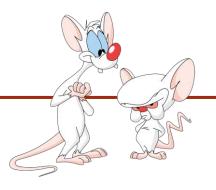
# ASSIGOMPO2501619 INTRODUCTION TO COMPUTER SCIENCE

Week 5-2: Singly Linked Lists

Giulia Alberini, Fall 2020

#### WHAT ARE WE GOING TO DO IN THIS VIDEO?



Singly Linked Listsignment Project Exam Help

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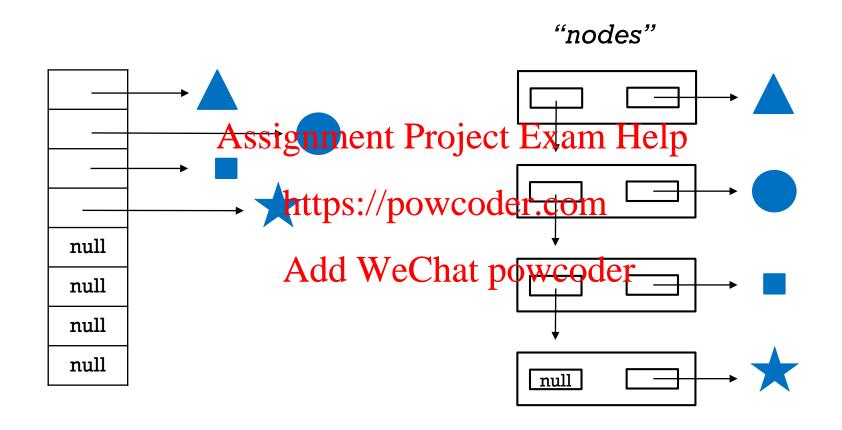
#### **IMPLEMENTATIONS**

There are different implementations of a list:

- Assignment Project Exam Help Array list
- Singly linked list <a href="https://powcoder.com">https://powcoder.com</a>
  Idea: the elements in the list are linked using pointers
- Doubly linked list Add WeChat powcoder

# Array list

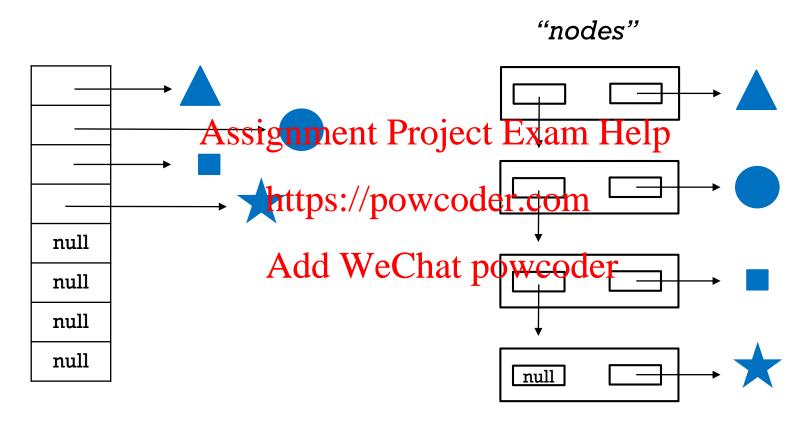
## Linked list



$$size = 4$$

# Array list

# Linked list



Array slots are in consecutive locations (addresses) in memory, but objects (elements) can be anywhere.

Linked list "nodes" and objects (elements) can be anywhere in memory.

#### SINGLY LINKED LIST NODE

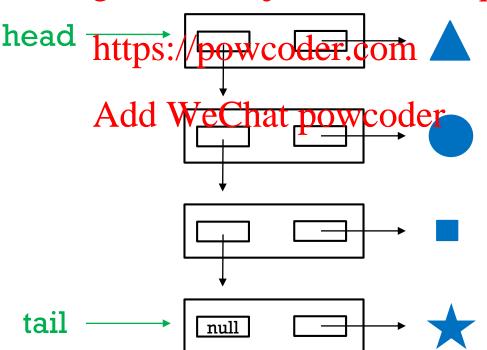
```
class SNode {
    Shape elementsisignment Project Exam Help SNode next;
} https://powcoder.com
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```

```
SNode myNode = new SNode();
n.element = new Shape( );
```

#### SINGLY LINKED LIST

We think of a linked list as a sequence of nodes, along with a reference to the first (head) and last (tail) node.

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#### SINGLY LINKED LIST

