Middlebury

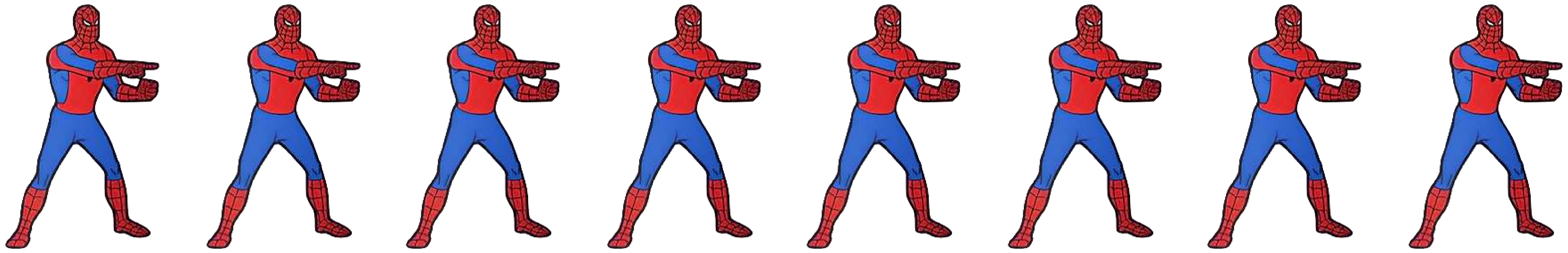
# CSCI 201: Data Structures

Fall 2024

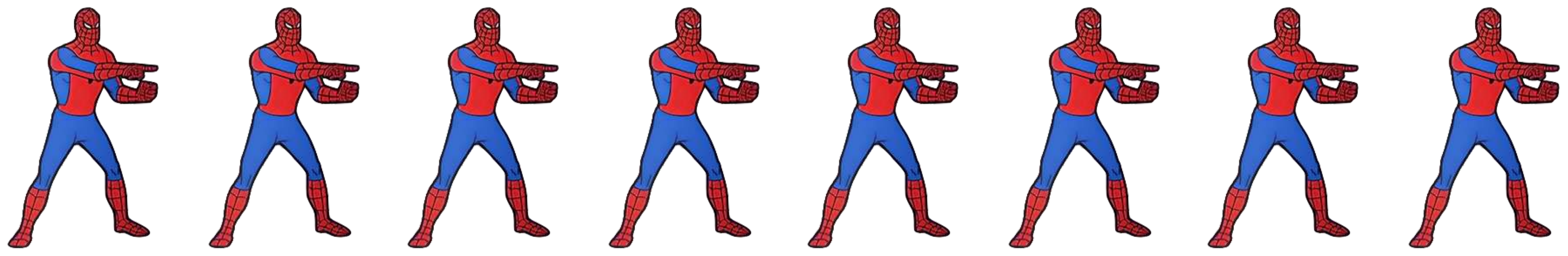
## Lecture 6R: More Linked Lists

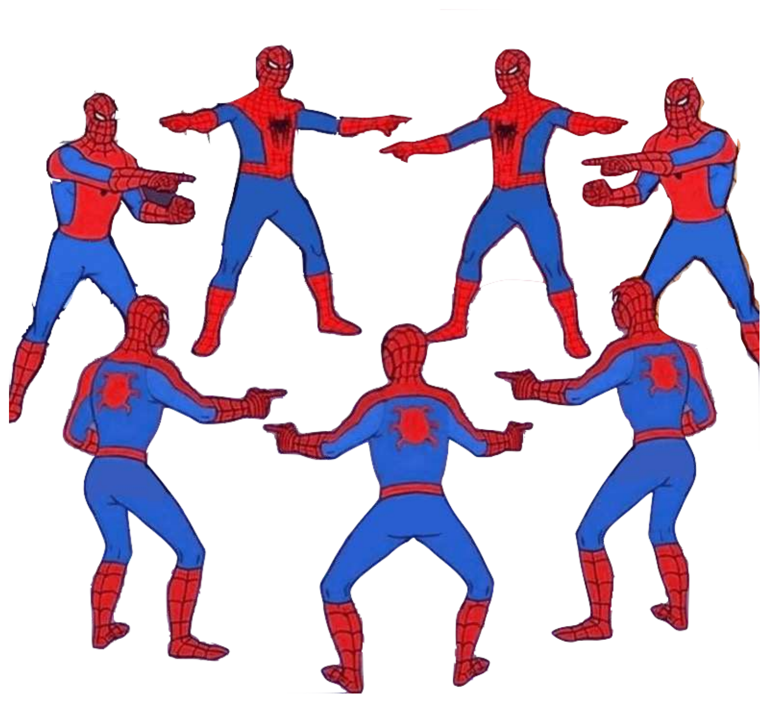
## Goals for today:

