CSCI 132:
Basic Data Structures and Algorithms

Linked Lists (Part 3)

Doubly Linked List + Circular Linked Lists

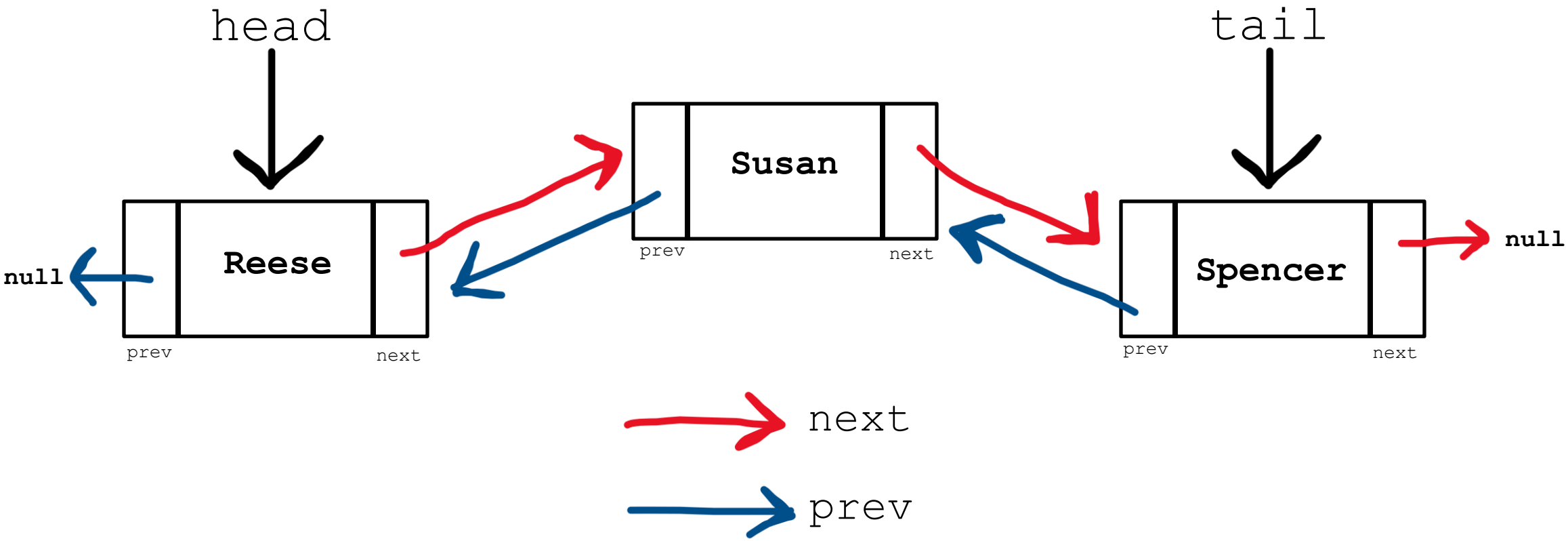
Reese Pearsall & Iliana Castillon

Fall 2024

Lab 5 (Linked Lists)

- Due tomorrow @ 11:59 PM

A **Doubly Linked List** keeps track of the next node and the previous node

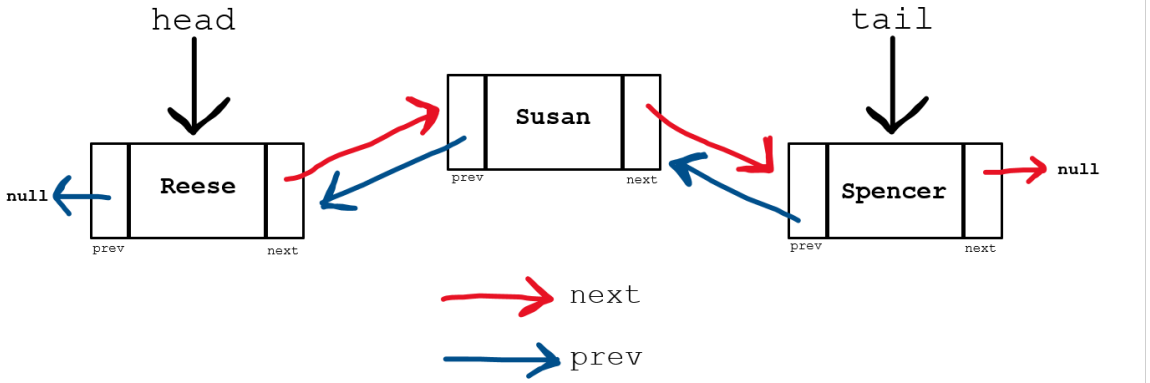


A **Doubly Linked List** keeps track of the next node and the previous node

Doubly Linked List Methods

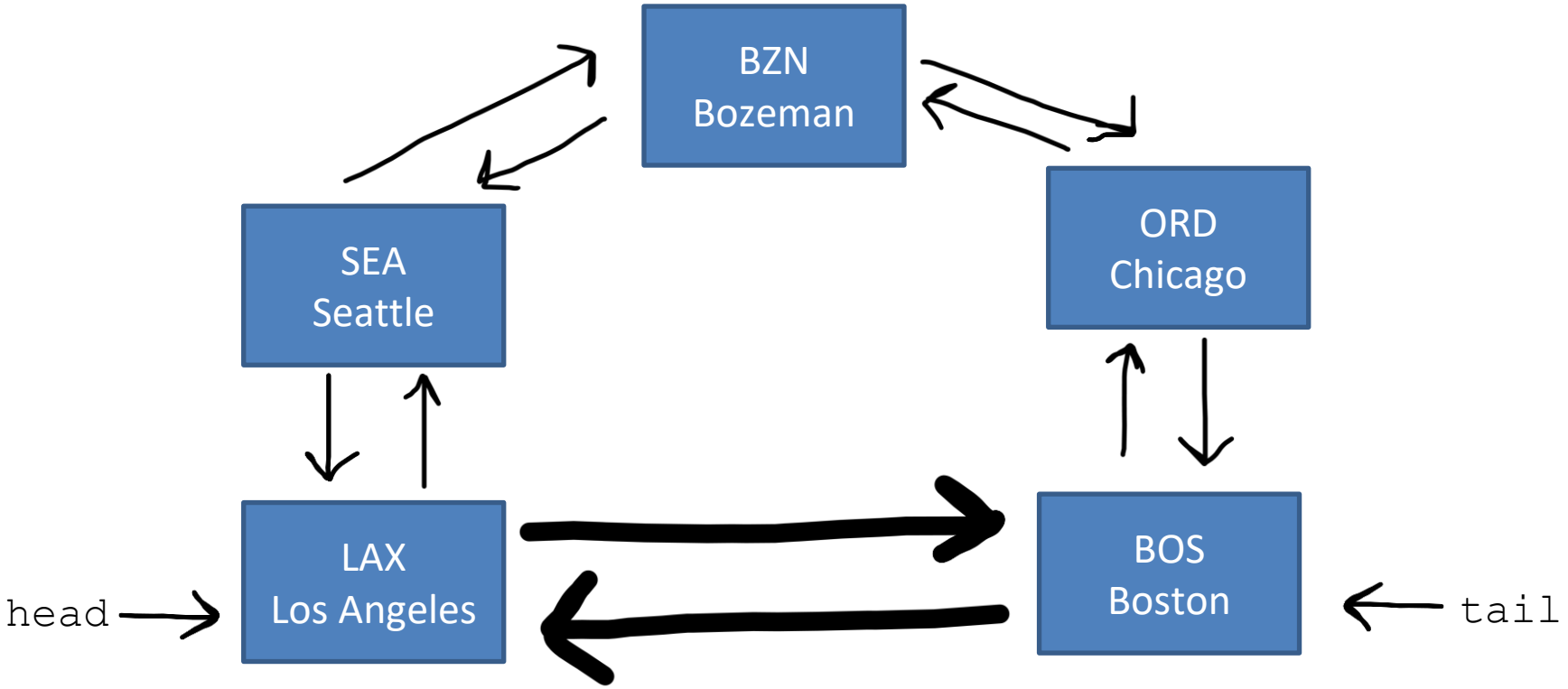
- insert(newNode, N) – Insert new node at spot N
- remove(name) – Remove node by name
- remove(N) – Remove node by Spot #

