

Singly and Doubly Linked Lists!

Part 1/2

William Fiset

Outline

- **Discussion about Singly & Doubly Linked Lists**
 - What is a linked list?
 - Where are linked lists used?
 - Terminology
 - Singly Linked vs. Doubly Linked
- **Implementation Details**
 - How to insert new elements
 - How to remove elements
- **Complexity analysis**
- **Code Implementation (Doubly linked list)**

Discussion

What is a linked list?

A linked list is a sequential list of nodes that hold data which point to other nodes also containing data.



Where are Linked Lists used?

- Used in many List, Queue & Stack implementations.
- Great for creating circular lists.
- Can easily model real world objects such as trains.
- Used in separate chaining, which is present in certain Hashtable implementations to deal with hashing collisions.
- Often used in the implementation of adjacency lists for graphs.

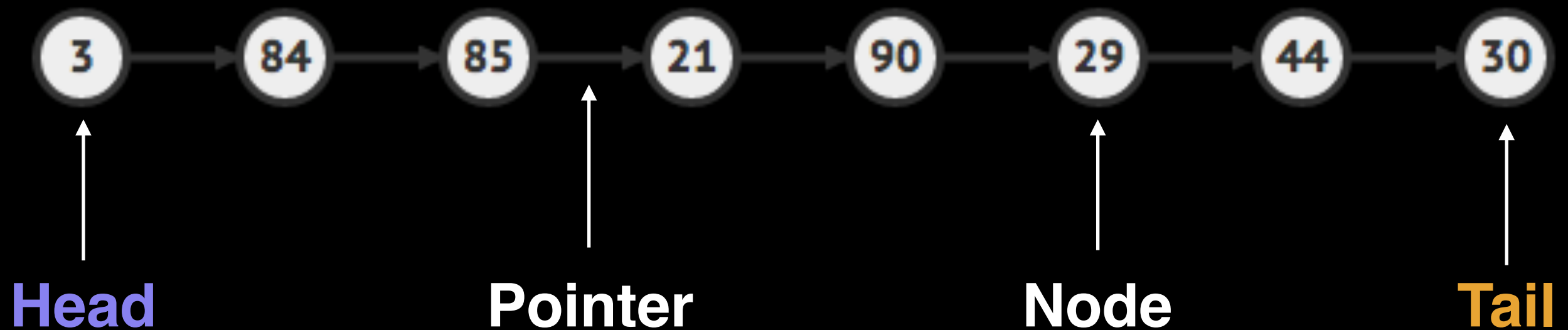
Terminology

Head: The first node in a linked list

Tail: The last node in a linked list

Pointer: Reference to another node

Node: An object containing data and pointer(s)



Singly vs Doubly Linked Lists

Singly linked lists only hold a reference to the next node. In the implementation you always maintain a reference to the **head** to the linked list and a reference to the **tail** node for quick additions/removals.



With a doubly linked list each node holds a reference to the next and previous node. In the implementation you always maintain a reference to the **head** and the **tail** of the doubly linked list to do quick additions/removals from both ends of your list.



Singly & Doubly Linked Lists

Pros and Cons

Pros

Cons

**Singly
Linked**

Uses less memory
Simpler implementation

Cannot easily access
previous elements

**Doubly
Linked**

Can be traversed
backwards

Takes 2x memory

Implementation details

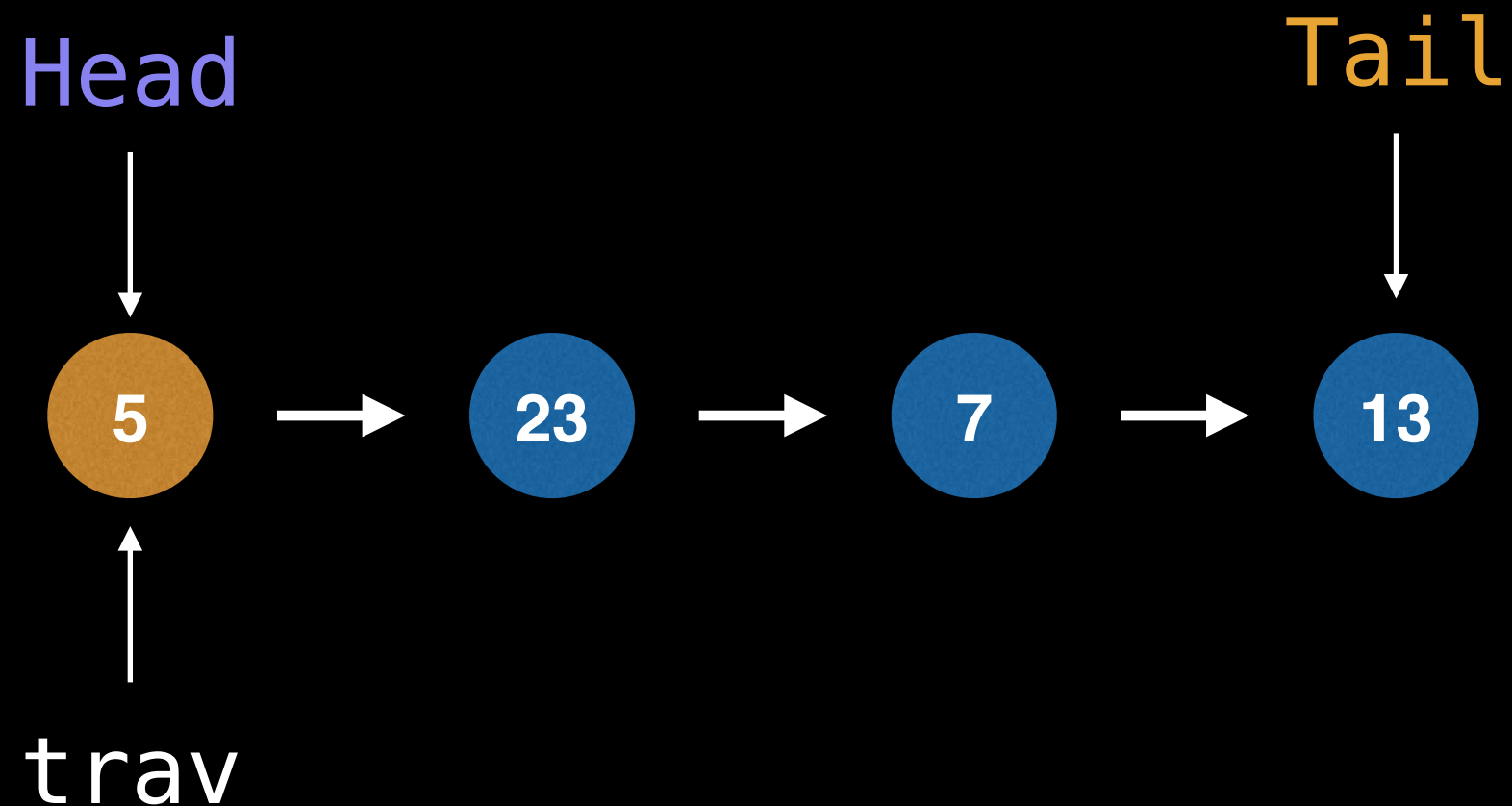
Inserting Singly Linked List

Insert 11 where the third node is.