- Implement a **doubly** linked list.
- Implement a **circular** linked list.
- **Analyze** the performance of various linked list operations.
- **Generic**-ify our linked list implementation.



## Types of linked lists.

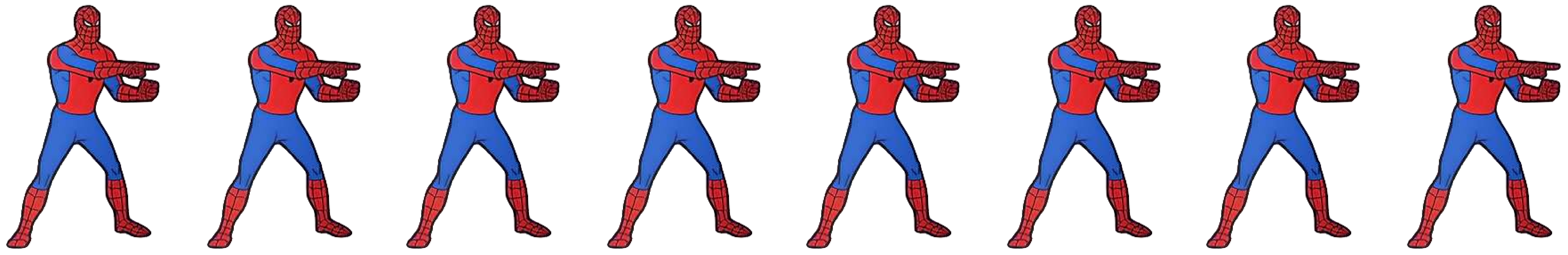




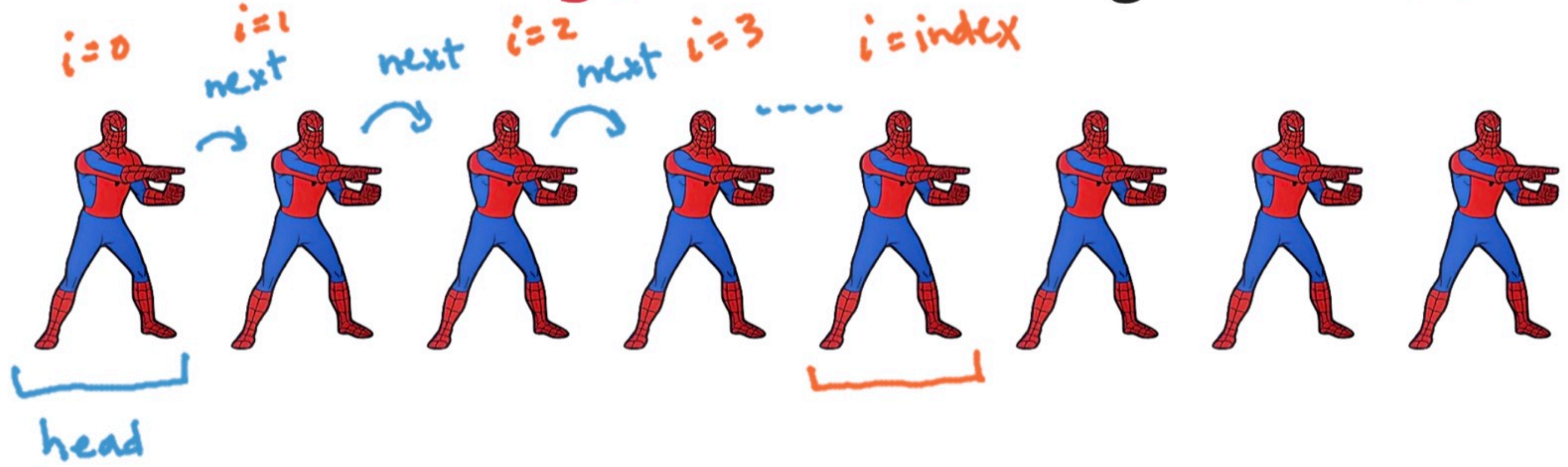
# Redesigning our LinkedList (for any type)!

```java
class ListNode<E> {
  public ListNode<E> next;
  private E data;

  public ListNode(E data) {
    this.data = data;
    next = null;
  }

  public E get() {
    return data;
  }
}
```

```java
public class LinkedList<E> {
  private ListNode<E> head;

  public LinkedList() {
    head = null;
  }
}
```

