CS 240 Midterm Exam

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1. (a) **(5 points)** Explain why the following statement is meaningless.

   "The running time $T(n)$ of algorithm A is at least $O(n^2)$."

   (b) **(5 points)** Prove that O is transitive. I.e.,

   $$\forall f, g, h, \quad f \in O(g) \wedge g \in O(h) \implies f \in O(h)$$

2. (a) **(5 points)** You'll sometimes hear the term "first in, last out" (or *FILO*) used to describe stacks. In your own words, describe what this property means. Is it distinct from *LIFO* (last in, first out)?

   (b) **(5 points)** Consider the (non-generic) `ArrayStack` class we've developed during the lectures. Briefly explain how you could conceptually alter the `push` method to instead make the "stack" *FIFO* (first in, first out)—**without** having to change `pop`. Is this distinct from *LILO* (last in, last out)?

3. **(10 points)** Suppose you've implemented the new `push` for your FIFO "stack", and you have the initially empty instance `stk` upon which you perform the following operations in order. What are the values of `stk`'s `this.data` and `this.top` fields after each operation, assuming `push` works as you described in Problem 2b?

   If an operation returns a value, write it in the **Output** column. If an operation triggers an `Exception`, write "Error" in the **Output** column, and proceed as though the operation had never been attempted.

Operation	Output	`this.top`	`this.data` (in order from [0] to [`this.top`])
stk.pop()			
stk.push(2)			
stk.push(1)			
stk.push(stk.pop())			
stk.pop()			
stk.push(stk.pop())			
stk.pop()			
stk.push(stk.peek())			
stk.push(3)			
stk.push(stk.peek())			

4. **(10 points)** Write a Java implementation of your new `push` method.

5. **(10 points)** What is the O-complexity of your algorithm for Problem 4? Can you make it better?