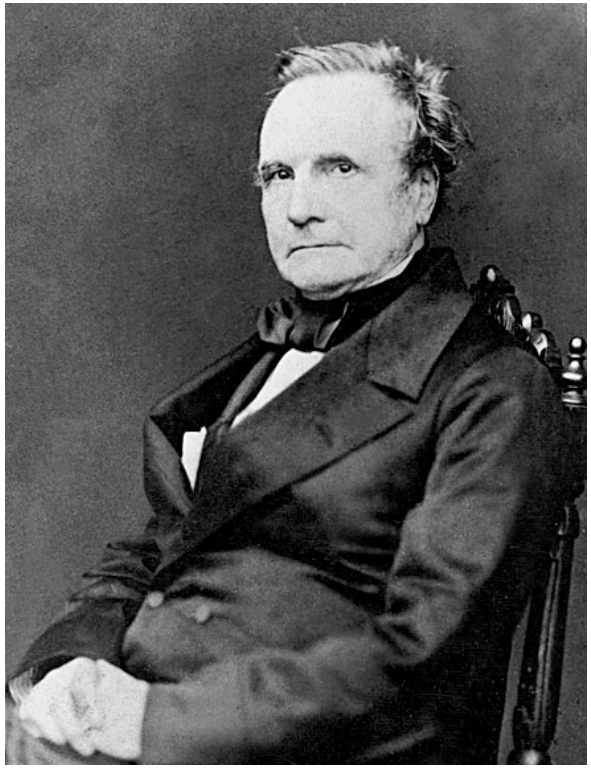
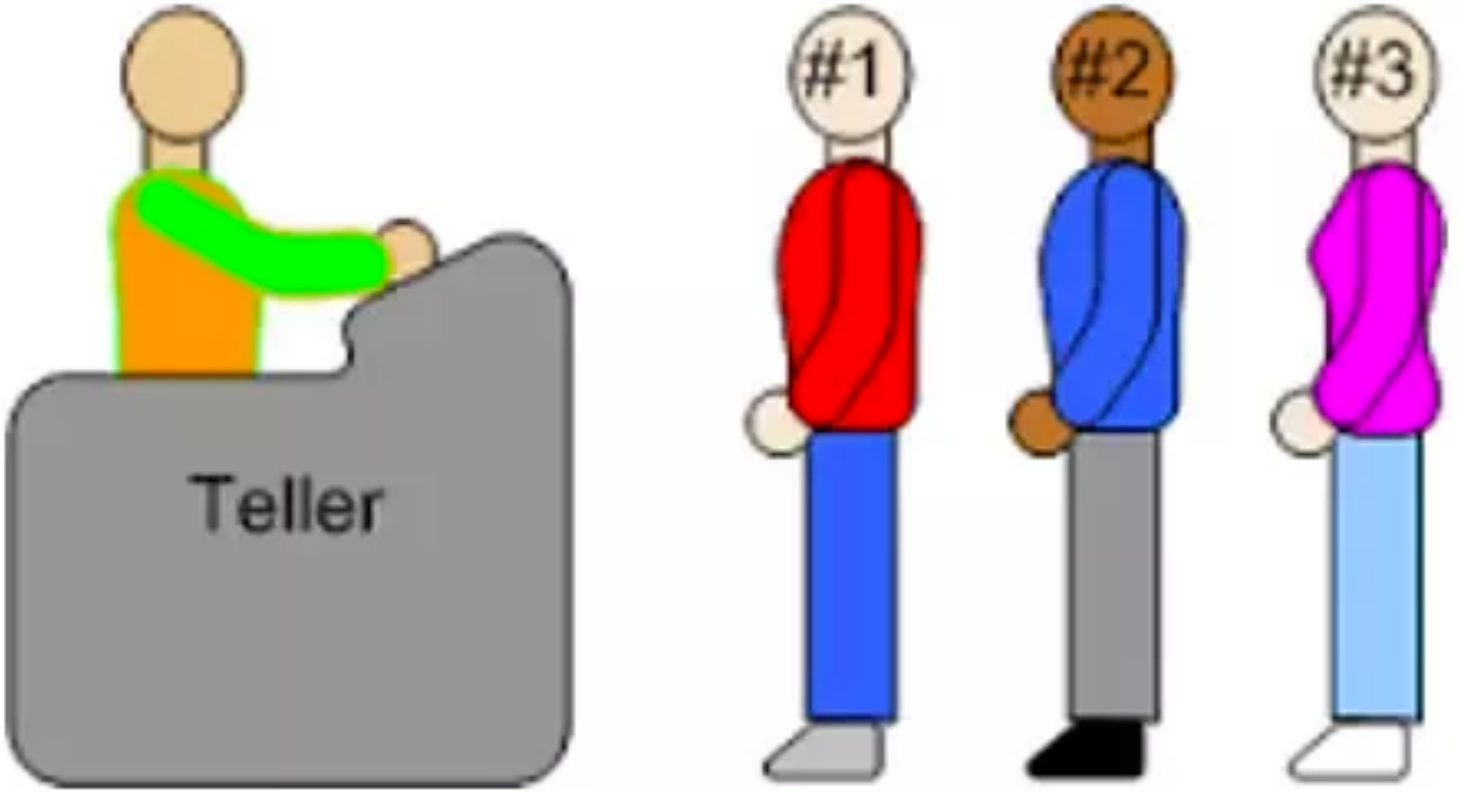
Queues

