CS 106A, Lecture 12
More Graphics

reading:

Art & Science of Java, 9.4

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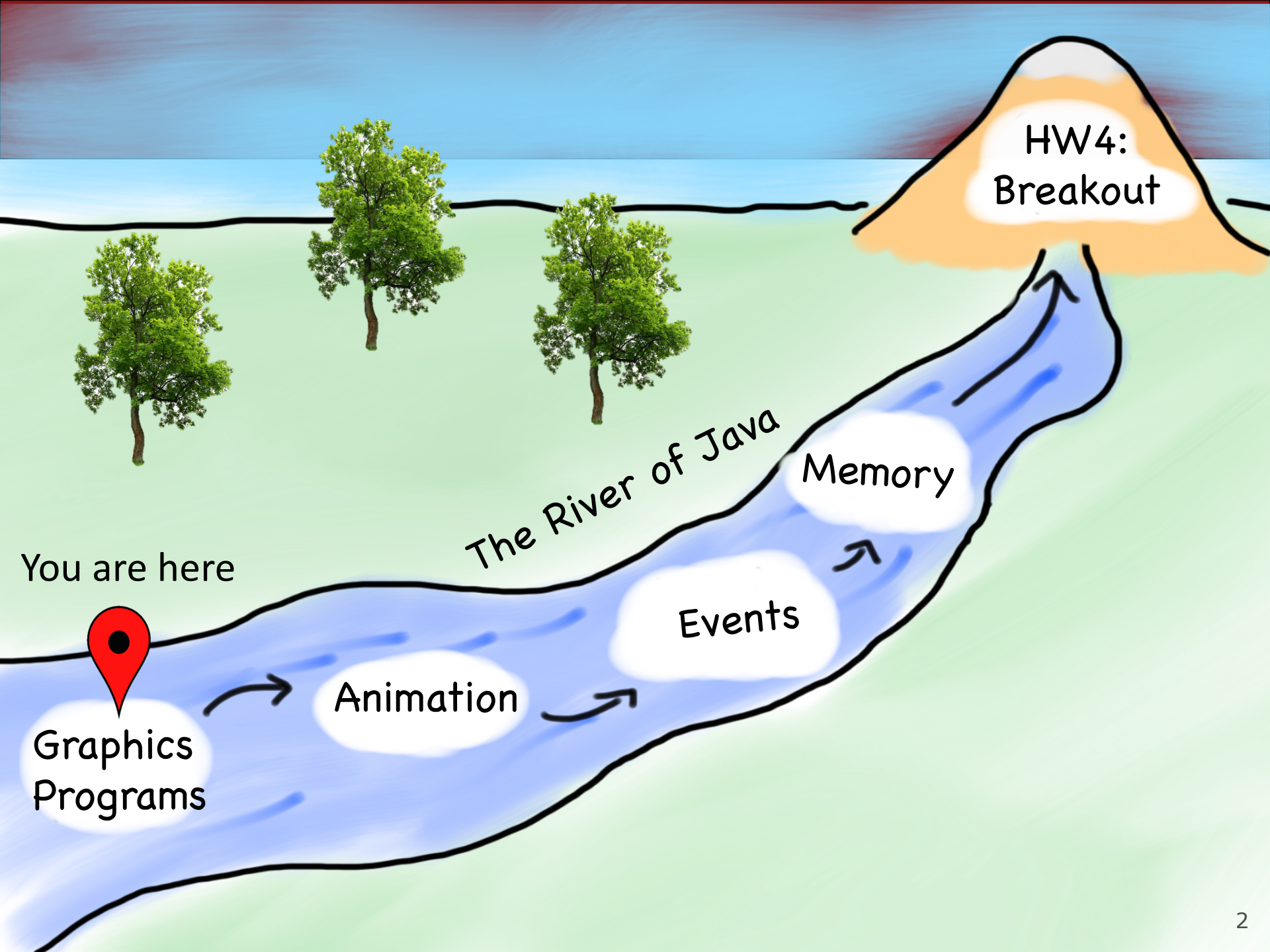
Based on slides created by Keith Schwarz, Mehran Sahami, Eric Roberts, Stuart Reges, and others.


HW4:
Breakout
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Graphics
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- Announcements
- Recap: Graphics
- GCompounds
- Getters
- Practice: Stoplights
- Practice: Checkerboard

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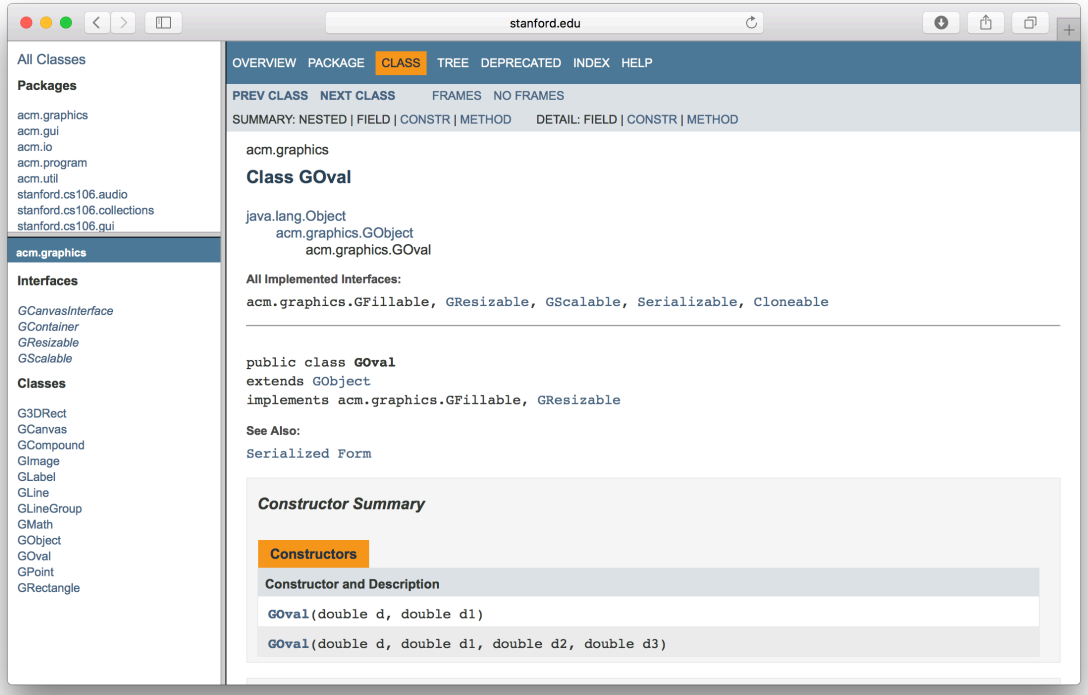
Announcements: Docs

- Click the "**Stanford Library Docs**" link in the 106A website sidebar.
  - This site lists every kind of object in the Stanford libraries.
  - Click an object type on the left and see its behavior on the right.
  - These kinds of pages exist for Stanford libraries and standard Java.



