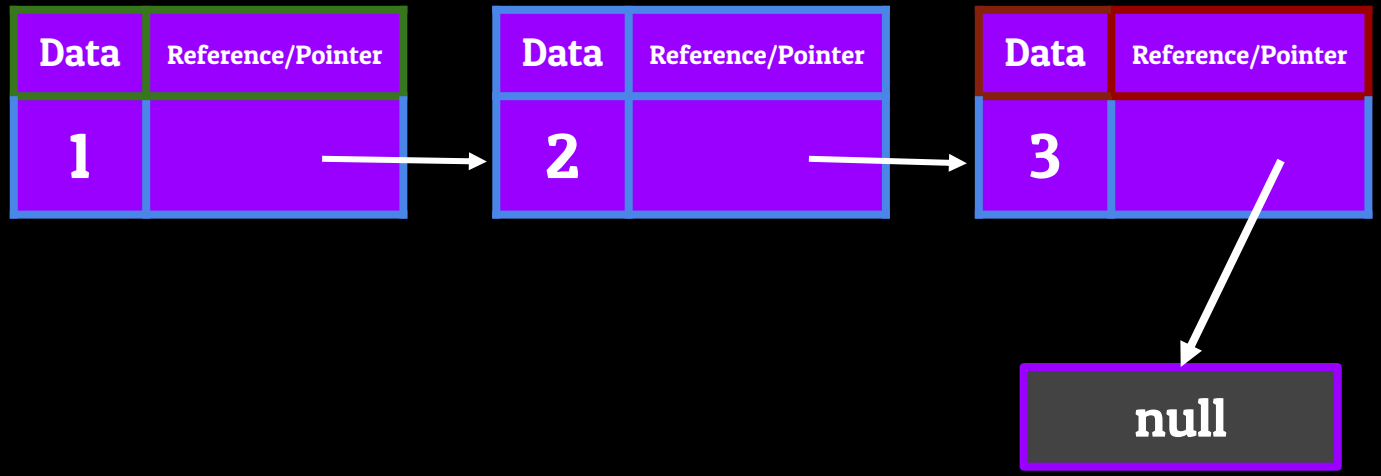
Accessing

O(n)

The LinkedList - Time Complexity Equations

Accessing

O(n)



The LinkedList - Time Complexity Equations

Accessing

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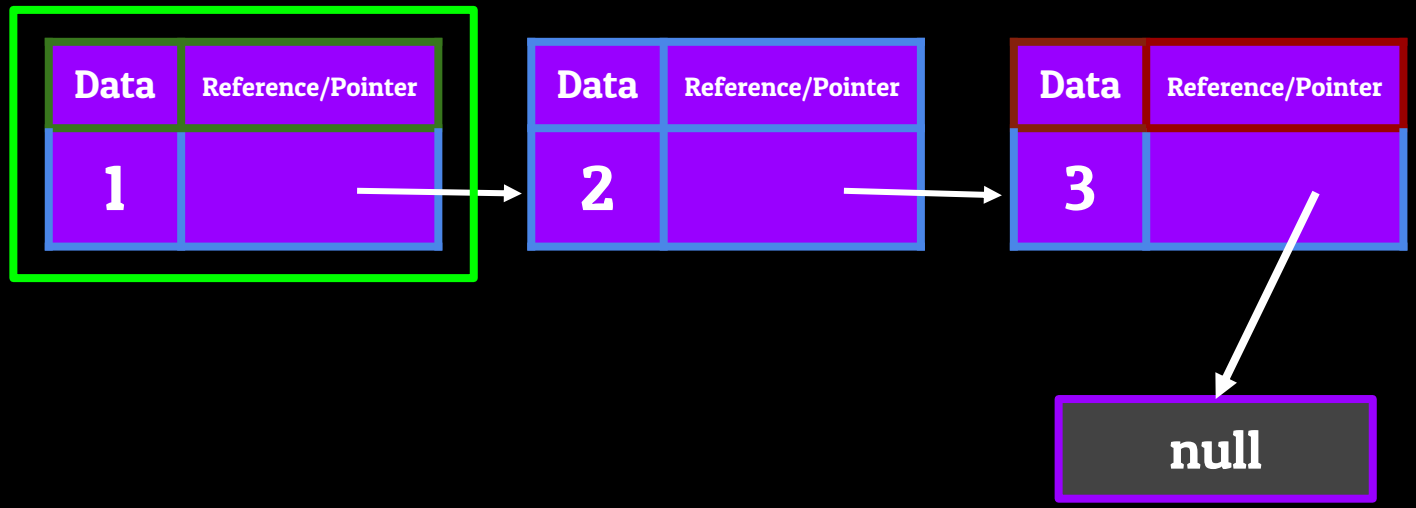

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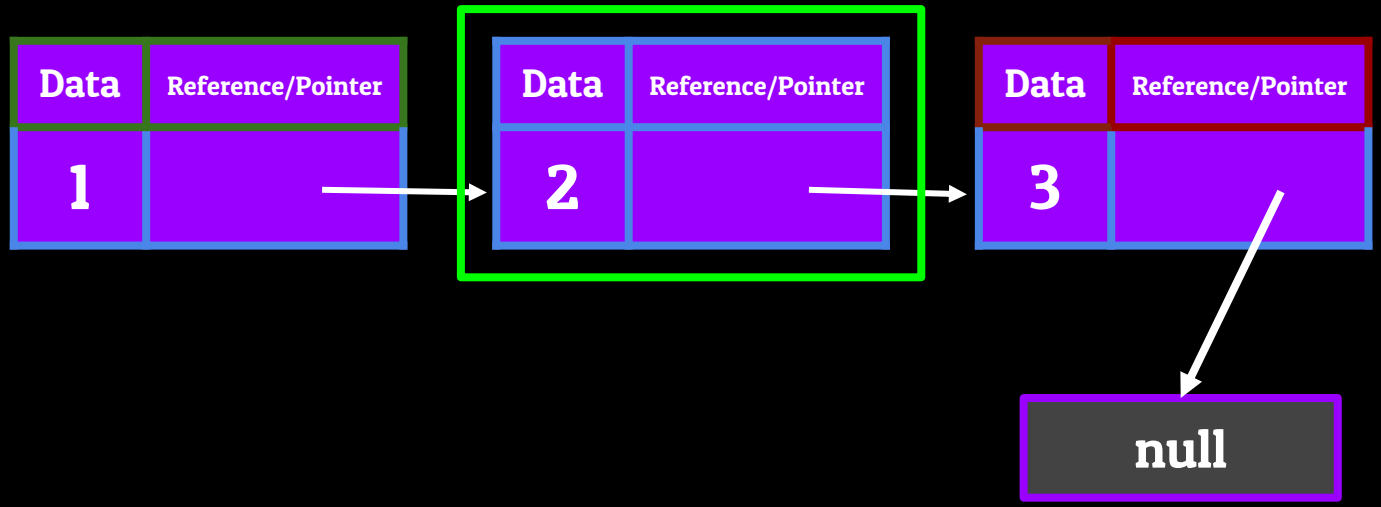

The LinkedList - Time Complexity Equations

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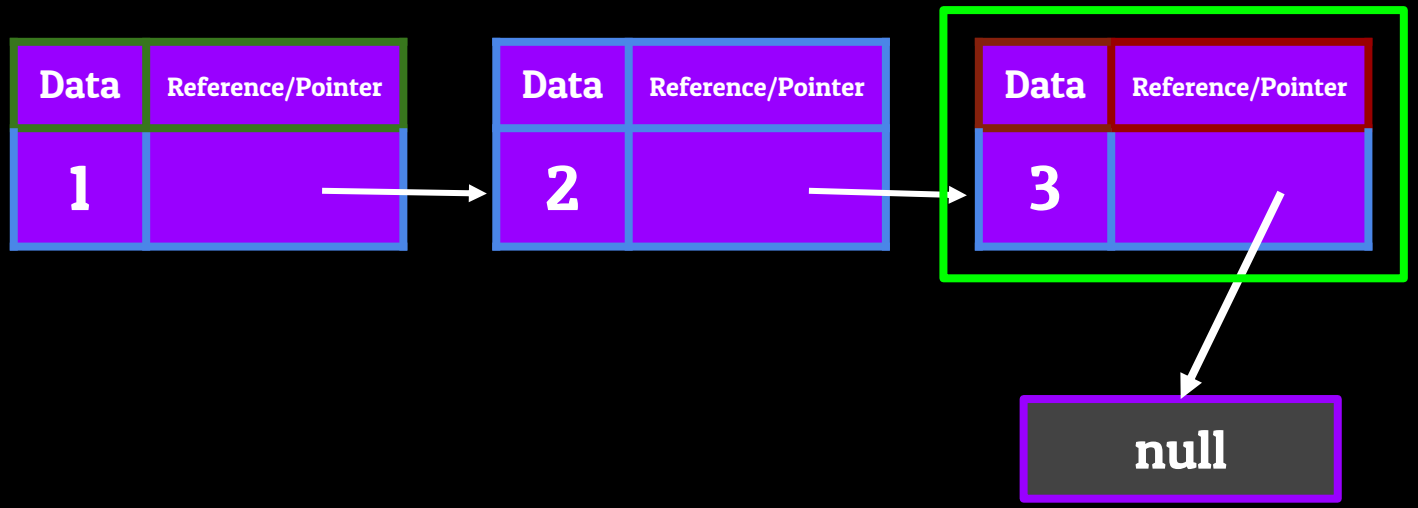

The LinkedList - Time Complexity Equations

Accessing

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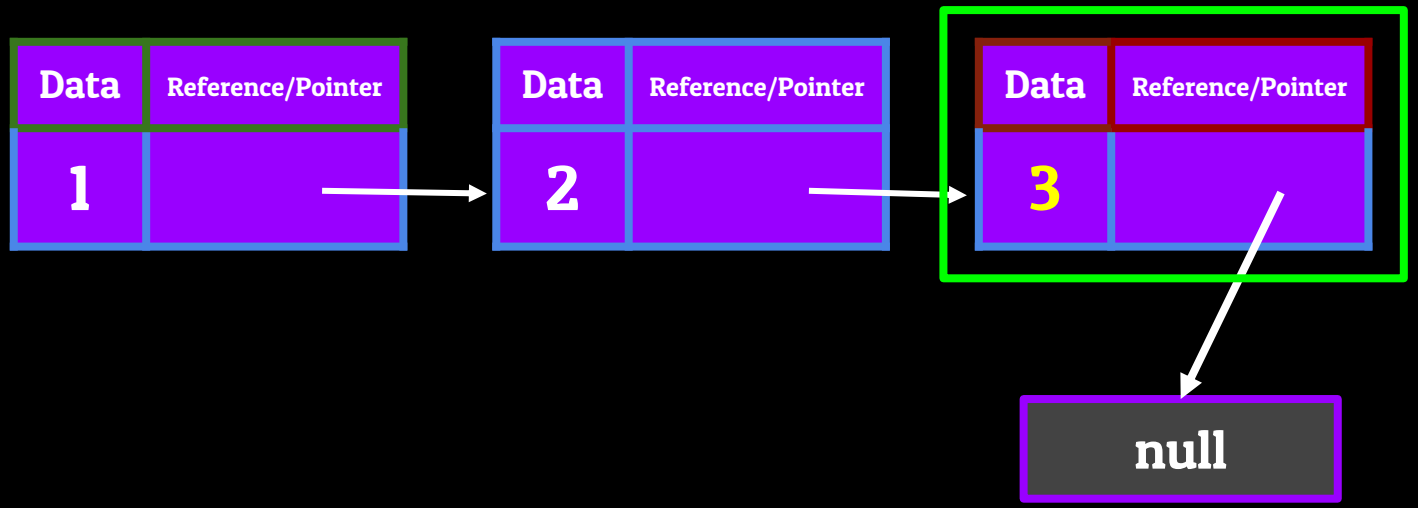

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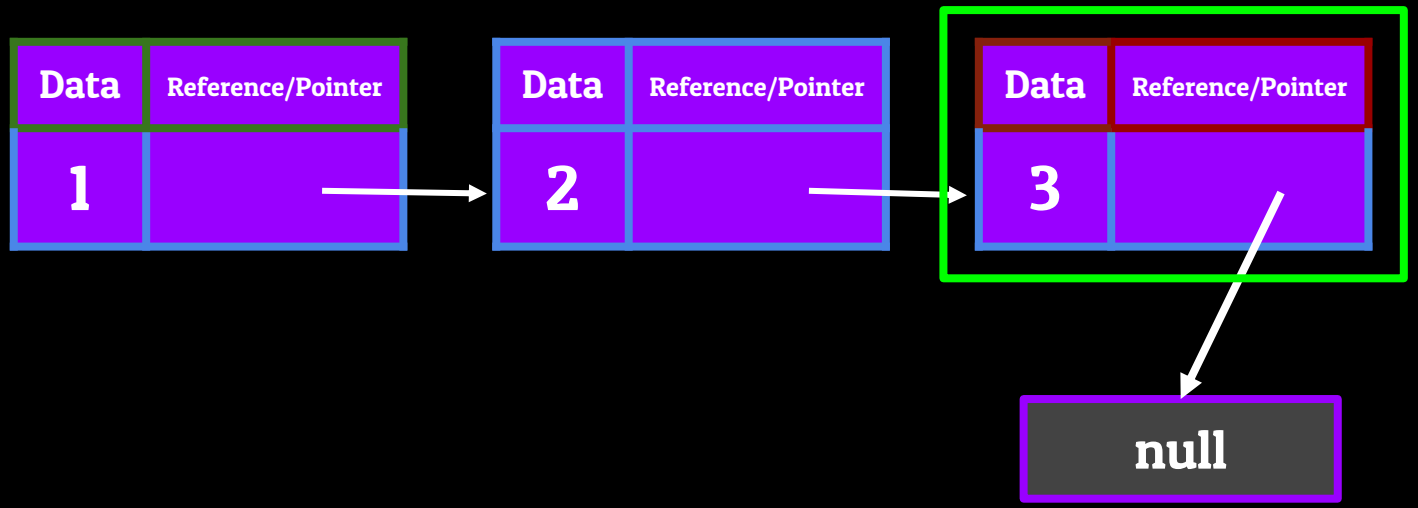

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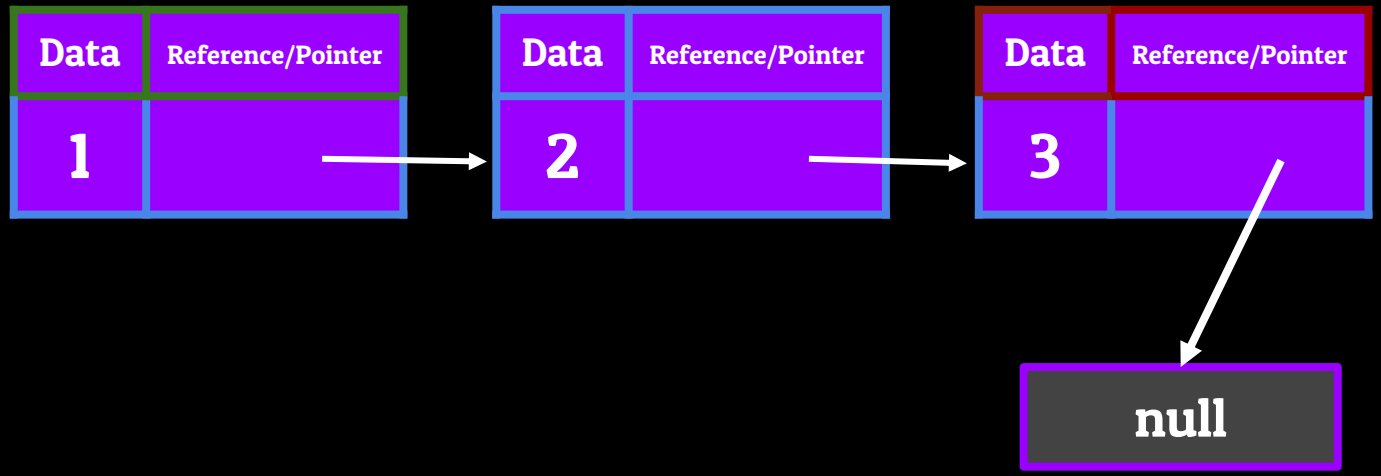

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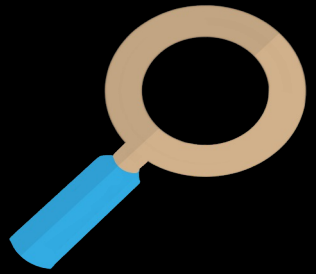

Searching

O(n)

The LinkedList - Time Complexity Equations

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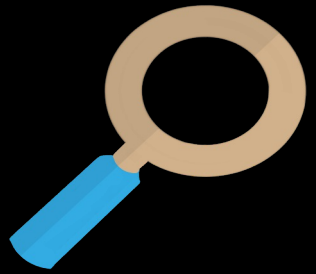

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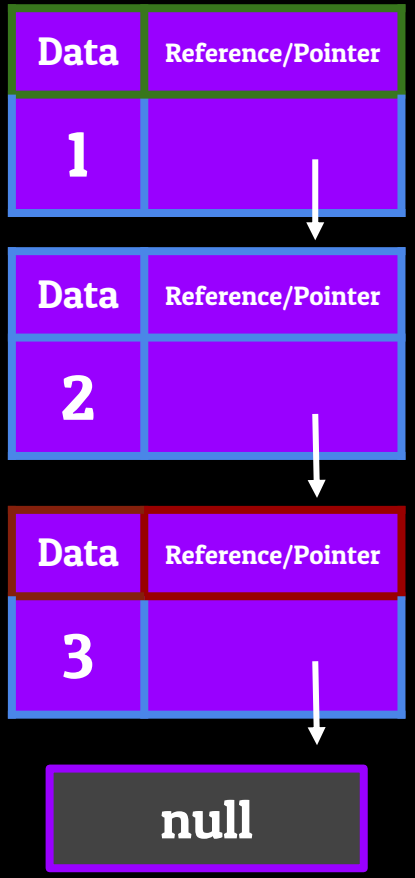

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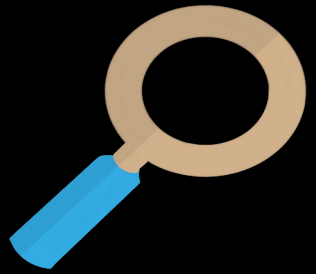

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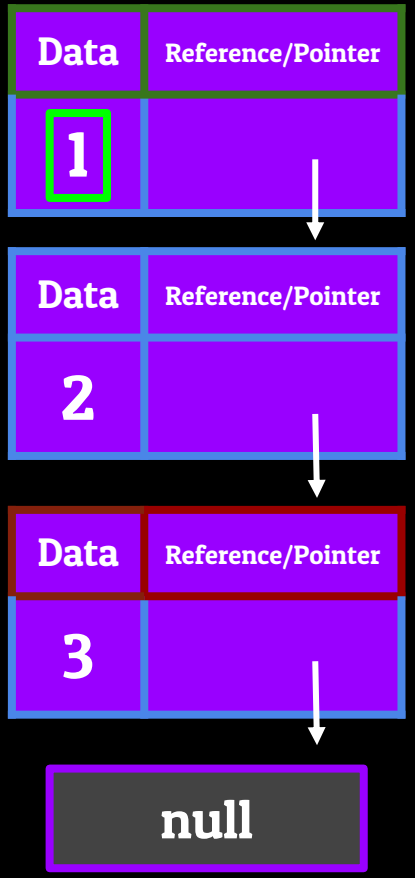

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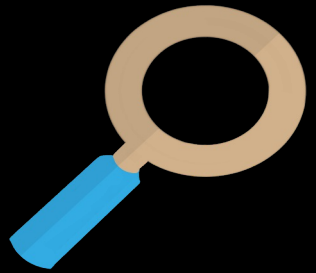

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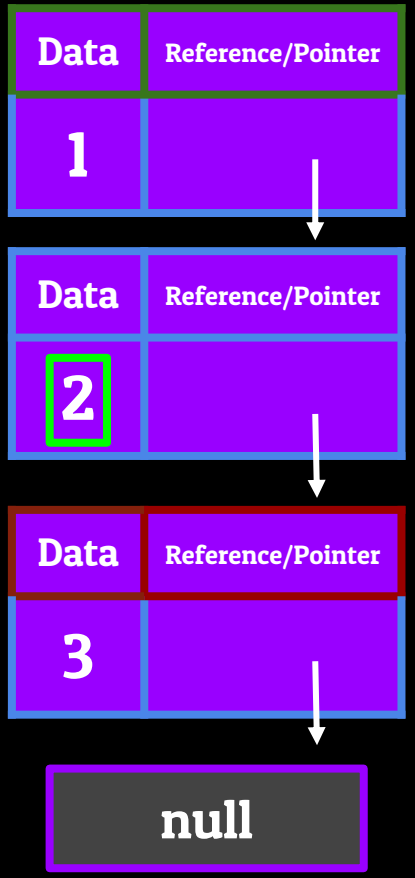

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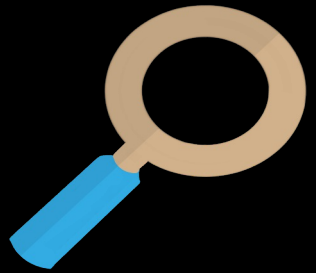

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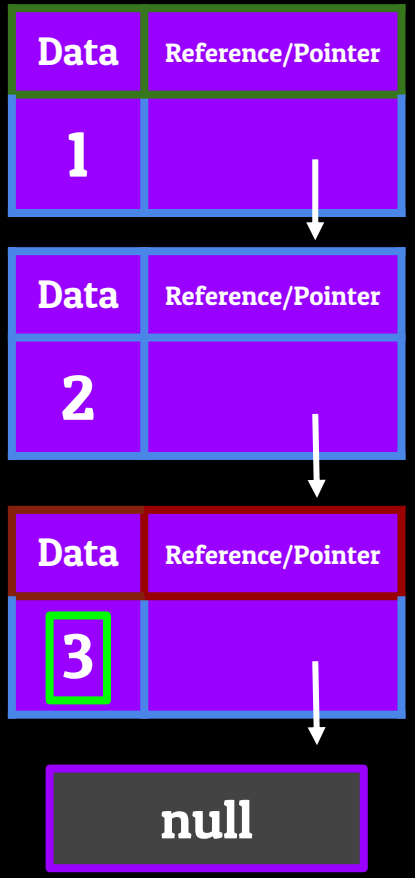

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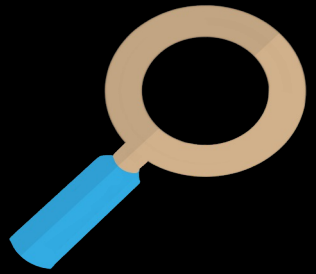

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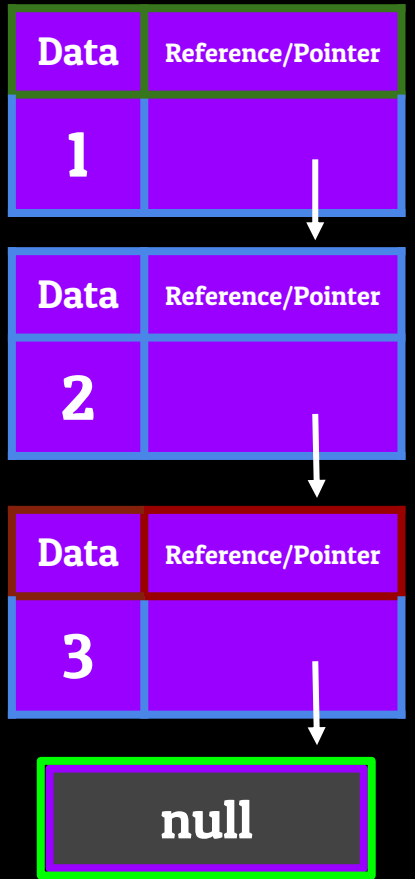

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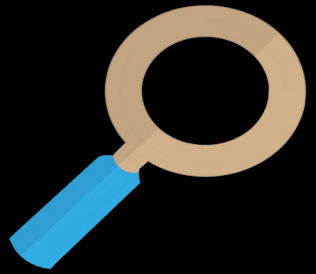

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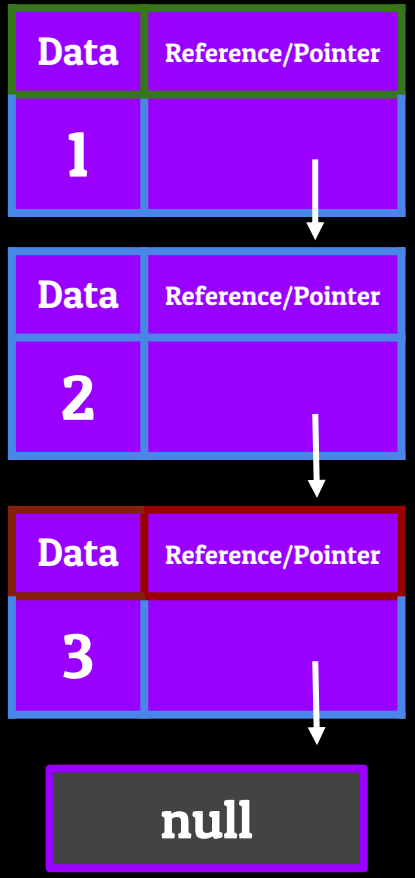

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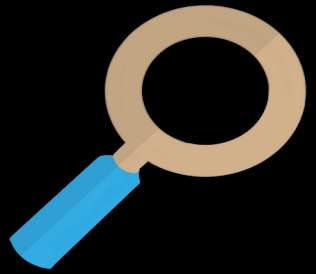

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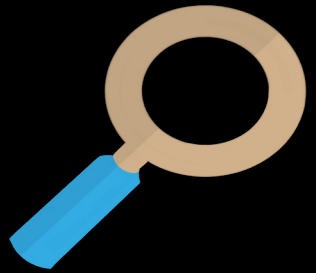

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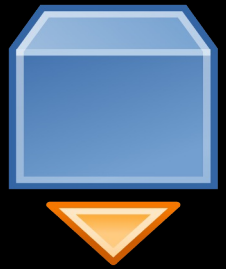

Inserting

Deleting

The LinkedList - Time Complexity Equations

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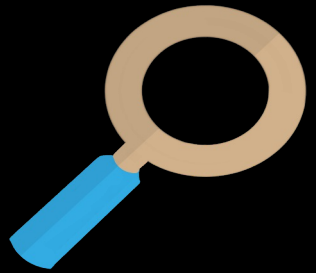
O(n)



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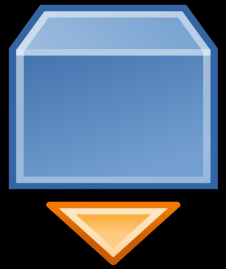

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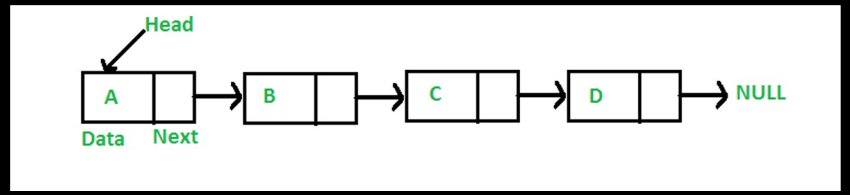

The LinkedList - Time Complexity Equations

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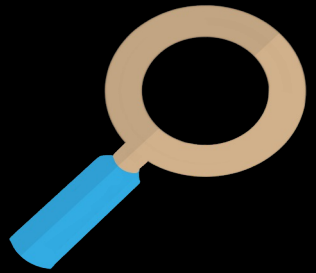

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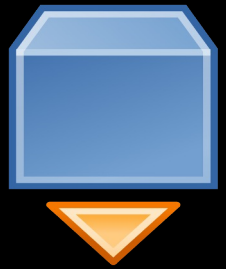

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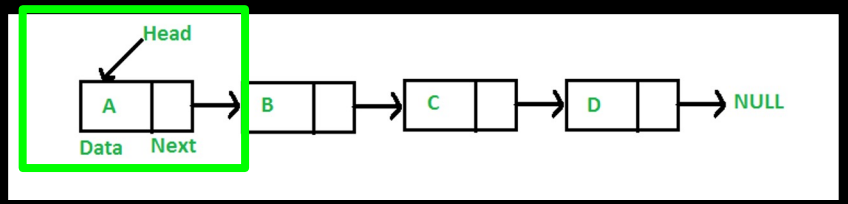

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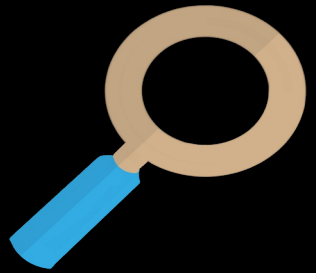

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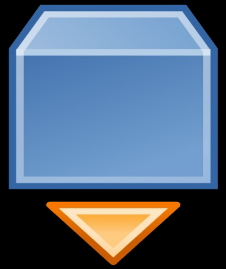
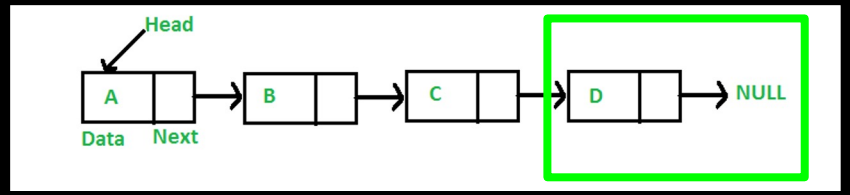


Inserting

Deleting



The LinkedList - Time Complexity Equations

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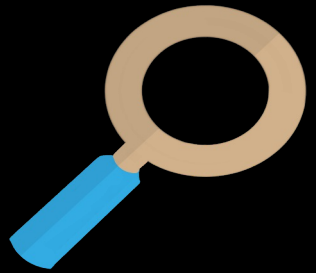

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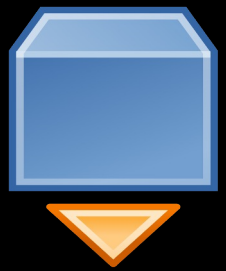

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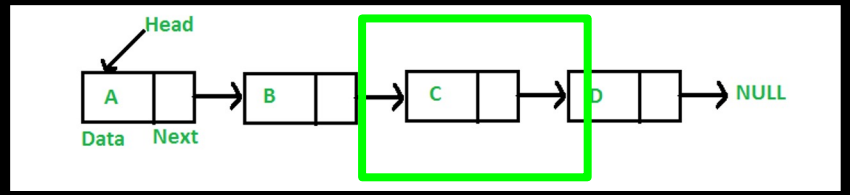

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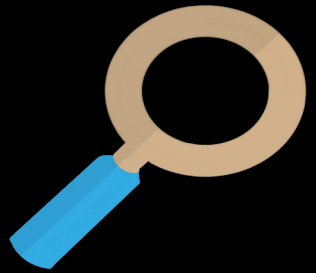
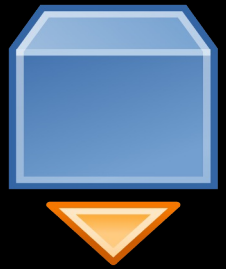


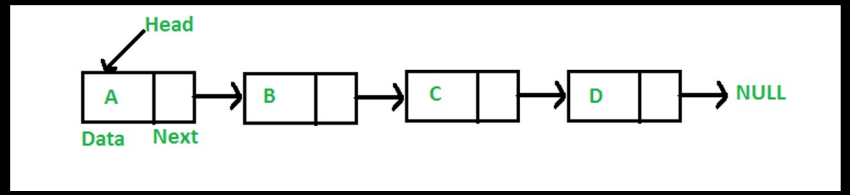
Searching

O(n)



Inserting

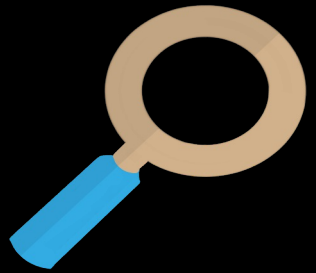
Deleting



The LinkedList - Time Complexity Equations

Accessing

O(n)



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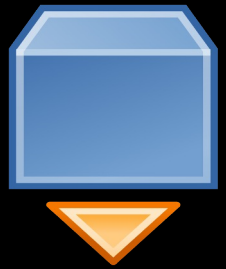

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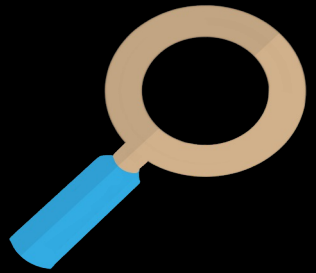

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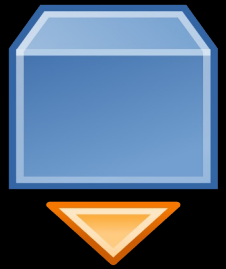

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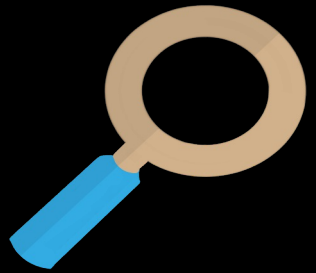

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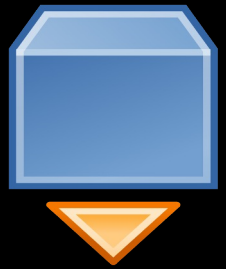
O(n)



Inserting

O(n) O(1)

Deleting

O(n) O(1)

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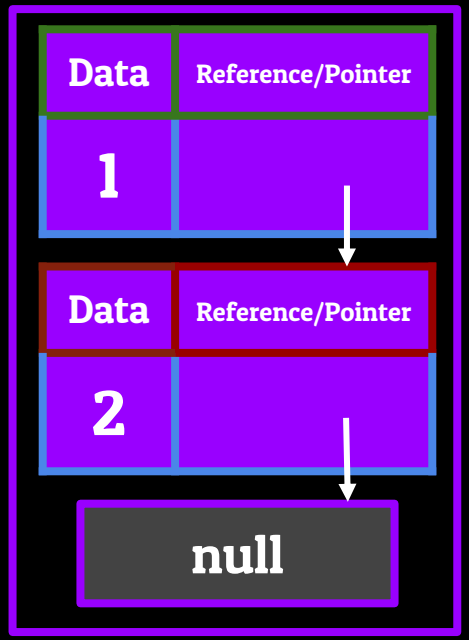

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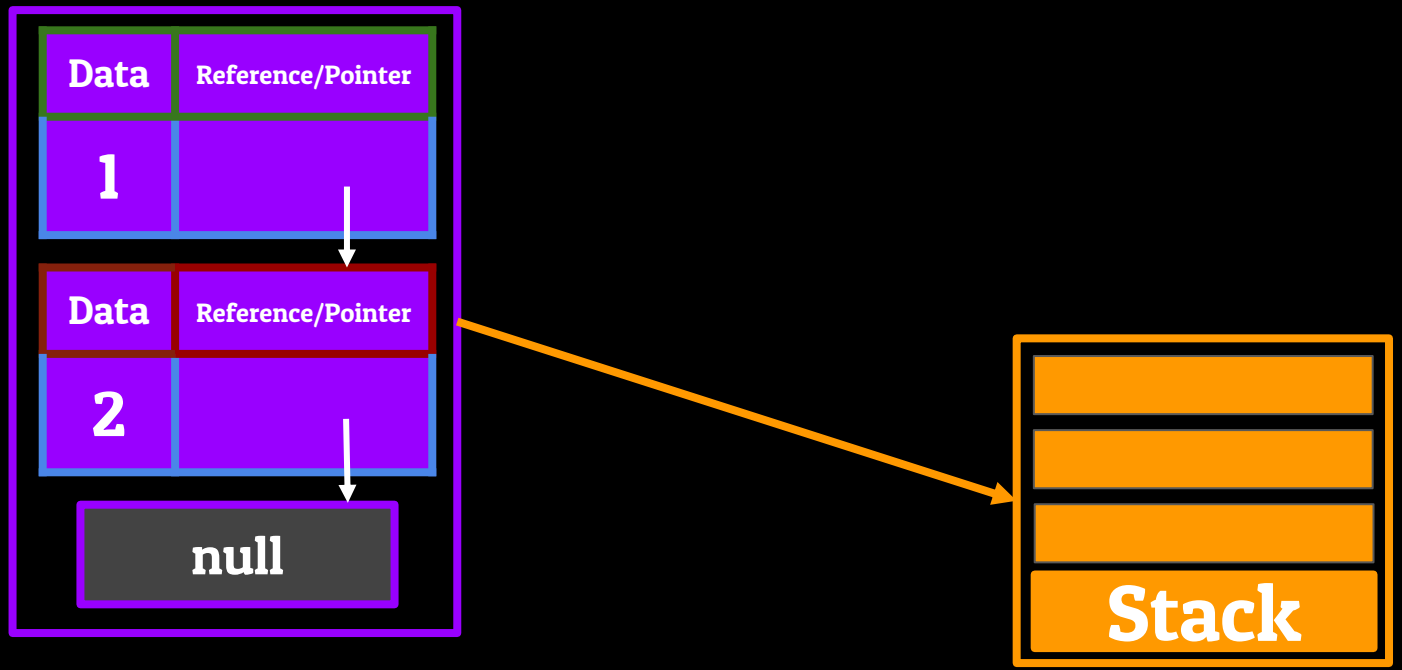

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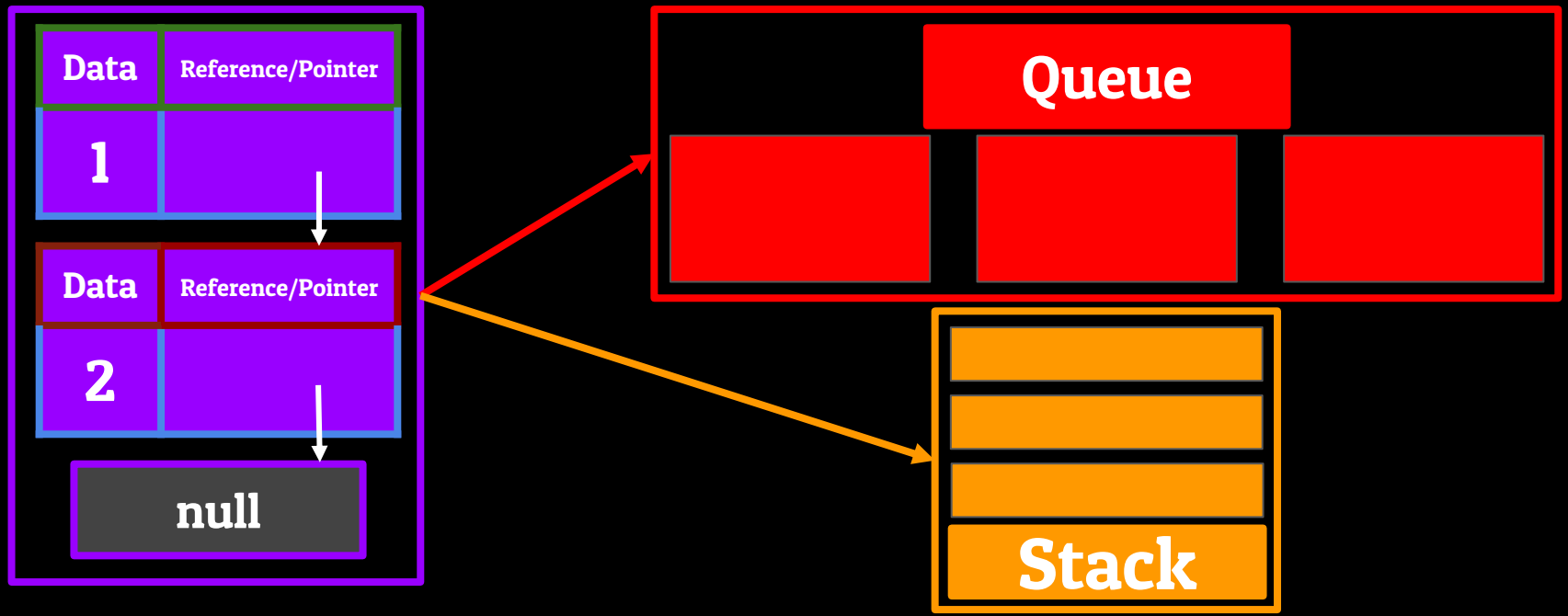

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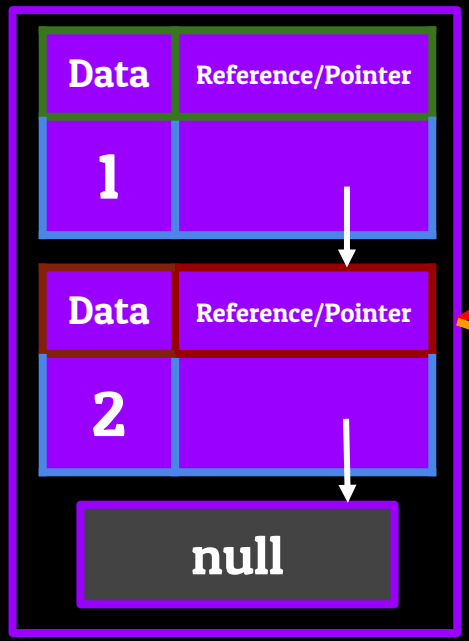

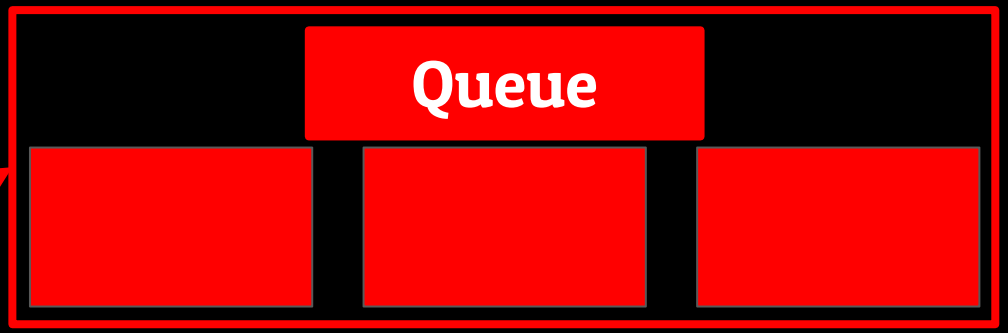

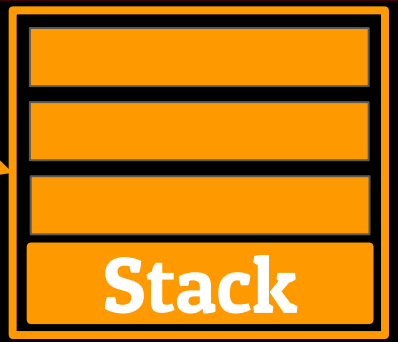

Article in The Description

The LinkedList - Uses for LinkedLists

The LinkedList - Uses for LinkedLists

NEXT TRACKS

#		SONG	ARTIST	ALBUM	
1	+	Don't Believe Her	Scorpions	Crazy World	4:56
2	+	To Be With You In Heaven	Scorpions	Crazy World	4:52
3	+	Wind Of Change	Scorpions	Crazy World	5:13
4	+	Restless Nights	Scorpions	Crazy World	5:48
5	+	Lust Or Love	Scorpions	Crazy World	4:23
6	+	Kicks After Six	Scorpions	Crazy World	3:50
7	+	Hit Between The Eyes	Scorpions	Crazy World	4:34
8	+	Money And Fame	Scorpions	Crazy World	5:07
9	+	Crazy World	Scorpions	Crazy World	5:09
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The LinkedList - Uses for LinkedLists

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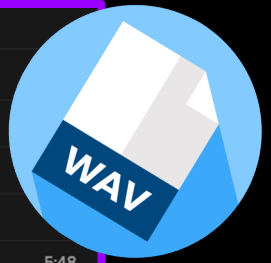

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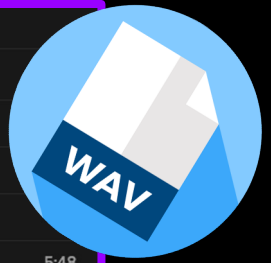

