Northeastern University

Lecture 18: Stack Implementations - 1

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Outline

- A Linked Implementation
- An Array-Based Implementation
- A Vector-Based Implementation

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A Linked Implementation

Stack Implementation

- Each operation involves the top of stack
  - `push`
  - `pop`
  - `peek`
- The head of linked list is easiest, fastest to access
  - Let this be the top of the stack

Linked Implementation

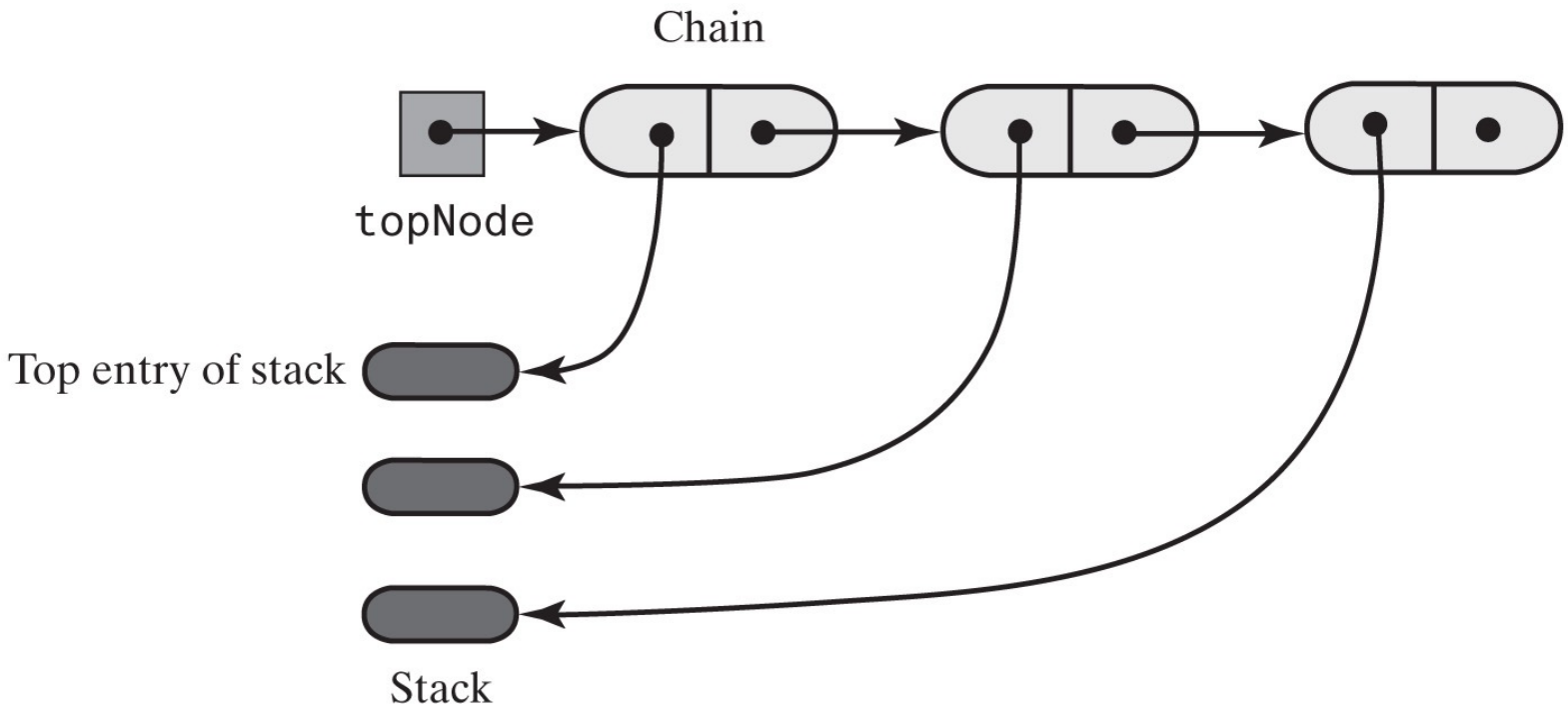


Figure 6-1: A chain of linked nodes that implements a stack

Linked Implementation

```
/** A class of stacks whose entries are stored in a chain of nodes. */
public final class LinkedStack<T> implements StackInterface<T>
{
   private Node topNode; // References the first node in the chain

   public LinkedStack()
   {
      topNode = null;
   } // end default constructor

   //  < Implementations of the stack operations go here. >
   //  . . .

   private class Node
   {
      private T    data; // Entry in stack
      private Node next; // Link to next node
      //  < Implementations of the node operations go here. >

   } // end Node
} // end LinkedStack
```