```
public class SLinkedList {
   private SNode head;
   private SNode tail; Assignment Project Exam Help
   private int size;
                         https://powcoder.com
   private class SNode {
                         Add WeChat powereder
      Shape element;
      SNode next;
                                                          null
```

```
SLinkedList list = new SLinkedList();
:
```

## LINKED LIST OPERATIONS

```
addFirst (e)
```

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removeFirst()

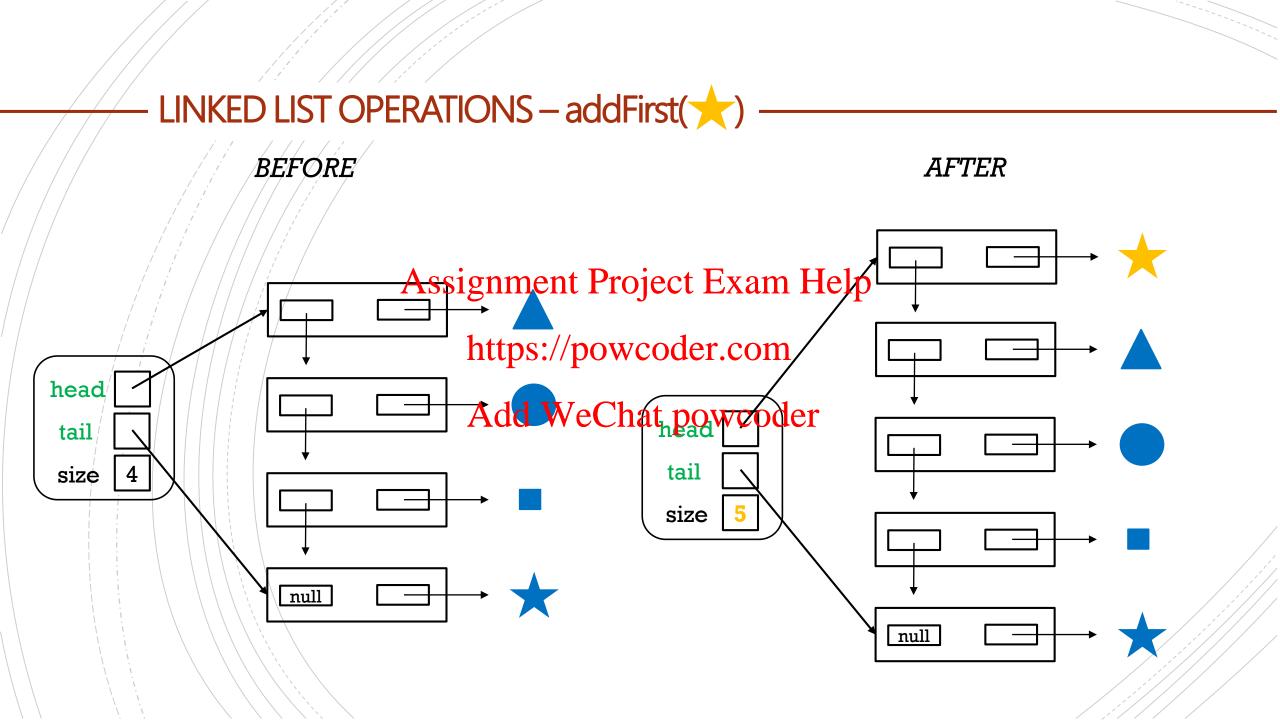
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addLast ( e )

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removeLast()

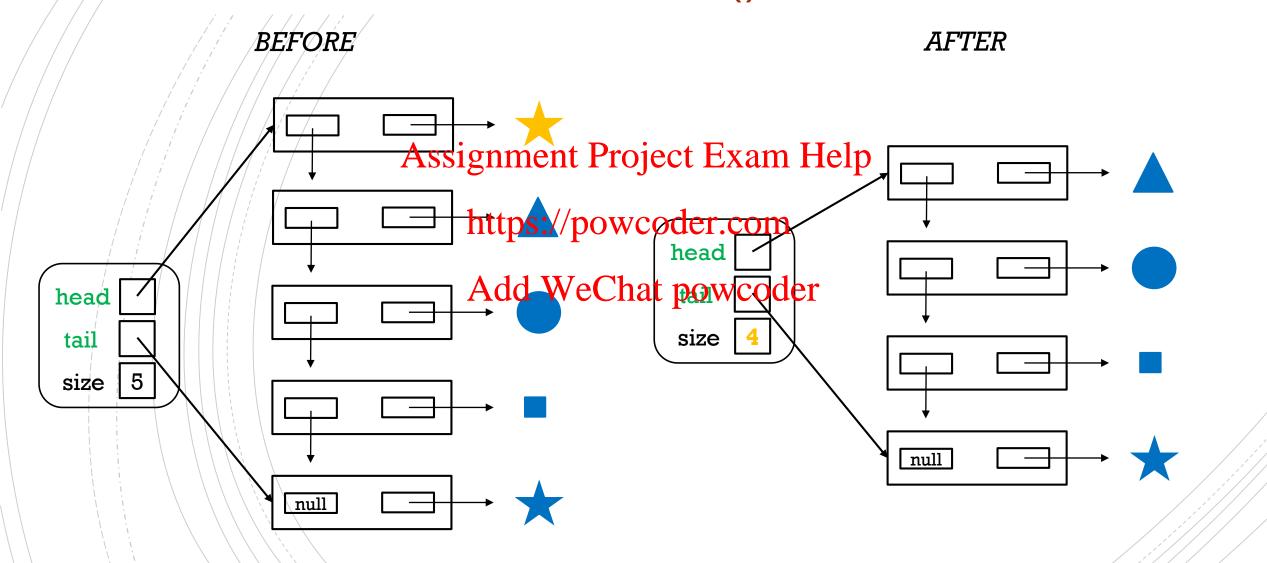
many other list operations



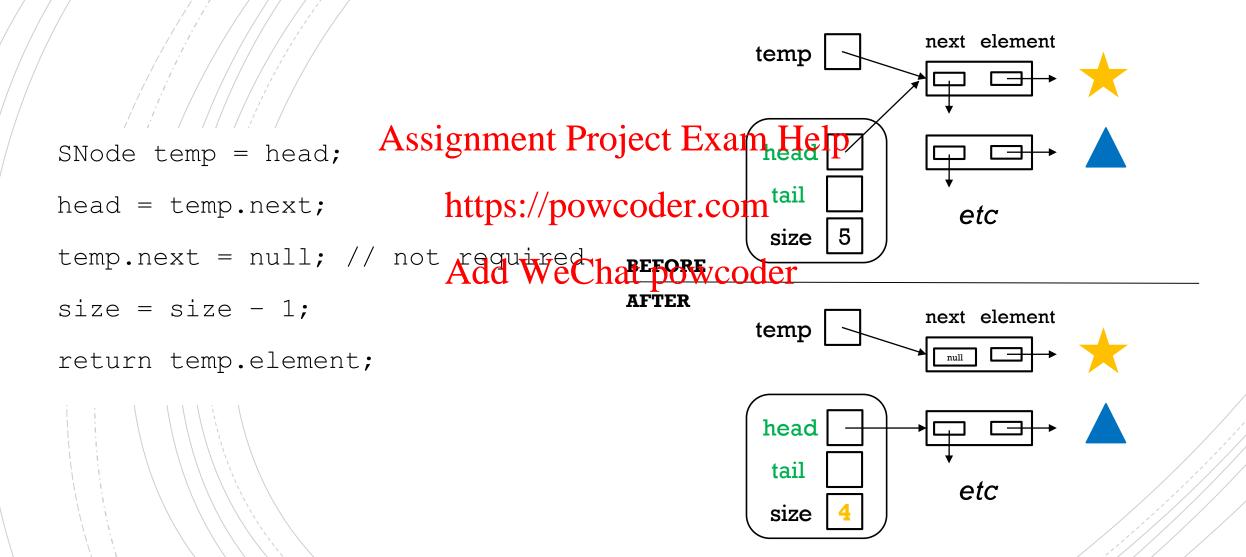
#### addFirst(e) - PSEUDOCODE