Title

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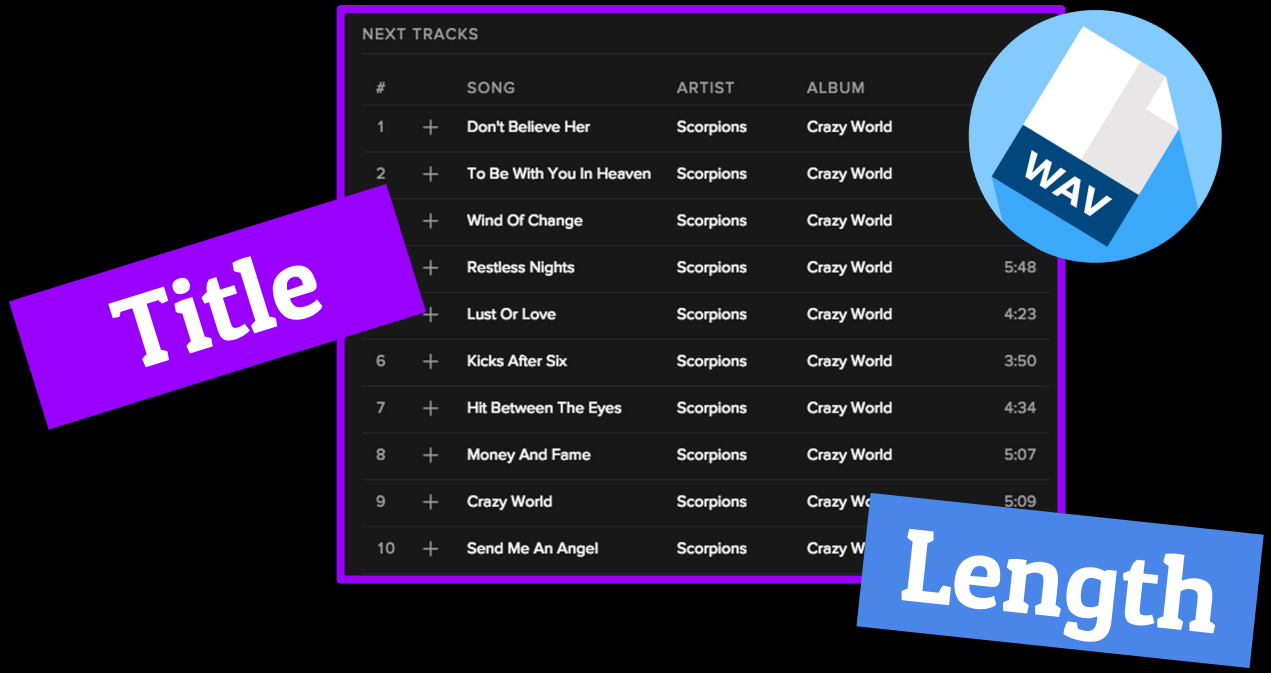

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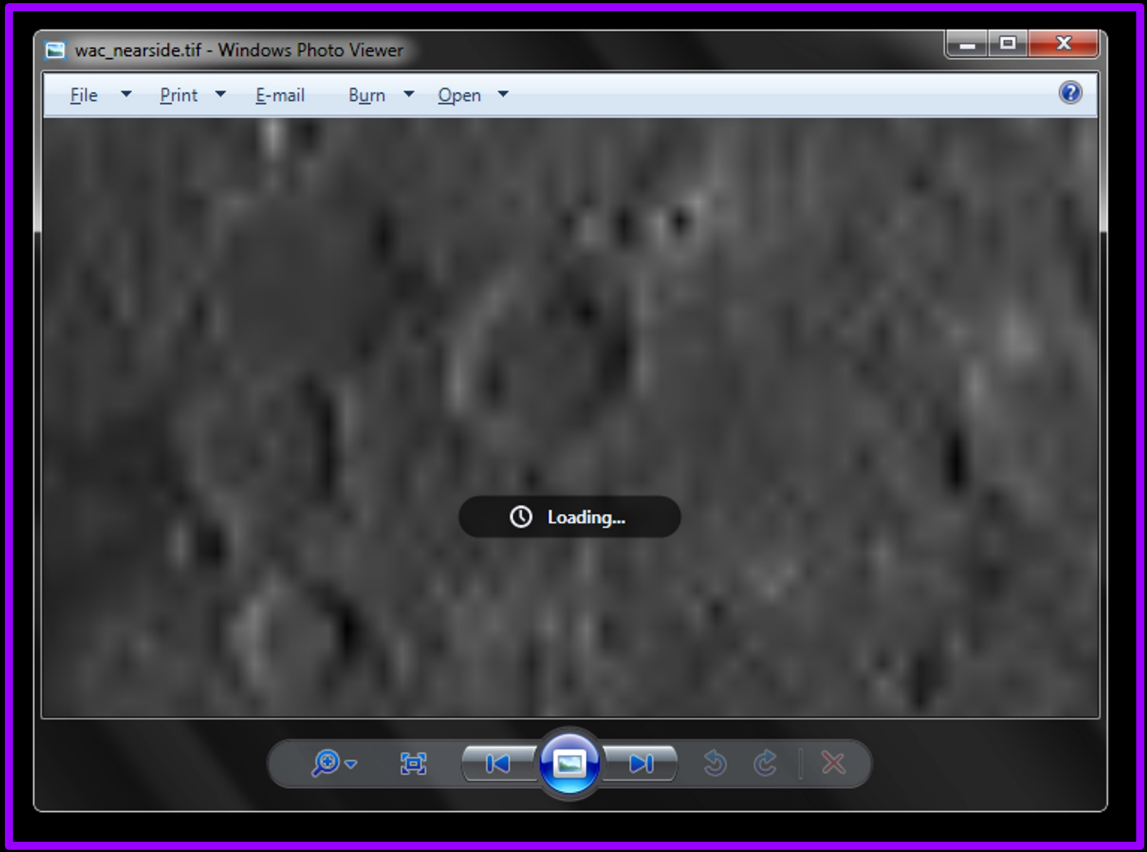
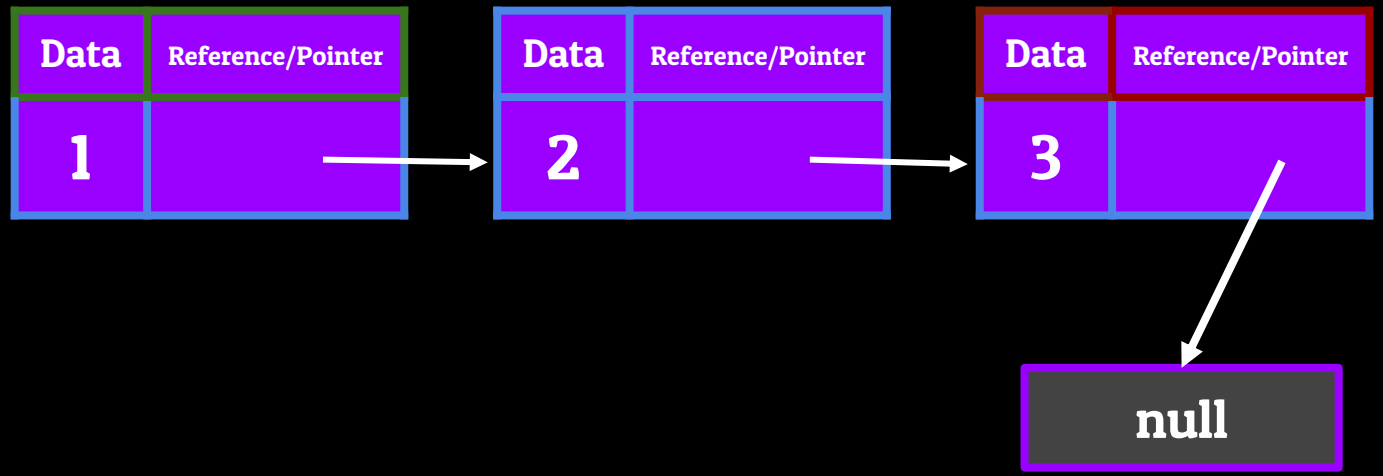


The LinkedList - Review + Conclusion

- A LinkedList is sequential access linear data structure in which every element is a separate object called a node, containing 2 parts
  - The data
  - The reference (or pointer) which points to the next Node in the List



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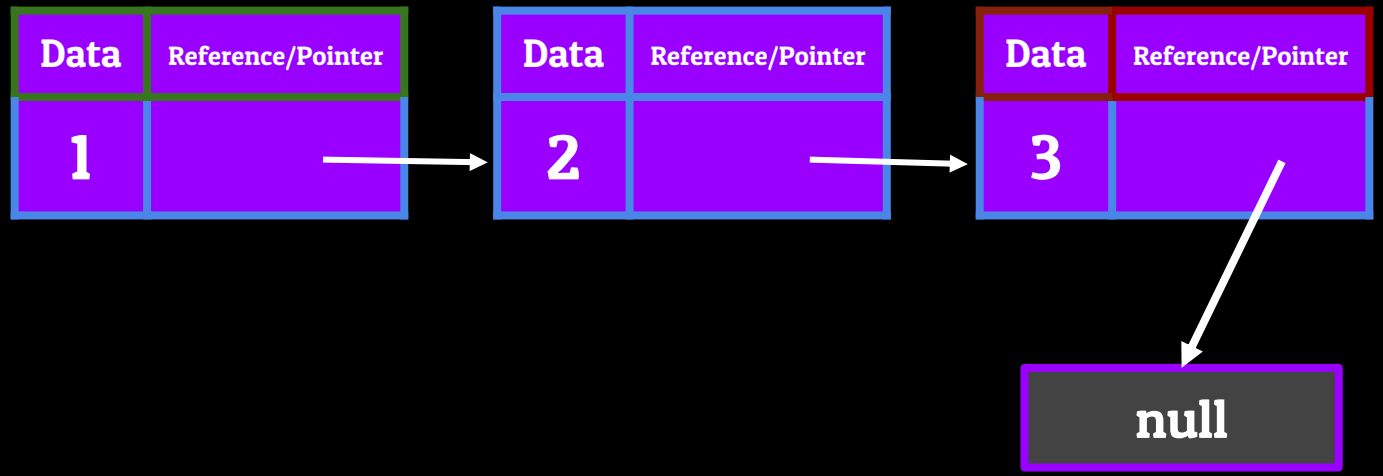
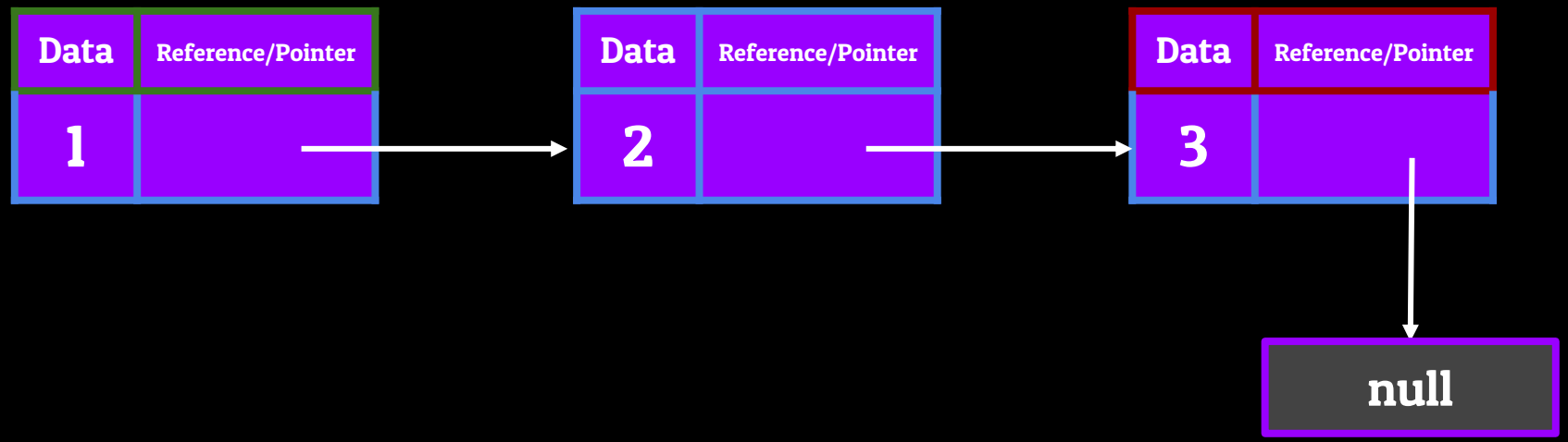


The LinkedList - One Big Drawback



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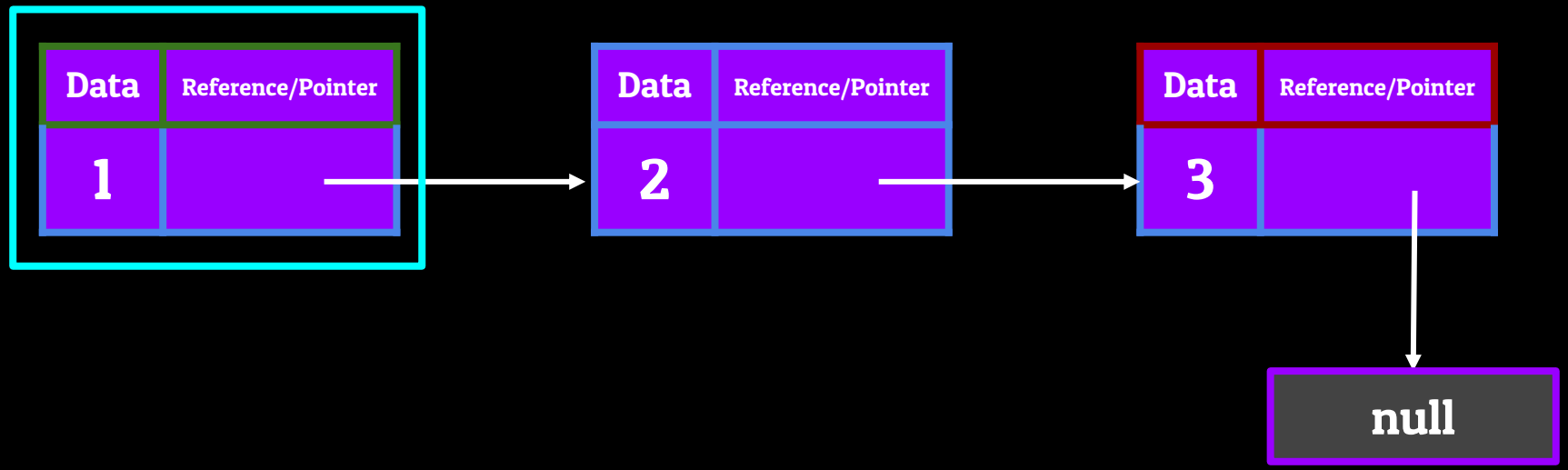

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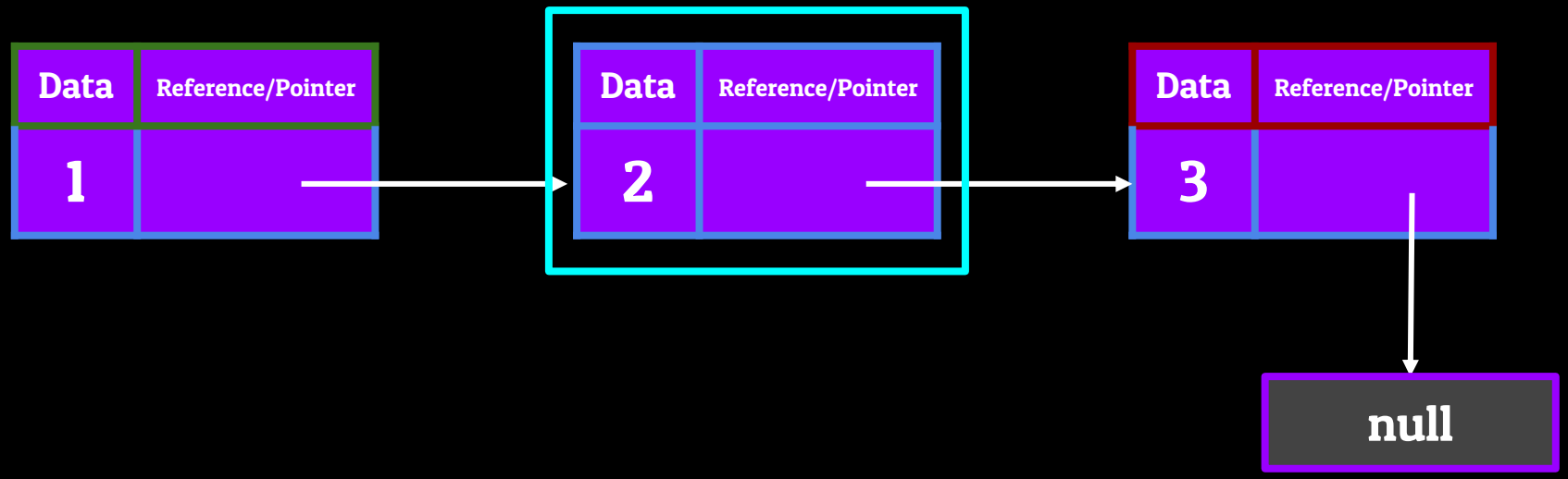

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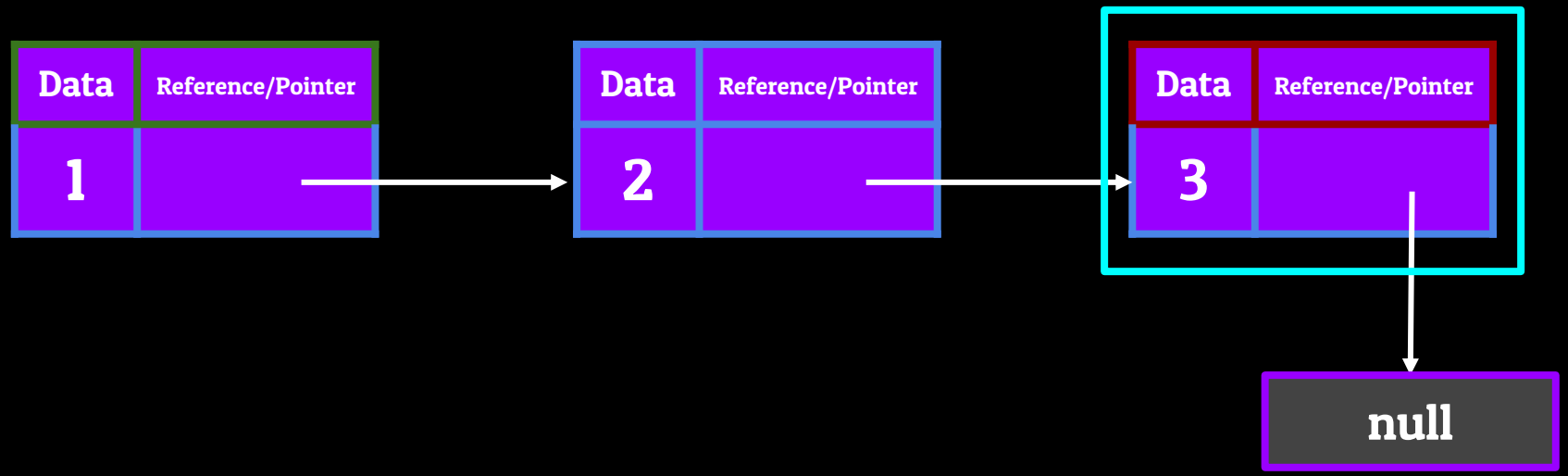

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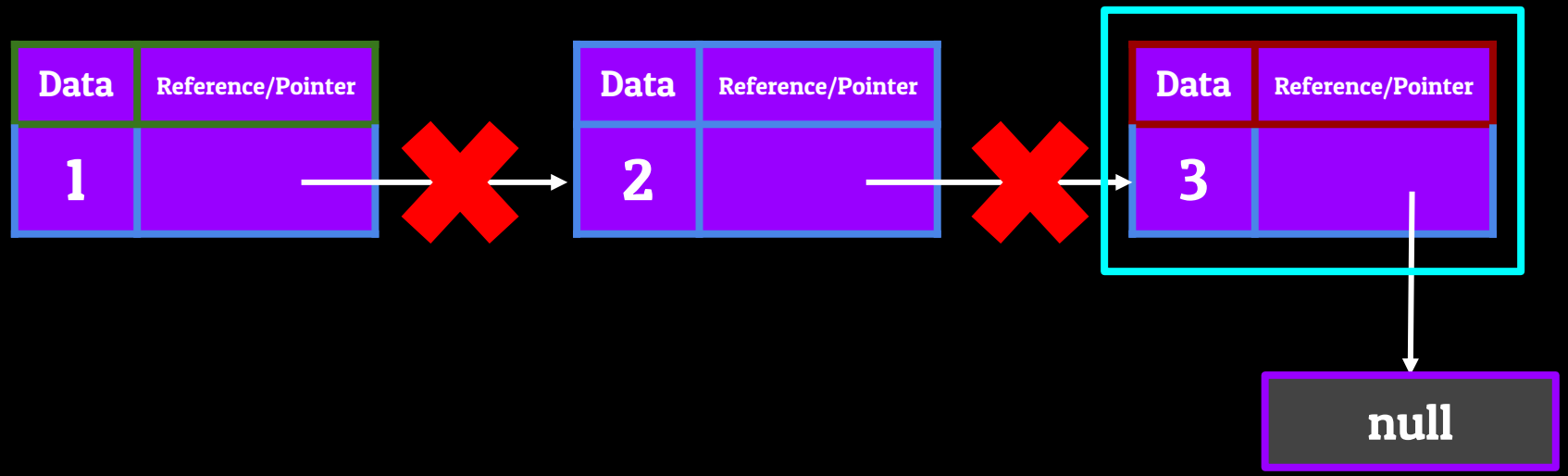

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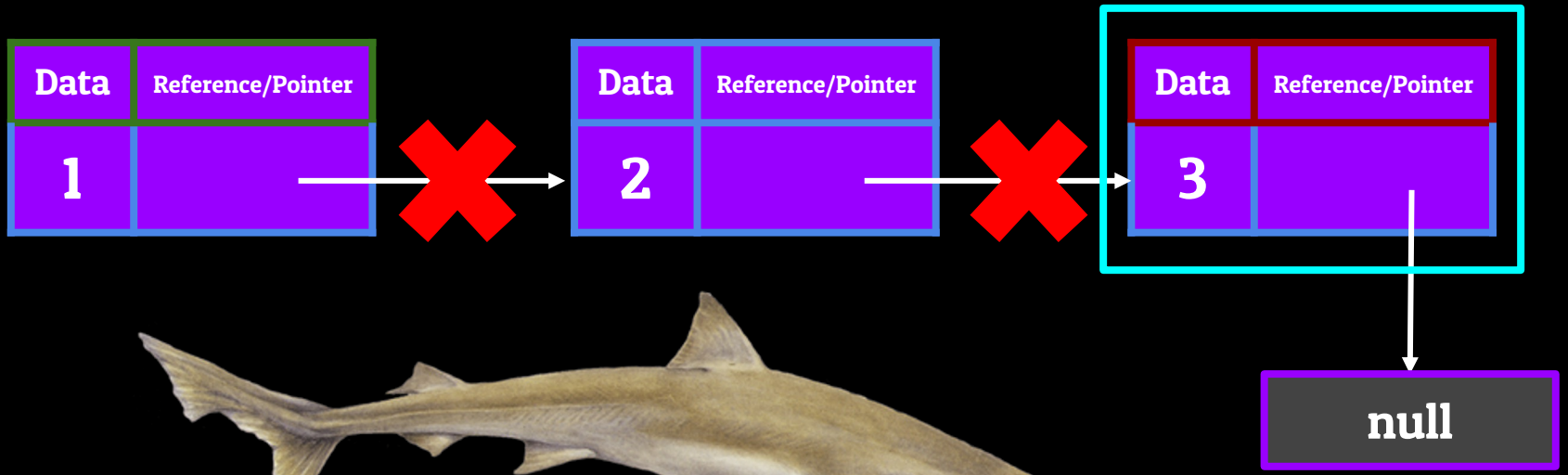

An Introduction to Data Structures

The Doubly-LinkedList

The Doubly-Linked List - Background Information

- **The Doubly-Linked List** is a **sequential access data structure** which stores data in the form of Nodes
  - Able to traverse both **forwards** and **backwards** using pointers

Node

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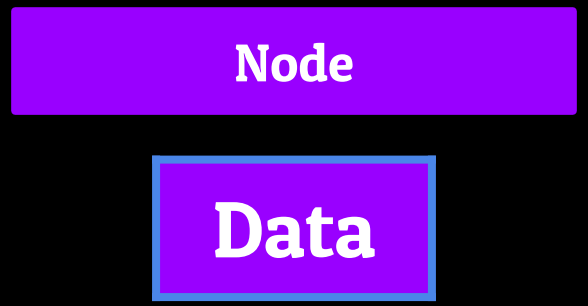

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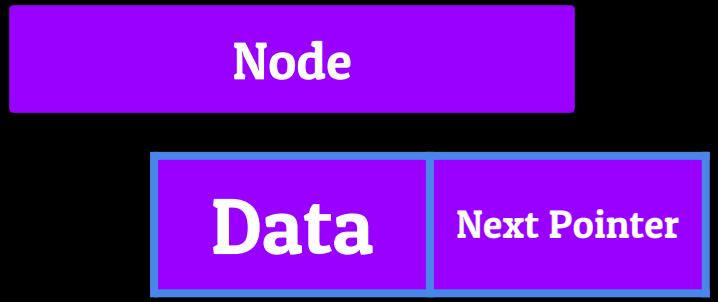

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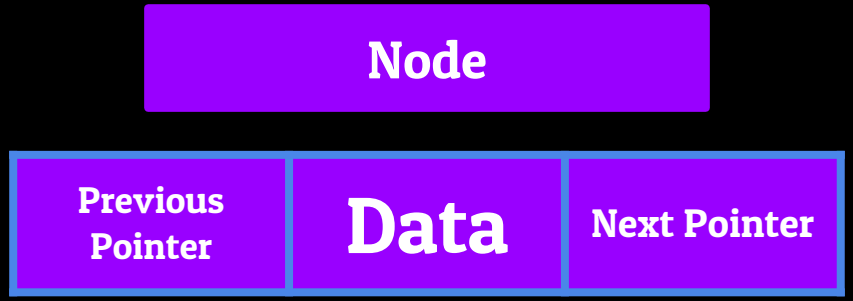

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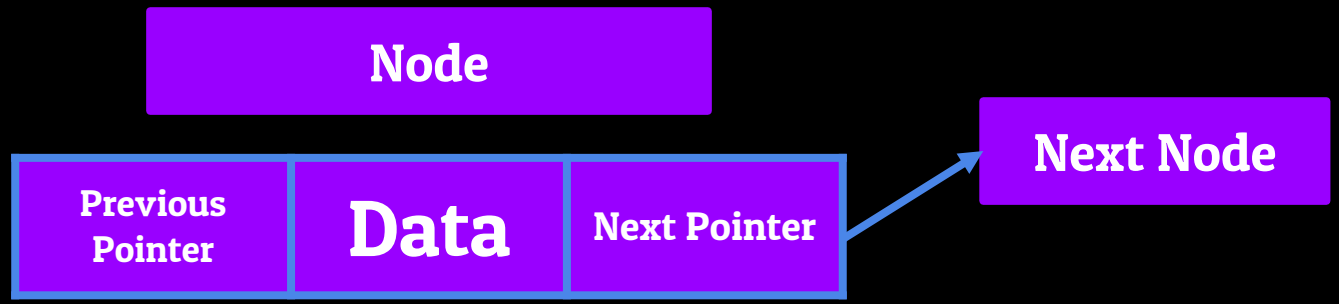

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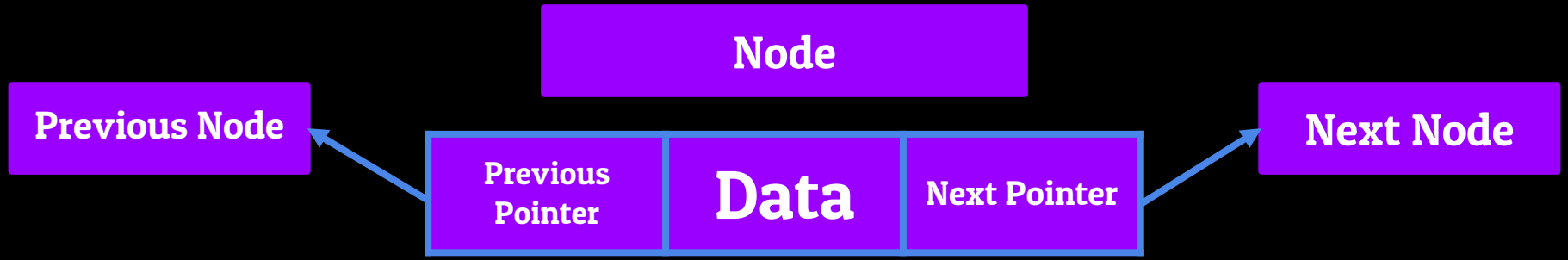

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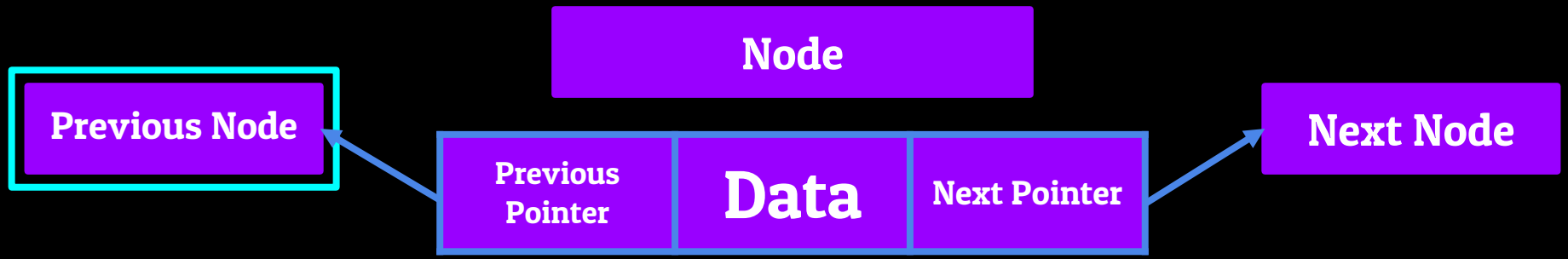

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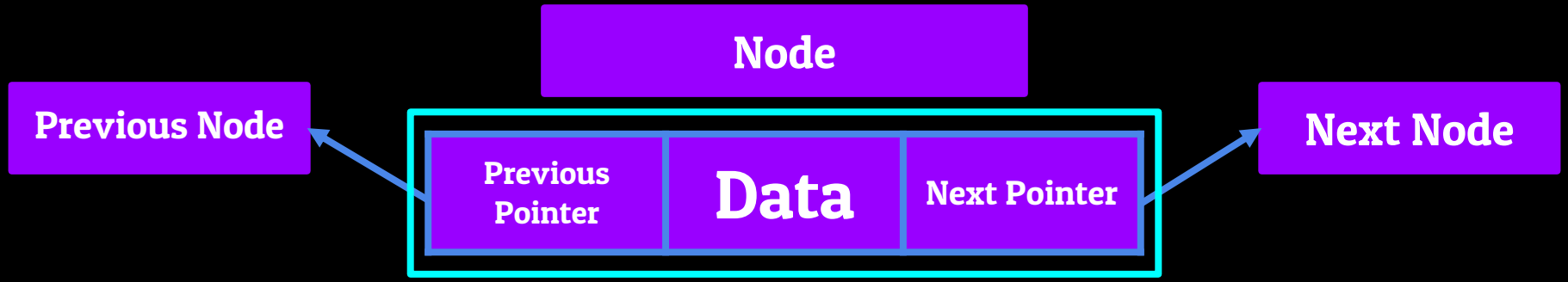

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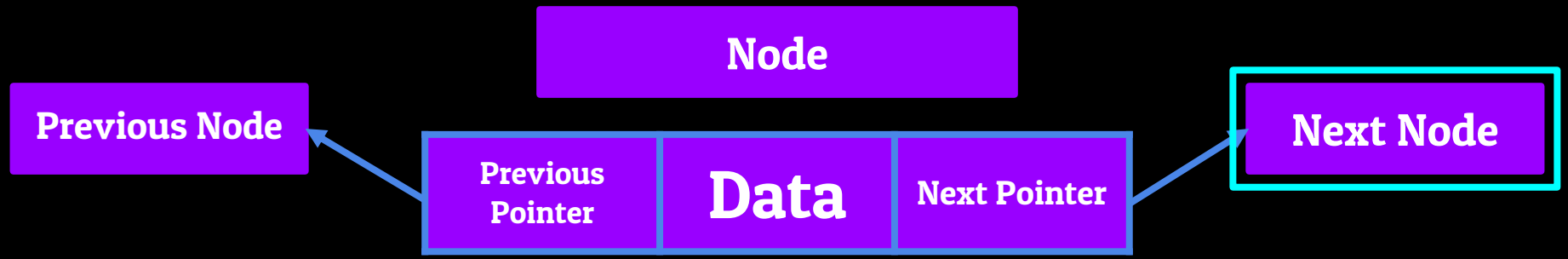

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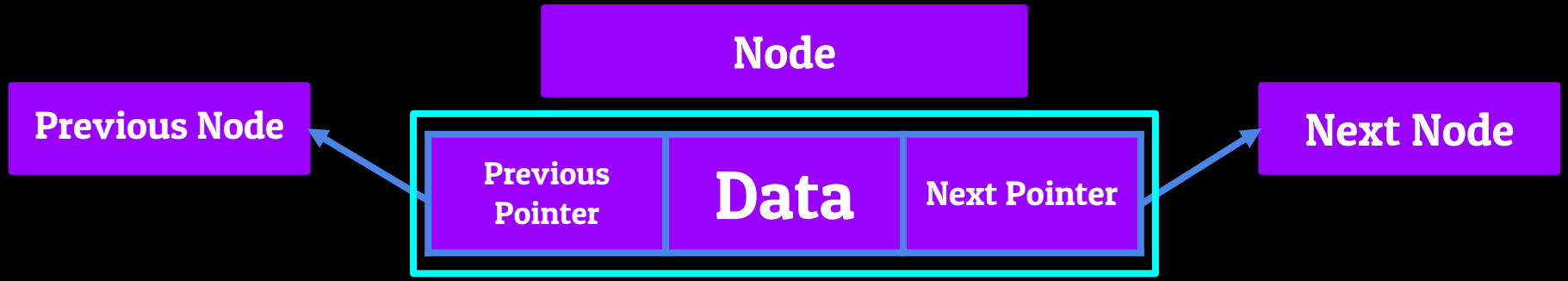

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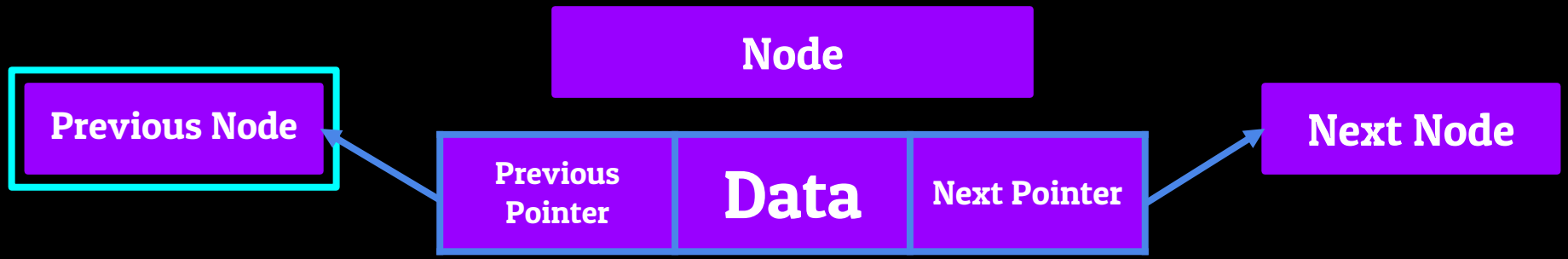

The Doubly-Linked List - Visualization

"Next" = That particular Nodes pointer which points to the next object in the List

The Doubly-Linked List - Visualization

"Next" = That particular Nodes pointer which points to the next object in the List

"Previous" = That particular Nodes pointer which points to the previous object in the List

The Doubly-Linked List - Visualization

The Doubly-Linked List - Visualization

The Doubly-Linked List

The Doubly-Linked List - Visualization

The Doubly-Linked List

Head Node

The Doubly-Linked List - Visualization

The Doubly-Linked List

Head Node

Pointer	Data	Pointer
•	1	•

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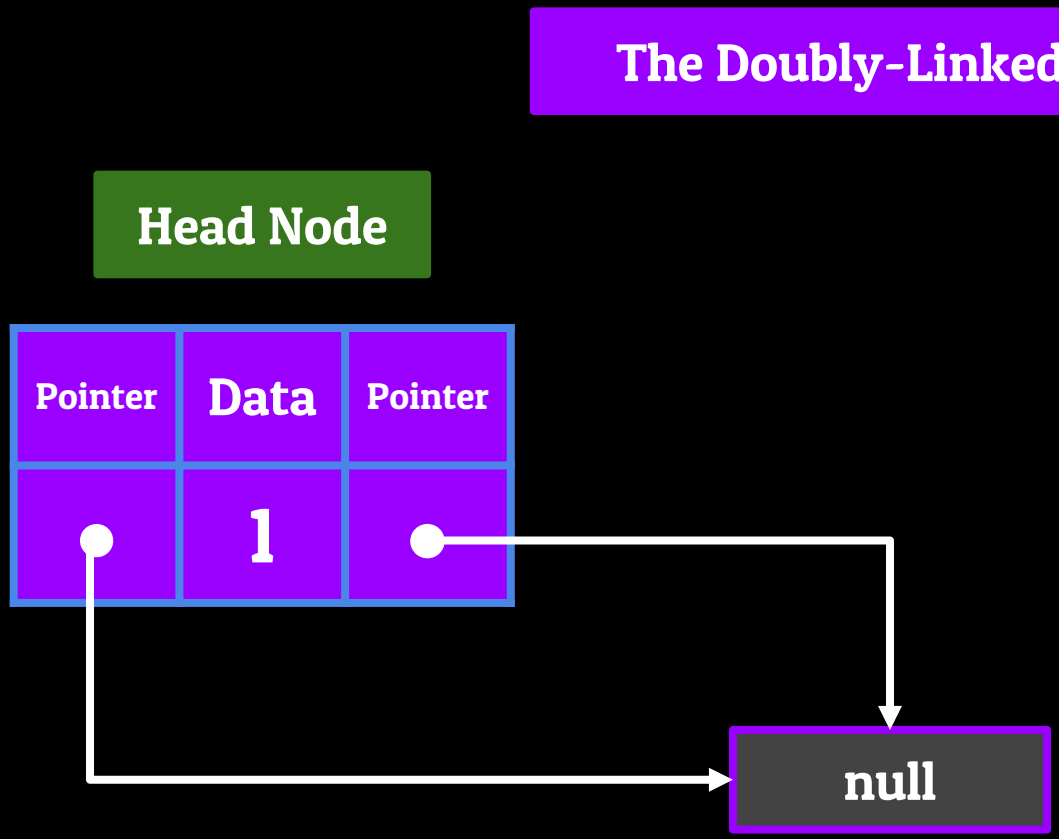

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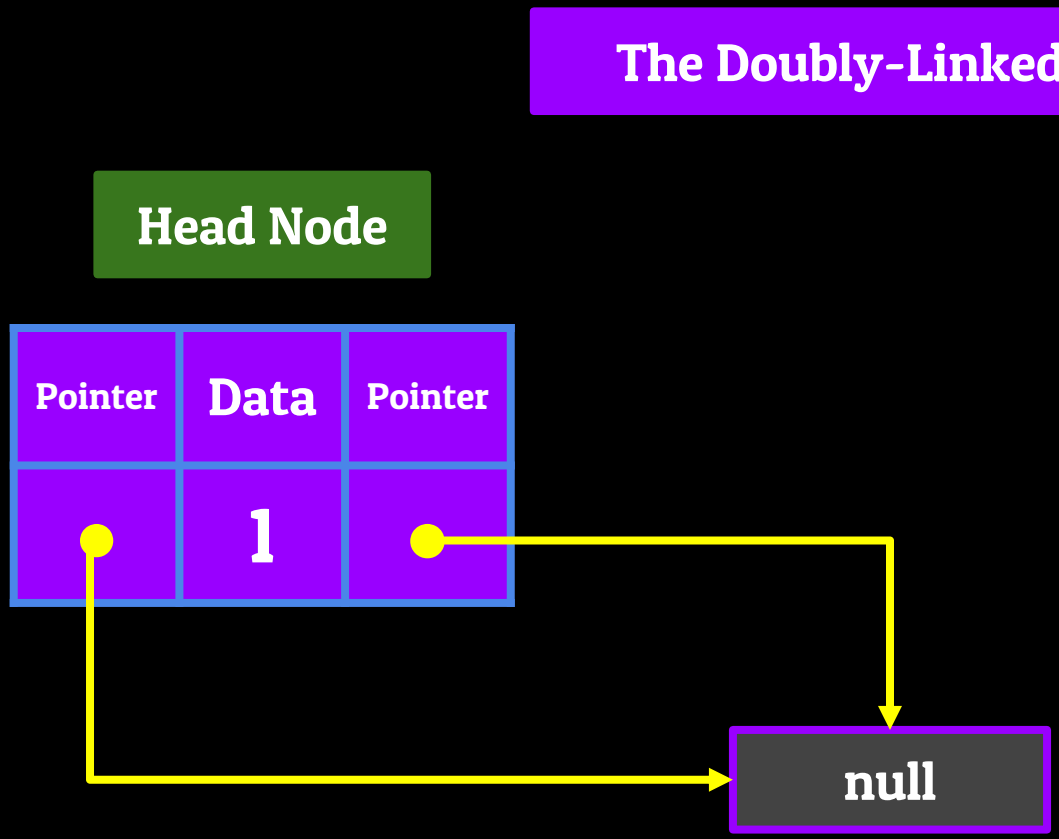

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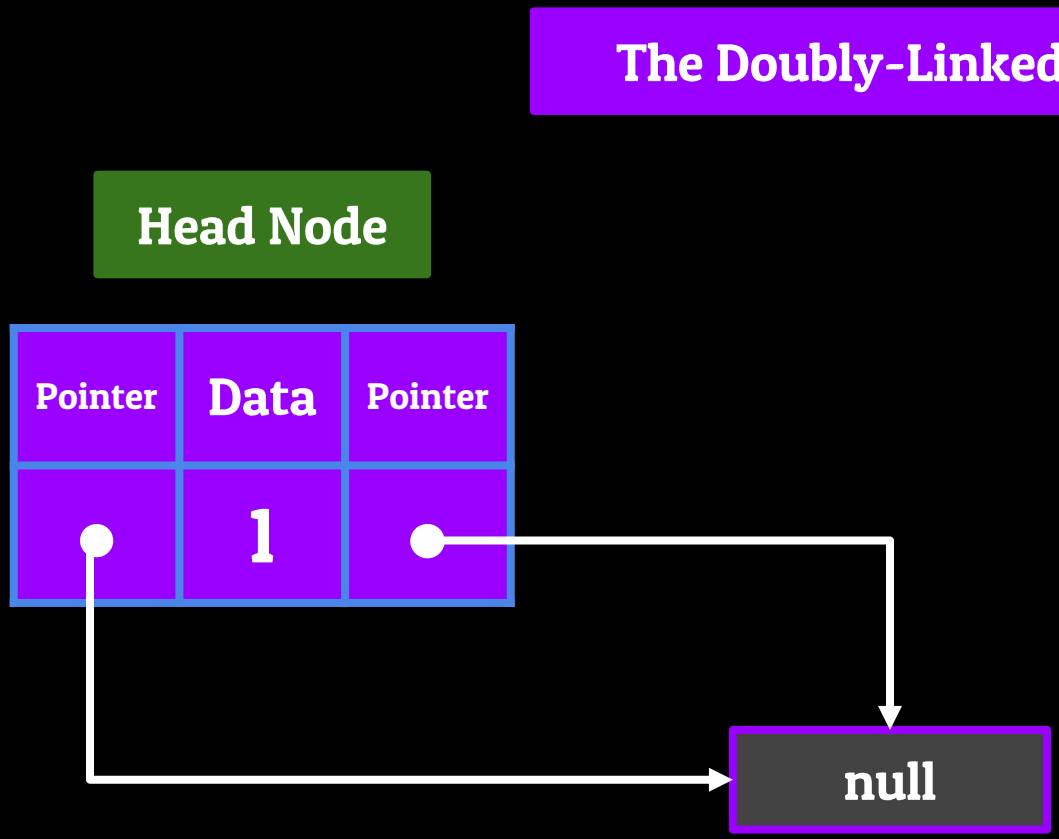

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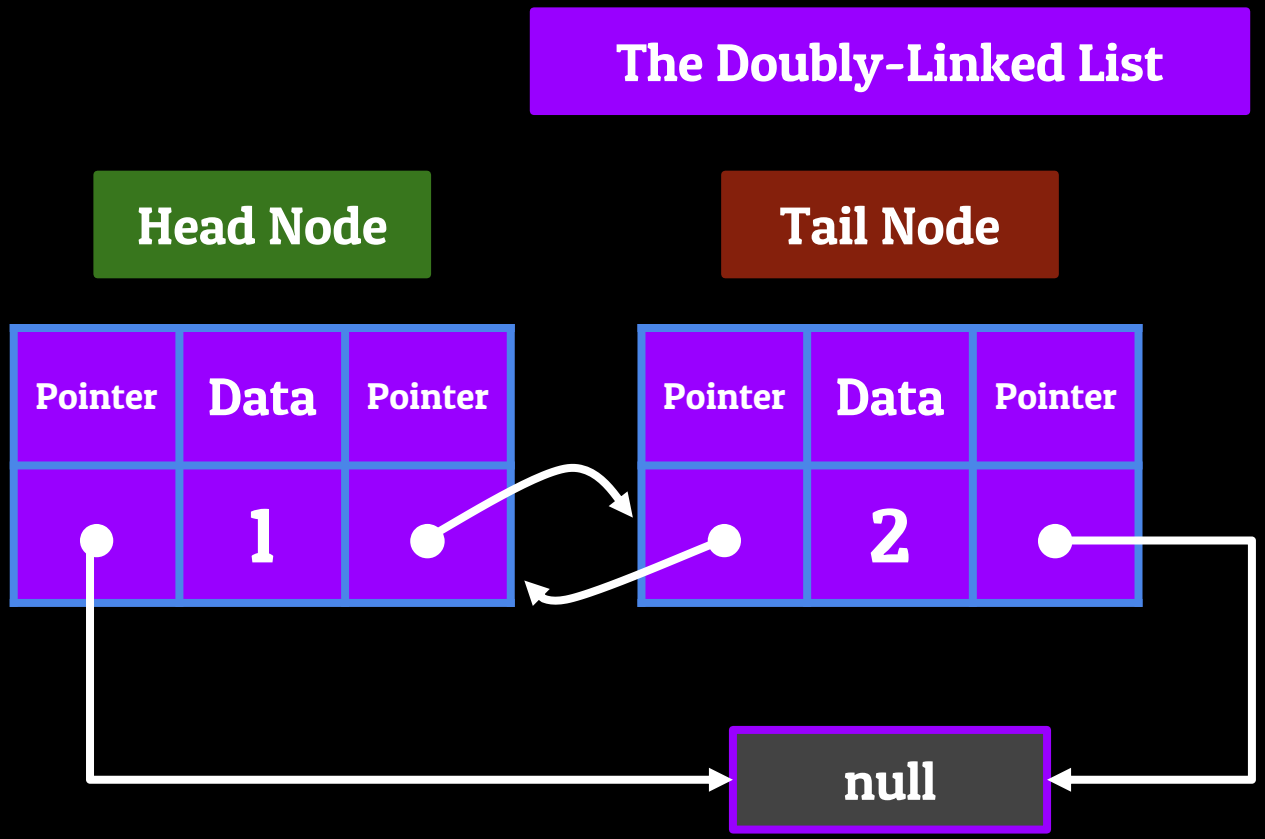

