

Queue and Iterator

Victor Milenkovic

Department of Computer Science
University of Miami

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Queue



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- ▶ **size** how many are in the queue?

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Have a look at the **Queue interface**.

AbstractQueue

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“A Queue implementation that extends this class must minimally define a method `Queue.offer(E)` which does not permit insertion of null elements, along with methods `Queue.peek()`, `Queue.poll()`, `Collection.size()`, and a `Collection.iterator()` supporting `Iterator.remove()`. Typically, additional methods will be overridden as well. If these requirements cannot be met, consider instead subclassing `AbstractCollection`.”



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Can you write it?



Implementations of Queue

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- ▶ **LinkedQueue** which uses a linked list



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- ▶ **ArrayQueue** which uses an array



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- ▶ **top** is the first one in line. **bottom** is the last.



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- ▶ Offer on an empty queue sets both top and bottom to the (sole) new Node.



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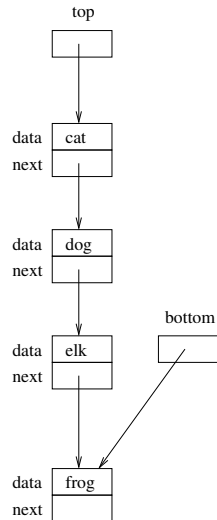
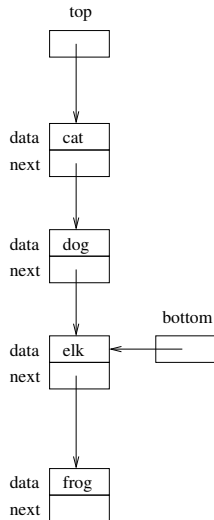
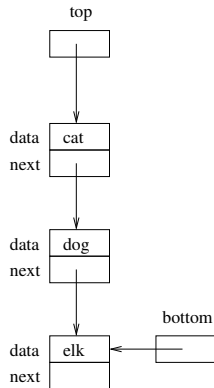
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- ▶ and sets bottom to the new Node.



LinkedQueue offer



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- ▶ Like **ArrayStack**, adds at the “end”.



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- ▶ which takes $O(n)$ time?



ArrayQueue Idea



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- ▶ but there is a row of five seats to sit in.

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- ▶ 0:Victor 1:Irina 2:Parul 3:Joe 4:null

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Serve Victor and then Irina.

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Serve Victor and then Irina.

- ▶ For the sake of clarity, I will set those locations to null,

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Serve Victor and then Irina.

- ▶ For the sake of clarity, I will set those locations to null,
- ▶ but I don't really have to.
- ▶ Actually, what I do is set first=2 and size=2.

People in Chairs, continued



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- ▶ 0:null 1:null 2:Parul 3:Joe 4:null (first=2, size=2)



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- ▶ 0:null 1:null 2:Parul 3:Joe 4:null (first=2, size=2)
- ▶ Lance arrives.



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- ▶ Parul gets served.



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- ▶ Parul gets served.
- ▶ 0:null 1:null 2:null 3:Joe 4:Lance (first=3, size=2)
- ▶ Ana arrives. Where should she sit? Do we need to buy more chairs??



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- ▶ Ana arrives. Where should she sit? Do we need to buy more chairs??
- ▶ 0:Ana 1:null 2:null 3:Joe 4:Lance (first=3, size=3)
- ▶ Philip arrives. Alex arrives.



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- ▶ Ana arrives. Where should she sit? Do we need to buy more chairs??
- ▶ 0:Ana 1:null 2:null 3:Joe 4:Lance (first=3, size=3)
- ▶ Philip arrives. Alex arrives.
- ▶ 0:Ana 1:Philip 2:Alex 3:Joe 4:Lance (first=3, size=5)



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- ▶ Lance arrives.
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- ▶ Parul gets served.
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- ▶ Ana arrives. Where should she sit? Do we need to buy more chairs??
- ▶ 0:Ana 1:null 2:null 3:Joe 4:Lance (first=3, size=3)
- ▶ Philip arrives. Alex arrives.
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- ▶ Joe is served (whew!)



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- ▶ Philip arrives. Alex arrives.
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- ▶ 0:Ana 1:Philip 2:Alex 3:null 4:Lance (first=4, size=5)
- ▶ Sam arrives



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- ▶ Philip arrives. Alex arrives.
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- ▶ Joe is served (whew!)
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- ▶ Joe is served (whew!)
- ▶ 0:Ana 1:Philip 2:Alex 3:null 4:Lance (first=4, size=5)
- ▶ Sam arrives
- ▶ 0:Ana 1:Philip 2:Alex 3:Sam 4:Lance (first=4, size=5)
- ▶ Song arrives (Uh oh!). NOW we have to buy more chairs!



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- ▶ Joe is served (whew!)
- ▶ 0:Ana 1:Philip 2:Alex 3:null 4:Lance (first=4, size=5)
- ▶ Sam arrives
- ▶ 0:Ana 1:Philip 2:Alex 3:Sam 4:Lance (first=4, size=5)
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People in Chairs, continued

- ▶ 0:null 1:null 2:Parul 3:Joe 4:null (first=2, size=2)
- ▶ Lance arrives.
- ▶ 0:null 1:null 2:Parul 3:Joe 4:Lance (first=2, size=3)
- ▶ Parul gets served.
- ▶ 0:null 1:null 2:null 3:Joe 4:Lance (first=3, size=2)
- ▶ Ana arrives. Where should she sit? Do we need to buy more chairs??
- ▶ 0:Ana 1:null 2:null 3:Joe 4:Lance (first=3, size=3)
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- ▶ Notice that we take the opportunity to put the first person in chair 0.



ArrayQueue Implementation



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- ▶ $(\text{first} + \text{size}) \% \text{length}$
- ▶ $(3 + 3) \% 5 = 1$
- ▶ The mod (%) operator effectively subtracts length until the result is less than length.



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- ▶ that does not depend on the implementation.



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void print (Queue<String> queue) {  
    Iterator iterator = queue.iterator();  
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It's a new kind of for-loop!



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for (Node n = ?; n != ?; n = ?)  
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The Iterator “deconstructs” these for-loops.



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- ▶ ArrayQueue implementation keeps track of offset from first.

