CS 106A, Lecture 11
Graphics

reading:

Art & Science of Java, 9.1-9.3

Plan For Today

- Announcements
- Recap: File Reading
- GraphicsProgram
- Graphical Objects
- Practice: Car

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File Reading Overview

1. Make a Scanner to open a file to read

```
Scanner input = new Scanner(new File("data.txt"));
```

2. Use Scanner methods such as nextLine or next to read in the file, usually in a loop
3. Scanner operations on files are ”dangerous”, so we need to use a try/catch block
4. Close the Scanner when you are done – `input.close()`

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Scanner methods

Method	Description
`sc``.nextLine()`	reads and returns a one-*line* `String` from the file
`sc``.next()`	reads and returns a one-word `String` from the file
`sc``.nextInt()`	reads and returns an `int` from the file
`sc``.nextDouble()`	reads and returns a `double` from the file
`sc``.hasNextLine()`	returns `true` if there are any more lines
`sc``.hasNext()`	returns `true` if there are any more tokens
`sc``.hasNextInt()`	returns `true` if there is a next token and it's an `int`
`sc``.hasNextDouble()`	returns `true` if there is a next token and it's a `double`
`sc``.close();`	should be called when done reading the file

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3. Scanner operations on files are ”dangerous”, so we need to use a try/catch block
4. Close the Scanner when you are done – `input.close()`

Try/Catch

```
try {
    statements;   // code that might throw an exception
} catch (ExceptionType name) {
    statements;   // code to handle the error
}
```

- To execute code that might throw an exception, you must enclose it in a `try/catch` statement.

```
try {
    Scanner input = new Scanner(new File("data.txt"));
    ...
} catch (IOException ex) {
    println("Error reading the file: " + ex);
}
```

Try/Catch

To execute code that might throw an exception, you must enclose it in a `try/catch` statement.

If something fails up here…

```
try {
    Scanner input = new Scanner(new File("data.txt"));
    while (input.hasNextLine()) {
          String line = input.nextLine();
          println(line);
    }
} catch (FileNotFoundException ex) {
    println("Error reading the file: " + ex);
}
```

Try/Catch

To execute code that might throw an exception, you must enclose it in a `try/catch` statement.

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```
try {
    Scanner input = new Scanner(new File("data.txt"));
    while (input.hasNextLine()) {
        String line = input.nextLine();
        println(line);
    }
} catch (FileNotFoundException ex) {
    println("Error reading the file: " + ex);
}
```

… we immediately jump down here.

Mixing lines and tokens

Input file `input.txt` :	Output to console:

`The quick brown fox jumps over`
`the lazy dog.`
	`Line has 6 words`
	`Line has 3 words`

```
// Counts the words on each line of a file
Scanner input = new Scanner(new File("input.txt"));
while (input.hasNextLine()) {
    Scanner tokens = new Scanner(input.nextLine());