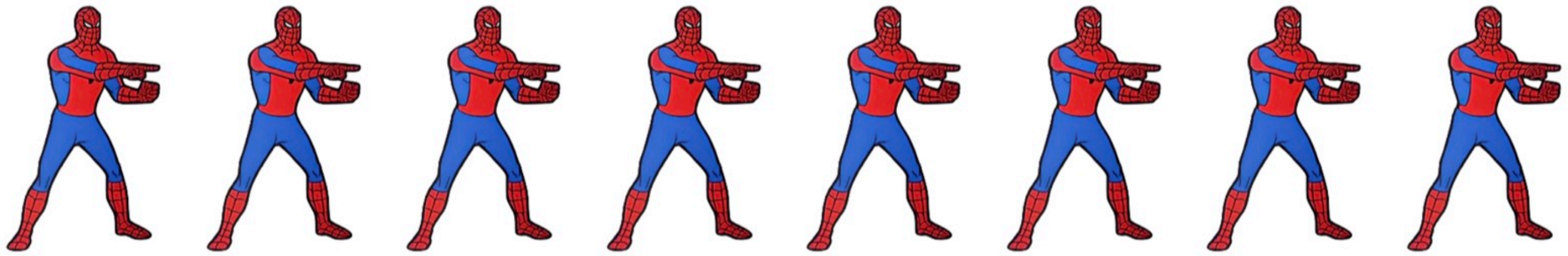


## What if we want to get an item at a given index?



```java
public E get(int index) {
  ListNode<E> node = head;
  for (int i = 0; i < index; i++) {
    node = node.next;
  }
  return node.get();
}
```