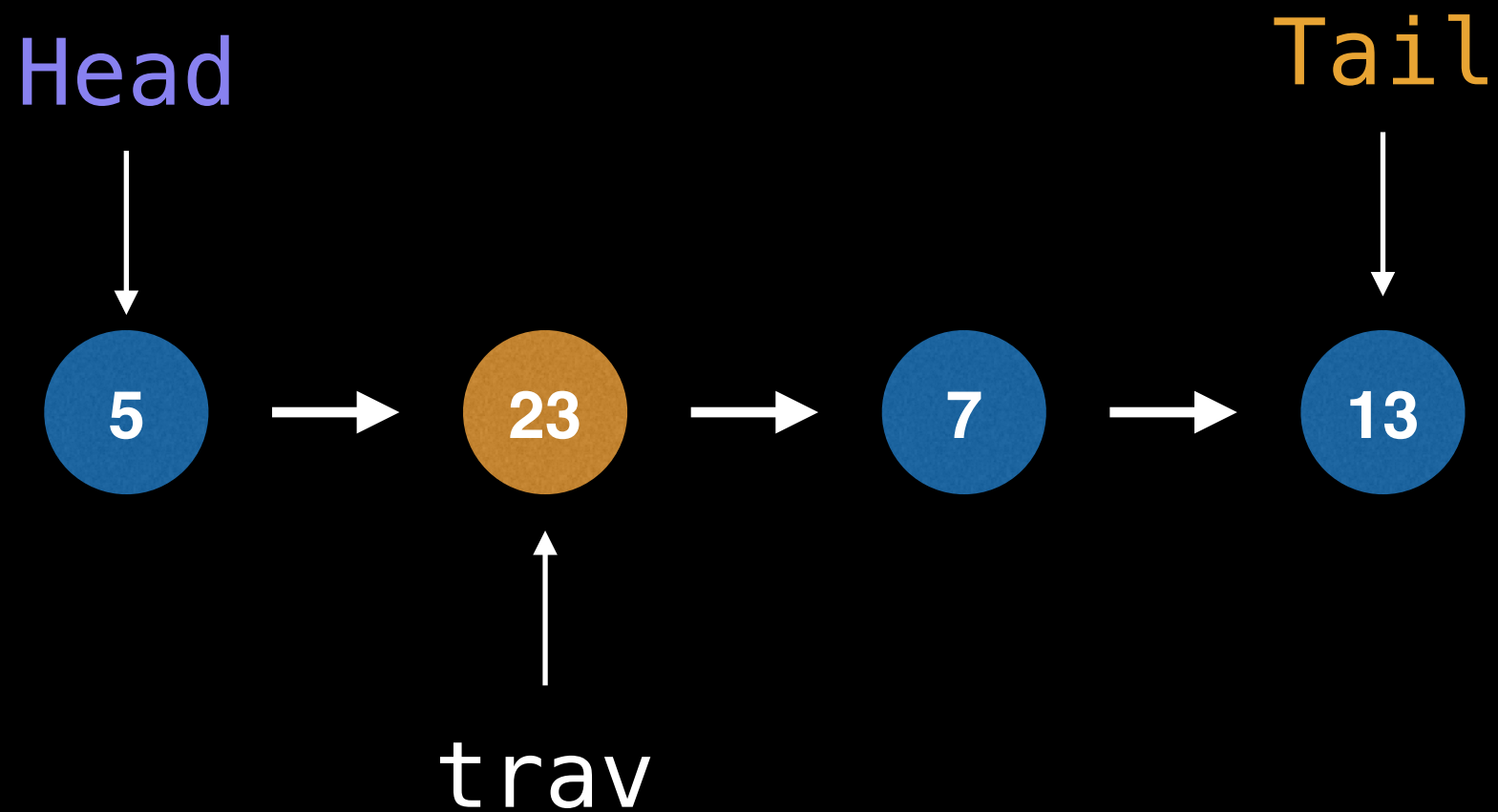
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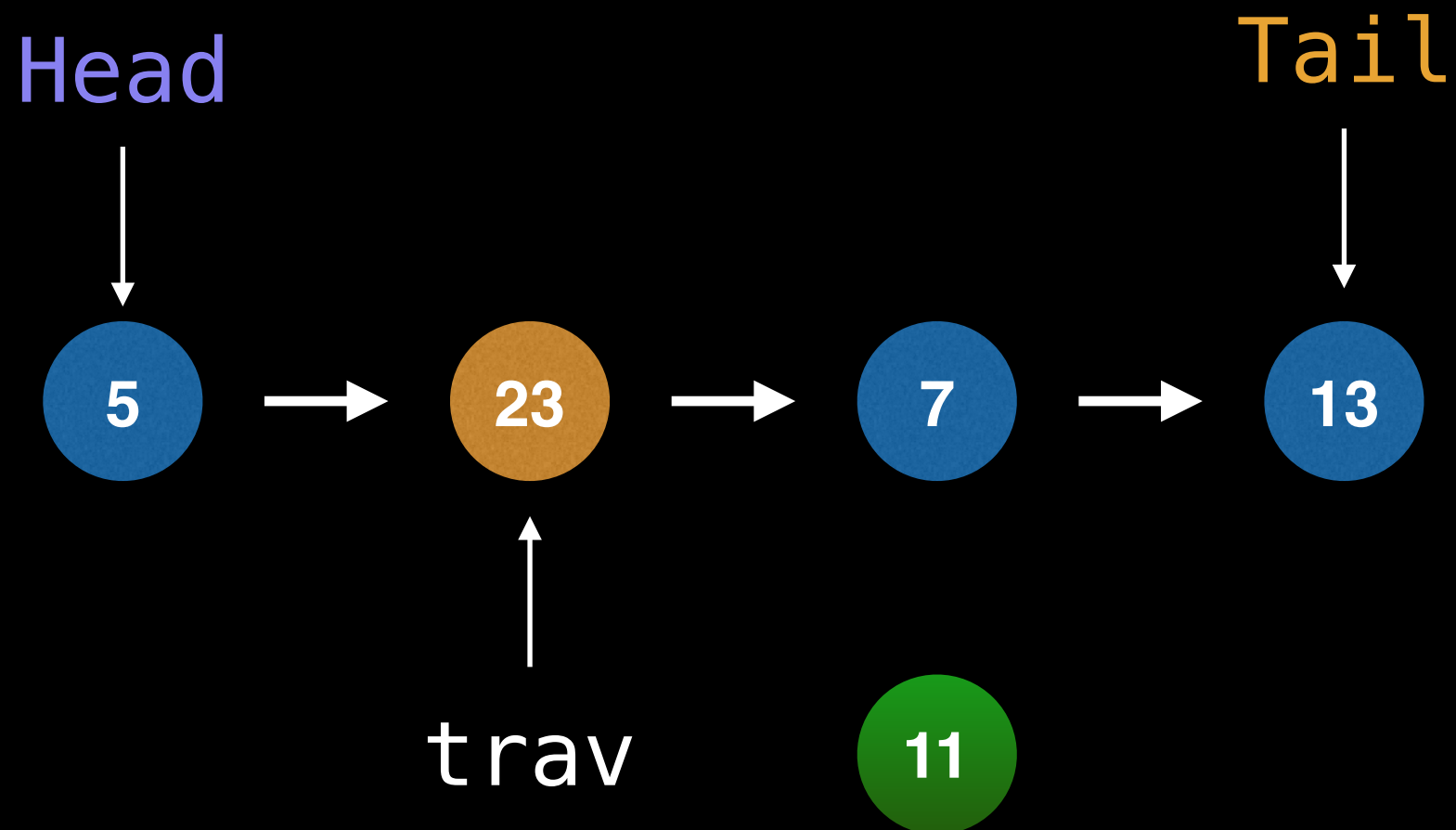
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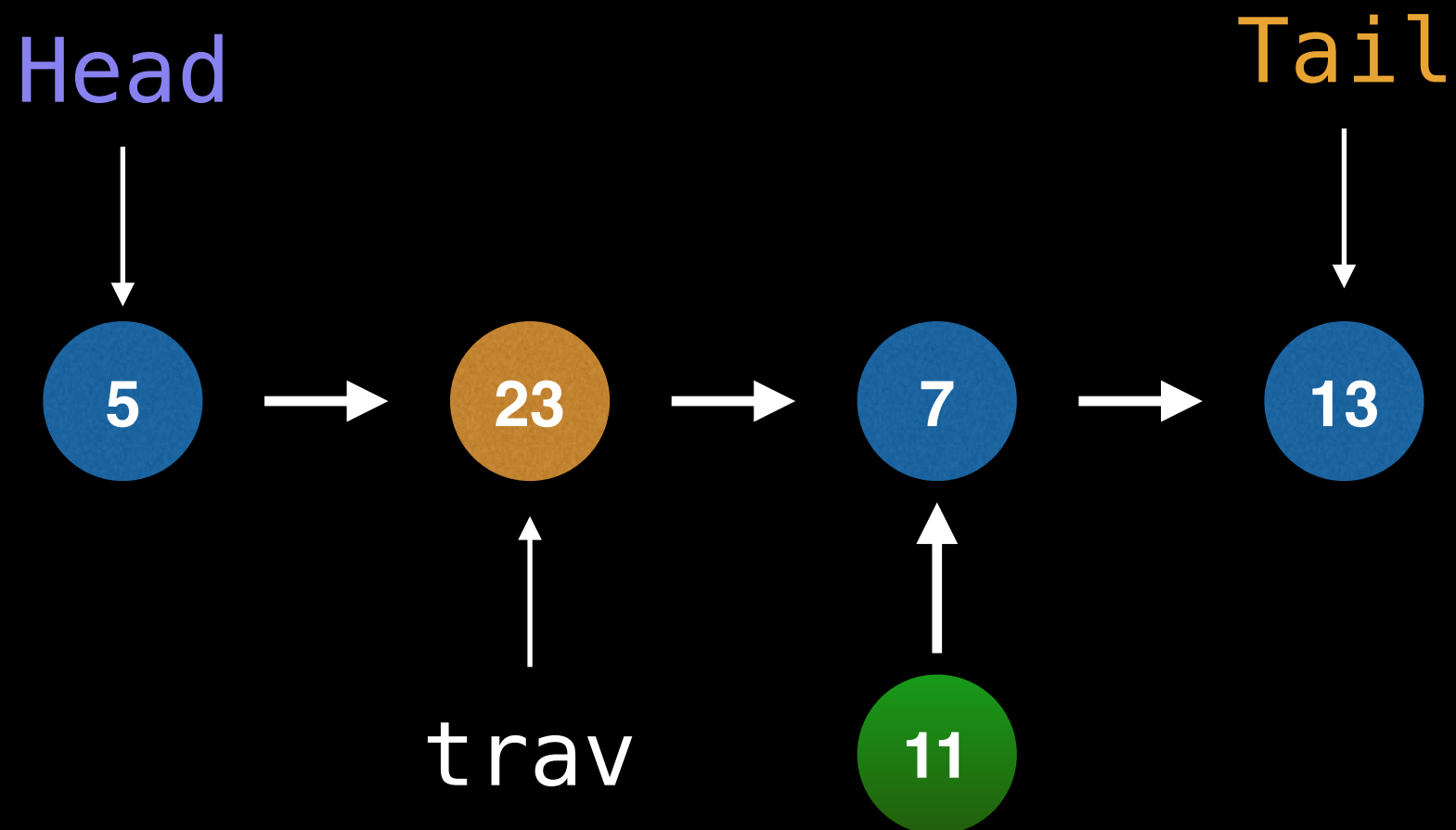
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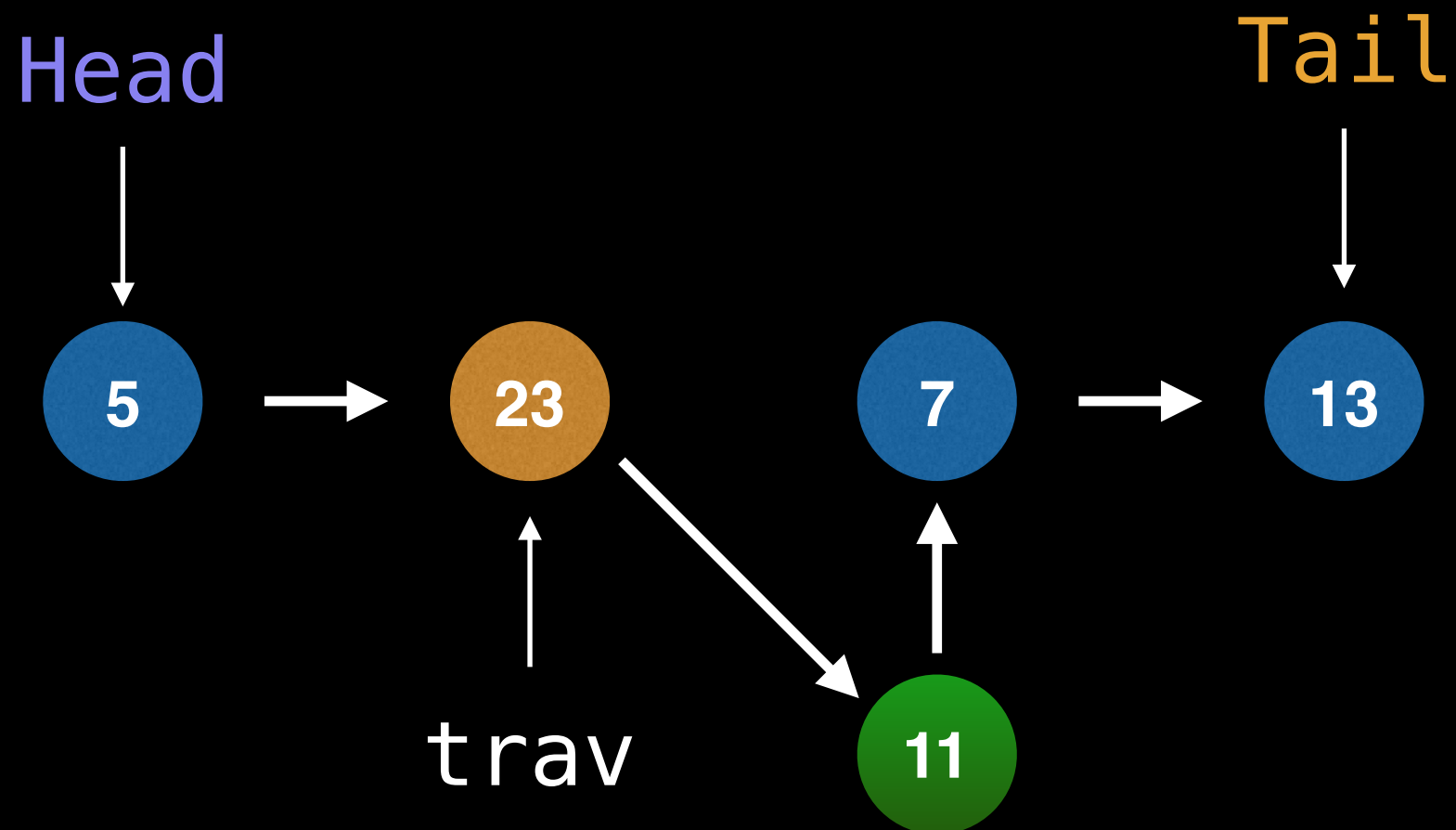
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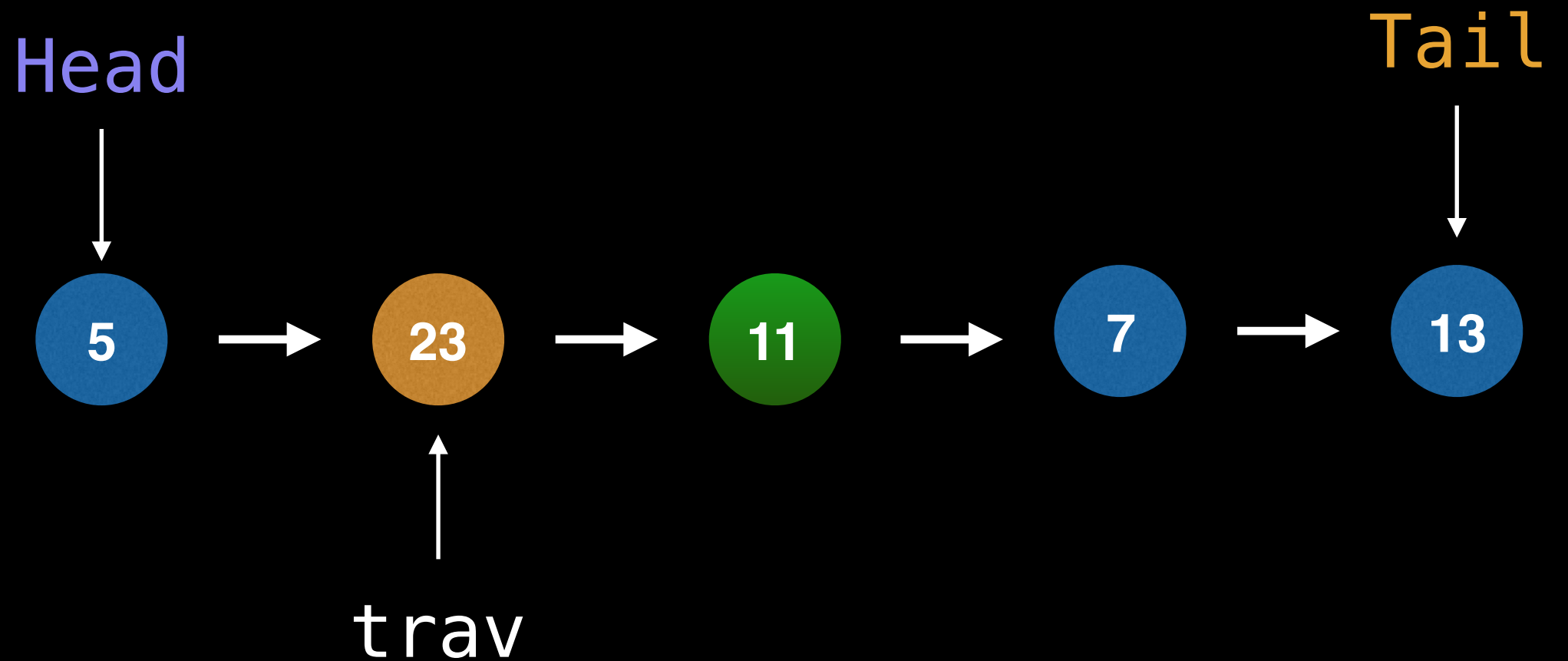
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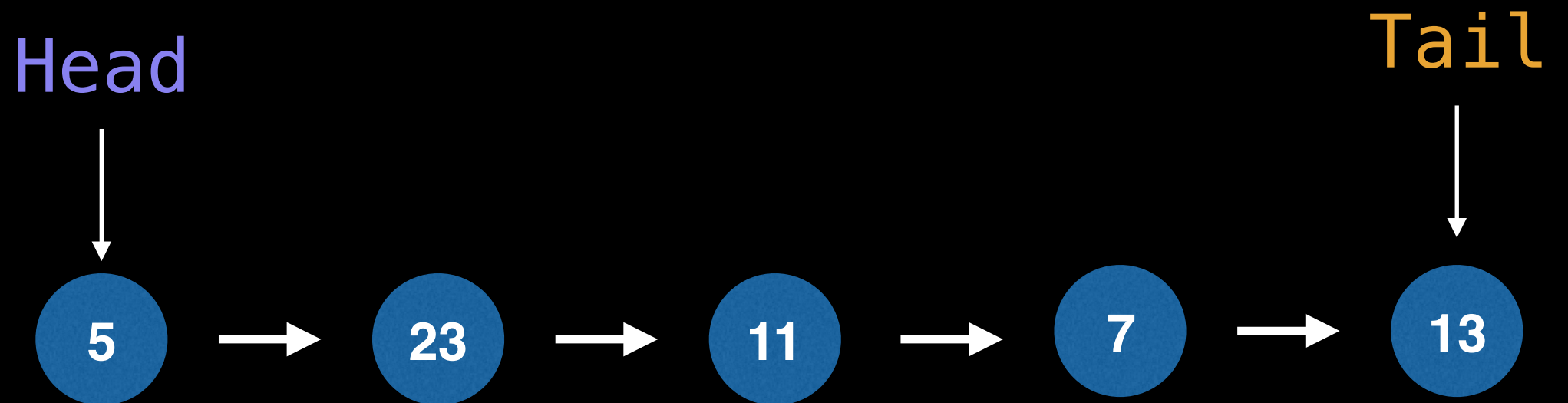
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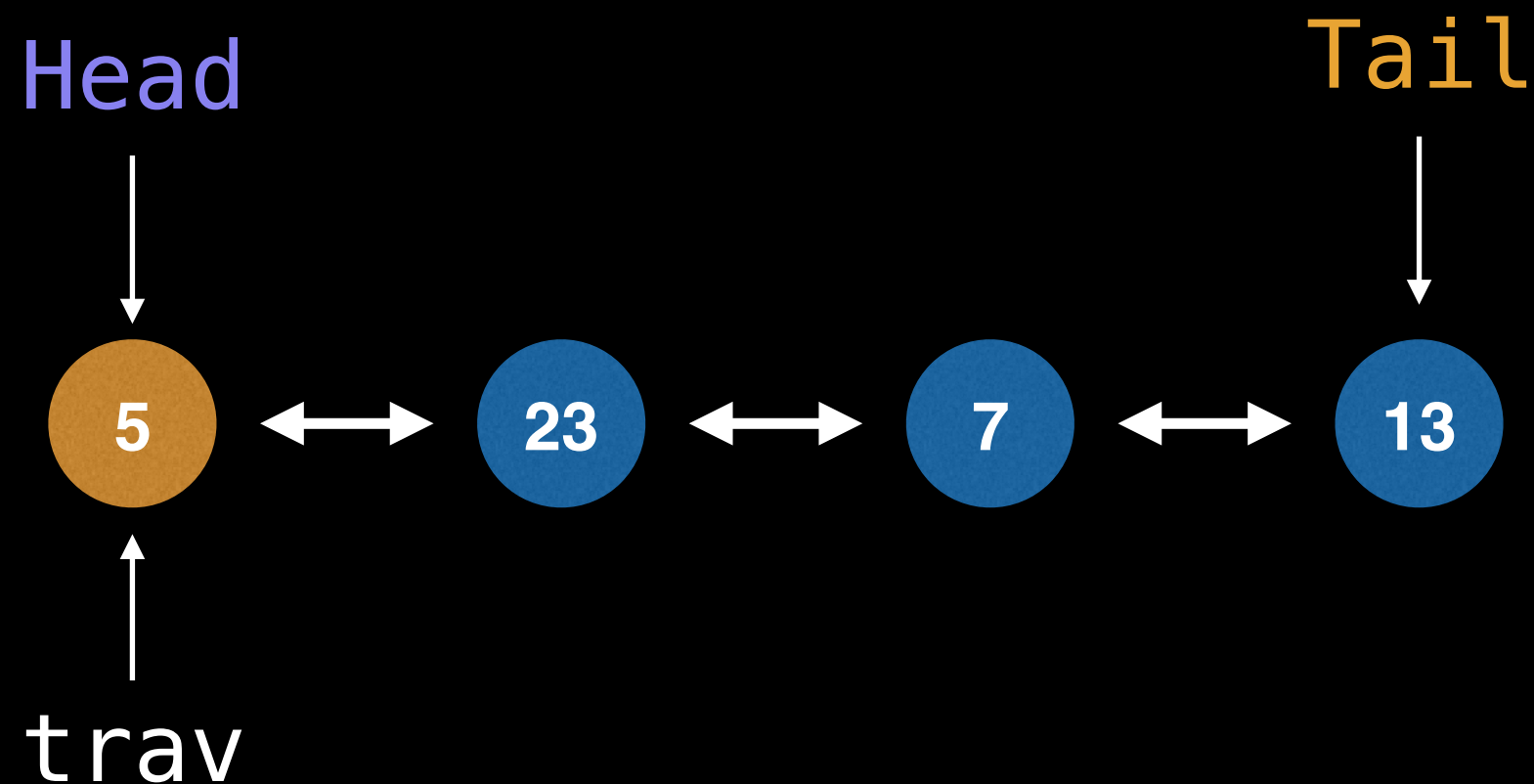
Inserting Doubly Linked List

