Victor Milenkovic

Department of Computer Science University of Miami

CSC220 Programming II - Spring 2019





Outline









► A Stack is a standard Interface







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- A Stack is a standard Interface
 - which is so standard
 - that Java didn't even bother making it an Interface.
- Like any kind of stack we can think of,
 - the top entry is easy to add, view, or remove.
 - Trying to add, view, or remove entries in the middle is messy and awkward.







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 - push add a new entry to the top of the stack
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 - peek look at the top entry of the stack without changing it
 - empty true if there is nothing in the stack, false otherwise
- When I put something on top of one of the towering stacks of papers on my desk,
 - I don't think of it as pushing,
 - nor do I think of it as popping when I remove it.
 - Peek and empty make sense though.









I think what the original inventors had in mind was a 1950s buffet diner spring loaded plate dispenser.



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- ▶ The power cord is to run a dish warmer.
- It doesn't shoot the dishes up when it pops!
- Instead, it always keeps the top dish level with the top of the dispenser,
- although I don't think that requires electricity.



Stack stack = new Stack();





```
Stack stack = new Stack();
stack.empty(); // returns true
```





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Stack stack = new Stack();
stack.empty(); // returns true
stack.push("mango");
```





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Stack stack = new Stack();
stack.empty();  // returns true
stack.push("mango");
stack.push("banana");
```













```
Stack stack = new Stack();

stack.empty();  // returns true

stack.push("mango");

stack.push("banana");

stack.push("coconut");

stack.pop();  // returns "coconut"

stack.peek();  // returns "banana"
```





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Stack stack = new Stack();

stack.empty();  // returns true

stack.push("mango");

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stack.pop();  // returns "coconut"

stack.peek();  // returns "banana"

stack.push("cantaloupe");
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stack.empty();  // returns true
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stack.push("cantaloupe");
stack.pop();  // returns "cantaloupe"
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stack.empty();
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stack.empty();
                              // returns false
stack.pop();
                              // returns "mango"
```





Stack methods in action

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                              // returns "banana"
stack.push("cantaloupe");
stack.pop();
                              // returns "cantaloupe"
stack.pop();
                              // returns "banana"
stack.empty();
                              // returns false
stack.pop();
                              // returns "mango"
stack.peek();
                              // throws Exception
```

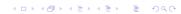






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- or a stack of any type of class.



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It has to be a class, however, so for primitive data types you have to use the class version of those types:

- ▶ char → Character
- int → Integer
- ▶ double → Double

This is less efficient (by a constant factor in space and time) than creating a specific StackOfChar, etc., but it is usually good enough.







ArrayStack.java

Array based implementation of StackInt.





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- ► So push is O(1),
- (unless the array is full and needs to be reallocated).
- This is the fastest way to implement a stack,
- but it might not be good for real time programming.

(Sorry the laser stopped in the middle of your eye, but we have to allocate a bigger array!)





LinkedStack.java



LinkedStack.java

► Linked list implementation



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- ► O(1) per operation (really?).



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- not the end.







ListStack.java





ListStack.java

Implementation using java.util.List





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- and its implementation java.util.ArrayList.





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Look at the List documentation,





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- ► How do we implement empty()?
- How do we implement peek()?
- ► How do we implement pop()?









Use ArrayList implementation of List.

Partially filled array.





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- ▶ We could easily use it if we wanted to,





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- Just like we have been doing.
- When size==length, it reallocates.
- Array variable and size are private.

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- Doubly linked list implementation of List.
- We could easily use it if we wanted to,
- thanks to the List interface.









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- ▶ The StackInt interface describes a Stack.
- Only adding or removing at the top is possible.
- Operations called push, pop, peek, empty.
- ▶ Implemented using array, linked list, or List interface.



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Implement using an array.



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Private Node class.





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- Use Java List interface.
- Use add(item), size(), get(index), remove(index).





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- node.next instead of node.getNext()
- Push and pop at front (head) of list.

- Use Java List interface.
- Use add(item), size(), get(index), remove(index).
- ArrayList implementation uses partially filled array.
- LinkedList is another implementation of List using a doubly linked list.



