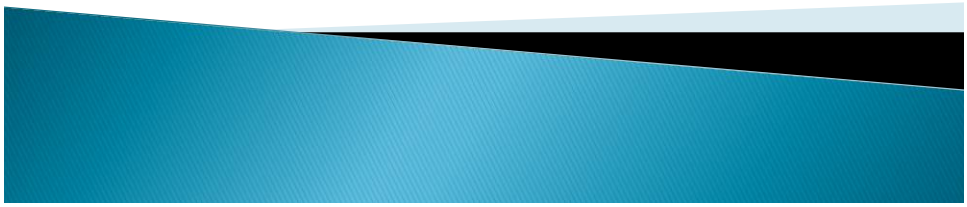
Lists (2)

CS212:Data Structure
1st semester 2011/12
Lecture 5-6



ADT List – Array

```
public class ArrayList<T>
{
    private int maxsize;
    private int size;
    private int current;
    private T[] nodes;

    /** Creates a new instance of ArrayList */
    public ArrayList(int n) {
        maxsize = n;
        size = 0;
        current = -1;
        nodes = (T[]) new Object[n]; }
```

ADT List Implementation

```
public boolean full () {
       return size == maxsize; }
public boolean empty ()
       return size == 0; }
public boolean last () {
       return current == (size-1); }
public void findfirst () {
       current = 0; }
public void findnext () {
       current++; }
```

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ADT List Implementation

```
public T retrieve () {
       return nodes[current]; }
public void update (T val) {
       nodes[current] = val; }
public void insert (T val) {
       for (int i = size-1; i > current; --i) {
           nodes[i+1] = nodes[i];
       }
       current++;
       nodes[current] = val;
       size++;
   }
```

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ADT List Implementation

```
public void remove () {
        for (int i = current + 1; i < size; i++) {
            nodes[i-1] = nodes[i];
        }
        size--;
        if (size == 0) current = -1;
        else if (current == size) current = 0;
    }
}
```

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ADT List

- How to use the ADT List?
- Example: You are required to implement a static method to search for an element e in a list L, and if e is present make current pointer point to e. Use operations of ADT List.
- The implementation of ADT is available to you as a Java class.

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Using ADT List

```
public class TestArrayList {
   public static void main ( String[] args ) {
            ArrayList<String> al = new ArrayList<String>(10);
            String s1= "xyz", s2 = "abc";
      al.insert(s1);
      al.insert(s2);
      al.findfirst();
      System.out.println(al.retrieve());
            System.out.println(al.full());

            System.out.println(length(al));
      System.out.println("Hello, World");
   }
```

Using ADT List

```
public static <T> int length(ArrayList<T> l)
    {
        int count = 0;
        l.findfirst();
        while (l.last() == false){
            count++;
            l.findnext();
        }
        return count;
    }
}
```

A static method to find the length of a list. Note: it has been implemented using the methods of ADT List

Comparison: Linked & Array Based Lists

- Comparison on the basis of number of Operations in *worst case* time complexity of insert & remove operations. All other operations have time complexity (one operation).
- Linked List: insert– ??; remove – ??
- Array List: insert – ??; remove – ??
- Best case time complexities?

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Comparison: Linked & Array Based Lists

- Linked list.
  - Disadvantage: A pointer at each node so more memory needed. For traversal, pointer hoping is required.
- Array based list.
  - Advantages: arrays are faster; no pointers to be stored – less memory. No pointer hoping
  - Disadvantage: list size must be known in advance. Insert – O(n). Remove – O(n).

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List: Other Implementations

- Singly-linked list.
  - Design Variations: (i) Count of elements may be kept i.e. *size*. Why? (ii) pointer to tail may be kept i.e. *last*. Why?
- Doubly-Linked list. each node has two pointers: next node and previous node.
  - Advantages: it is efficient to go from a node to its previous node or move back-to-front in the list; operations insert – O(1); remove – O(1). (We will cover this topic in detail later)

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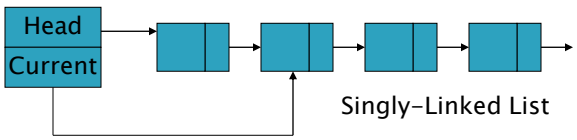
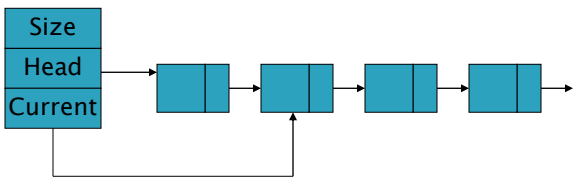
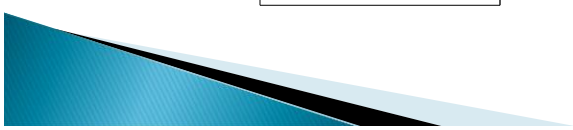
List: Singly Linked







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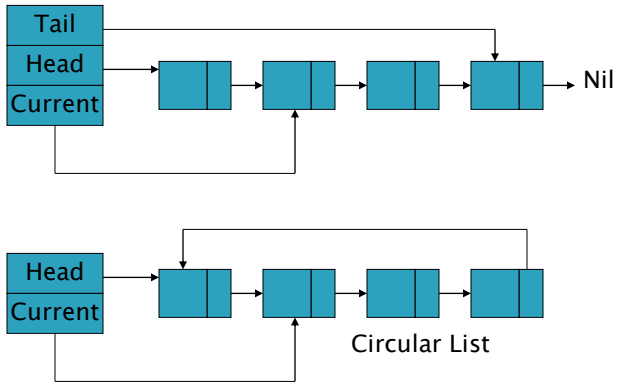
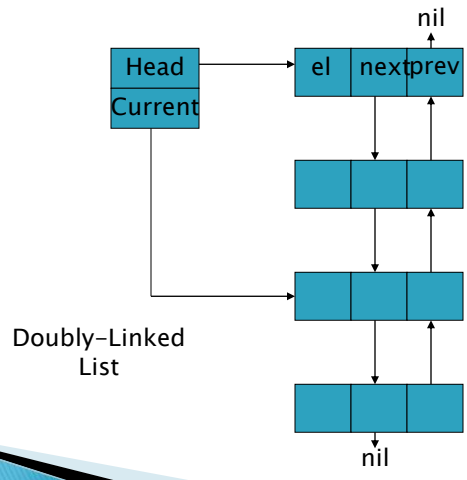
List: Singly Linked & Circular



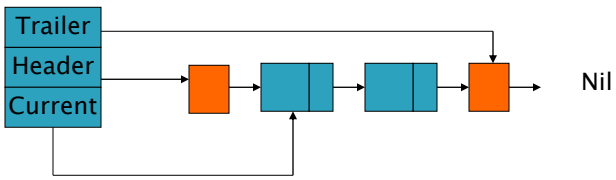
List: Doubly-Linked



List: Other Implementations

- List with Sentinel Nodes.
  - Has special header & trailer nodes that do not store data
  - All nodes that store data have previous & next nodes – so no special cases for insert & remove.
  - Advantage– simplifies code
- Circular List.
  - tail pointer made to point to the head → tail has next node. Advantage: simpler code.

List: Sentinel Nodes



List with sentinel nodes

ToDo

- Read 6.1.1 of the Textbook.