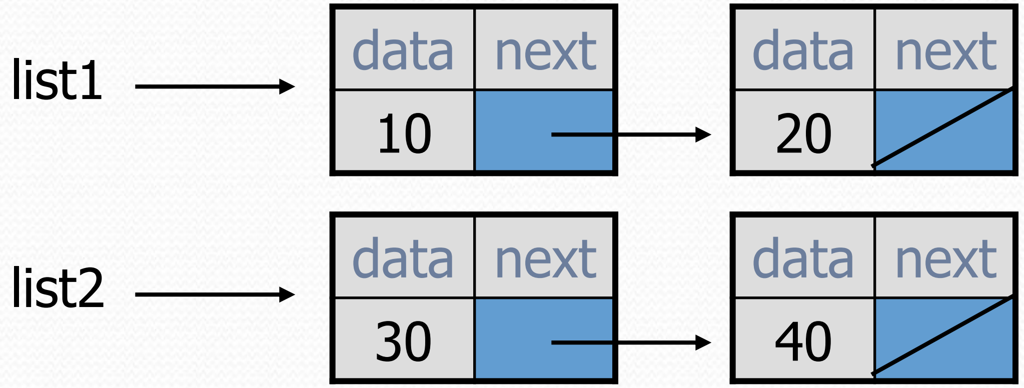
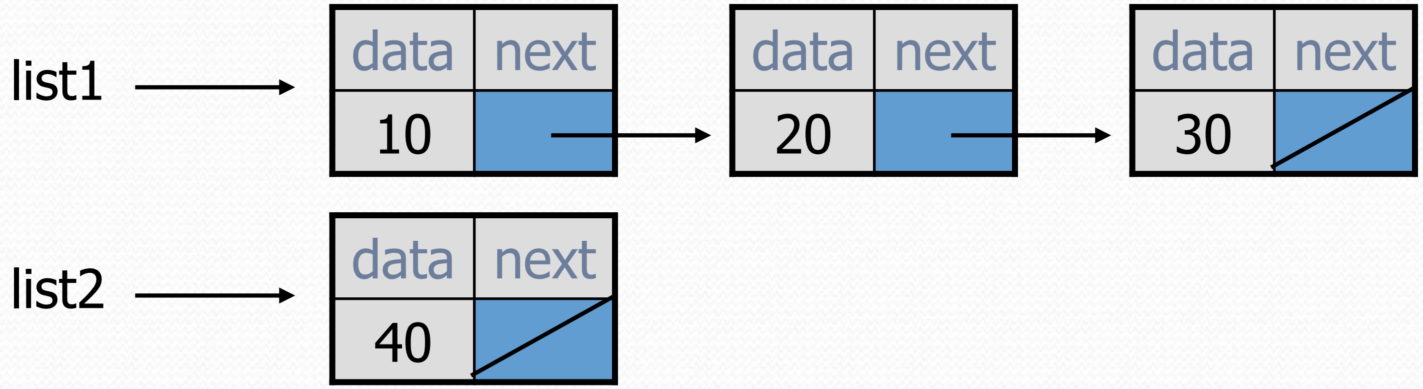
Linked node problem 3

- What set of statements turns this picture:

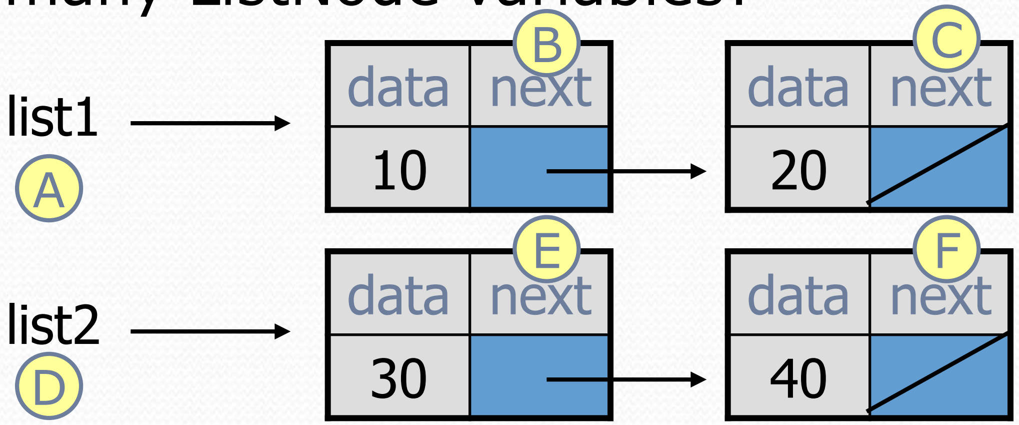


- Into this?