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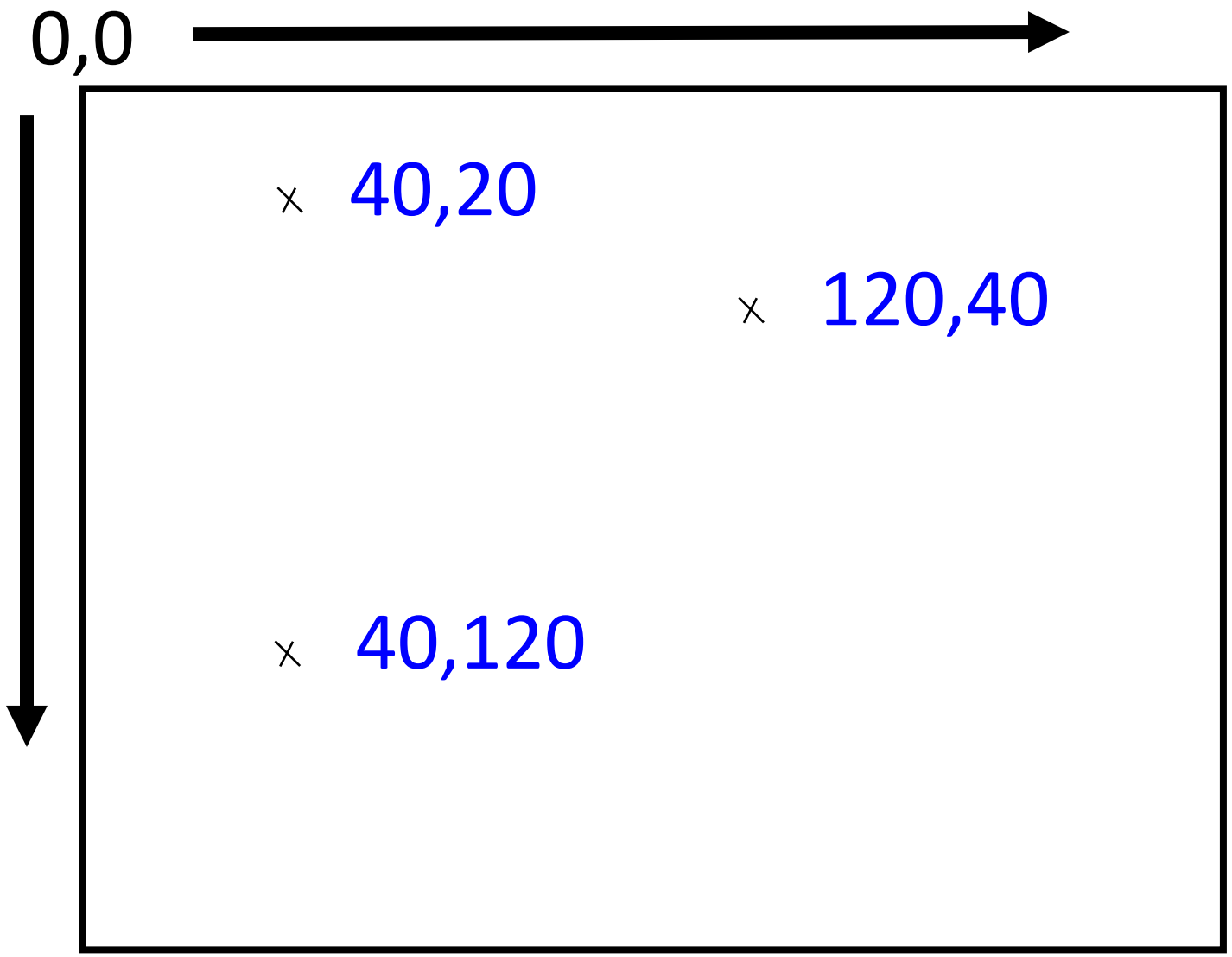
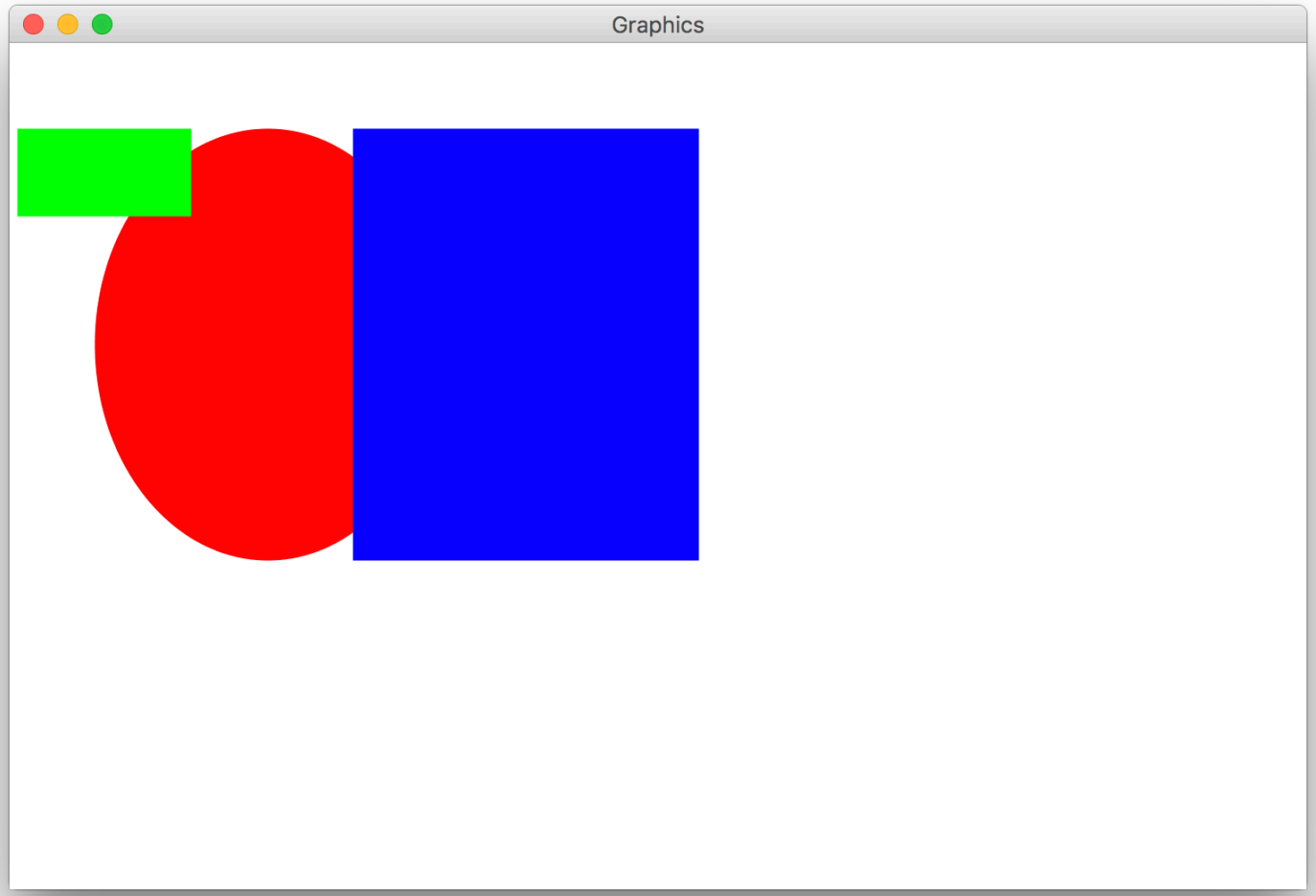
The Graphics Canvas

