Data Structures

Lists II

CS284

Structure of this week's classes

Implementing Lists as Double-Linked Lists

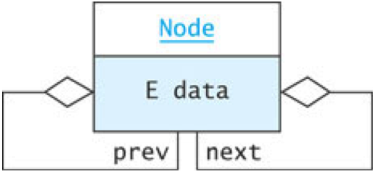
List

- Last class we introduced lists
- We studied an array based implementation
- We also studied a linked-list based implementation (Single Linked Lists)
- Next we present a double-linked list implementation (Double Linked Lists)
- Also, we present Iterators

Implementing Lists as Double-Linked Lists

Node Class

```
private static class Node<E> {
  private E data;
  private Node<E> next = null;
  private Node<E> prev = null;
  private Node(E dataItem) {
    data = dataItem;
  }
  private Node(E dataItem, Node<E> p, Node<E> n ) {
    data = dataItem;
    prev = p;
    next = n;
  }
}
```



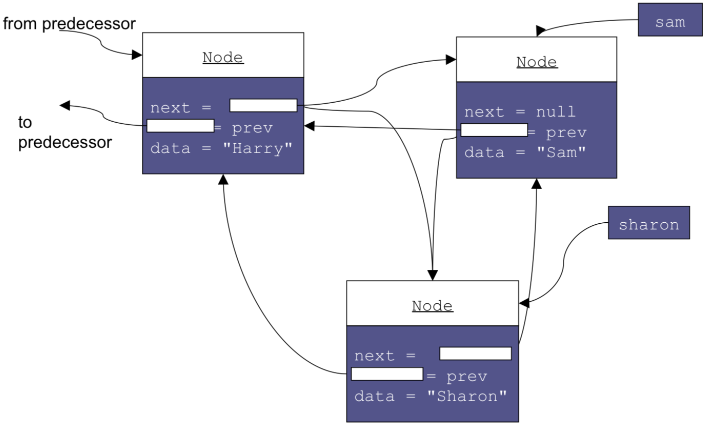
Inserting into a Double-Linked List

```
Node<String> sam = new Node<String>("Sam");
Node<String> harry = new Node<String>("Harry");
harry.next = sam;
sam.prev = harry;
```

- Let's draw a diagram

Inserting into a Double-Linked List

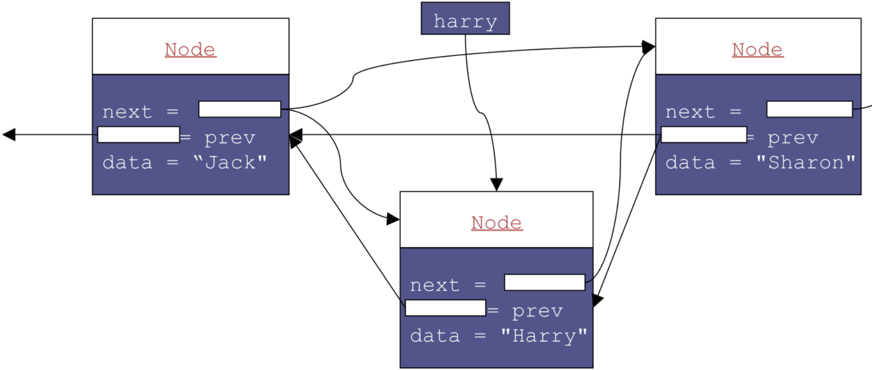
```
Node<String> sharon = new Node<String>("Sharon");
sharon.next = sam;
sharon.prev = sam.prev;
sam.prev.next = sharon;
sam.prev = sharon
```



How do we remove a node?

Consider the execution of the following additional lines

```
harry.prev.next = harry.next
harry.next.prev = harry.prev
```



The class `DLList<E>`

```java
public class DLList<E> {

    private class Node<E> {
          /* As defined above */
          ...
    }
    /** The first element in the list */
    private Node<E> head;
    /** The last element in the list */
    private Node<E> tail;
    /** The size of the list */
    private int size = 0;

  // Operations should follow
}
```

Implement `public void add(E item)`

- This operation should add the item in a new node at the beginning of the list

Double-Linked List

- So far we have worked only with internal nodes
- As with the single-linked class, it is best to access the internal nodes with a double-linked list object
- A double-linked list object has data fields:
  - head (a reference to the first list Node)
  - tail (a reference to the last list Node)
  - size
- Insertion at either end is $\mathcal{O}(1)$; insertion elsewhere is still $\mathcal{O}(n)$
- For the second assignment you will be asked to implement an indexed double-linked list.

Circular lists

- Circular double-linked list:
    - Link last node to the first node, and
    - Link first node to the last node
- We can also build singly-linked circular lists:
    - Traverse in forward direction only
- Advantages:
    - Continue to traverse even after passing the first or last node
    - Visit all elements from any starting point
    - Never fall off the end of a list
- Disadvantage: Code must avoid an infinite loop!