- printReverse() – Prints LL in reverse order



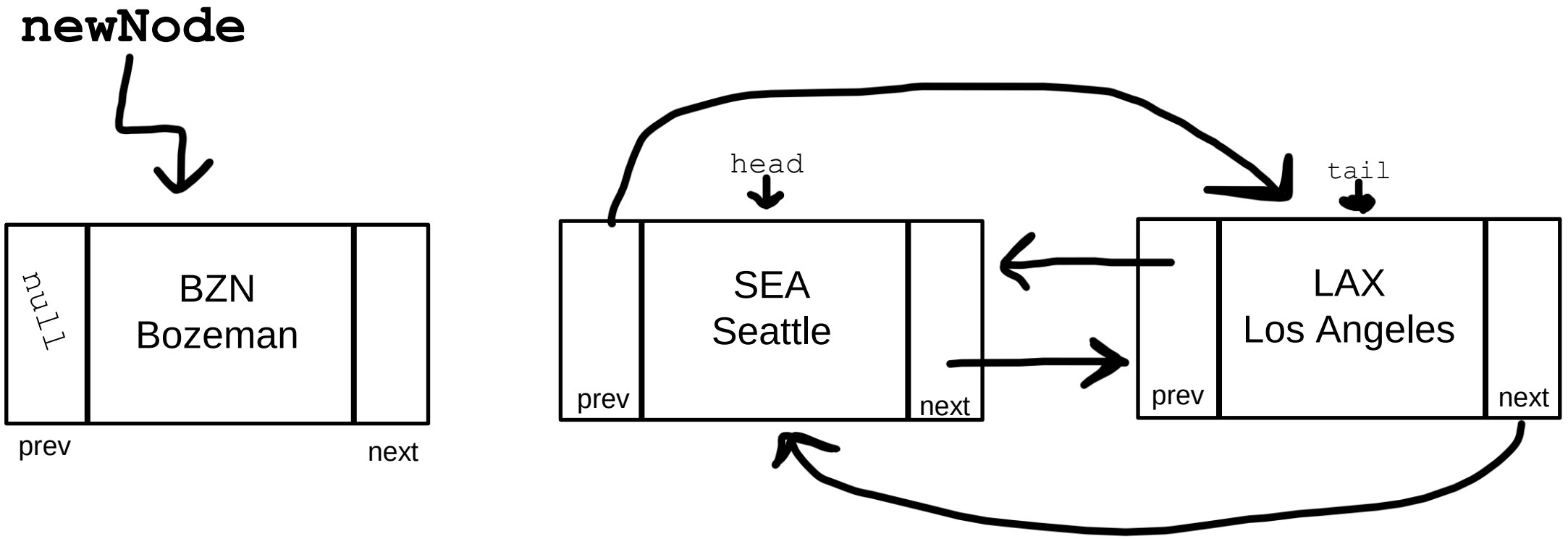
A **Doubly Linked List** keeps track of the next node and the previous node

A **Circular Linked List** is a linked list where the first and last node are connected, which creates a circle



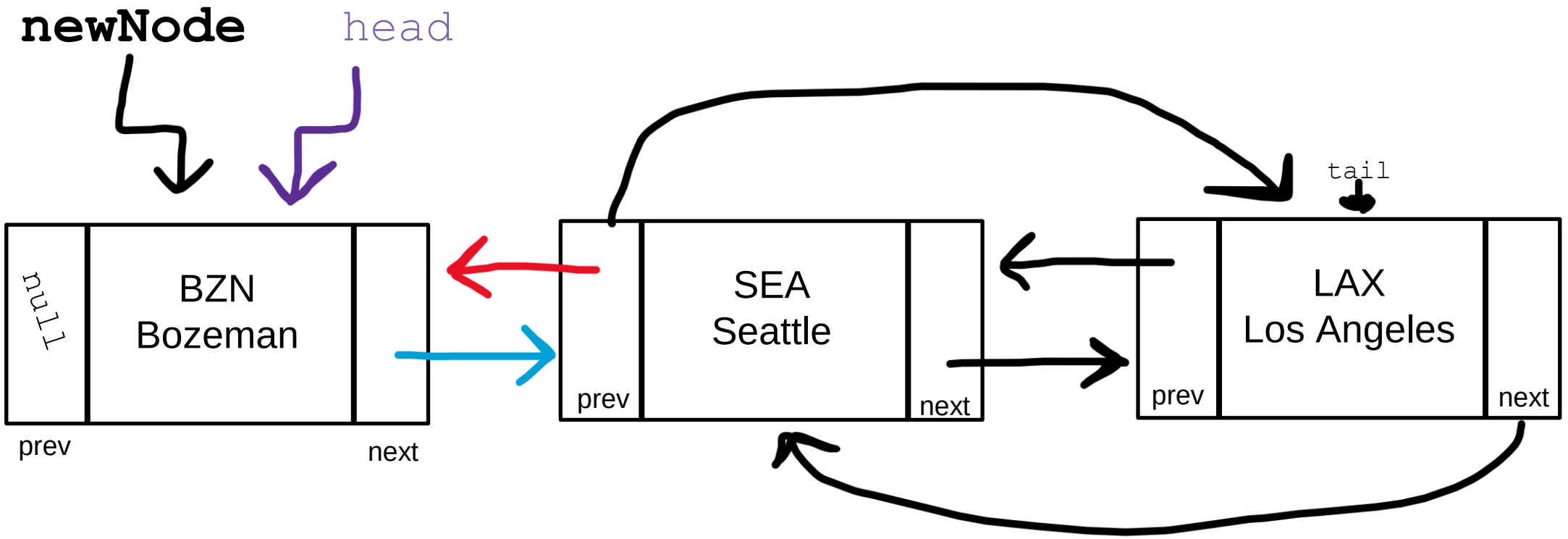
We will take our Doubly Linked List Implementation, and convert it into a Circular Doubly Linked List

Case 2: The user is inserting a node at the very beginning (N = 1)



???