Listing 6-1: An outline of a linked implementation of the ADT stack

Linked Implementation - Push Operation

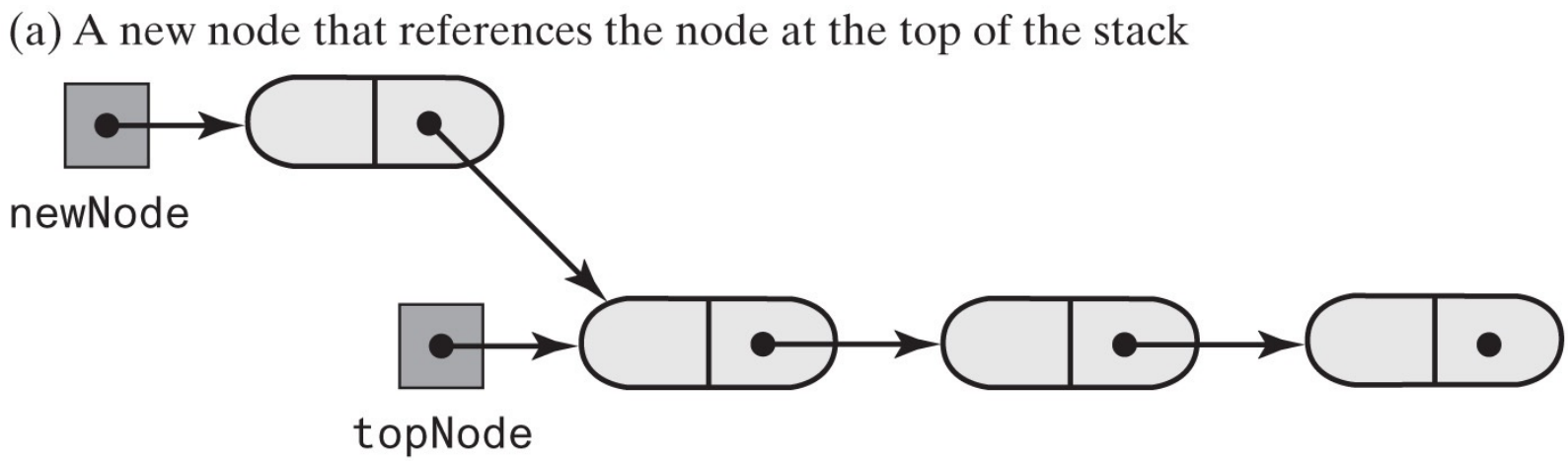


Figure 6-2: (a) A new node that references the node at the top of the stack;

Linked Implementation - Push Operation (cont.)