## Exercise 1: implement size() to determine # items in the list.



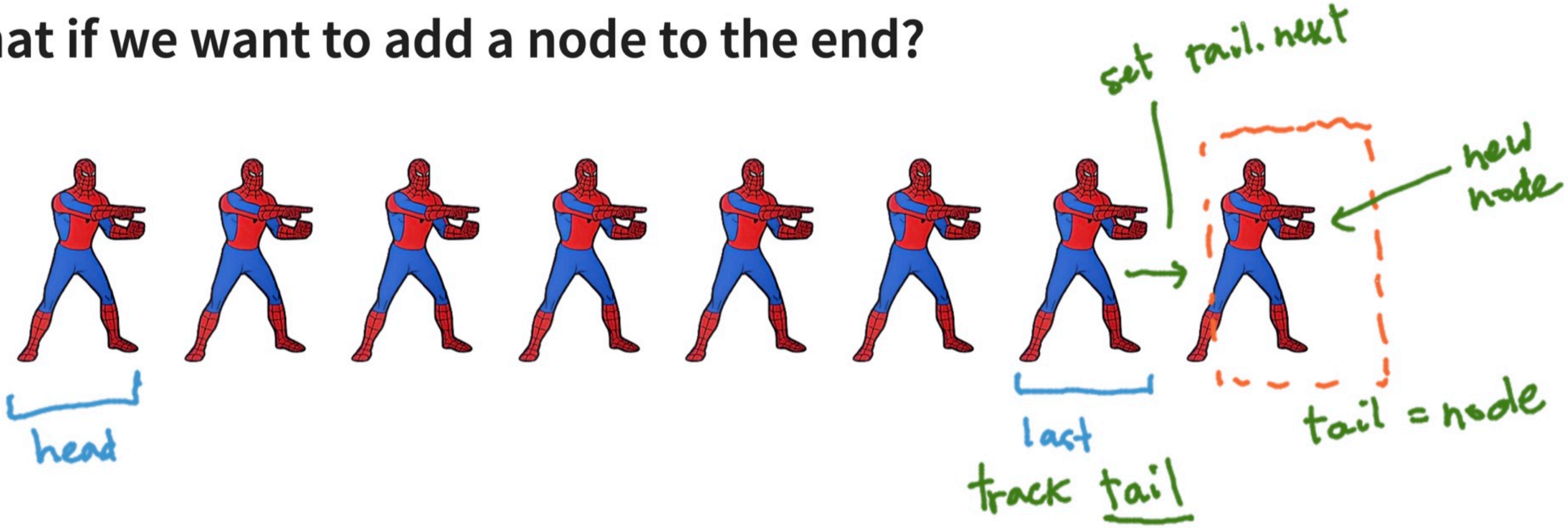
n items

O(n)

```java
int size() {
  ListNode<E> node = head;
  int nItems = 0;
  while (node != null) {
    node = node.next;
    nItems++;
  }
  return nItems;
}
```

```java
public class LinkedList<E> {
  ListNode<E> head;
  int nItems;

  int size() {
    // keep track of nItems
    // with each add/remove
    return nItems;
  }
}
```

## What if we want to add a node to the end?

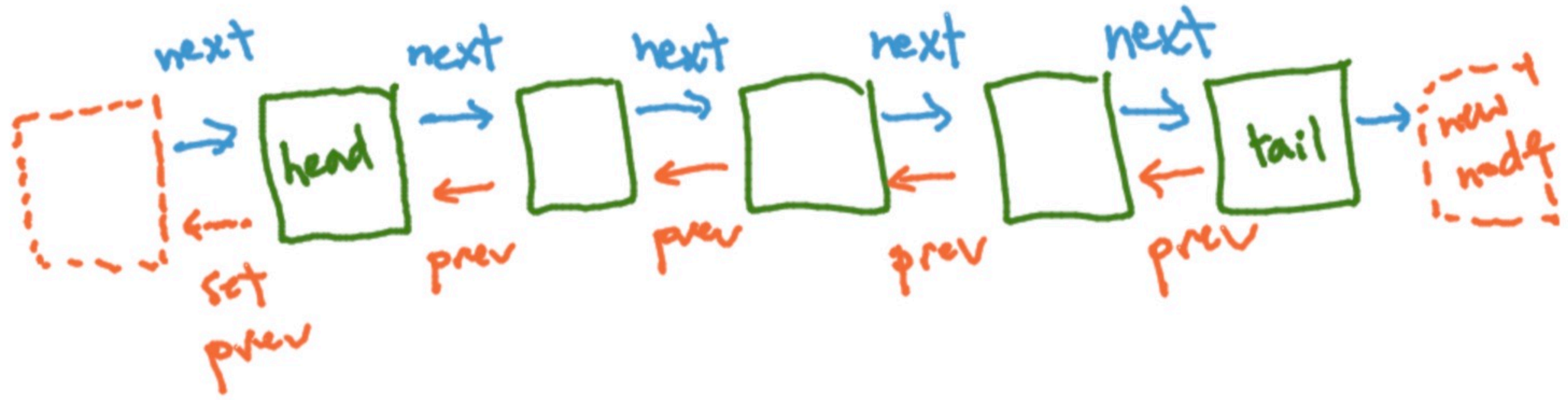


```java
public class LinkedList<E> {
  ListNode<E> head;
  ListNode<E> tail;

  void addLast(E data) {
    // should check if head/tail is not null
    ListNode<E> node = new ListNode<E>(data);
    tail.next = node;
    tail = node;
  }
}
```

