Queue applications

❖ Simulation, discrete-event simulation
  ❑ How many toll-booths do we need? How many express lanes or self-checkout at grocery store? Runway access at airport?
  ❑ Queues facilitate simulation with mathematical distributions governing events, e.g., Poisson distribution for arrival times

❖ Shortest path, e.g., in flood-fill to find path to some neighbor or in word-ladder
  ❑ How do we get from "white" to "house" one-letter at a time?
    ○ white, while, whale, shale, shake, …?
Blob Finding with Queues

- An Alternative to Recursion

```java
myGrid[row][col] = fillWith; // mark pixel
size++; // count pixel
myQueue.add(myPairGrid[row][col]);
while (myQueue.size() != 0){
    Pair p = myQueue.remove();
    for(int k=0; k < rowDelta.length; k++){
        row = p.row + rowDelta[k];
        col = p.col + colDelta[k];
        if (inRange(row,col) &&
            myGrid[row][col] == lookFor){
            myQueue.add(myPairGrid[row][col]);
            myGrid[row][col] = fillWith;
            size++;
        }
    }
}
```
public boolean ladderExists(String[] words, String from, String to){
    Queue<String> q = new LinkedList<String>();
    Set<String> used = new TreeSet<String>();
    for(String s : words){
        if (oneAway(from, s)){
            q.add(s);
            used.add(s);
        }
    }
    while (q.size() != 0){
        String current = q.remove();
        if (oneAway(current, to)) return true;
        // add code here, what?
    }
    return false;
}

Queue for shortest path (WordLadder APT)
Shortest Path reprised

- How does use of Queue ensure we find shortest path?
  - Where are words one away from start?
  - Where are words two away from start?

- What would a recursive approach have given us?
  - What data structure does recursion seem to replace?

- Why do we need to avoid revisiting a word, when?
  - Why do we use a set for this? Why a TreeSet?
  - Alternatives?

- What if we want the ladder, not just whether it exists
  - What’s path from white to house? We know there is one.
  - Ideas? Options?