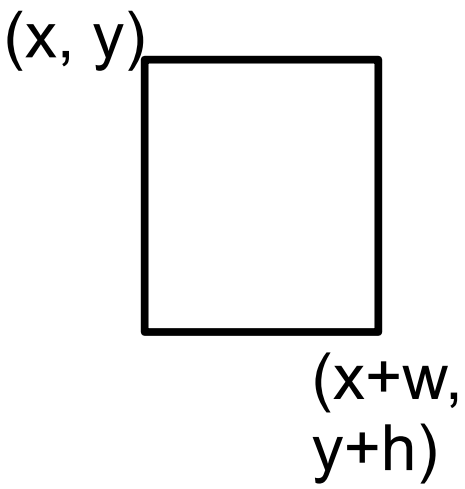


Collage Model

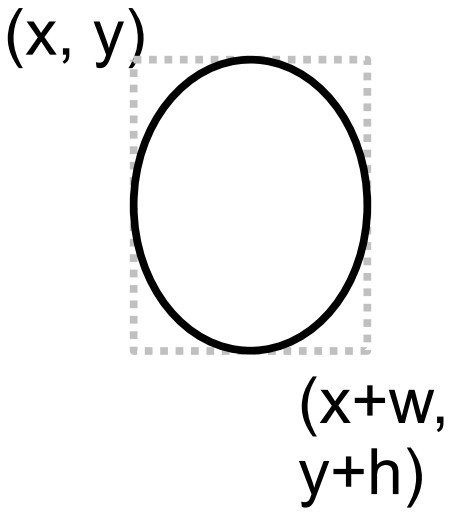


Graphical Objects

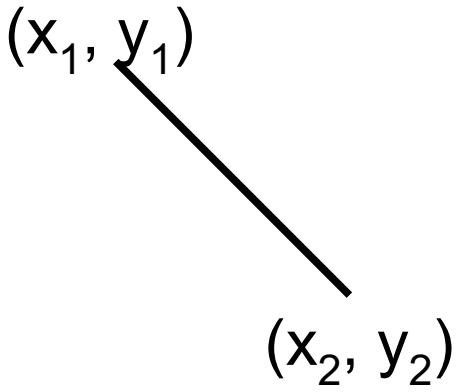
GRect



GOval



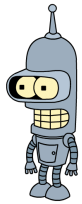
GLine



GLabel

Hello there!

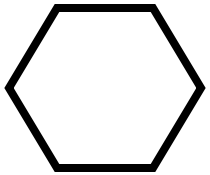
GImage



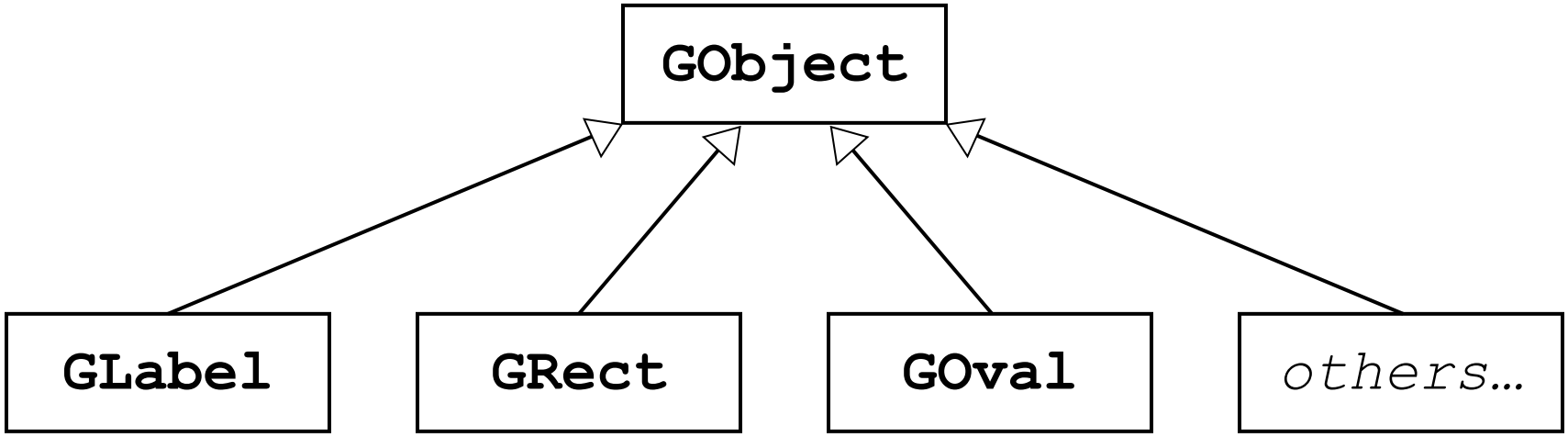
GArc

GRoundRect

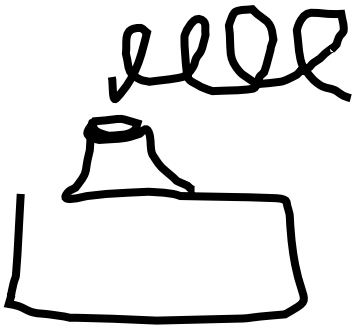
GPolygon



Graphical Objects




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



Primitives vs. Objects

Primitive Variable Types

```
int
double
char
boolean
```

Object Variable Types

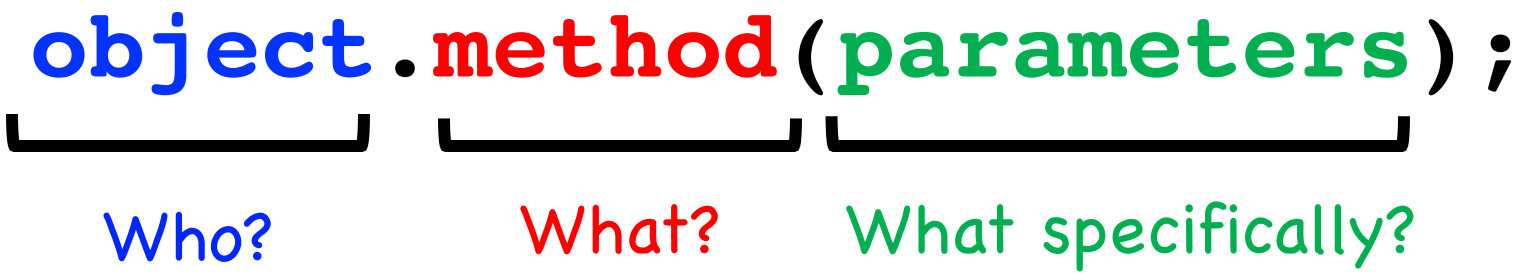
```
GRect
GOval
GLine
Scanner
...
```

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:



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
and more…

Graphic courtesy of Eric Roberts

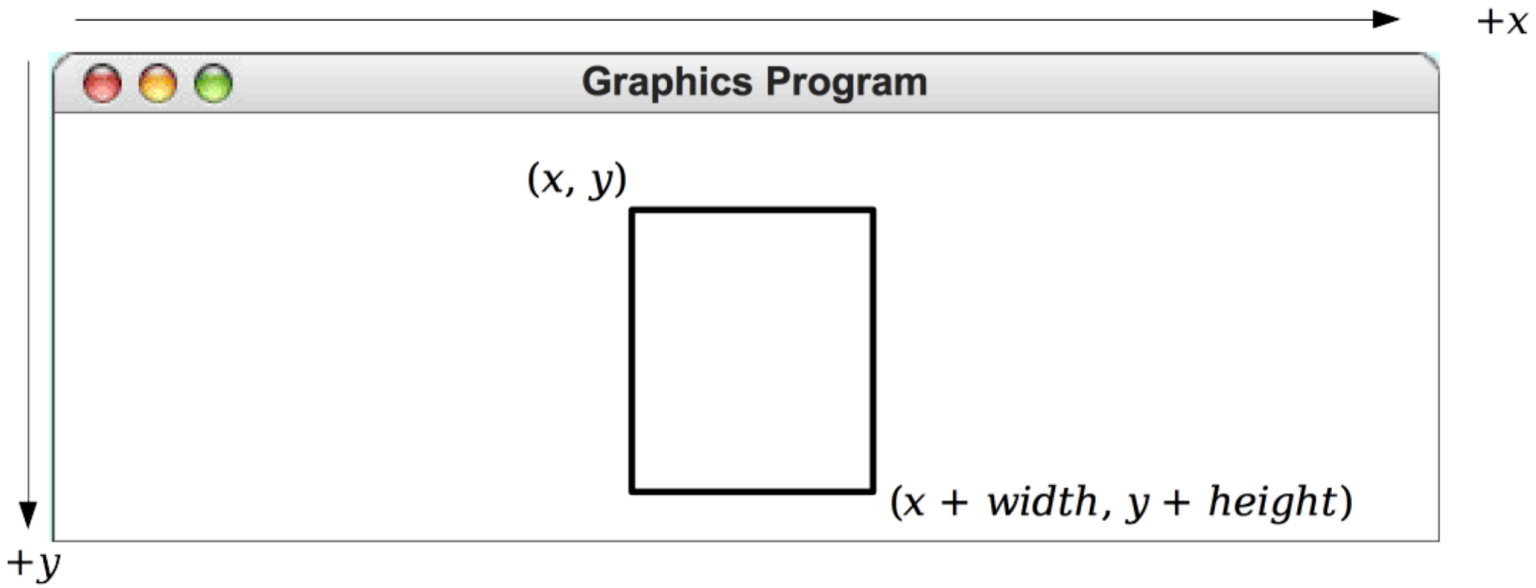
GRect

`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)



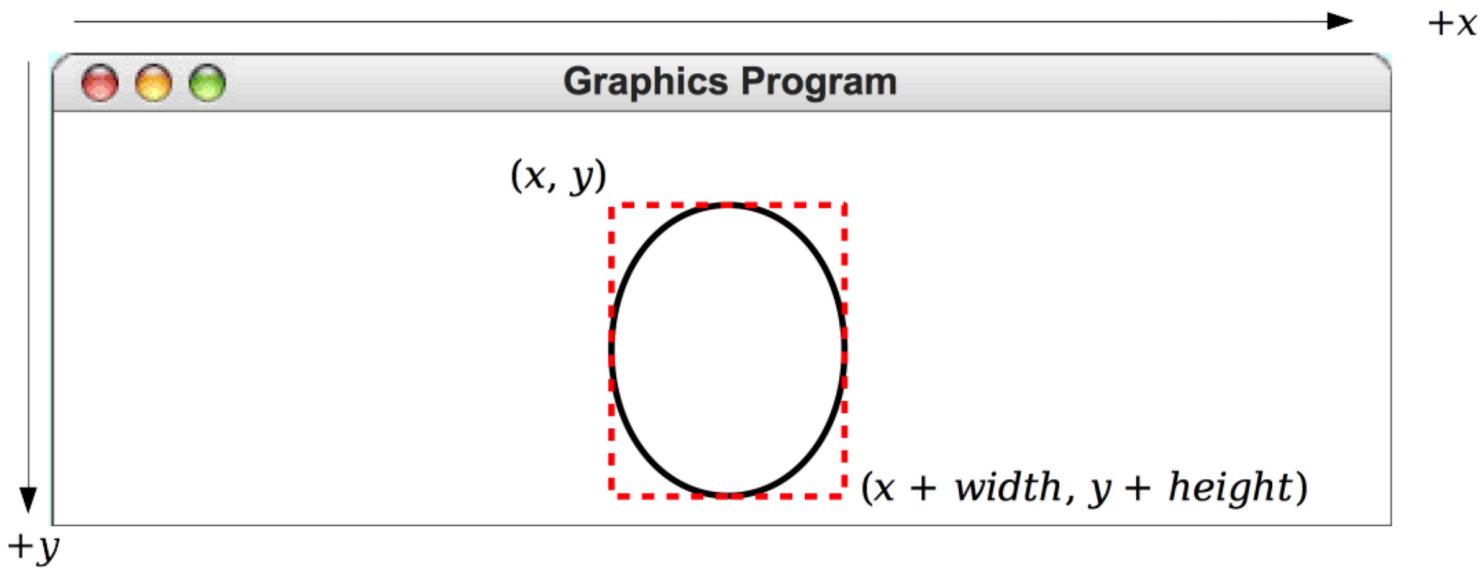
GOval

`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

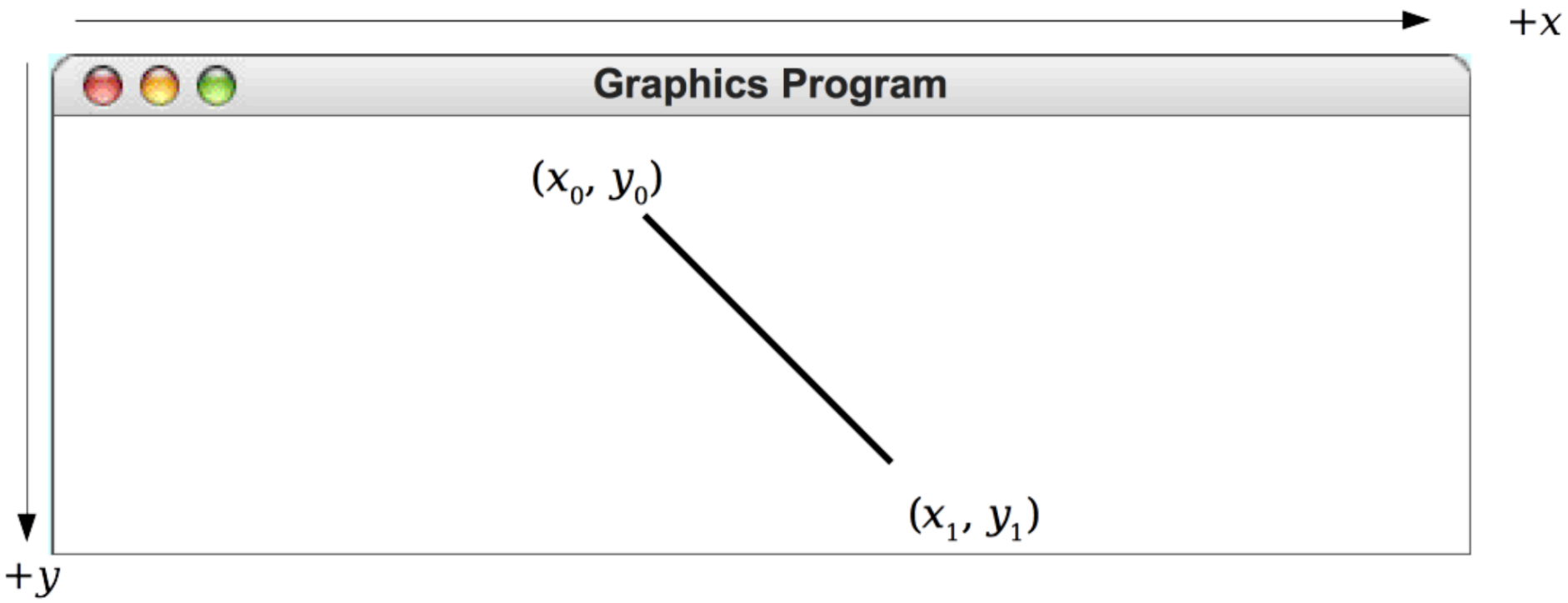
Methods shared by the **`GRect`** and **`GOval`** classes

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)