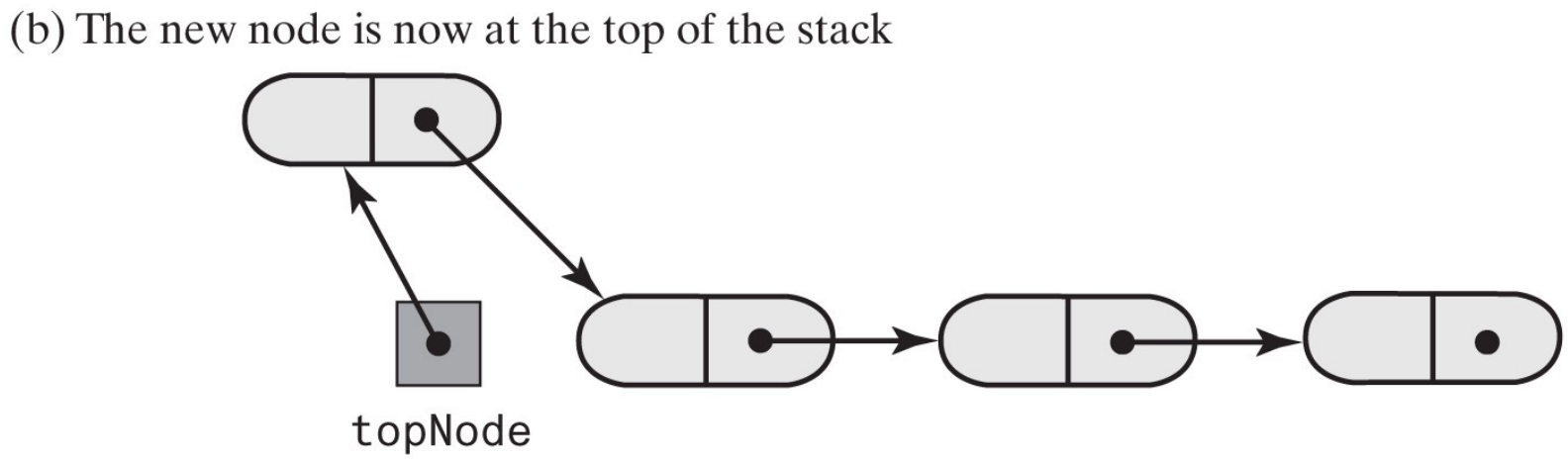
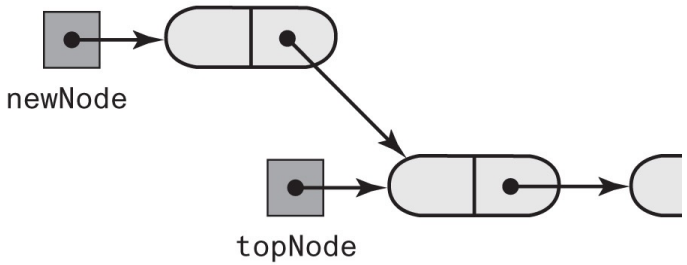


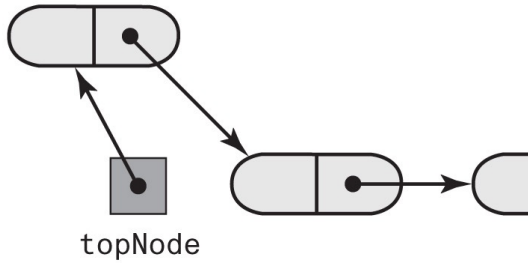
Figure 6-2: (b) the new node is now at the top of the stack

Linked Implementation - Push Operation (cont.)




```
public void push(T newEntry)
{
   Node newNode = new Node(newEntry, topNode);
   topNode = newNode;
} // end push
```