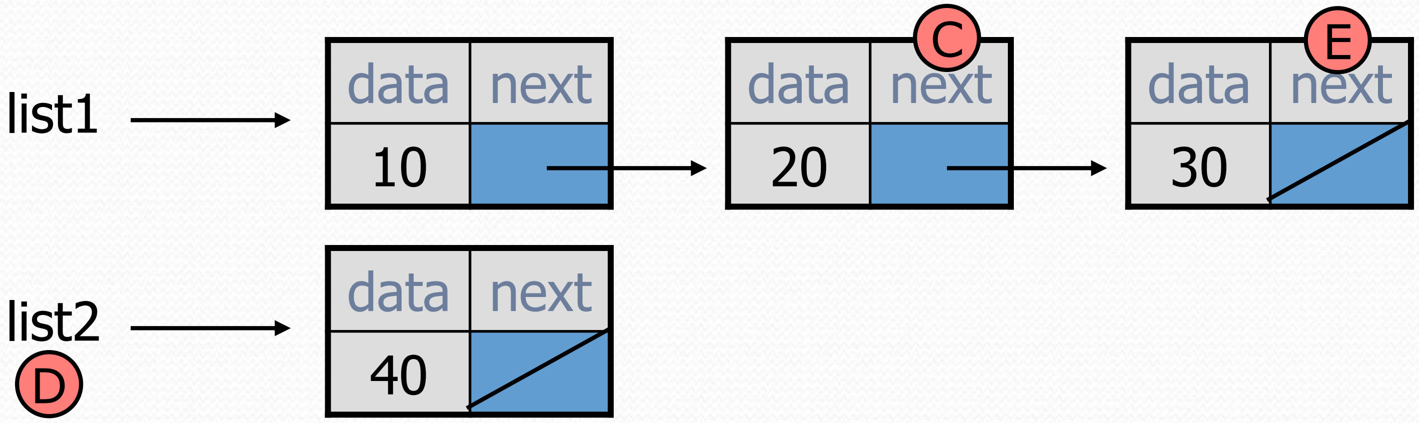


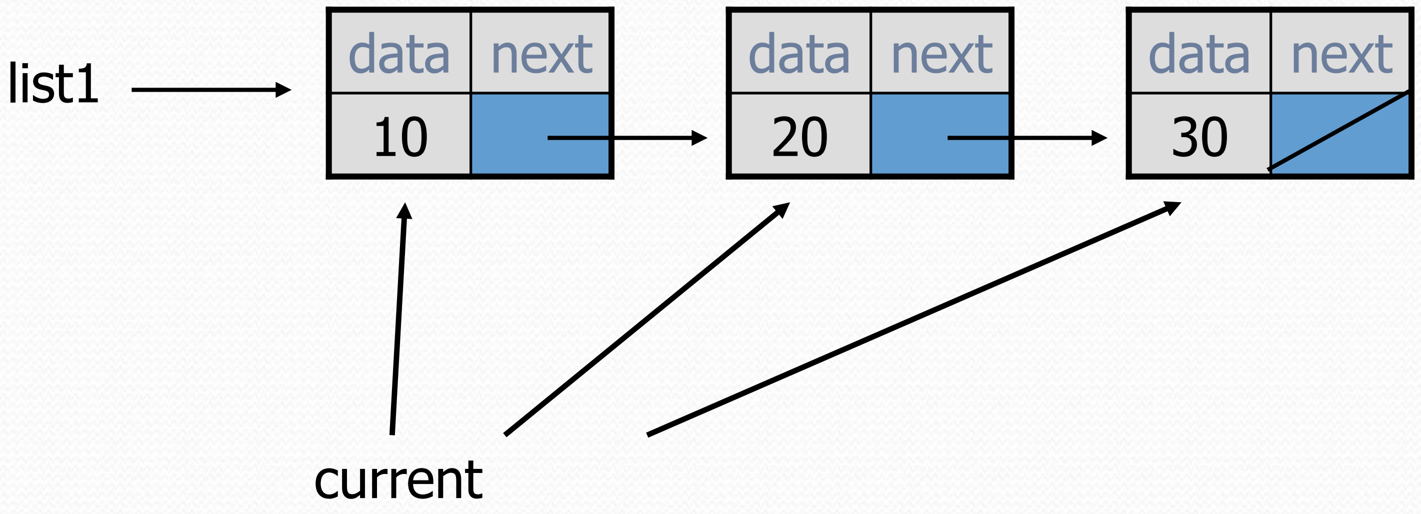
Linked node problem 3

- How many ListNode variables?



- Which variables change?




list1
data
next
10
data
next
20
data
next
30
current

Abstract data types (ADTs)

- **abstract data type (ADT)**: A specification of a collection of data and the operations that can be performed on it.
  - Describes *what* a collection does, not *how* it does it

- Java's collection framework describes several ADTs:
  - `Queue, List, Collection, Deque, List, Map, Set`

- An ADT can be implemented in multiple ways:
  - `ArrayList` and `LinkedList` implement `List`
  - `HashSet` and `TreeSet` implement `Set`
  - `LinkedList`, `ArrayDeque`, etc. implement `Queue`

- The **same** external behavior can be implemented in many different ways, each with pros and cons.