Case 2: The user is inserting a node at the very beginning (N = 1)



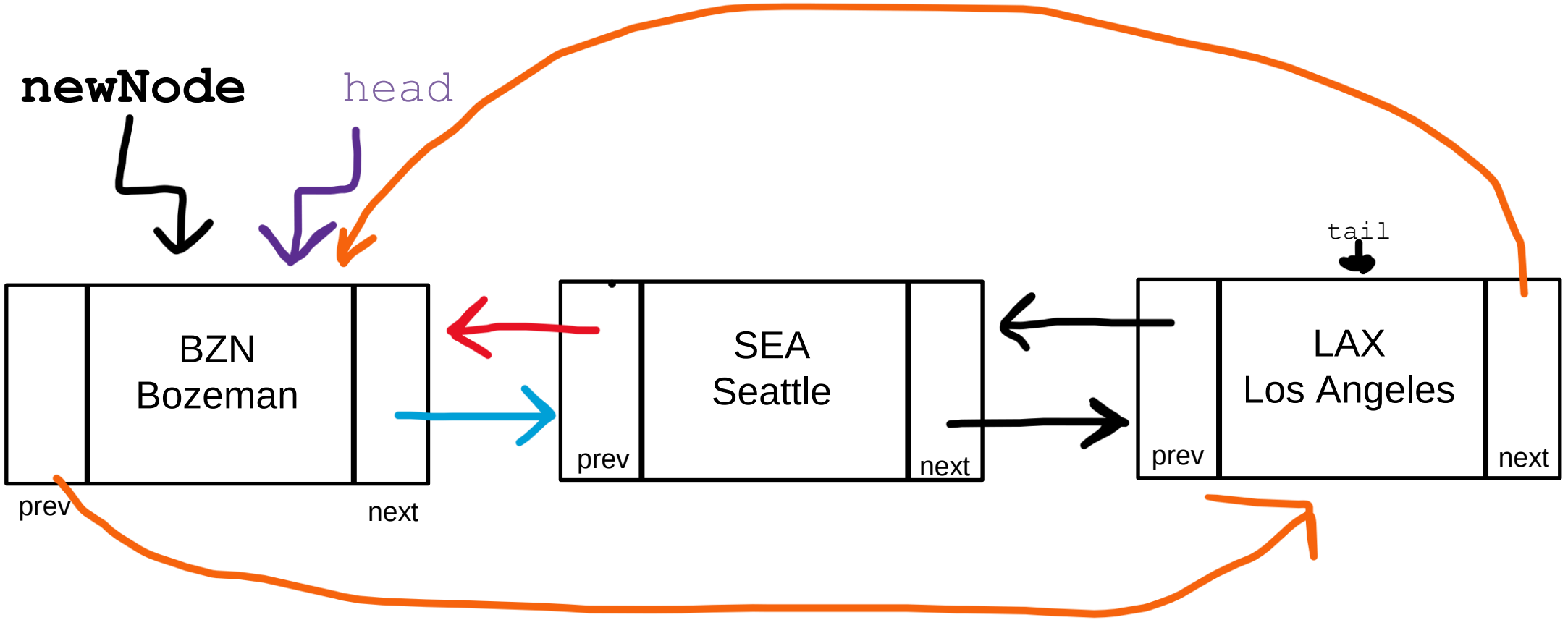
Update the `head` node `prev` value to `newNode`

Update the `newNode`'s `next` value to be the current `head` node

Update the `head` node to be the `newNode`

NEW: Because this is a circular linked list, we need to make sure our tail and head are connected

Case 2: The user is inserting a node at the very beginning (N = 1)



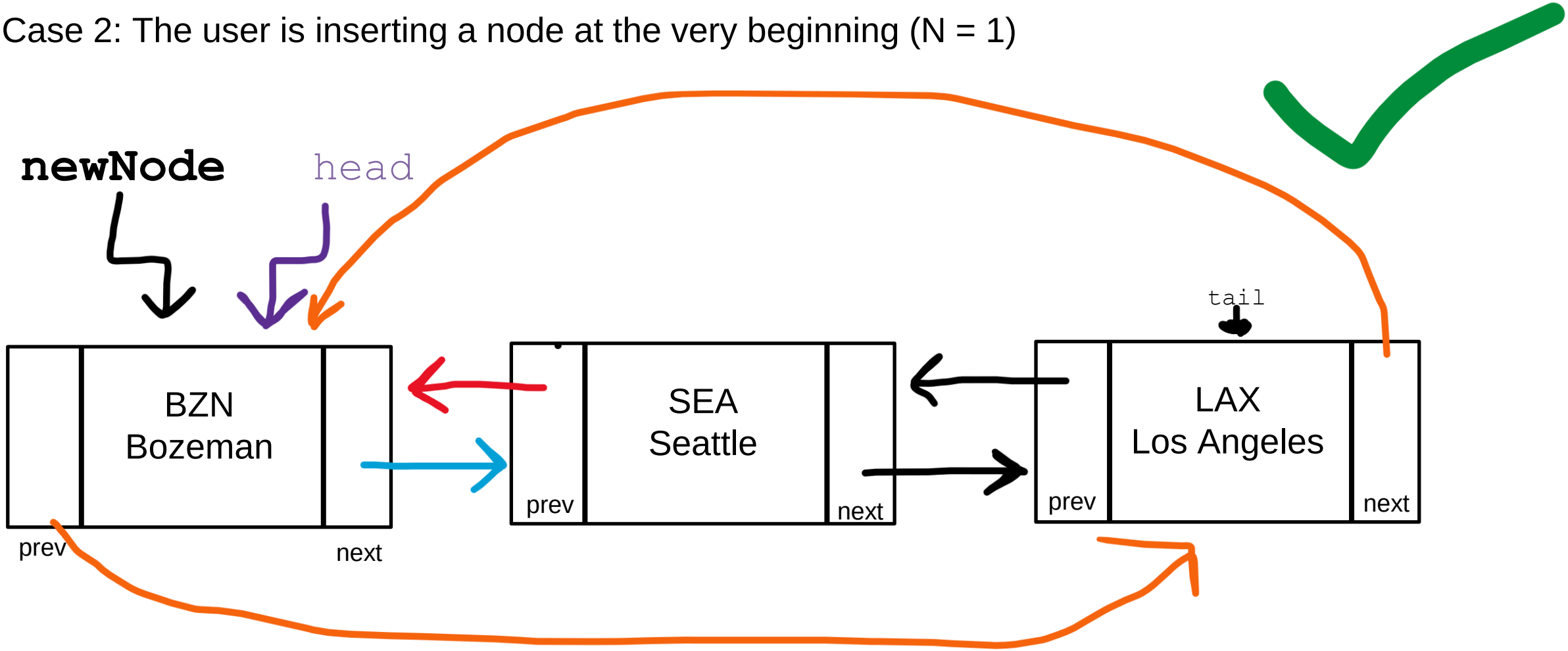
Update the `head` node `prev` value to `newNode`

Update the `newNode`'s `next` value to be the current `head` node

Update the `head` node to be the `newNode`

NEW: Reconnect the `head` and `tail` node

Case 2: The user is inserting a node at the very beginning (N = 1)