Definition of **`push`**



Linked Implementation - Pop Operation

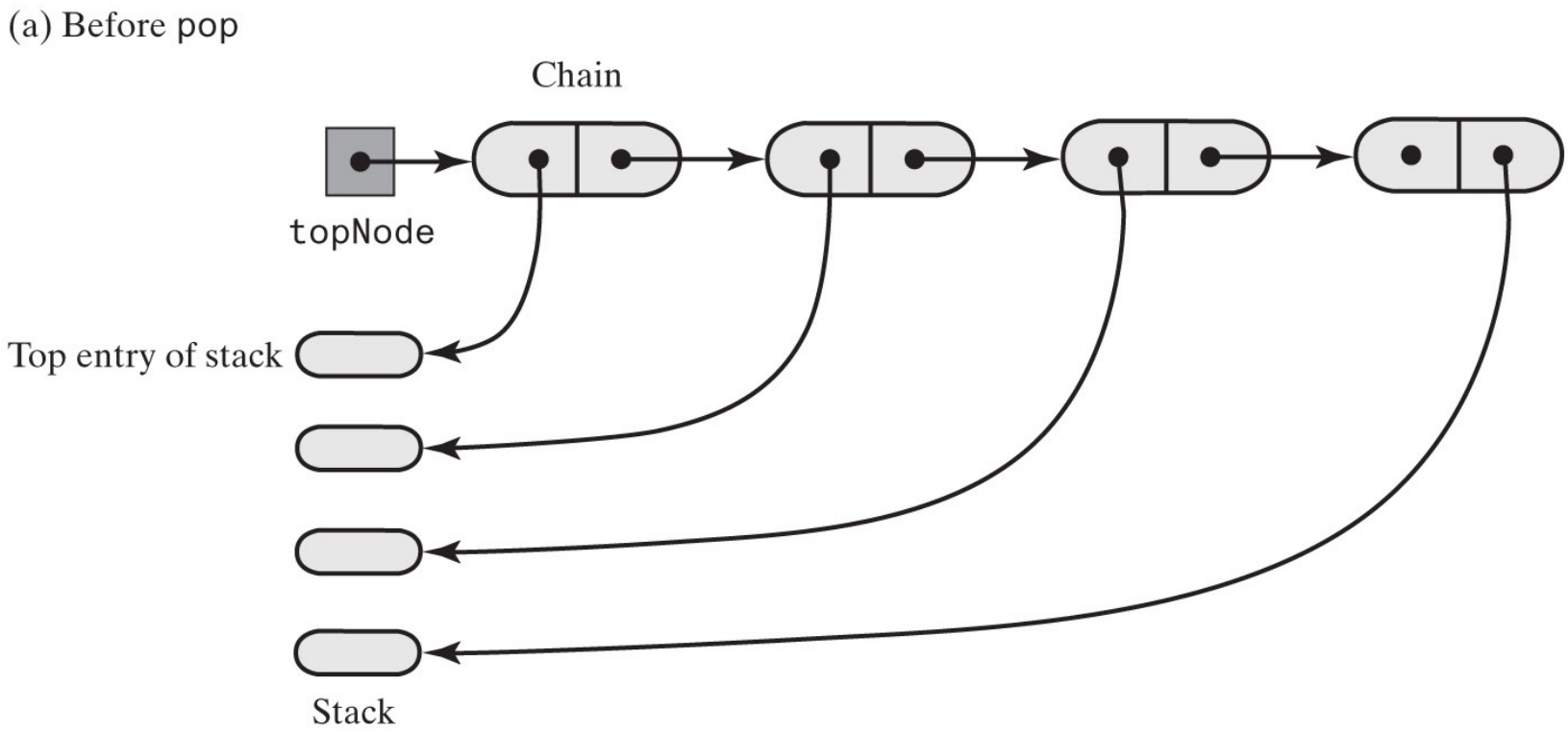


Figure 6-3: The stack (a) before the first node in the chain is deleted

Linked Implementation - Pop Operation (cont.)

