

3 Object-Oriented Programming (RKH)

The Java class below defines a queue data structure with a fixed capacity.

```
public class FixedCapacityQueue {
    int[] mData = null;
    int  mHead=0; // index of first full cell
    int  mTail=0; // index of next empty cell

    public FixedCapacityQueue(int capacity) {
        mData = new int[capacity];
    }

    public boolean enqueue(int x) {
        if (mTail==mData.length) return false;
        mData[mTail]=x;
        mTail++;
        return true;
    }

    public int dequeue() {
        if (mTail==mHead) return -1;
        int v=mData[mHead];
        mHead++;
        return v;
    }
}
```

- (a) Explain the risks posed by the lack of access modifiers specified on the state. Which access modifier is appropriate for these entities? [3 marks]
- (b) Discuss the choice to signal enqueue and dequeue errors using return values of false and -1, respectively. Suggest a better alternative and modify `enqueue` and `dequeue` to use it. [5 marks]
- (c) Explain how an enqueue operation on a `FixedCapacityQueue` object could fail with an error even when there are fewer items in the queue than the assigned capacity of the object. Show how to fix this. [3 marks]
- (d) Rewrite the class to use Java's Generics so that it can be used to represent queues of arbitrary objects (`Integers`, `Strings`, etc). Use the `java.util.ArrayList` class instead of `int[]` for the type of `mData`. [4 marks]
- (e) Explain why it was necessary to replace the `int[]` type of `mData` in part (d), and why `ArrayList` does not suffer from the same issue. [5 marks]