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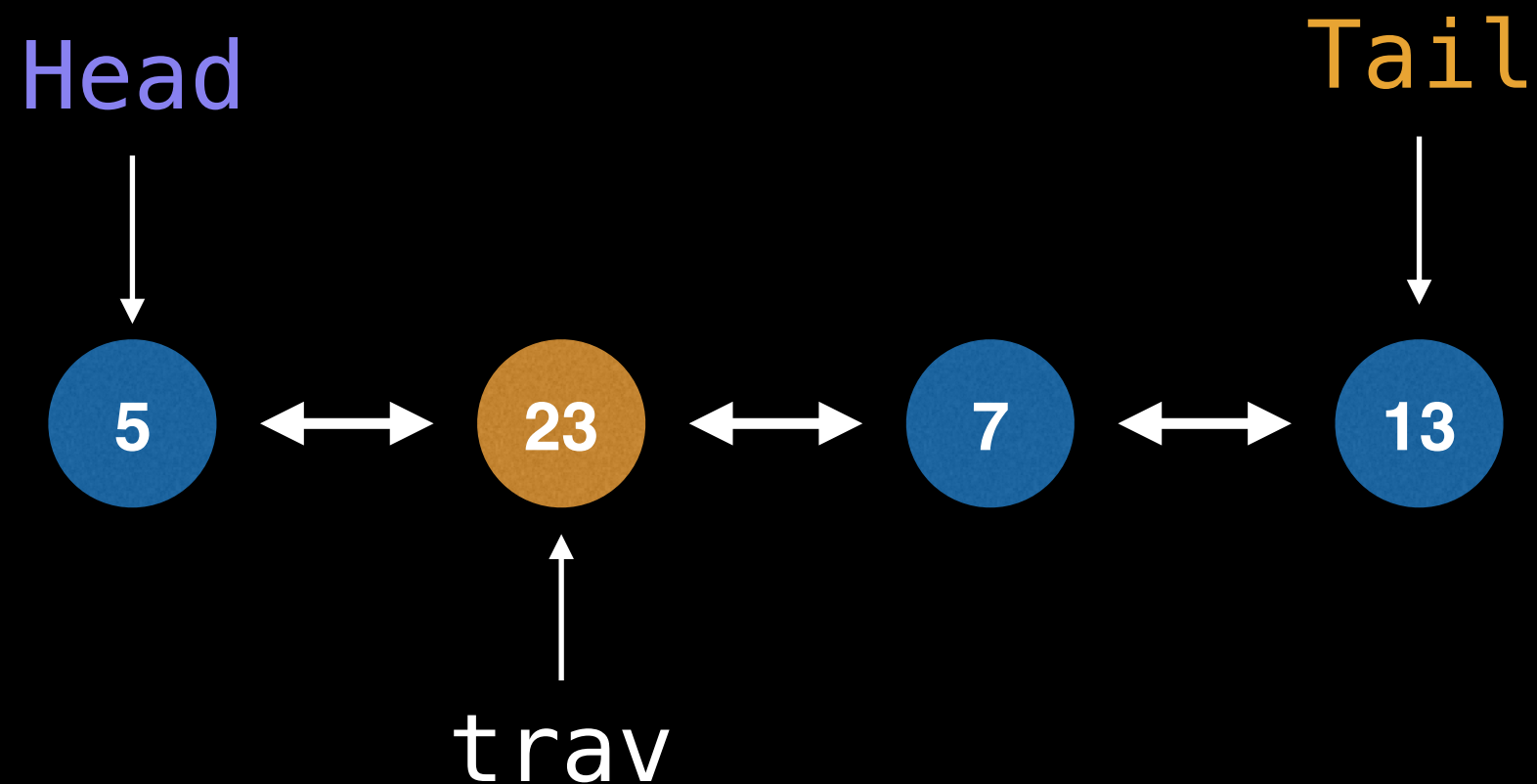
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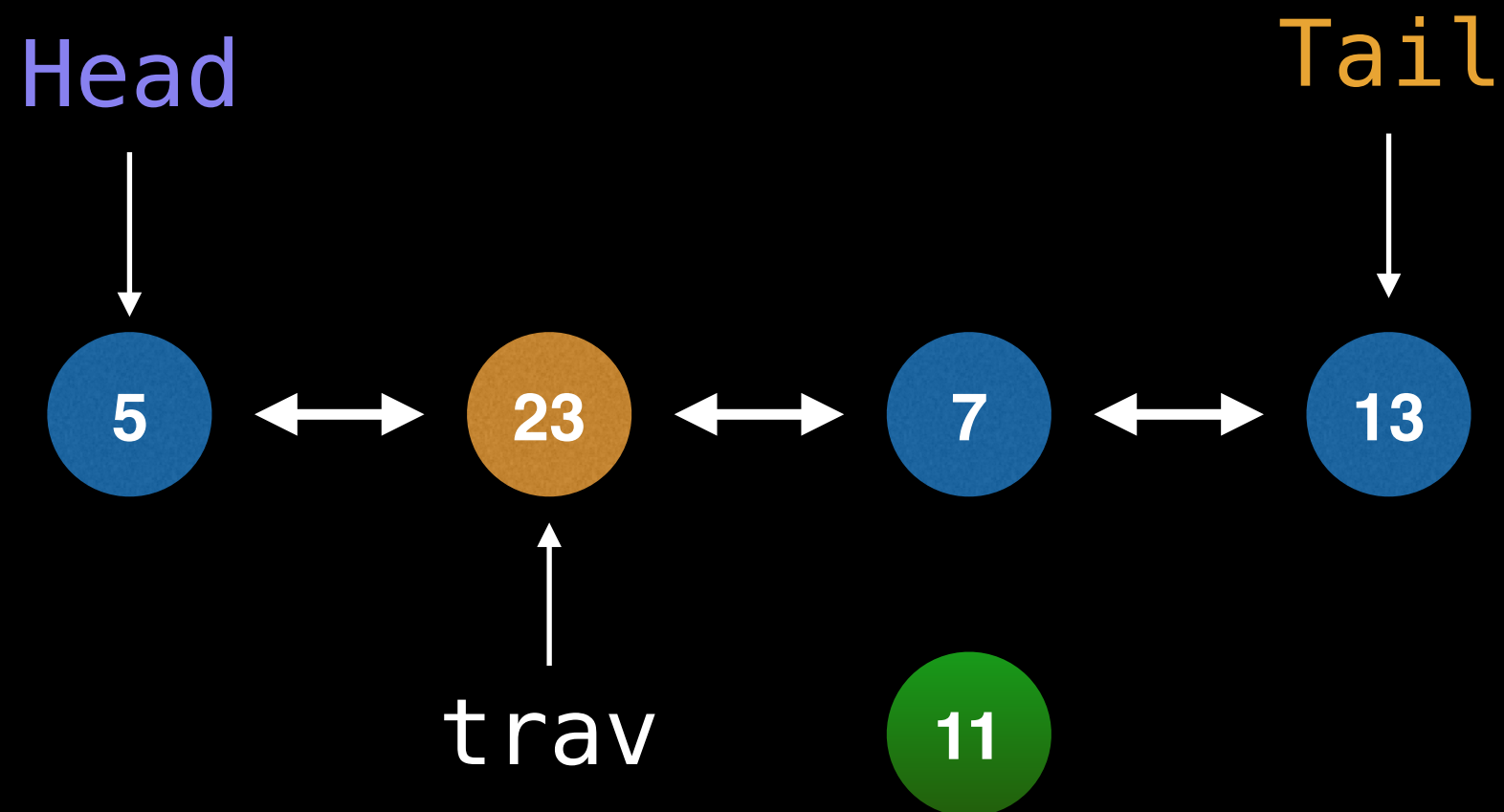
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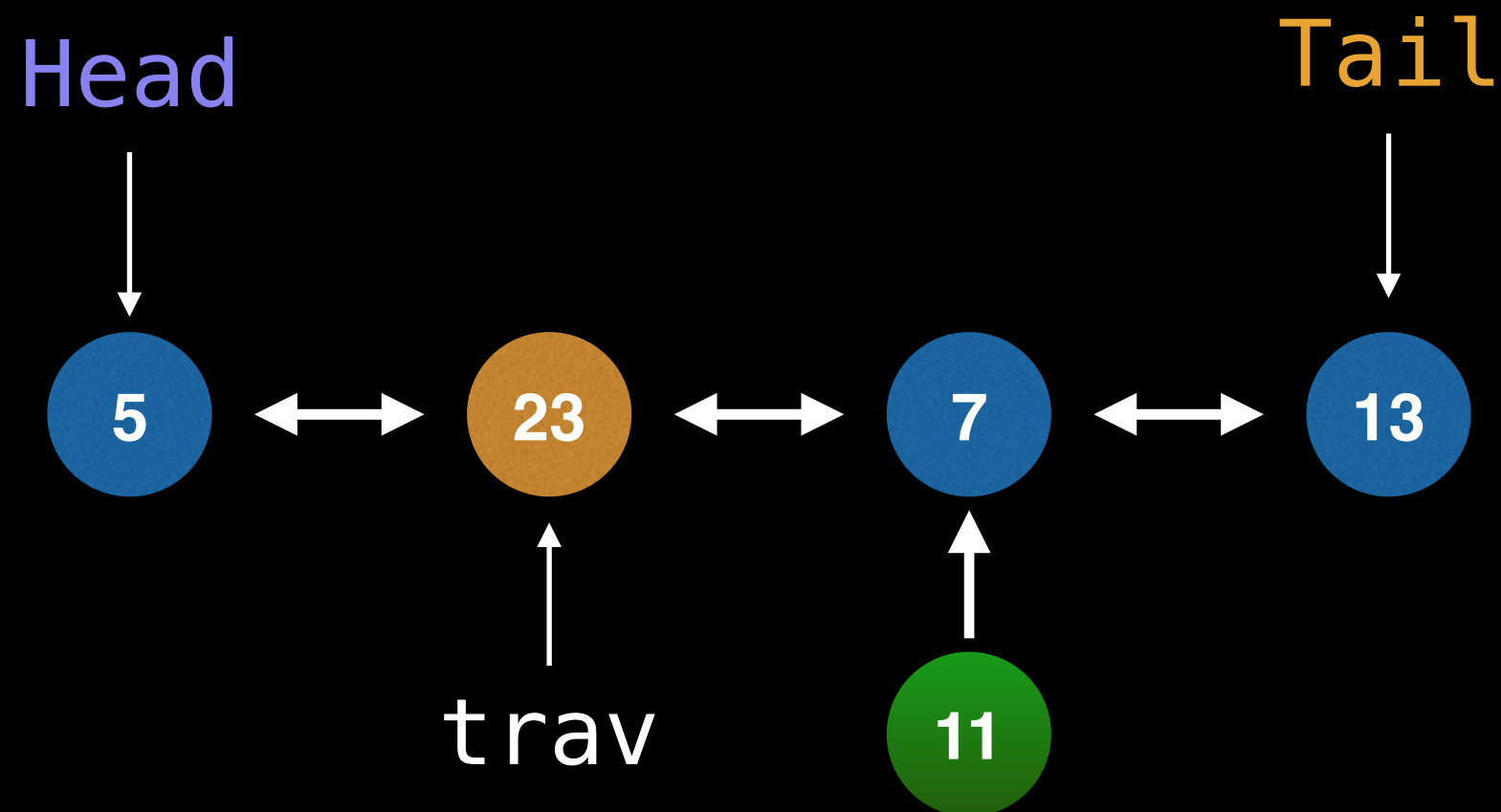
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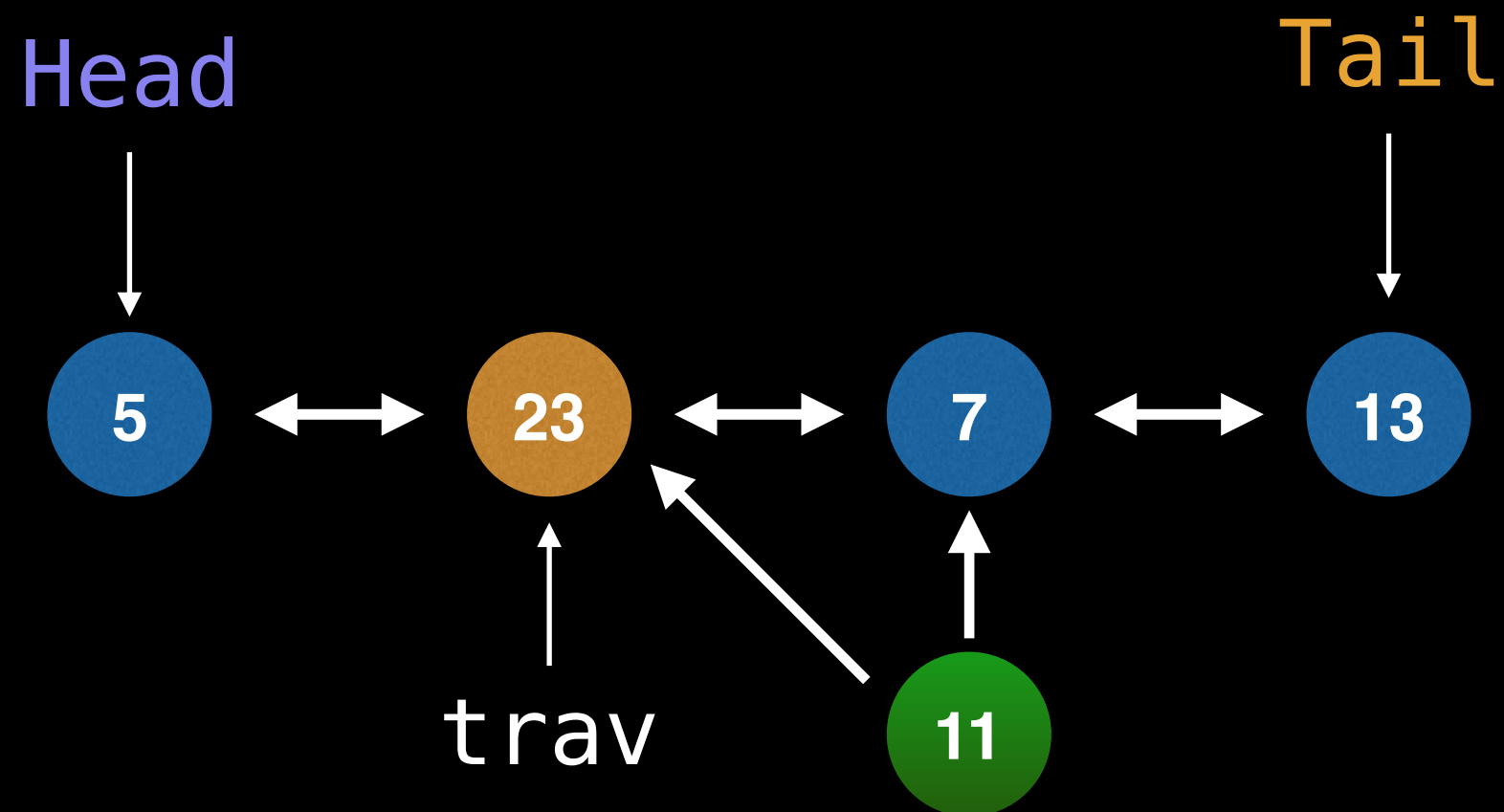
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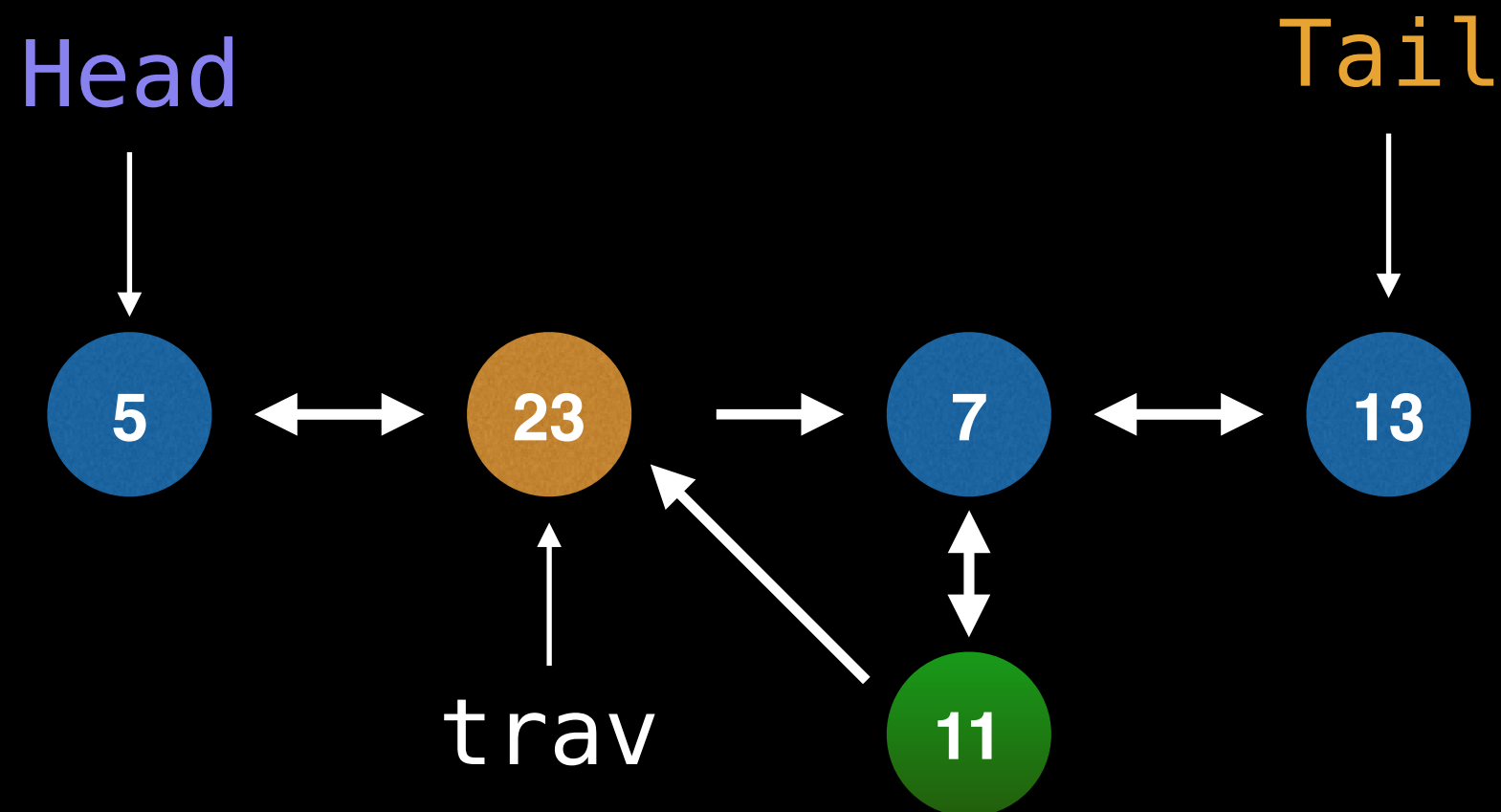