    // process the contents of this line
    int count = 0;
    while (tokens.hasNext()) {
        String word = tokens.next();
        count++;
    }
    println("Line has " + count + " words");
}
...
```

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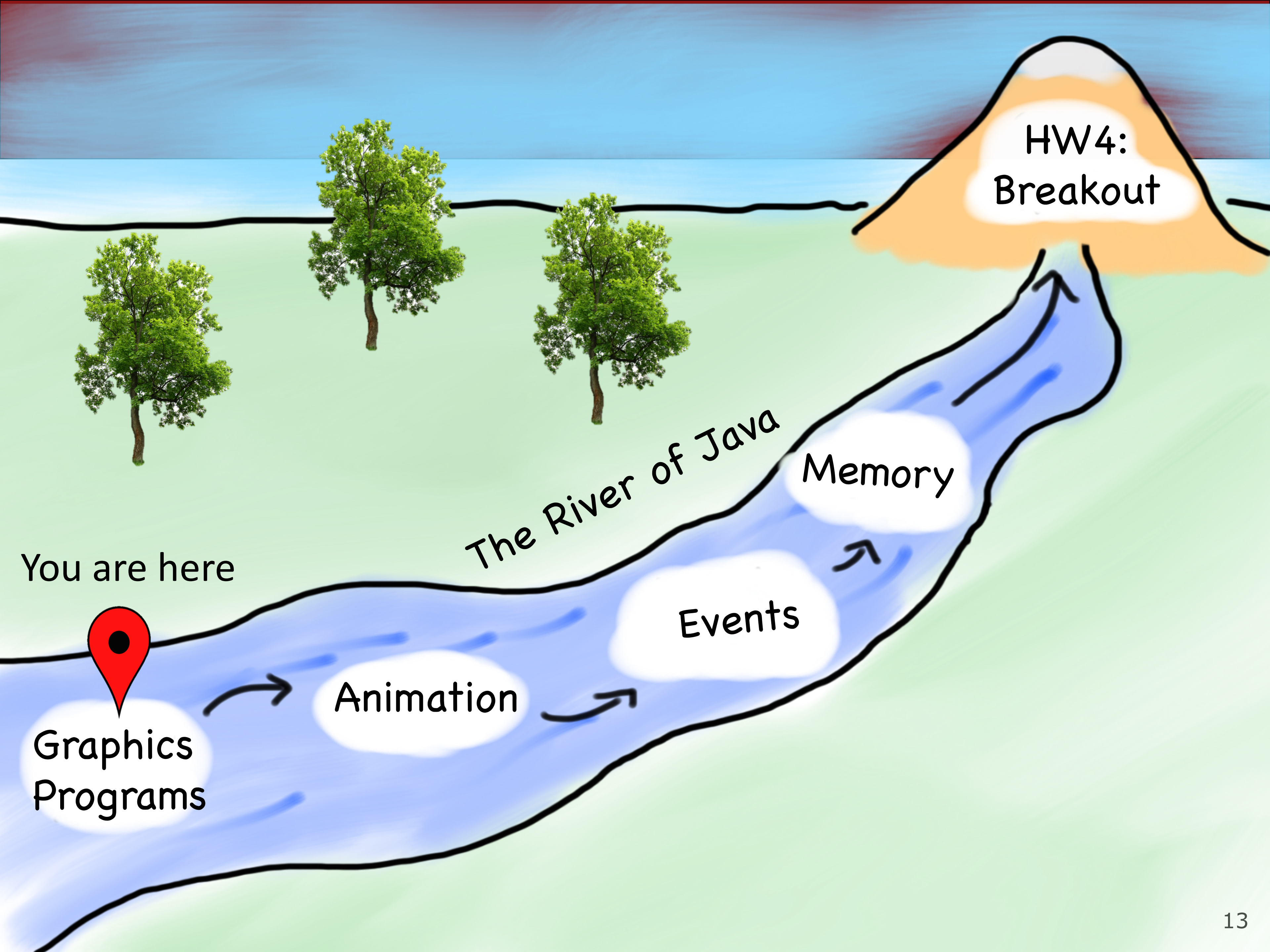
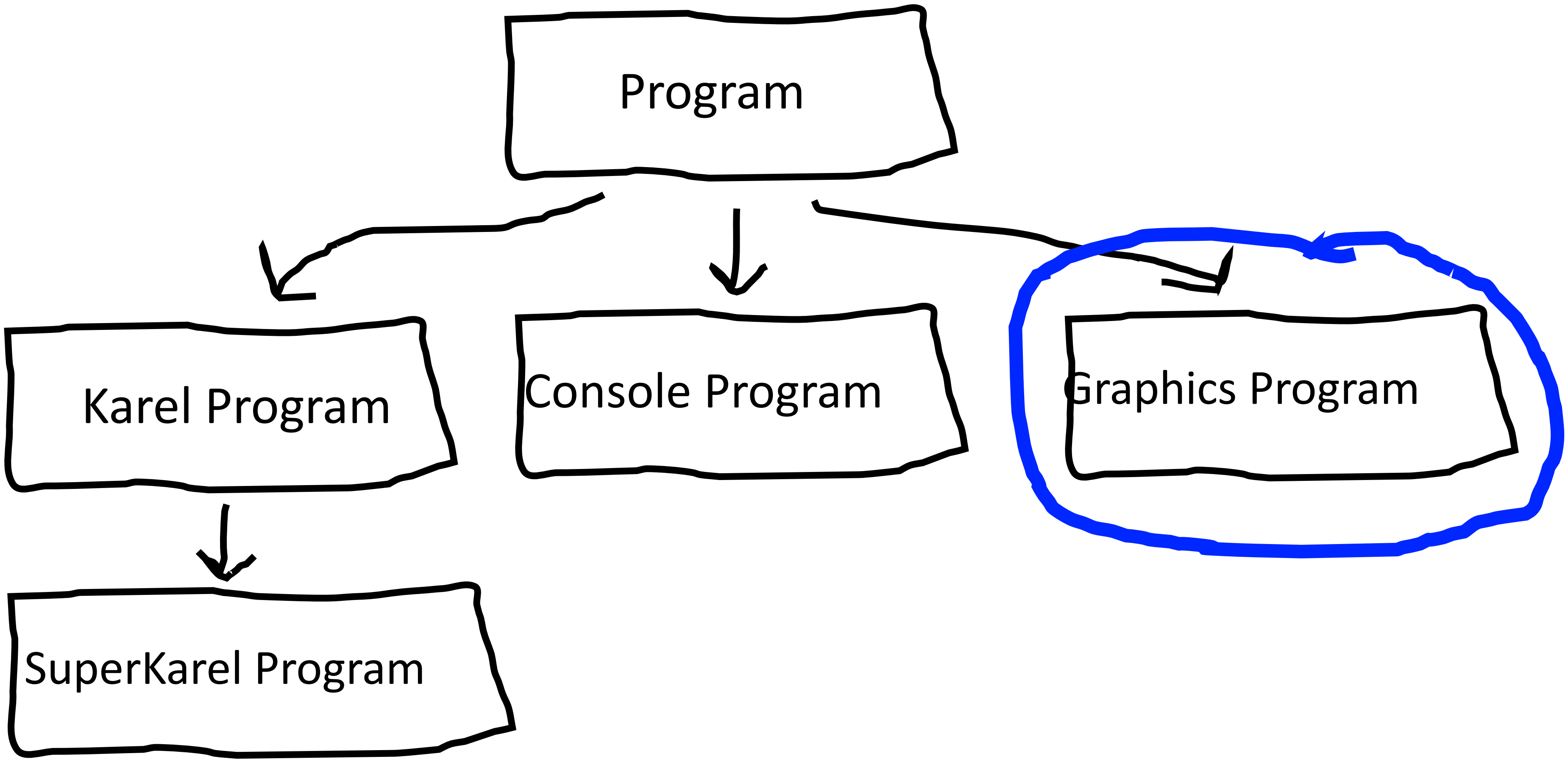
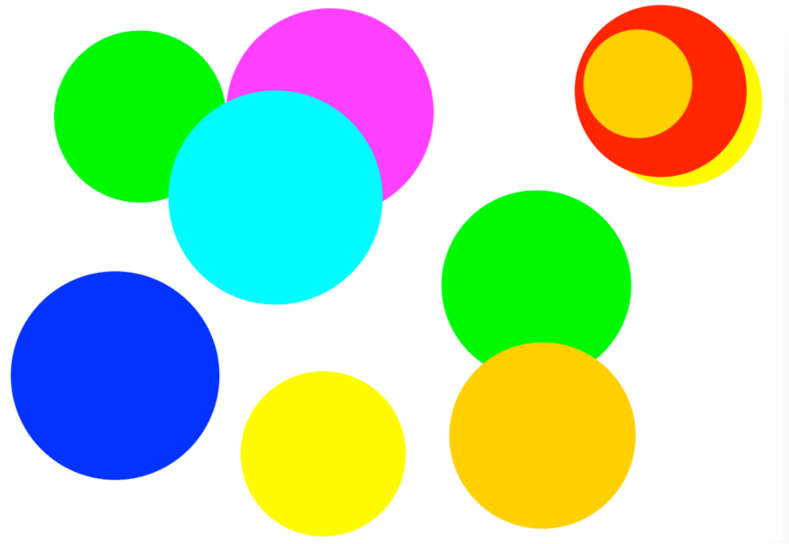
