Lecture 3: Stacks and Queues

Data Structures and Algorithms

Thanks to Kasey Champion, Ben Jones, Adam Blank, Michael Lee, Evan McCarty, Whitaker Brand, Stuart Reges, Zora Fung, Justin Hsia, and many others for sample slides and materials ...

Warm Up – Discuss with your neighbors!

From last lecture:

- What is an example of “constant time” complexity
- What is an example of “linear time” complexity
- What operations is an Array better at compared to Linked List?
- What operations is a Linked List better at compared to an Array?

From CSE 143:

- What is a “stack” and what operations is it best at?
- What is a “queue” and what operations is it best at?

Today’s Goals:

- Implementing List ADT
- Review Generics
- Implementing Stack ADT
- Review Queues

Implementing a List with a Linked List

Review: Generics

```
// a parameterized (generic) class
public class name<TypeParameter> {
    ...
}
```

- Forces any client that constructs your object to supply a type.
  - Don't write an actual type such as String; the client does that.
  - Instead, write a type variable name such as `E` (for "element") or `T` (for "type").
  - You can require multiple type parameters separated by commas.
- The rest of your class's code can refer to that type by name.

```
public class Box {
   private Object object;
   public void set(Object object) {
      this.object = object;
   }
   public Object get() {
      return object;
   }
}
```

```
public class Box<T> {
   private T t;
   public void set(T t) {
      this.t = t;
   }
   public T get() {
      return t;
   }
}
```

More details: https://docs.oracle.com/javase/tutorial/java/generics/types.html

Implementing a Generic List

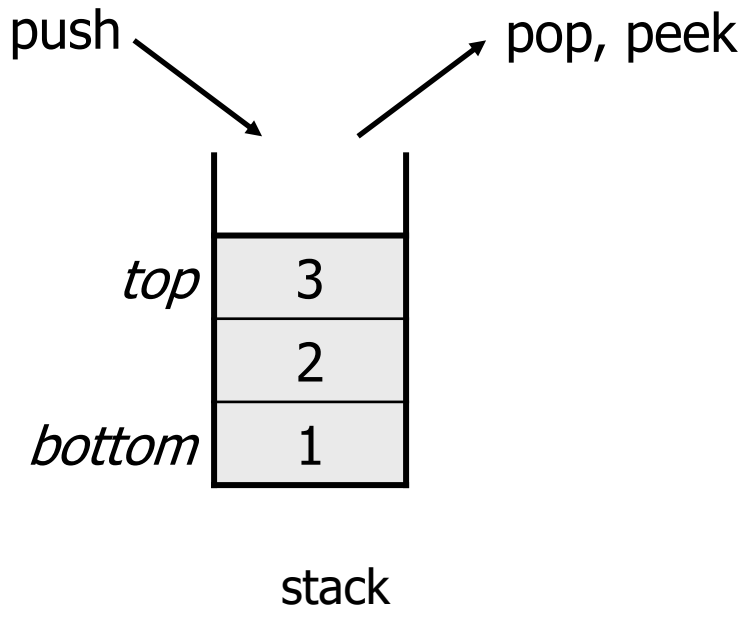
Review: What is a Stack?

stack: A collection based on the principle of adding elements and retrieving them in the opposite order.

- Last-In, First-Out ("LIFO")
- Elements are stored in order of insertion.
  - We do not think of them as having indexes.
- Client can only add/remove/examine the last element added (the "top").

basic stack operations:

- **push(item)**: Add an element to the top of stack
- **pop()**: Remove the top element and returns it
- **peek()**: Examine the top element without removing it
- **size():** how many items are in the stack?
- **isEmpty():** true if there are 1 or more items in stack, false otherwise



Implementing a Stack with an Array

Implementing a Stack with a Linked List

Discuss with your neighbors!

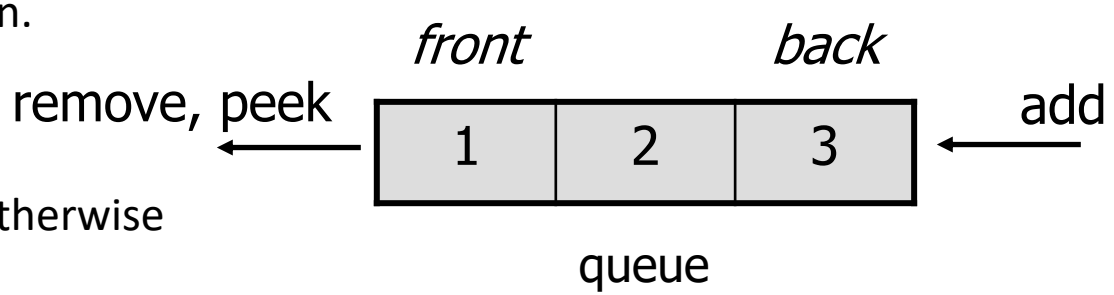
Review: What is a Queue?

queue: Retrieves elements in the order they were added.

- First-In, First-Out ("FIFO")
- Elements are stored in order of insertion but don't have indexes.
- Client can only add to the end of the queue, and can only examine/remove the front of the queue.

basic queue operations:

- **add(item):** aka “enqueue” add an element to the back.
- **remove():** aka “dequeue” Remove the front element and return.
- **peek()**: Examine the front element without removing it.
- **size():** how many items are stored in the queue?
- **isEmpty():** if 1 or more items in the queue returns true, false otherwise



Implementing Queues with a Linked List

Implementing Queues with an Array

TODO list

- Fill out pre-course survey!
  - Link on course webpage
  - Due today (10/1)
- Homework 1 is out!
  - Individual assignment
  - Due 10/5 11:59pm