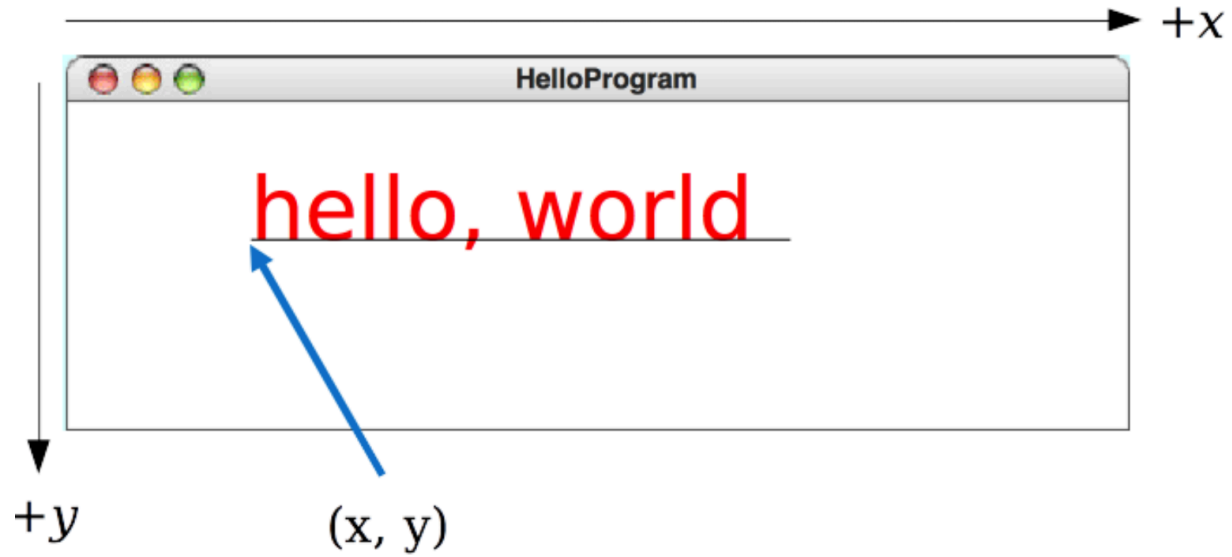
GLabel

`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 (e.g. "SansSerif")
style is either **`PLAIN`**, **`BOLD`**, **`ITALIC`**, or **`BOLDITALIC`**
size is an integer indicating the point size

Graphic courtesy of Eric Roberts

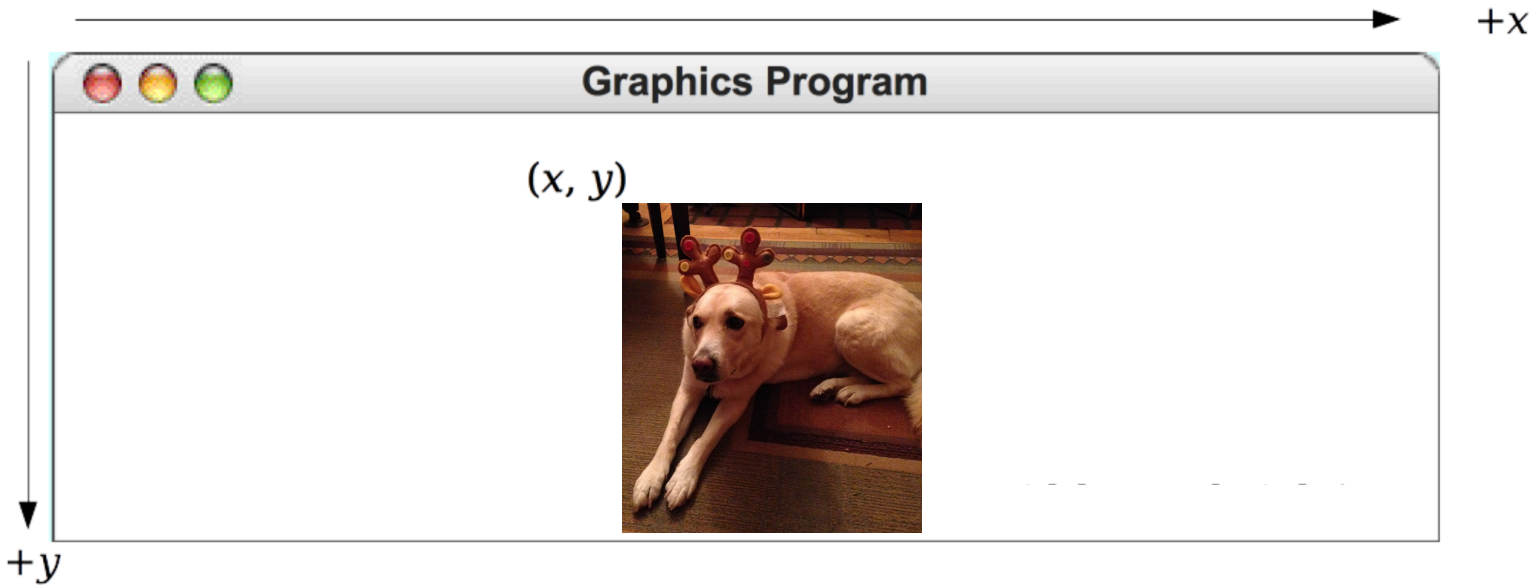
GImage

`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

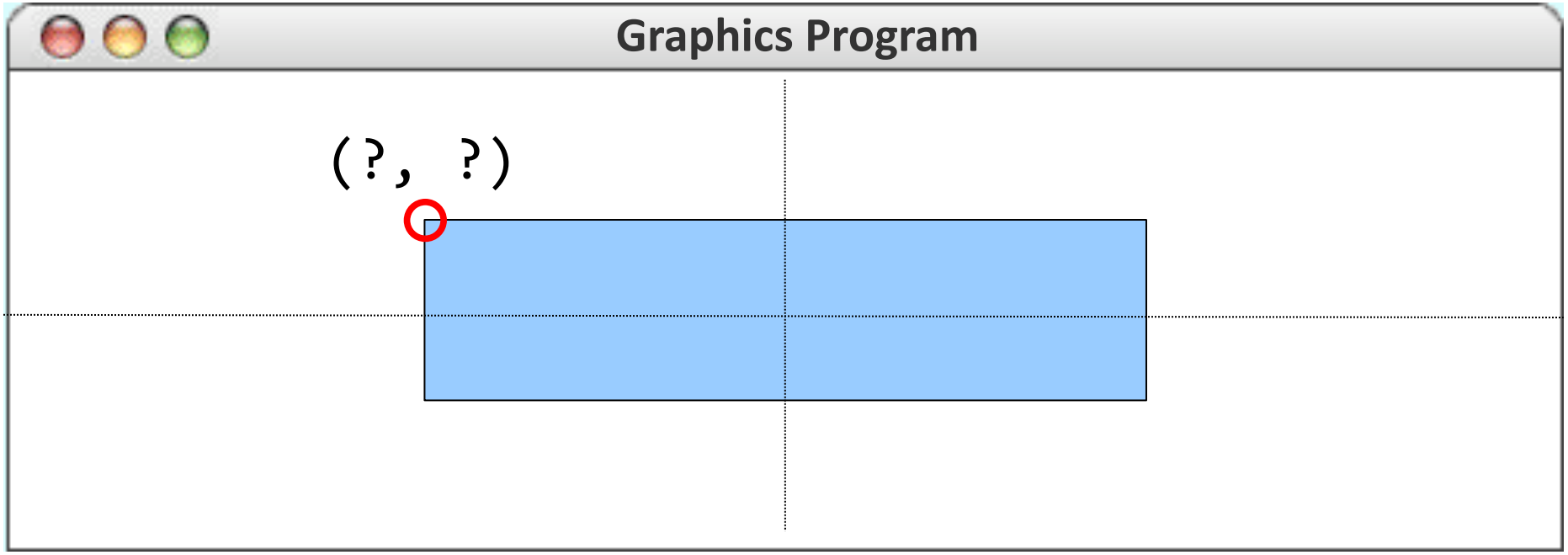
object`.setSize(`*width, height*`)`
Sets the object's size to be the given width and height