## And now let's add a `prev` field to each `ListNode`. Why? What if we want to traverse the nodes backwards?

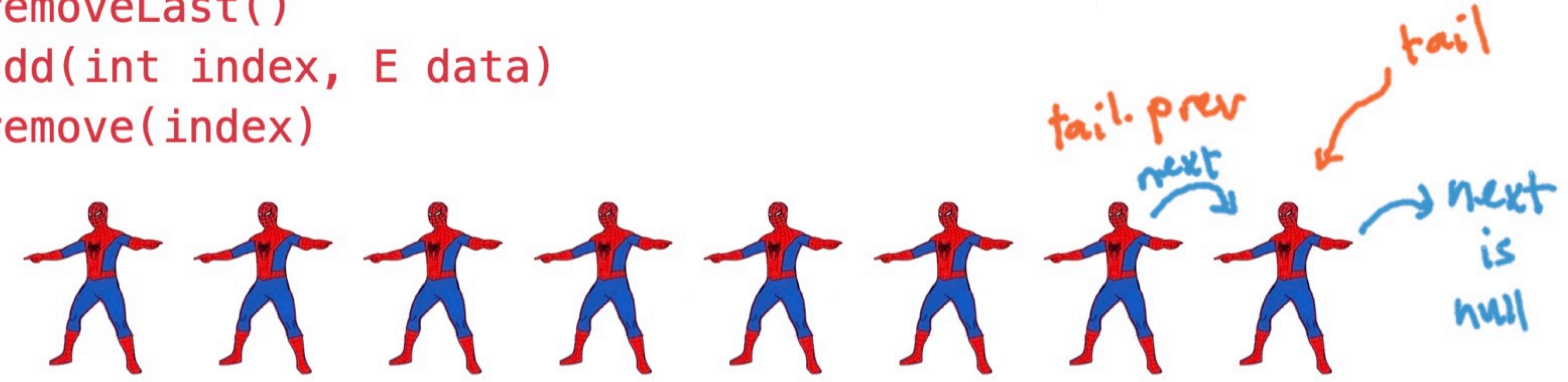
```java
class ListNode<E> {
  public ListNode<E> next;
  public ListNode<E> prev;
  private E data;

  public ListNode(E data) {
    this.data = data;
    next = null;
    prev = null;
  }

  public E get() {
    return data;
  }
}
```