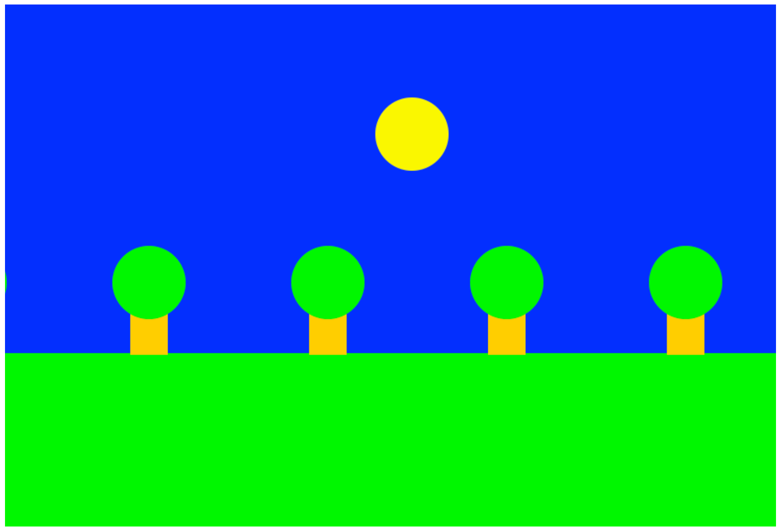

HW4:
Breakout
The River of Java
Memory
Events
You are here
Animation
Graphics
Programs

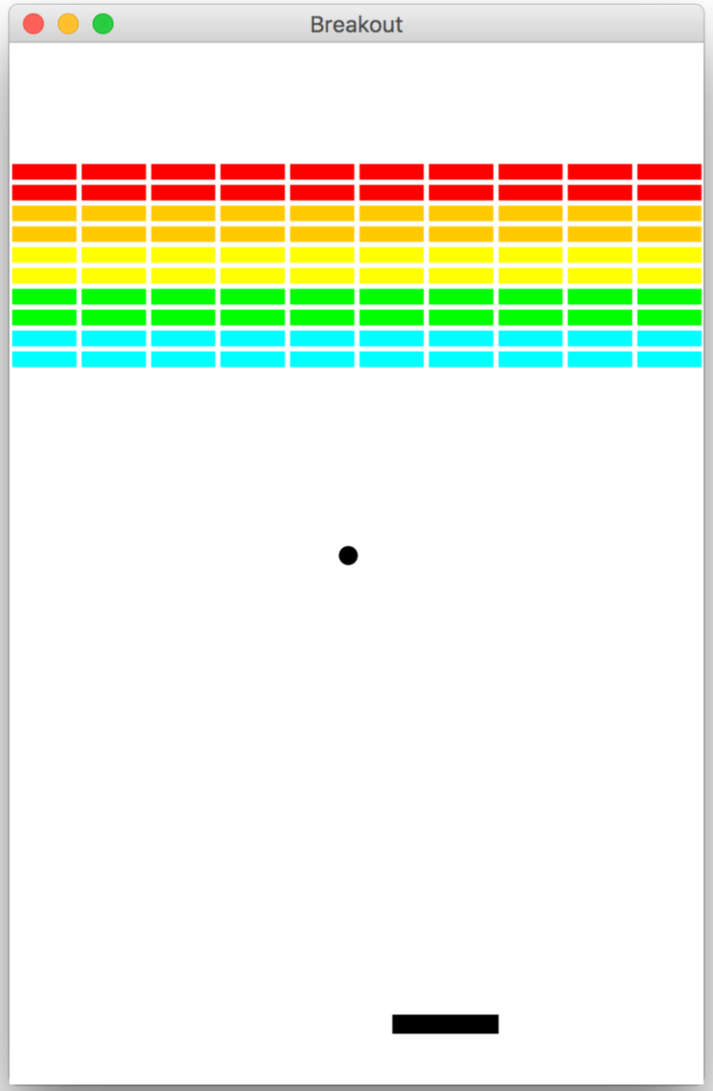
Java


Program
Karel Program
Console Program
Graphics Program
SuperKarel Program

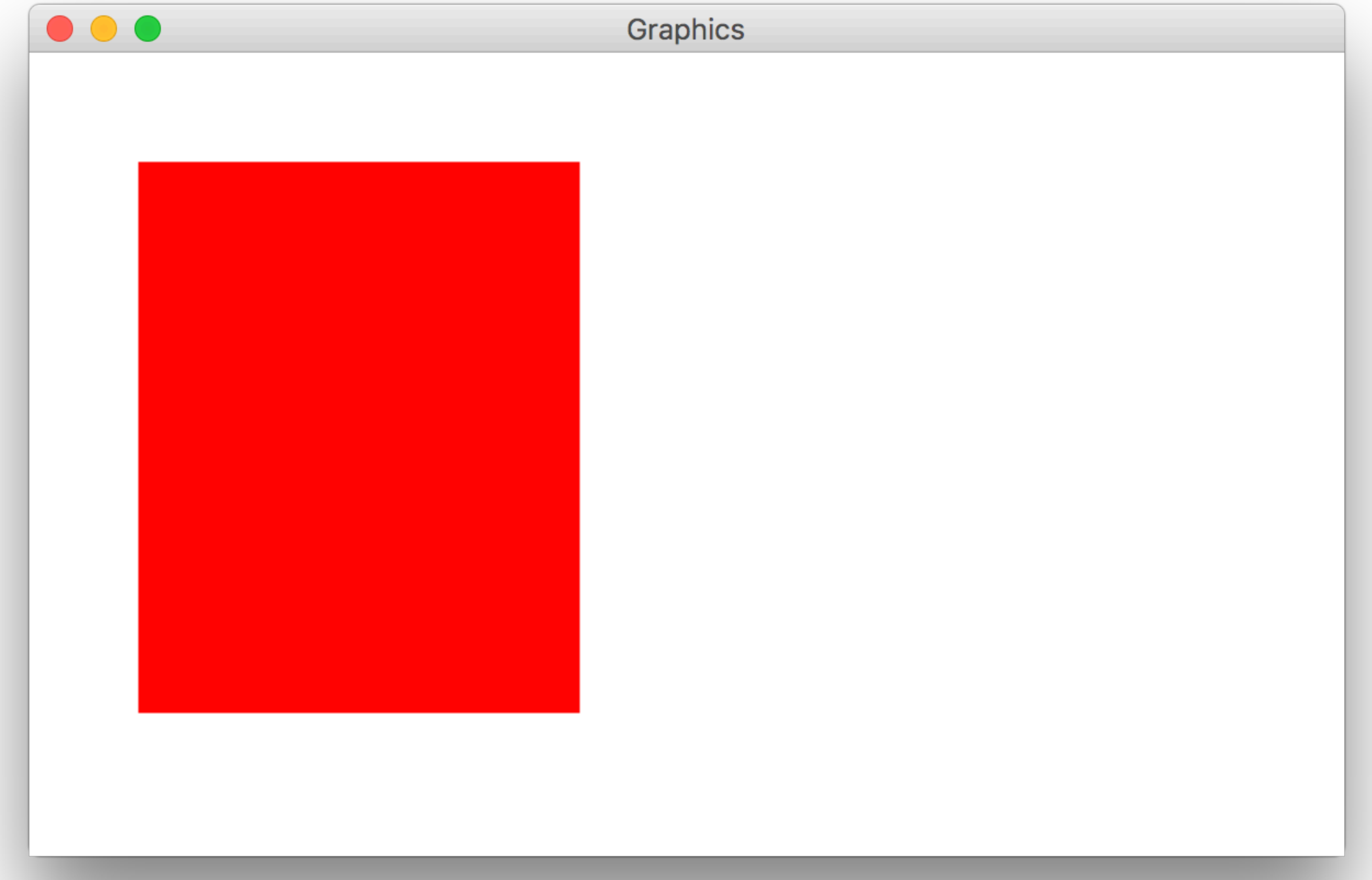
Graphics Programs







Our First GraphicsProgram



Our First GraphicsProgram