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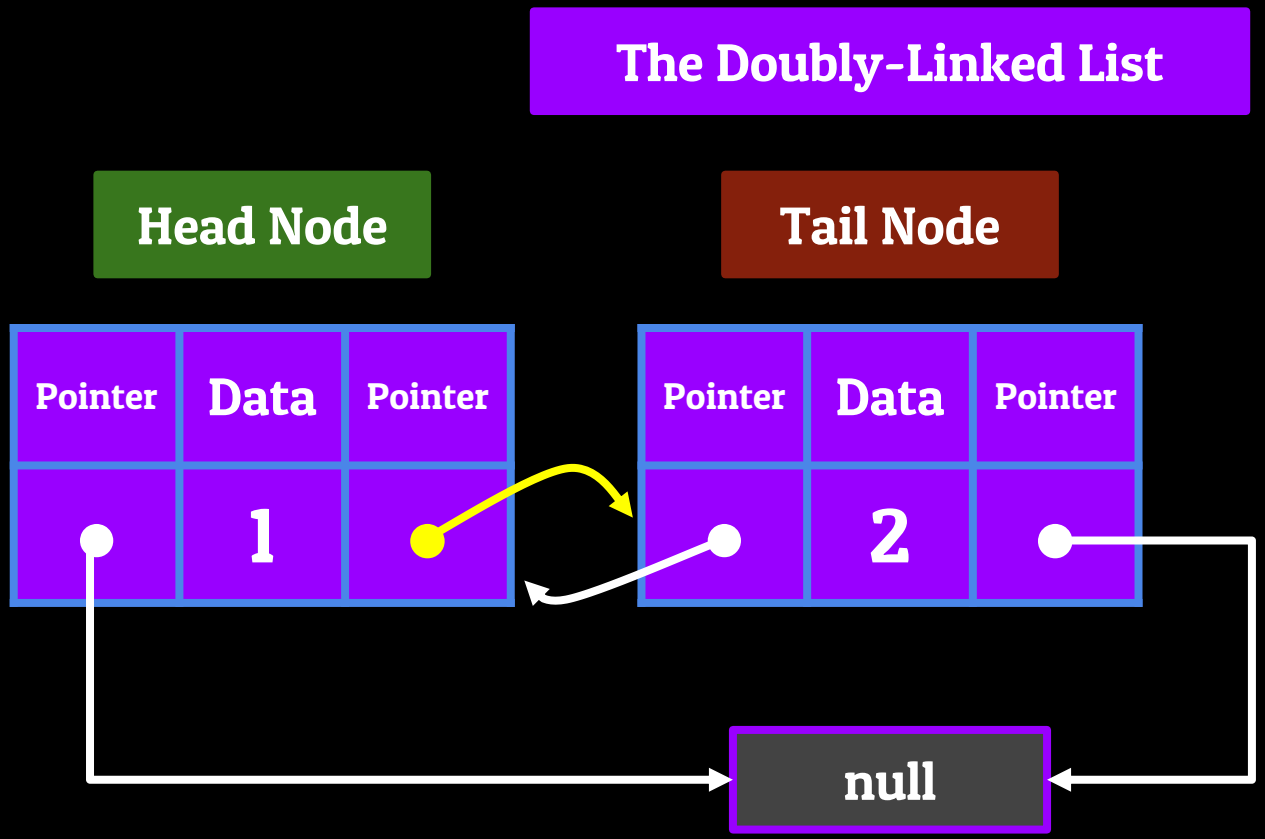

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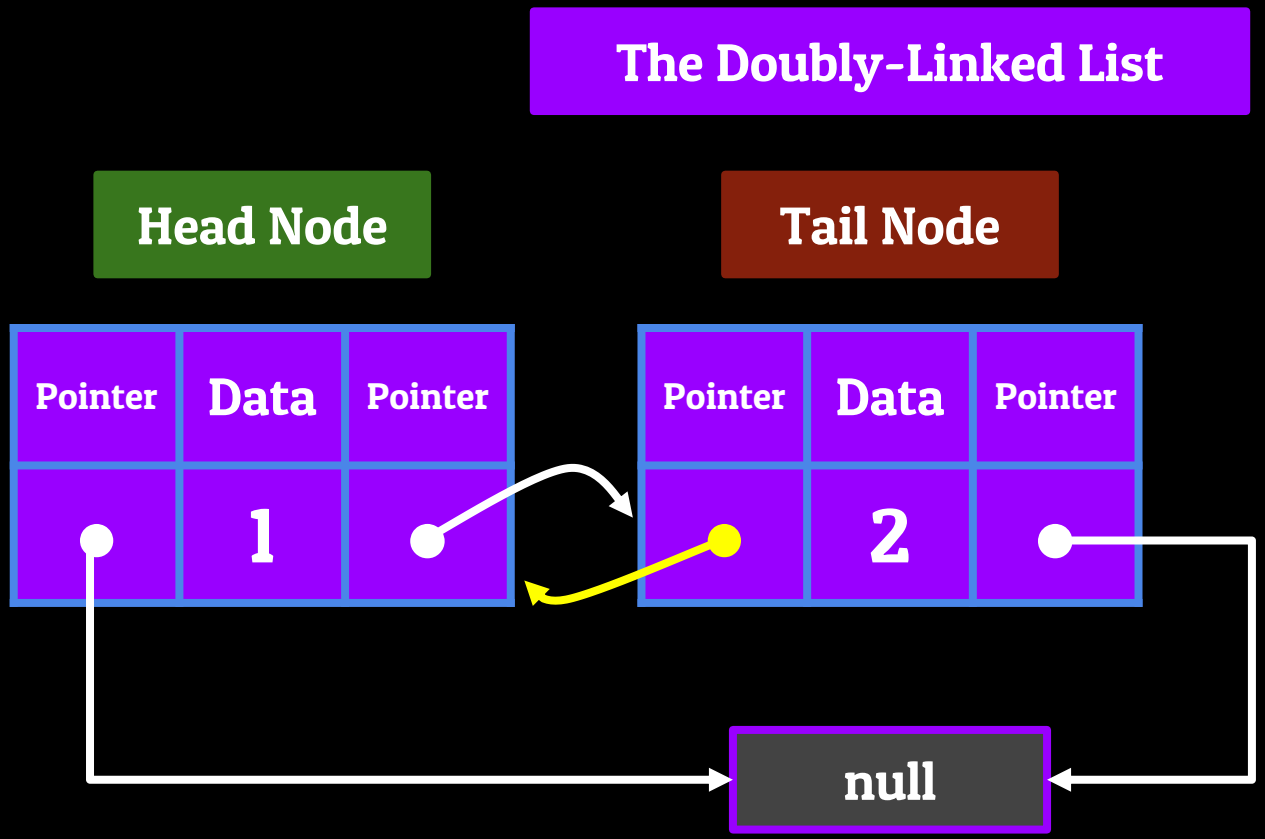

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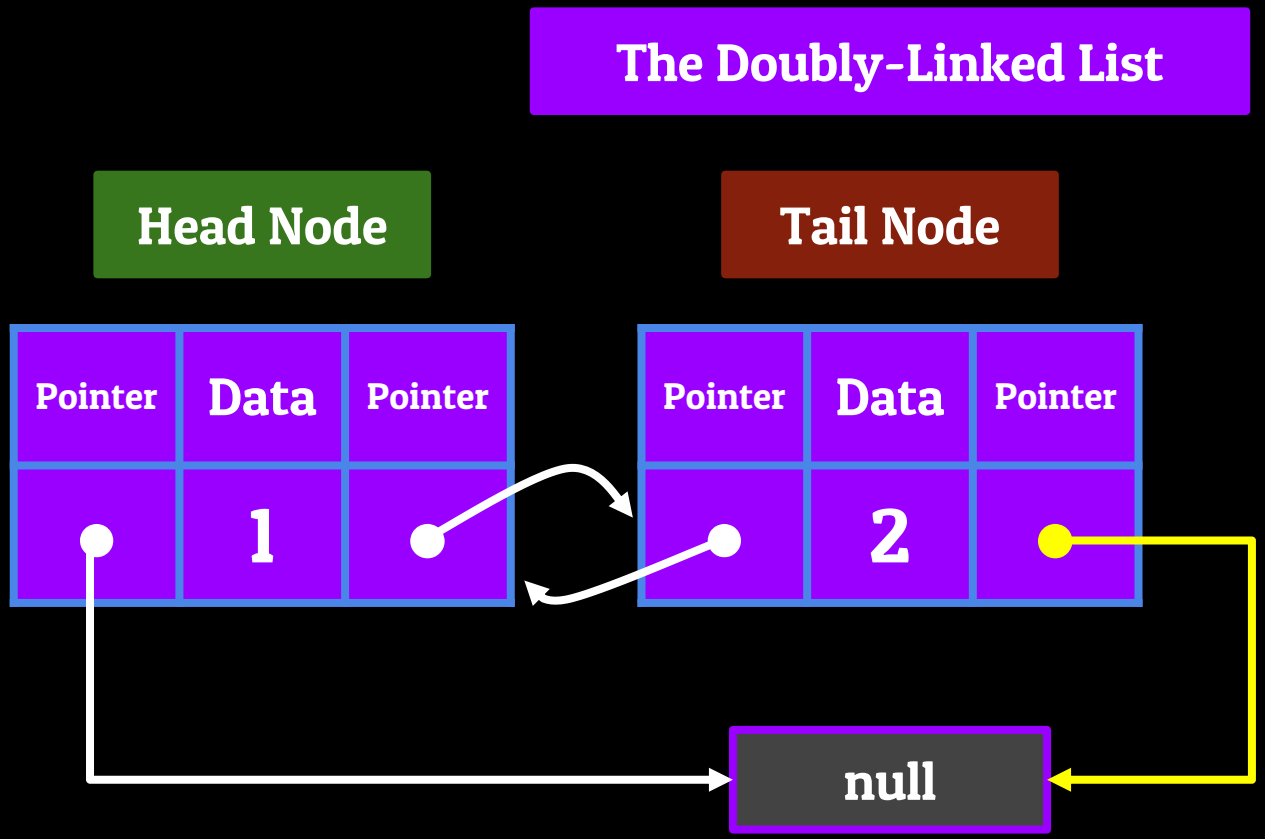

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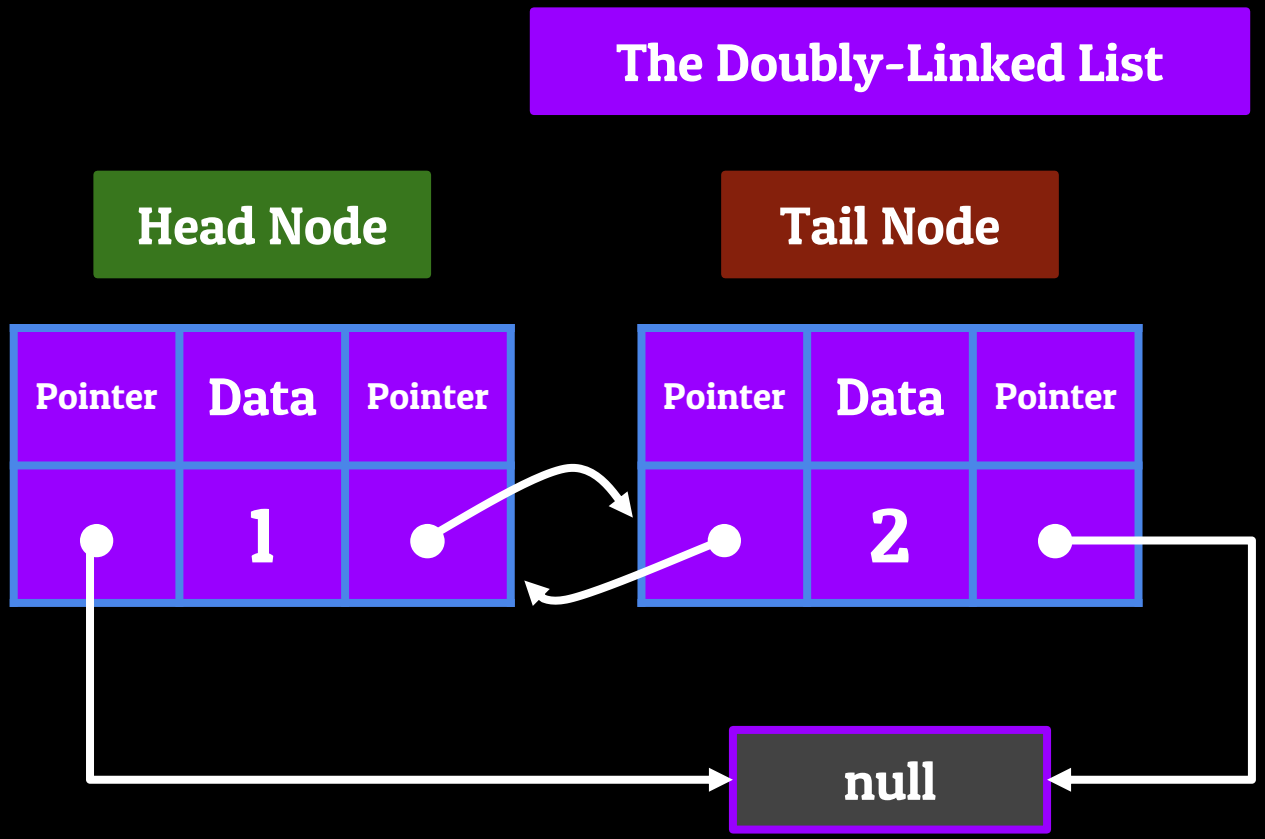

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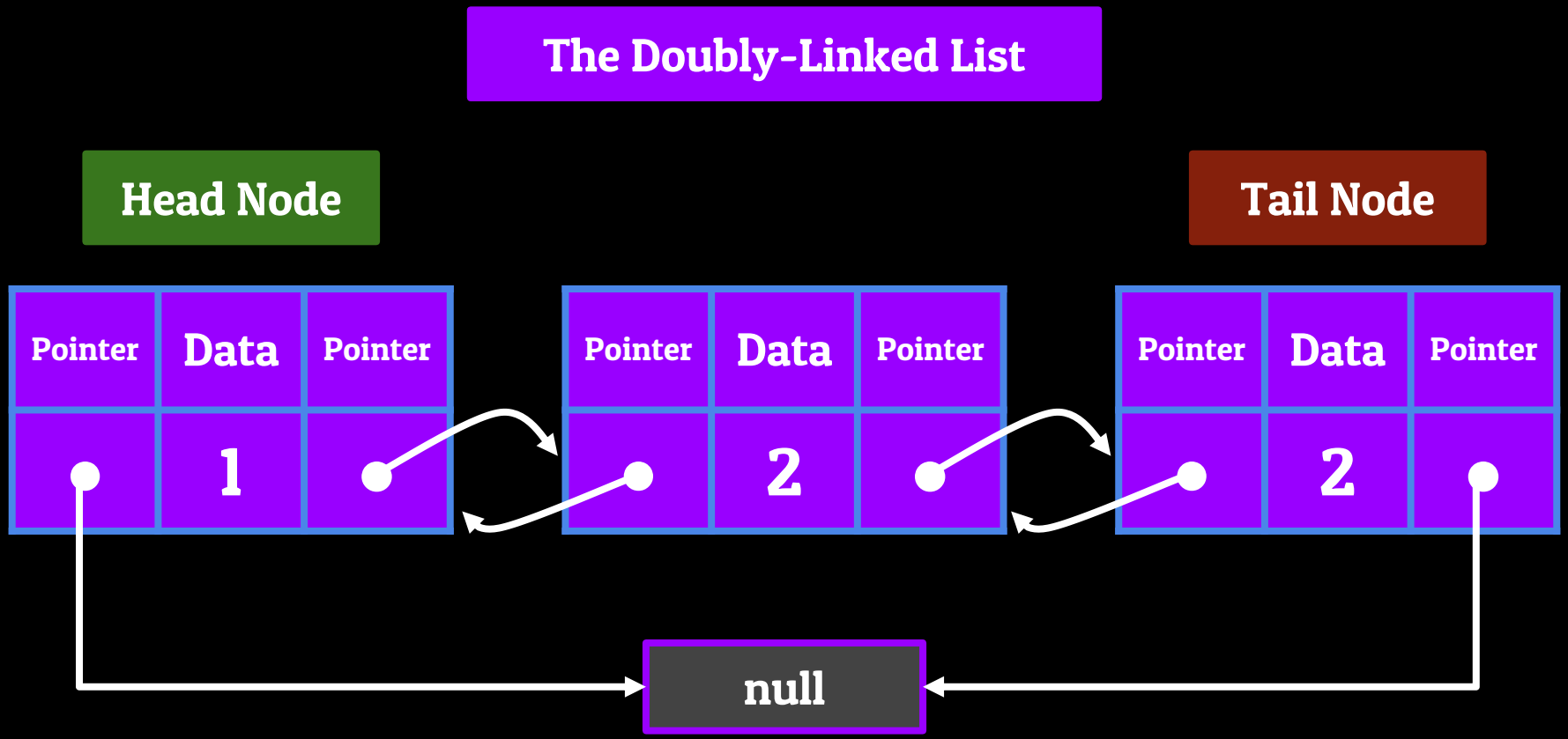
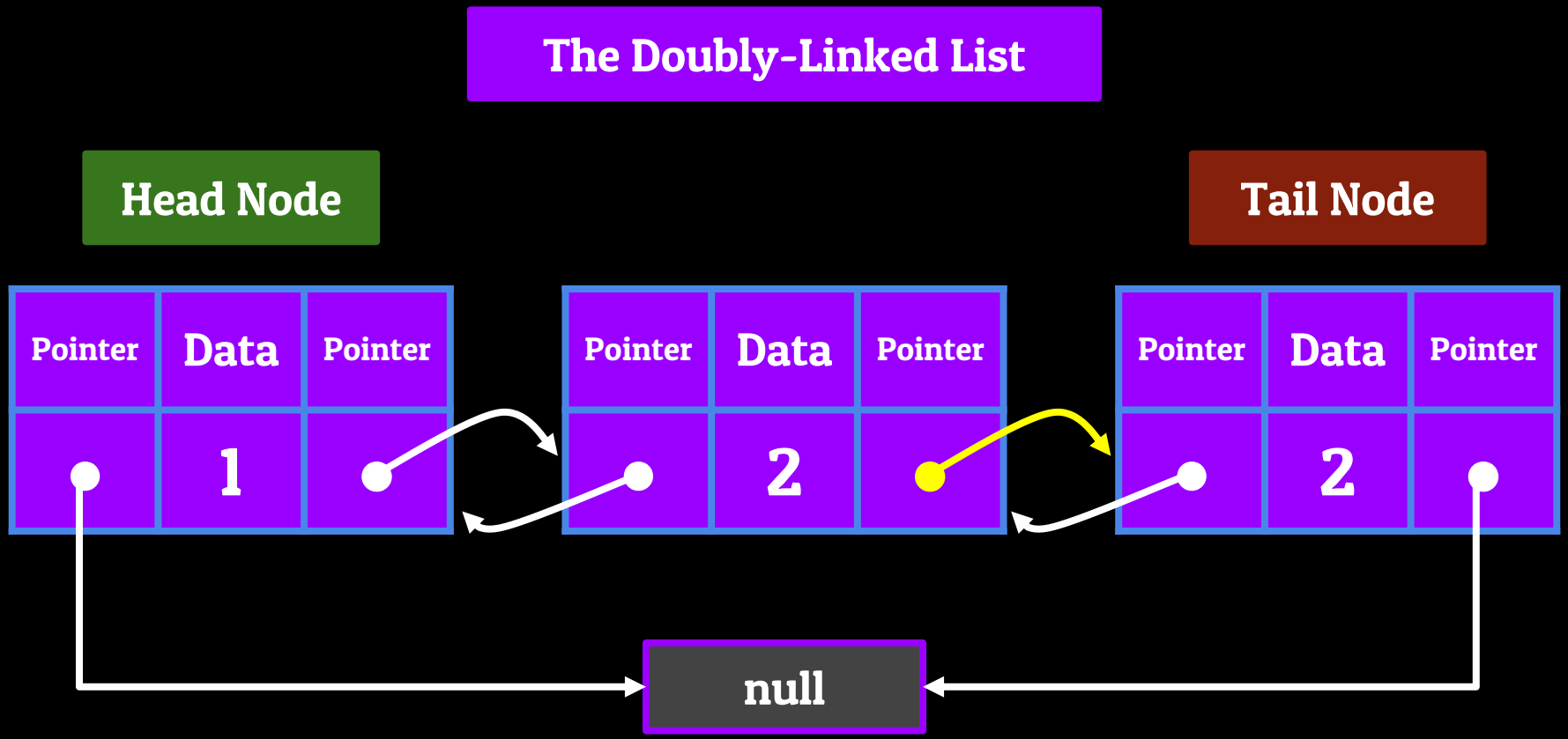
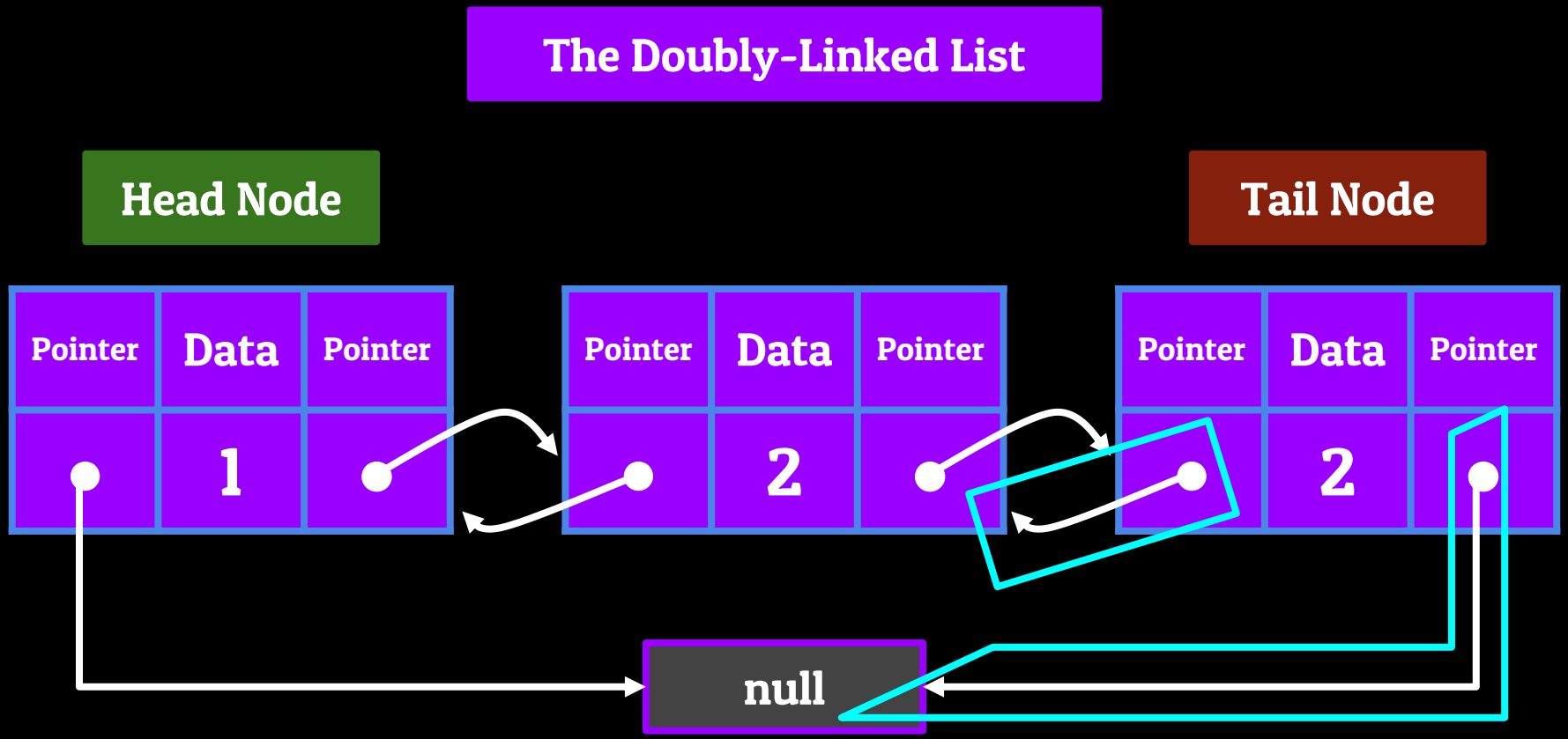


