Building Java Programs

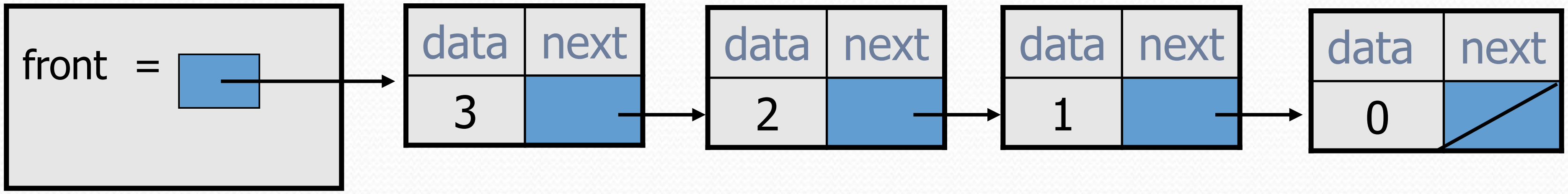
Complex Linked List Code

reading: 16.2 – 16.3

First order of business : bug check.

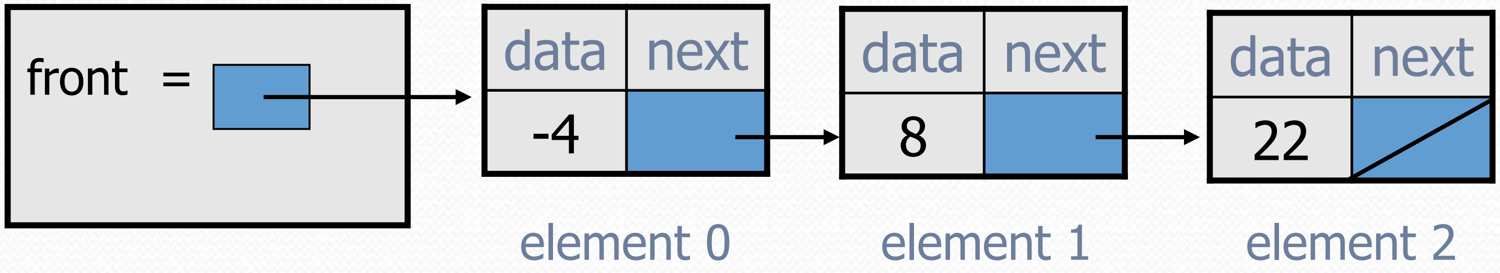
LinkedIntList(int n)

- Write a constructor for `LinkedIntList` that accepts an `int n` parameter and makes a list of the number from 0 to `n`
  - `new LinkedIntList(3) :`

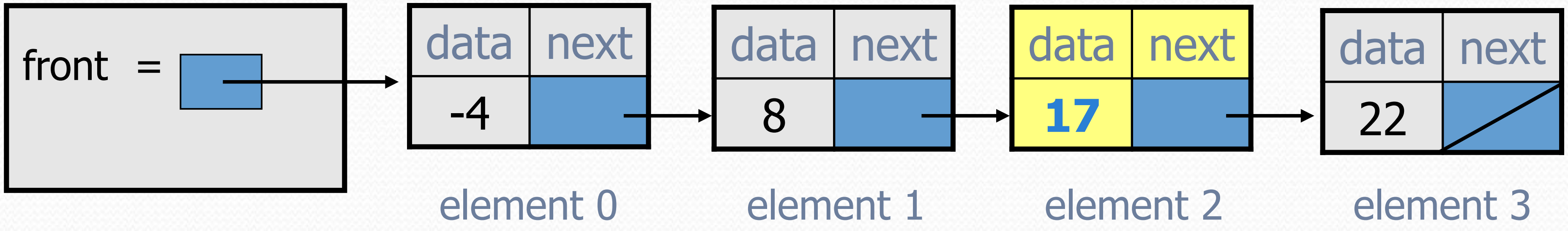


addSorted

- Write a method `addSorted` that accepts an `int` as a parameter and adds it to a sorted list in sorted order.
  - Before `addSorted(17)` :