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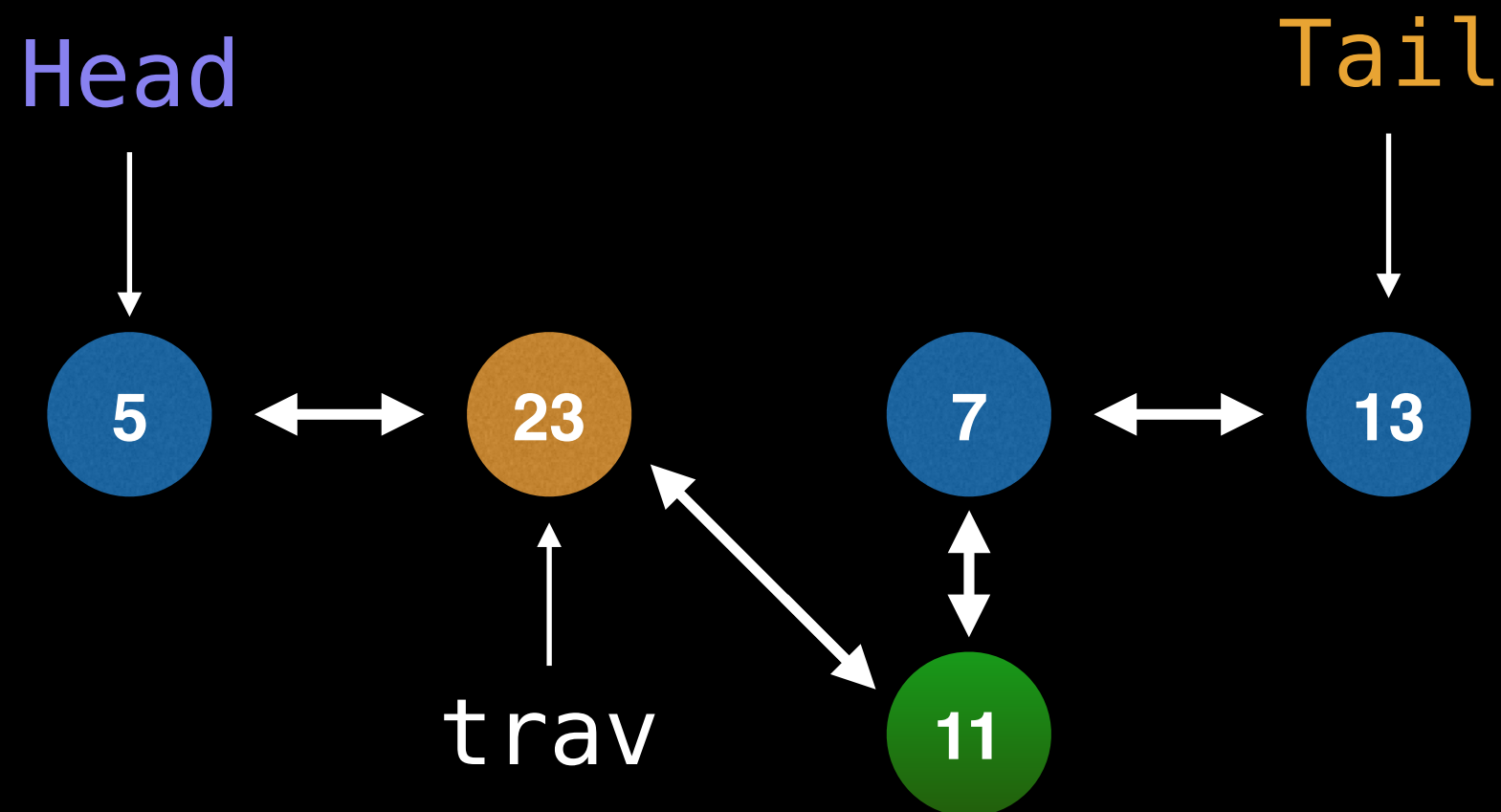
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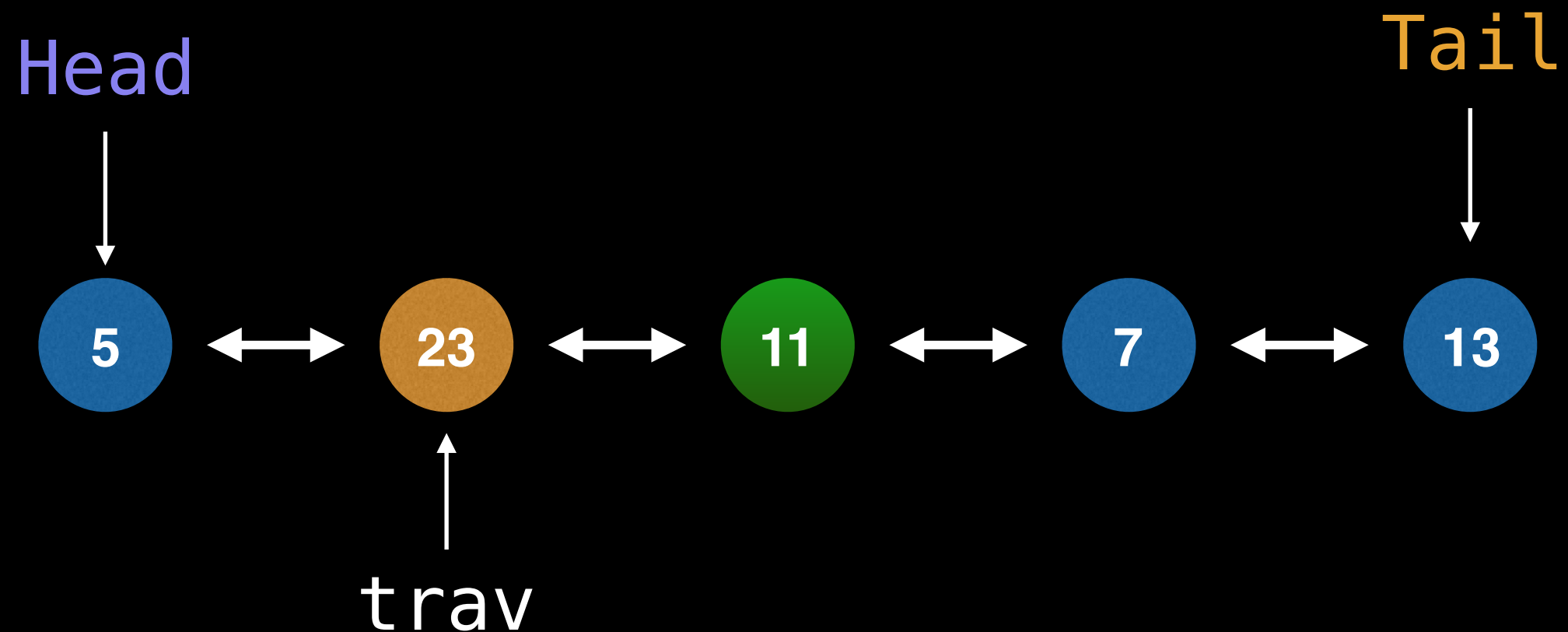
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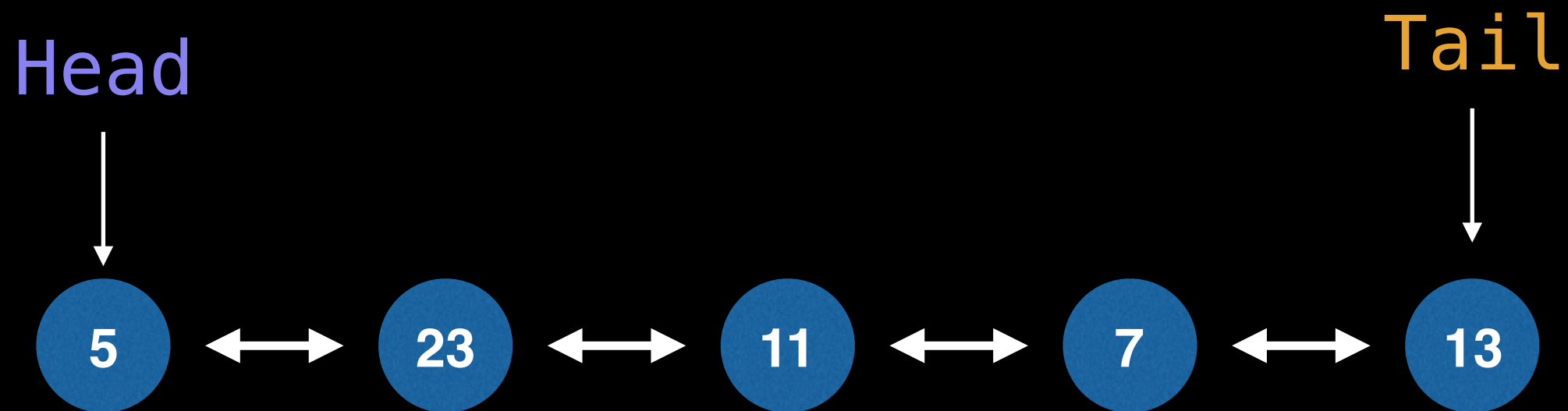
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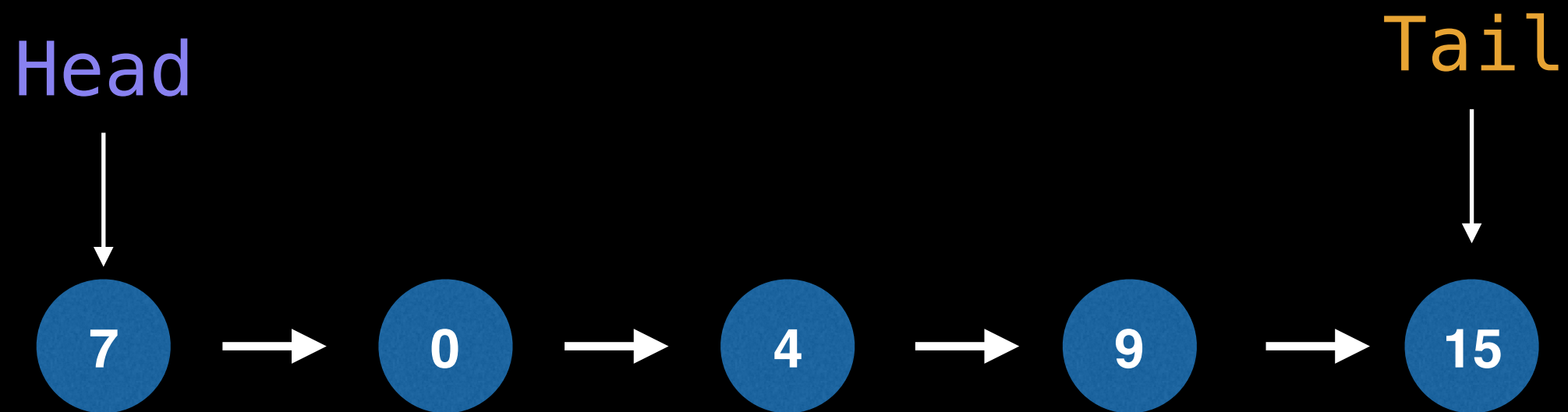
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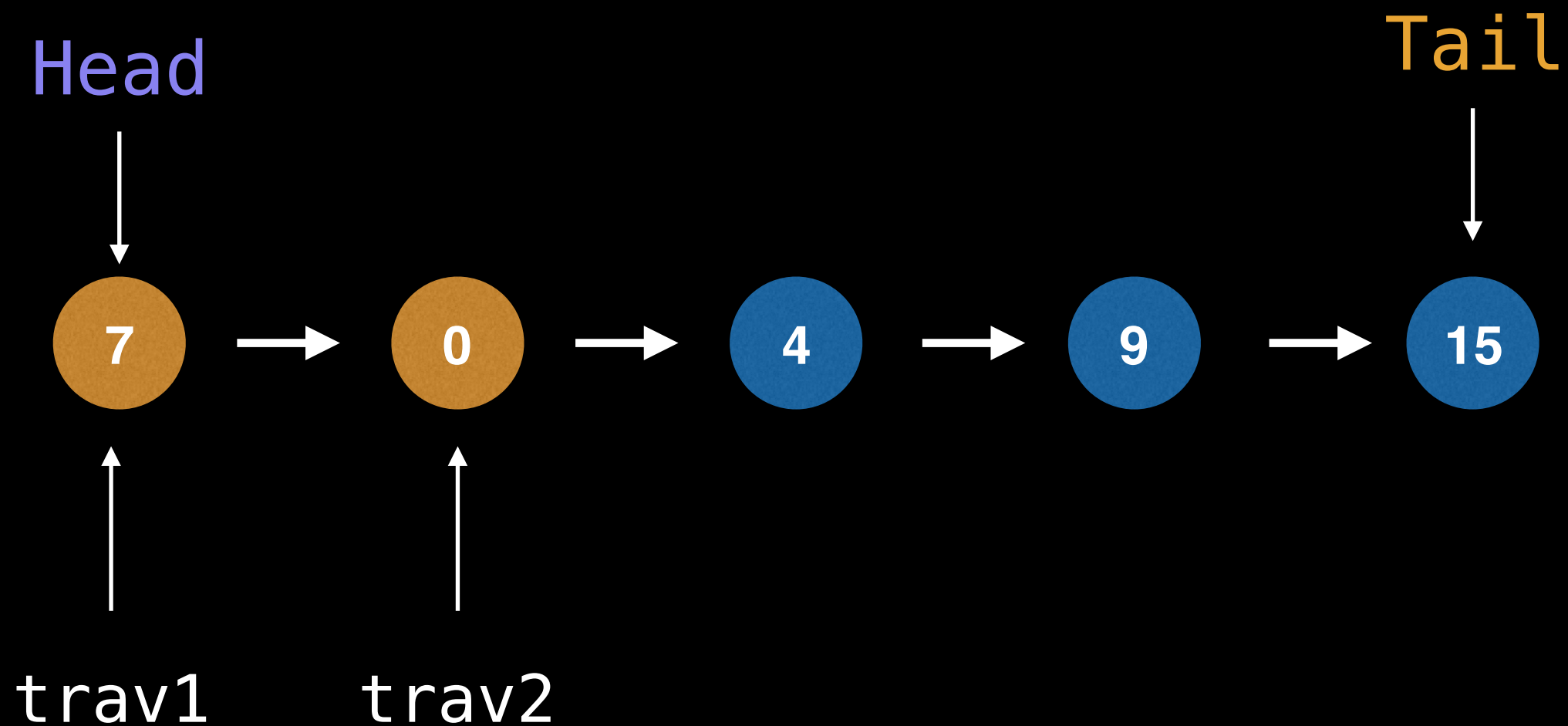
Removing from Singly Linked List