Linked List vs. Array

- Print list values:

```
ListNode list= ...;

ListNode current = list;
while (current != null) {
    System.out.println(current.data);
    current = current.next;
}
```

- Similar to array code:

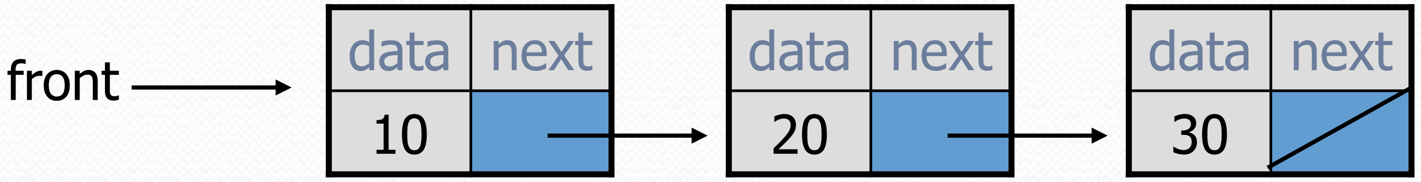
```
int[] a = ...;

int i = 0;
while (i < a.length) {
    System.out.println(a[i]);
    i++;
}
```

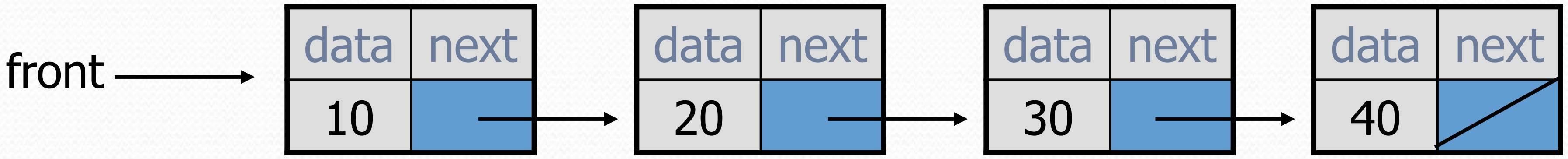
Description	Array Code	Linked List Code
Go to front of list	`int i = 0;`	`ListNode current = list;`
Test for more elements	`i < size`	`current != null`
Current value	`elementData[i]`	`current.data`
Go to next element	`i++;`	`current = current.next;`

Before/After

- Before



- After



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