Linked Lists

Singly Linked List (§ 4.4.1)

- ◆ A singly linked list is a concrete data structure consisting of a sequence of nodes
- ◆ Each node stores
  - element
  - link to the next node

next

elem   node

A   B   C   D
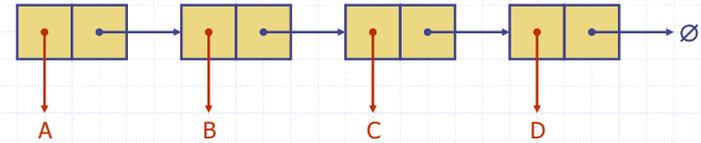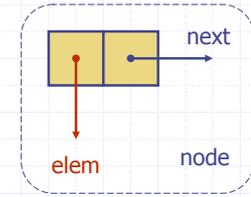
The Node Class for List Nodes

```java
public class Node {
    // Instance variables:
    private Object element;
    private Node next;
    /** Creates a node with null references to its element and next node. */
    public Node() {
        this(null, null);
    }
    /** Creates a node with the given element and next node. */
    public Node(Object e, Node n) {
        element = e;
        next = n;
    }
    // Accessor methods:
    public Object getElement() {
        return element;
    }
    public Node getNext() {
        return next;
    }
    // Modifier methods:
    public void setElement(Object newElem) {
        element = newElem;
    }
    public void setNext(Node newNext) {
        next = newNext;
    }
}
```

Inserting at the Head

1. Allocate a new node
2. Insert new element
3. Have new node point to old head
4. Update head to point to new node
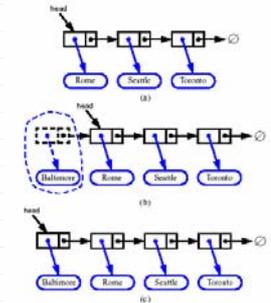
Removing at the Head

1. Update head to point to next node in the list
2. Allow garbage collector to reclaim the former first node
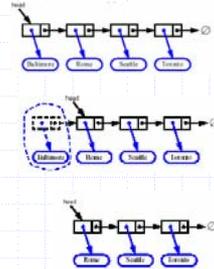
Inserting at the Tail

1. Allocate a new node
2. Insert new element
3. Have new node point to null
4. Have old last node point to new node
5. Update tail to point to new node
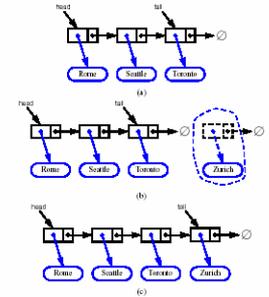
Removing at the Tail

◈ Removing at the tail of a singly linked list is not efficient!
◈ There is no constant-time way to update the tail to point to the previous node
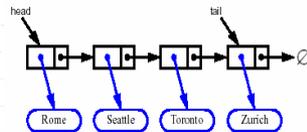
Stack with a Singly Linked List

◈ We can implement a stack with a singly linked list
◈ The top element is stored at the first node of the list
◈ The space used is $O(n)$ and each operation of the Stack ADT takes $O(1)$ time
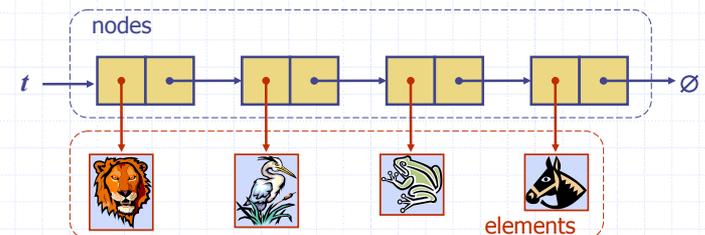
Queue with a Singly Linked List

- We can implement a queue with a singly linked list
  - The front element is stored at the first node
  - The rear element is stored at the last node
- The space used is $O(n)$ and each operation of the Queue ADT takes $O(1)$ time