Update the `head` node `prev` value to `newNode`

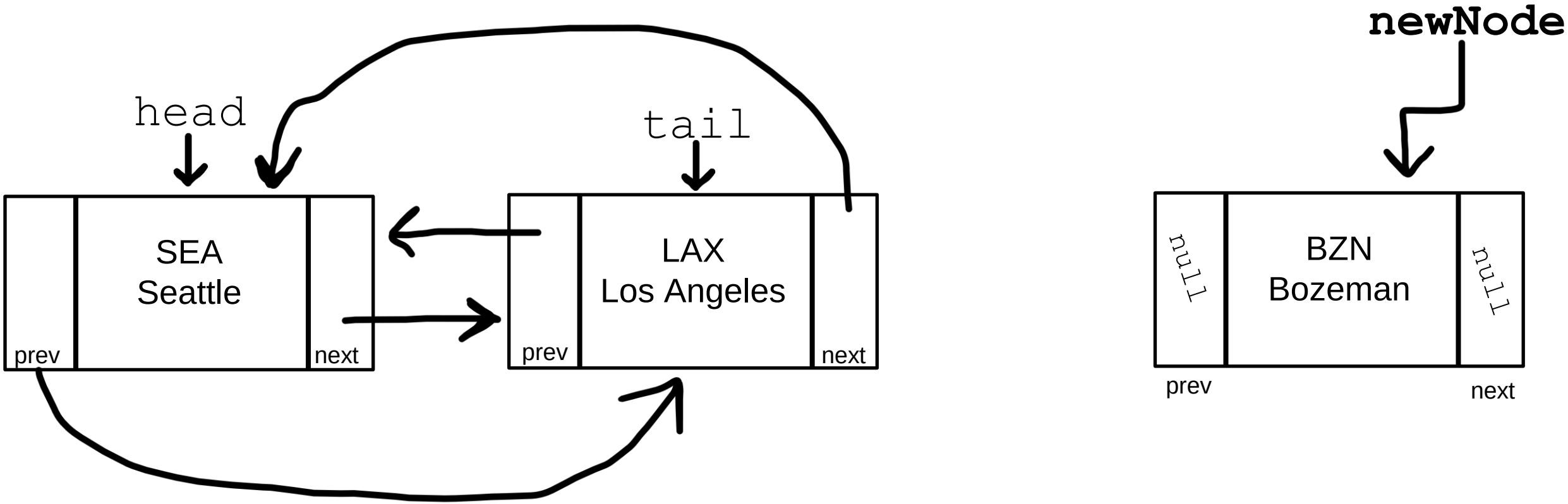
Update the `newNode`'s `next` value to be the current `head` node

Update the `head` node to be the `newNode`

NEW: Reconnect the `head` and `tail` node

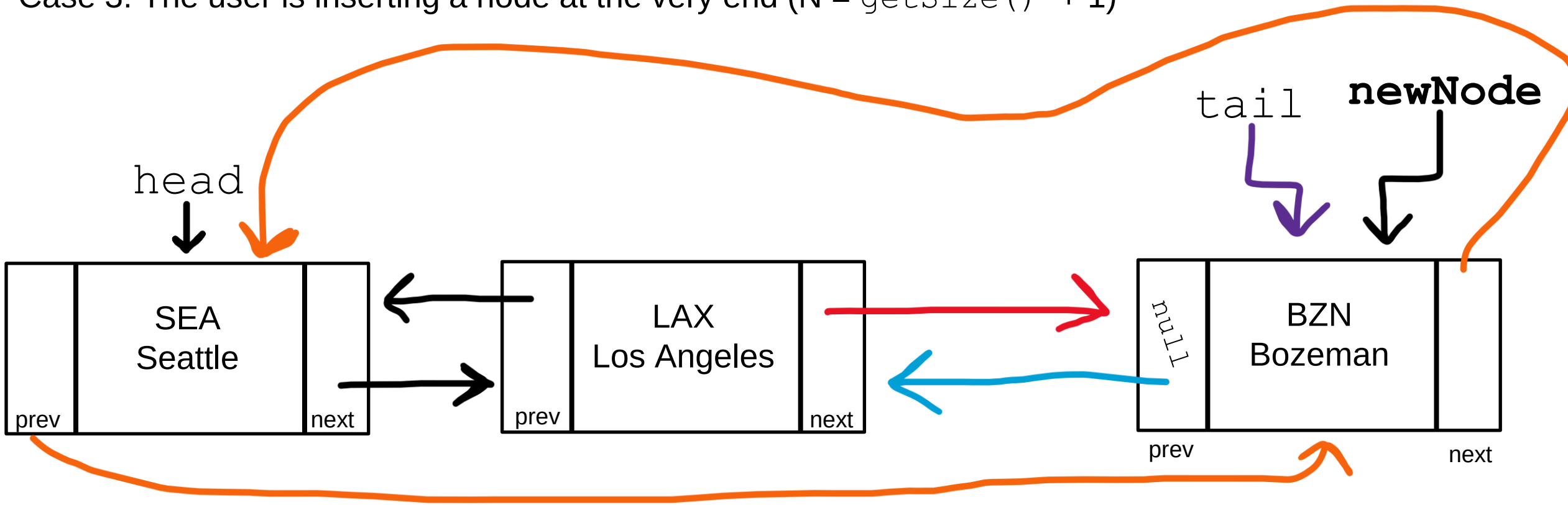
- **`insert(newNode, N)`** — Insert new node (`newNode`) at spot **N**

Case 3: The user is inserting a node at the very end (N = `getSize()` + 1)



- **`insert(newNode, N)`** — Insert new node (`newNode`) at spot **N**

Case 3: The user is inserting a node at the very end (N = `getSize()` + 1)



Update the `tail` node `next` value to `newNode`

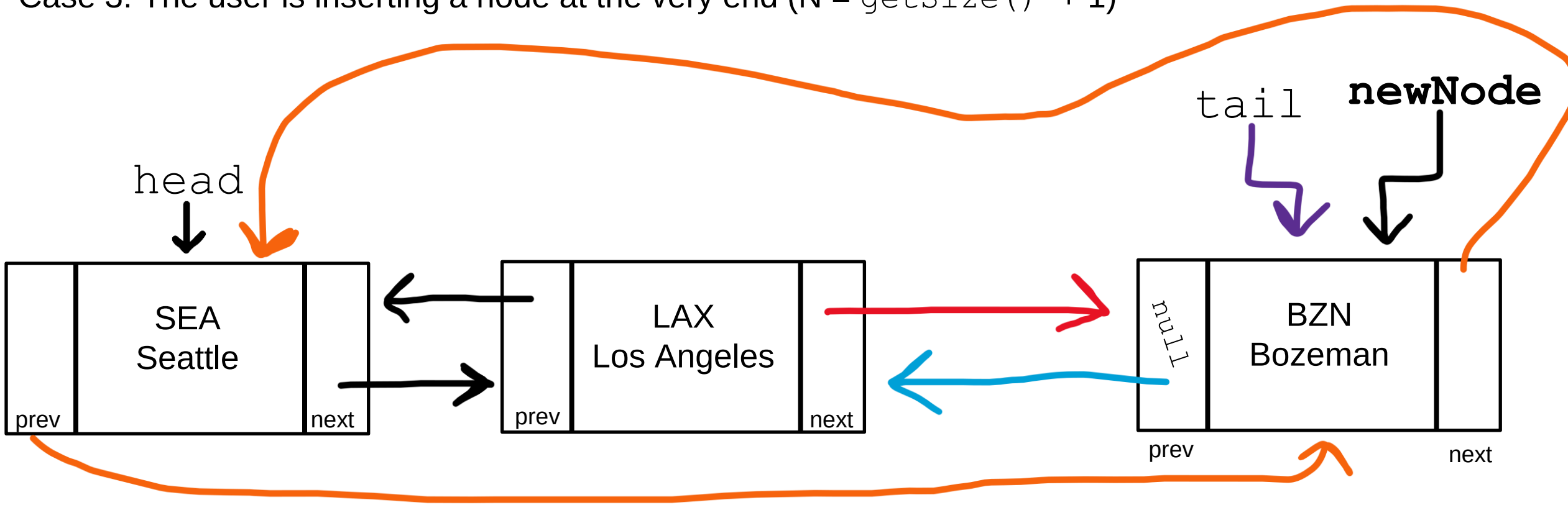
Update the `newNode`'s `prev` value to be the current `tail` node