Remove 9 from the following SLL



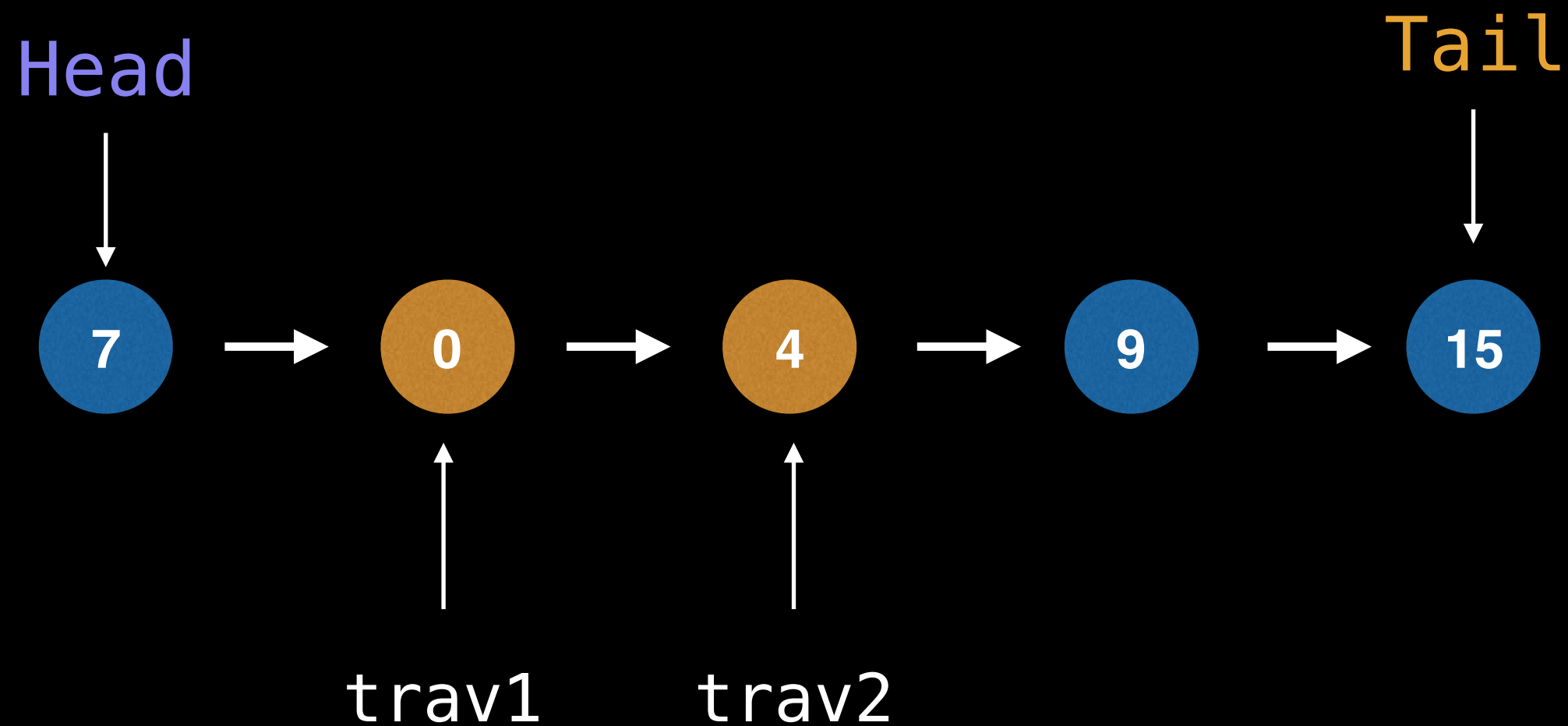
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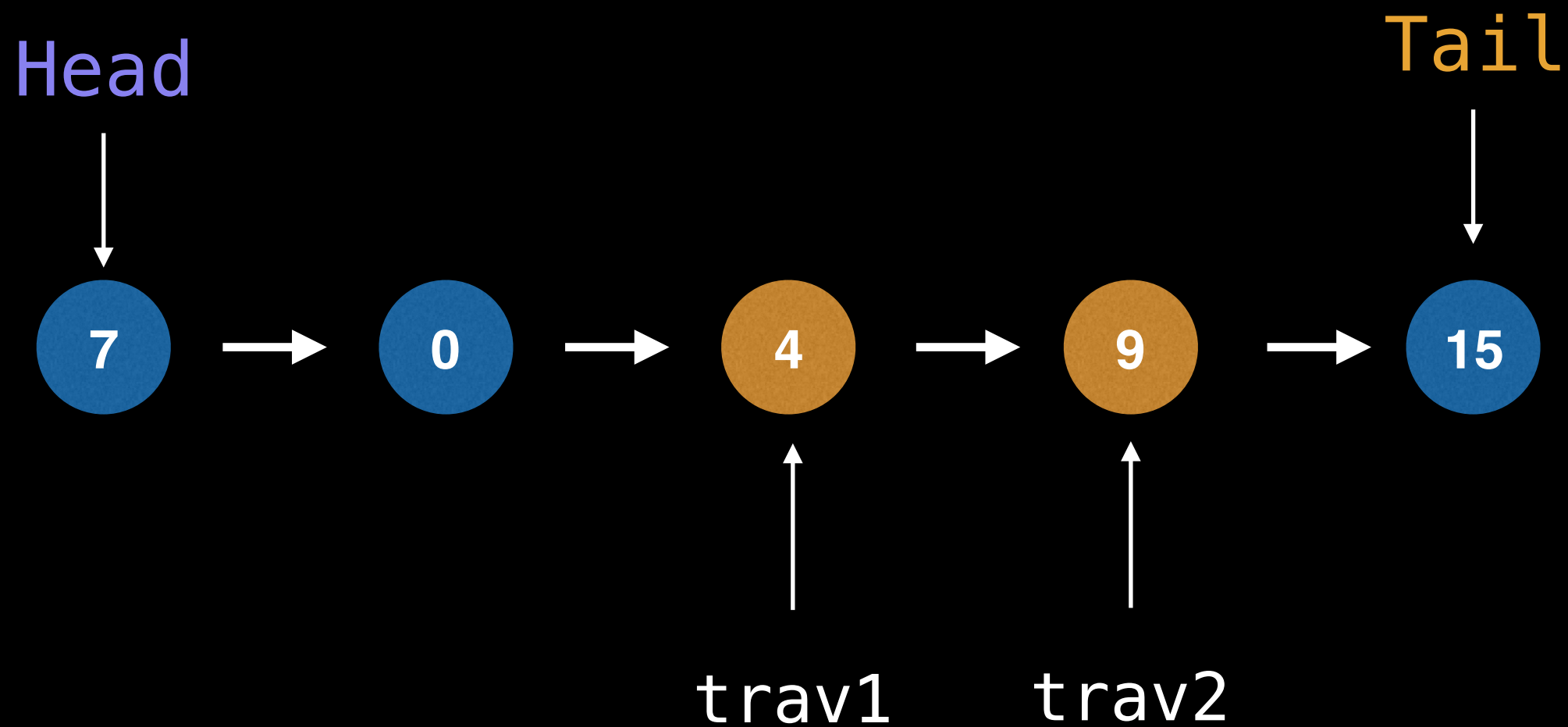
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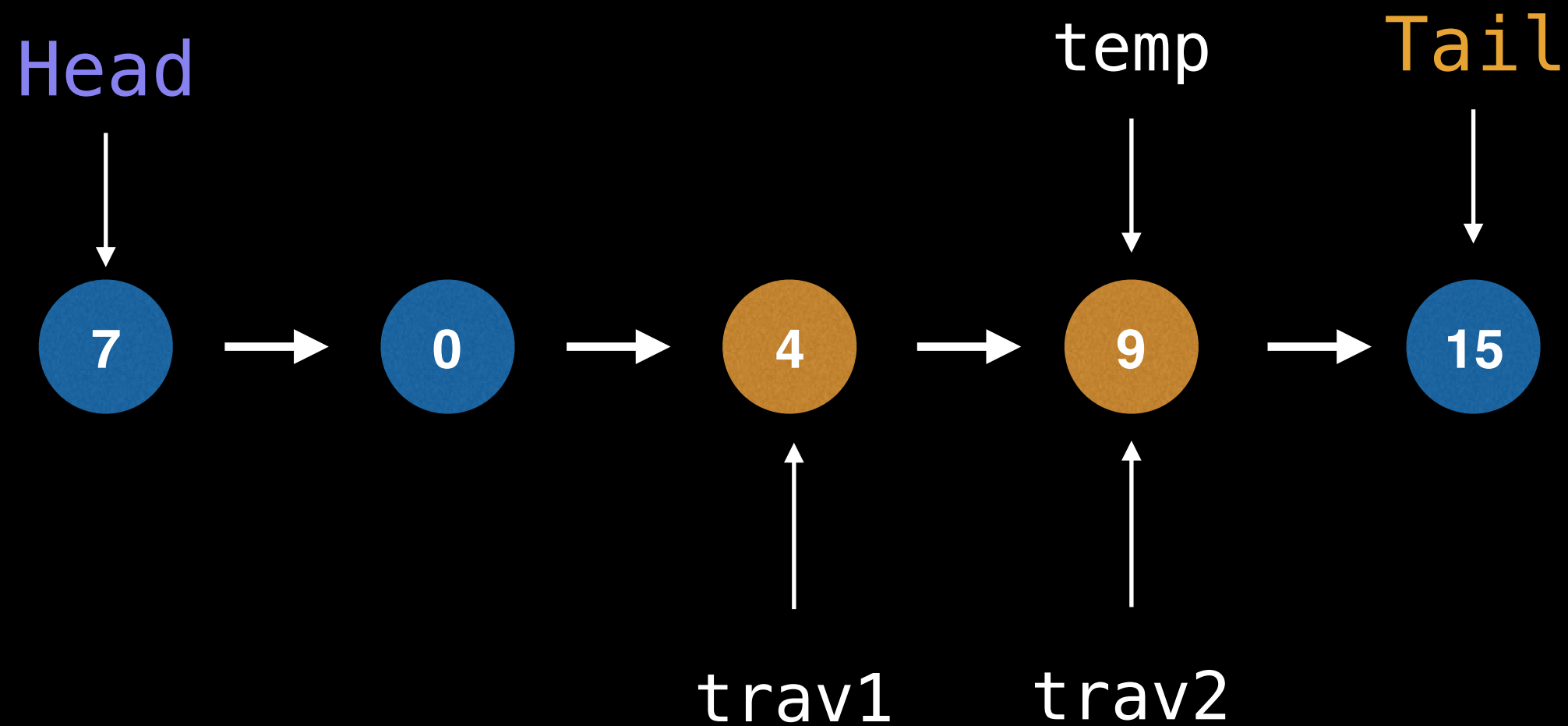
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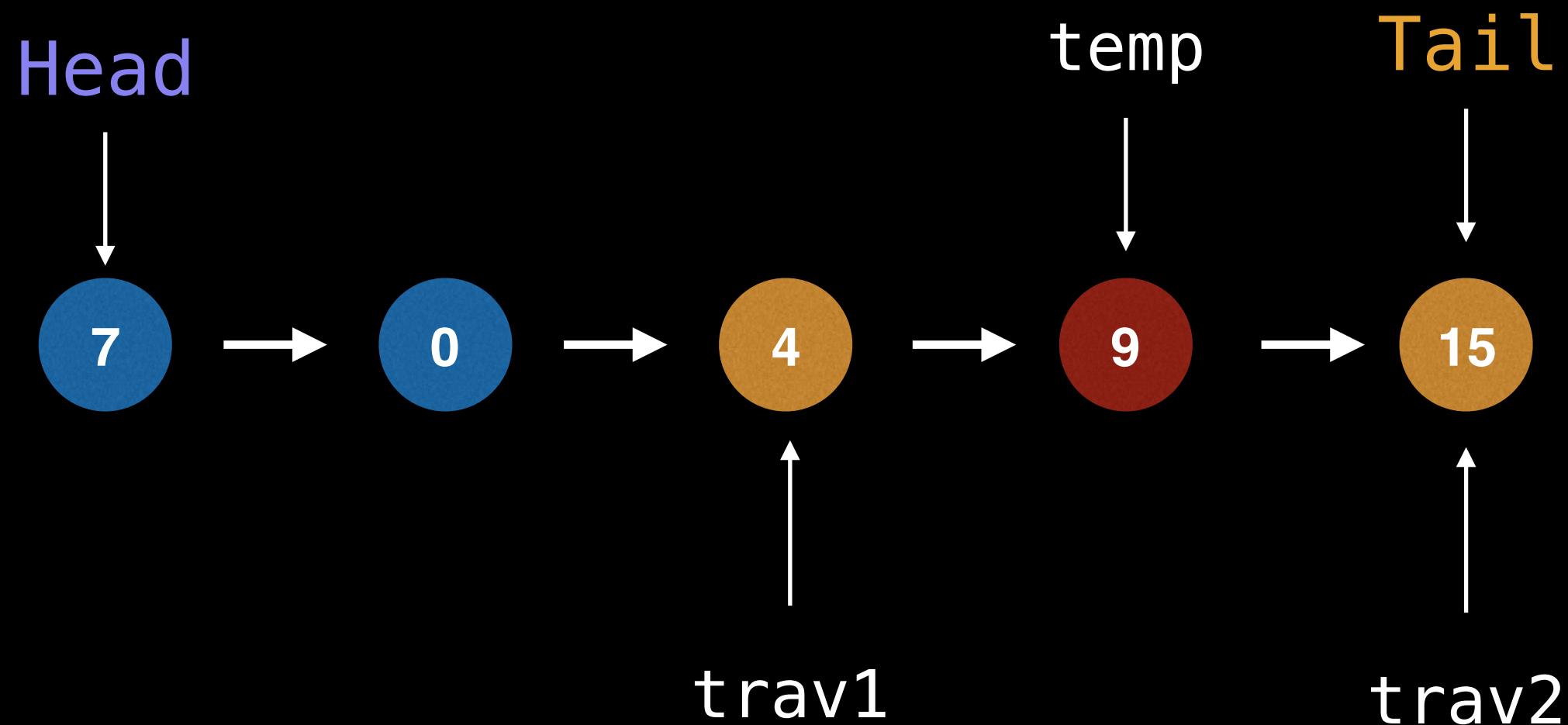
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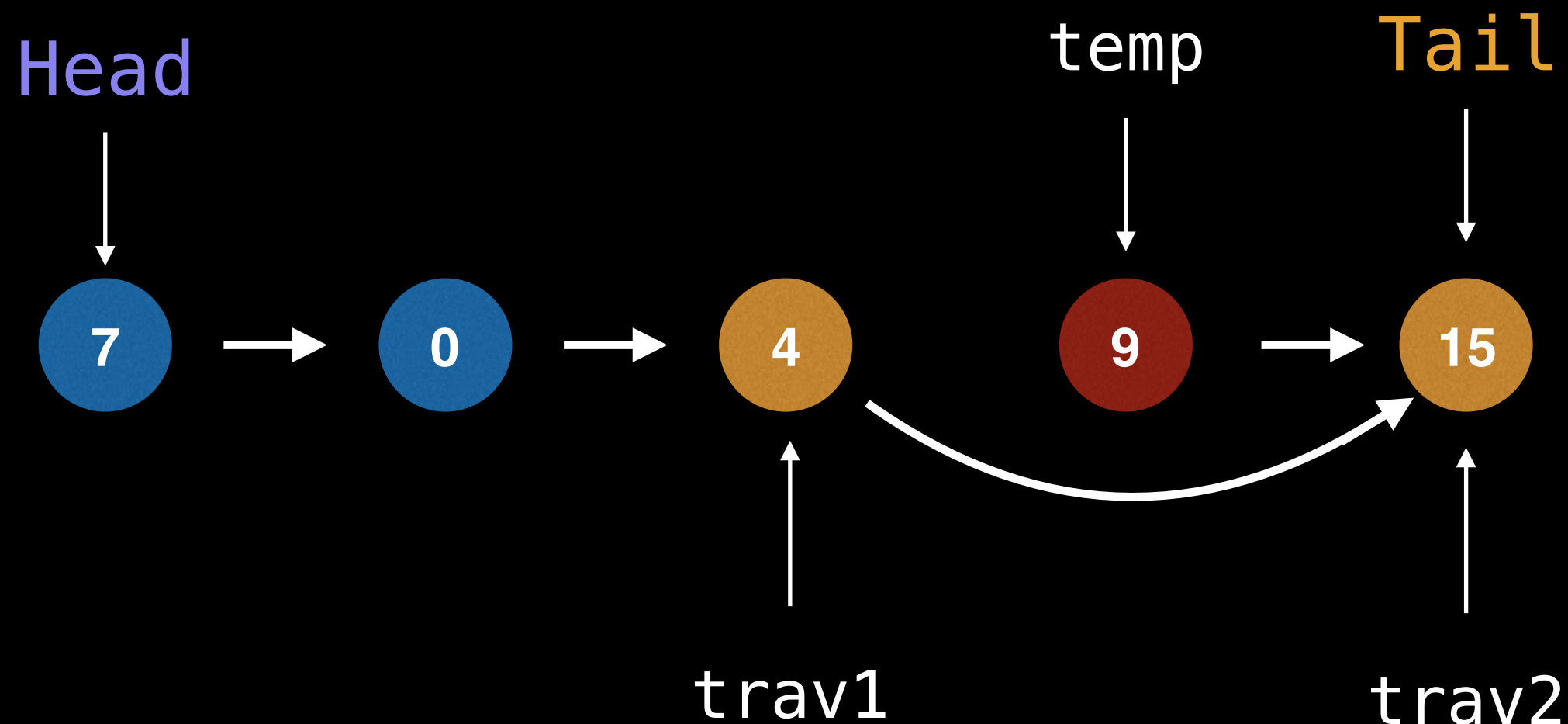
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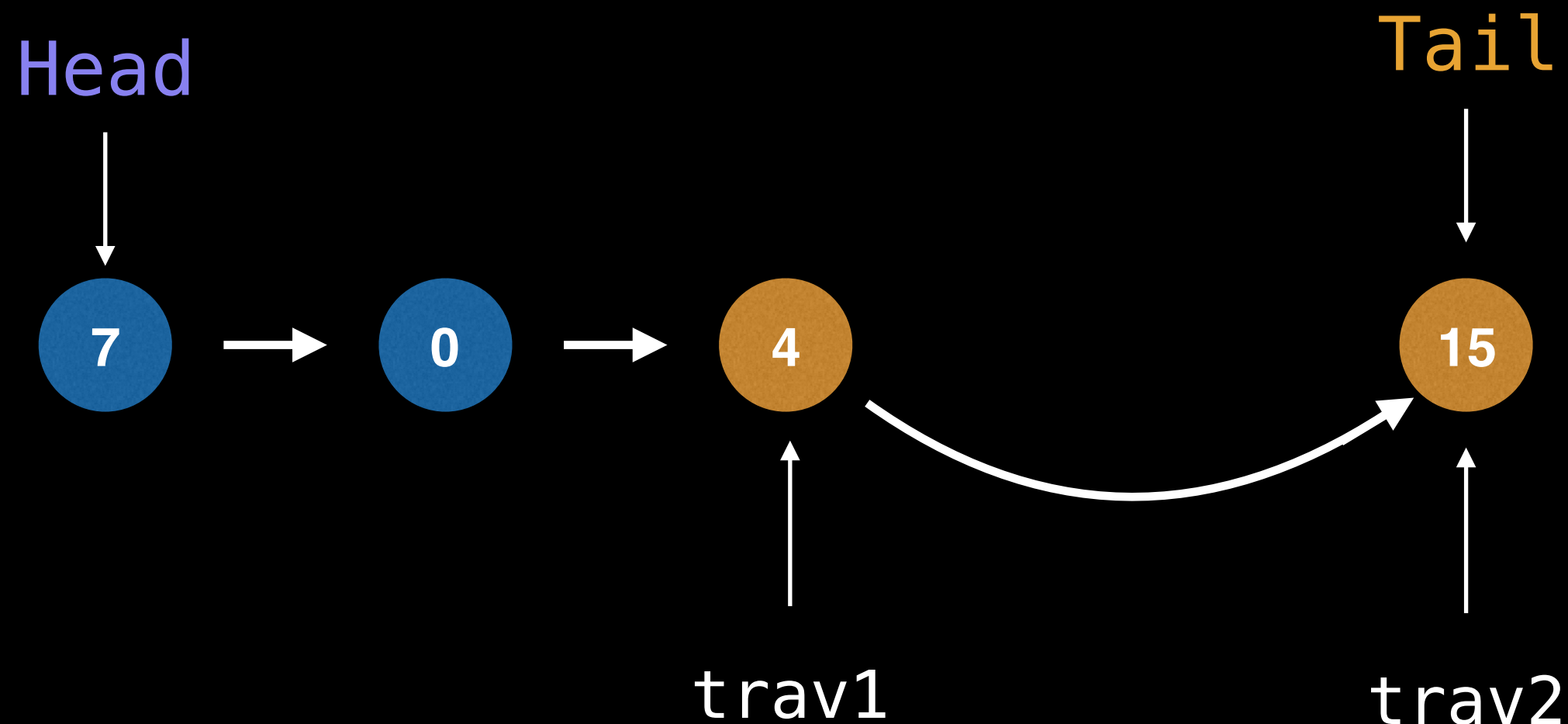
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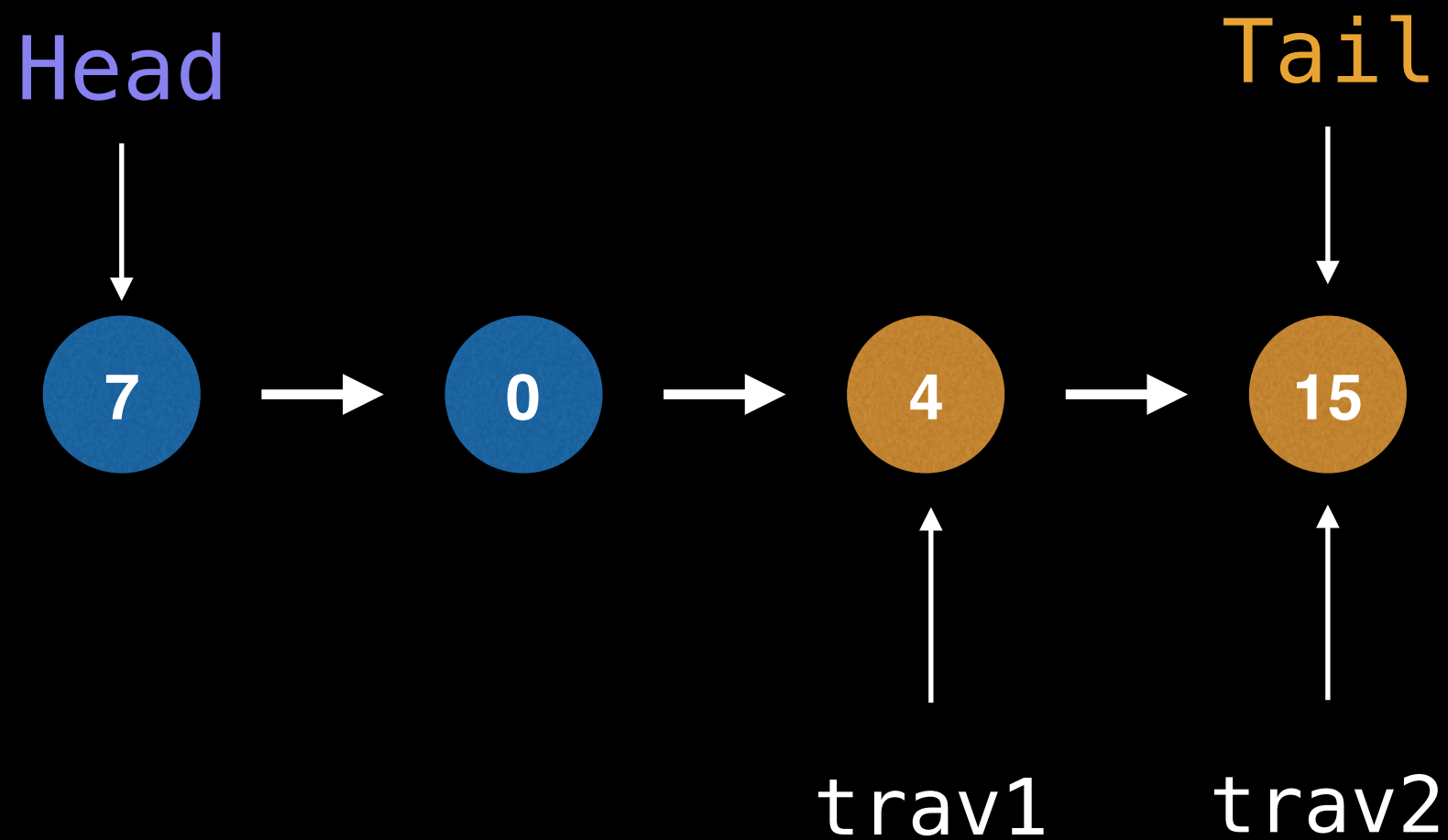