More with Comparable

Priority Queues



Queues



Queueing Theory

Agner Krarup Erlang

`Queue` Interface

- `null` is returned from `getFront()` and `dequeue()` when queue is empty
- return false from offer when cannot add to queue.

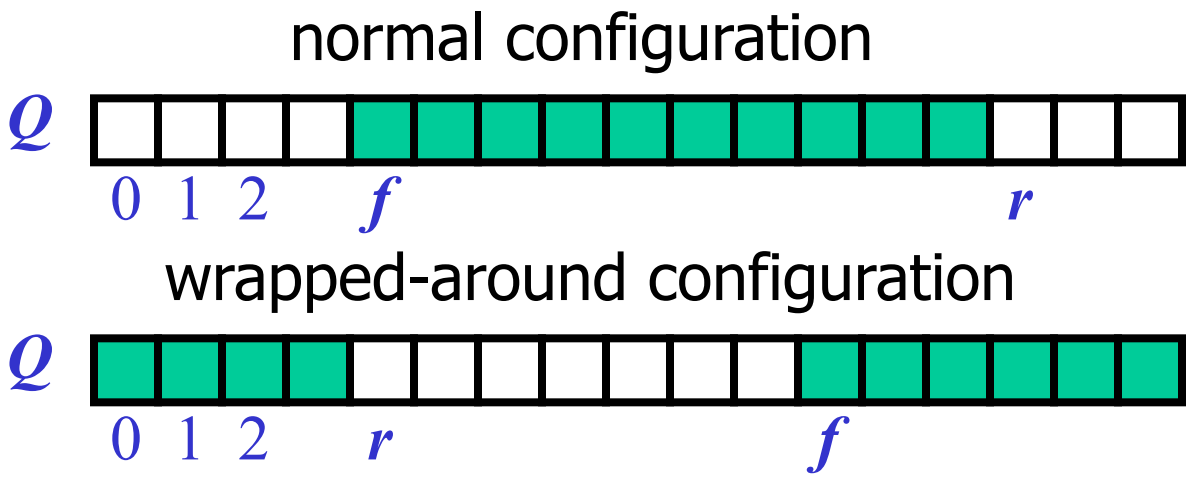
```
public interface QueueInterface<E> {
   int size();
   boolean isEmpty();
   E getFront();     // peek
   boolean enqueue(E e);
   E dequeue();
   void clear();
}
```

Example

Operation	output	Queue Contents
enqueue(5)	TRUE	{5}
enqueue(3)	TRUE	{5, 3}
dequeue()	5	{3}
enqueue(7)	TRUE	{3, 7}
dequeue()	3	{7}
getFront()	7	{7}
dequeue()	7	{}
dequeue()	null	{}