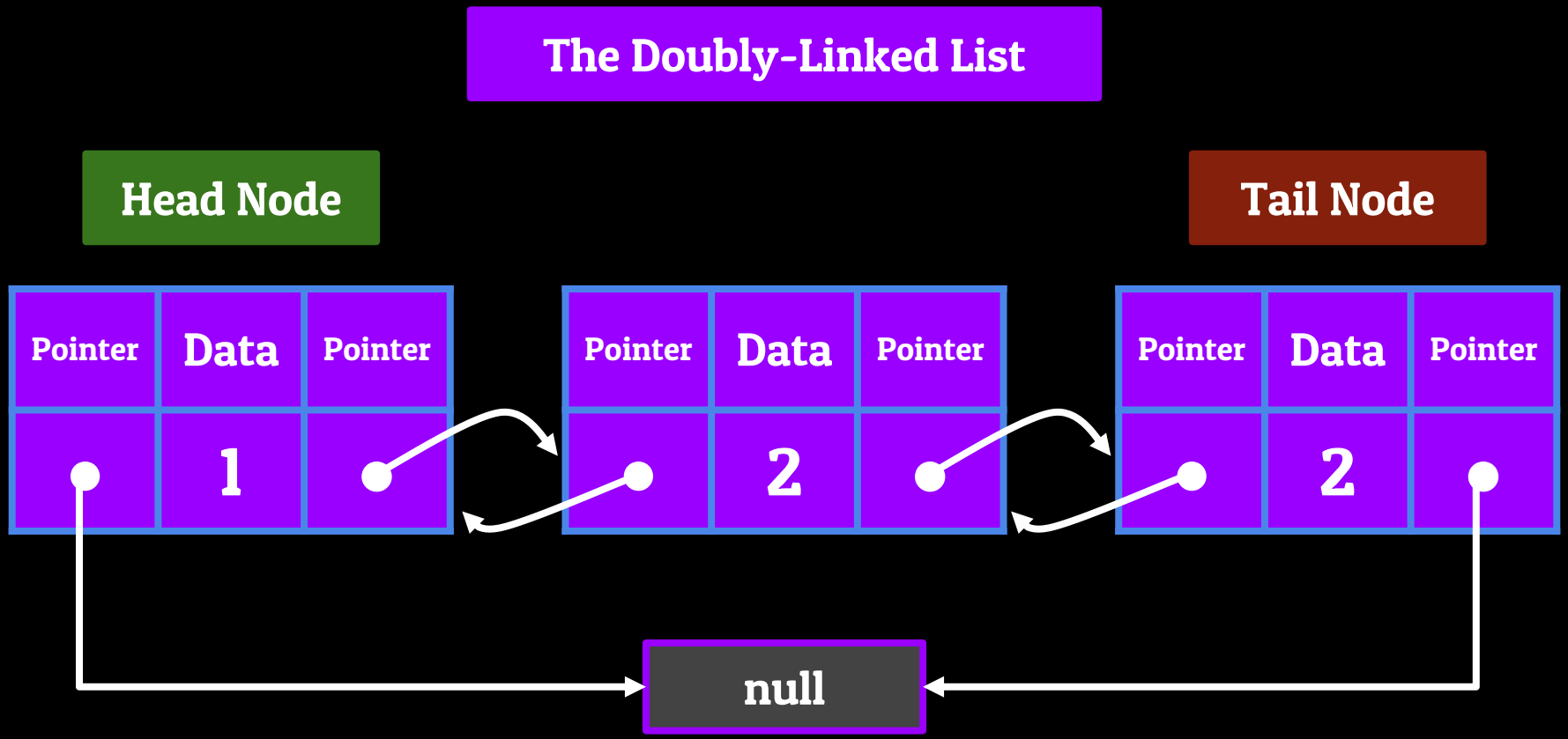
The Doubly-Linked List - Visualization



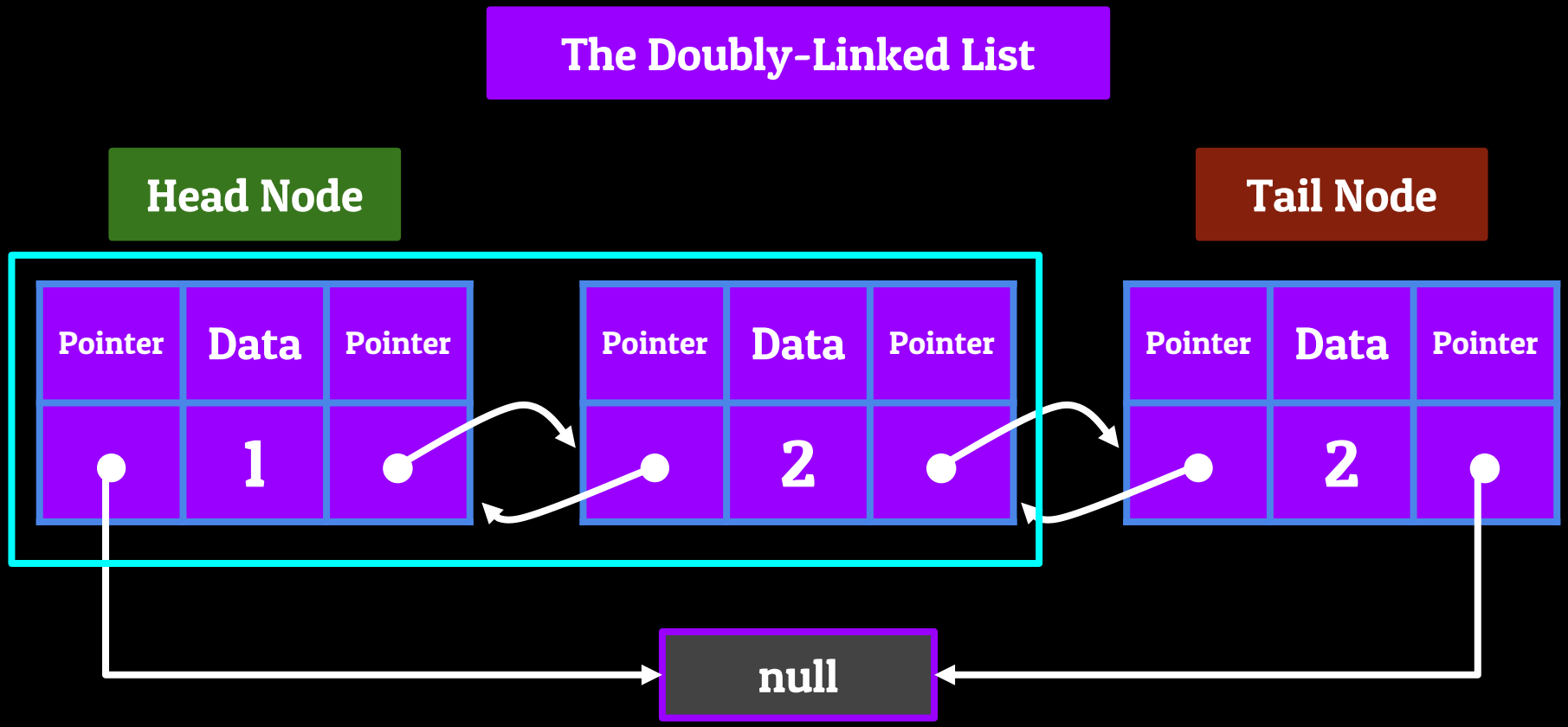
The Doubly-Linked List - Visualization



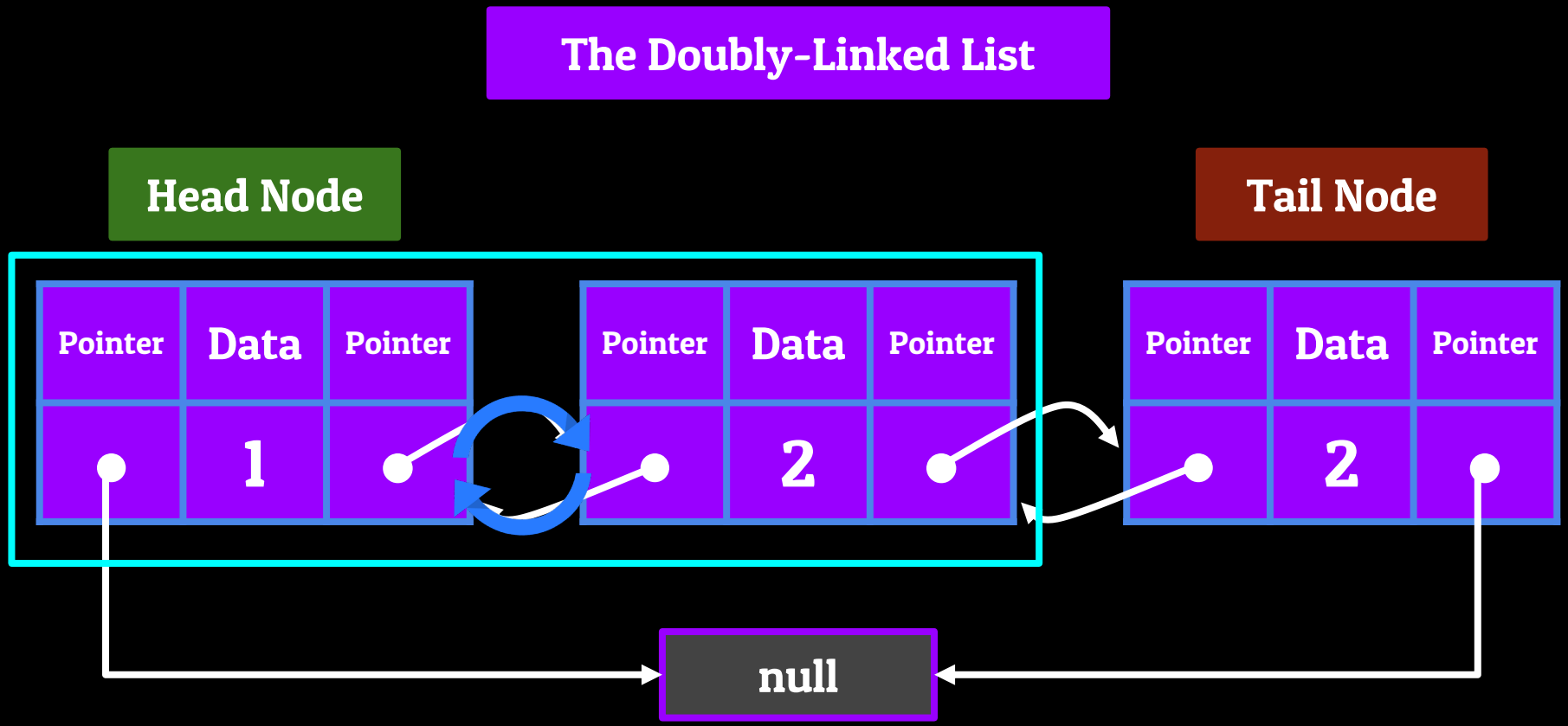
The Doubly-Linked List - Visualization



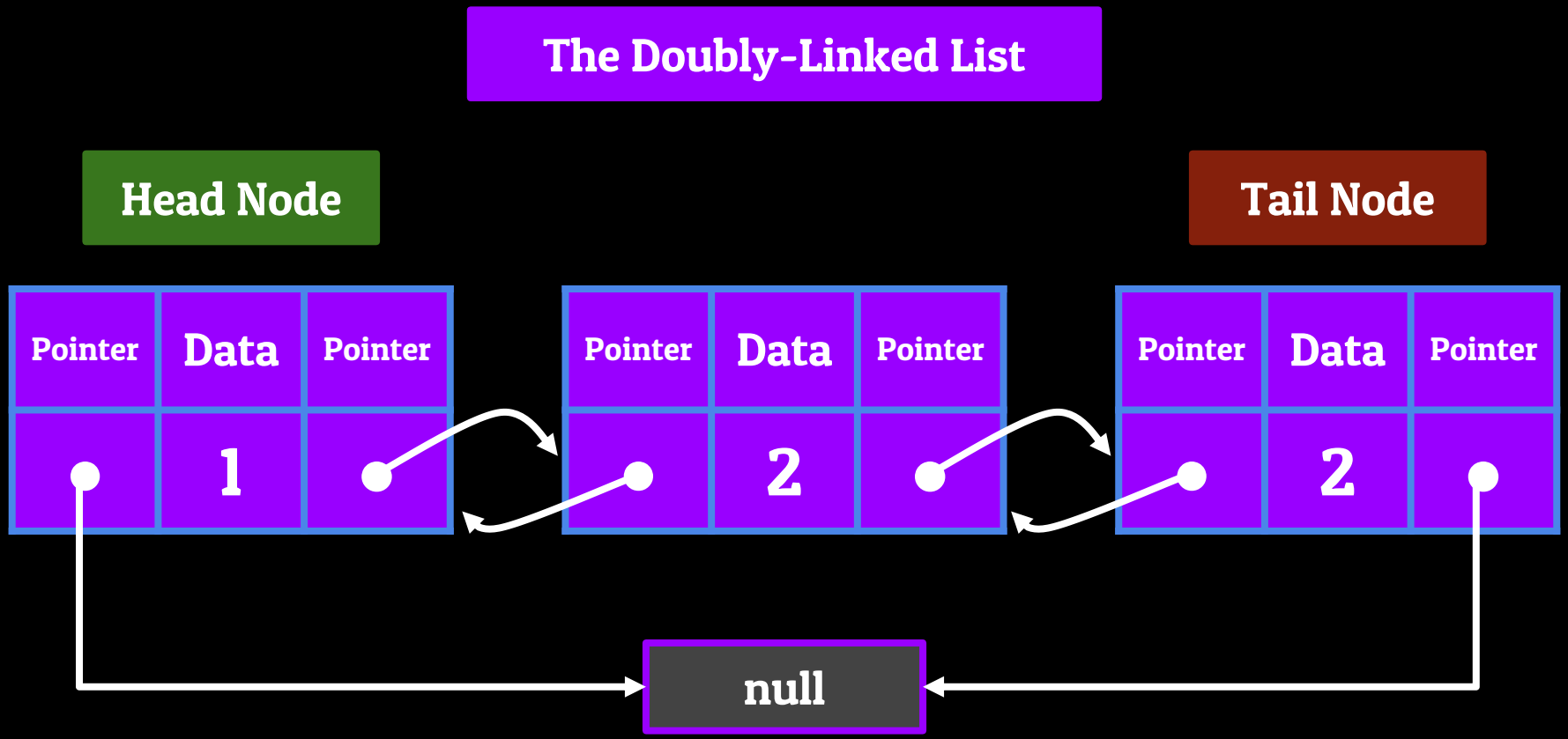
The Doubly-Linked List - Visualization



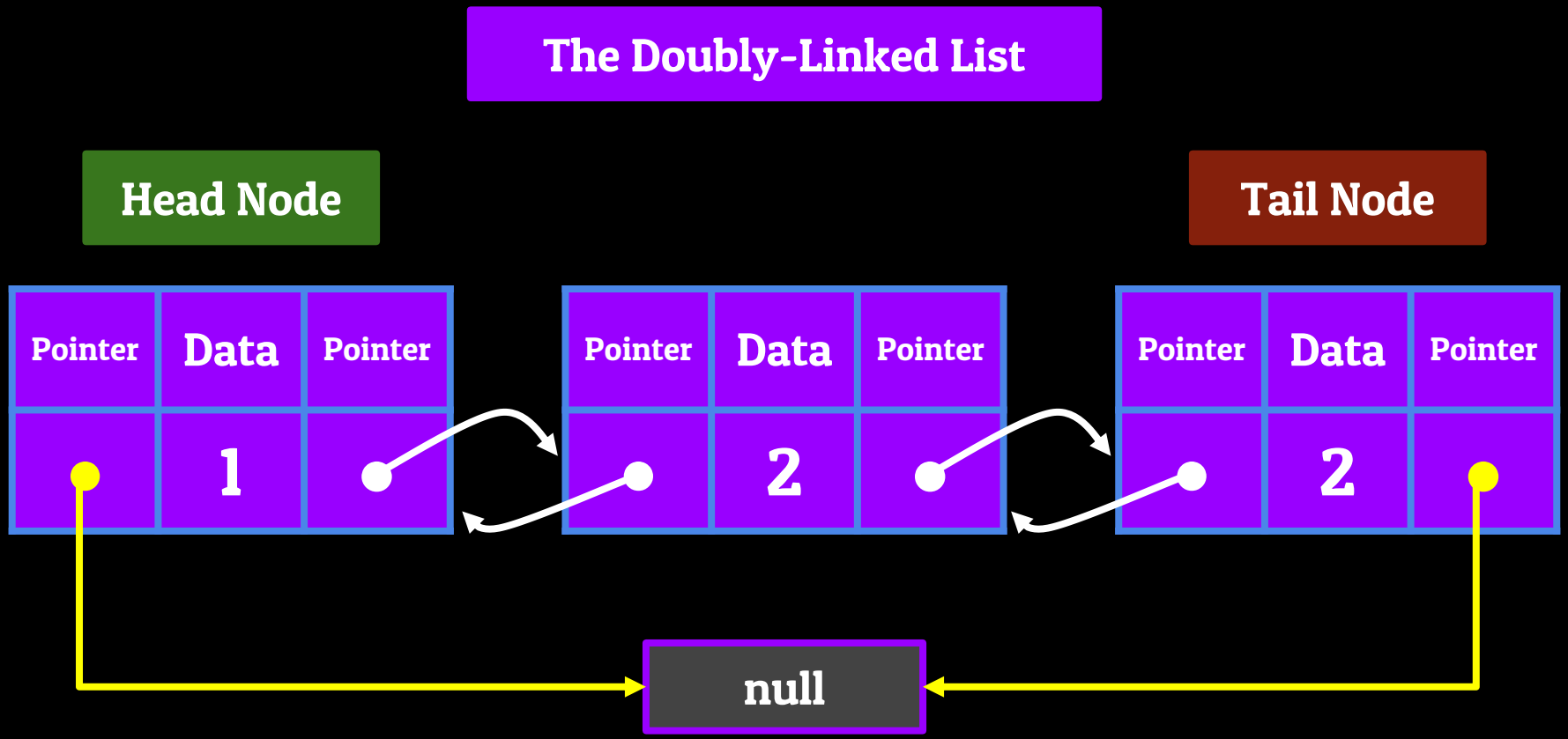
The Doubly-Linked List - Visualization



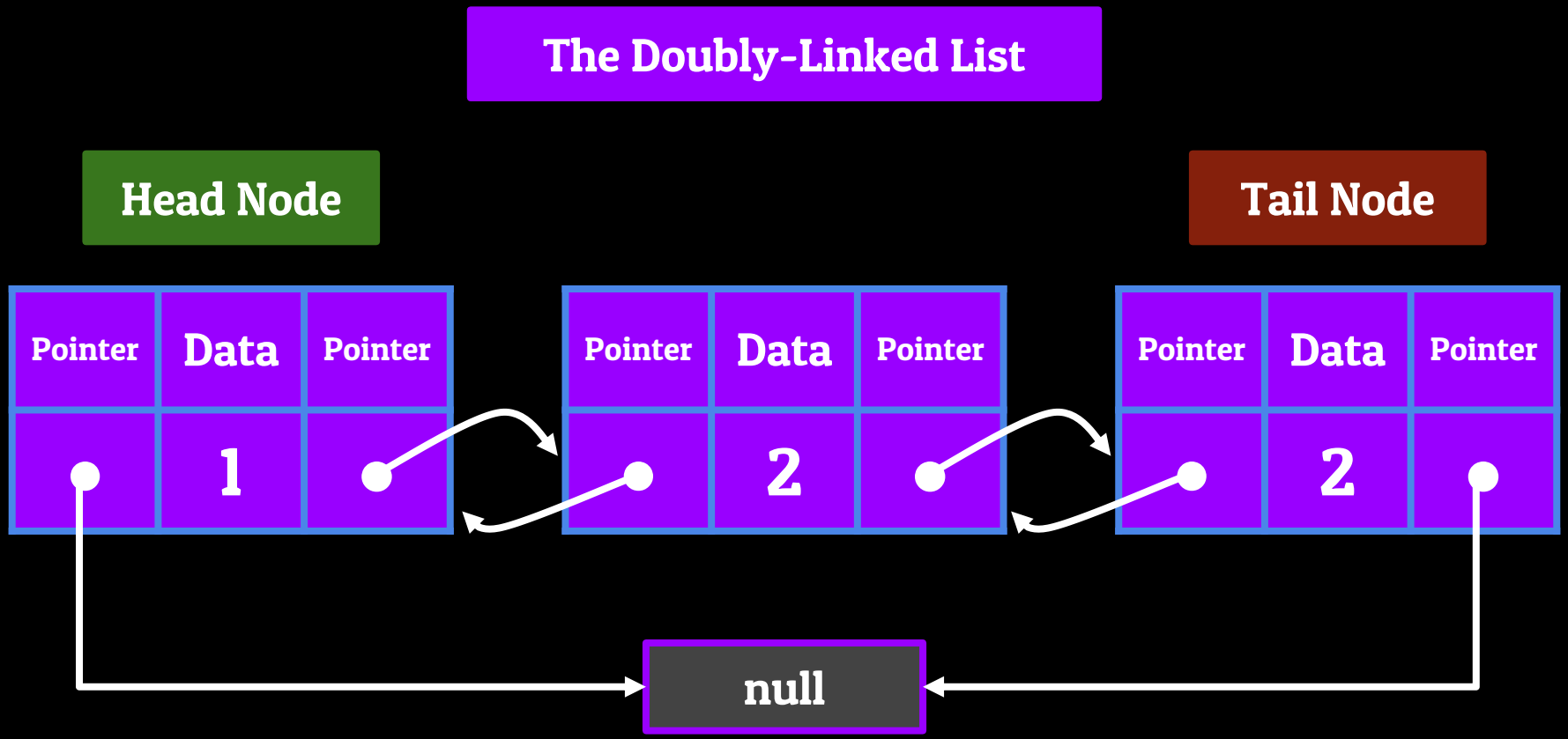
The Doubly-Linked List - Visualization



The Doubly-Linked List - Visualization



The Doubly-Linked List - Visualization



The Doubly-Linked List - Adding and Removing Information

The Doubly-Linked List - Adding and Removing Information

Add to Head

Remove from Head

The Doubly-Linked List - Adding and Removing Information

Add to Head

Add to the Middle

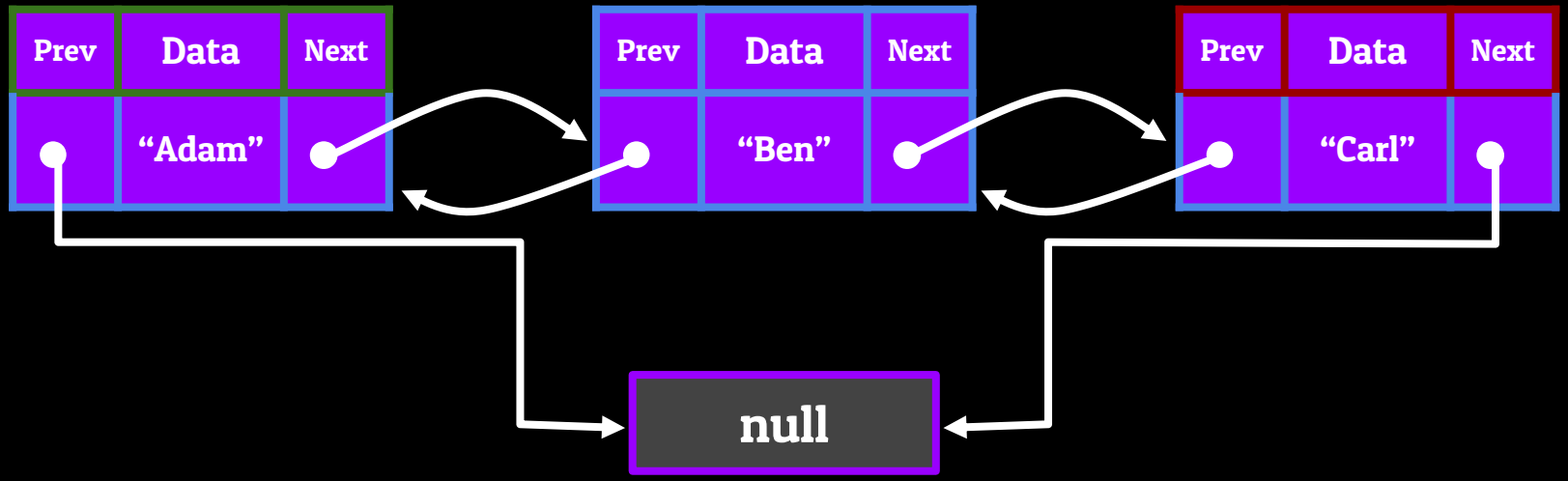
Remove from Head

Remove from the Middle

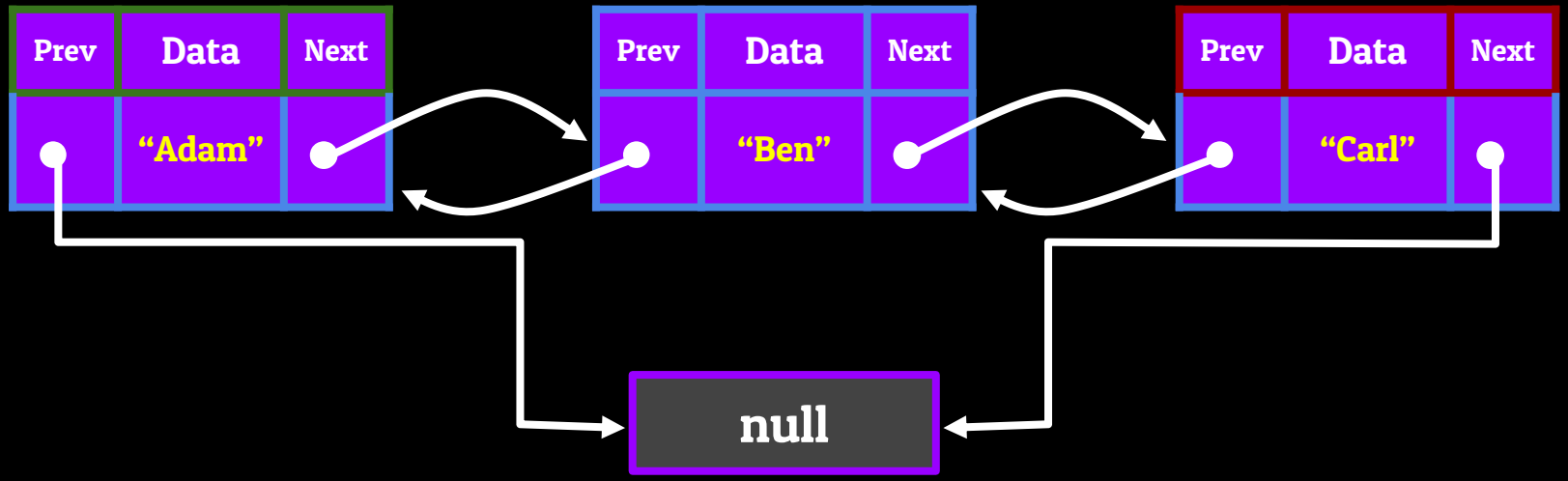
The Doubly-Linked List - Adding and Removing Information

Add to Head	Add to the Middle	Add to Tail
Remove from Head	Remove from the Middle	Remove from Tail

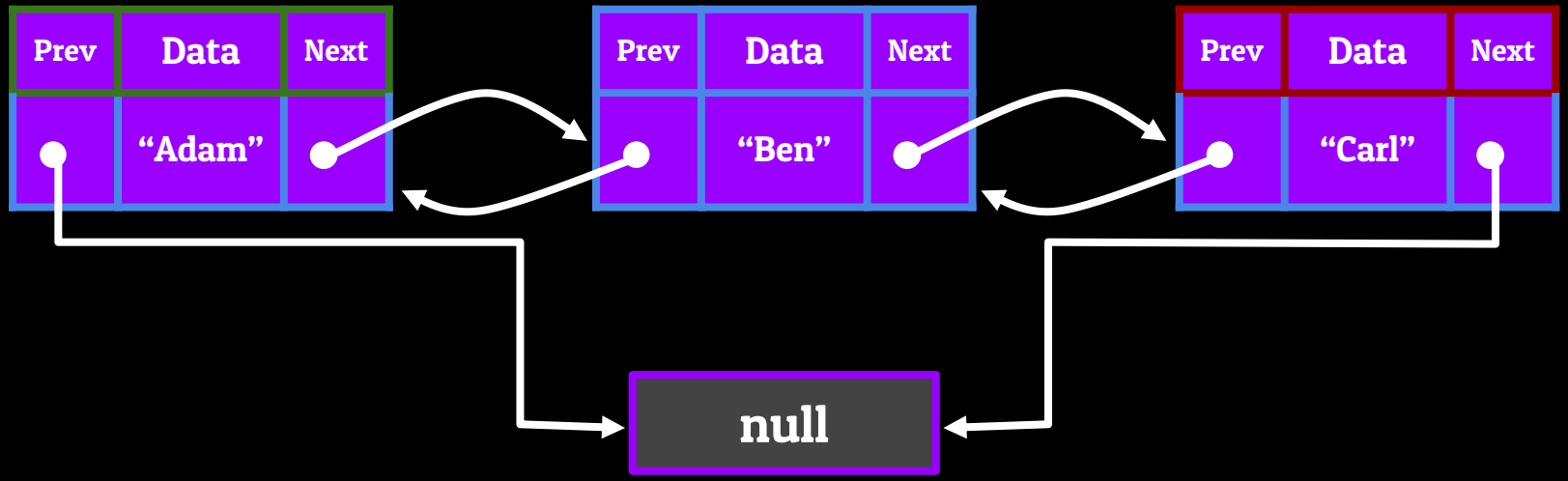
The Doubly-Linked List - Adding and Removing Information



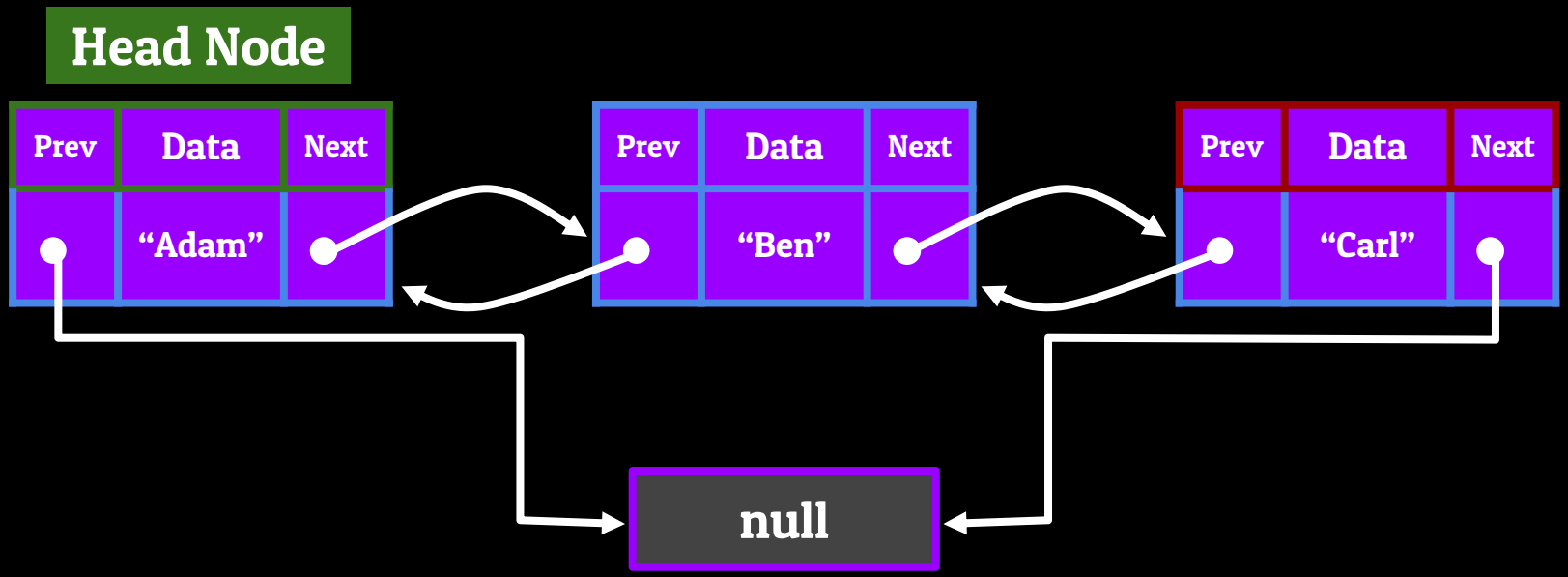
The Doubly-Linked List - Adding and Removing Information



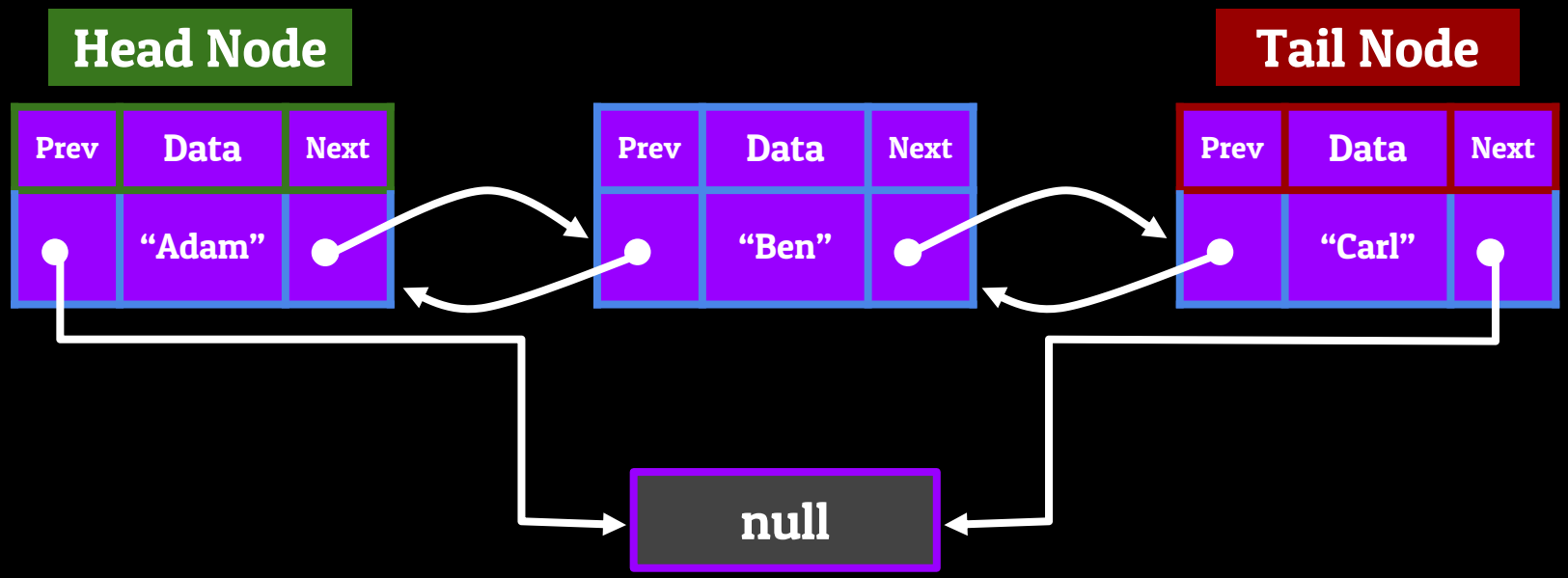
The Doubly-Linked List - Adding and Removing Information



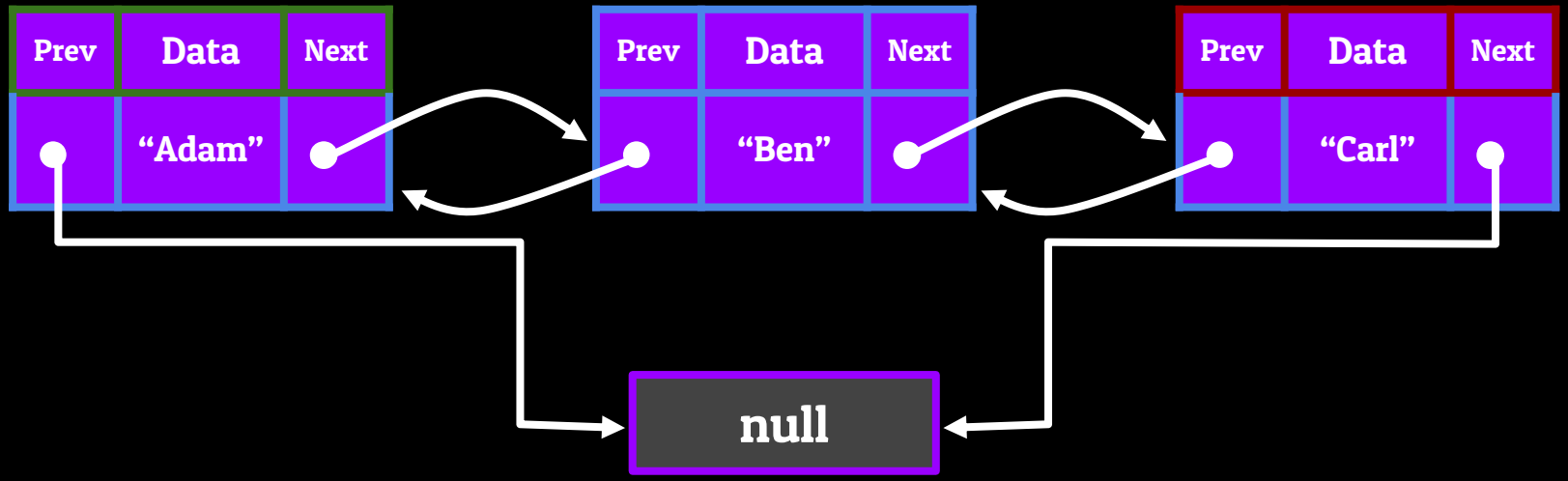
The Doubly-Linked List - Adding and Removing Information



The Doubly-Linked List - Adding and Removing Information

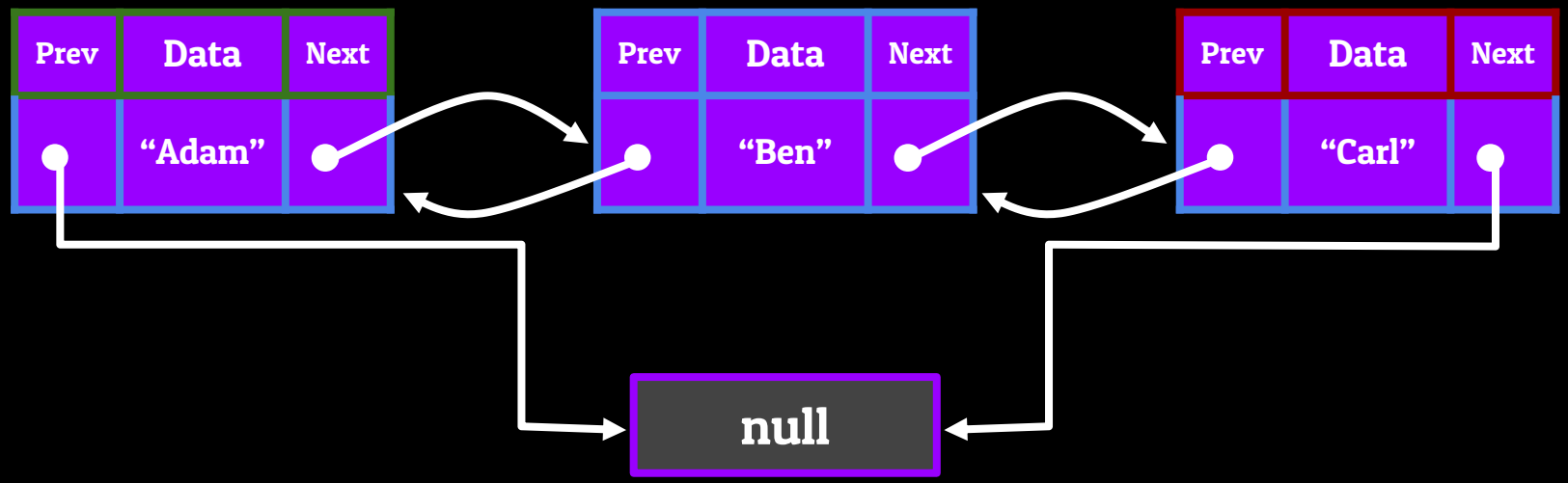


The Doubly-Linked List - Adding and Removing Information



The Doubly-Linked List - Adding and Removing Information

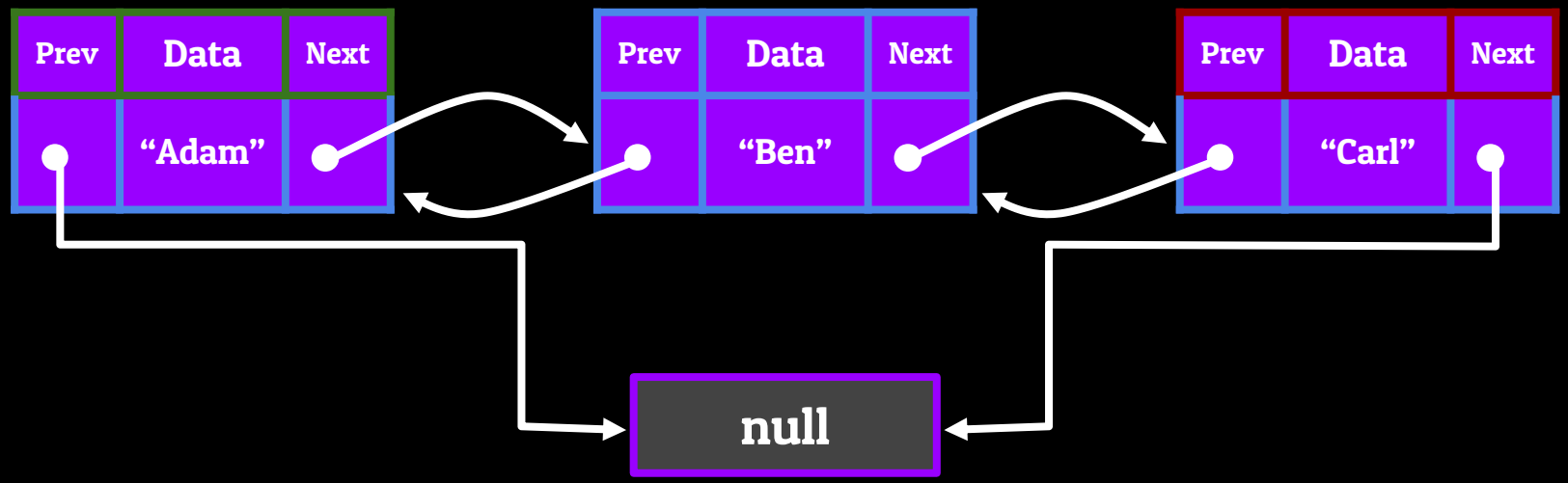
Adding to the Head of a Doubly-LinkedList



The Doubly-Linked List - Adding and Removing Information

Adding to the Head of a Doubly-LinkedList

Set the new Nodes next to point towards the current head of the List

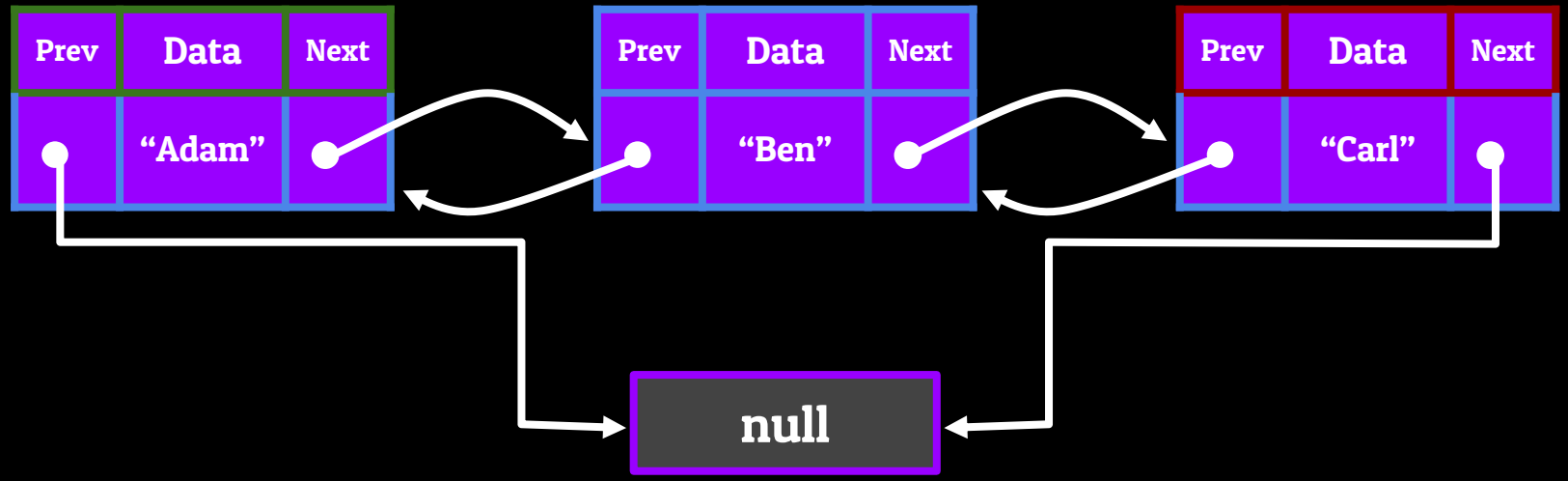


The Doubly-Linked List - Adding and Removing Information

Adding to the Head of a Doubly-LinkedList

Set the new Nodes next to point towards the current head of the List

Take the new Node that we want to insert, and set it's previous to null



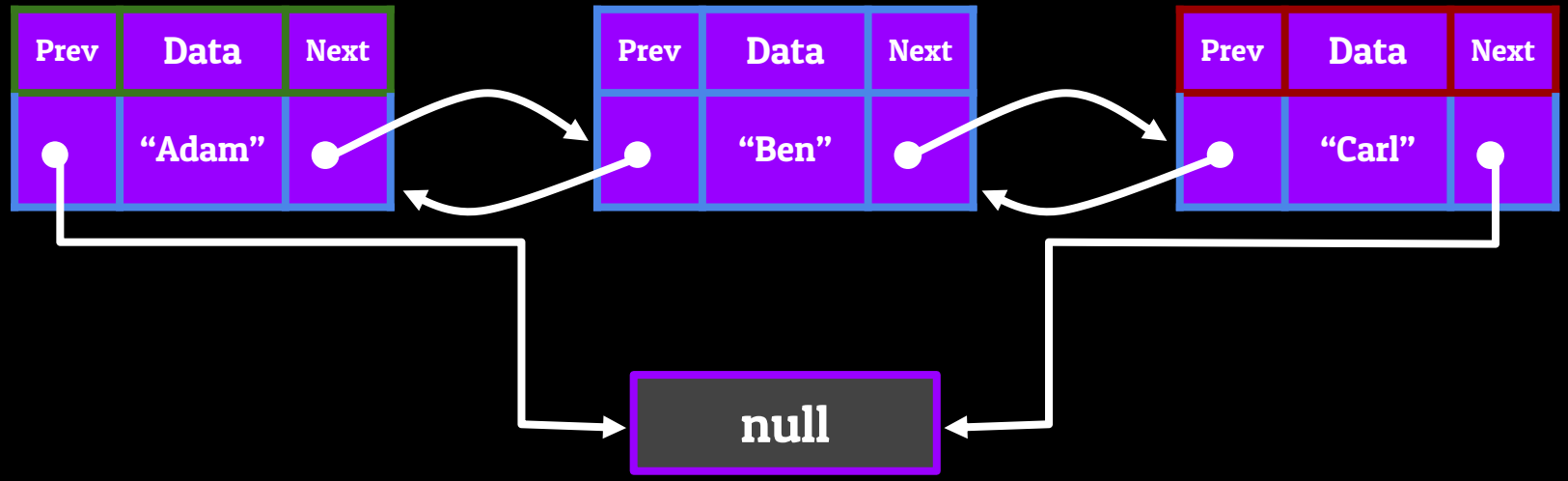
The Doubly-Linked List - Adding and Removing Information

Adding to the Head of a Doubly-LinkedList

Set the new Nodes next to point towards the current head of the List

Take the new Node that we want to insert, and set it's previous to null

Set the current head's previous to point towards this new Node



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Take the new Node that we want to insert, and set it's previous to null

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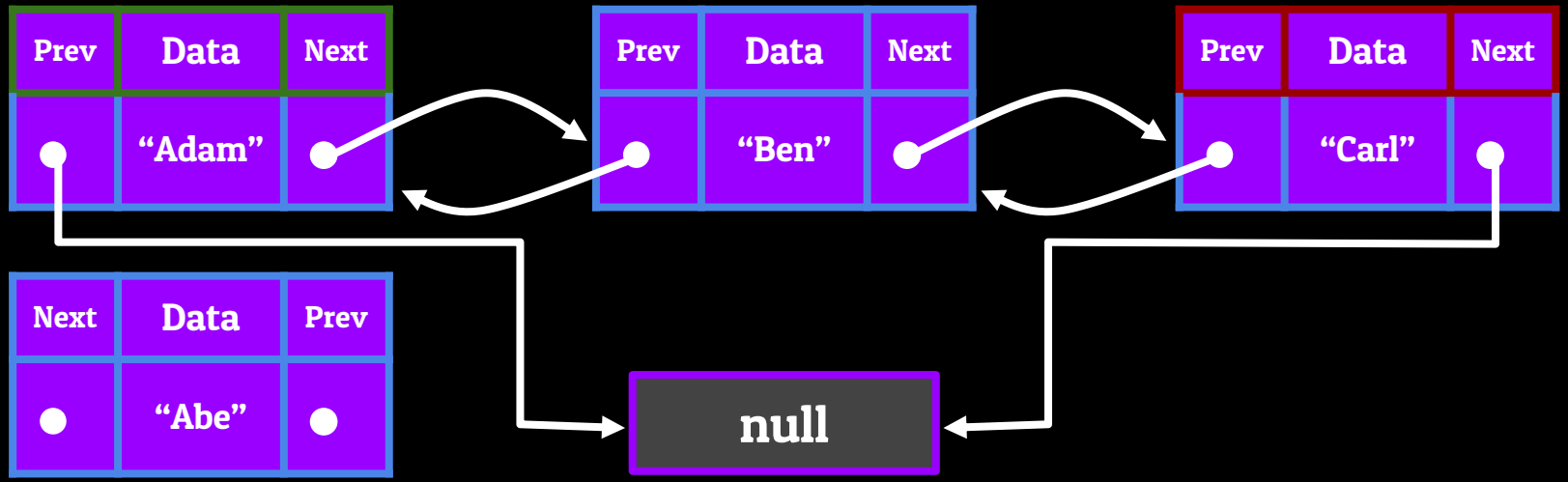

The Doubly-Linked List - Adding and Removing Information

Adding to the Head of a Doubly-LinkedList

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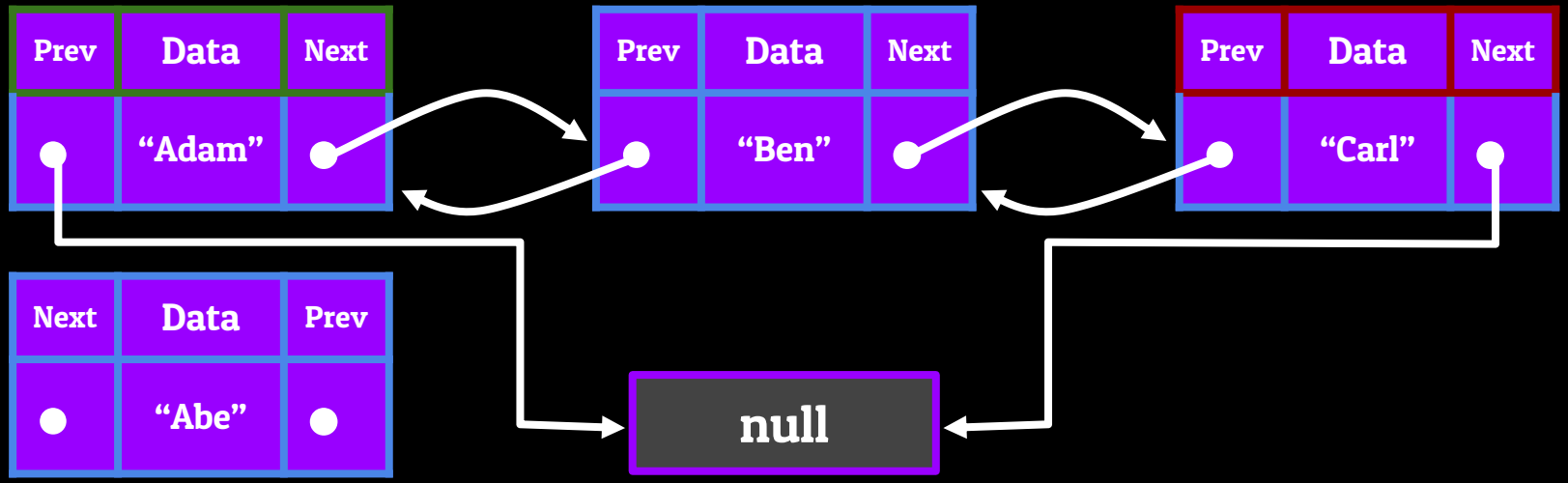
Set the current head's previous to point towards this new Node



The Doubly-Linked List - Adding and Removing Information

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Take the new Node that we want to insert, and set it's previous to null

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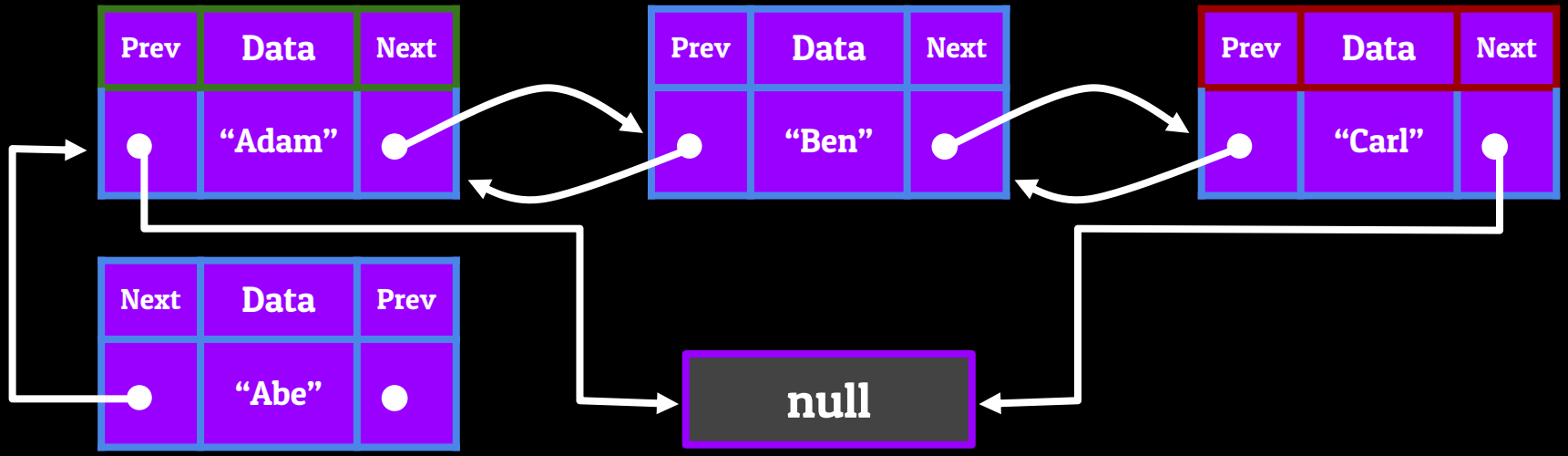

The Doubly-Linked List - Adding and Removing Information

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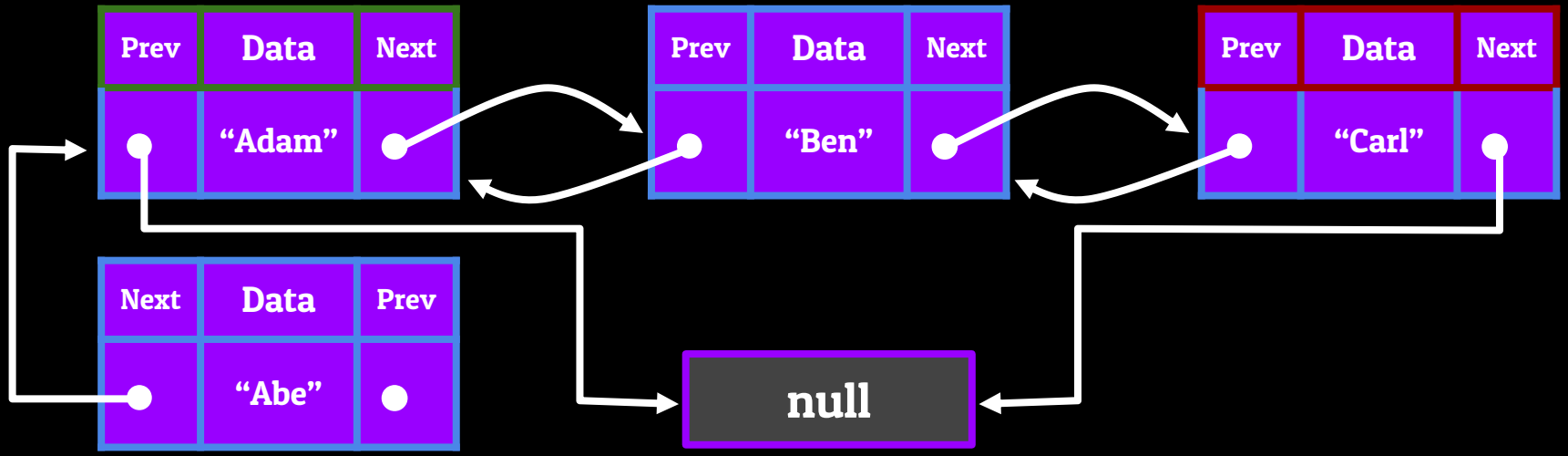

The Doubly-Linked List - Adding and Removing Information

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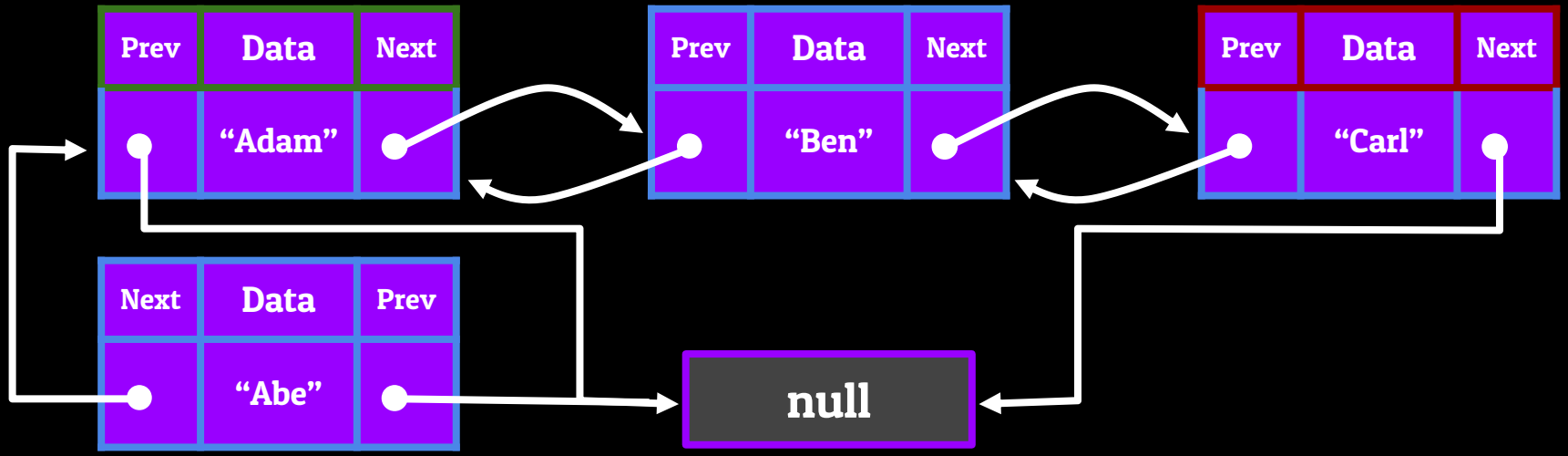

The Doubly-Linked List - Adding and Removing Information

Adding to the Head of a Doubly-LinkedList

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Take the new Node that we want to insert, and set it's previous to null

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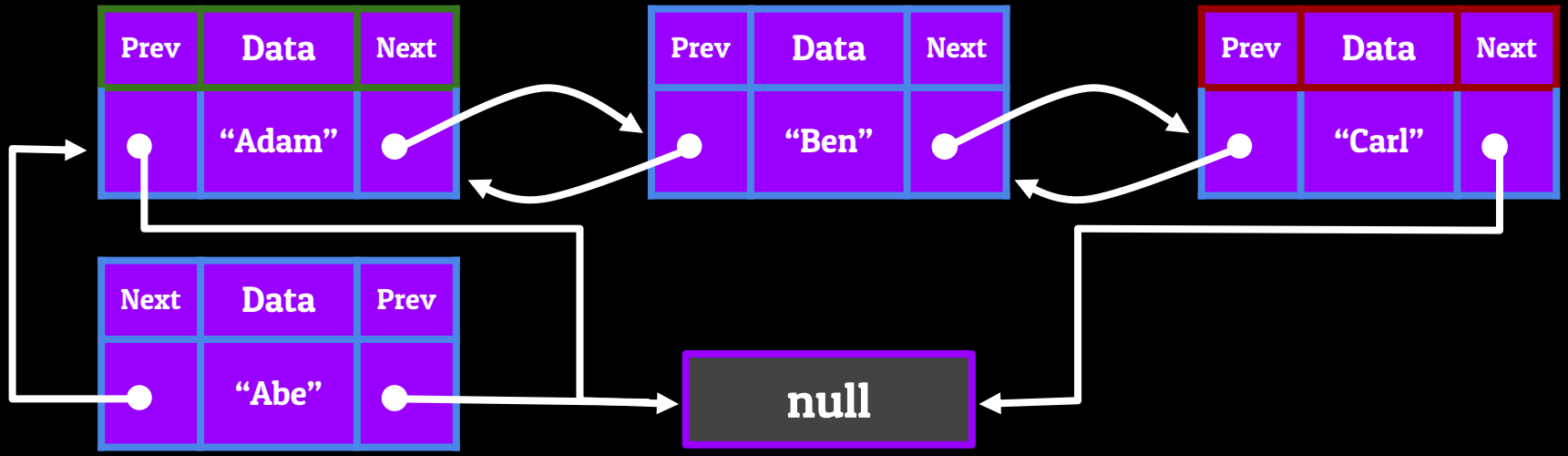

The Doubly-Linked List - Adding and Removing Information

Adding to the Head of a Doubly-LinkedList

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Take the new Node that we want to insert, and set it's previous to null

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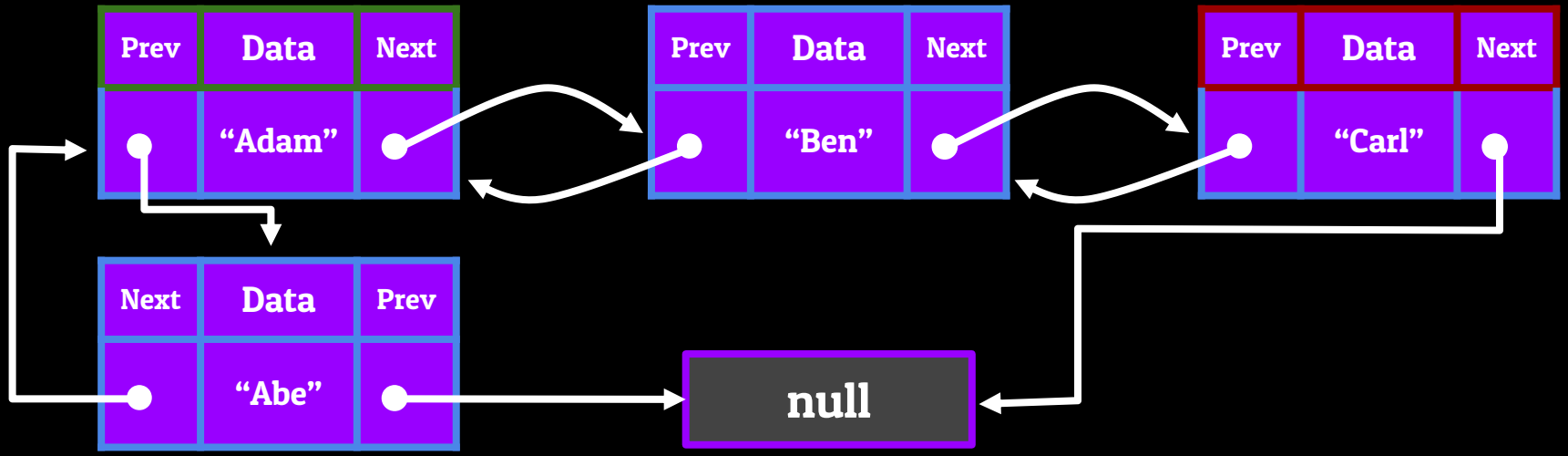