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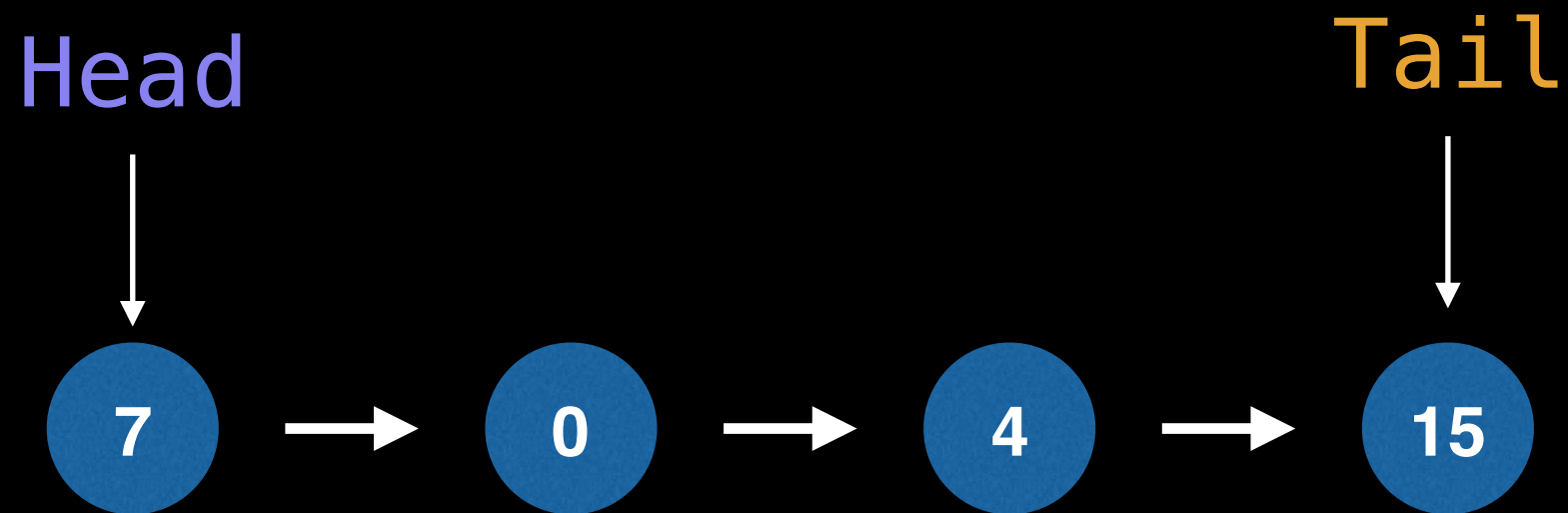
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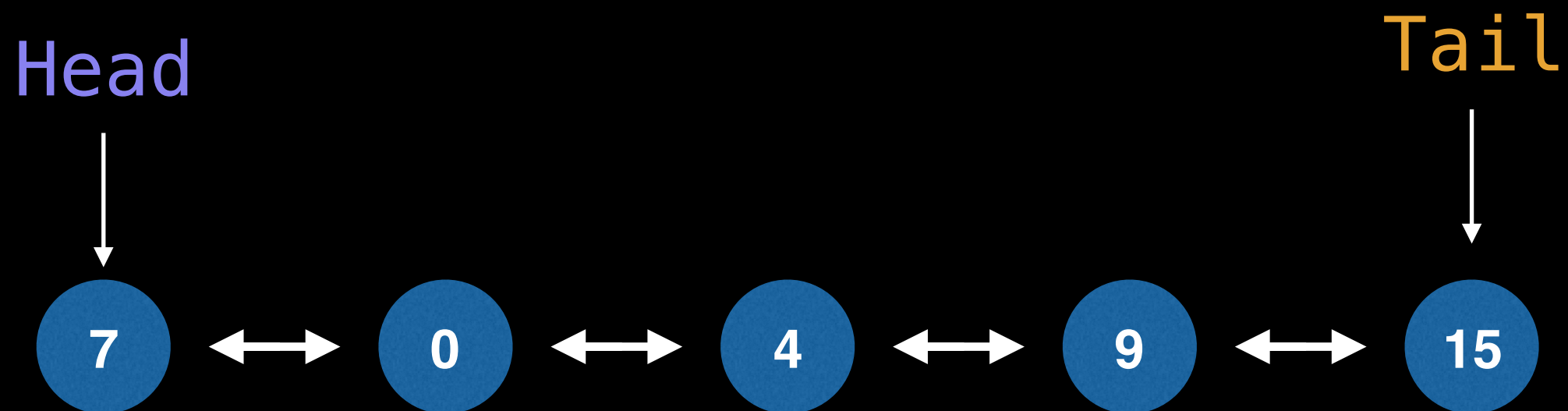
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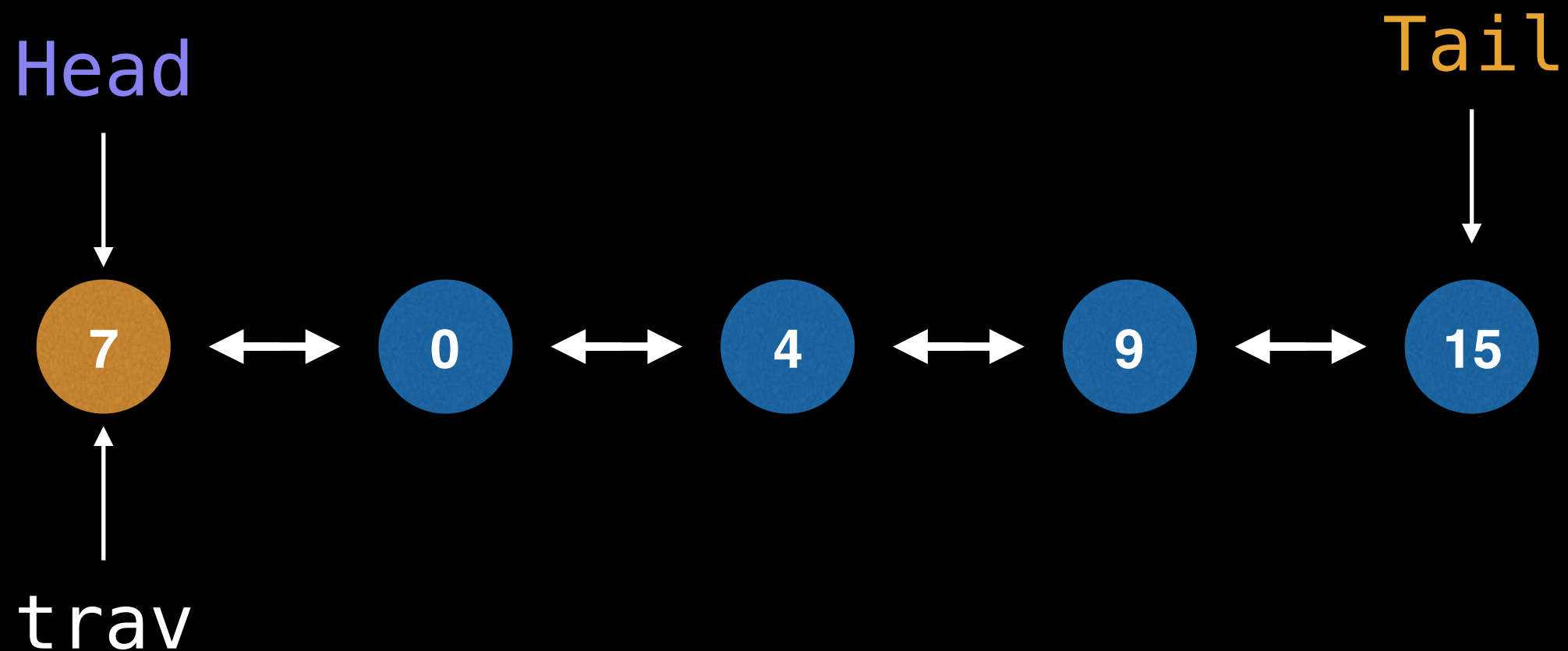
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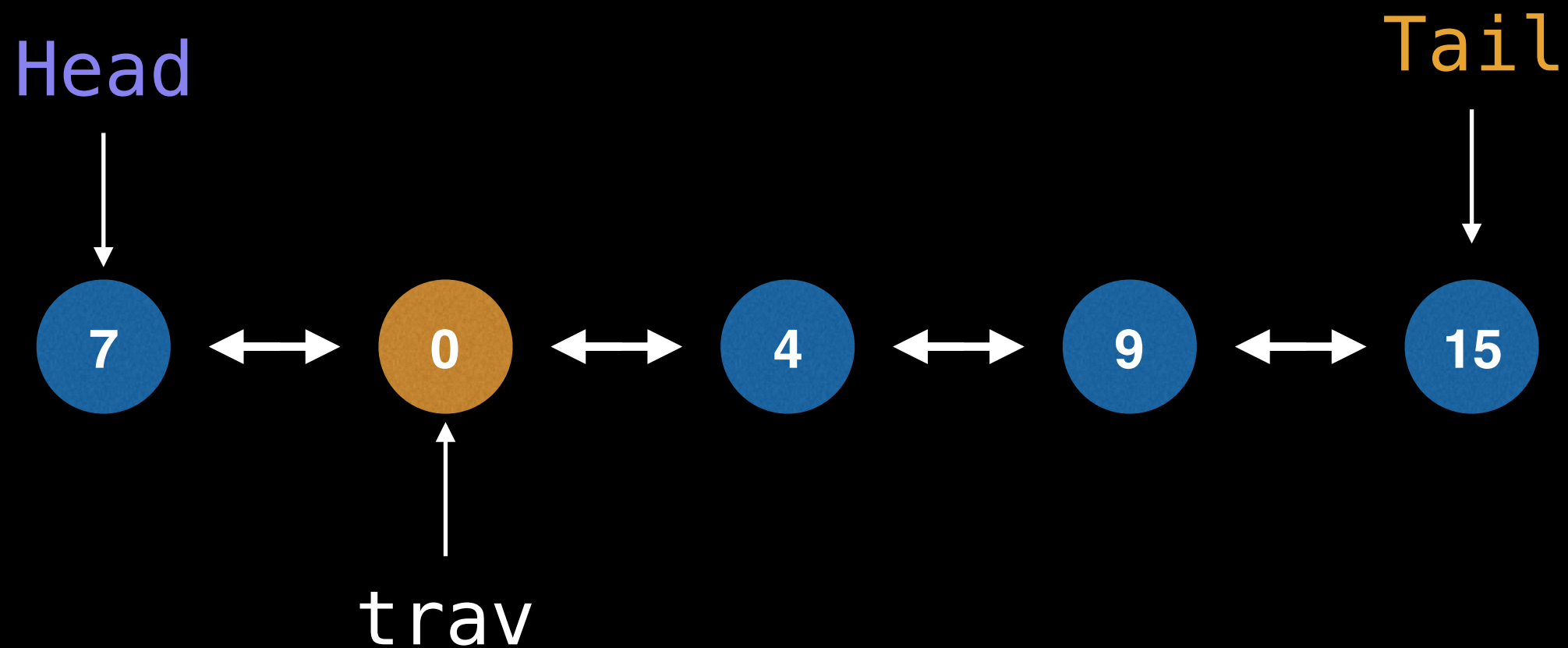
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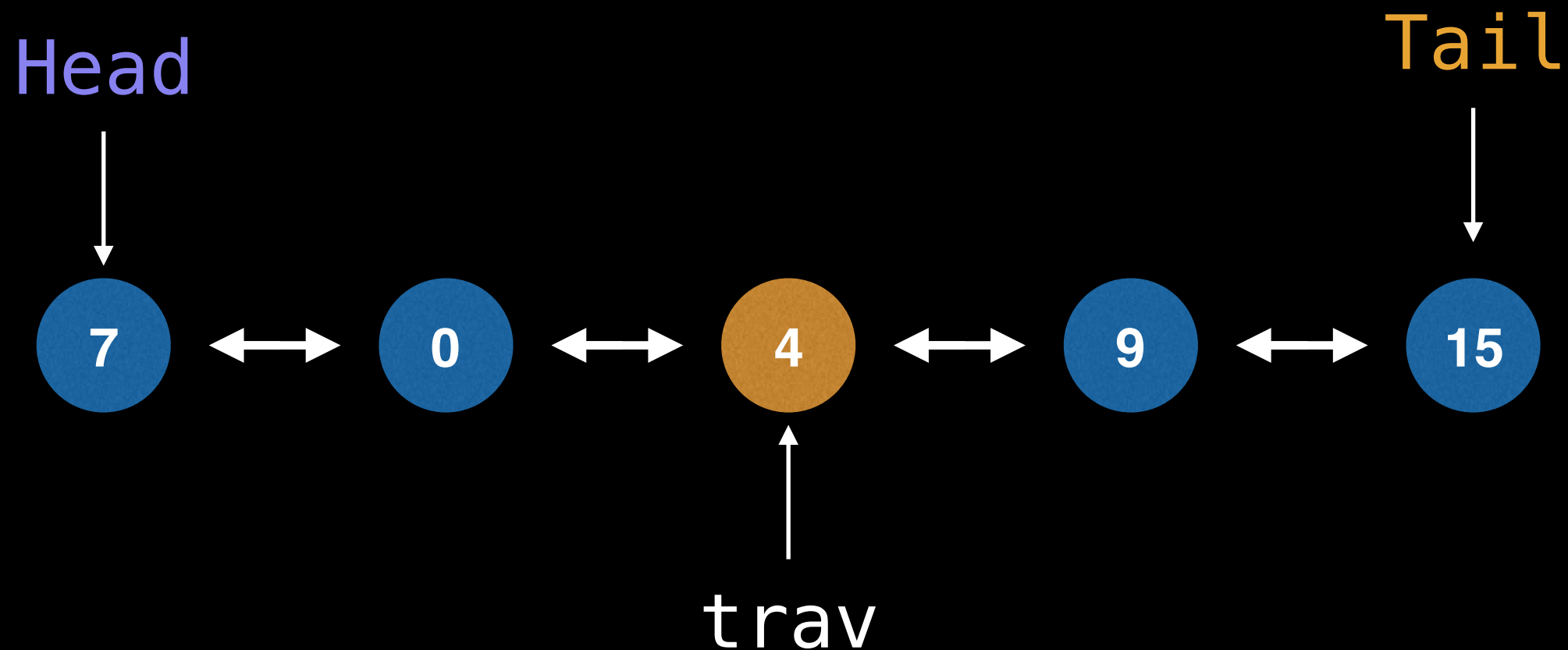
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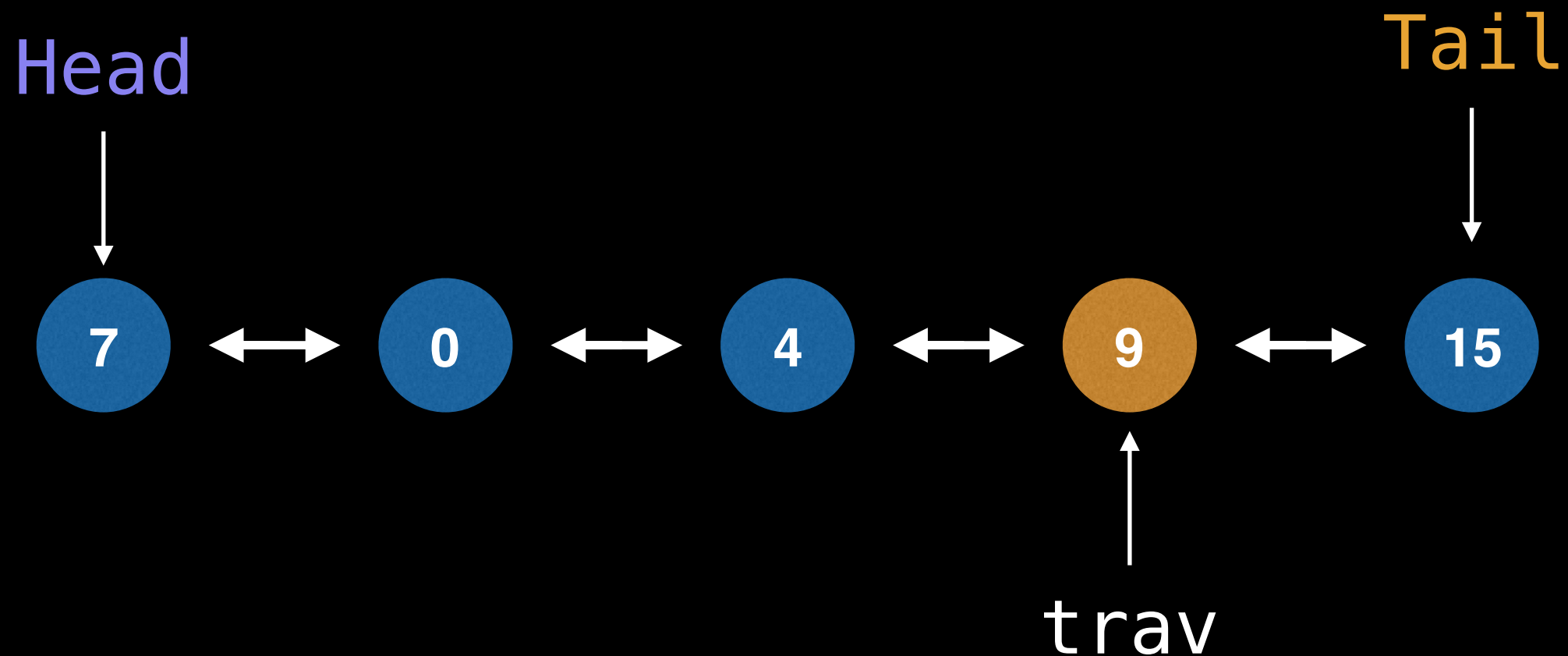
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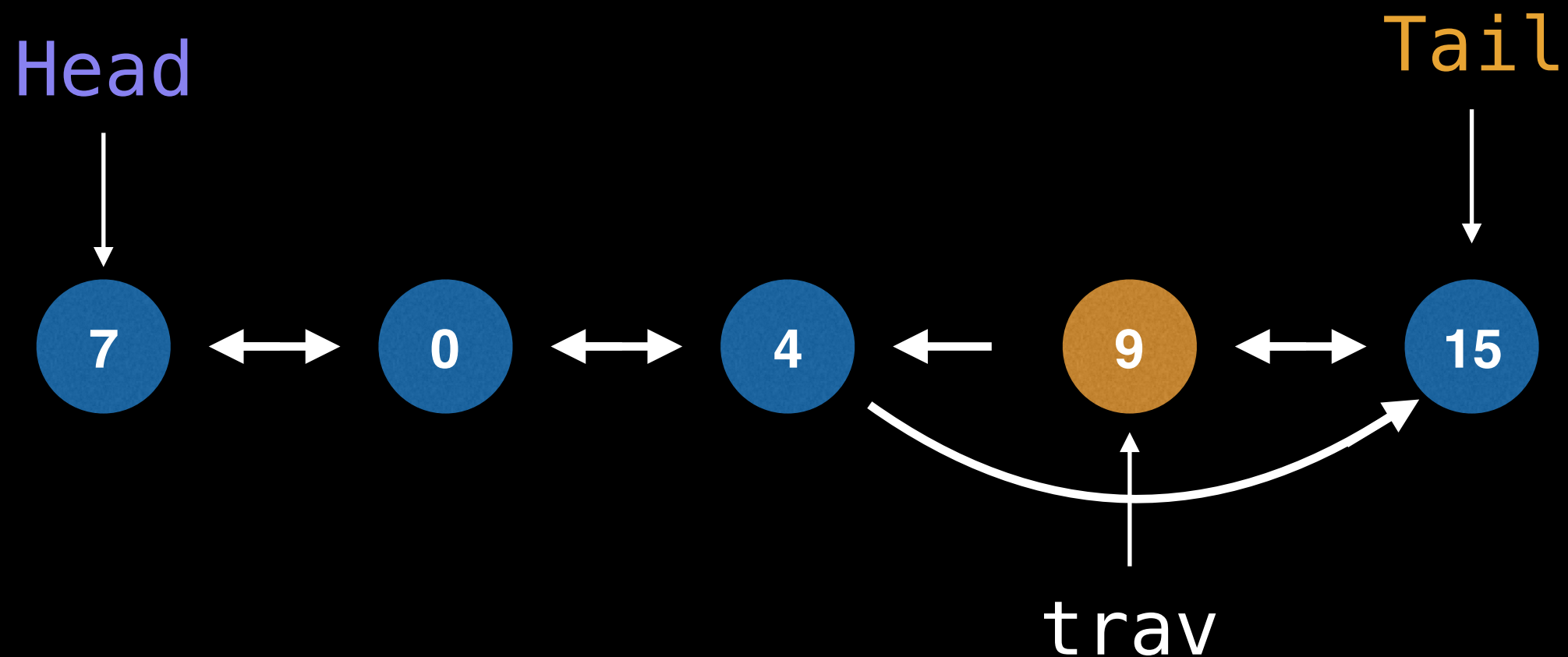
