# Solutions to Practice Final Exam

Portions of this handout by Eric Roberts

## **Problem 1: Short answer (15 points)**

#### Answer for 1a:

When an object is passed into method, a *reference* to the object (i.e., its address in memory) is what is actually being passed to the method (this is called *pass-by-reference*). Any changes made to the object are made through that reference (address), so the place in memory where that original object resides is modified. As a result, when the method completes, any changes made to the object persist since the changes were made to the same place in memory as where the original object resided.

When an int is passed as a parameter to a method, the method actually receives a *copy* of the int's value (this is called *pass-by-value*). Any changes made to that parameter in the method are just changing this copy of the value, so the original int variable that was passed in as a parameter is not modified.

#### Answer to 1b:

As written, the program leaves the array in the following state:

list				
50	10	10	10	10

If you had wanted mystery to "rotate" the array elements, you would need to run the loop in the opposite order to ensure that no elements are overwritten, like this:

```
private void mystery(int[] array) {
   int tmp = array[array.length - 1];
   for (int i = array.length - 1; i > 0; i--) {
      array[i] = array[i - 1];
   }
   array[0] = tmp;
}
```

# **Problem 2: Graphics and Interactivity (35 points)**

```
/*
  * File: EtchASketch.java
  * ------
  * This program solves the Etch-a-Sketch problem from the practice final
  */
import acm.graphics.*;
import acm.program.*;
import java.awt.event.*;
import java.awt.*;
import javax.swing.*;
```

```
public class EtchASketch extends GraphicsProgram {
   /** Cross size */
  private static final double CROSS SIZE = 10;
  /** Step size */
  private static final double STEP SIZE = 20;
  /** Initialize the application */
  public void init() {
      add(new JButton("North"), SOUTH);
     add(new JButton("South"), SOUTH);
     add(new JButton("East"), SOUTH);
     add(new JButton("West"), SOUTH);
     x = getWidth() / 2;
     y = getHeight() / 2;
     double delta = CROSS SIZE / 2;
     cross = new GCompound();
     cross.add(new GLine(-delta, -delta, delta, delta));
     cross.add(new GLine(-delta, delta, delta, -delta));
     add(cross, x, y);
     addActionListeners();
  }
   /** Called when an action event is detected */
  public void actionPerformed(ActionEvent e) {
      String cmd = e.getActionCommand();
     if (cmd.equals("North")) {
        moveCross(0, -STEP SIZE);
      } else if (cmd.equals("South")) {
        moveCross(0, STEP SIZE);
      } else if (cmd.equals("East")) {
        moveCross(STEP SIZE, 0);
      } else if (cmd.equals("West")) {
        moveCross(-STEP SIZE, 0);
      }
  }
   * Moves the cross and adds a red line to the canvas connecting its
   * old and new positions.
   */
  private void moveCross(double dx, double dy) {
     GLine line = new GLine(x, y, x + dx, y + dy);
     line.setColor(Color.RED);
     add(line);
     x += dx;
     y += dy;
      cross.move(dx, dy);
  /* Private instance variables */
  private GCompound cross;
  private double x, y;
```

#### **Problem 3: Strings (35 points)**

```
/*
 * File: CheckWordLadder.java
 * Solution for checking a word ladder from the practice final exam.
import acm.program.*;
/** Checks to see whether a word ladder is legal */
public class CheckWordLadder extends ConsoleProgram {
  public void run() {
     println("Program to check a word ladder.");
     println("Enter a sequence of words ending with a blank line.");
     String previous = null;
     String current = null;
     while (true) {
         while (true) {
            current = readLine();
            if (current.equals("")) break;
            if (isLegalLadderPair(previous, current)) break;
            println("That word is not legal. Try again.");
         if (current.equals("")) break;
         previous = current;
      }
   }
   /** Method: isLegalLadderPair(previous, current)
    * Checks to see if it is legal to link the two words in a
    * word ladder.
  private boolean isLegalLadderPair(String previous, String current) {
     if (!lexicon.isEnglishWord(current)) return false;
     if (previous == null) return true;
     if (previous.length() != current.length()) return false;
      return countCharacterDifferences(previous, current) == 1;
   /** Method: CountCharacterDifferences(s1, s2)
    * Counts the number of character positions in s1 and s2 that contain
    * different characters.
  private int countCharacterDifferences(String s1, String s2) {
      int count = 0;
      for (int i = 0; i < s1.length(); i++) {
         if (s1.charAt(i) != s2.charAt(i)) {
            count++;
     return count;
   /* Private instance variables */
  private Lexicon lexicon = new Lexicon("english.dat");
```