The Doubly-Linked List - Adding and Removing Information

Adding to the Head of a Doubly-LinkedList

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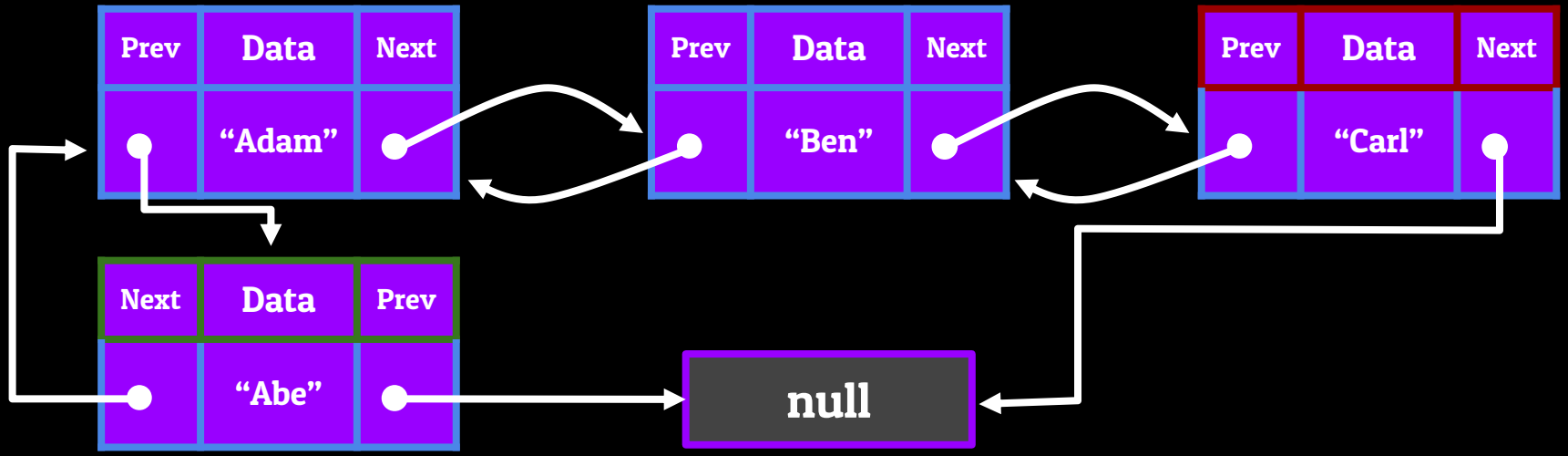
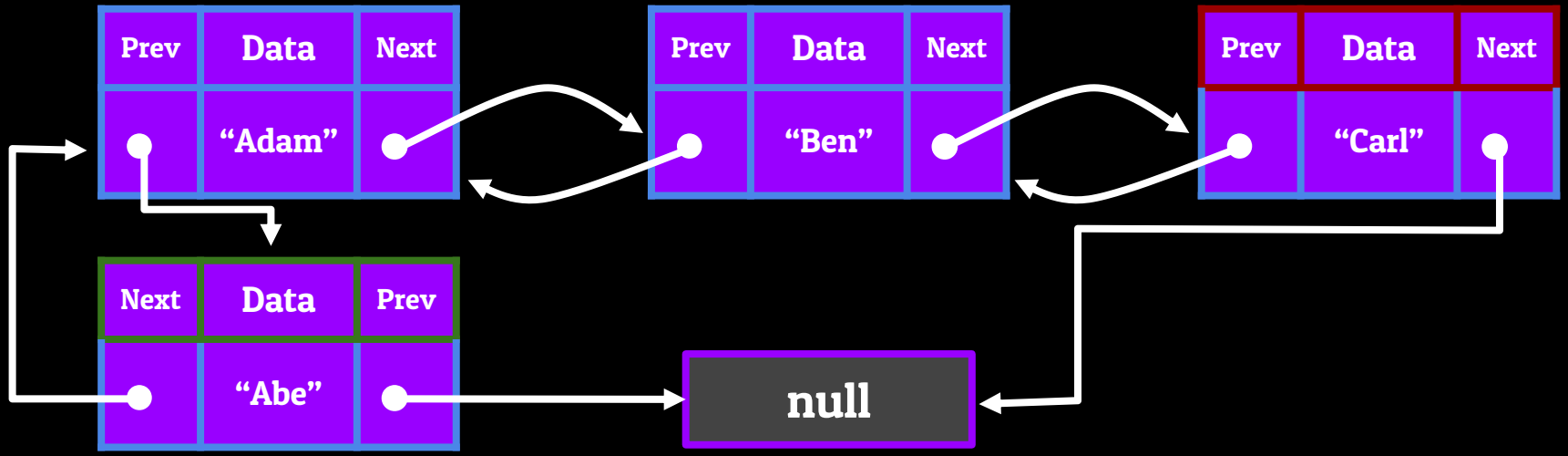
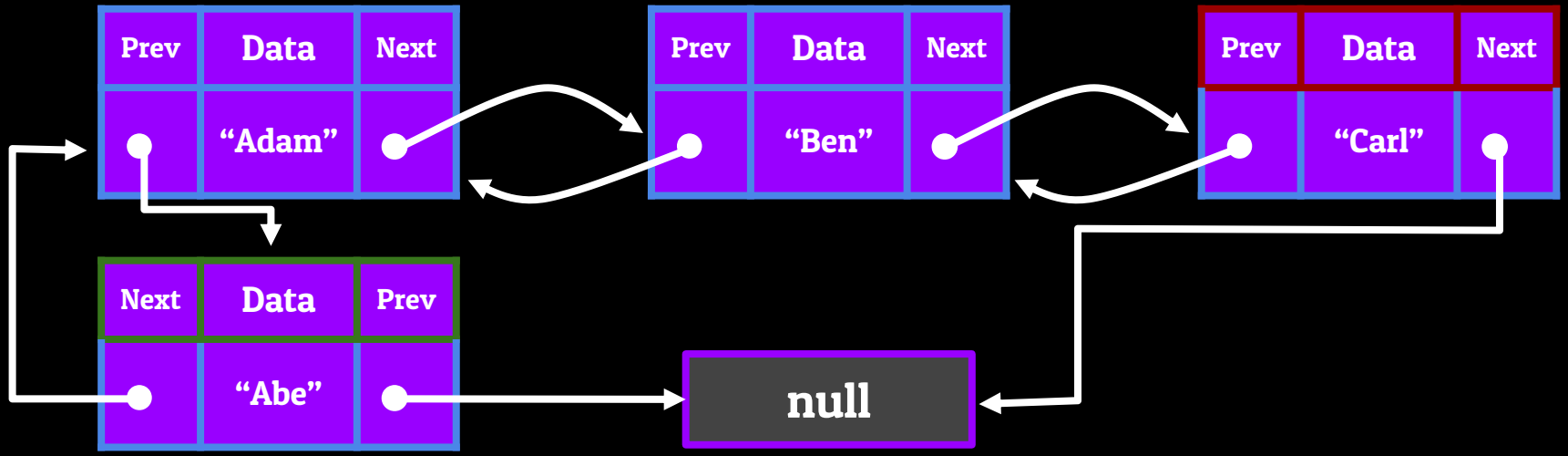


The Doubly-Linked List - Adding and Removing Information



The Doubly-Linked List - Adding and Removing Information

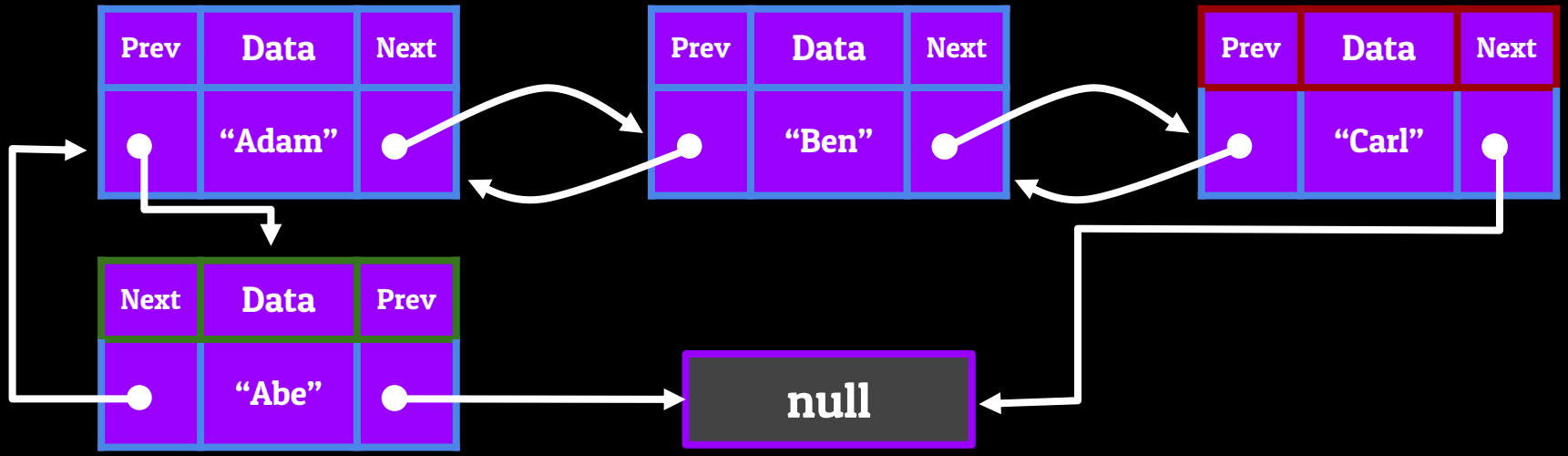
Removing from the Head of a Doubly-LinkedList



The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

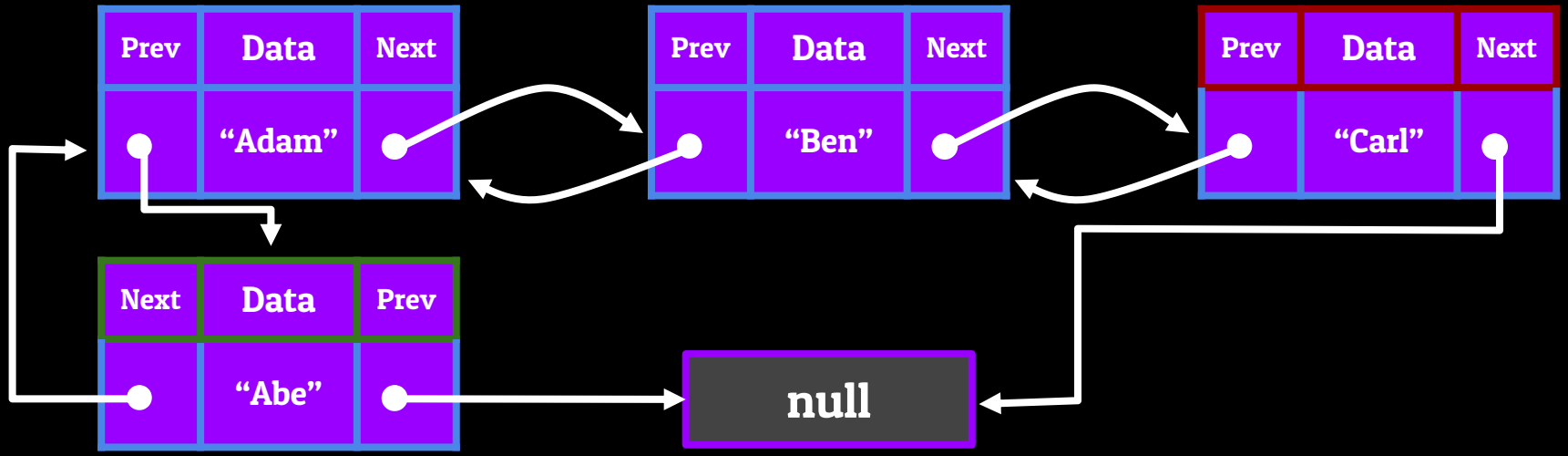


The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

Set the second Node's previous to also point towards a null value

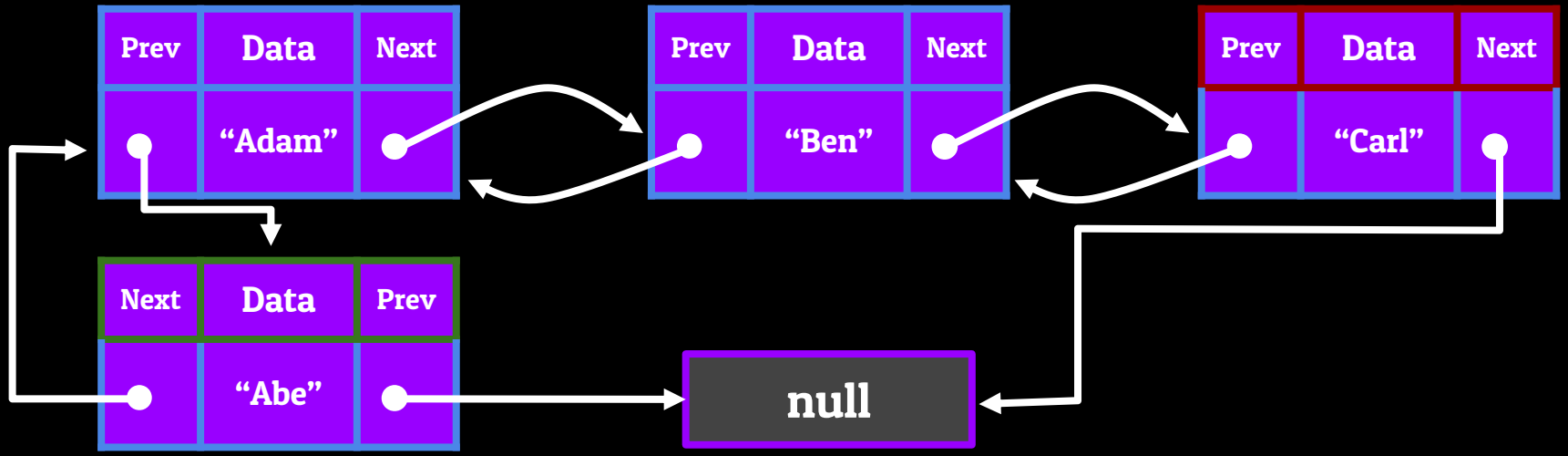


The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

Set the second Node's previous to also point towards a null value



The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

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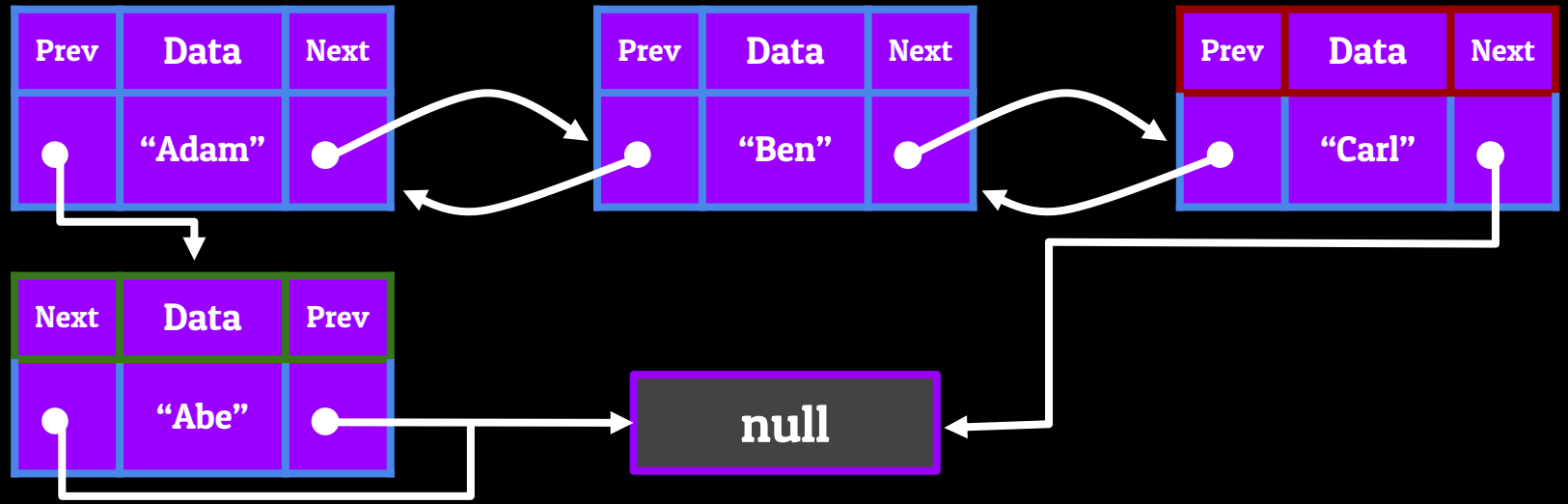
Set the second Node's previous to also point towards a null value



The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

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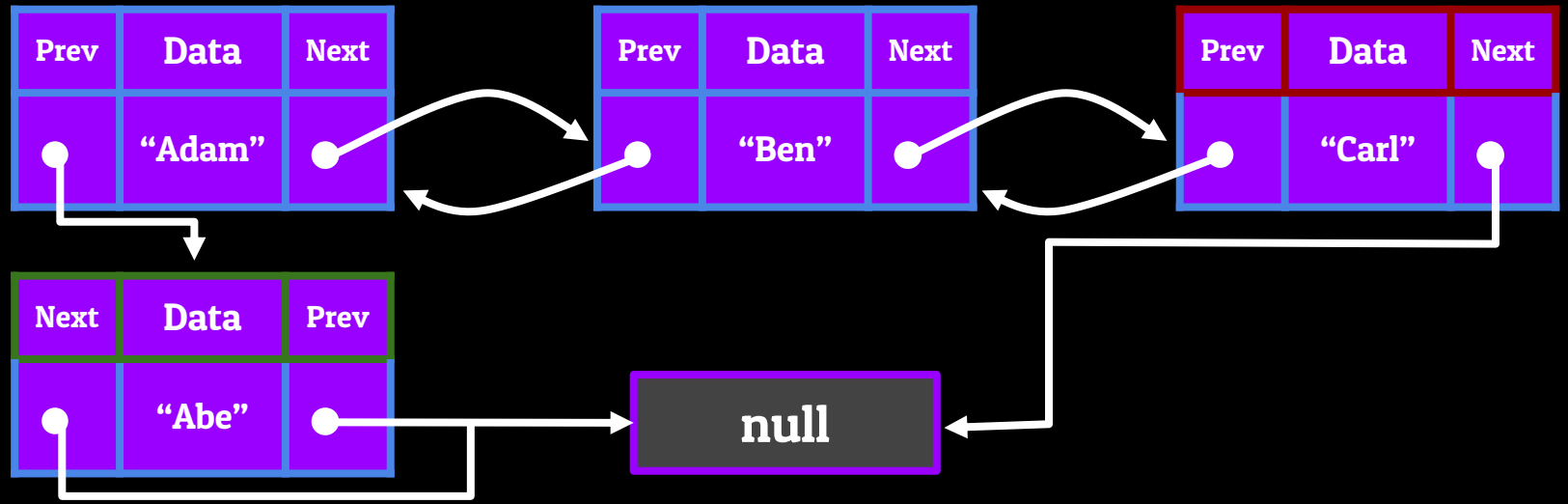
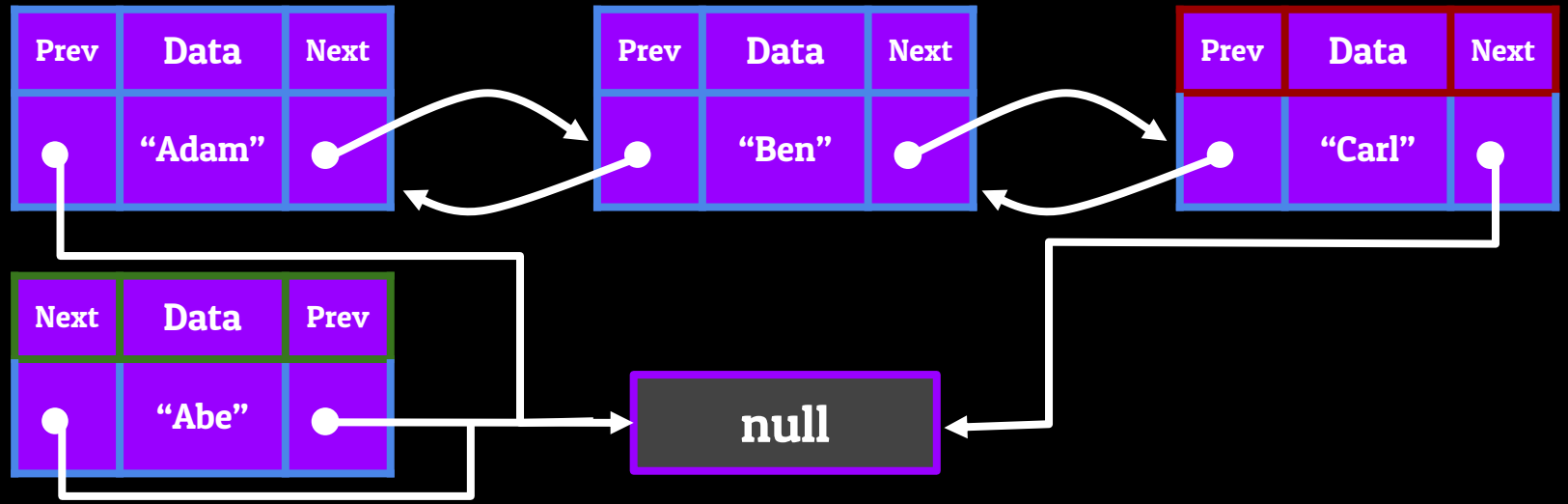


The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

Set the second Node's previous to also point towards a null value

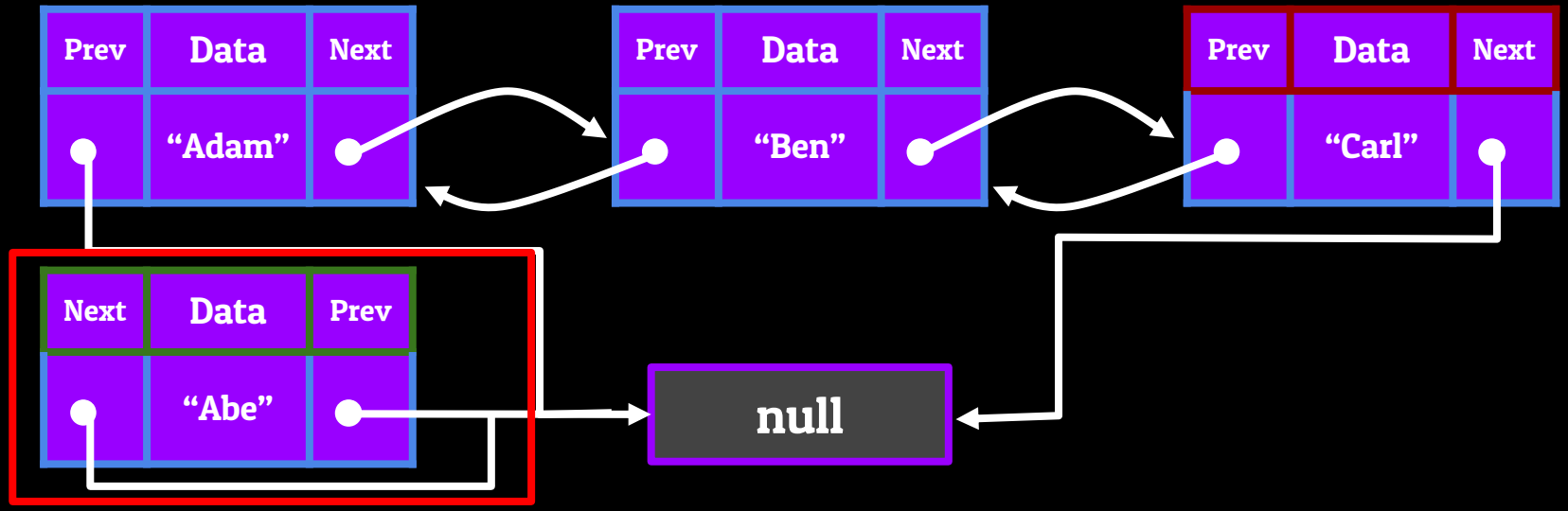


The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

Set the second Node's previous to also point towards a null value

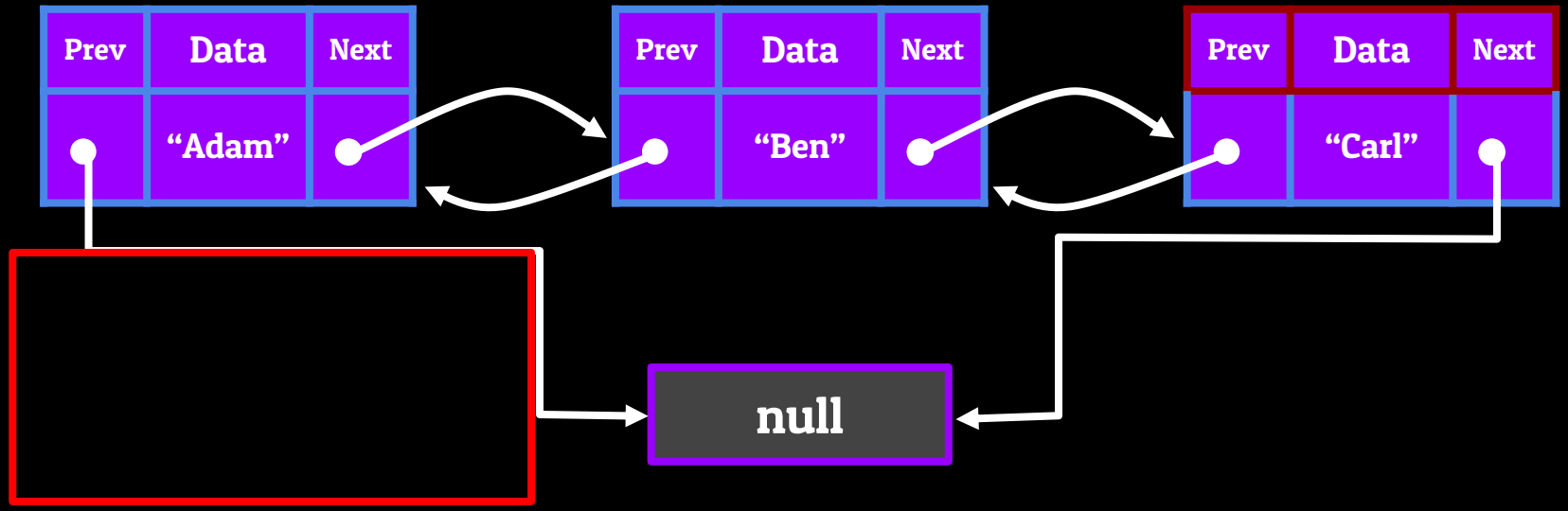


The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

Set the second Node's previous to also point towards a null value

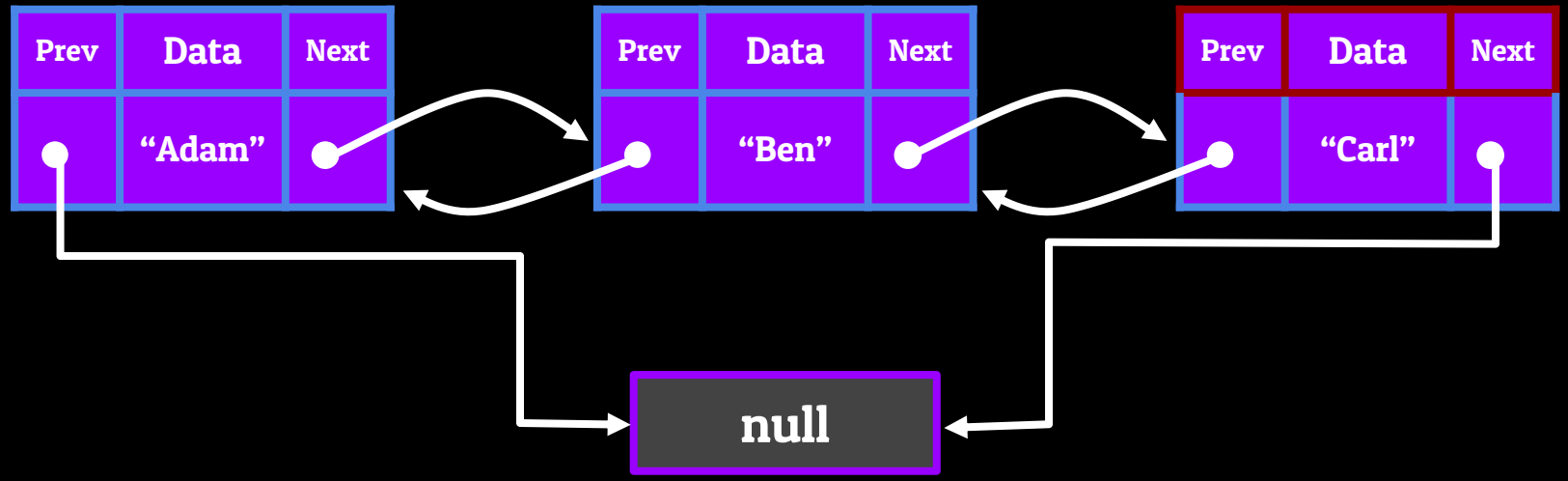


The Doubly-Linked List - Adding and Removing Information

Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

Set the second Node's previous to also point towards a null value

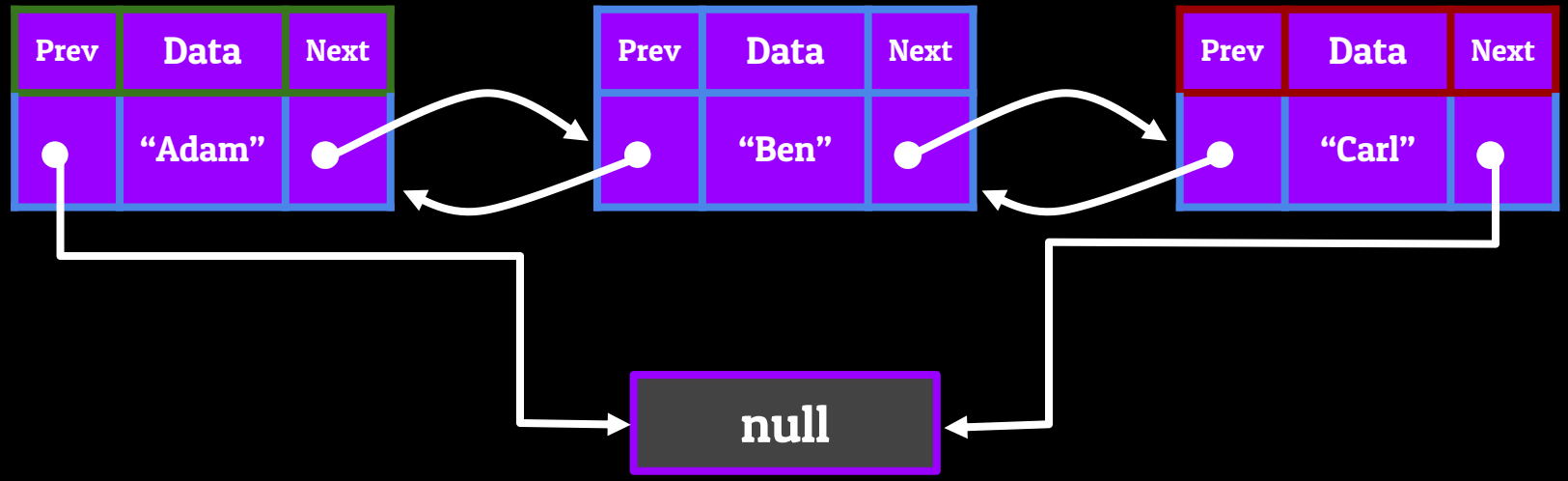


The Doubly-Linked List - Adding and Removing Information

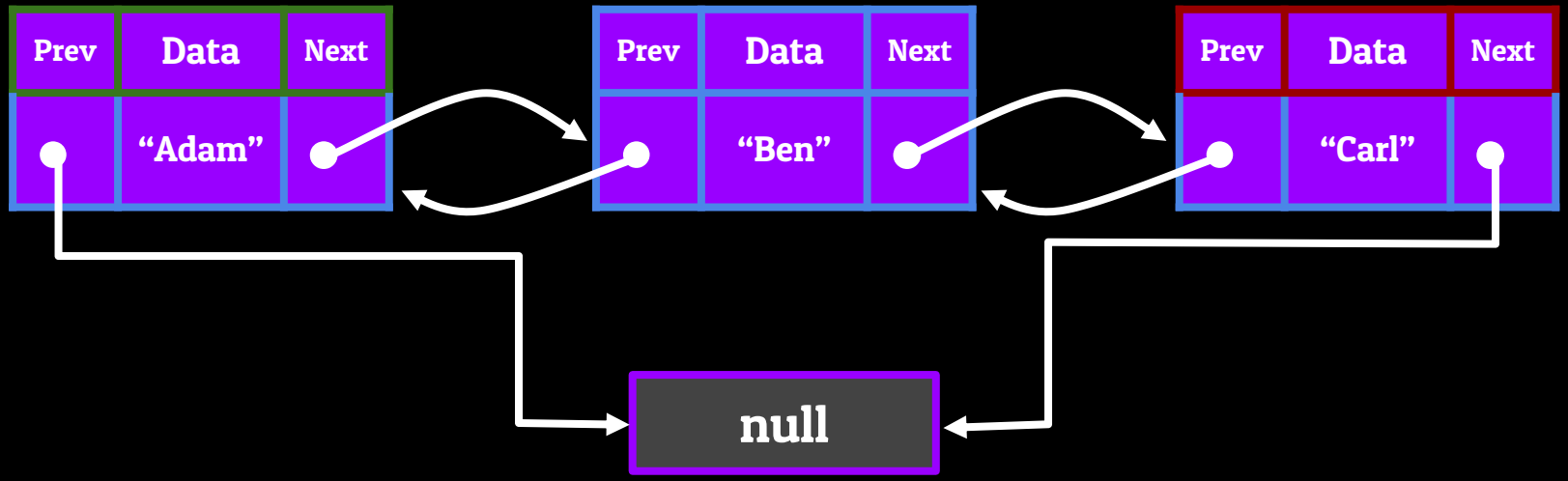
Removing from the Head of a Doubly-LinkedList

Set the head Node's next to point towards a null value

Set the second Node's previous to also point towards a null value

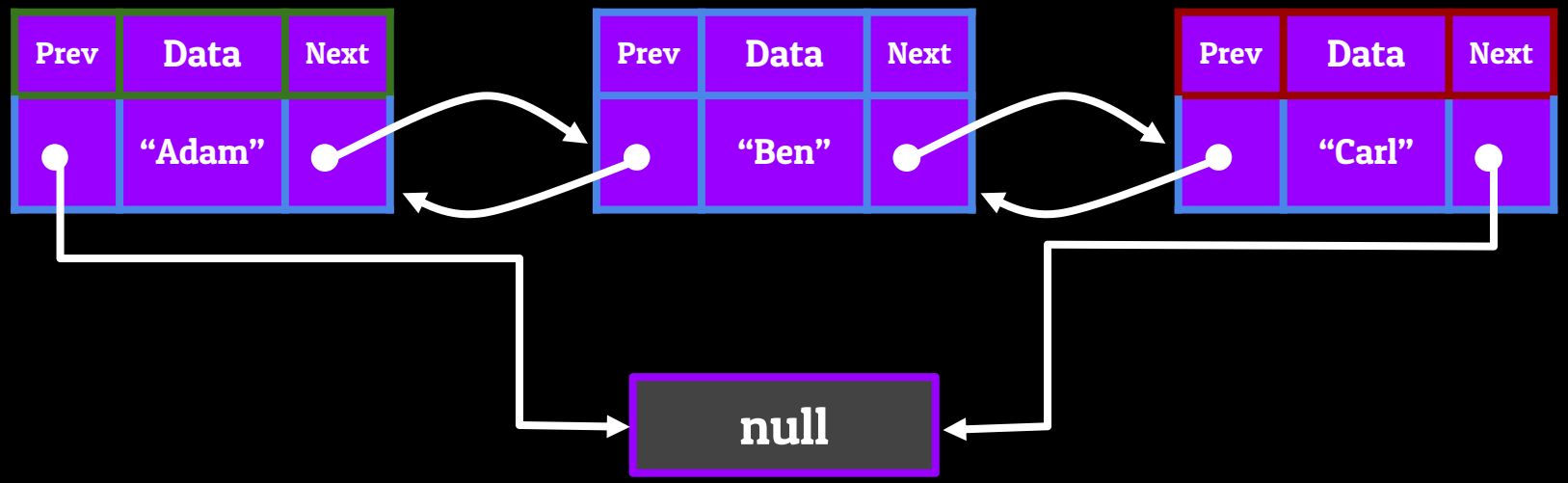


The Doubly-Linked List - Adding and Removing Information



The Doubly-Linked List - Adding and Removing Information

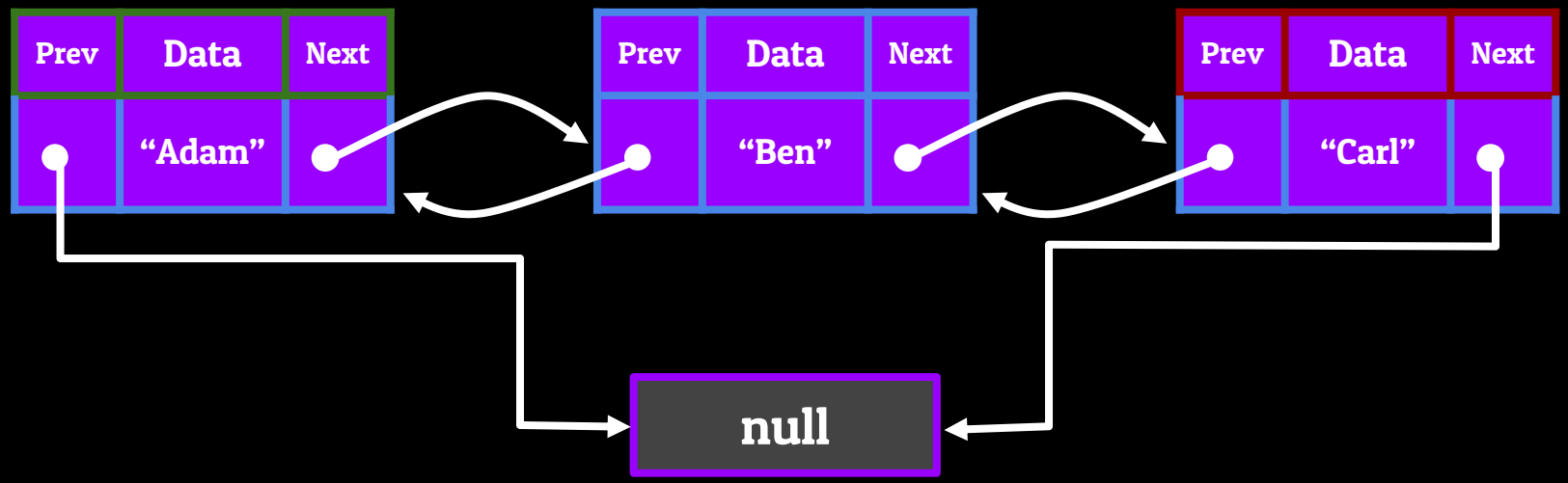
Inserting into the Middle of a Doubly-LinkedList



The Doubly-Linked List - Adding and Removing Information

Inserting into the Middle of a Doubly-LinkedList

Set the new Node's previous to point towards the Node previous to the position you want to insert at

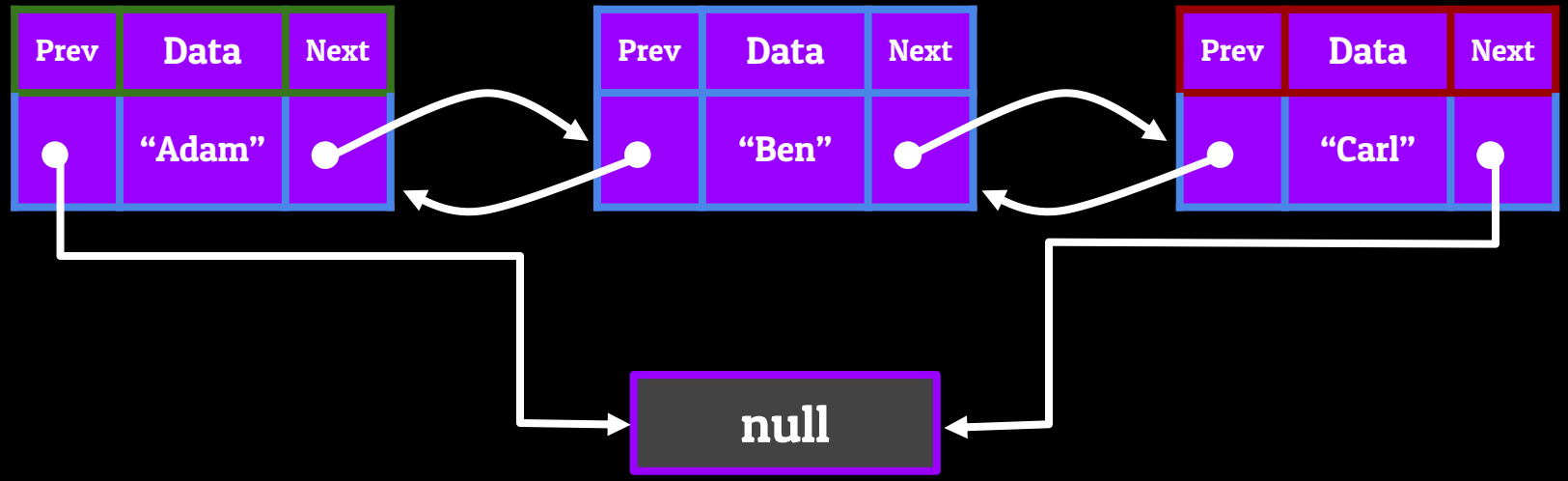


The Doubly-Linked List - Adding and Removing Information

Inserting into the Middle of a Doubly-LinkedList

Set the new Node's previous to point towards the Node previous to the position you want to insert at

Set the new Node's next to point towards the Node after the position you want to insert at



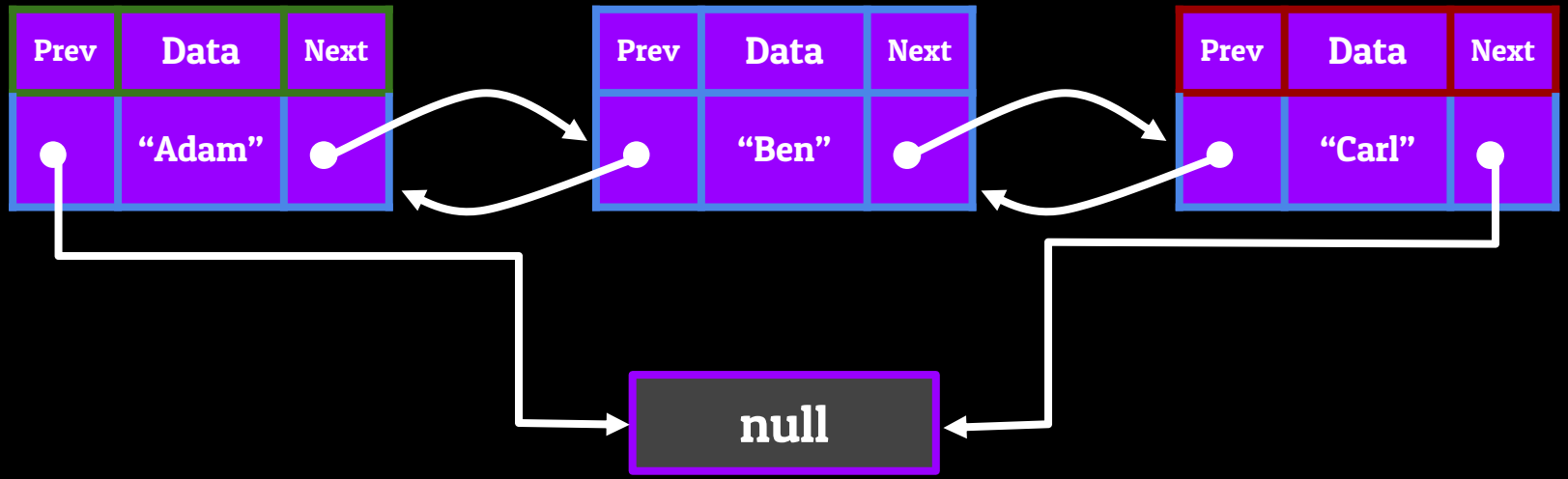
The Doubly-Linked List - Adding and Removing Information