```
import acm.program.*;
import acm.graphics.*; // Stanford graphical objects
import java.awt.*;      // Java graphical objects

public class MyGraphics extends GraphicsProgram {
     public void run() {
          GRect rect = new GRect(50, 50, 200, 250);
          rect.setFilled(true);
          rect.setColor(Color.RED);
          add(rect);
     }
}
```

Our First GraphicsProgram

```
// Create a 200x250 GRect at (50, 50)
GRect rect = new GRect(50, 50, 200, 250);

// Set some properties
rect.setFilled(true);
rect.setColor(Color.RED);

// Add to the canvas
add(rect);
```

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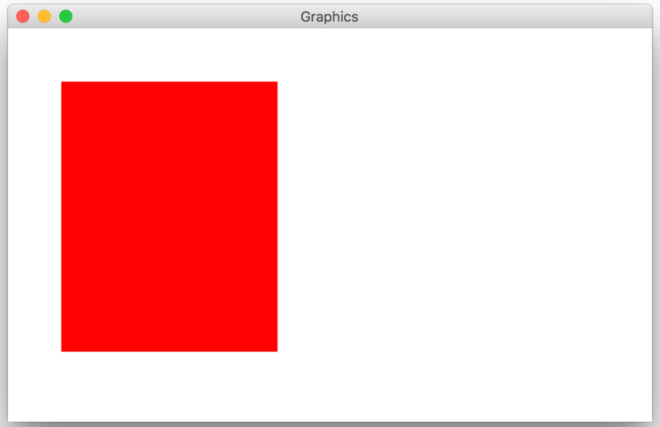
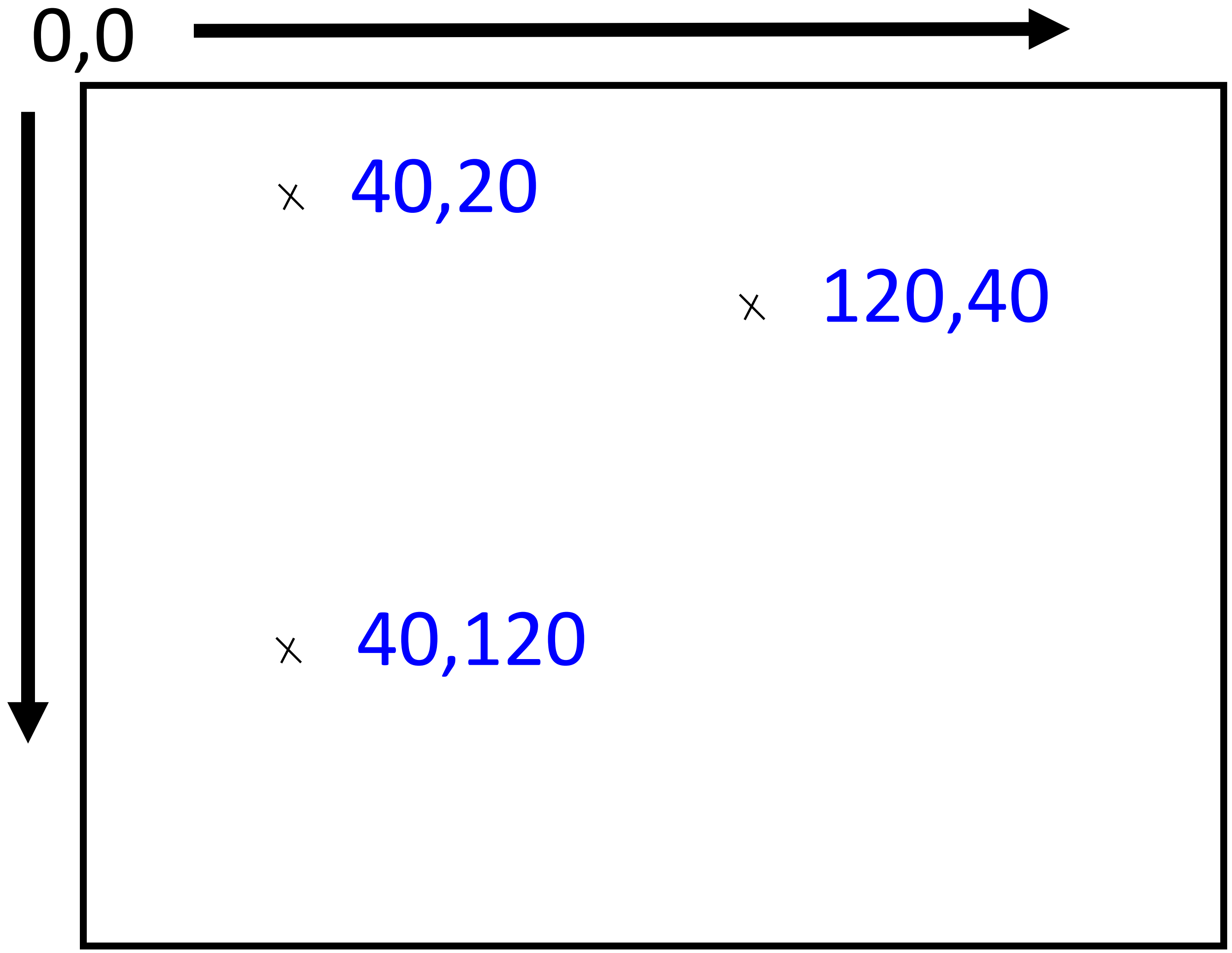
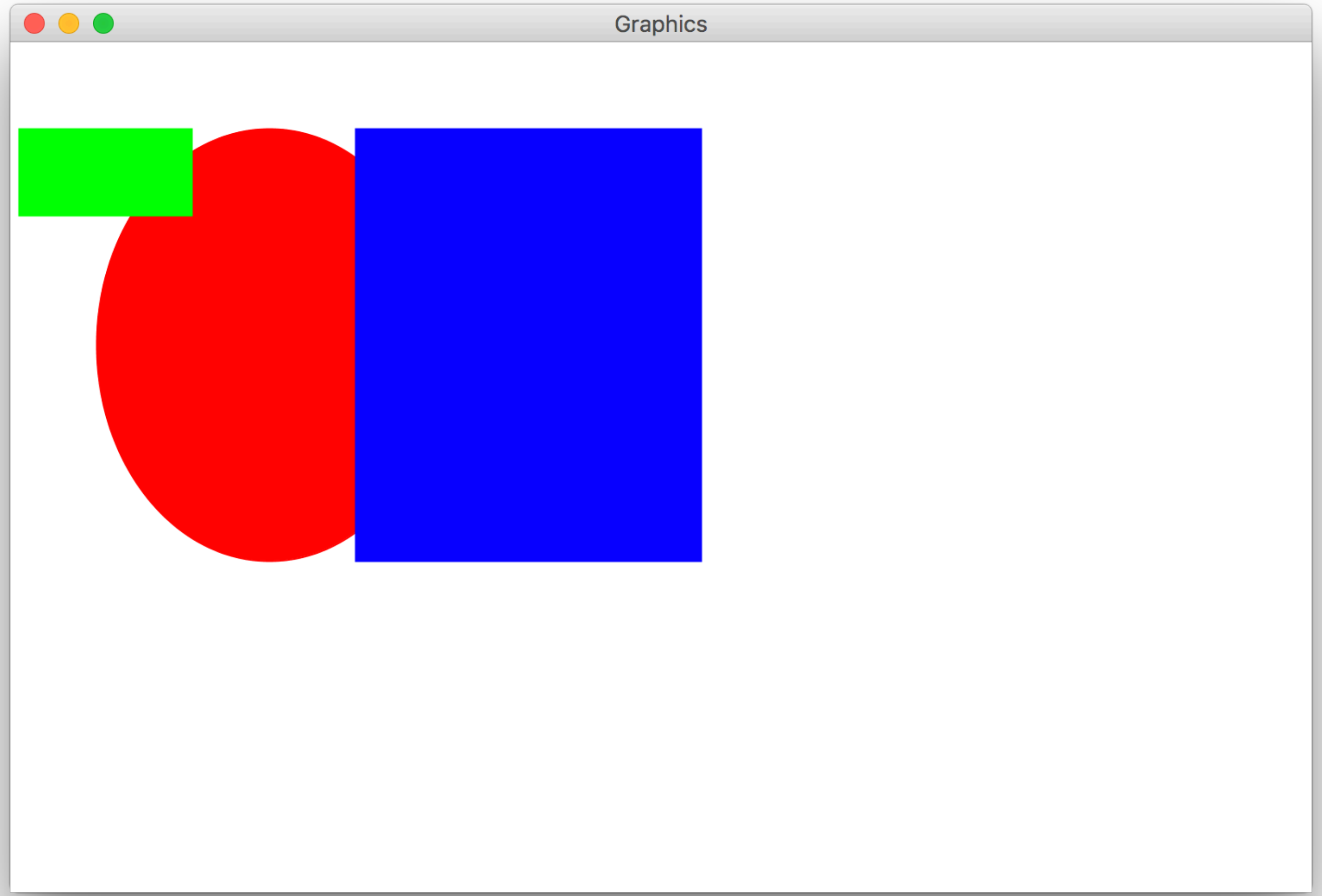


The Graphics Canvas



Collage Model



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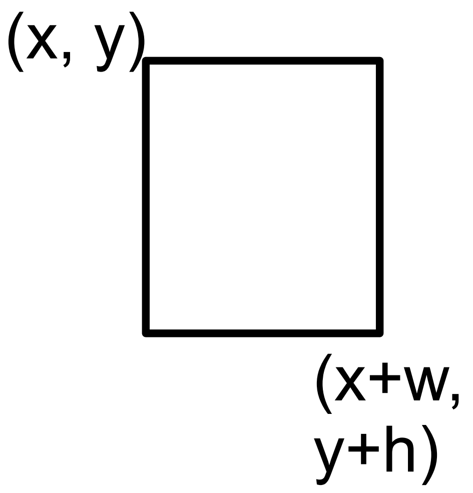
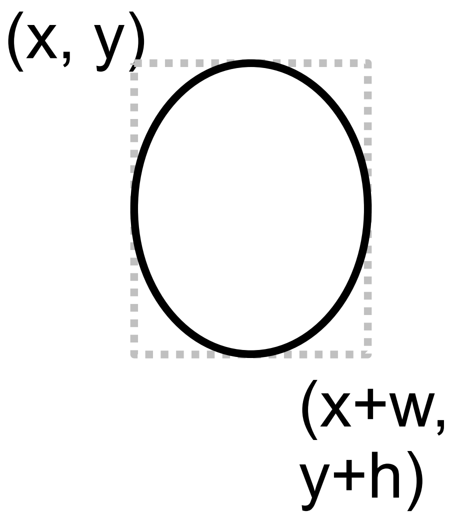
Graphical Objects

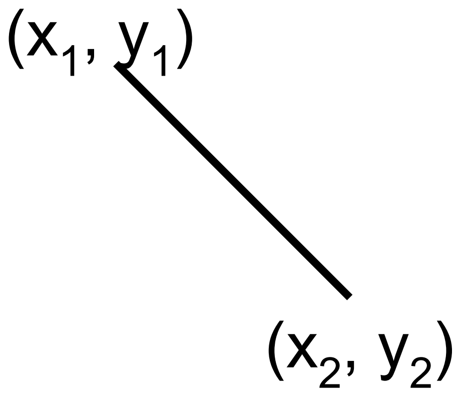
GRect



GOval



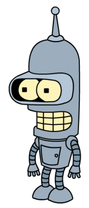
GLine



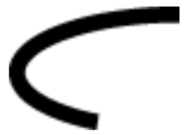
GLabel

Hello there!

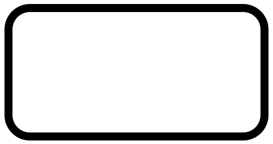
GImage



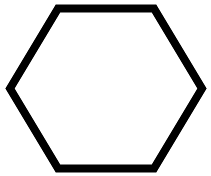
GArc



GRoundRect

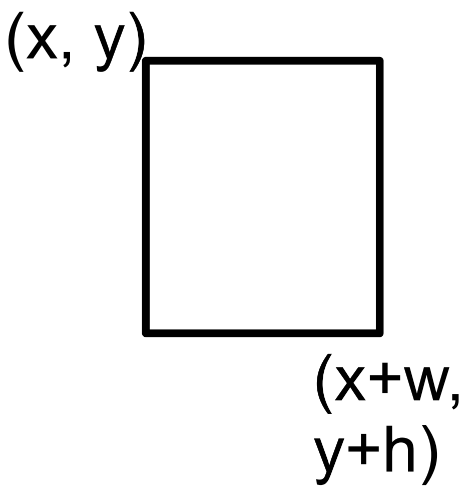


GPolygon

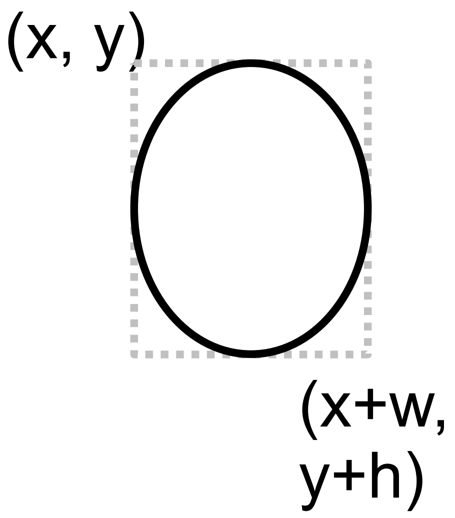


Graphical Objects

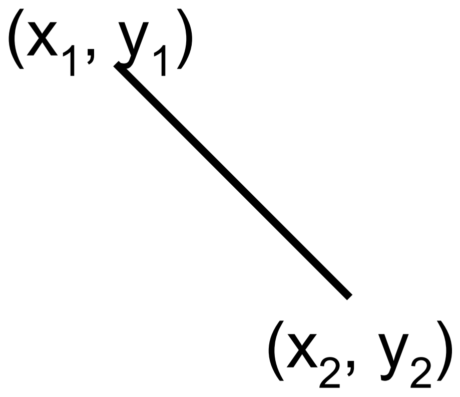
GRect



GOval



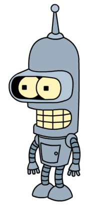
GLine



GLabel

Hello there!

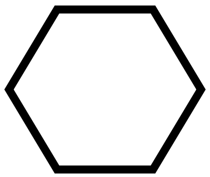
GImage



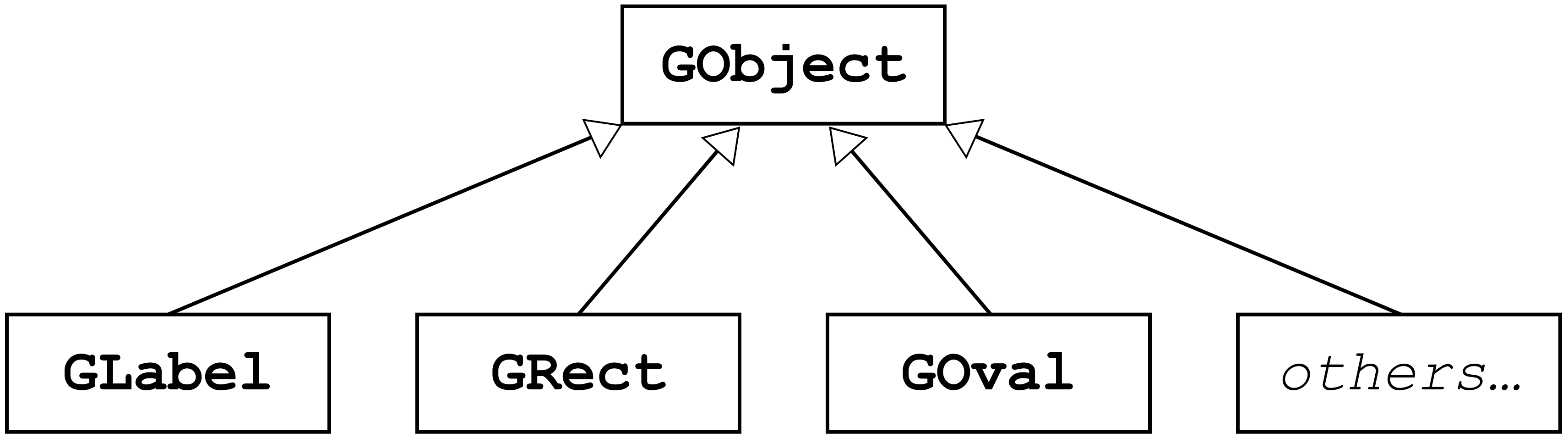
GArc

GRoundRect

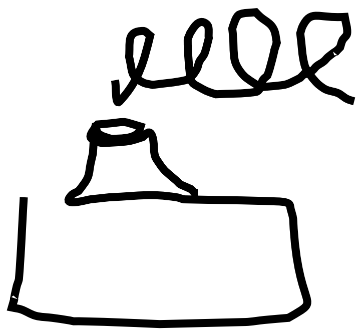
GPolygon



Graphical Objects