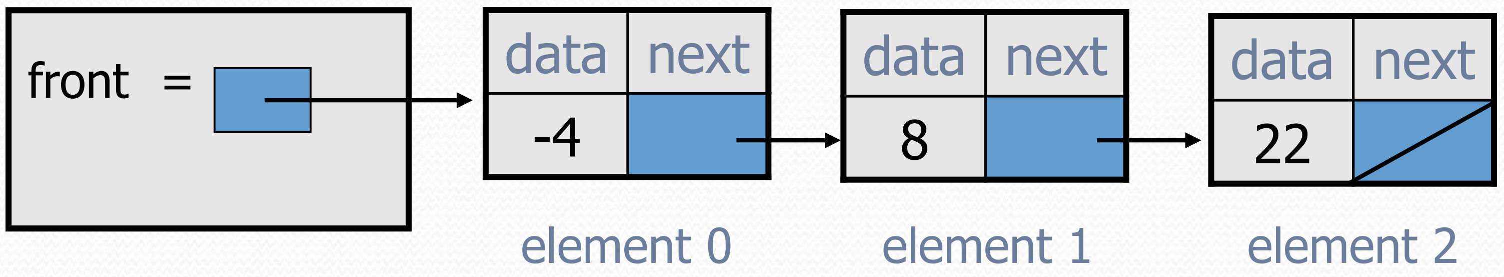
  - After `addSorted(17)` :



The common case

- Adding to the middle of a list:

  `addSorted(17)`

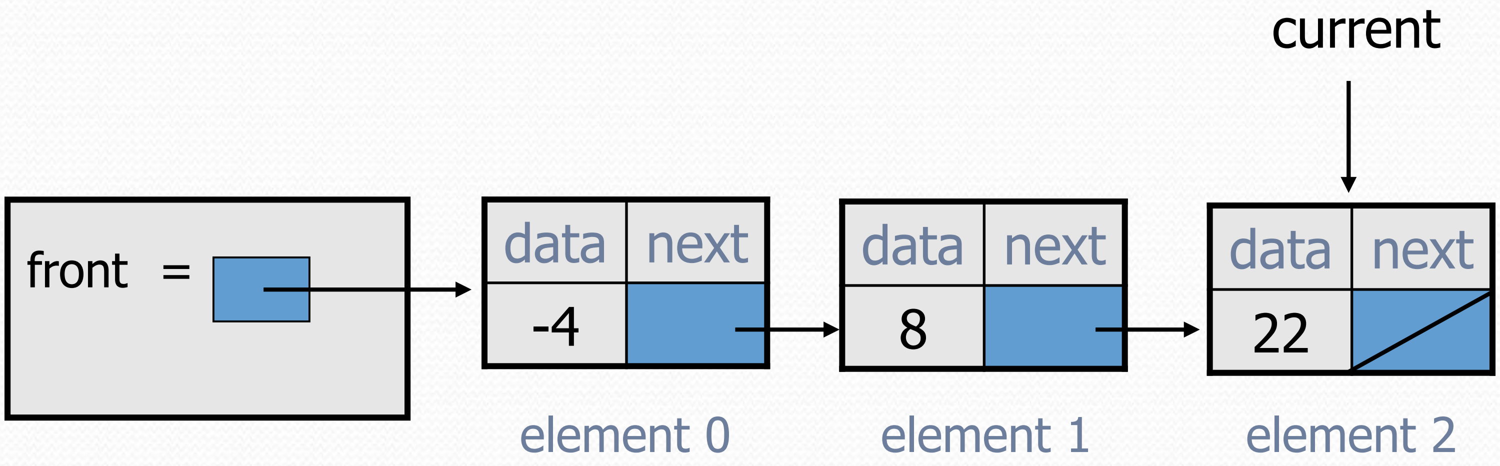


  - Which references must be changed?
  - What sort of loop do we need?
  - When should the loop stop?

First attempt

- An incorrect loop:

```
ListNode current = front;
while (current.data < value) {
    current = current.next;
}
```



- What is wrong with this code?
    - The loop stops too late to affect the list in the right way.