Update the `tail` node to be the `newNode`

NEW: Reconnect the `head` and `tail` node

- **`insert(newNode, N)`** — Insert new node (`newNode`) at spot **N**

Case 3: The user is inserting a node at the very end (N = `getSize()` + 1)



Update the `tail` node `next` value to `newNode`

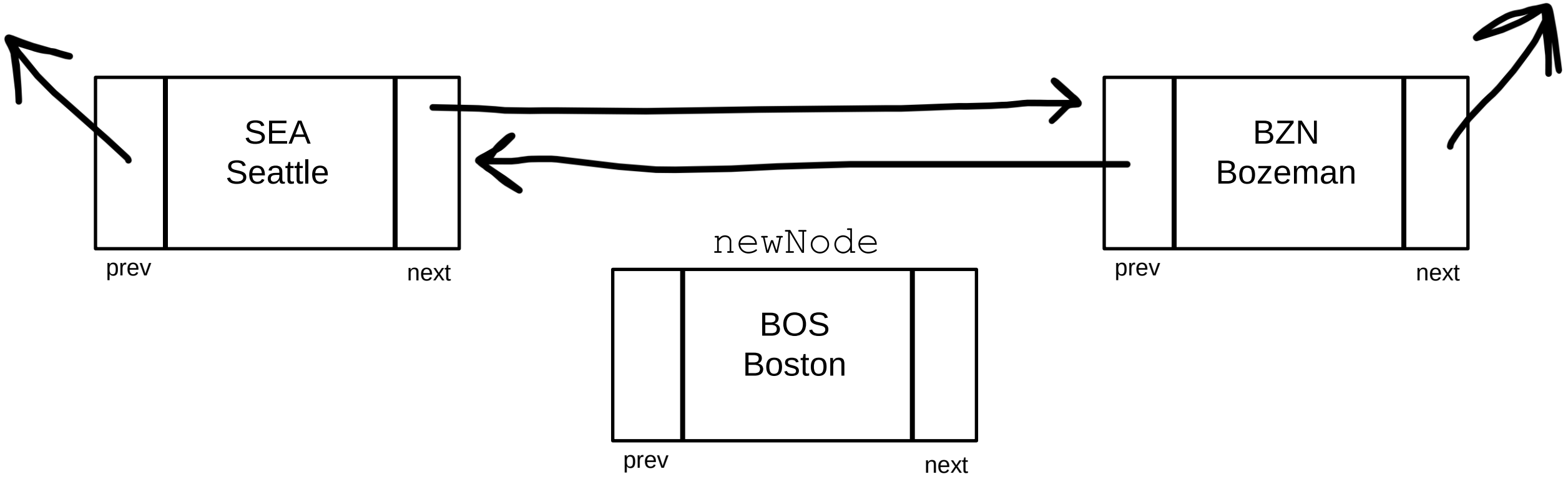
Update the `newNode`'s `prev` value to be the current `tail` node

Update the `tail` node to be the `newNode`

NEW: Reconnect the `head` and `tail` node

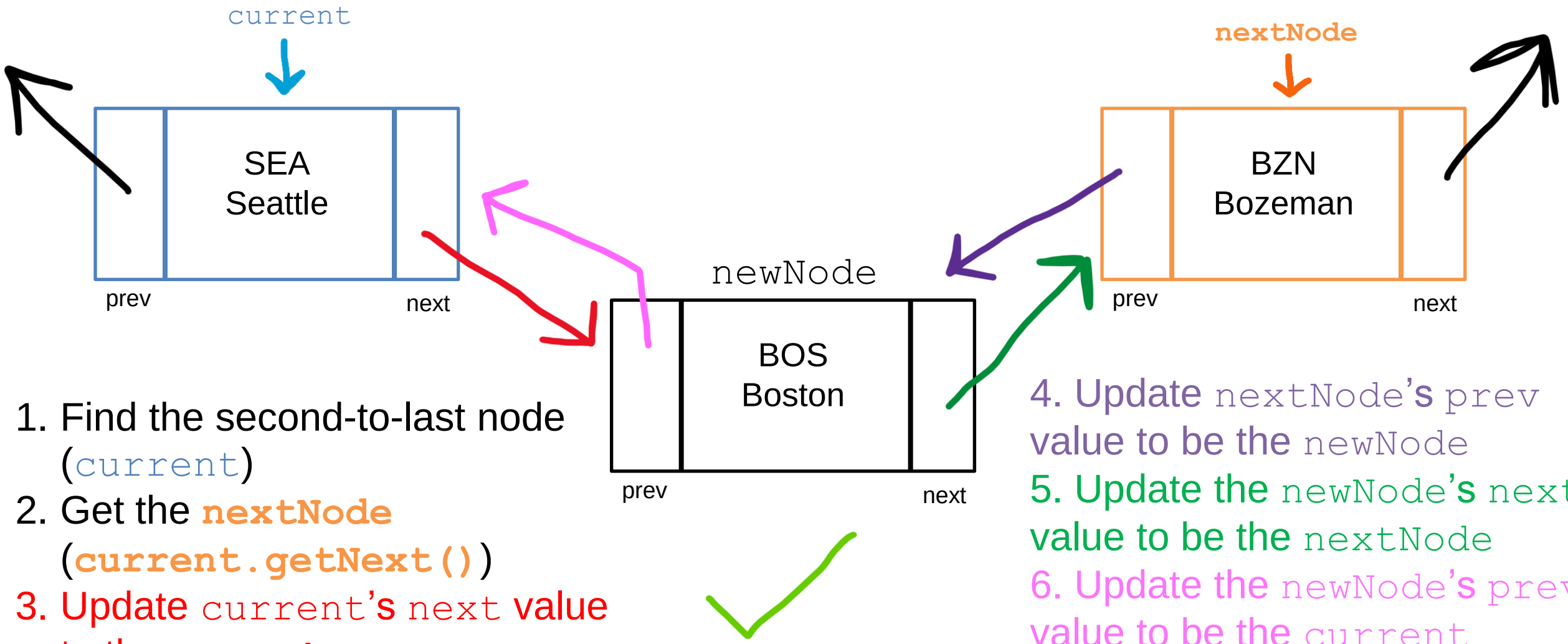
- **`insert(newNode, N)`** — Insert new node (`newNode`) at spot **N**

Case 4: The user is inserting a node somewhere in the middle of the LL



- **`insert(newNode, N)`** — Insert new node (`newNode`) at spot **N**

Case 4: The user is inserting a node somewhere in the middle of the LL

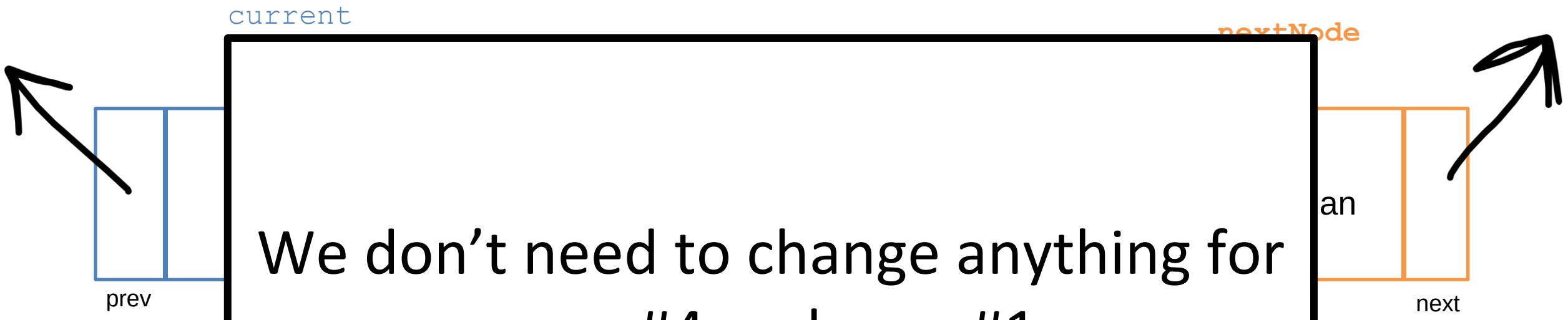


1. Find the second-to-last node (`current`)
2. Get the **`nextNode`** (**`current.getNext()`**)
3. Update `current`'s `next` value to the `newNode`

