Building Java Programs

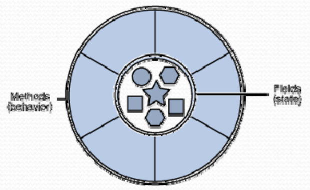
Graphics

reading: Supplement 3G

videos: Ch. 3G #1-2

Objects (briefly)

- **object:** An entity that contains data and behavior.
  - *data*: variables inside the object
  - *behavior*: methods inside the object
    - You interact with the methods; the data is hidden in the object.
    - A **class** is a type of objects.



- Constructing (creating) an object:

  Type objectName = new **Type**(**parameters**);

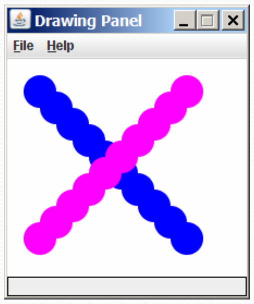
- Calling an object's method:

  objectName.**methodName**(**parameters**);

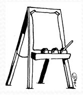
Graphical objects

We will draw graphics in Java using 3 kinds of objects:

- `DrawingPanel`: A window on the screen.
  - Not part of Java; provided by the authors. See class web site.
- `Graphics`: A "pen" to draw shapes and lines on a window.
- `Color`: Colors in which to draw shapes.



DrawingPanel



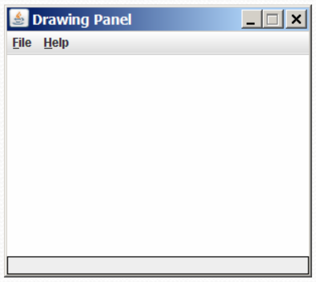
"Canvas" objects that represents windows/drawing surfaces

- To create a window:

  `DrawingPanel` **name** `= new DrawingPanel(`**width, height**`);`

  Example:

  ```
  DrawingPanel panel = new DrawingPanel(300, 200);
  ```



- The window has nothing on it.
  - We draw shapes / lines on it with another object of type `Graphics`.

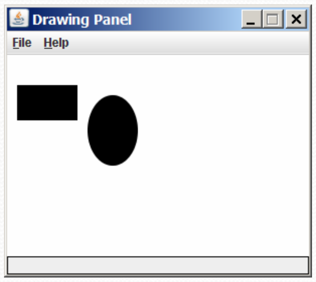
Graphics

"Pen" or "paint brush" objects to draw lines and shapes

- Access it by calling `getGraphics` on your `DrawingPanel`.
  ```
  Graphics g = panel.getGraphics();
  ```

- Draw shapes by calling methods on the `Graphics` object.

```
g.fillRect(10, 30, 60, 35);
g.fillOval(80, 40, 50, 70);
```



Java class libraries, import

- **Java class libraries**: Classes included with Java's JDK.
  - organized into groups named *packages*
  - To use a package, put an *import declaration* in your program:

```
// put this at the very top of your program
import packageName.*;
```

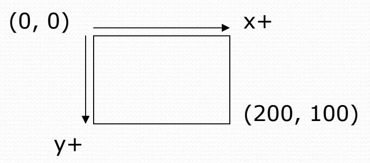
- `Graphics` belongs to a package named `java.awt`

```
import java.awt.*;
```

  - To use `Graphics`, you must place the above line at the very top of your program, before the `public class` header.

Coordinate system

- Each (x, y) position is a *pixel* ("picture element").
- Position (0, 0) is at the window's top-left corner.
  - x increases rightward and the y increases downward.
- The rectangle from (0, 0) to (200, 100) looks like this:



`Graphics` methods

Method name	Description
`g.drawLine(`**x1**, **y1**, **x2**, **y2**`);`	line between points (*x1*, *y1*), (*x2*, *y2*)
`g.drawOval(`**x**, **y**, **width**, **height**`);`	outline largest oval that fits in a box of size *width* * *height* with top-left at (*x*, *y*)
`g.drawRect(`**x**, **y**, **width**, **height**`);`	outline of rectangle of size *width* * *height* with top-left at (*x*, *y*)
`g.drawString(`**text**, **x**, **y**`);`	text with bottom-left at *(x, y)*
`g.fillOval(`**x**, **y**, **width**, **height**`);`	fill largest oval that fits in a box of size *width* * *height* with top-left at (*x*, *y*)
`g.fillRect(`**x**, **y**, **width**, **height**`);`	fill rectangle of size *width* * *height* with top-left at (*x*, *y*)
`g.setColor(`**Color**`);`	set `Graphics` to paint any following shapes in the given color

Color

- Specified as predefined `Color` class constants:

  `Color.`**CONSTANT_NAME**

  where **CONSTANT_NAME** is one of:

```
BLACK,    BLUE,         CYAN,     DARK_GRAY,   GRAY,
GREEN,    LIGHT_GRAY,   MAGENTA,  ORANGE,
PINK,     RED,          WHITE,    YELLOW
```

- Or create one using <u>R</u>ed-<u>G</u>reen-<u>B</u>lue (RGB) values of 0-255

```
Color name = new Color(red, green, blue);
```

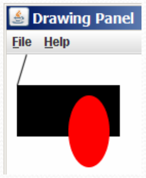
  - Example:

```
Color brown = new Color(192, 128, 64);
```

Using colors

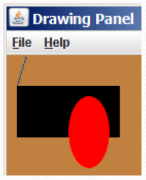
- Pass a `Color` to `Graphics` object's `setColor` method
  - Subsequent shapes will be drawn in the new color.

```
g.setColor(Color.BLACK);
g.fillRect(10, 30, 100, 50);
g.drawLine(20, 0, 10, 30);
g.setColor(Color.RED);
g.fillOval(60, 40, 40, 70);
```



- Pass a color to `DrawingPanel`'s `setBackground` method
  - The overall window background color will change.

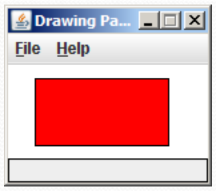
```
Color brown = new Color(192, 128, 64);
panel.setBackground(brown);
```



Outlined shapes

- To draw a colored shape with an outline, first *fill* it, then *draw* the same shape in the outline color.

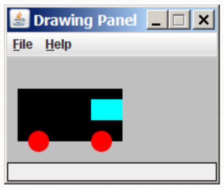
```
import java.awt.*;  // so I can use Graphics
public class OutlineExample {
    public static void main(String[] args) {
        DrawingPanel panel = new DrawingPanel(150, 70);
        Graphics g = panel.getGraphics();
        // inner red fill
        g.setColor(Color.RED);
        g.fillRect(20, 10, 100, 50);
        // black outline
        g.setColor(Color.BLACK);
        g.drawRect(20, 10, 100, 50);
    }
}
```



Superimposing shapes

- When ≥ 2 shapes occupy the same pixels, the last drawn "wins."

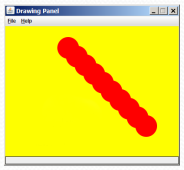
```
import java.awt.*;

public class Car {
    public static void main(String[] args) {
        DrawingPanel panel = new DrawingPanel(200, 100);
        panel.setBackground(Color.LIGHT_GRAY);
        Graphics g = panel.getGraphics();

        g.setColor(Color.BLACK);
        g.fillRect(10, 30, 100, 50);

        g.setColor(Color.RED);
        g.fillOval(20, 70, 20, 20);
        g.fillOval(80, 70, 20, 20);

        g.setColor(Color.CYAN);
        g.fillRect(80, 40, 30, 20);
    }
}
```



Drawing with loops

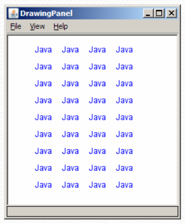
- The *x*,*y*,*w*,*h* expressions can use the loop counter variable:

```
panel.setBackground(Color.YELLOW);
g.setColor(Color.RED);
for (int i = 1; i <= 10; i++) {
    //              x               y           w    h
    g.fillOval(100 + 20 * i, 5 + 20 * i, 50, 50);
}
```



- Nested loops can be used with graphics:

```
g.setColor(Color.BLUE);
for (int x = 1; x <= 4; x++) {
    for (int y = 1; y <= 9; y++) {
        g.drawString("Java", x * 40, y * 25);
    }
}
```

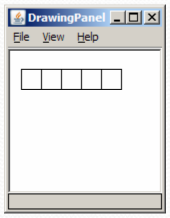


```
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
```

Zero-based loops

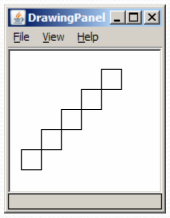
- Beginning at 0 and using < can make coordinates easier.

```
DrawingPanel panel = new DrawingPanel(150, 140);
Graphics g = panel.getGraphics();

// horizontal line of 5 20x20 rectangles starting
// at (11, 18); x increases by 20 each time
for (int i = 0; i < 5; i++) {
    g.drawRect(11 + 20 * i, 18, 20, 20);
}
```



- Exercise: Write a variation of the above program that draws the output at right.
    - The bottom-left rectangle is at (11, 98).

```
for (int i = 0; i < 5; i++) {
    g.drawRect(11 + 20 * i, 98 - 20 * i, 20, 20);
}
```


DrawingPanel
File View Help