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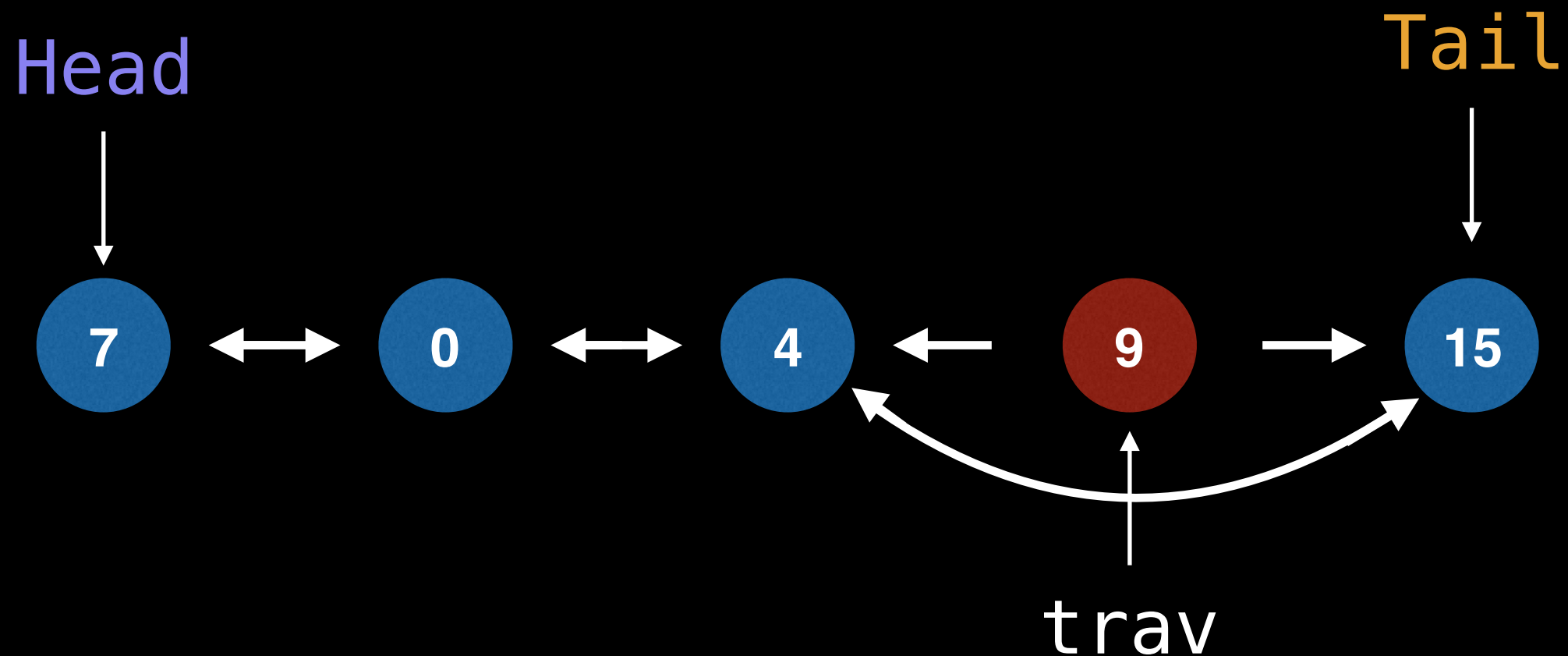
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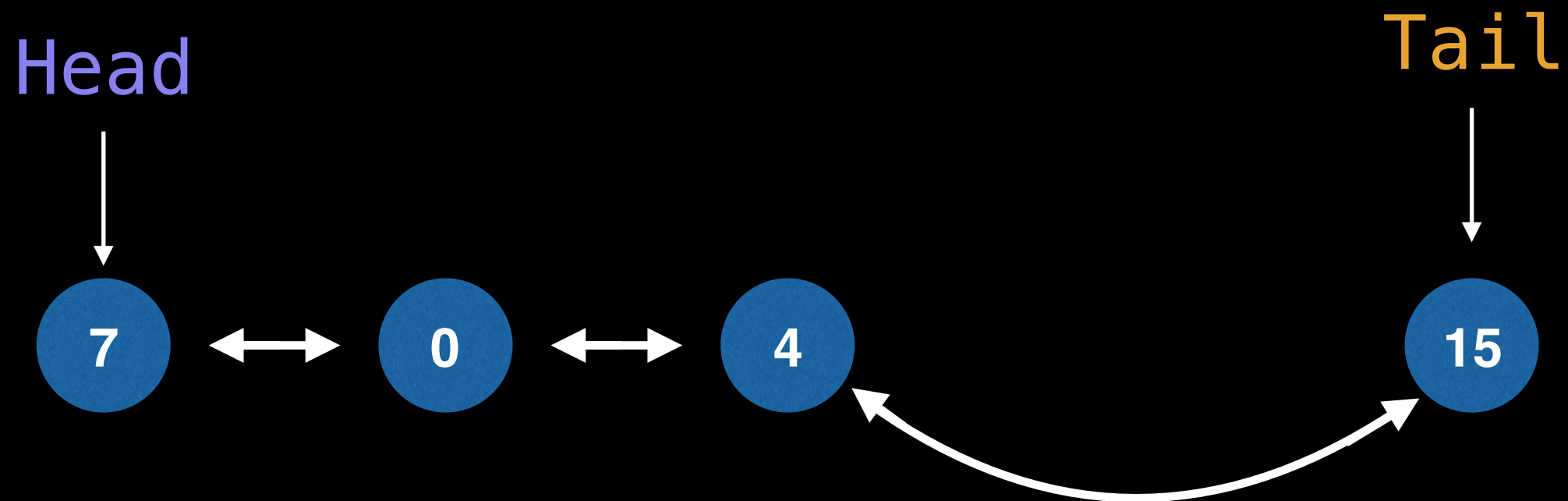
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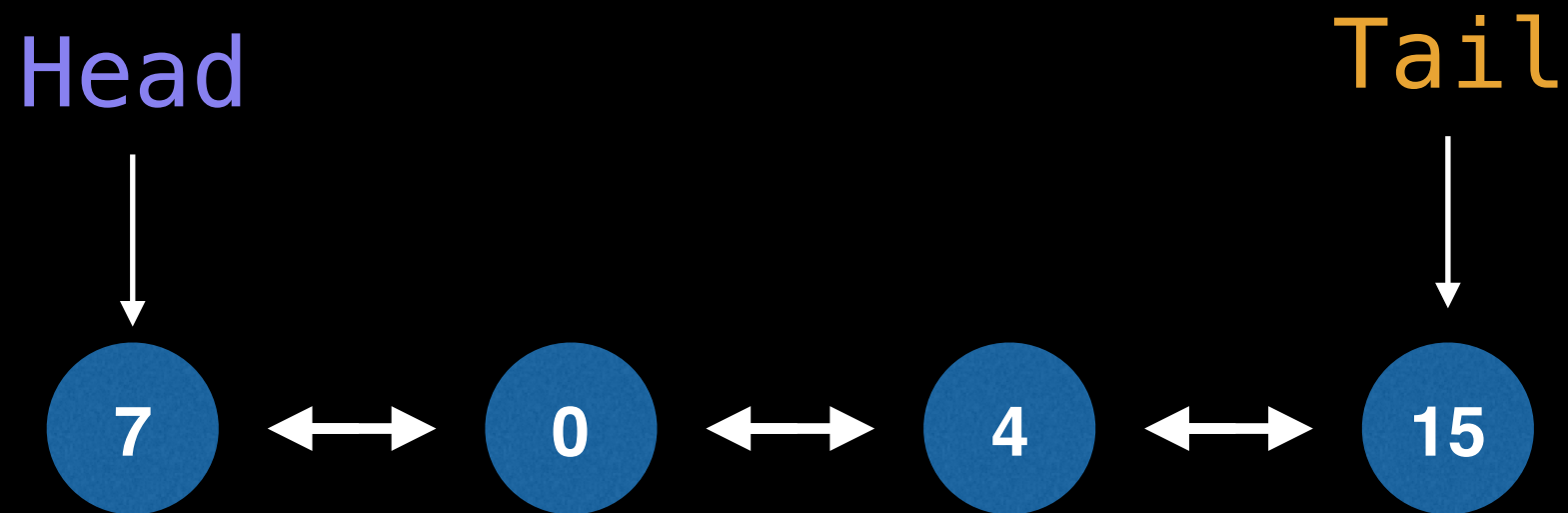
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Removing from Doubly Linked List

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Complexity Analysis

Complexity

Singly Linked

Doubly Linked

	Singly Linked	Doubly Linked
Search	$O(n)$	$O(n)$
Insert at head	$O(1)$	$O(1)$
Insert at tail	$O(1)$	$O(1)$

Complexity

Singly Linked

Doubly Linked

Remove at head	$O(1)$	$O(1)$
Remove at tail	$O(n)$	$O(1)$
Remove in middle	$O(n)$	$O(n)$

Implementation in next video

Implementation source code and tests can
all be found at the following link:

github.com/williamfiset/data-structures

Testing of this Linked List is thanks to Micah Stairs.

Doubly Linked List Source Code

Part 2/2

William Fiset

Source Code Link

Implementation source code
and tests can all be found
at the following link:

github.com/williamfiset/data-structures

NOTE: Make sure you have understood part 1
of the linked list series before continuing!