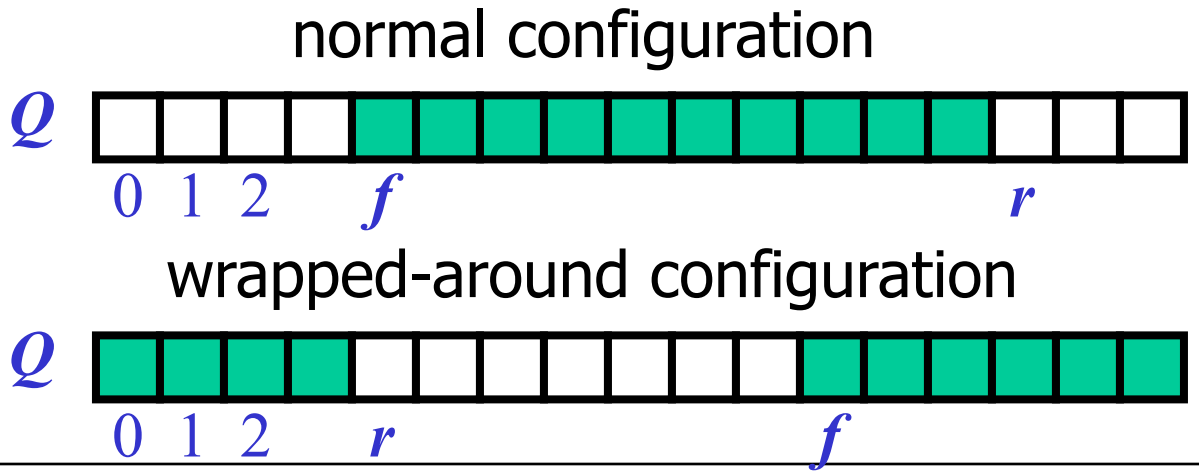
Array-based Queue

- An array of size `n` in a circular fashion
  - `frontLoc`: index of the front element
    - where objects are read
  - `count`: number of stored elements
  - `rearLoc`: index of rear element
    - where objects are added



Circular Array and Queue

- When the queue has fewer than `n` elements, location



Performance and Limitations for array-based Queue

- Performance
  - let n be the number of objects in the queue
  - The space used is $O(n)$
  - Each operation runs in time $O(1)$
- Limitations
  - Max size is limited and can not be changed
  - Adding to a full queue returns false (offer method)

Start of Queue Implementation

```
public class ArrayQueue<Q> implements QueueInterface<Q> {
    /** the default capacity for the backing array */
    private static final int CAPACITY = 40;
    /** The array in which the queue data is stored */
    private Q[] backingArray;
    /** The number of items in the queue */
    private int count;
    /** The array location of the end of the queue  (ie the
     * location of the item shown by the peek command) */
    private int frontLoc;
    public ArrayQueue(int qSize) {
        count = 0;
        frontLoc = 0;
        backingArray = (Q[]) new Object[qSize];
    }
```

write add, remove

Java Documentation
Queue offer Method (enqueue)

`boolean offer(E e)`

Inserts the specified element into this queue if it is possible to do so immediately without violating capacity restrictions. When using a capacity-restricted queue, this method is generally preferable to `add(E)`, which can fail to insert an element only by throwing an exception.

Parameters:

`e` - the element to add

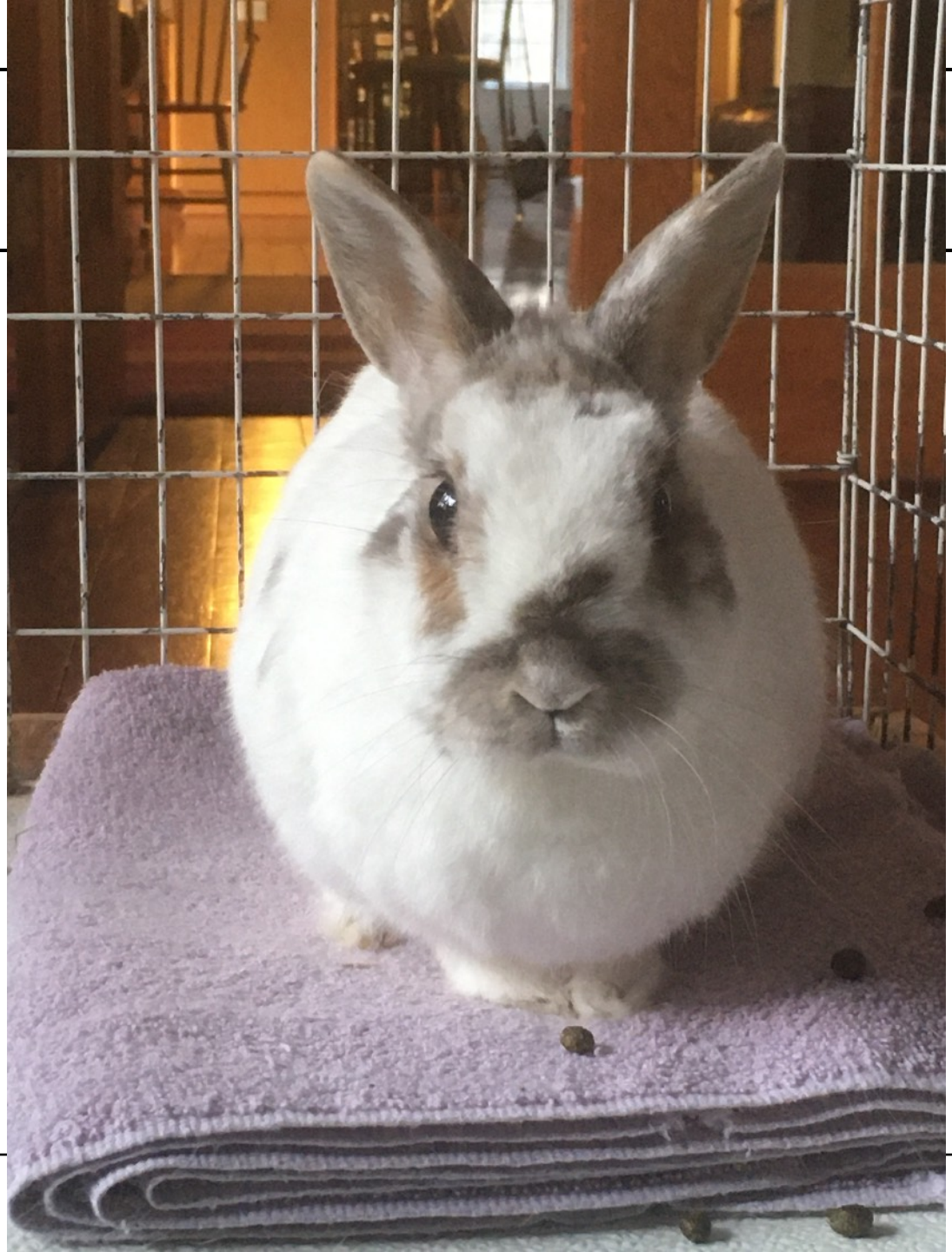
Returns:

`true` if the element was added to this queue, else `false`

Write enqueue and dequeue

```
public class ArrayQueue<Q> implements QueueInterface<Q> {
    /** the default capacity for the backing array */
    private static final int CAPACITY = 40;
    /** The array in which the queue data is stored */
    private Q[] backingArray;
    /** The number of items in the queue */
    private int count;
    /** The array location of the end of the queue  (ie the
     * location of the item shown by the peek command) */
    private int frontLoc;

    boolean enqueue(E e);  // add item to queue
    E dequeue(); // remove item from queue
```



Comparable Rabbit

```
public class Rabbit implements Comparable<Rabbit> {
    private final int iD;
    private final String nickname;
    public Rabbit(int id, String nn) {
        this.iD = id;
        this.nickname = nn==null ? makeName() : nn;
    }

// implement Comparable interface so that rabbits
// are sorted based on their iD.
```

Priority Queue

- Rather than FiFo, remove items according to their priority
  - Implement:
    - same methods as queue(?)
      - Others needed?

```
public class PriorityQueue<B extends Comparable<B>>
    extends ArrayList<B>
    implements QueueInterface<B>

public class PriorityQueueSAL<P extends Comparable<P>>
    extends SALextending<P>
    implements QueueInterface<P>
```

PriorityQueue

- Implementation a trivial extension on SAL!!!
- Small difference
  - Usually PQ are on K,V pairs where
    - K — the priority
    - V — the item in the queue
- Q: Does K,V pair matter?