Control Statements

Based on a handout by Eric Roberts and Mehran Sahami

This handout offers some additional notes on Java's control statements (described more fully in Chapter 4 of the textbook) that emphasize the important concepts. It also describes a programming problem making use of various control structures.

To write programs, you need to understand control statements from two perspectives: you must have a holistic sense of when to use them and why, but you must also learn to understand the reductionistic details. For this big-picture perspective, you can rely to a large extent on your experience from Karel:

- If you want to test a condition that requires an **`if`** statement in Karel, you need the **`if`** statement in Java.
- If you would use the **`while`** or **`for`** statement in Karel, you will presumably use the same statement form in Java.

The other holistic point that is essential about control statements is that the control line is conceptually independent from the body. Thus, if you see a construct like

```
for (int i = 0; i < 10; i++) {          ———— Control line
    statements                          ———— Body
}
```

the statements in the body will be repeated for each of the values of **`i`** from 0 to 9. It doesn't matter at all what those statements are.

Boolean data

Another important topic is that of the data type **`boolean`**, which is the means by which Java programs ask questions. In Karel, the counterparts to **`boolean`** are the conditions such as **`frontIsClear()`** or **`beepersPresent()`**. In Java, the range of available conditions is much richer and involves the relational operators and the logical operators (both covered on page 78 of textbook). The most important lessons to take from these sections are:

- Watch out for confusing **`=`** (assignment) with **`==`** (equality). This feature of several programming languages (including C, C++, and Java) has probably caused more bugs than any other.
- Be careful to understand both the interpretation and the evaluation order of the logical operators **`&&`** (and), **`||`** (or), and **`!`** (not).

The time you put into making sure you understand **`boolean`** data now will pay for itself many times over when the programs get more complicated later in the quarter.

Graphics library documentation

The **javadoc** documentation for the ACM libraries is available under the "Links" section of the CS 106A home page. Also, the methods in Figure 1 will help with the assignment.

Figure 1. Some useful methods in acm.graphics

Constructors

new GLabel(String text) *or* **new GLabel(String text, double x, double y)** Creates a new **GLabel** object; the second form sets its location as well.
new GRect(double x, double y, double width, double height) Creates a new **GRect** object; the **x** and **y** parameters can be omitted and default to 0.
new GOval(double x, double y, double width, double height) Creates a new **GOval** object; the **x** and **y** parameters can be omitted and default to 0.
new GLine(double x1, double y1, double x2, double y2) Creates a new **GLine** object connecting (**x1**, **y1**) and (**x2**, **y2**).

Methods common to all graphical object

void setLocation(double x, double y) Sets the location of this object to the specified coordinates.
void move(double dx, double dy) Moves the object using the displacements **dx** and **dy**.
double getWidth() Returns the width of the object.
double getHeight() Returns the height of the object.
void setColor(Color c) Sets the color of the object.

Methods available for GRect and GOval only

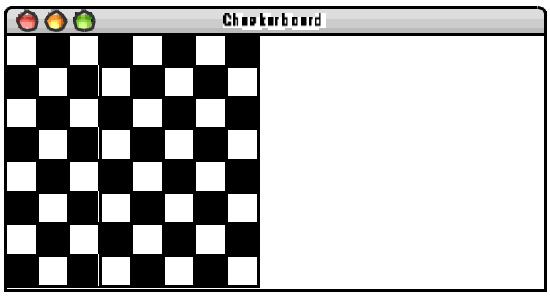
void setFilled(boolean fill) Sets whether this object is filled (**true** means filled, **false** means outlined).
boolean isFilled() Returns **true** if the object is filled.
void setFillColor(Color c) Sets the color used to fill this object. If the color is **null**, filling uses the color of the object.

Methods available for GLabel only

void setFont(String fontName) Sets the font, as described in Chapter 5.
double getAscent() Returns the height above the baseline.

Checkerboard problem

Create a **GraphicsProgram** subclass that draws a checkerboard in the graphics window. The number of rows and columns are given by the named constants **NROWS** and **NCOLUMNS**, and the squares should be sized so that they fill the vertical space. For example, if **NROWS** and **NCOLUMNS** are both 8, running this program should produce the following output:



Solution to the Checkerboard problem

```
/*
 * File: Checkerboard.java
 * -----------------------
 * This program draws a checkerboard.
 */

import acm.graphics.*;
import acm.program.*;

/*
 * This class draws a checkerboard on the graphics window.
 * The size of the checkerboard is specified by the
 * constants NROWS and NCOLUMNS, and the checkboard fills
 * the vertical space available.
 */

public class Checkerboard extends GraphicsProgram {

      /* Number of rows */
      private static final int NROWS = 8;

      /* Number of columns */
      private static final int NCOLUMNS = 8;

      /* Runs the program */
      public void run() {
            /* Determine the size of a single square. */
            int sqSize = getHeight() / NROWS;

            for (int i = 0; i < NROWS; i++) {
                  for (int j = 0; j < NCOLUMNS; j++) {
                        int x = j * sqSize;
                        int y = i * sqSize;
                        GRect sq = new GRect(x, y, sqSize, sqSize);
                        sq.setFilled(((i + j) % 2) != 0);
                        add(sq);
                  }
            }
      }
}
```

How would you change this program so that if the window is taller than it is wide, you can draw a checkerboard that doesn't overflow the window?