4. Update `nextNode`'s `prev` value to be the `newNode`
5. Update the `newNode`'s `next` value to be the `nextNode`
6. Update the `newNode`'s `prev` value to be the `current`

- **`insert(newNode, N)`** — Insert new node (`newNode`) at spot **N**

Case 4: The user is inserting a node somewhere in the middle of the LL

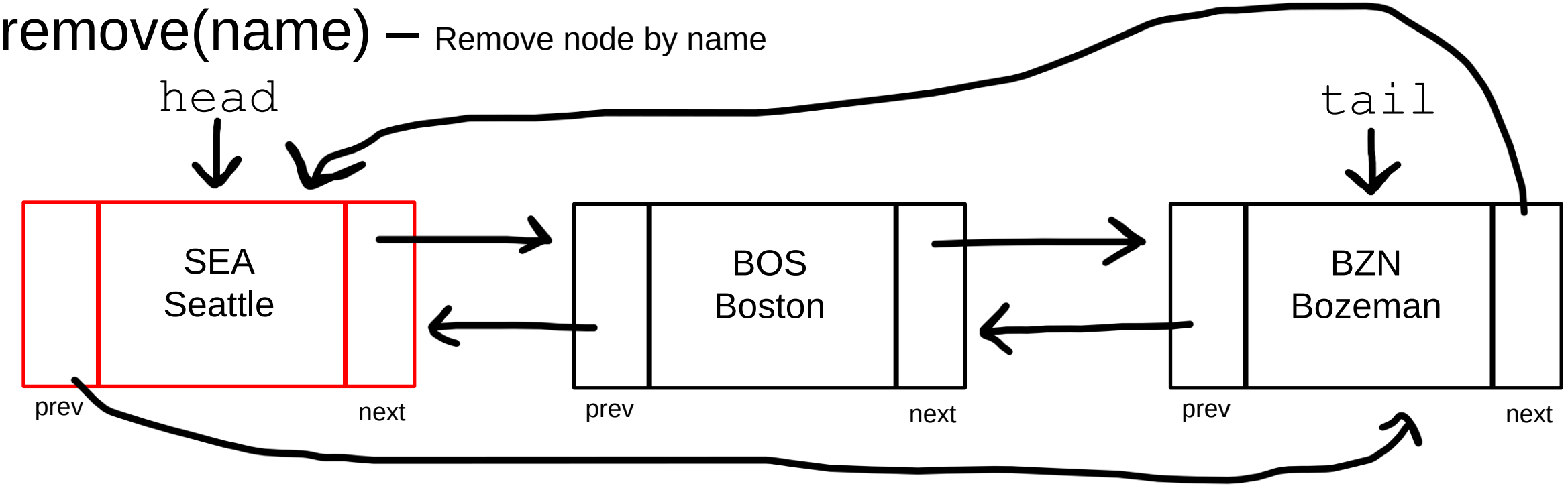


We don't need to change anything for case #4 and case #1

1. Find the s
   (current
2. Get the n
   (`current.getNext()`)
3. Update `current`'s `next` value to the `newNode`

Node's prev
newNode
ewNode's next
nextNode
6. Update the `newNode`'s `prev` value to be the `current`

- remove(name) – Remove node by name

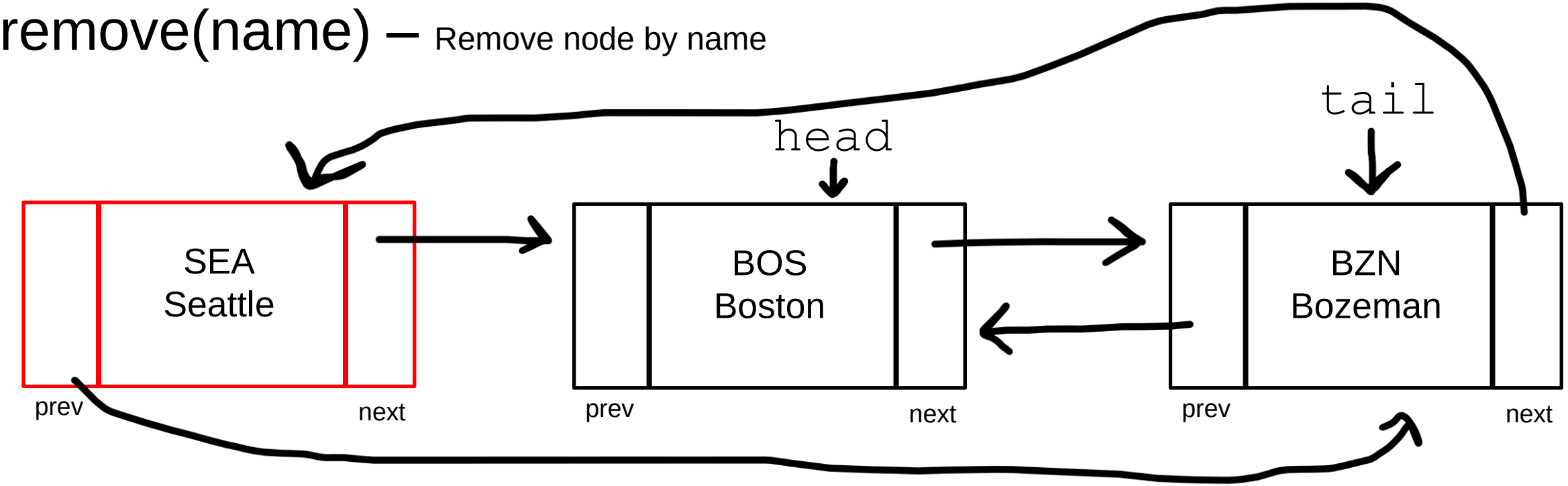


1. Traverse the Linked List and look for a match

`remove("SEA")`

What if the removed node is the head?

