

Threads/Synchronization Exercise II

1. A lock can be acquired by only one thread at a time. True or False (Explain)
2. Rewrite the following code fragment for a synchronized method foo() to an equivalent code providing mutual exclusion, but **without** using a synchronized method.

```
public synchronized void foo( ) {           public void foo( ) { // YOUR CODE HERE

// mutual exclusion HERE                   // provide mutual exclusion HERE

}
```

3. Consider the following code if several MaybeRace objects are created and multiple threads execute their increment methods in parallel:

```
public class MaybeRace {
    static int x = 0;
    Object y = new Object ( );
    static Object z = new Object( );
    public void inc1( ) {
        synchronized(y) { x = x + 1; }
    }
    public void inc2( ) {
        synchronized(z) { x = x + 1; }
    }
    public synchronized void inc3( ) { x = x + 1; }
}
```

- a. Using inc1() will prevent data races True or False (Explain)
- b. Using inc2() will prevent data races True or False (Explain)
- c. Using inc3() will prevent data races True or False (Explain)

4. The following class simulates a bank processing requests (transactions). Each request is a String that must be added to the List requestLog. Rewrite the class so that each request is processed (added to requestLog) by a separate thread, so that requests may be processed concurrently (in parallel). The following restrictions are associated with this problem:

- Your code must process each request in a separate (and new) thread
- You must insert synchronization to prevent data races if needed
- You may not add any instance variables or methods to the Bank class
- You may add one inner class to Bank

```
public class Bank {
    private List<String> requestLog = new ArrayList<String>( );
    public void processRequests(String[] requests) {
        for (String r : requests)
            requestLog.add( r );    // Appends argument to list
    }
}
```

5. The following class implements a queue.

```
public class MyQueue<E> {
    private ArrayList<E> list = new ArrayList<E>();

    public boolean isEmpty() {
        synchronized(this) {
            if (list.size() == 0)
                return true;
            return false;
        }
    }

    public E getFirst() {
        synchronized(this) {
            return list.remove(0); // removes first element and shift
                                   // elements to the right
        }
    }

    public void offer(E data) {
        synchronized(this) {
            list.add(data);
        }
    }

    /** If queue not empty, remove value from queue and return it.
     * Otherwise, if queue is empty, return null */
    public E dequeue() {
        if (!isEmpty())
            return getFirst();
        return null;
    }
}
```

Describe a possible scenario where the dequeue method will not work as documented when the dequeue is accessed by multiple threads.