## How do `addFirst` and `addLast` change with a doubly-linked list?



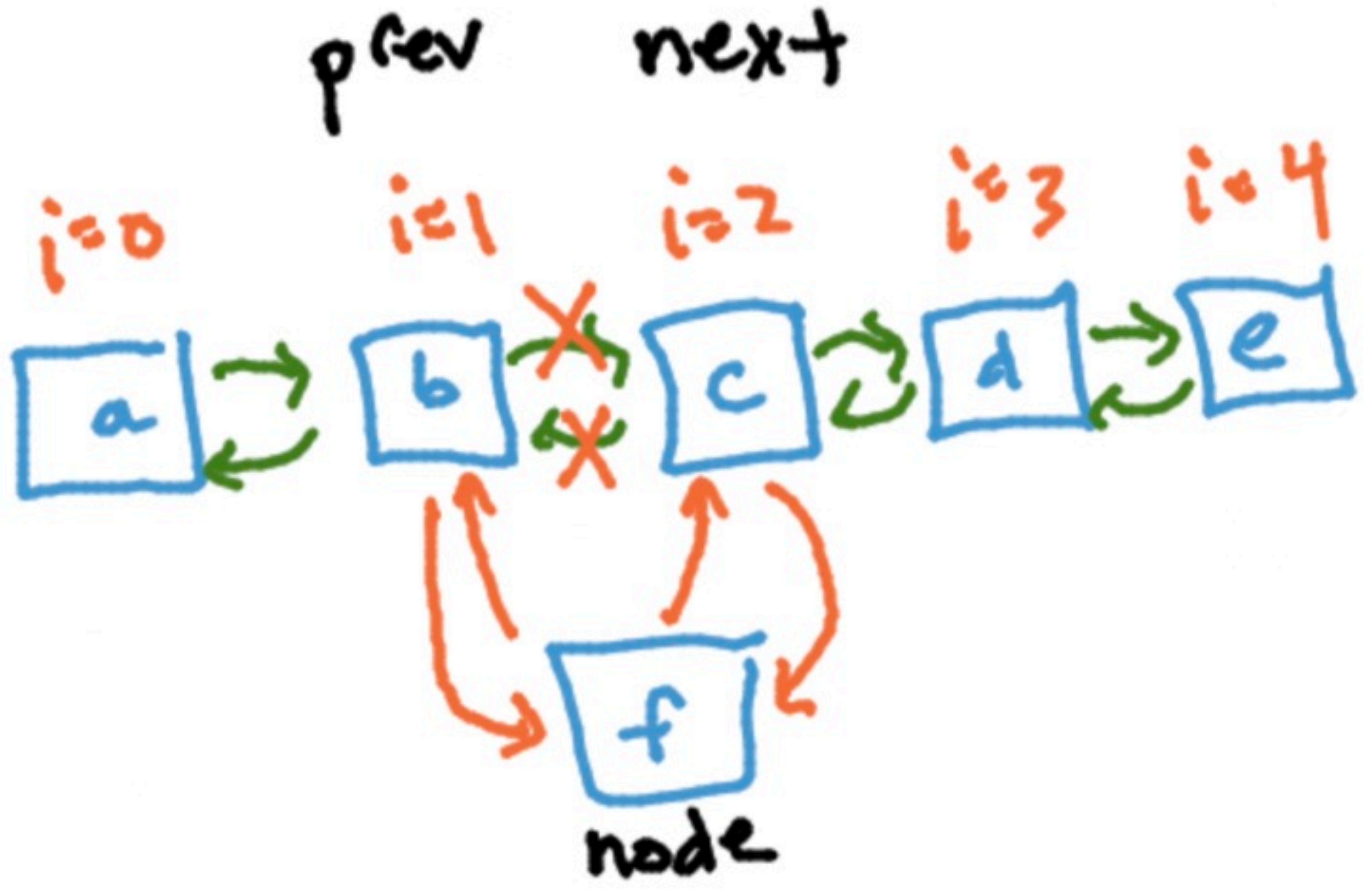
## Exercises: use a LiveShare server to complete the following methods for a doubly-linked list.

- `removeLast()`
- `add(int index, E data)`
- `remove(index)`



add:

add(2,f)



## See you tomorrow!

- **Homework 5** due tomorrow (10/18) at 11:59pm.
  - Implement a variant of `Merge Sort`.
- **Lab 5** tomorrow will involve writing our own text editor:
  - Think about how you would represent a line of characters using a linked list, and how to represent the cursor.
- **Midterm Study Guide** will be posted by the end of the week.
- Reminder that Noah (go/noah) and Smith (go/smith) have office hours throughout the week and the 201 Course Assistants have drop-in hours in the late afternoons/evenings (go/cshelp).
- Submit exit ticket 6R today.