```
GRect myRect = new GRect(50, 50, 350, 270);
```



Primitives vs. Objects

Primitive Variable Types	Object Variable Types
`int`	`GRect`
`double`	`GOval`
`char`	`GLine`
`boolean`	`Scanner`
	`...`

Object variables:

1. Have upper camel case types
2. You can call methods on them
3. Are constructed using **`new`**

Methods on Graphics Objects

We manipulate graphics objects by calling methods on them:

$$\underbrace{\texttt{object}}_{\text{Receiver}}\texttt{.}\underbrace{\texttt{method(parameters);}}_{\text{Message}}$$

Methods on Graphics Objects

We manipulate graphics objects by calling methods on them:

$$\underbrace{\texttt{object}}_{\text{Who?}}\texttt{.}\underbrace{\texttt{method}}_{\text{What?}}\texttt{(}\underbrace{\texttt{parameters}}_{\text{What specifically?}}\texttt{);}$$

Example:

```
rect.setColor(Color.RED);
```

GObject Methods

The following operations apply to all **`GObject`**s:

object.**`setColor(`***color***`)`** Sets the color of the object to the specified color constant.
object.**`setLocation(`***x*, *y***`)`** Changes the location of the object to the point (*x*, *y*).
object.**`move(`***dx*, *dy***`)`** Moves the object on the screen by adding *dx* and *dy* to its current coordinates.
object.**`getWidth()`** Returns the width of the object
object.**`getHeight()`** Returns the height of the object

Graphic courtesy of Eric Roberts

Colors

- Specified as predefined `Color` constants:

  `Color.`***`NAME`*** , where ***NAME*** is one of:

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

```
rect.setColor(Color.MAGENTA);
```

- Or create one using Red-Green-Blue (RGB) values of 0-255

  `new Color(`***`red`***`, `***`green`***`, `***`blue`***`)`

  – Example:

```
rect.setColor(new Color(192, 128, 64));
```

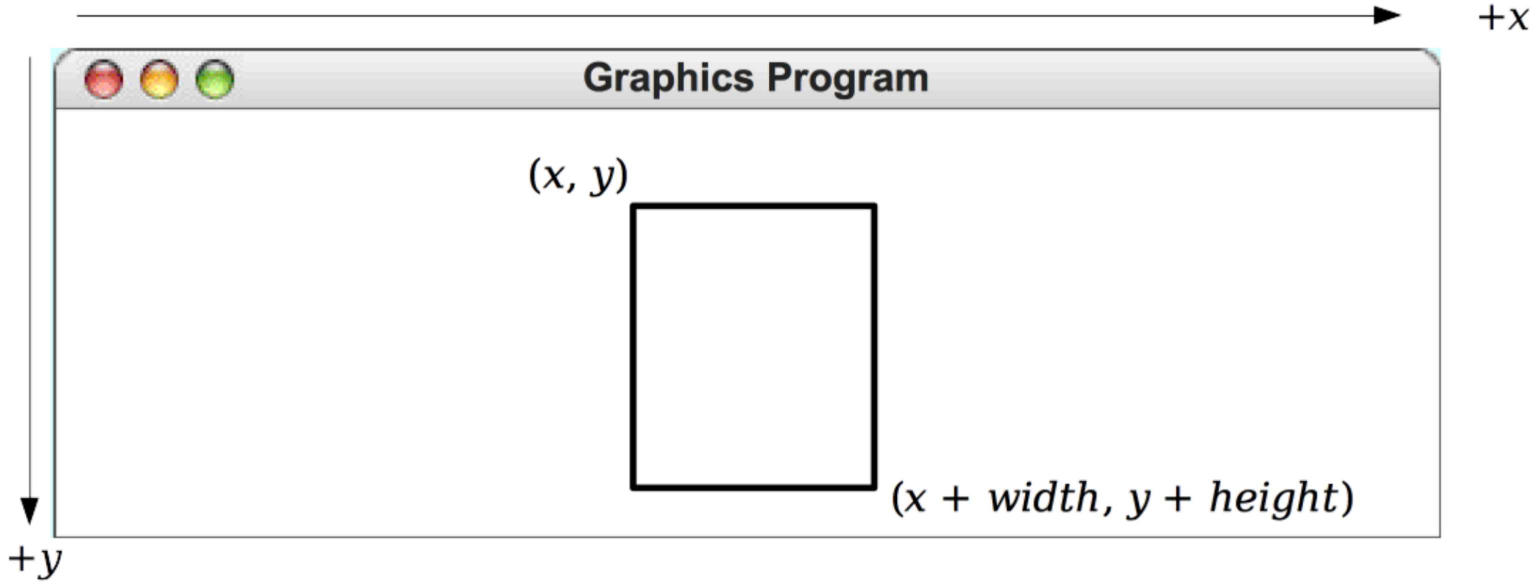
GRect

`new GRect(x, y, width, height);`

- Creates a rectangle with the given width and height, whose upper-left corner is at (x, y)

`new GRect(width, height);`

- Same as above, but defaults to (x, y) = (0, 0)



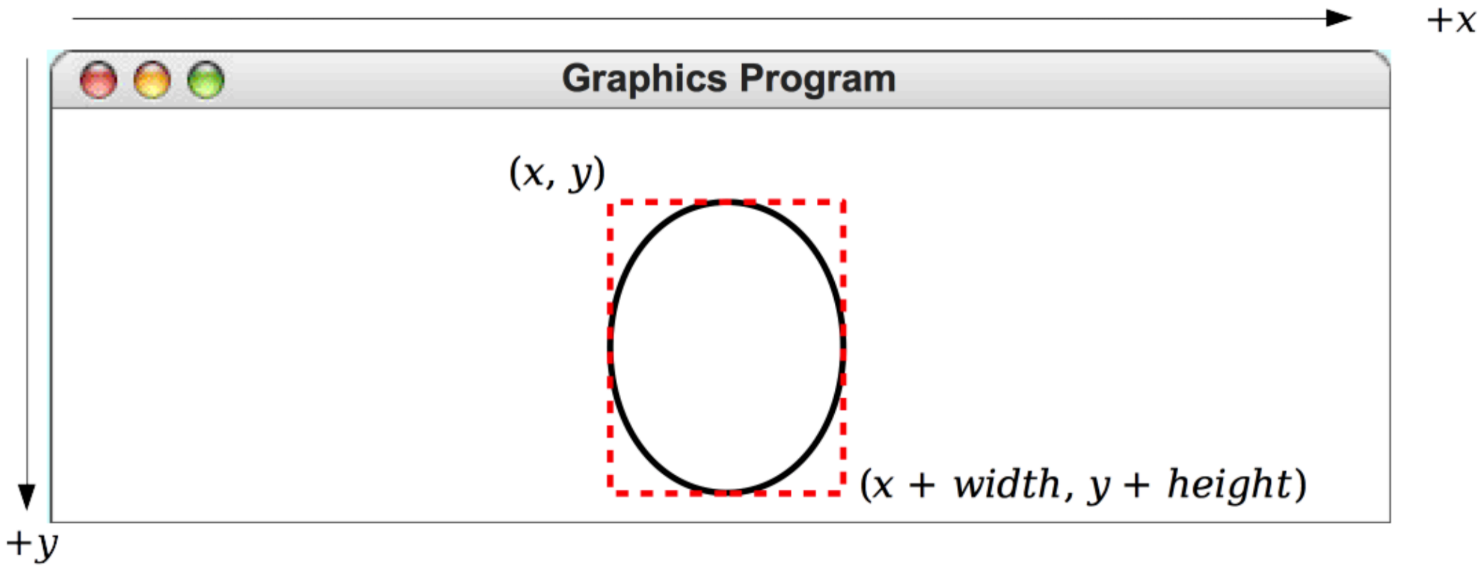
GOval

new GOval(*x*, *y*, *width*, *height*);

- Creates an oval that fits inside a rectangle with the given width and height, and whose upper-left corner is at (x, y)

new GOval(*width*, *height*);

- Same as above, but defaults to (x, y) = (0, 0)



GRect and GOval

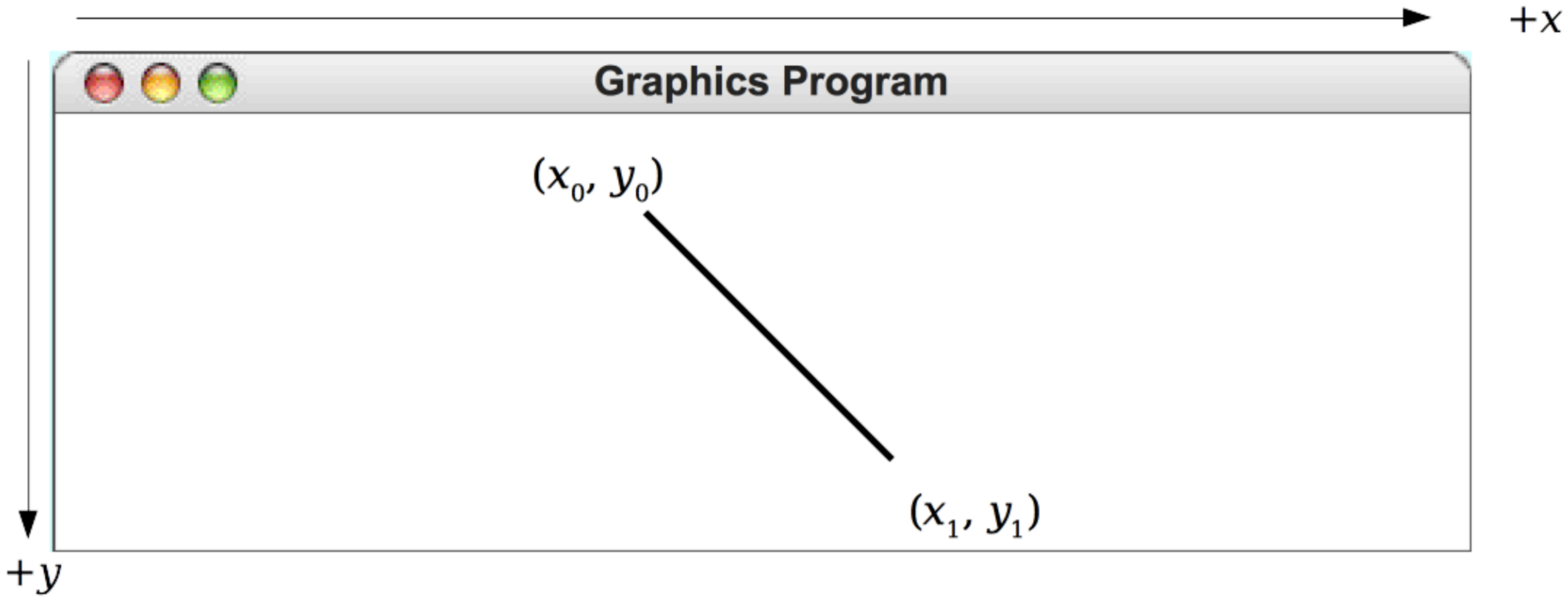
Methods shared by the **`GRect`** and **`GOval`** classes

object`.`**`setFilled(`***fill***`)`** If *fill* is **`true`**, fills in the interior of the object; if **`false`**, shows only the outline.
object`.`**`setFillColor(`***color***`)`** Sets the color used to fill the interior, which can be different from the border.
object`.`**`setSize(`***width, height***`)`** Sets the object's size to be the given width and height

GLine

`new GLine(`*`x0, y0, x1, y1`*`);`

– Creates a line extending from (x0, y0) to (x1, y1)



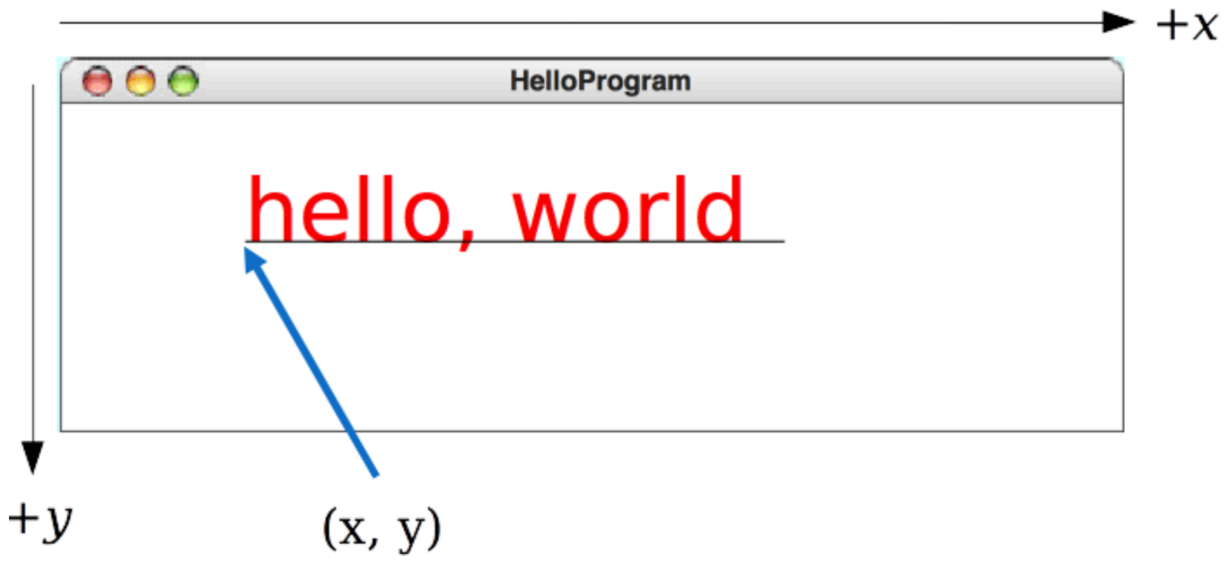
GLabel

`new GLabel(`*`“your text here”, x, y`*`);`

- Creates a label with the given text, whose ***baseline*** starts at (x, y). NOT positioned according to the top-left corner!

`new GLabel(`*`“your text here”`*`);`

- Same as above, but defaults to (x, y) = (0, 0)



GLabel Methods

Methods specific to the **`GLabel`** class

label`.`**`getDescent()`** Returns the height of the label below its baseline.
label`.`**`getAscent()`** Returns the height of the label above its baseline.