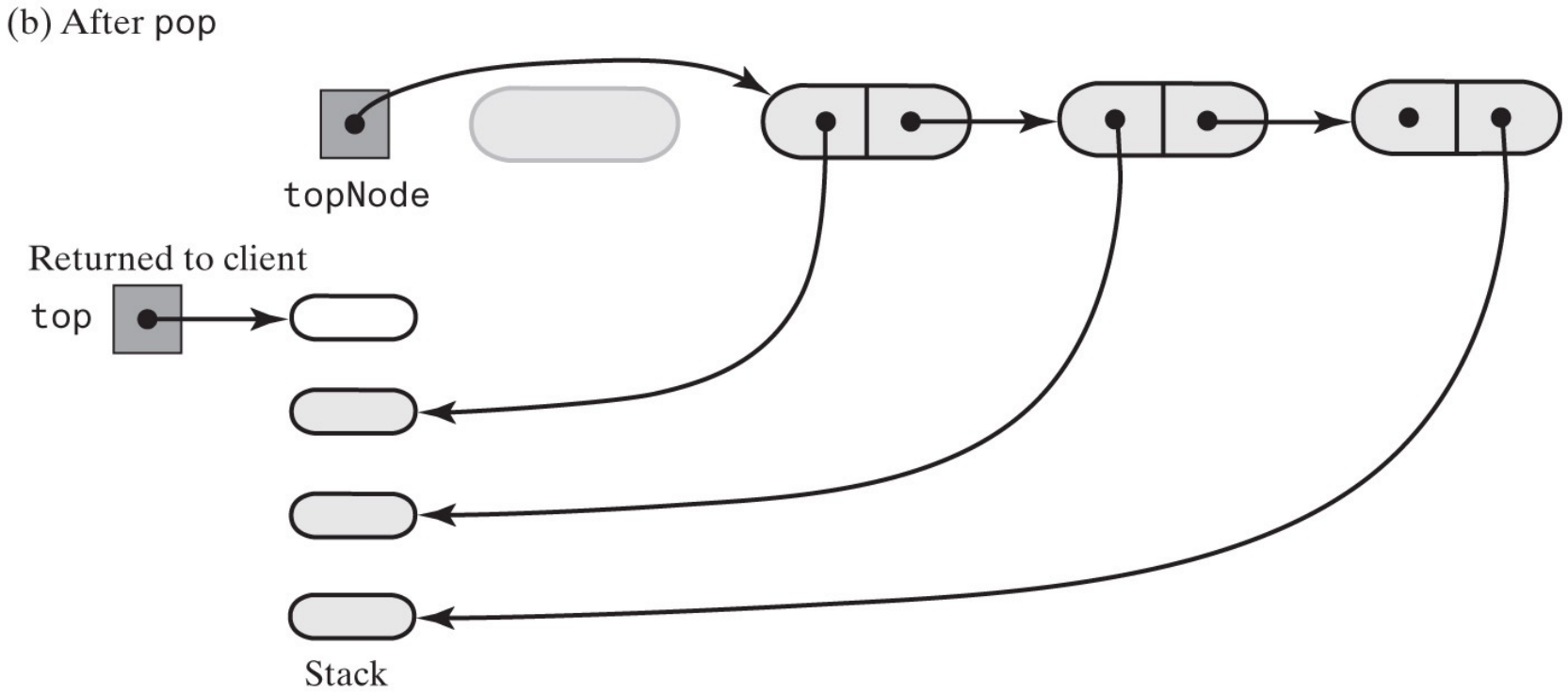


Figure 6-3: The stack (b) after the first node in the chain is deleted

Linked Implementation - Peek & Pop Operations

```
public T peek()
{
   if (isEmpty())
      throw new EmptyStackException();
   else
      return topNode.getData();
} // end peek

public T pop()
{
   T top = peek();  // Might throw EmptyStackException

   // Assertion: topNode != null
   topNode = topNode.getNextNode();

   return top;
} // end pop
```

Definition of `peek` and `pop`

Linked Implementation - isEmpty() & clear()

```
public boolean isEmpty()
{
   return topNode == null;
} // end isEmpty


public void clear()
{
   topNode = null;
} // end clear
```

Definition of **`isEmpty`** and **`clear`**

Exercise

- Download "L18_E1.zip" from the Canvas
- Revise the implementation of `pop()` so that it does not call peek()

```
public T pop()
{
   T top = peek(); // Might throw EmptyStackException
   assert topNode != null;
   topNode = topNode.getNextNode();
   return top;
} // end pop
```

Note: Assertions in Eclipse

- How to enable assertions in Eclipse?
  - » Open the Run Dialog (Run > Run Configurations)
  - » Click on the tab, "(x)= Arguments."
  - » Under the field for "VM arguments," type -ea to enable assertions.
  - » Click on the "Apply" and "Run" button

Answer

```
public T pop(){

  if(topNode != null){
     T top = topNode.getData();
     topNode = topNode.getNextNode();
     numberOfEntries--;
     return top;
  }else{
     throw new EmptyStackException();
  }

}
```

Exercise

- Is an implementation of the ADT stack reasonable if the top of the stack is at the end of a chain of linked nodes instead of its beginning? Explain.

Answer

- No
- Although adding a reference to the chain's last node enable you to access the stack's top entry or push a new entry onto the stack efficiently, it is not enough for pop the stack.
- You also need a reference to next-to-last node to remove the chain's last node.
- Therefore, placing the stack's top entry at the end of the chain is not as efficient or easy to implement as placing it at the beginning.