GraphicsProgram Methods

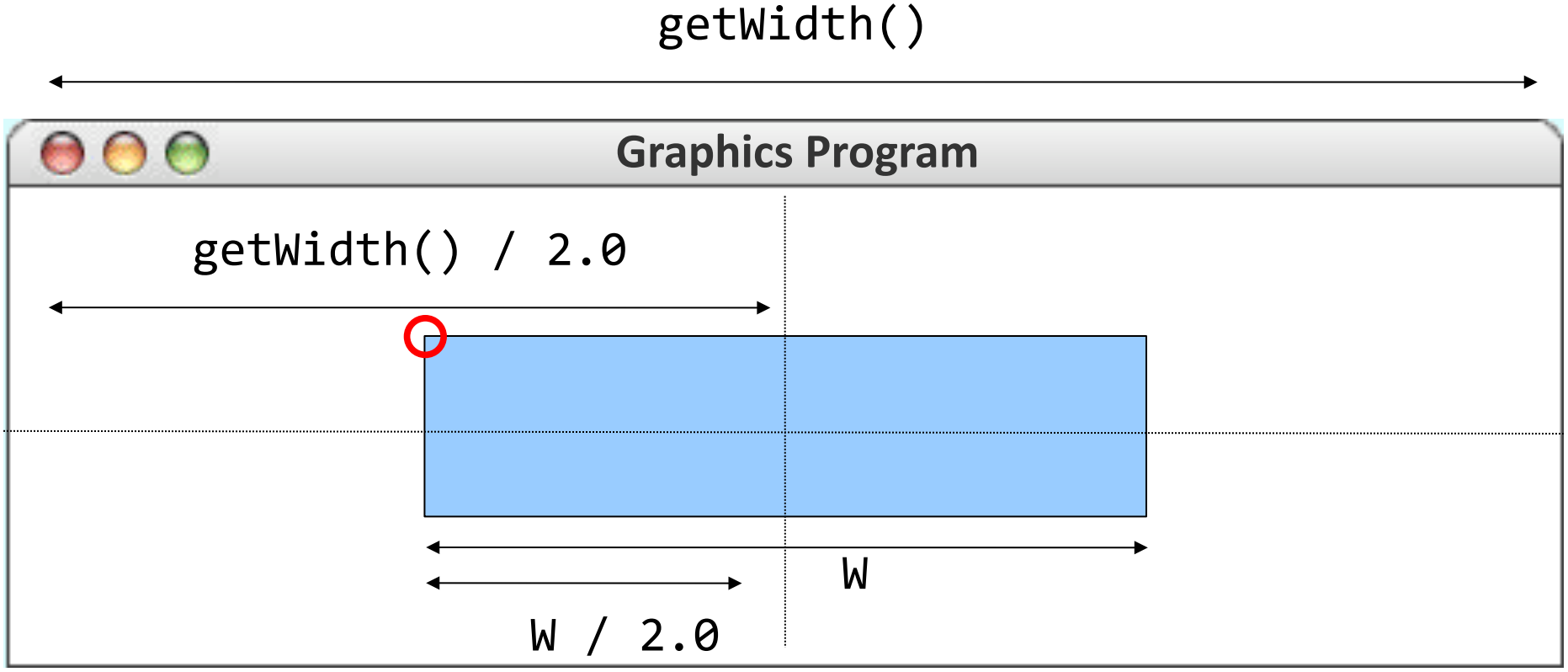
- `GraphicsProgram` contains these useful methods:

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

Recap Practice: Centering

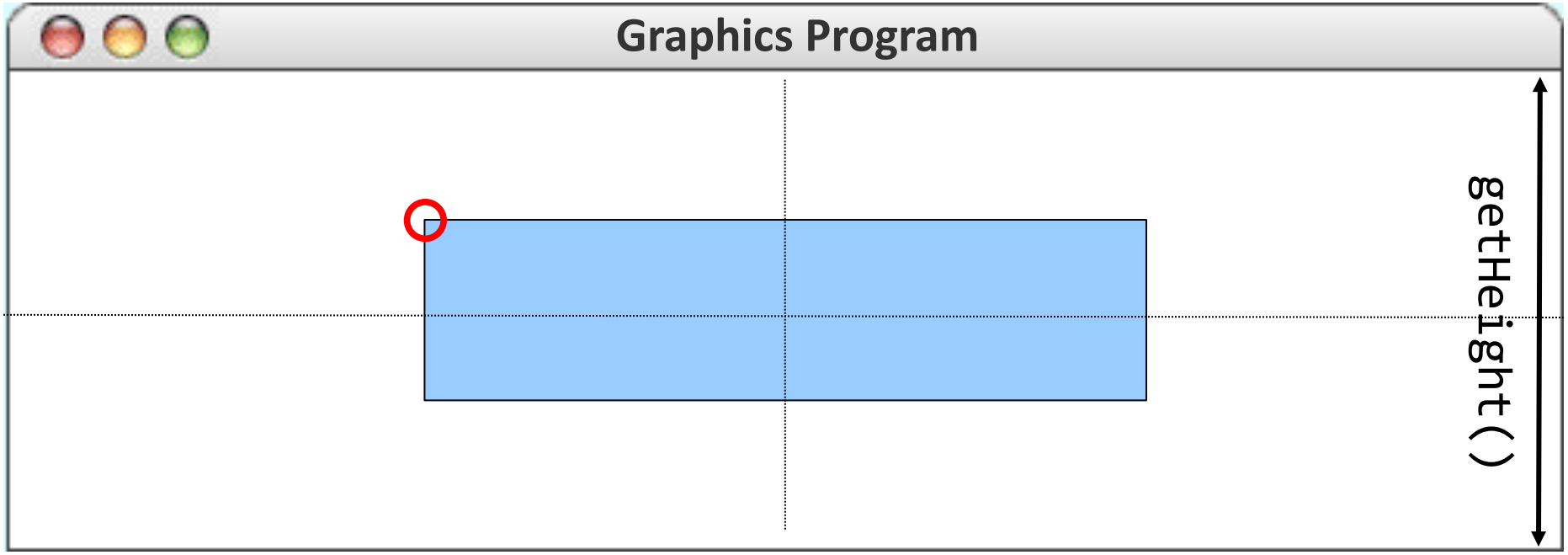


Recap Practice: Centering




```
rectangle's x value = getWidth() / 2.0 – W / 2.0
```

Recap Practice: Centering




```
rectangle's y value = getHeight() / 2.0 - H / 2.0
```

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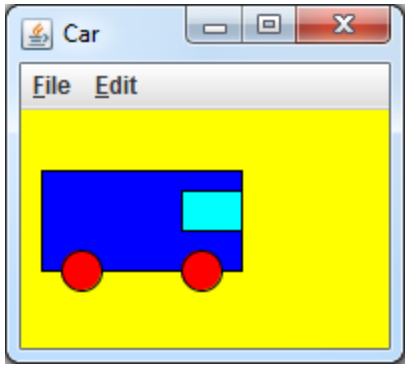
GCompound

A **GCompound** contains other GObjects. It's useful when you want to do one operation on multiple GObjects at the same time.

```
GCompound compound = new GCompound();
compound.add(shape);
compound.add(shape);
...
compound.add(shape);

add(compound);
```



– E.g. you can make a GCompound to represent a car.