```
SNode newNode = new SNode();
newNode.element = eAssignment Project Exam Help
                        https://powcoder.com
newNode.next = head;
                                              next element
                                newNode
// edge case
                        Add WeChat powcoder
if (head == null)
                                    head
      tail = newNode;
                                    tail
                                                 etc
head = newNode;
                                    size
size = size +1;
```

## LINKED LIST OPERATIONS – removeFirst()



#### removeFirst() - PSEUDOCODE



#### removeFirst() - EDGE CASES (SIZE IS 0 OR 1)

```
temp | null
SNode temp = head;
if (size == 0)
                        Assignment Project Exam Help [null
       throw exception
                                                       tail
                                                            null
                             https://powcoder.com
head = temp.next;
                                                       size
                             Add WeChat powcoder
temp.next = null;
                                Size = 1
                                                      Before After
size = size - 1;
                                 temp
                                                             temp
if (size == 0)
                                            next element
                                                                        next element
       tail = null;
                                 head
                                                             head
                                                                  null
return temp.element;
                                  tail
                                                              tail
                                                                  null
                                                                   0
                                  size
                                                              size
```

## WORSE CASE TIME COMPLEXITY (N = LIST SIZE)

array list linked list

addFirst()

removeFirst()

Assignment Project Exam Help O(N) O(1)

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O(N) O(1) Add WeChat powcoder

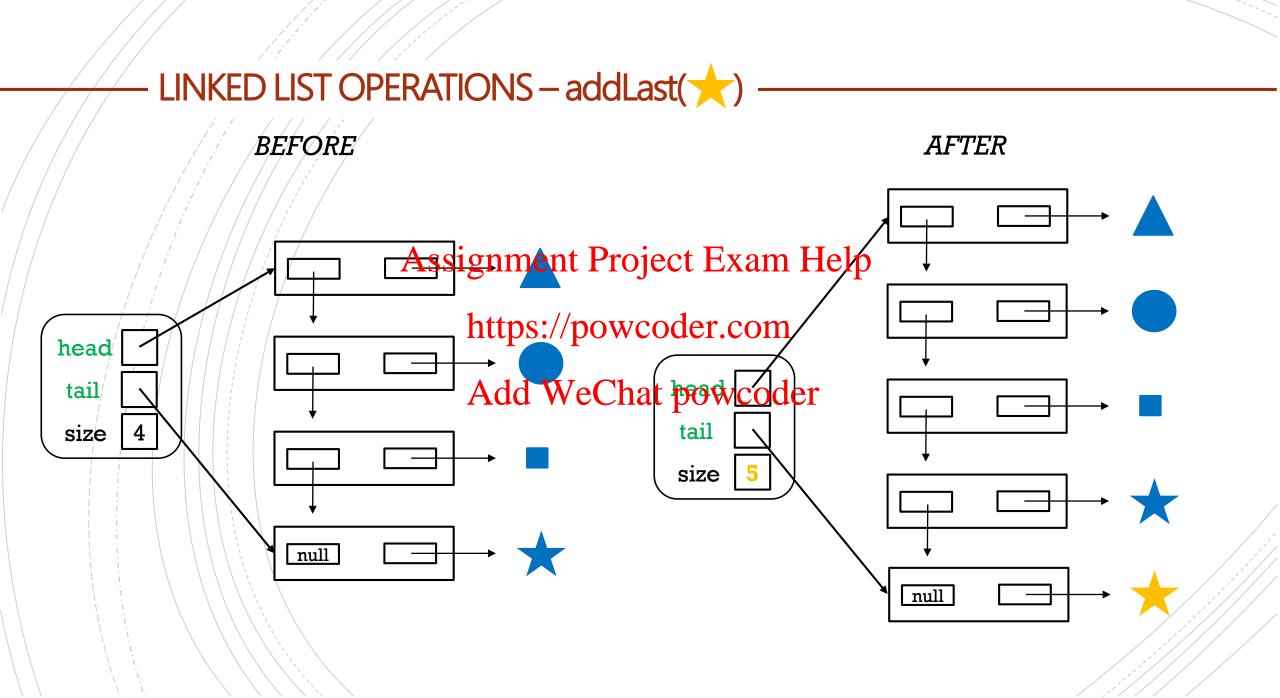
For arraylist with N elements, recall that add(0, e) and remove(0)required a loop with N iterations

For linked lists the implementation of addFirst() and removeFirst() does not depend on the number of elements in the list

## WORSE CASE TIME COMPLEXITY (N = LIST SIZE)

```
array list linked list
            Assignment Project Exam Help O(N) O(1)
addFirst()
                https://powcoder.com
                O(N) O(1)
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removeFirst()
                        O(1)*
addLast()
                        O(1)
removeLast()
```

\*if array is not full



#### addLast(e) - PSEUDOCODE

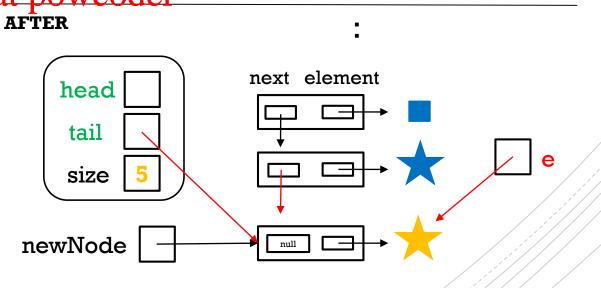
```
// create a new node