- remove(name) – Remove node by name



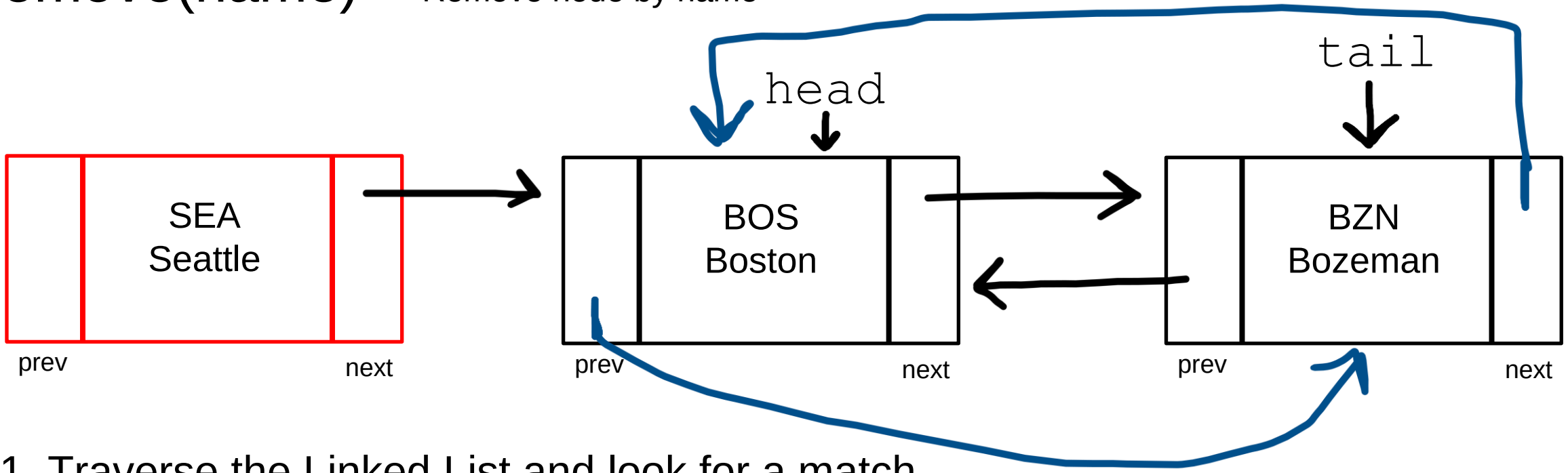
1. Traverse the Linked List and look for a match

`remove("SEA")`

What if the removed node is the head?

2. Update the `head` to be the next node
3. Update the new `head`'s `prev` value to be null

- remove(name) – Remove node by name



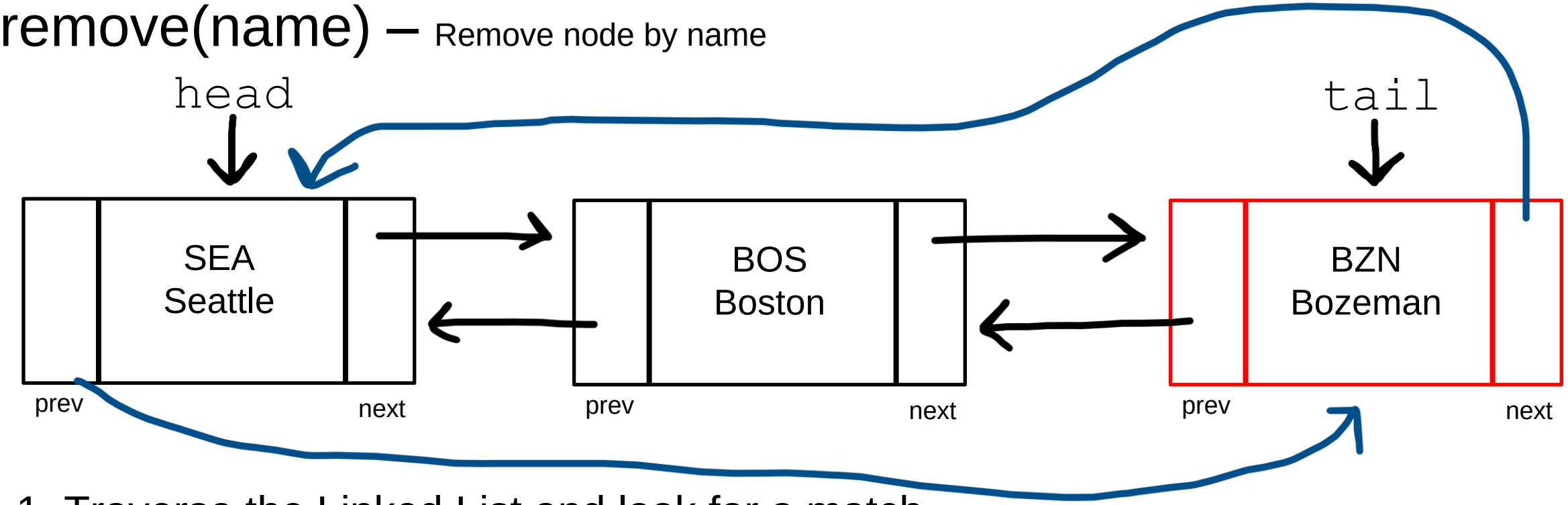
1. Traverse the Linked List and look for a match

`remove("SEA")`

What if the removed node is the head?

2. Update the `head` to be the next node
3. ~~Update the new `head`'s `prev` value to be null~~
4. NEW: Reconnect the `head` and `tail` nodes

- remove(name) – Remove node by name

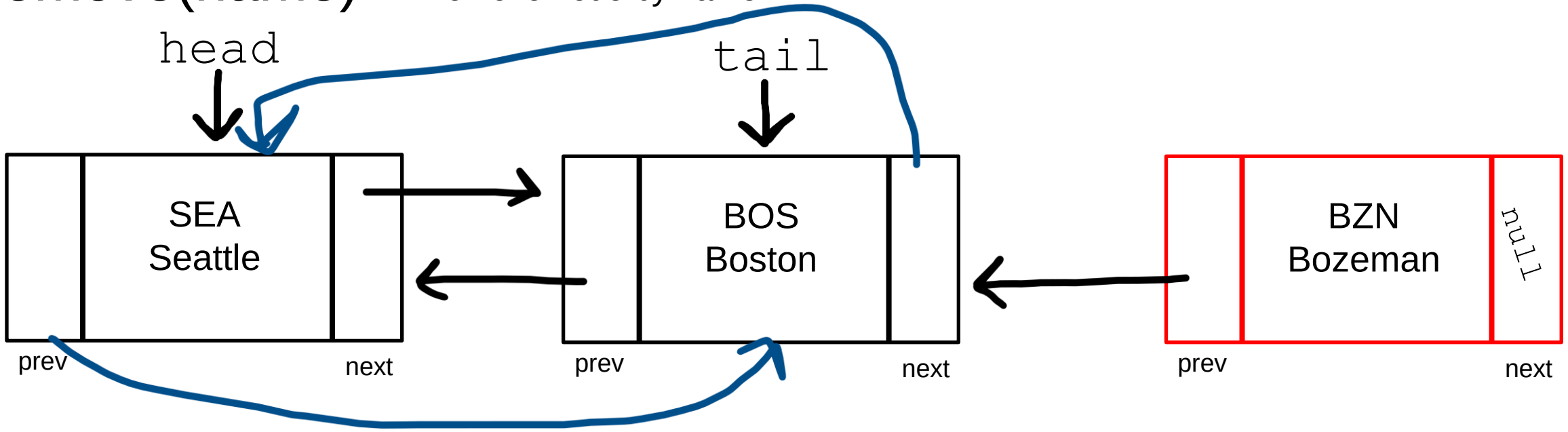


1. Traverse the Linked List and look for a match

`remove("BZN")`

What if the removed node is the tail?