GCompound

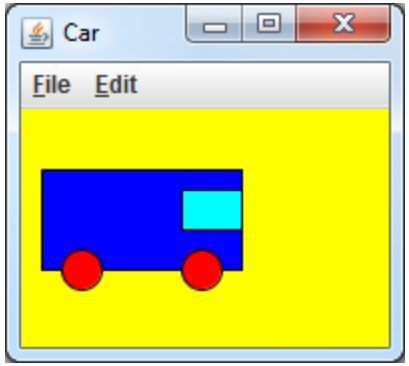
```
setBackground(Color.YELLOW);
GCompound car = new GCompound();

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

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

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

GRect windshield = new GRect(80, 40, 30, 20);
windshield.setFilled(true);
windshield.setFillColor(Color.CYAN);
car.add(windshield);
add(car);      // at  0,0!  Where we want this "sub-canvas" to go
```



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Graphics Program "Getters"

- Methods of graphical objects that return values:

Method	Description
obj.getColor()	the color used to color the shape outline
obj.getFillColor()	the color used to color the shape interior
obj.getX()	the left *x*-coordinate of the shape
obj.getY()	the top *y*-coordinate of the shape
obj.getWidth()	number of pixels wide the shape is
obj.getHeight()	number of pixels tall the shape is

  - Example: Swapping the x/y coordinates of a shape:

```
GRect rect = new GRect(...);
...
int rx = rect.getX();
int ry = rect.getY();
rect.setLocation(ry, rx);
```

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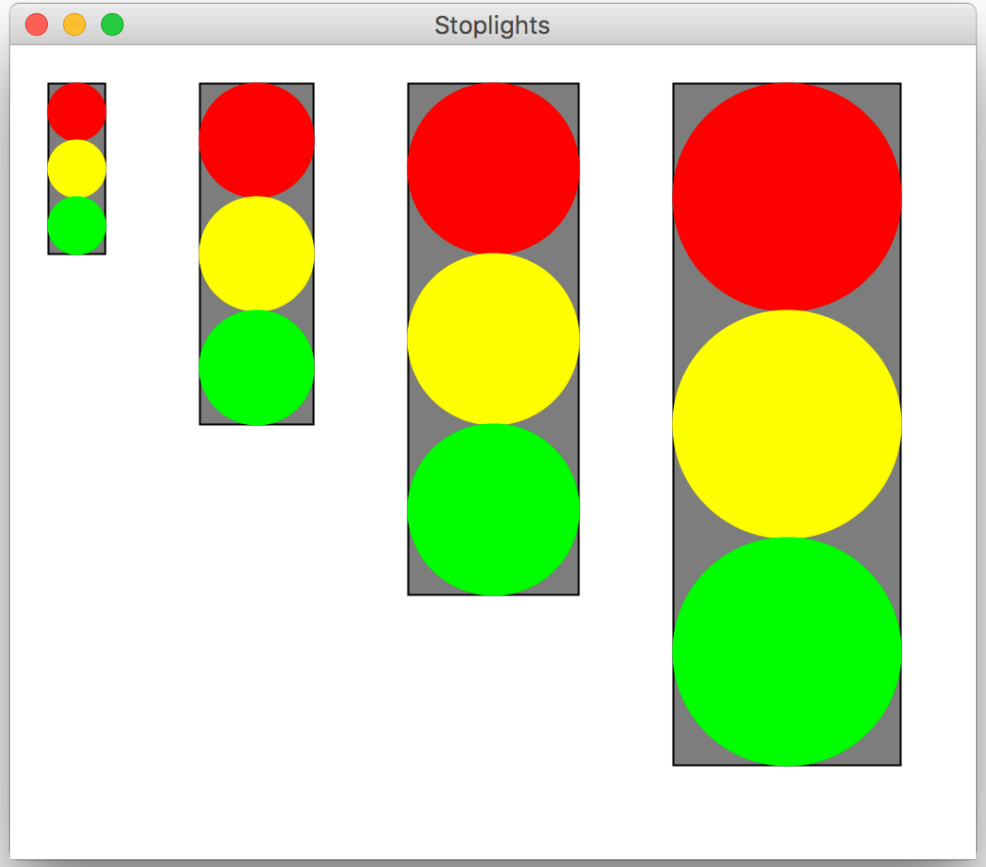
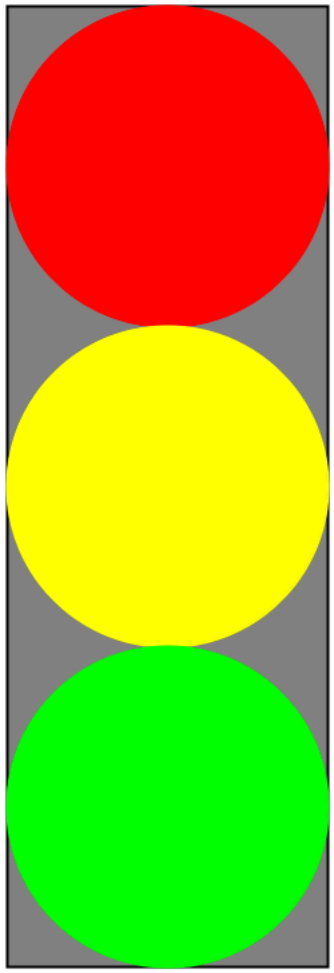
Practice: Stoplights

How would you make a method for drawing stoplights of different locations and sizes?



Practice: Stoplights



What information do we need in order to draw this?

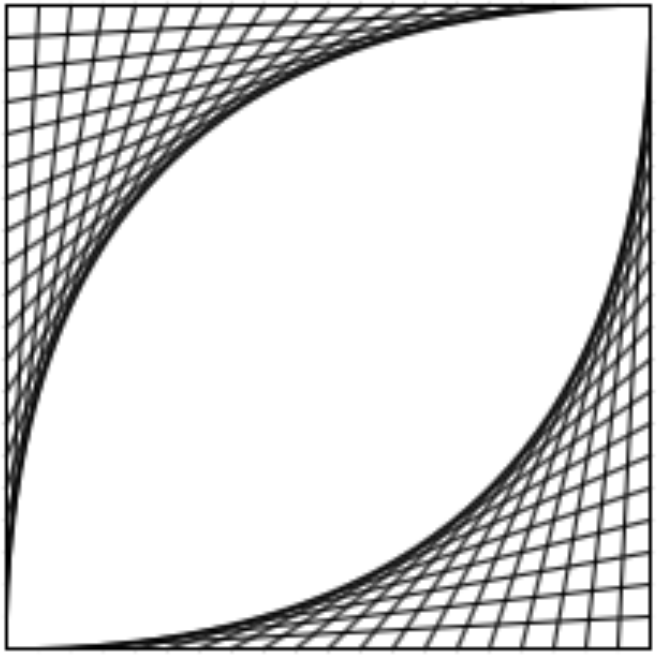
Extra Practice: Line Art

Write a graphical program **LineArt** that draws a series of lines (see lecture code for solution):

- Outer square is at (10, 30) and size 200x200
- each line is 10px apart in each dimension

coordinates of top-left lines:
- (210, 30) to (10, 30)
- (200, 30) to (10, 40)
- (190, 30) to (10, 50)
- ...
- (20, 30) to (10, 220)

coordinates of bottom-right lines:
- (210, 30) to (210, 230)
- (210, 40) to (200, 230)
- ...
- (210, 220) to (20, 230)