Inserting into the Middle of a Doubly-LinkedList

Set the new Node's previous to point towards the Node previous to the position you want to insert at

Set the new Node's next to point towards the Node after the position you want to insert at

Set the next and previous on the Node's before and after the one you're inserting to point towards the new Node



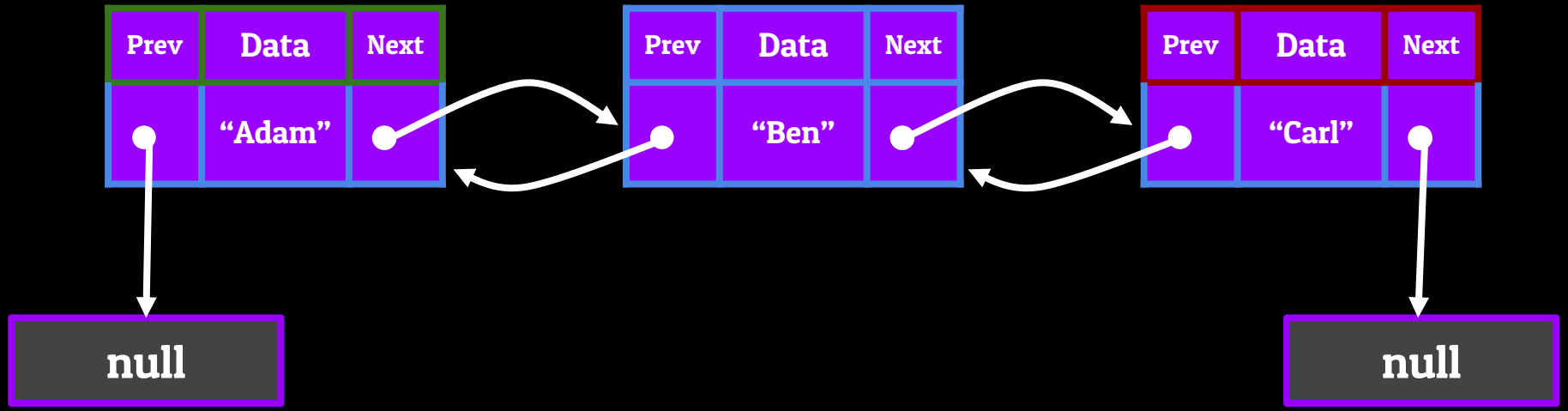
The Doubly-Linked List - Adding and Removing Information

Inserting into the Middle of a Doubly-LinkedList

Set the new Node's previous to point towards the Node previous to the position you want to insert at

Set the new Node's next to point towards the Node after the position you want to insert at

Set the next and previous on the Node's before and after the one you're inserting to point towards the new Node



The Doubly-Linked List - Adding and Removing Information

Inserting into the Middle of a Doubly-LinkedList

Set the new Node's previous to point towards the Node previous to the position you want to insert at

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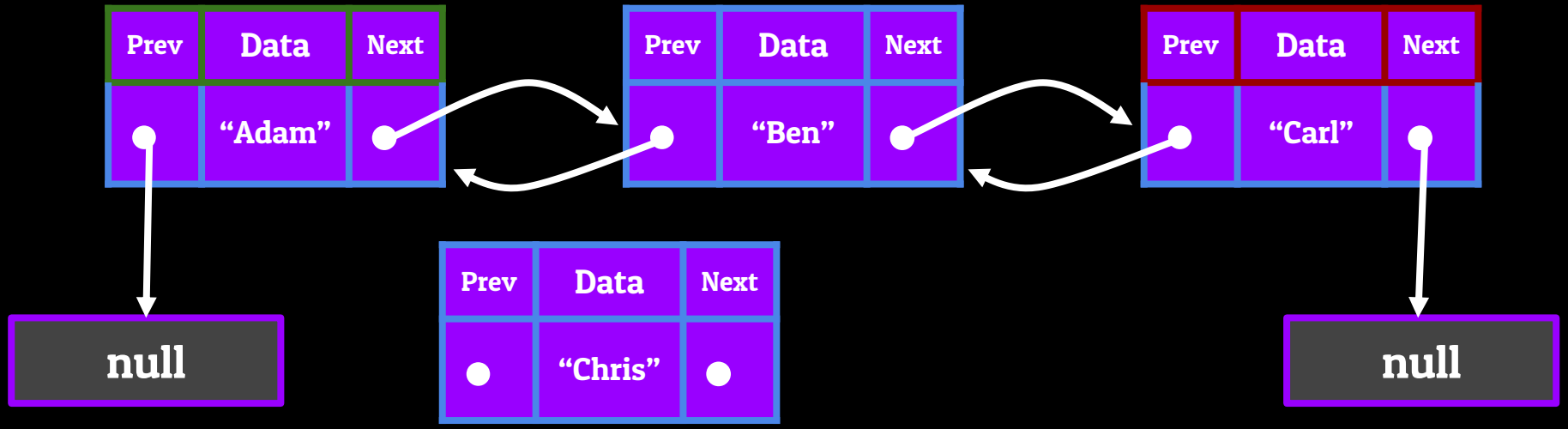

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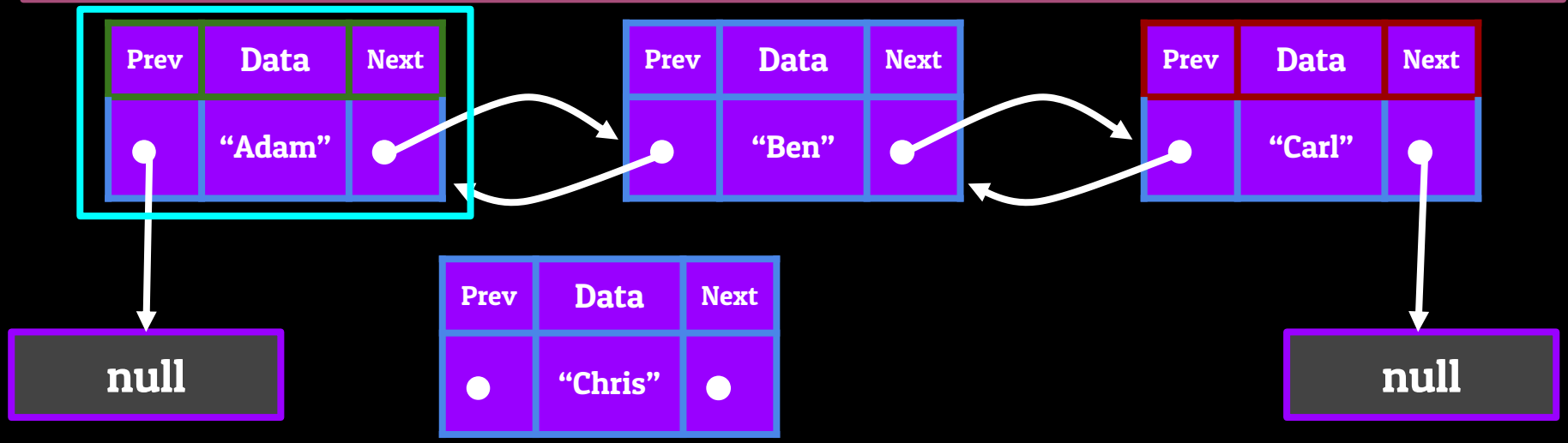
Set the new Node's next to point towards the Node after the position you want to insert at

Set the next and previous on the Node's before and after the one you're inserting to point towards the new Node



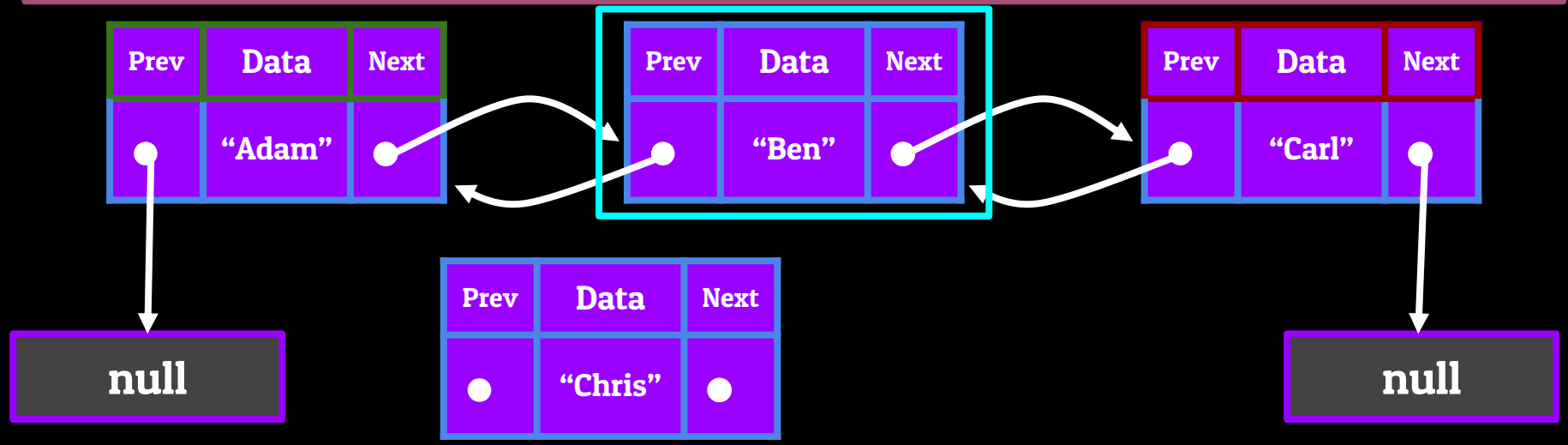
The Doubly-Linked List - Adding and Removing Information

Inserting into the Middle of a Doubly-LinkedList

Set the new Node's previous to point towards the Node previous to the position you want to insert at

Set the new Node's next to point towards the Node after the position you want to insert at

Set the next and previous on the Node's before and after the one you're inserting to point towards the new Node



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Inserting into the Middle of a Doubly-LinkedList

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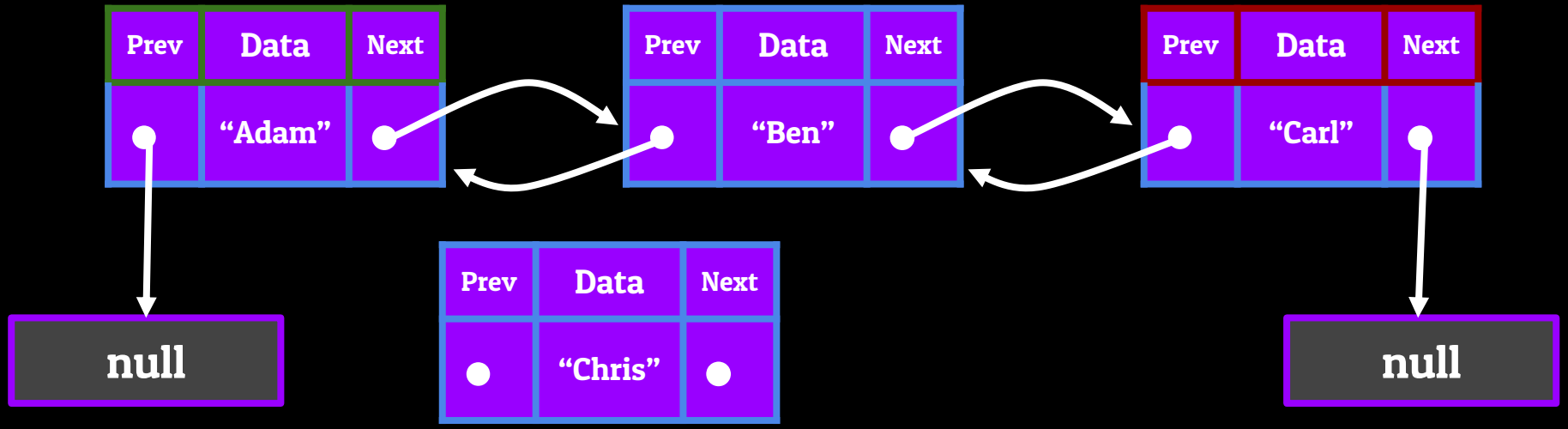

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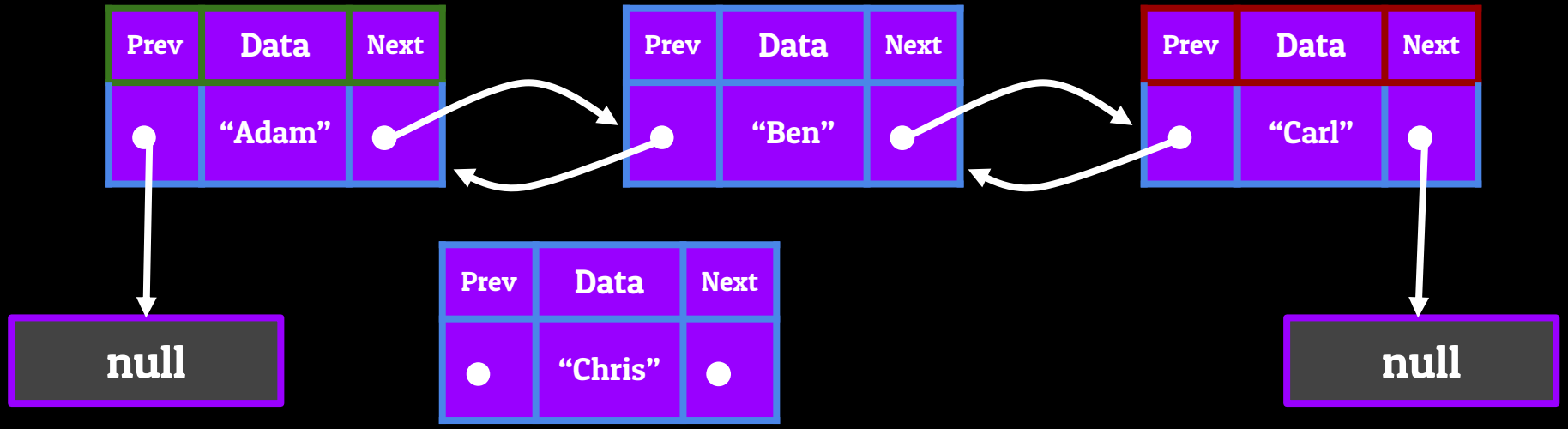

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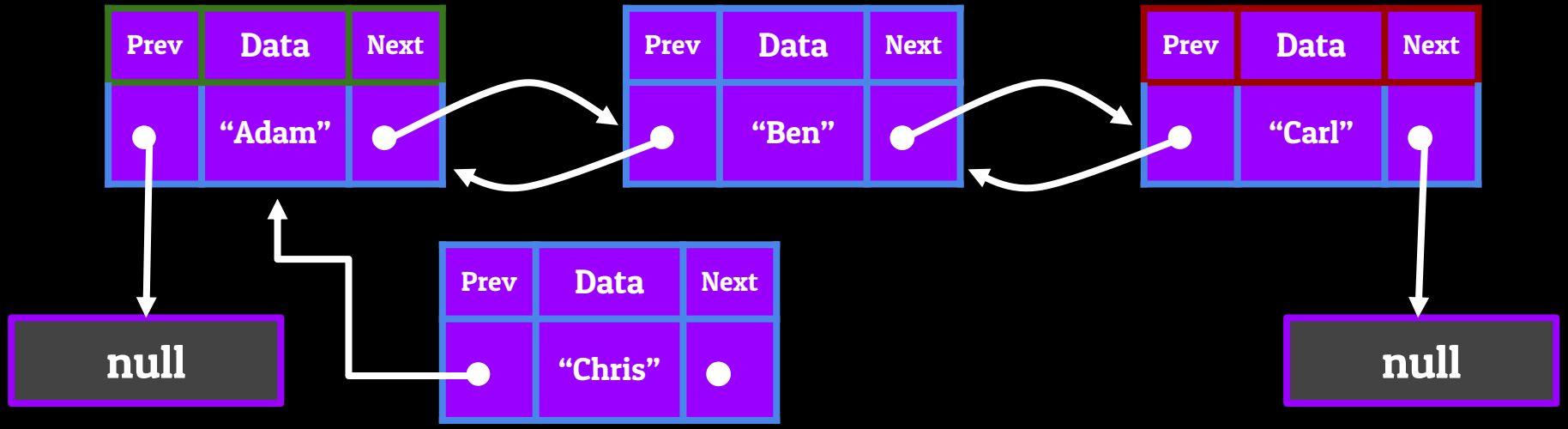

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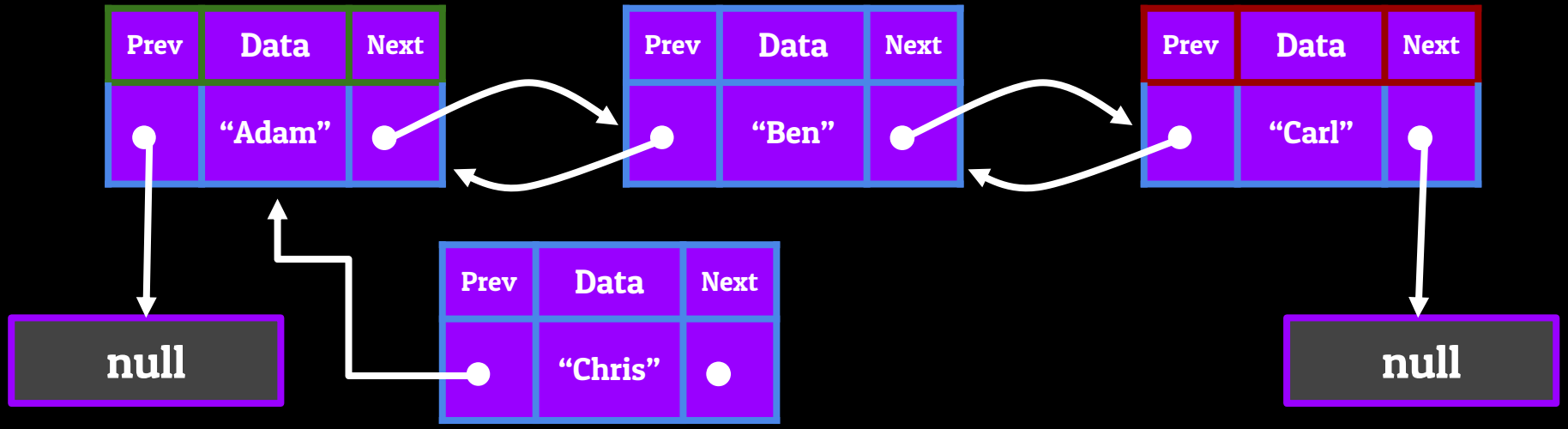

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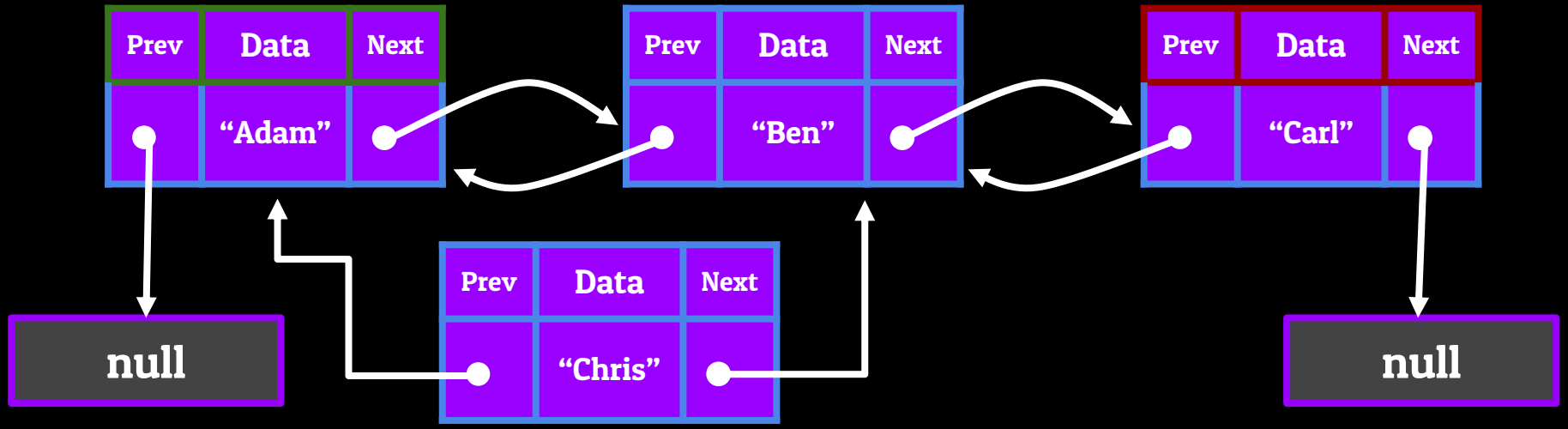

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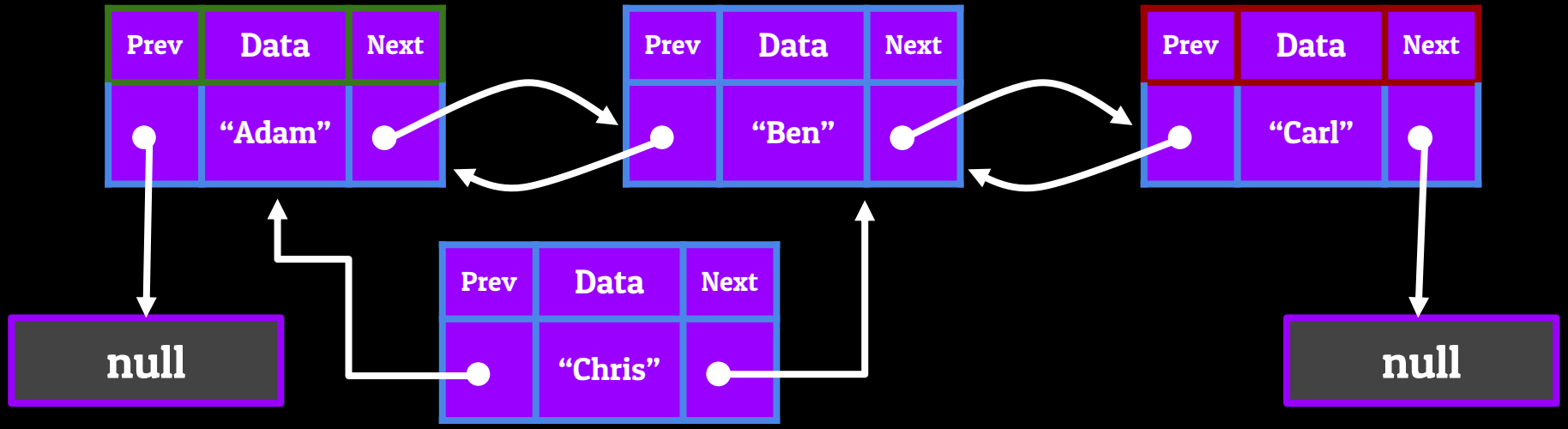

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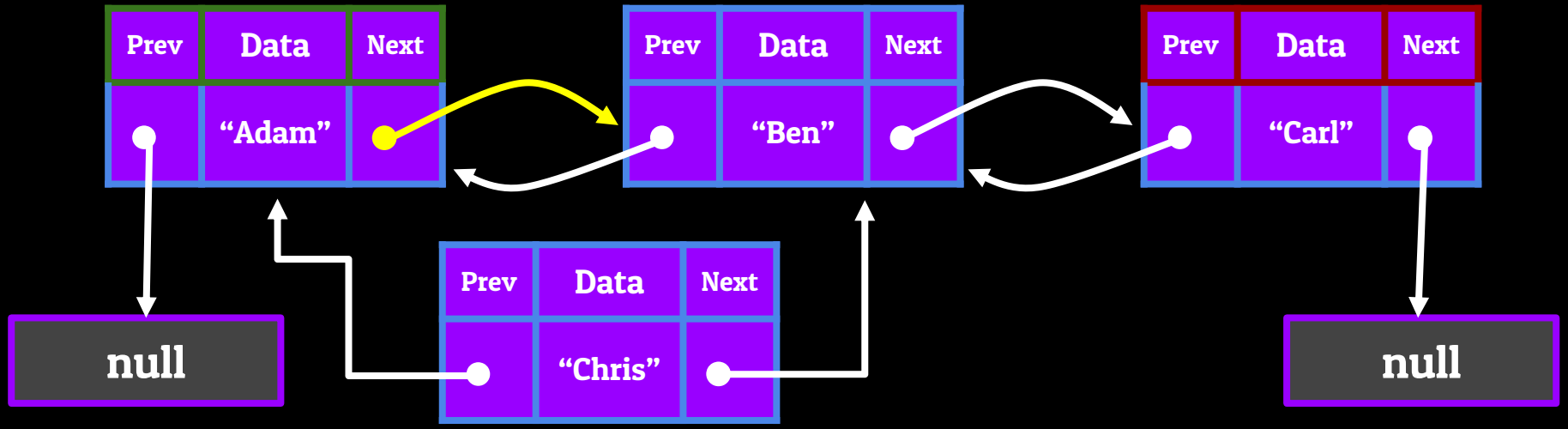

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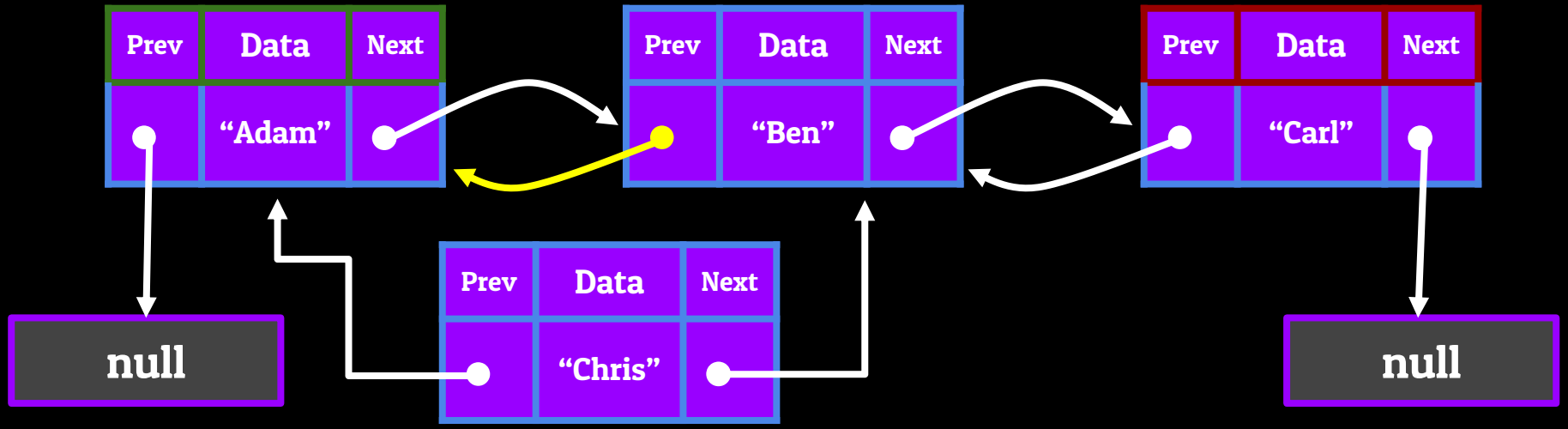

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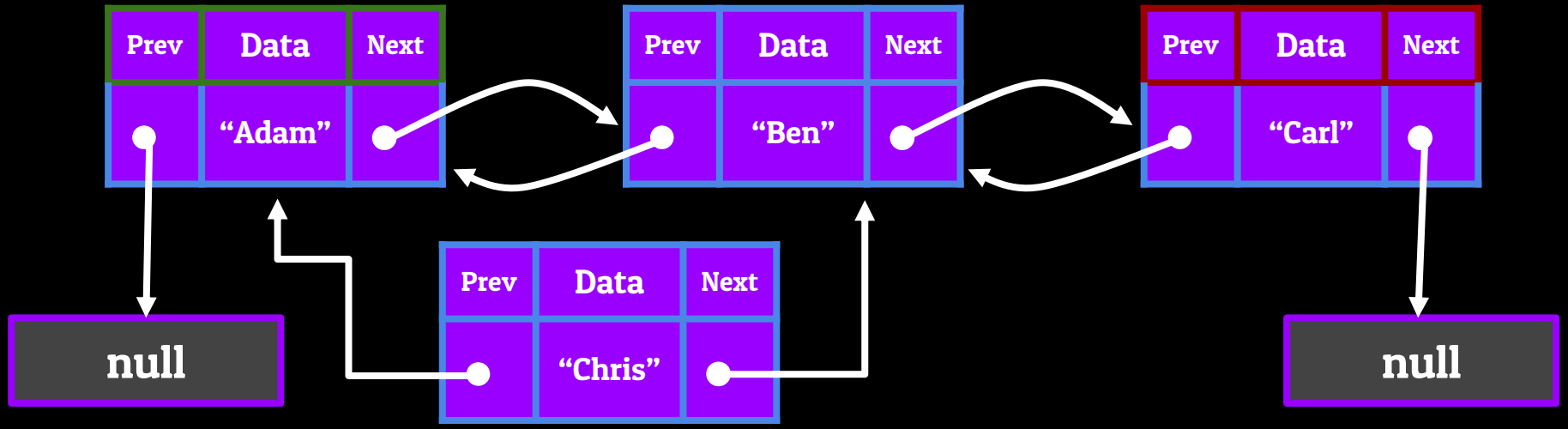

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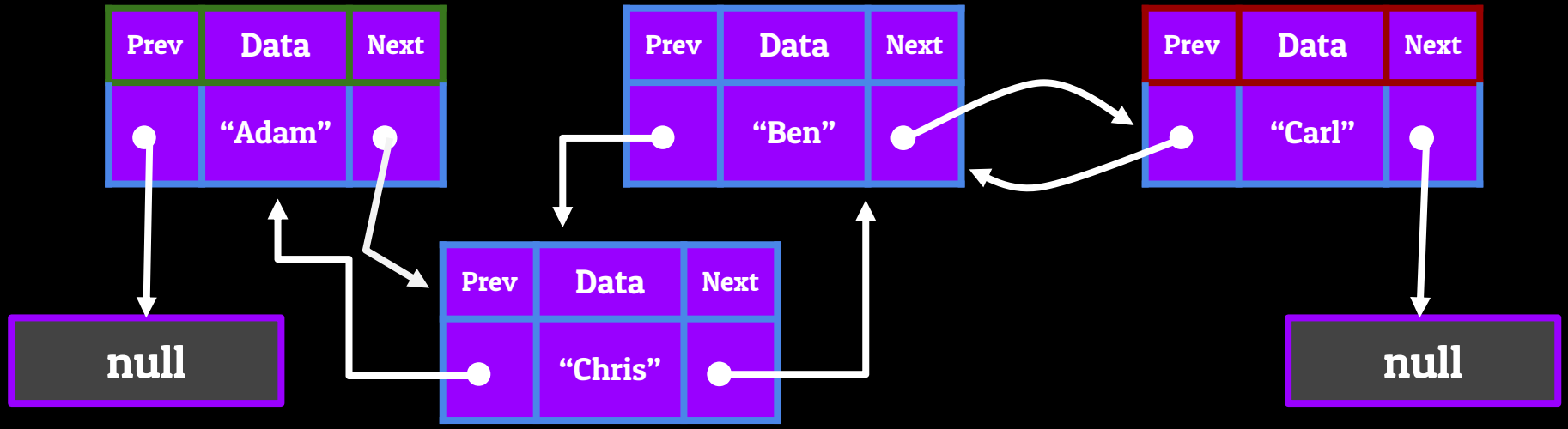

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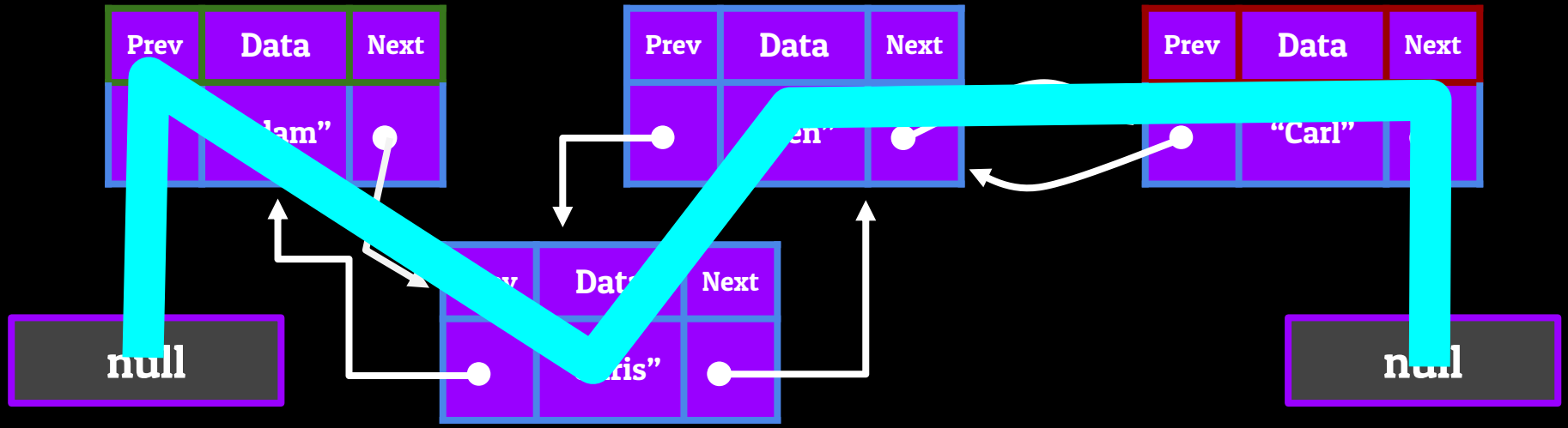

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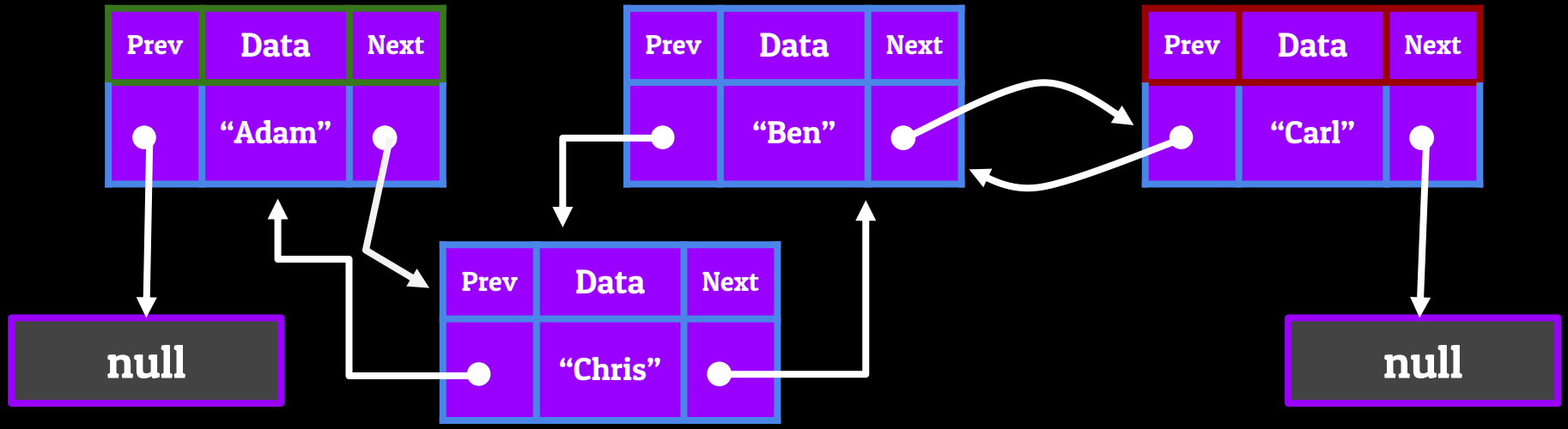

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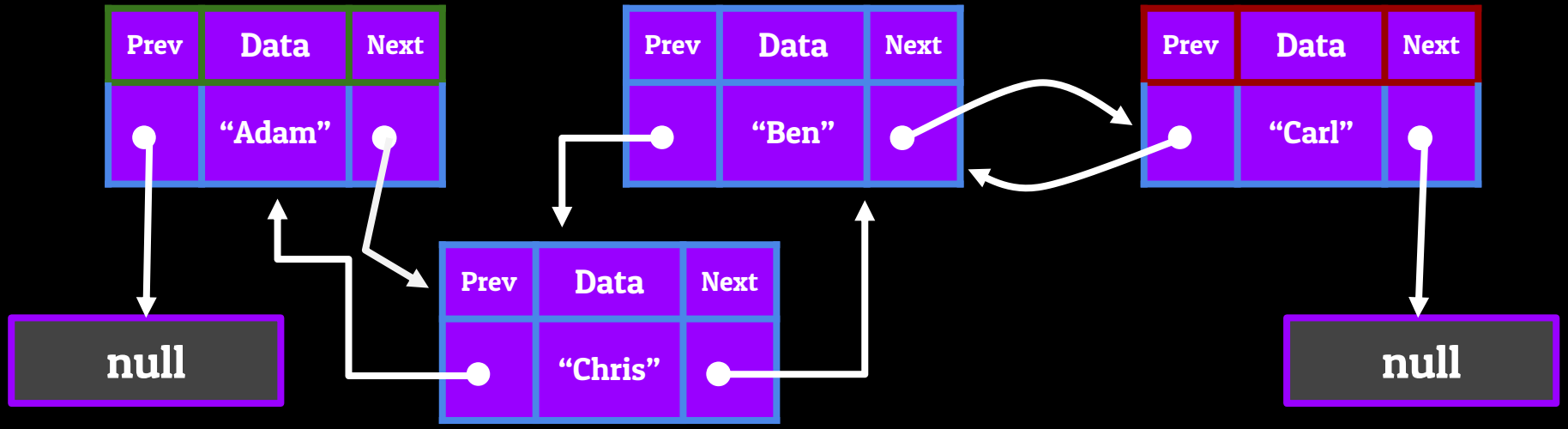
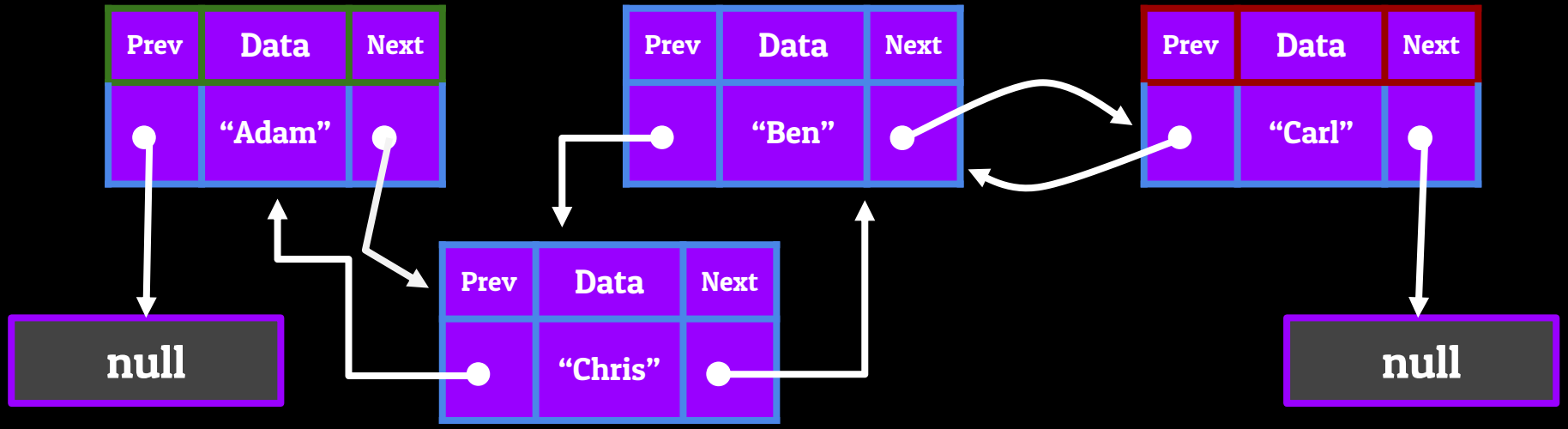


The Doubly-Linked List - Adding and Removing Information

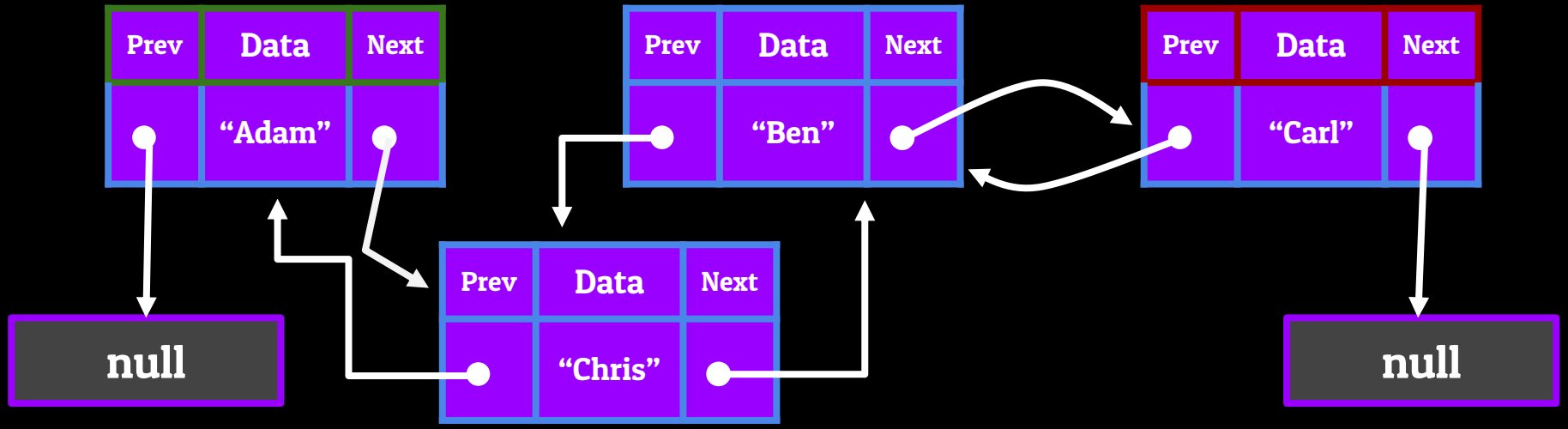
Removing from the Middle of a Doubly-LinkedList



The Doubly-Linked List - Adding and Removing Information

Removing from the Middle of a Doubly-LinkedList

Set the Node before the one we want to remove's next to point towards the Node after the one we want to remove



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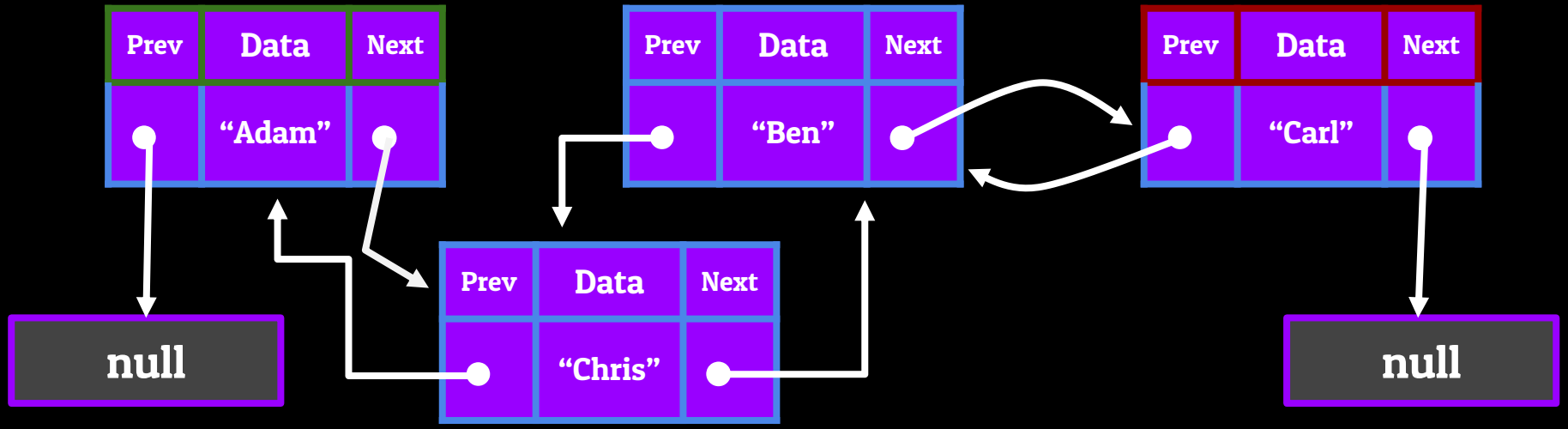