# Problem 4: Arrays (20 points)

```
/** Method: checkUpperLeftCorner
 * This method checks the upper left corner of a Sudoku array
 * to see if it correctly contains one copy of each digit
 * between 1 and 9. If so, the method returns true. If it
 * contains values that are duplicated or out of range, the
 * method returns false.
private boolean checkUpperLeftCorner(int[][] matrix) {
   boolean[] alreadyUsed = new boolean[10];
   for (int i = 0; i < 3; i++) {
      for (int j = 0; j < 3; j++) {
         int digit = matrix[i][j];
         if (digit < 1 || digit > 9) return false;
         if (alreadyUsed[digit]) return false;
         alreadyUsed[digit] = true;
   return true;
}
```

## Problem 5: Data structure design (25 points)

```
/*
 * File: StringQueue.java
 * -----
 * This program implements the MinimalStringQueue interface using
 * an ArrayList for internal storage.
 */
import java.util.*;
/** Implements an ArrayList queue */
public class StringQueue implements MinimalStringQueue {
/** Creates a new empty queue. */
  public StringQueue() {
     waitingLine = new ArrayList<String>();
/** Adds a new String to the end of the queue */
  public void add(String str) {
     waitingLine.add(str);
/** Removes and returns the first String (or null if queue is empty) */
  public String poll() {
      if (waitingLine.isEmpty()) return null;
     String first = waitingLine.get(0);
     waitingLine.remove(0);
     return first;
   }
/** Returns the number of entries in the queue. */
  public int size() {
     return waitingLine.size();
/* Private instance variables */
  private ArrayList<String> waitingLine;
```

# **Problem 6: Java programming (30 points)**

```
/** Method: isGooglewhack(word1, word2)
 * Returns true if word1 and word2 appear on exactly one web page,
 * as reported by googleSearch.
  private boolean isGooglewhack(String word1, String word2) {
      String[] pages1 = googleSearch(word1);
      String[] pages2 = googleSearch(word2);
      int matches = 0;
      for (int i = 0; i < pages1.length; i++) {</pre>
         if (findStringInArray(pages1[i], pages2) != -1) {
            matches++;
            if (matches > 1) return false;
         }
      return (matches == 1);
/** Method: findStringInArray(key, array)
 * Returns the index of the first occurrence of key in the array.
 * If key does not appear in the array, findStringInArray
 * returns -1.
  private int findStringInArray(String key, String[] array) {
      for (int i = 0; i < array.length; i++) {</pre>
         if (key.equals(array[i])) return i;
      return -1;
```

# Problem 7: Using data structures (20 points)

```
/** Method: commonKeyValuePairs(map1, map2)
 * Returns a count of the number of common key/value pairs in the
 * two HashMaps that are passed in.
  public int commonKeyValuePairs(HashMap<String,String> map1,
                                 HashMap<String,String> map2) {
     int count = 0;
     // Get iterator over map1
     Iterator<String> it = map1.keySet().iterator();
     while (it.hasNext()) {
        // Get key from map1
        String key = it.next();
        // See if that keys exists in map2
        if (map2.containsKey(key)) {
           // Look up values associated with key in both maps
           String map1Value = map1.get(key);
           String map2Value = map2.get(key);
           // See if values are equal
           if (map2Value.equals(map1Value)) {
              count++;
           }
        }
     }
     return count;
  }
```