SNode newNode = newAssignment Project Sixen4 Help

newNode.element = e; https://powcodentoden

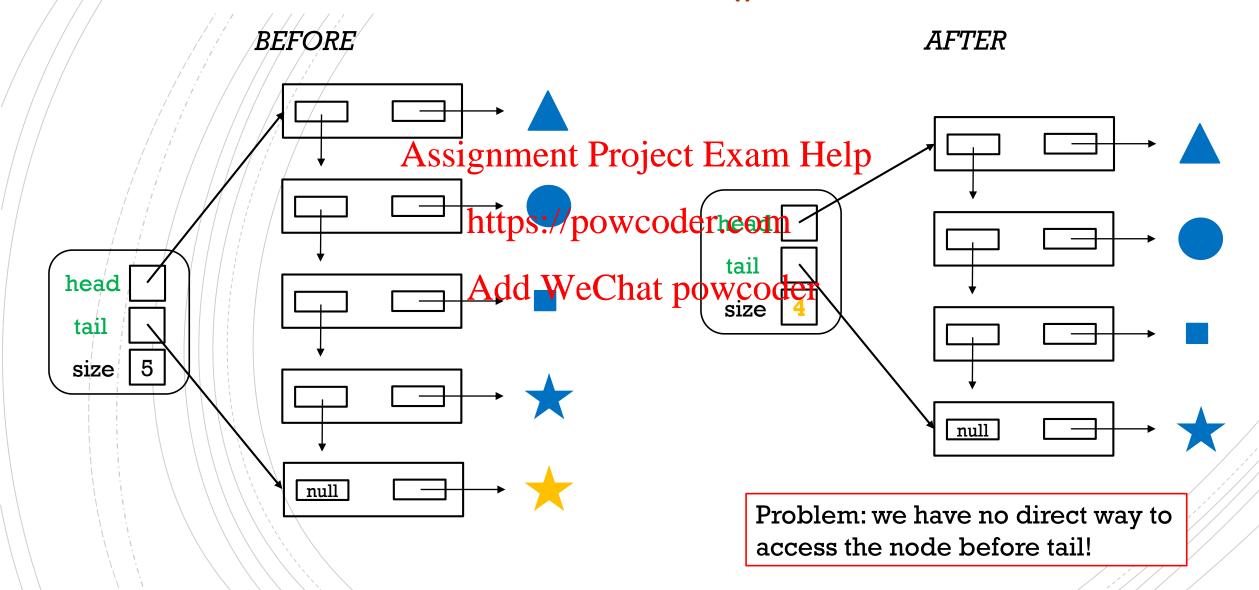
Add WeChafeforevcoder
```

// add it at the end
tail.next = newNode;
tail = tail.next;
size = size + 1;



next element

## LINKED LIST OPERATIONS – removeLast()



#### removeLast() - PSEUDOCODE

```
SNode tmp = head;
                                                     next element
while (tmp.next != tail)
                                       head
     tmp = tmp.next; Assignment Project Exam Help
                         https://powcoder.com
                         Add WeChat powcoder
```

#### removeLast() - PSEUDOCODE

// edge cases for size = 0 and 1 to be added

```
SNode tmp = head;
                                                        next element
while (tmp.next != tail)
                                         head
      tmp = tmp.next; Assignment Project Exam Help
                          https://powcoder.com
                          Add WeChat powcoder
tail = tmp;
tail.next = null;
size = size - 1;
// to return the element,
// you need to do a bit more work
```

#### removeLast() - EDGE CASES (SIZE IS 0 OR 1)

```
temp | null
if (size == 0)
       throw exception Assignment Project Exam [Help null
if (size == 1)
                                                         tail
                                                             null
                              https://powcoder.com
                                                         size
       head = null;
                              Add WeChat powcoder
       tail = null;
                                Size = 1
                                                       Before After
else {
                                             next element
                                                                          next element
                                                               head
                                  head
                                                                    null
                                   tail
                                                               tail
                                                                    null
size = size - 1;
                                  size
                                                               size
```

## WORSE CASE TIME COMPLEXITY (N = LIST SIZE)

```
array list linked list
            Assignment Project Exam Help O(N) O(1)
addFirst()
                https://powcoder.com
                O(N) O(1) Add WeChat powcoder
removeFirst()
                        O(1)*
addLast()
                                       O(1)
                        O(1)
removeLast()
                                       O(N)
```

\*if array is not full



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Doubly Linked Lists

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