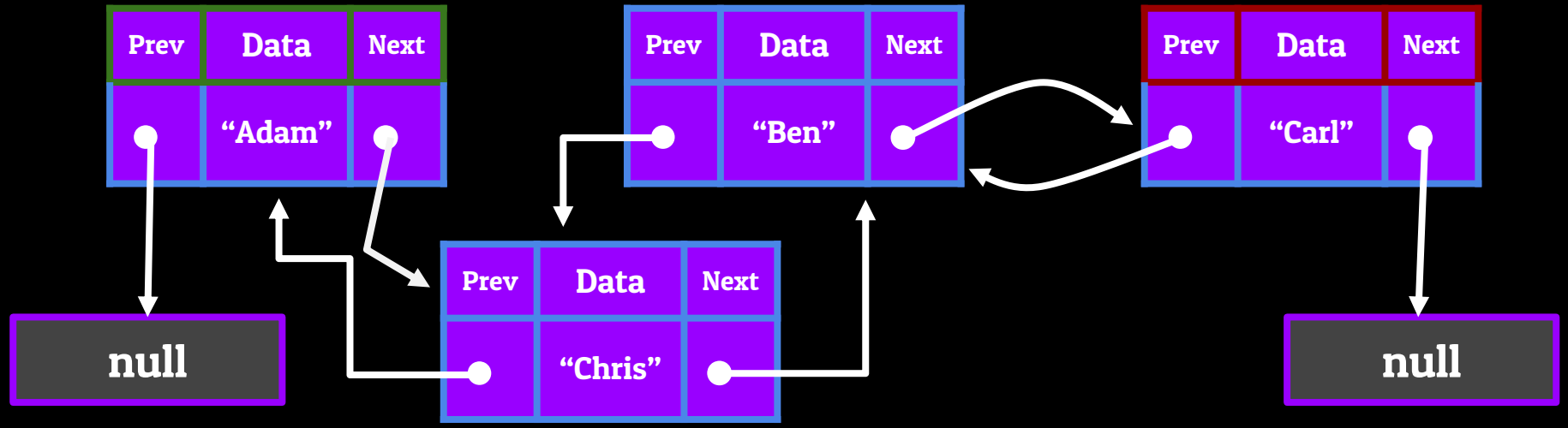
The Doubly-Linked List - Adding and Removing Information

Removing from the Middle of a Doubly-LinkedList

Set the Node before the one we want to remove's next to point towards the Node after the one we want to remove

Set the Node after the one we want to remove's previous to point towards the Node before the one we want to remove

Set both pointers of the Node we want to remove to point towards a null value



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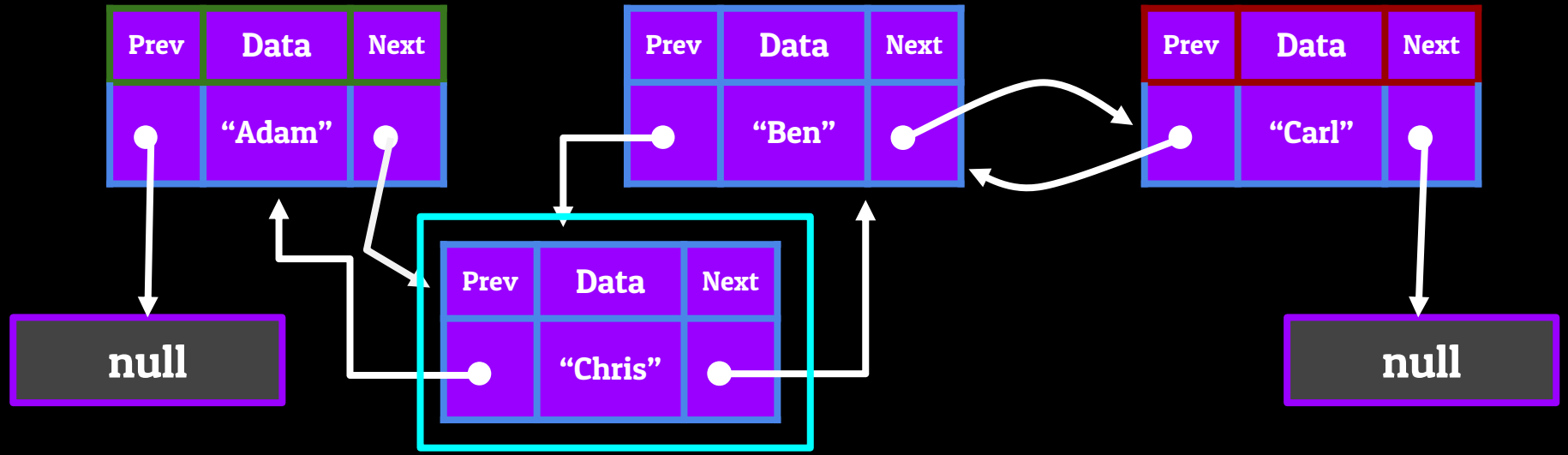

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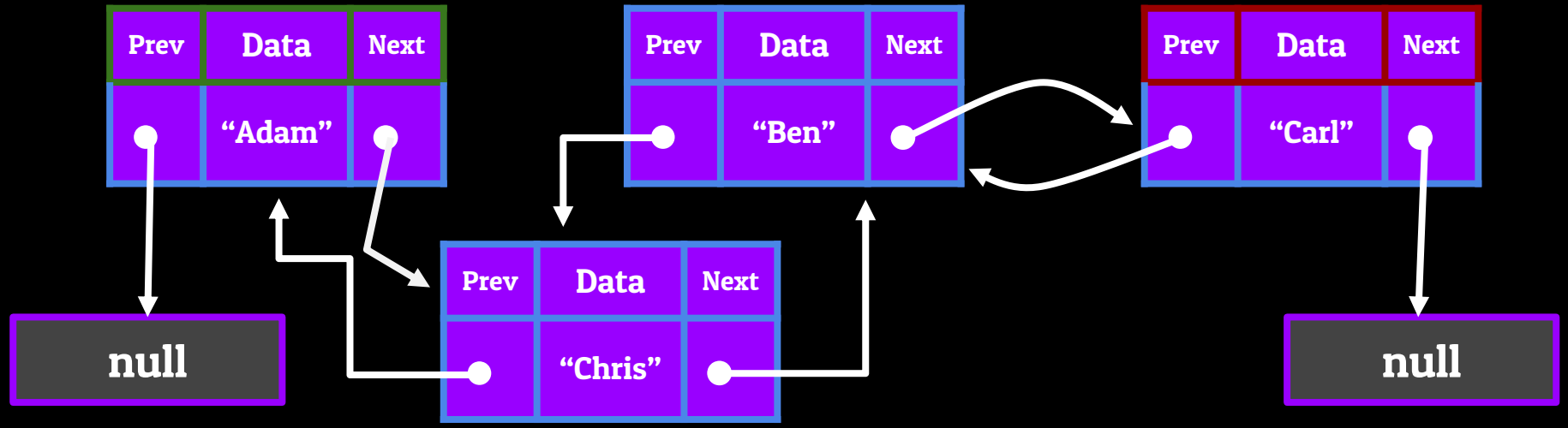

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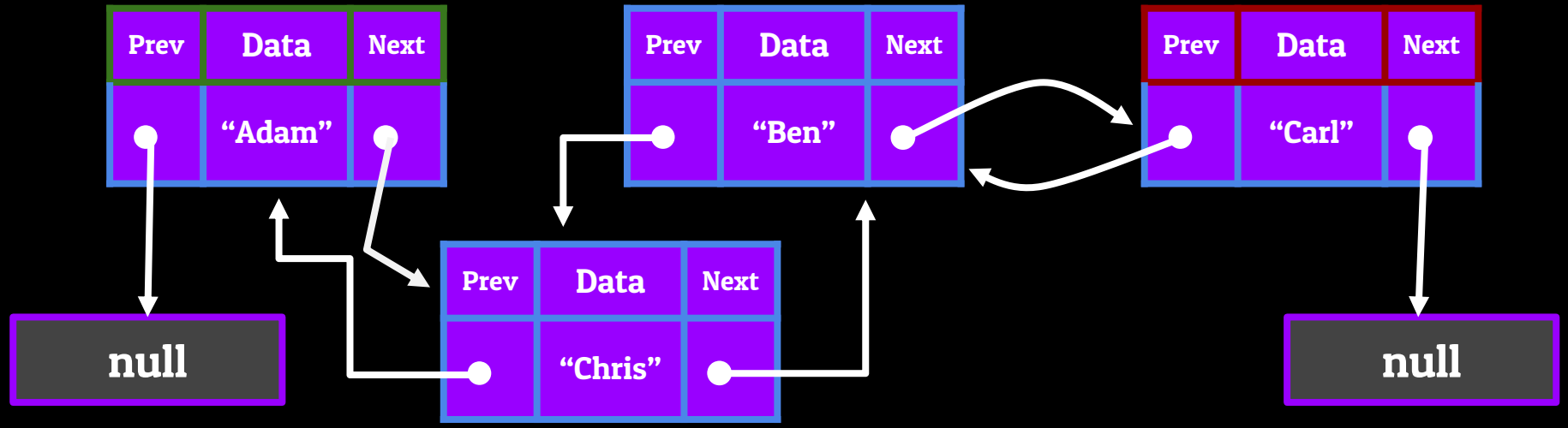

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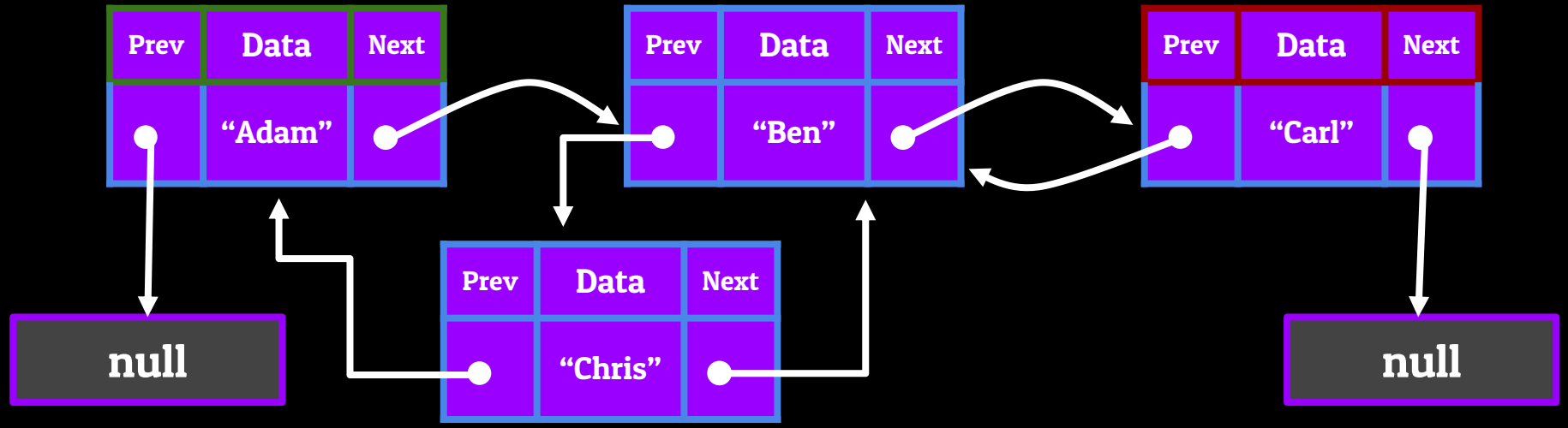

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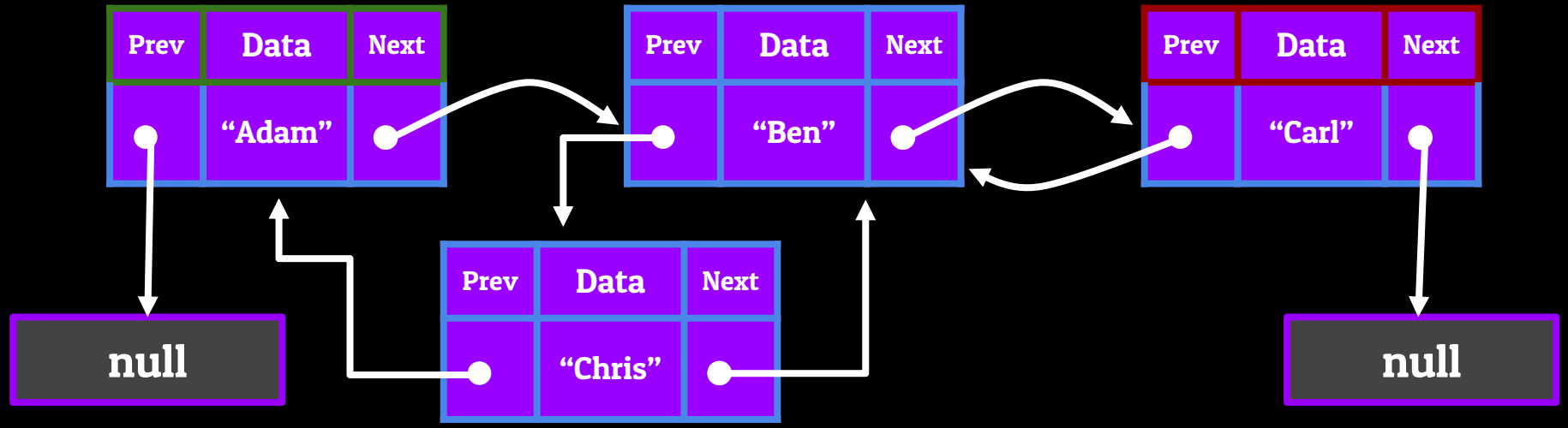

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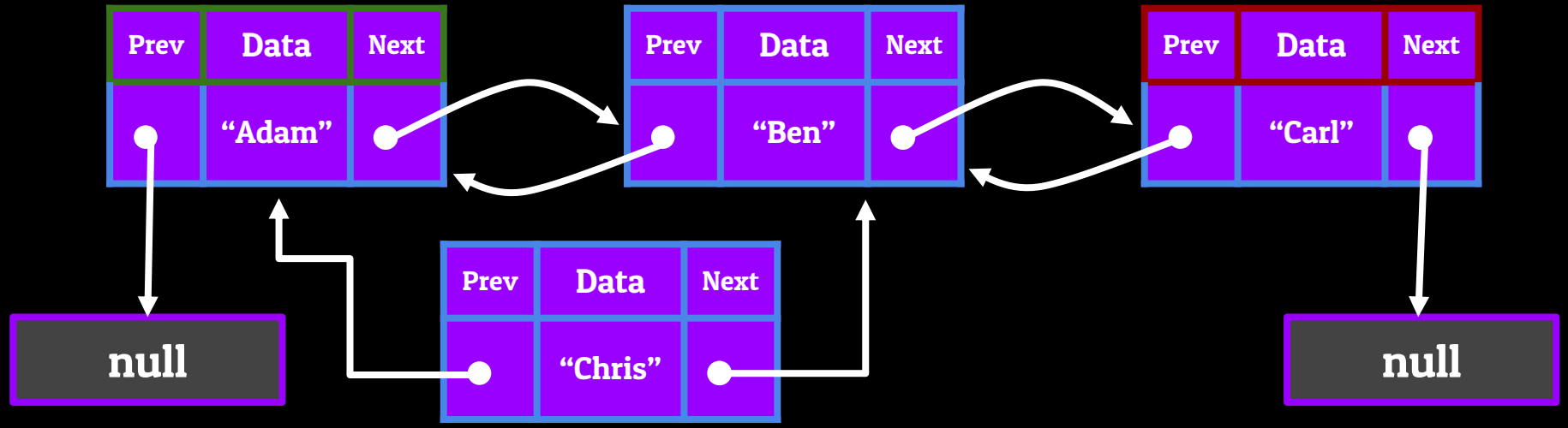

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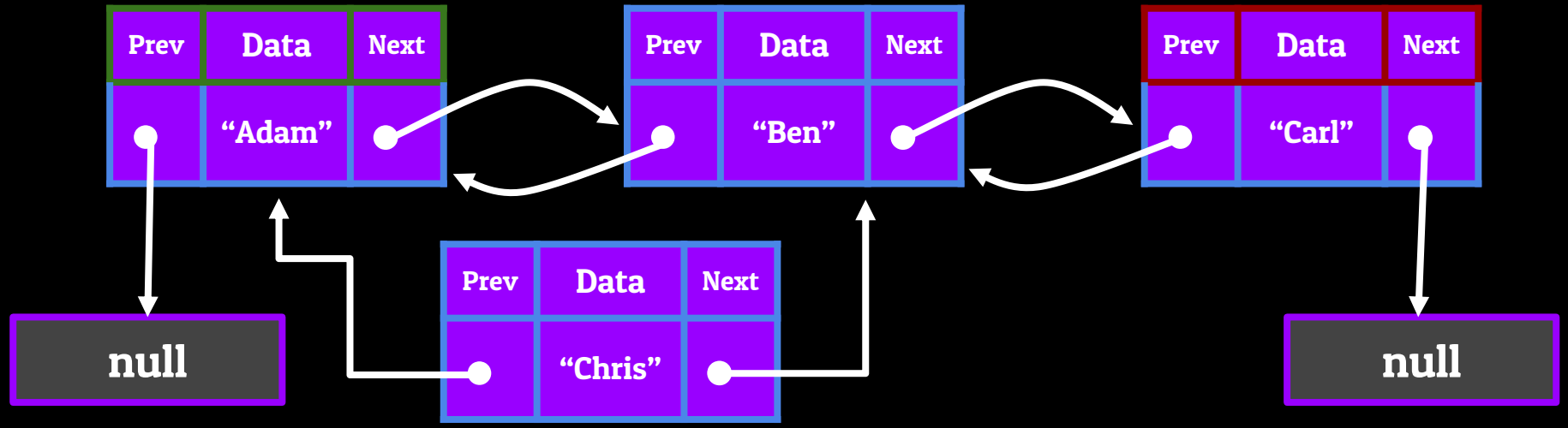

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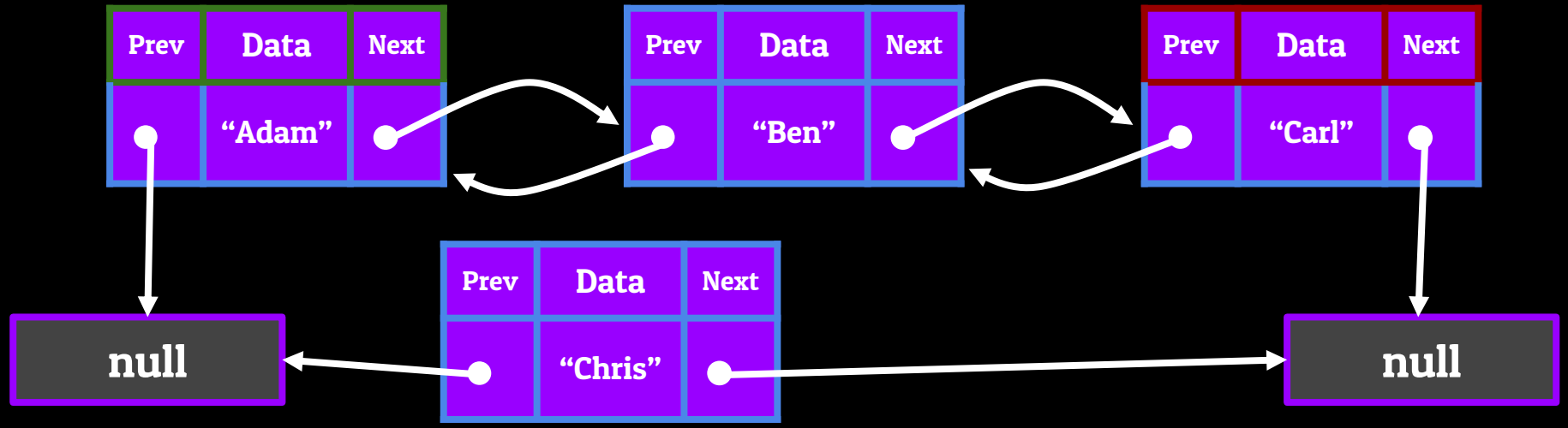

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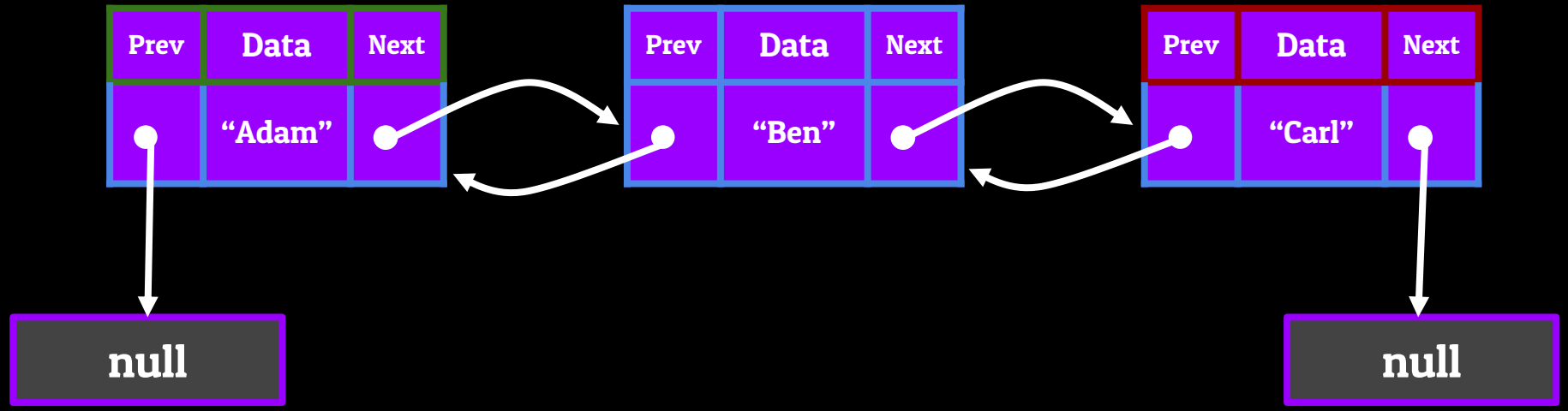
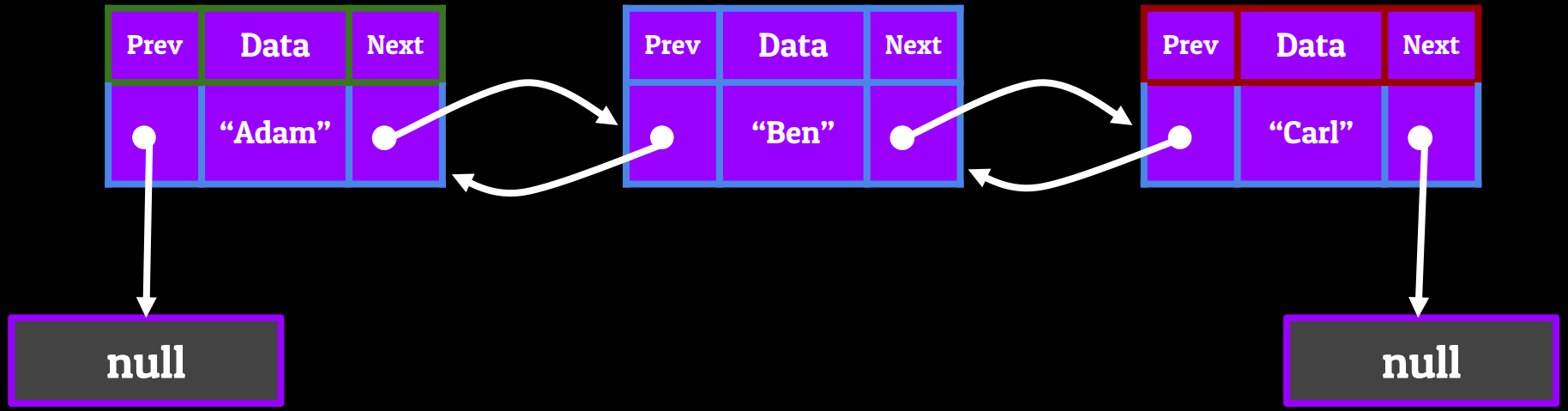
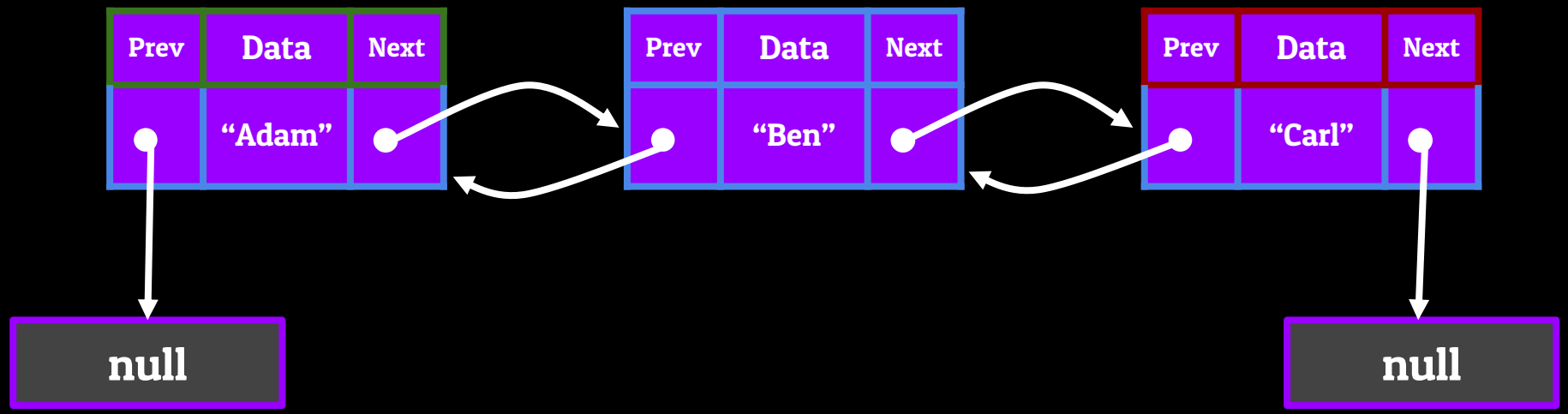


The Doubly-Linked List - Adding and Removing Information



The Doubly-Linked List - Adding and Removing Information

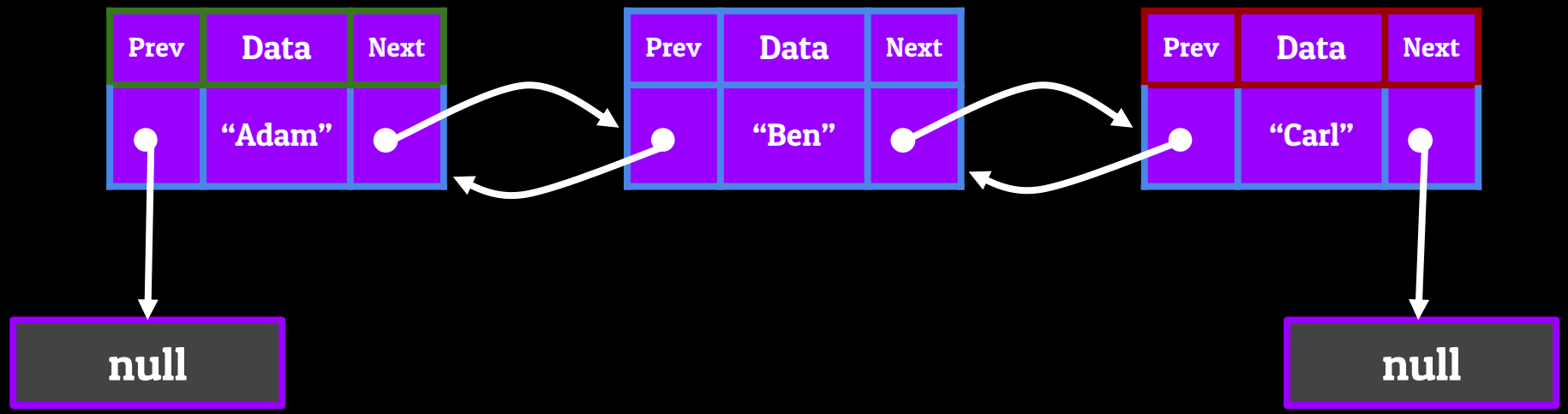
Add to the Tail of a Doubly-LinkedList



The Doubly-Linked List - Adding and Removing Information

Add to the Tail of a Doubly-LinkedList

Set the next pointer of the current tail to point towards the new Node we want to become the tail

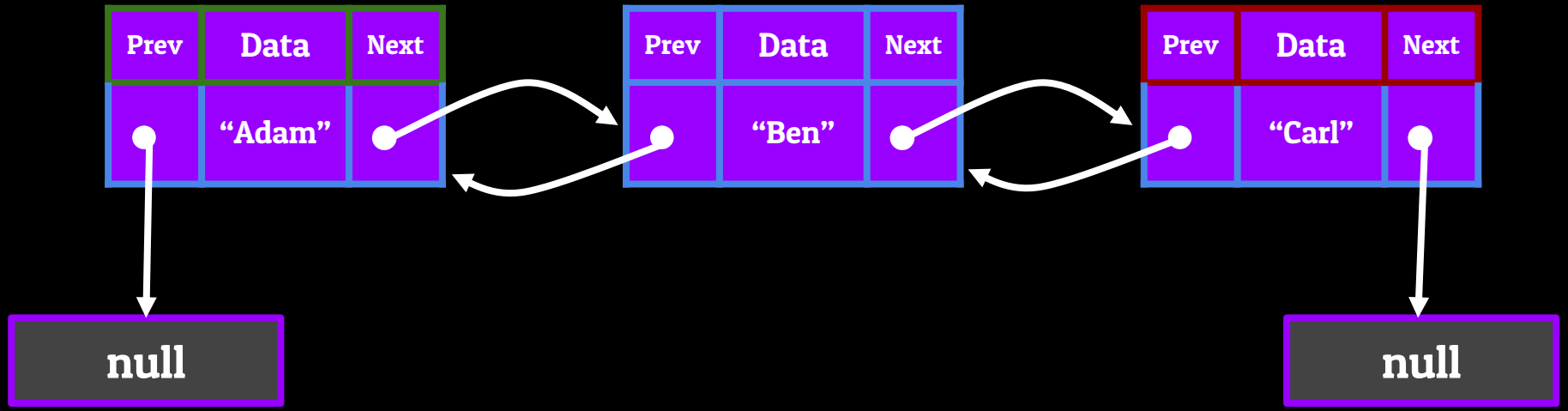


The Doubly-Linked List - Adding and Removing Information

Add to the Tail of a Doubly-LinkedList

Set the next pointer of the current tail to point towards the new Node we want to become the tail

Set the previous of the new Node that we're adding to be pointing towards the current tail of the List



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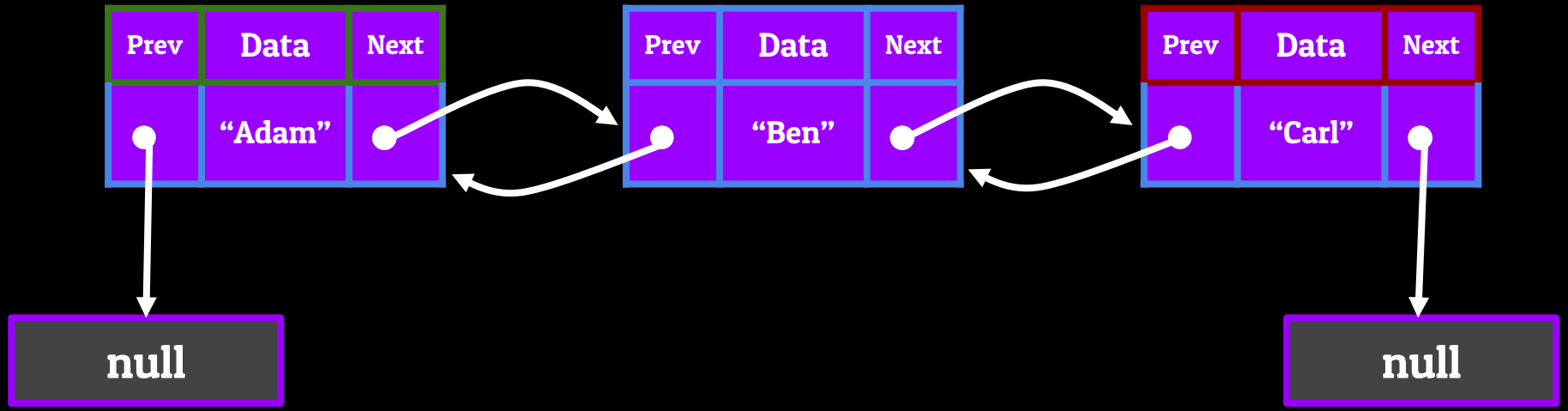
Make the new Node's next point towards a Null value



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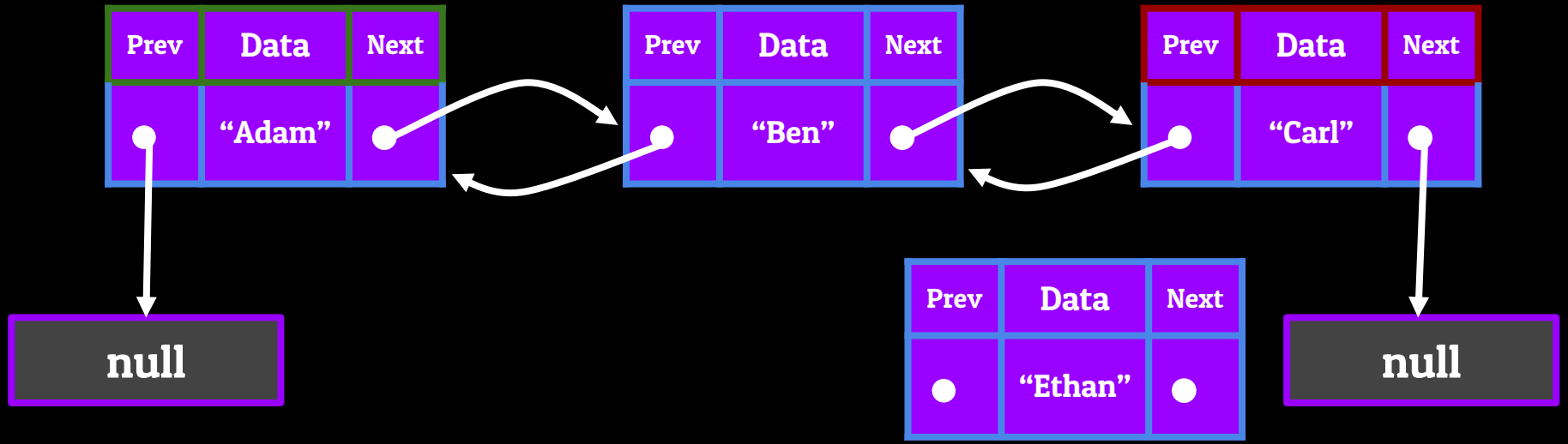

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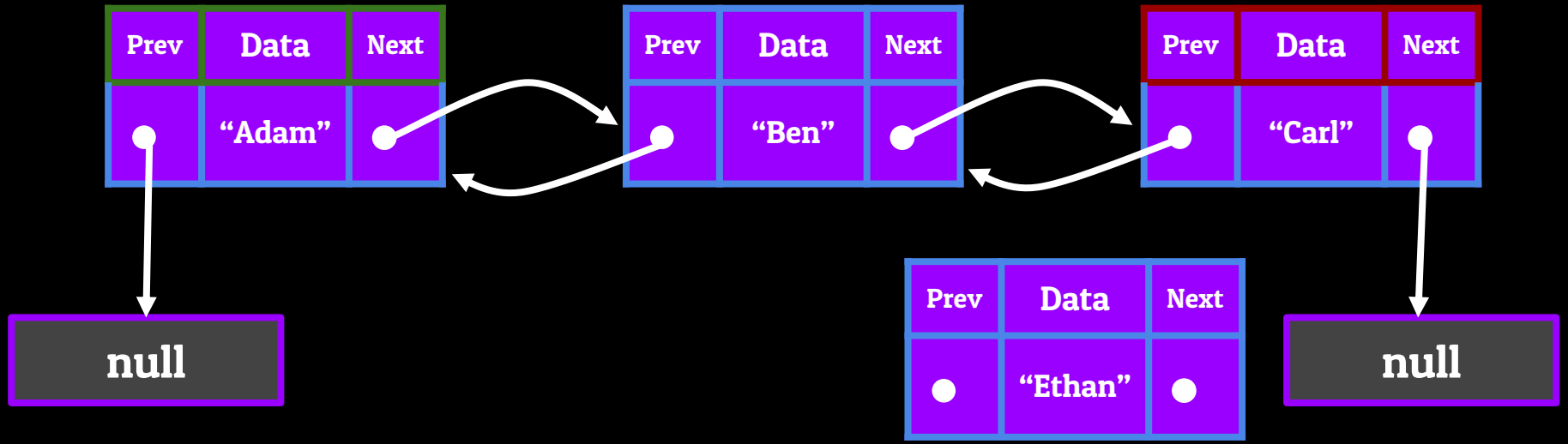

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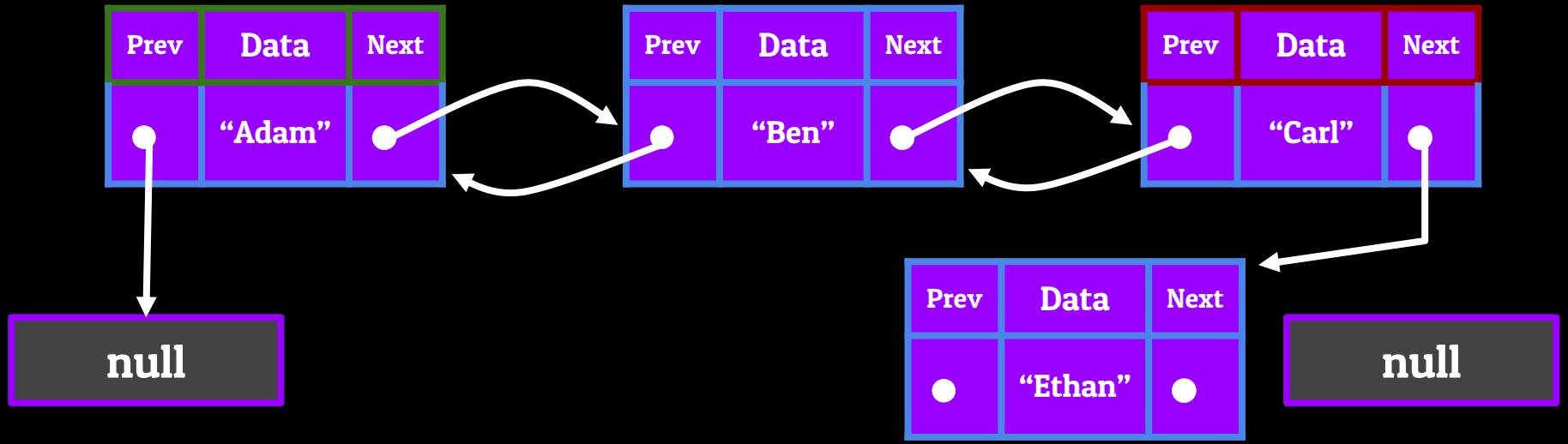

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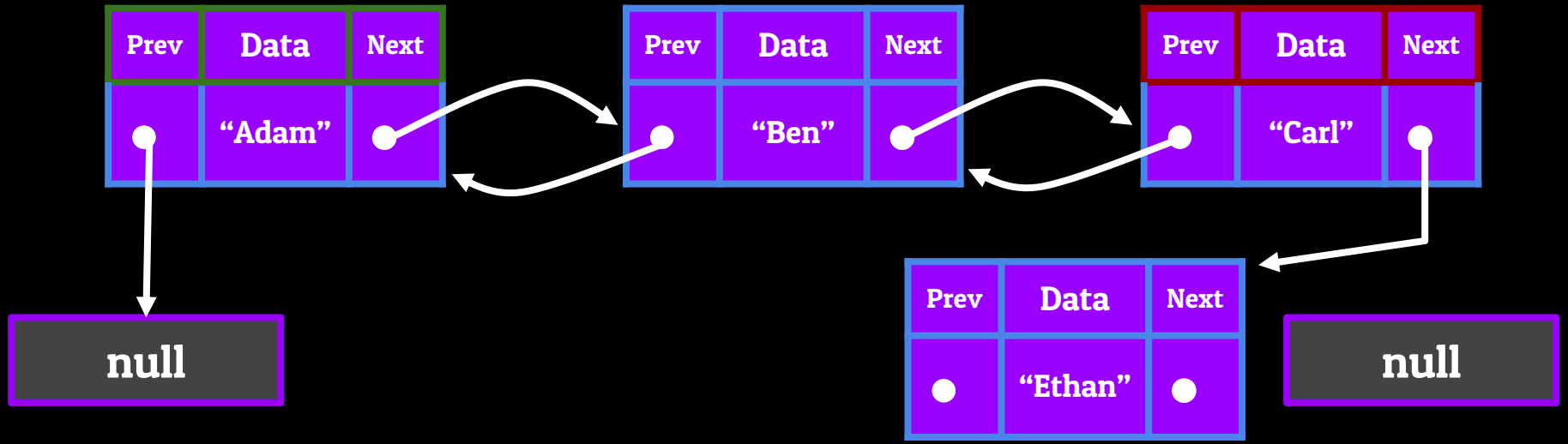

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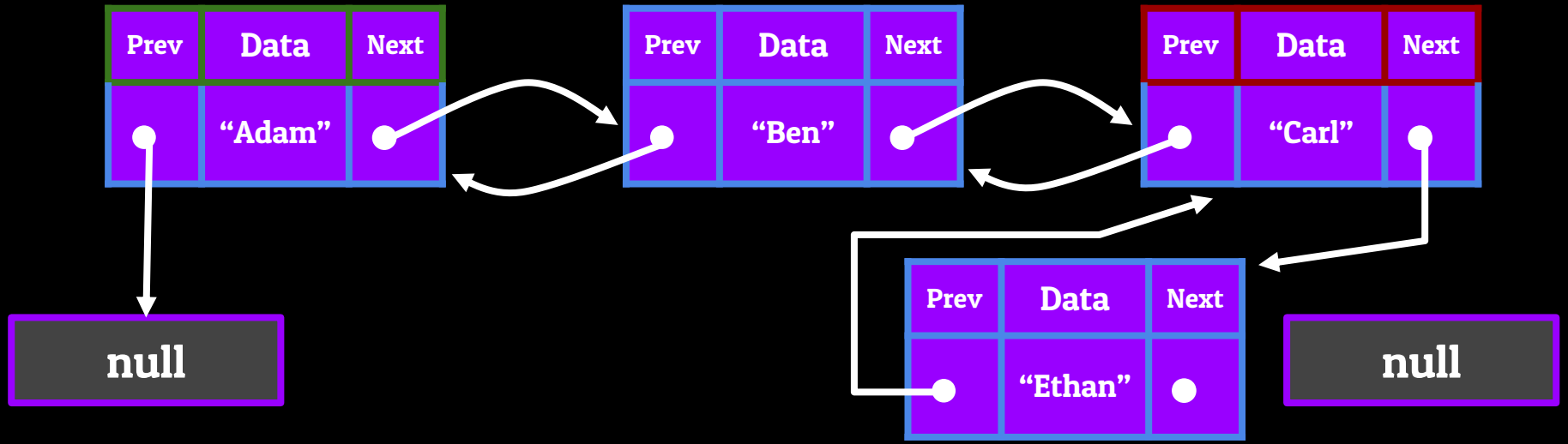

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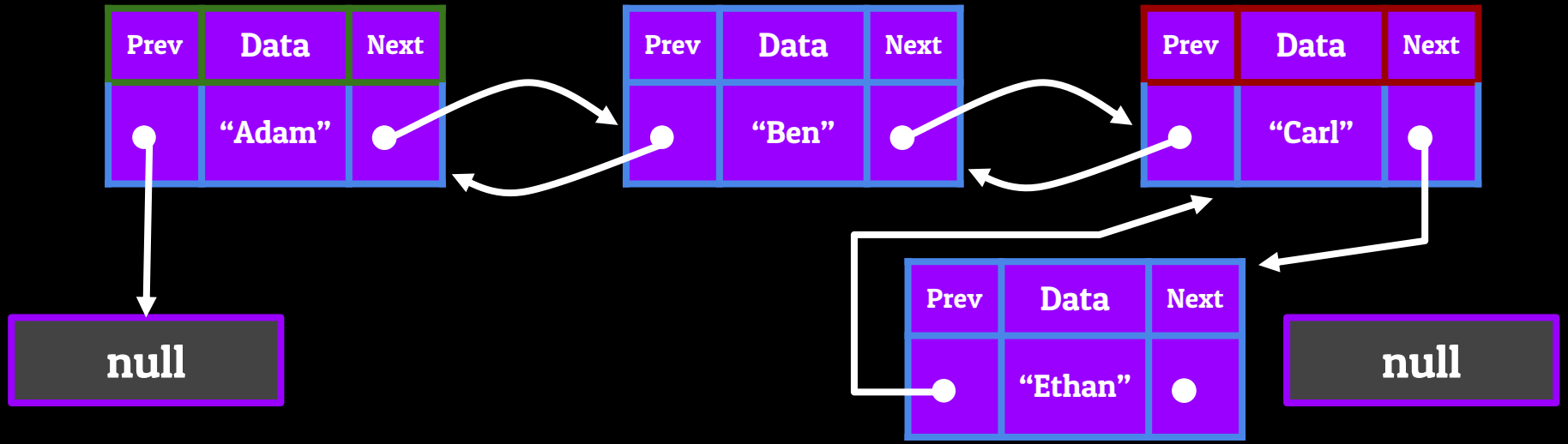