label`.`**`setFont(`***font***`)`** Sets the font used to display the label as specified by the font string.

The font is typically specified as a string in the form

"*family*-*style*-*size*"

family is the name of a font family
style is either **`PLAIN`**, **`BOLD`**, **`ITALIC`**, or **`BOLDITALIC`**
size is an integer indicating the point size

Graphic courtesy of Eric Roberts

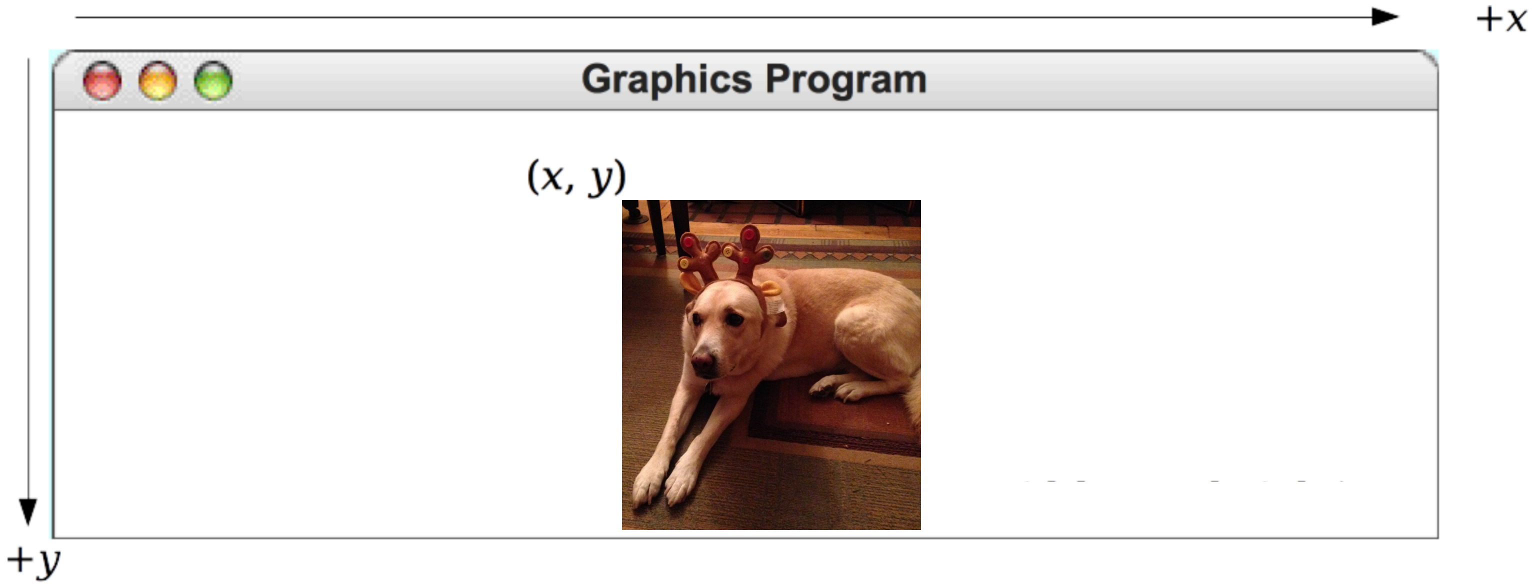
GImage

`new GImage(“`*`your filename here`*`”, `*`x`*`, `*`y`*`);`

– Creates a an image displaying the given file, whose upper-left corner is at (x, y)

`new GImage(“`*`your filename here`*`”);`

– Same as above, but defaults to (x, y) = (0, 0)



GImage Methods

object`.setSize(`*width, height*`)`
Sets the object's size to be the given width and height

GraphicsProgram Methods

- `GraphicsProgram` contains these useful methods:

Method	Description

`add(`***gobj***`);`
`add(`***gobj***`, `***x***`, `***y***`);`
	adds a graphical object to the window

`getElementAt(`***x***`, `***y***`)`	return the object at the given (x,y) position(s)
`getElementCount()`	return number of graphical objects onscreen
`getWidth(), getHeight()`	return dimensions of window
`remove(`***gobj***`);`	removes a graphical object from the window
`removeAll();`	remove all graphical objects from window
`setCanvasSize(`***w***`, `***h***`);`	set size of drawing area
`setBackground(`***color***`);`	set window's background color

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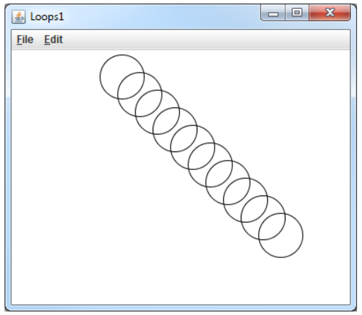
Practice: Drawing w/ Loops

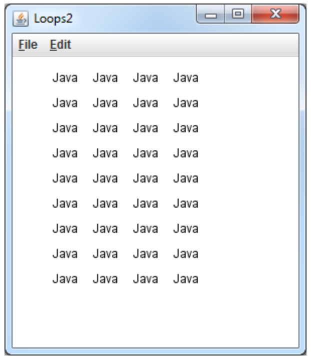
- The *x,y,w,h* expressions can use the loop counter variable:

```
for (int i = 0; i < 10; i++) {
    add(new GOval(100 + 20 * i, 5 + 20 * i, 50, 50));
}   //               x           y       w   h
```



- Nested loops can be used with graphics:

```
for (int x = 1; x <= 4; x++) {
    for (int y = 1; y <= 9; y++) {
        add(new GLabel("Java", x * 40, y * 25));
    }
}
```



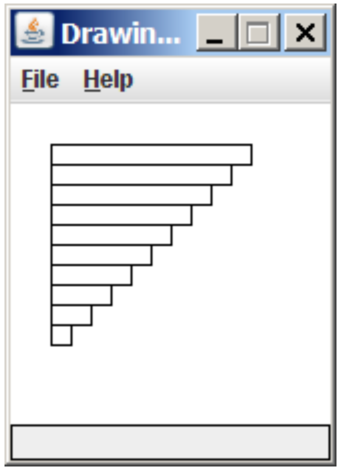
```
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
Java  Java  Java  Java
```

Practice: Drawing w/ Loops

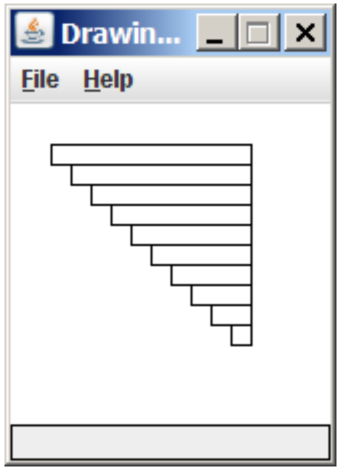
- **Q:** What is the output of the following code?

```
for (int i = 0; i < 10; i++) {
    add(new GRect(20 + 10 * i,  20 + 10 * i,
                  100 - 10 * i, 10));
}
```

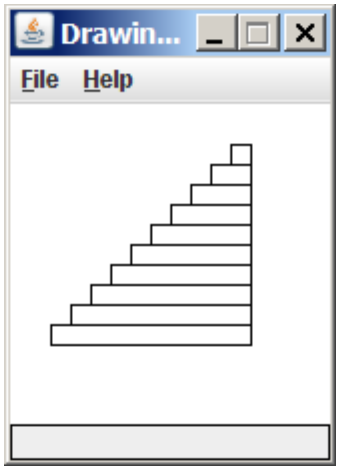
A.



B.



C.



D.

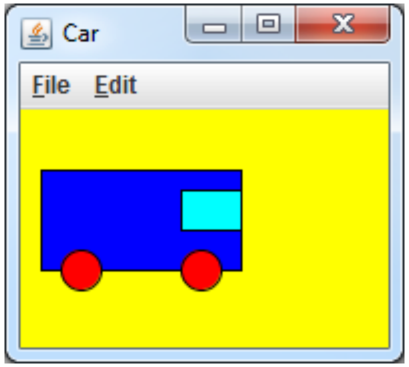
none

– *(How would we modify the code above to produce each output?)*

Practice: Car

Write a graphical program named **Car** that draws a figure that looks (kind of) like a car.

- Red wheels at (20, 70) and (80, 70), size 20x20
- Cyan windshield at (80, 40), size 30x20
- Blue body at (10, 30), size 100x50
- yellow background



Car Solution

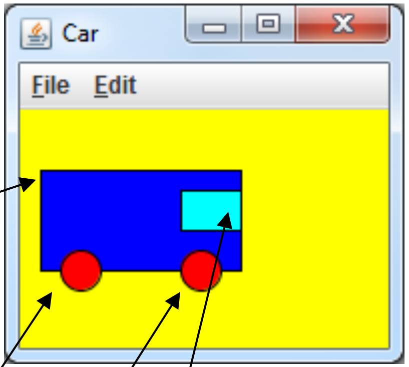
```
// When 2 shapes occupy the same pixels, the last one drawn "wins"
public class Car extends GraphicsProgram {
    public void run() {
        setBackground(Color.YELLOW);

        GRect body = new GRect(10, 30, 100, 50);
        body.setFilled(true);
        body.setFillColor(Color.BLUE);
        add(body);

        GOval wheel1 = new GOval(20, 70, 20, 20);
        wheel1.setFilled(true);
        wheel1.setFillColor(Color.RED);
        add(wheel1);

        GOval wheel2 = new GOval(80, 70, 20, 20);
        wheel2.setFilled(true);
        wheel2.setFillColor(Color.RED);
        add(wheel2);

        GRect windshield = new GRect(80, 40, 30, 20);
        windshield.setFilled(true);
        windshield.setFillColor(Color.CYAN);
        add(windshield);
    }
}
```



Recap

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Next time: More Graphics + Animation