CSE12 - Lecture 5

Wednesday, April 12, 2023 8:00 AM

PA1 → slip day → due today @10pm

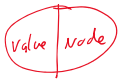
PA2 → released → due Tues

What is a Linked List?

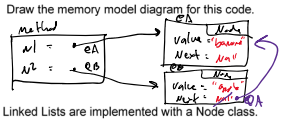
A Linked List is a data structure that implements a List ADT, where elements in the list may appear anywhere in memory, but are "linked" together in a particular order using references or pointers.

```
class Node {
  String value;
  Node next;
  public Node(String value, Node next) {
    this.value = value;
    this.next = next;
  }
}

// Somewhere else in the code... still inside Node class (can access next)
Node n1 = new Node("banana", null);
Node n2 = new Node("apple", null);
n2.next = n1;
```



Draw the memory model diagram for this code.



Linked Lists are implemented with a Node class.

The Node forms the structure of the list.

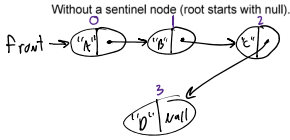
It contains:

- A reference to the data stored at that position in the list
- A reference to the next node in the list
- Optionally (for a doubly linked list) a reference to the previous node in the list.

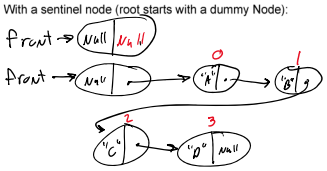
The Linked List itself usually contains only a reference to the first node in the list (head), and sometimes a reference to the last node (tail). It also might store the list's size.

Assume that a linked list contains the following elements in this order: "A", "B", "C", "D". Draw the memory model of the linked list. Label the index of each element.

Without a sentinel node (root starts with null).



With a sentinel node (root starts with a dummy Node):



front = Null

Name: _____ PID: _____ Code: 1479

```
public class LinkedStringList implements StringList {
  Node front;
  int size;

  public LinkedStringList() {
    this.front = new Node(null, null);
  }

  /* Add an element at the beginning of the list */
  public void prepend(String s) {
    Node newFront = new Node(s, this.front.next);
    this.front.next = newFront;
    this.size += 1;
  }

  /* Add an element at the end of the list */
  public void add(String s) {
    Node curNode = front;
    while (curNode.next != null) {
      curNode = curNode.next;
    }
    curNode.next = new Node(s, null);
    size += 1;
  }

  /* Add an element at the specified index */
  public void insert(int index, String s) {
    Node curNode = front;
    int count = 0;
    while (count < index) {
      curNode = curNode.next;
      count += 1;
    }
    Node node = new Node(s, curNode.next);
    curNode.next = node;
  }
    size += 1;
  /* Remove the element at the specified index */
  public void remove(int index) {
    Node curNode = front;
    for (int i=0; i< index; i++) {
      curNode = curNode.next;
    }
    curNode.next = curNode.next.next;
    size -= 1;

  }
}
```

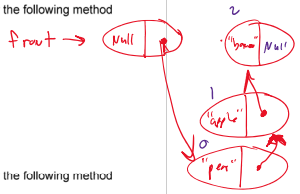
traverse list

traverse list → for loop also works

traverse list

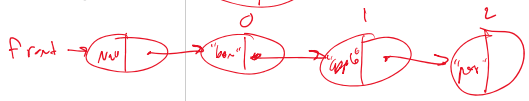
Draw the linked list for the following method calls:

prepend("banana");
prepend("apple");
prepend("pear");



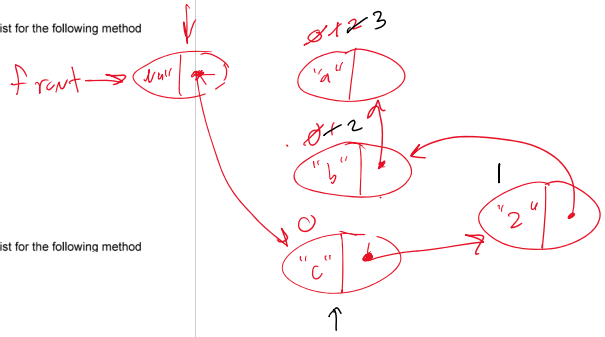
Draw the linked list for the following method calls:

add("banana");
add("apple");
add("pear"),



Draw the linked list for the following method calls:

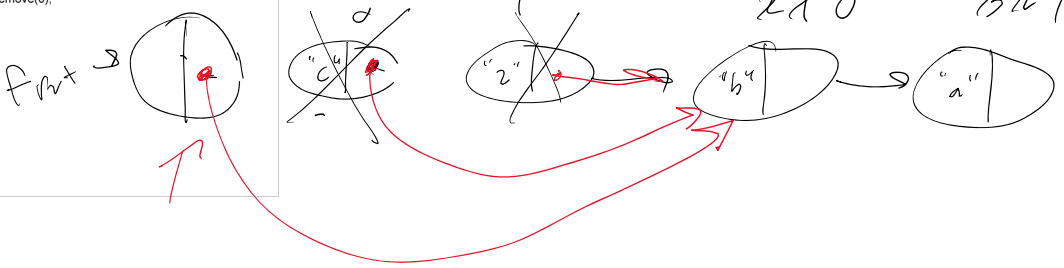
insert(0, "a");
insert(0, "b");
insert(0, "c");
insert(1, "z");



Draw the linked list for the following method calls:

add("c");
add("z");
add("b");
add("a");

remove(1);
remove(0);



No dummy/sentinel node:

front → null

```
void add(  )
  if (front == null) {
      front = new Node(...);
      size += 1;
  }
  else {
      // same code as add() above
  }
}
```

special case

→ required for add, get, insert, remove etc.

using dummy node removes the special case → code works the same if size == 0 and if size > 0