Drawings

MODULAR IV

1

Objectives

- How to draw simple shapes on an image.
- How to set the color to draw with
- How to set the font to write with
- How to draw text on top of an image

2

- We already learned a lot about how to create and manipulate images in various ways in Java.
- Now we will look at a class called java.awt.Graphics, which allows us to draw lines, shapes and text on an image.
- To use this class, you'll need to import java.awt.Graphics or import java.awt.*

3

Basic Drawing

- Drawing on a picture is really just setting pixels to the color we want.
- For example, we can draw a horizontal line across a picture by setting all of the pixels in one row of the picture to the color black
  - We could add a lines to a picture every 20 pixels:
  - For Vertical lines:
    - Start with x = 20, x < width, x += 20
      - Start with y = 0, y < height, y++
  - For horizontal lines:
    - Start with x = 0, x < width, x++
      - Start with y = 20, y < height, y+=20

4

learn by doing

- Write a method drawGrid in your Picture class to add horizontal and vertical lines to a picture every 20 pixels.
- Test your method using:

```
Picture p = new Picture ("<file location>");
p.drawGrid();
p.show();
```

5

solution

```
public void drawGrid() {
    for (int x = 20; x < this.getWidth(); x+=20) {
        for (int y = 0; y < this.getHeight(); y++) {
            this.getPixel(x,y).setColor(Color.BLACK);
        }
    }
    for (int x = 0; x < this.getWidth(); x++) {
        for (int y = 20; y < this.getHeight(); y+=20) {
            this.getPixel(x,y).setColor(Color.BLACK);
        }
    }
}
```

6

Java Graphics

- You can use the same basic idea as above to draw a circle, a string of characters, lines, or other shapes on an image.
- But determining which pixels to change would require some thought. Since circles, strings, lines, and other shapes are basic elements of almost any on-screen drawing, good programming practice dictates that we don't ask every programmer to re-invent the wheel.
- Instead, Java provides the Graphics class to do this sort of stuff.
- Every picture object has a Graphics object associated with it, which has methods for drawing simple lines, shapes, and text. The method for retrieving the Graphics object is:

pictureObj.getGraphics()

7

Java Graphics

- The methods in the java.awt.Graphics class let you paint on an image as follows:
  - Pick any color to draw with.
  - Draw shapes: circles, ellipses, rectangles, lines, arcs, polygons
  - Shapes drawn will cover whatever is on the image already, including other drawings.
  - Draw text: Set the font and write text strings in that font.

8

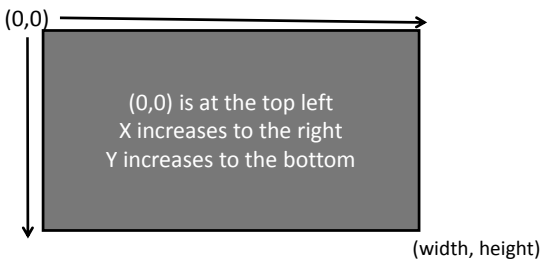
Java Graphics

- Set the current color using:
  - graphicsObj.setColor(Color c);
- Similarly, you can get the current color using:
  - graphicsObj.getColor();
- As described when we first began manipulating images, colors can be created from scratch using new Color(red, green, blue), referenced using pre-defined constants (such as Color.RED), and so on. Make sure that you import java.awt.* or java.awt.Color before you use colors, so the class is defined.

9

Graphics Environment

- As we have discussed, the upper left corner of a Picture is at (0,0), while the bottom right corner is at (width, height). Every Graphics object in Java functions the same way: Any commands you give it assume that the x and y coordinates of a point are counted from (0,0) at top left of the image, something like this:



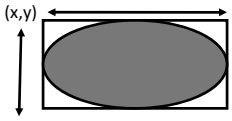
10

Drawing Circles and Ovals

- To draw a circle or oval, we can use

  drawOval(x,y,width,height) or fillOval(x,y,width,height)

- x and y are the coordinates of the top left corner of the enclosing rectangle, and width and height are the width and height of the enclosing rectangle.



- fillOval(x,y,width,height) does the same thing as drawOval(...), except it fills in the inside of the oval.

11

Fonts and Strings

- One of the most common things drawn on screen in today's interactive systems is text. Text is drawn using a method call drawString().
- In addition to the color of text, you can also control its font.
  - First import java.awt.Font
  - Font labelFont = new Font("TimesRoman", Font.BOLD, 24); (styles are PLAIN, BOLD, ITALIC, and BOLDITALIC. These are all available as fields in the Font class).
  - Tell the graphics object to use this font: graphicsObj.setFont(labelFont)
  - use the graphics object to get font information:
    - graphicsObj.getStyle() to get font style
    - graphicsObj.getSize() for the point size,
    - graphicsObj.getName() for the font name (e.g. "TimesRoman")
    - graphicsObj.getFamily() for the font family (e.g. Helvetica).

12

Fonts and Strings

- The graphics object provides a method to draw a string on an image:
  graphicsObj.drawString("string", leftX, baselineY).
- The location coordinates are defined as follows:
  - *leftX* simply refers to the leftmost part of the string.
  - *baselineY* refers to the Y position of the base of characters that do not have a descender. For ex., the 'g' descends below baselineY.
- We can get the font information by using the FontMetrics class.

```
import java.awt.FontMetrics;
FontMetrics currFontMetrics = graphicsObj.getFontMetrics();
int baselineY = currFontMetrics.getHeight() -
    currFontMetrics.getDescent();
int width = currFontMetrics.stringWidth("string");
```

- Note that width isn't required to draw a string, but can be useful regardless.

13

Other types of drawing elements:

graphicsObj.drawLine(x1,y1,x2,y2);

graphicsObj.fillPolygon(xArray, yArray, numPoints);

Where xArray holds all the x points and yArray holds all the y points

graphicsObj.drawArc(x, y, width, height, startAngle, arcAngle);

graphicsObj.fillArc(x, y, width, height, startAngle, arcAngle);

graphicsObj.drawRect(x, y, width, height);

graphicsObj.drawRoundRect(x, y, width, height, arcWidth, arcHeight);

14

Summary

- You can draw by changing the color of the pixels directly. Or you can use *java.awt.Graphics* to do drawings
  - *import java.awt.Graphics*
  - Get a graphics object from a picture object with: *Graphics graphics = pictureObj.getGraphics();*
  - Set the color to draw with: *graphics.setColor(color);*
  - Do simple drawing.
  - Draw a filled in version of everything (but line) using *fillobject*

15