changing a list

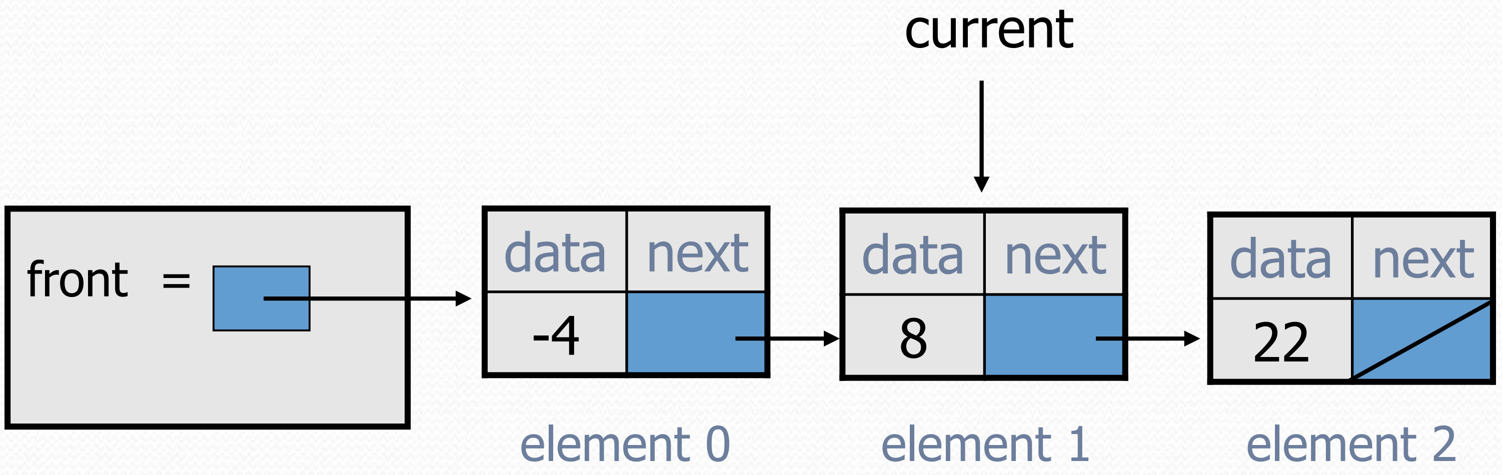
- There are only two ways to change a linked list:
  - Change the value of `front` (modify the front of the list)
  - Change the value of `<node>.next` (modify middle or end of list to point somewhere else)

- Implications:
  - To add in the middle, need a reference to the *previous* node
  - Front is often a special case

Key idea: peeking ahead

- Corrected version of the loop:

```
ListNode current = front;
while (current.next.data < value) {
    current = current.next;
}
```

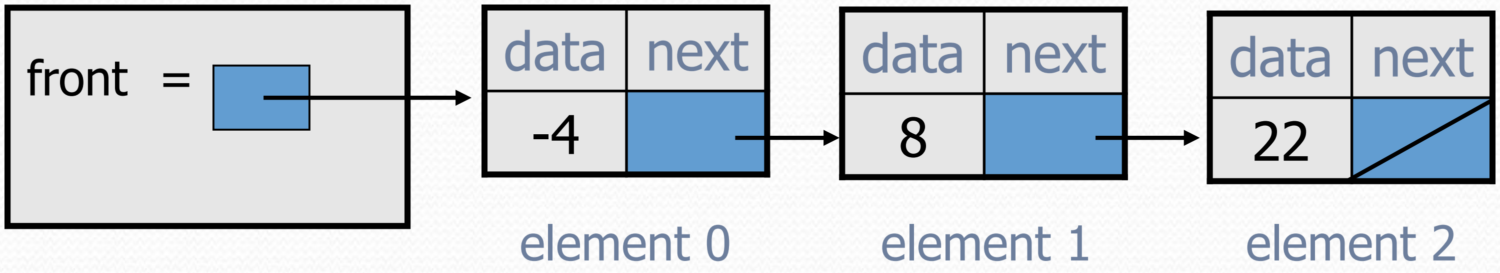


- This time the loop stops in the right place.

Another case to handle

- Adding to the end of a list:

  `addSorted(42)`



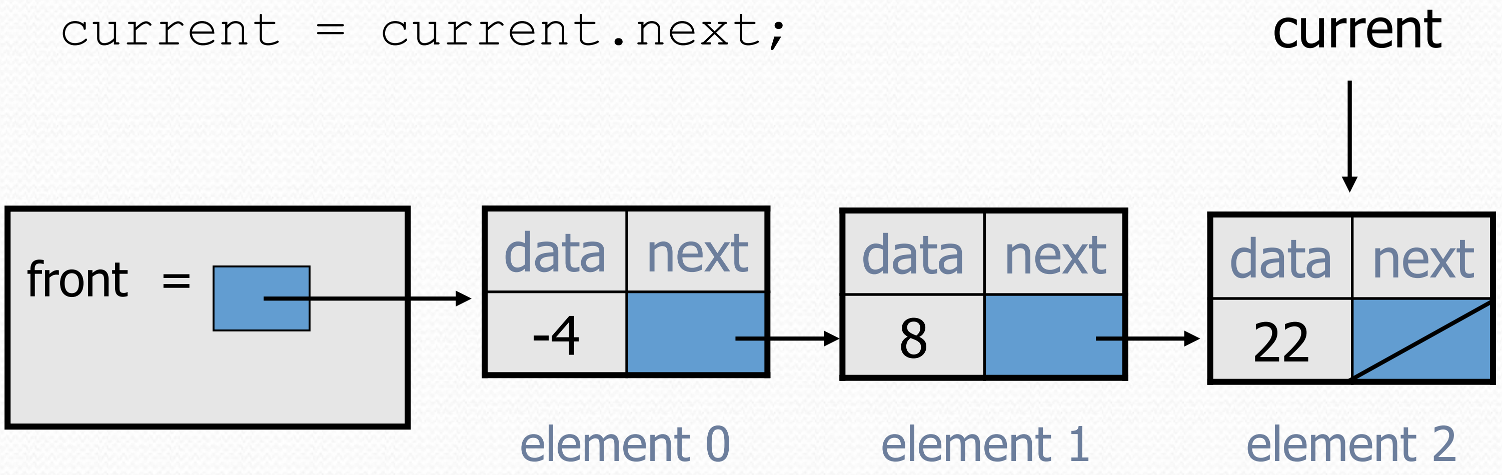
```
Exception in thread "main": java.lang.NullPointerException
```

  - Why does our code crash?
  - What can we change to fix this case?

Multiple loop tests

- A correction to our loop:

```
ListNode current = front;
while (current.next != null &&
       current.next.data < value) {
    current = current.next;
}
```

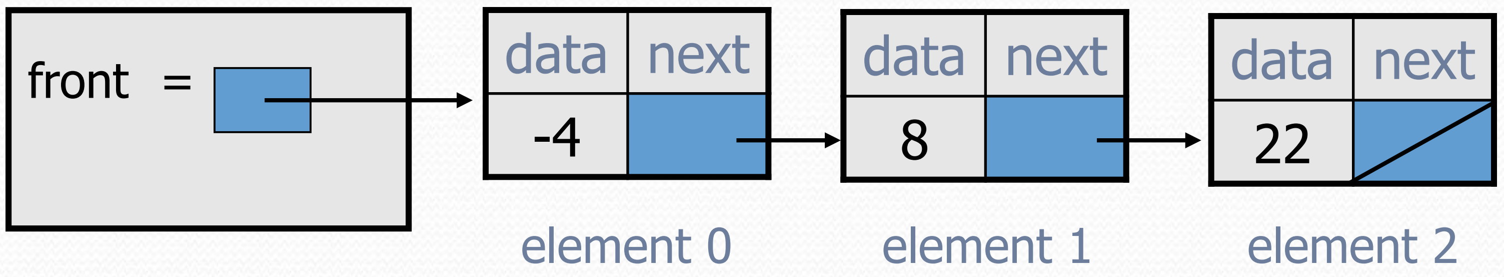


- We must check for a `next` of `null` *before* we check its `.data`.

Third case to handle

- Adding to the front of a list:

```
addSorted(-10)
```



  - What will our code do in this case?
  - What can we change to fix it?

Handling the front

- Another correction to our code:

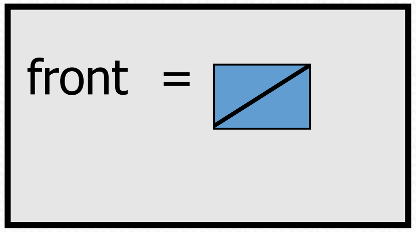
```
if (value <= front.data) {
    // insert at front of list
    front = new ListNode(value, front);
} else {
    // insert in middle of list
    ListNode current = front;
    while (current.next != null &&
           current.next.data < value) {
        current = current.next;
    }
}
```

  - Does our code now handle every possible case?

Fourth case to handle

- Adding to (the front of) an empty list:

  `addSorted(42)`



  - What will our code do in this case?
  - What can we change to fix it?

Final version of code

```
// Adds given value to list in sorted order.
// Precondition: Existing elements are sorted
public void addSorted(int value) {
    if (front == null || value <= front.data) {
        // insert at front of list
        front = new ListNode(value, front);
    } else {
        // insert in middle of list
        ListNode current = front;
        while (current.next != null &&
                current.next.data < value) {
            current = current.next;
        }
    }
}
```

Common cases

- **middle**: "typical" case in the middle of an existing list
- **back**: special case at the back of an existing list
- **front**: special case at the front of an existing list
- **empty**: special case of an empty list