- remove(name) – Remove node by name



1. Traverse the Linked List and look for a match

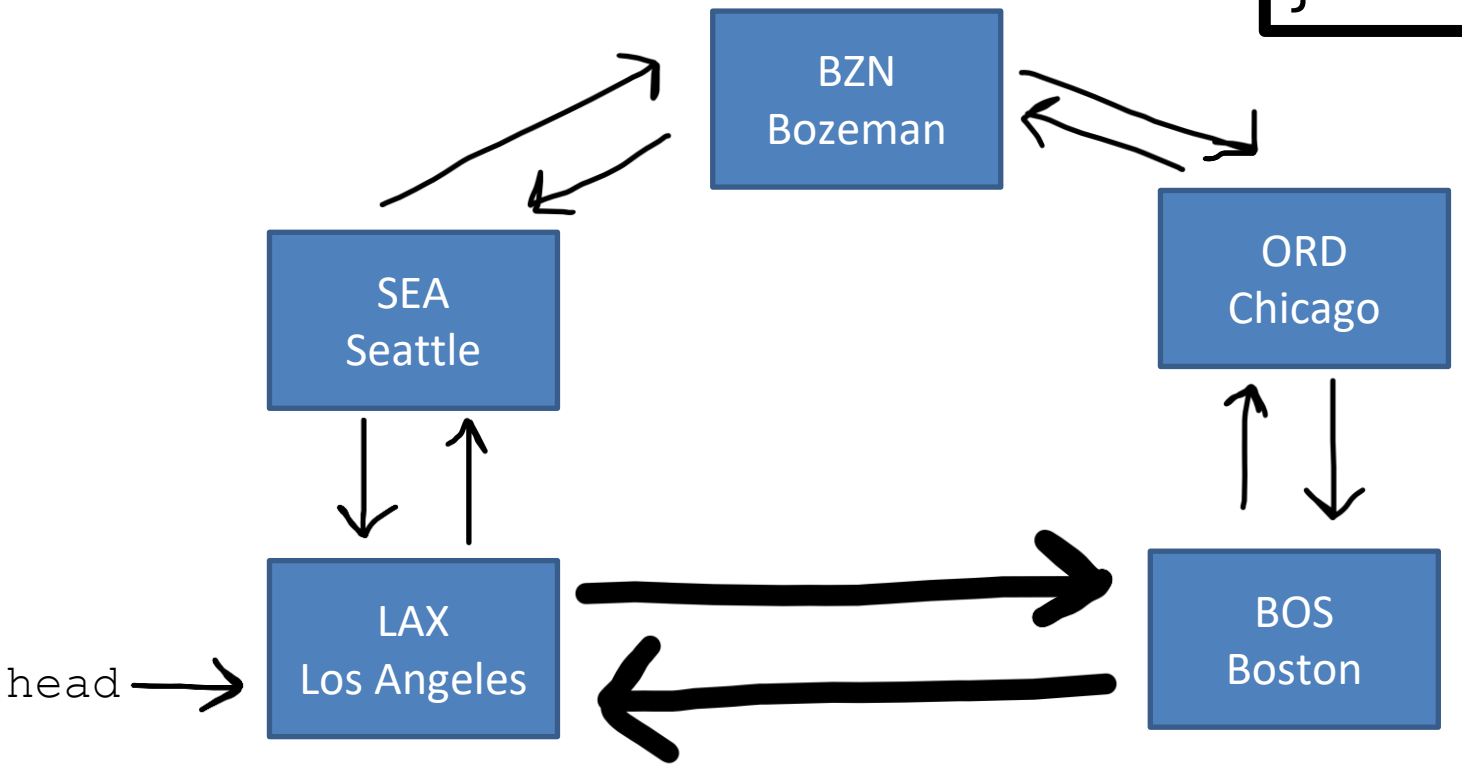
`remove("BZN")`

What if the removed node is the tail?

2. Update the `tail` to be the previous node
3. ~~Update the new `tail`'s `next` value to be `null`~~
4. NEW: Reconnect the `head` and `tail` nodes

Traversing a Circular Linked List

```
public void printList() {
    Node current = this.head;
    while(current != null) {
        current.printNode();
        current = current.getNext();
    }
}
```

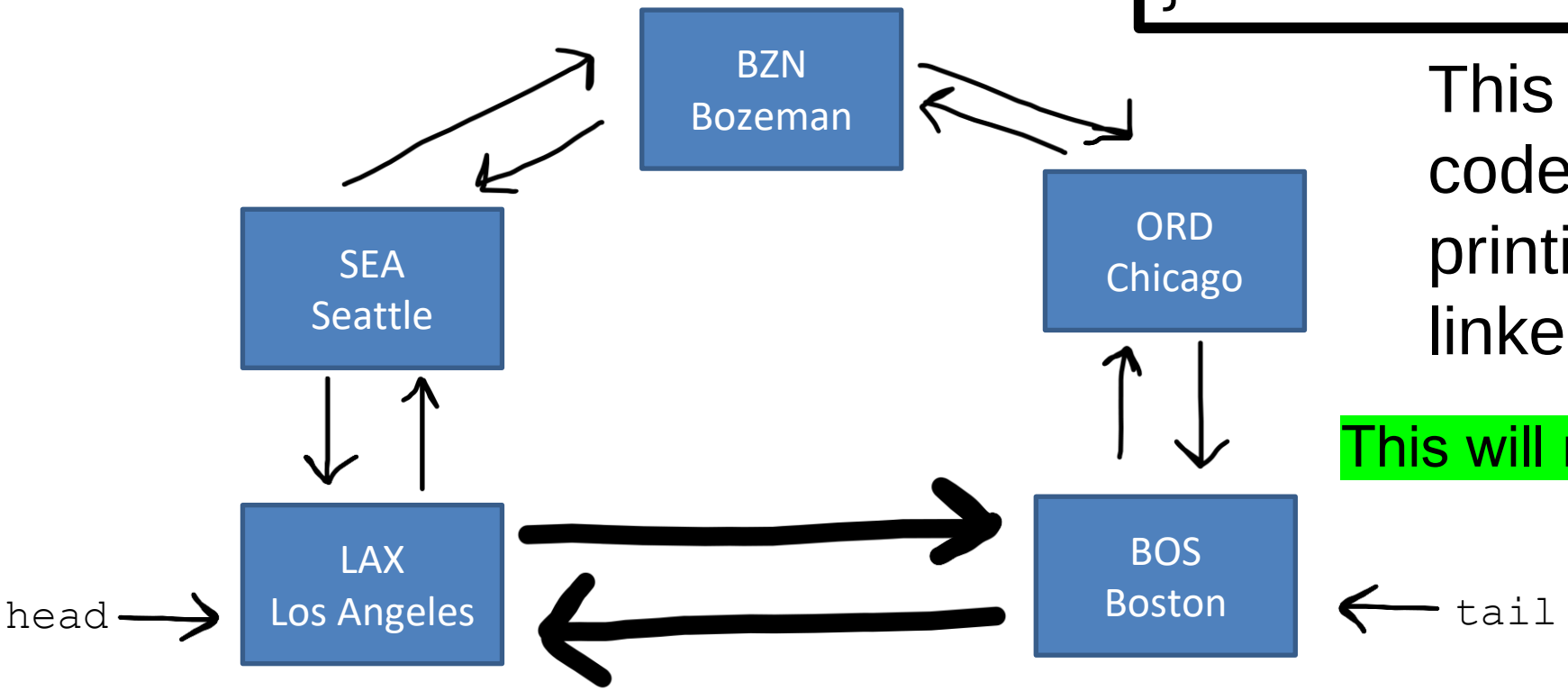


This was our previous code for traversing and printing out nodes in a linked list

This will no longer work because…

Traversing a Circular Linked List

```
public void printList() {
    Node current = this.head;
    while(current != null) {
        current.printNode();
        current = current.getNext();
    }
}
```



This was our previous code for traversing and printing out nodes in a linked list

This will no longer work because…

We will never reach `null`