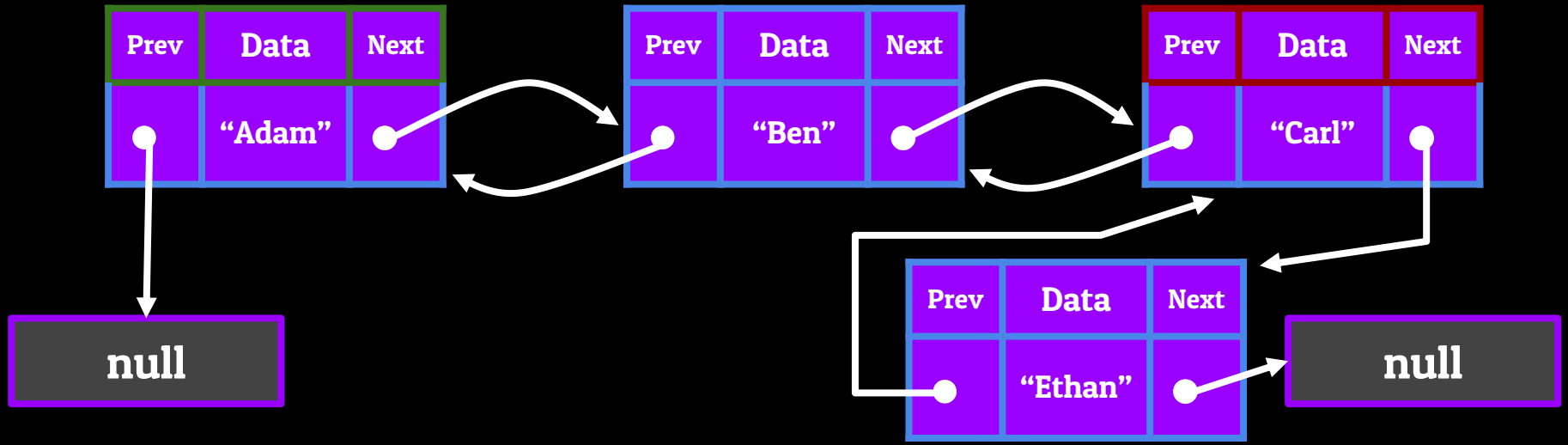
The Doubly-Linked List - Adding and Removing Information

Add to the Tail of a Doubly-LinkedList

Set the next pointer of the current tail to point towards the new Node we want to become the tail

Set the previous of the new Node that we're adding to be pointing towards the current tail of the List

Make the new Node's next point towards a Null value



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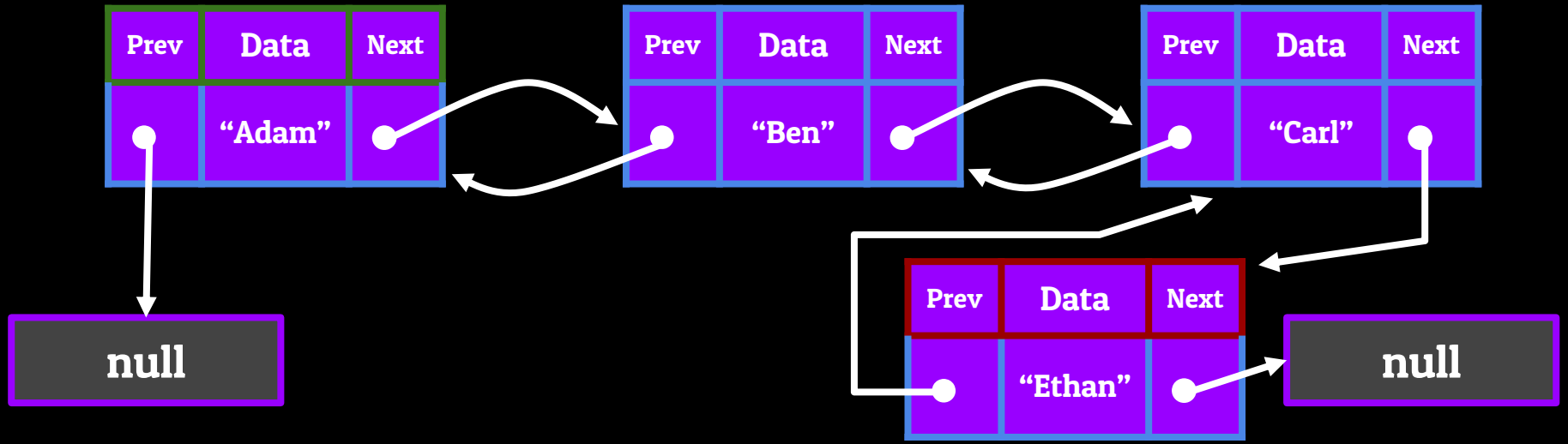

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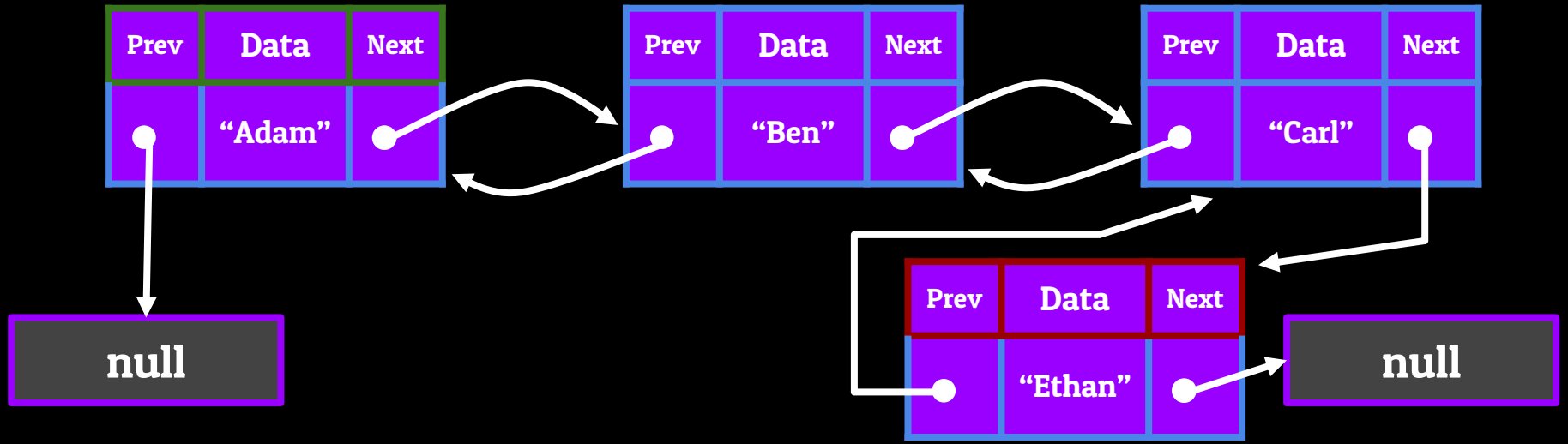

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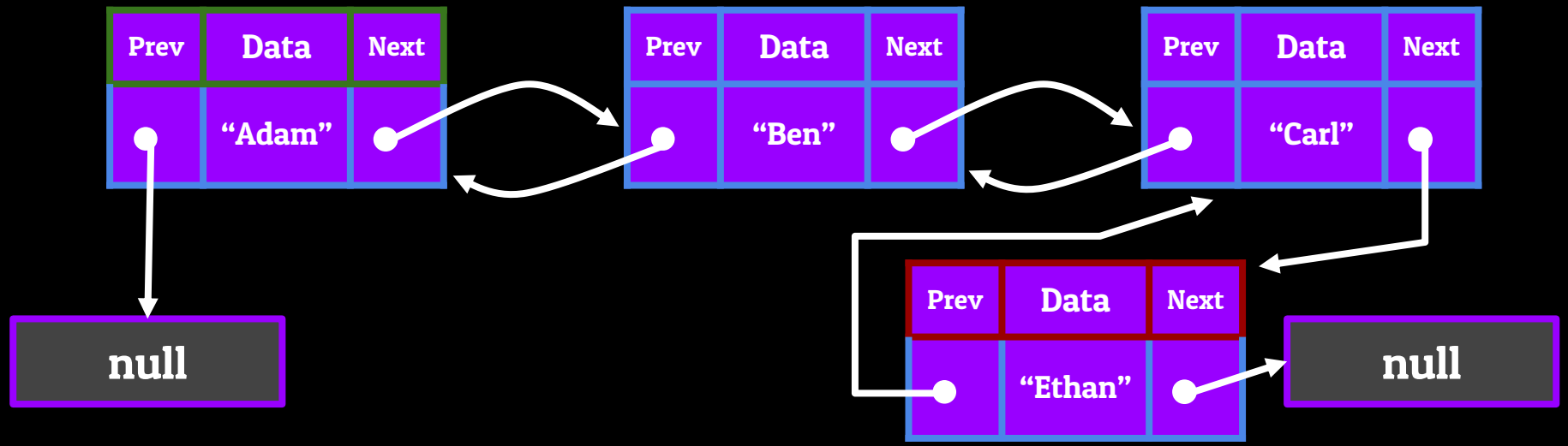

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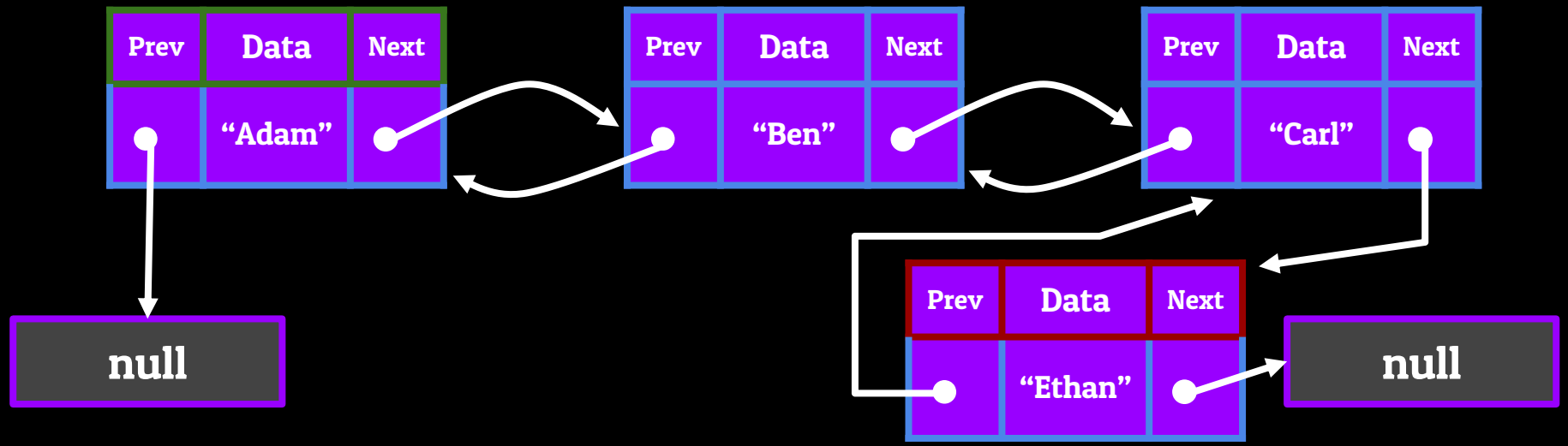

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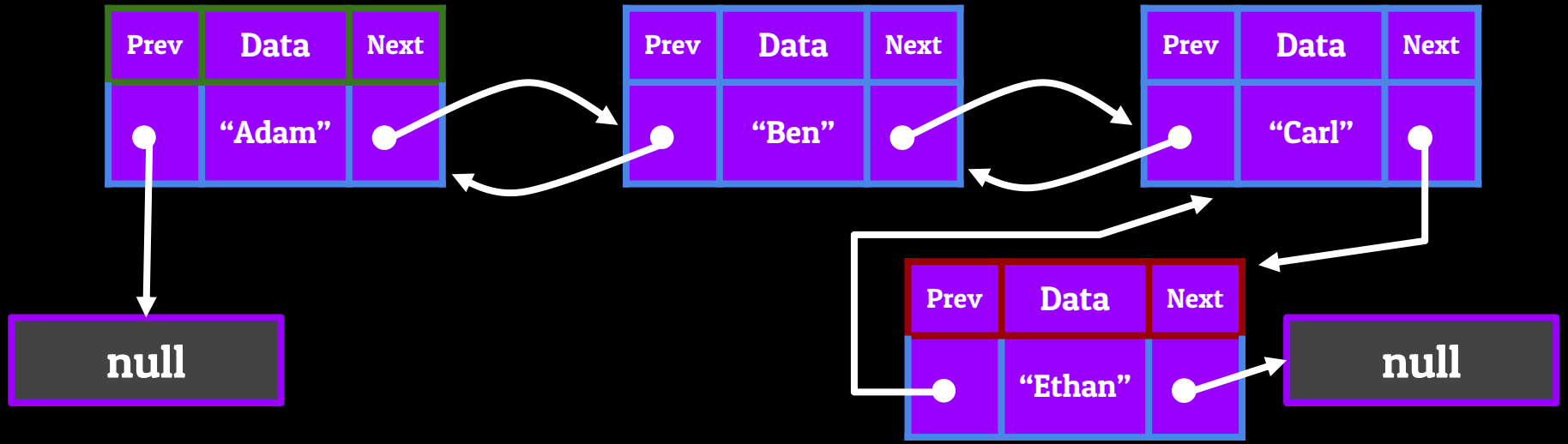

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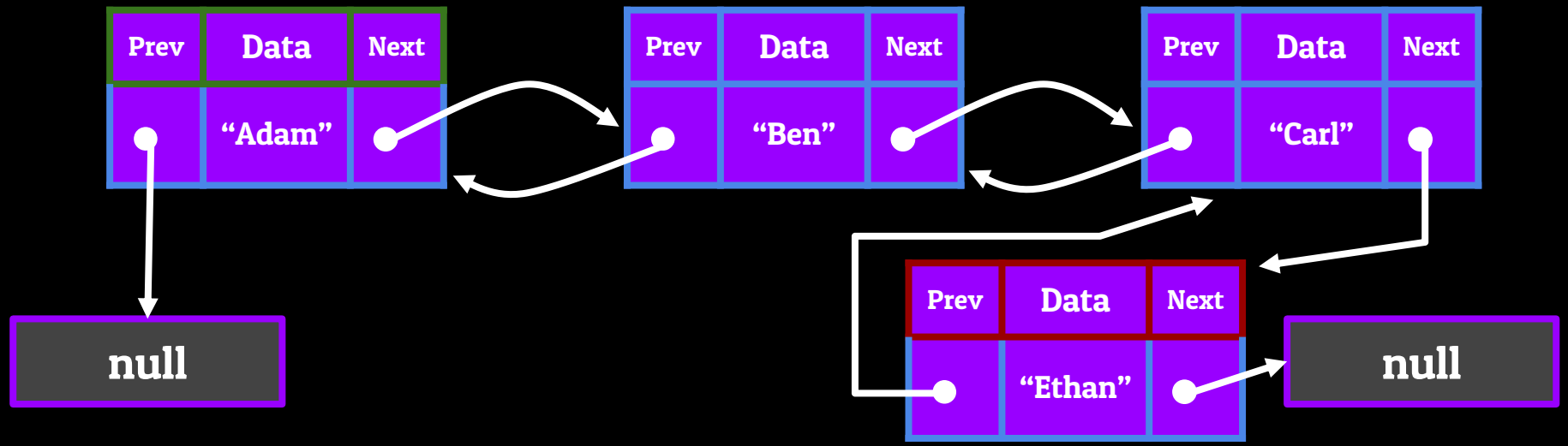

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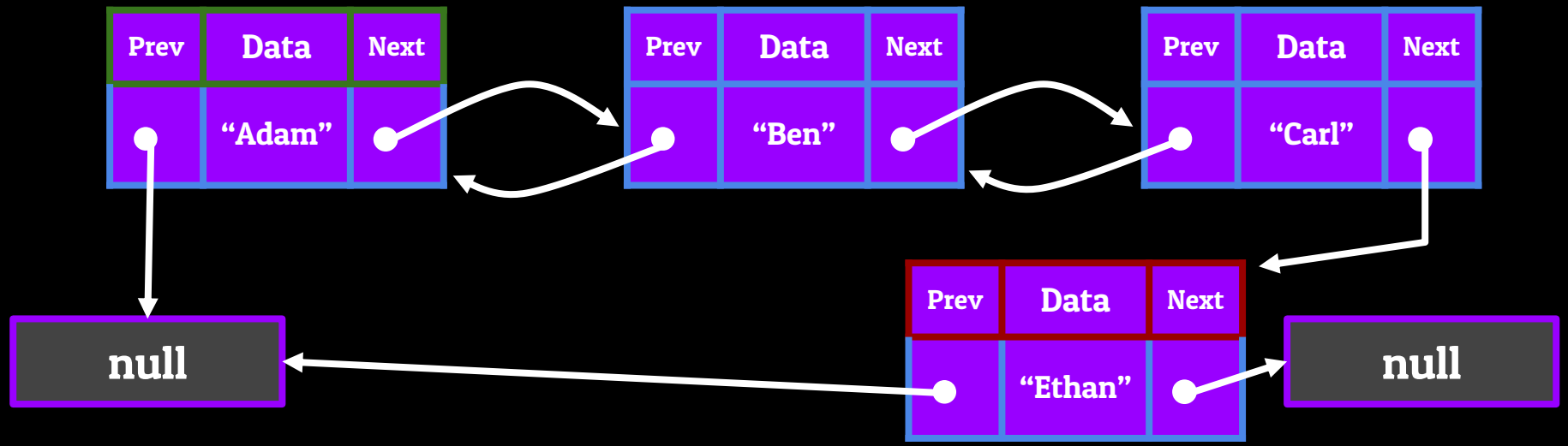

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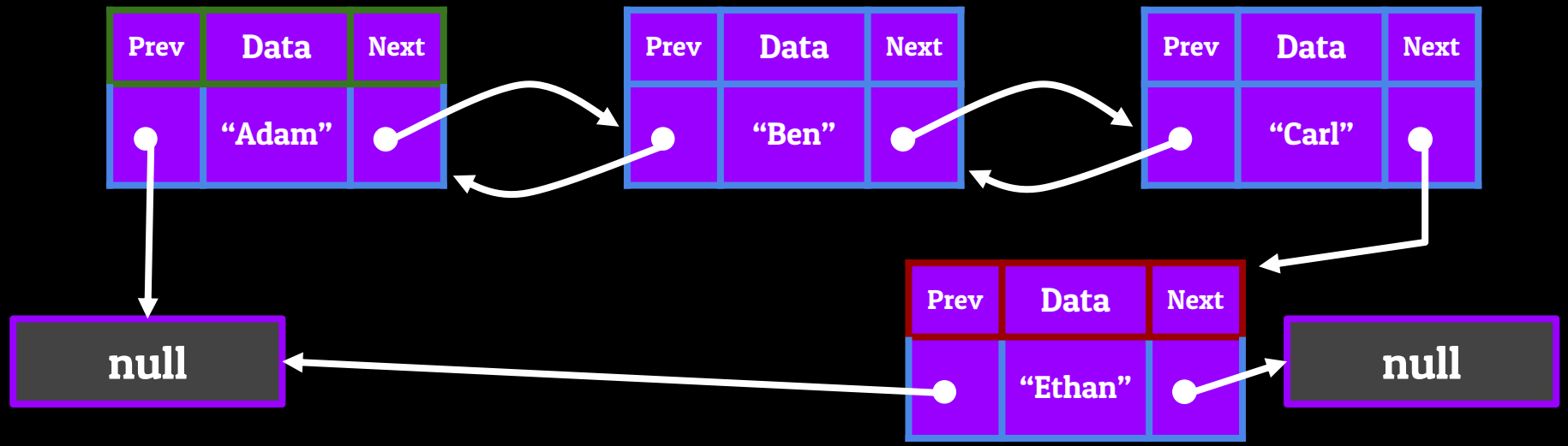

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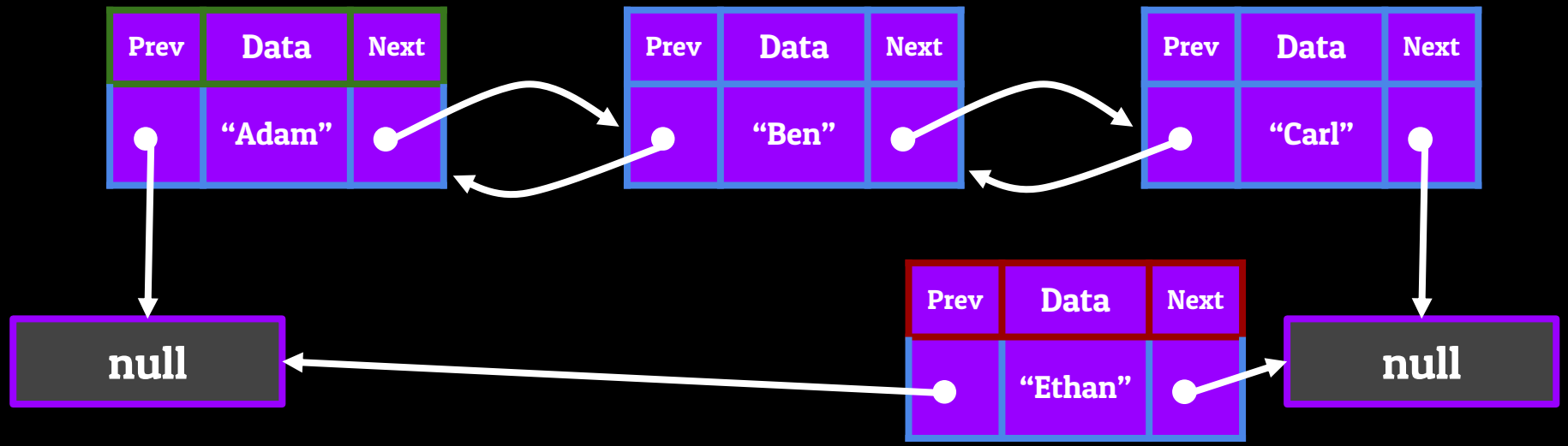

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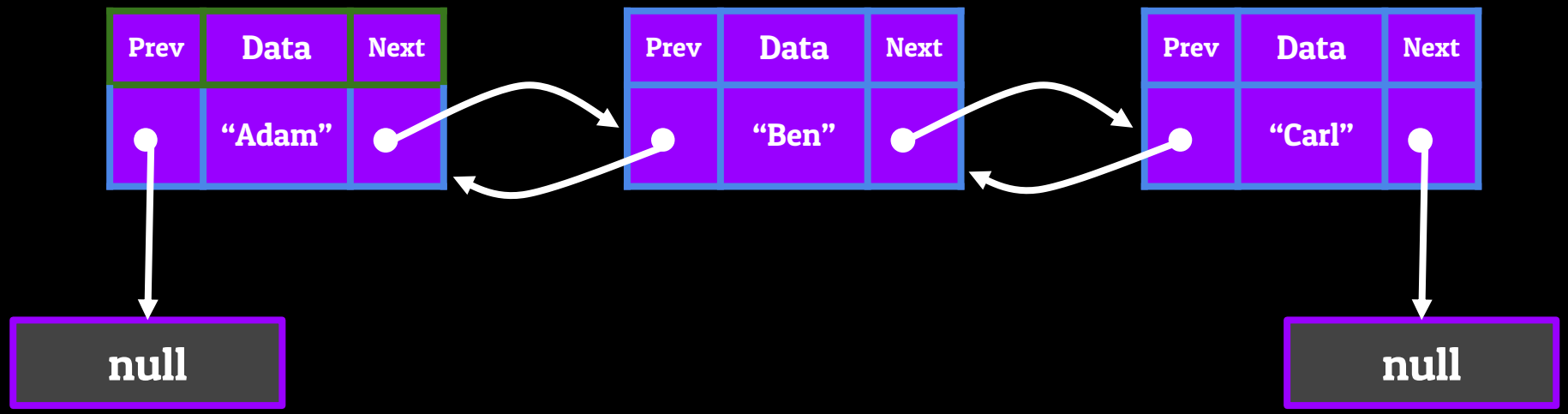

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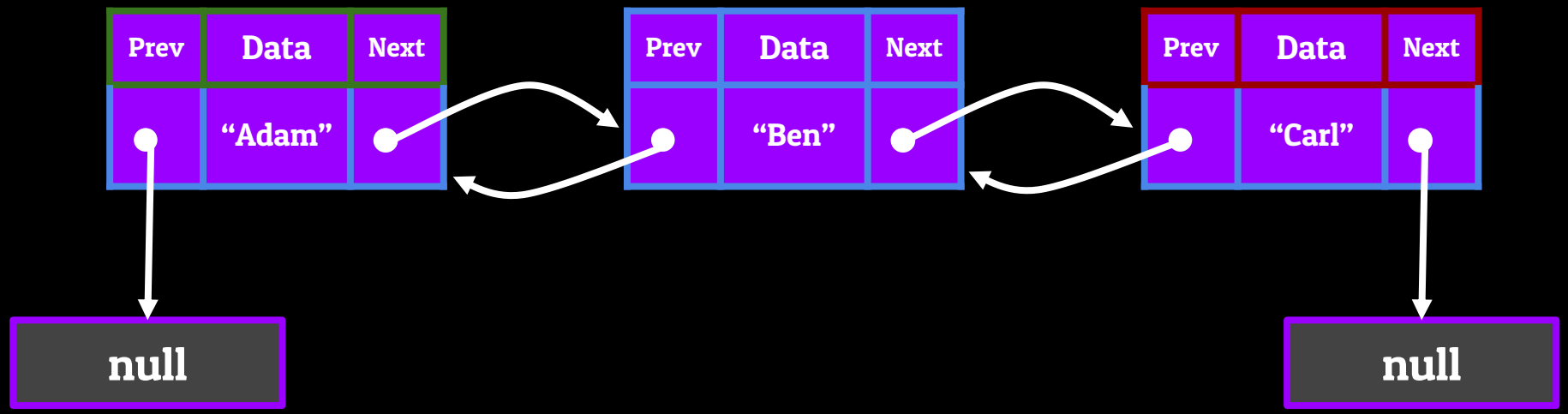

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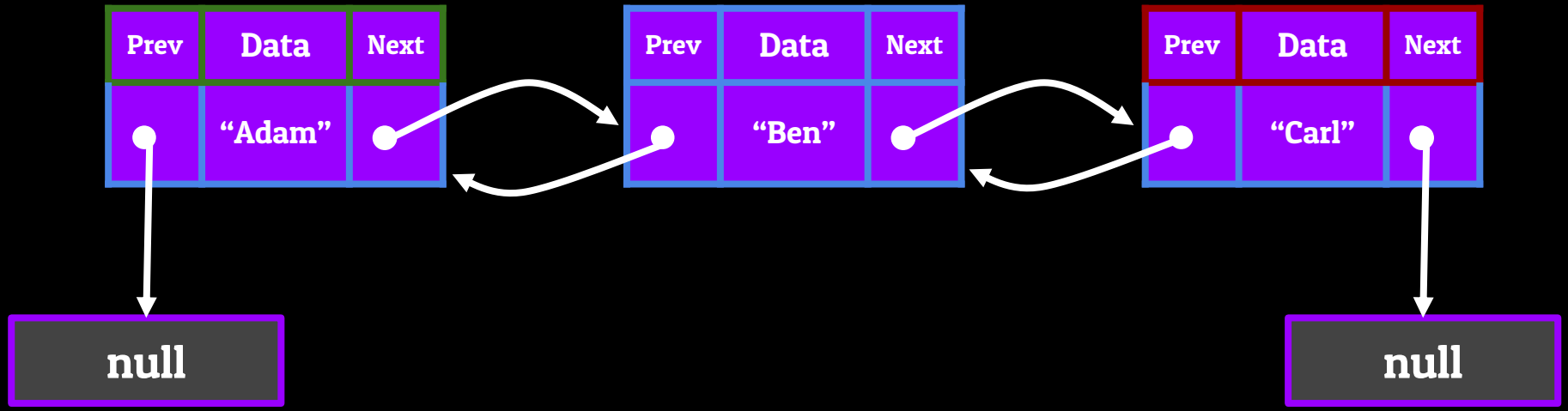

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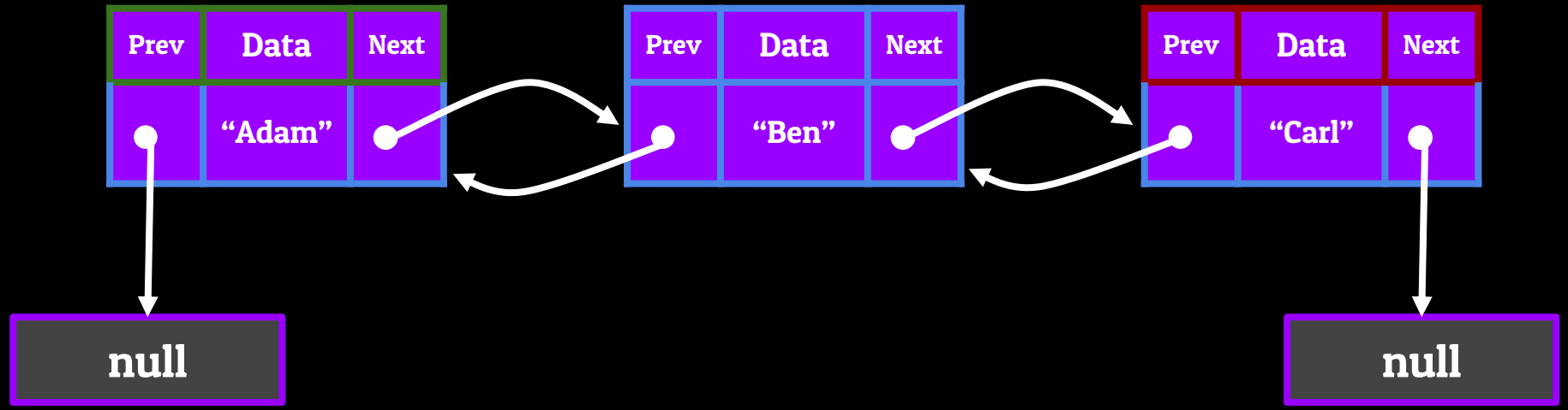

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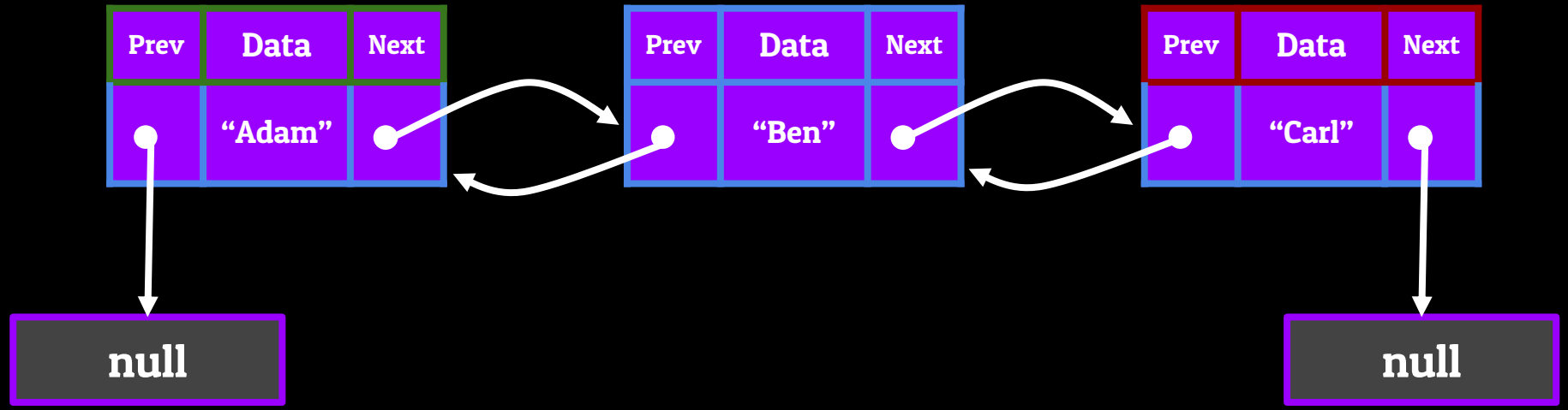

The Doubly-Linked List - Time Complexity Equations

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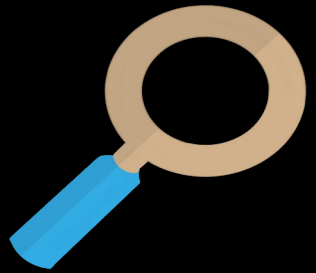
Accessing

O(n)



Searching

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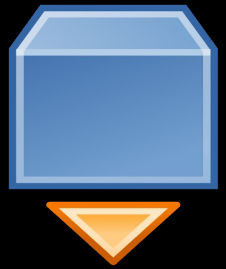

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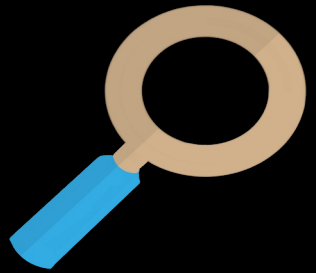

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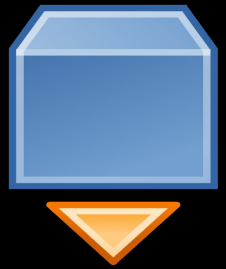

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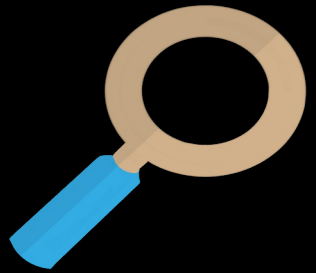

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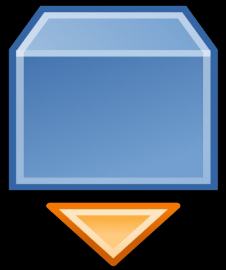

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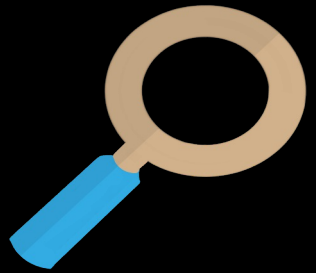

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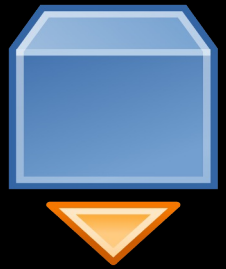

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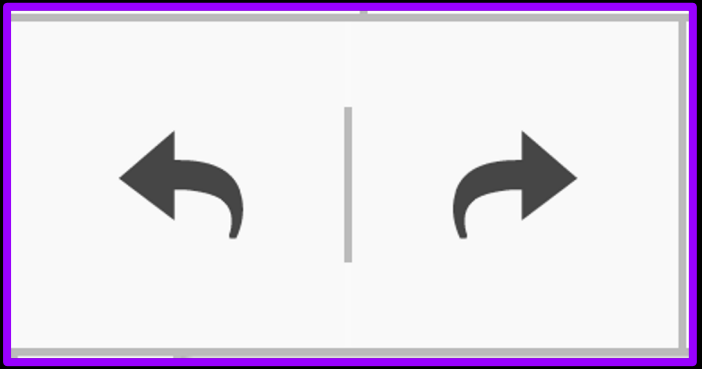

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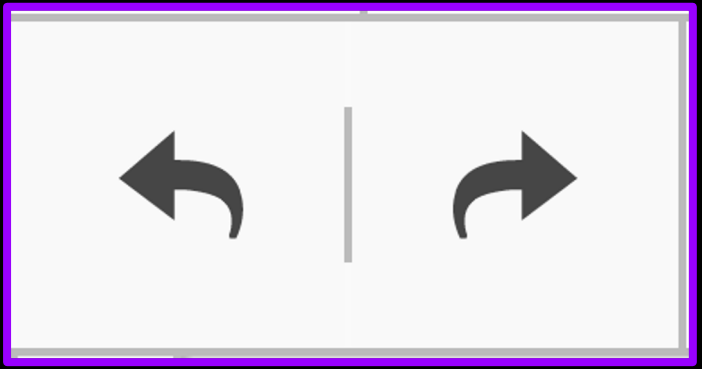

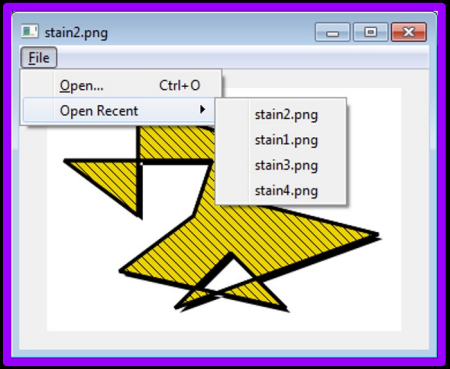

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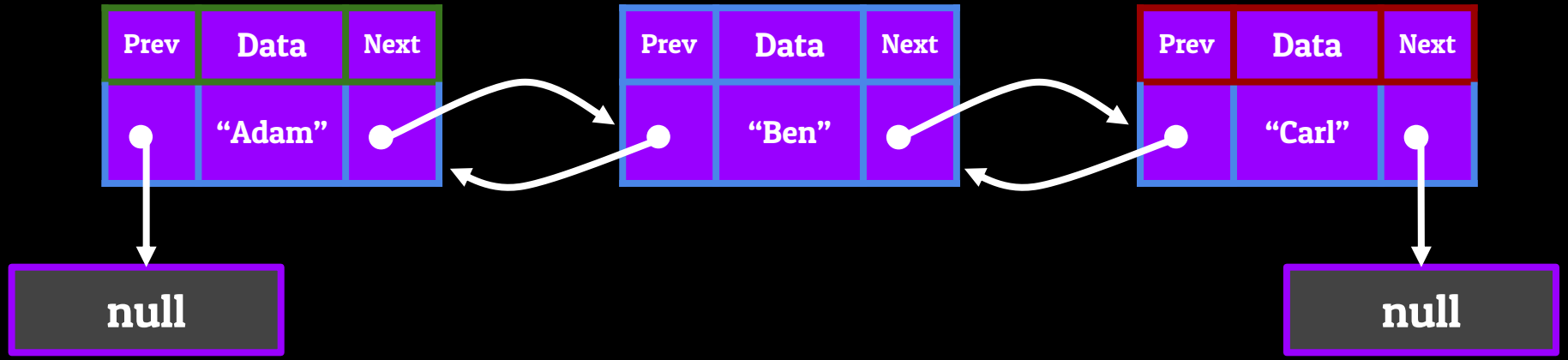

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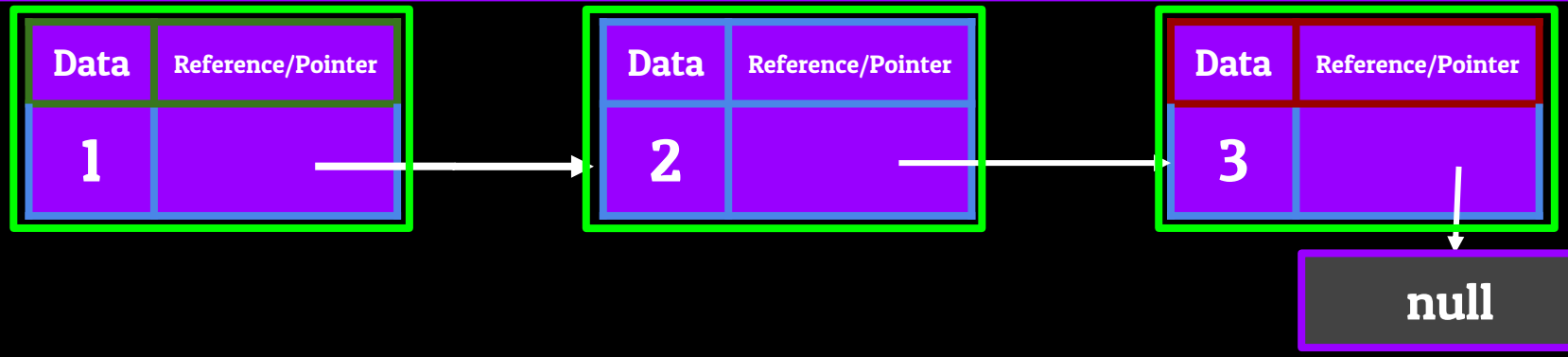

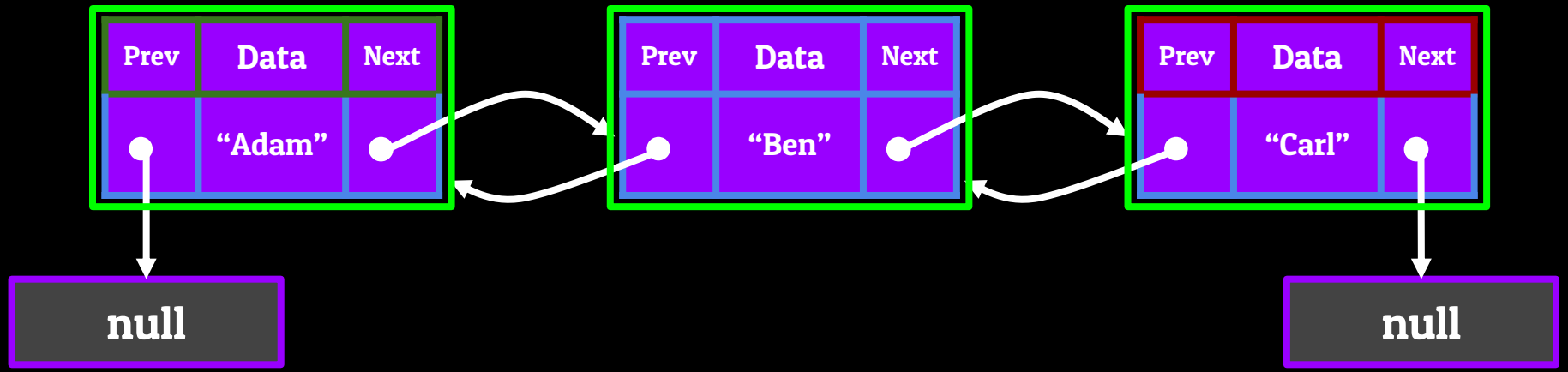

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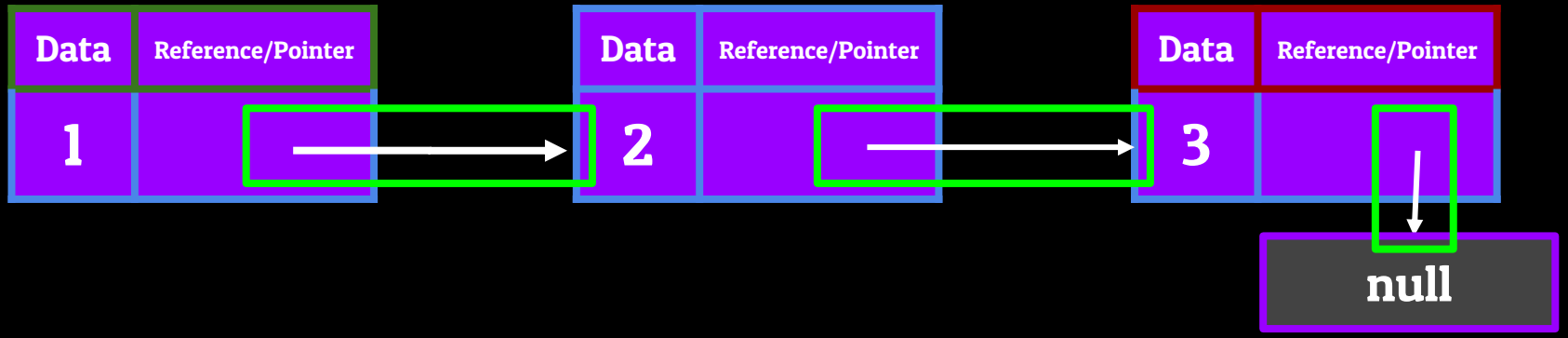

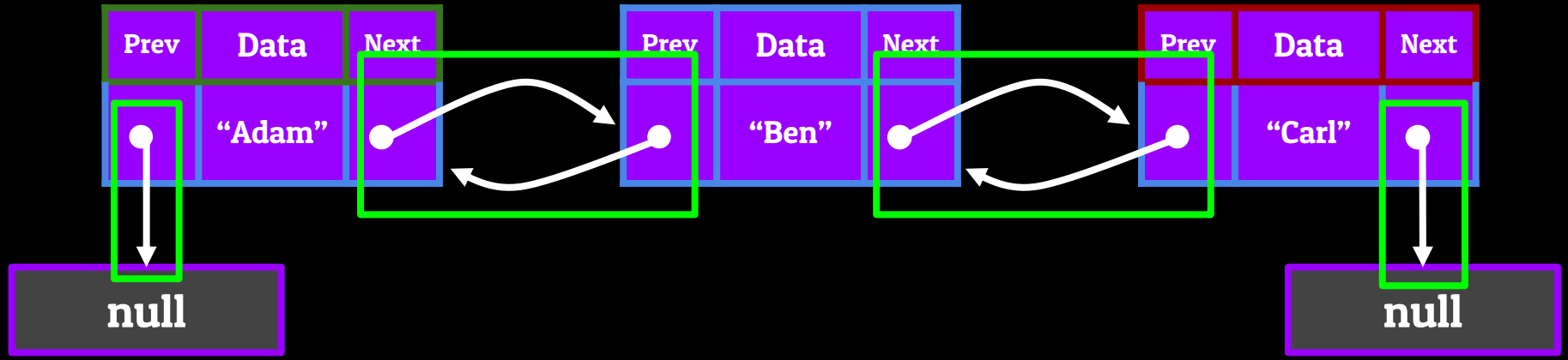

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