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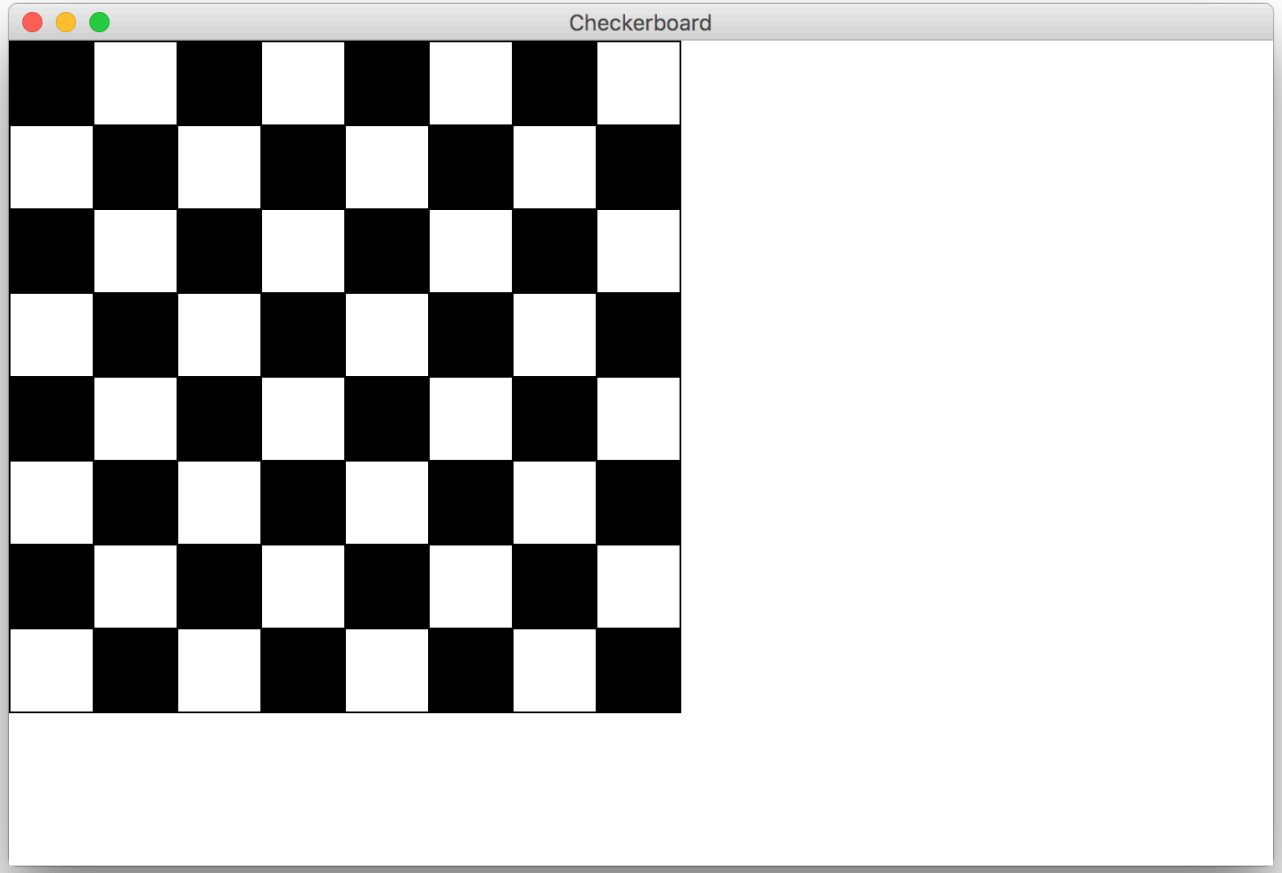
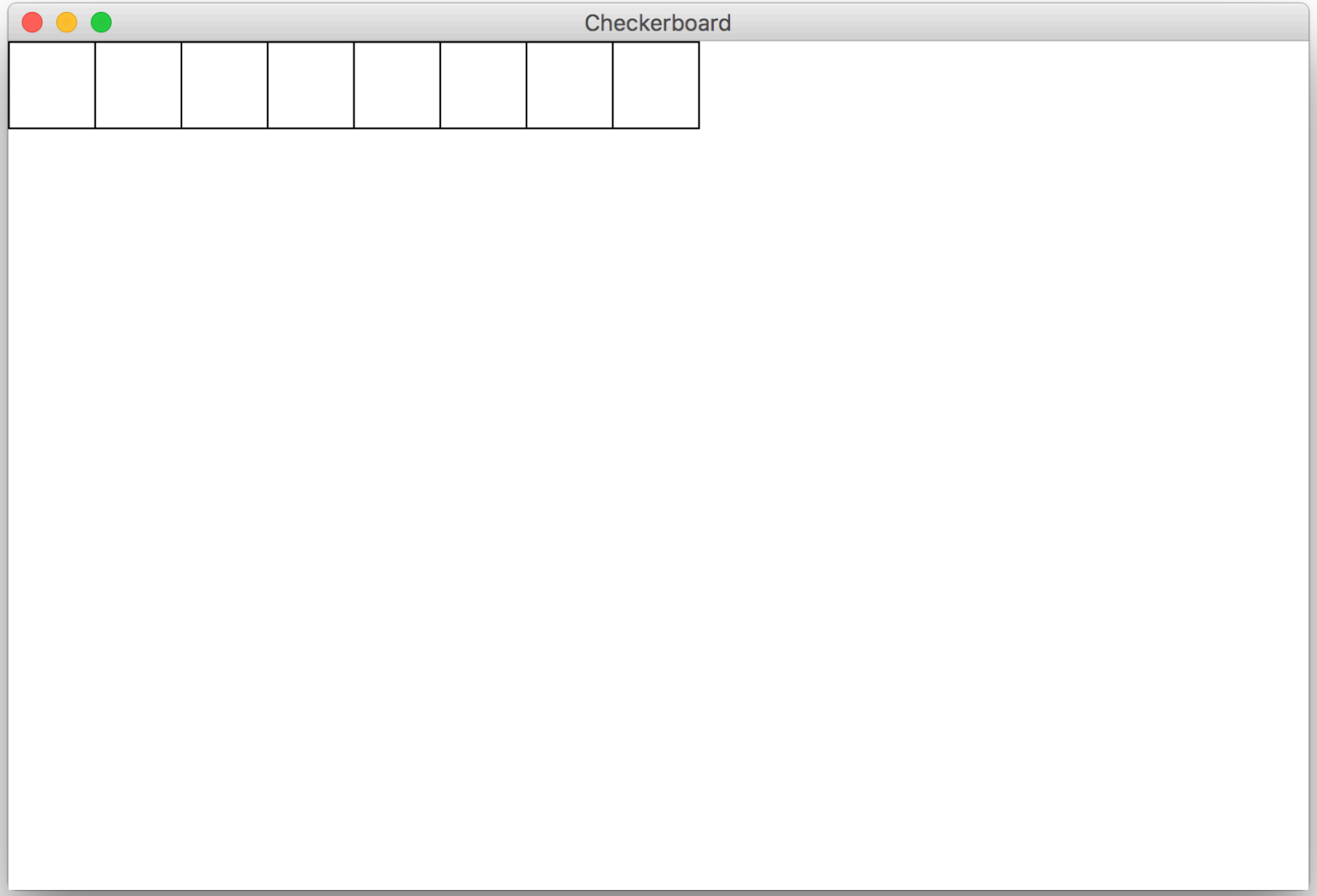
Practice: Checkerboard

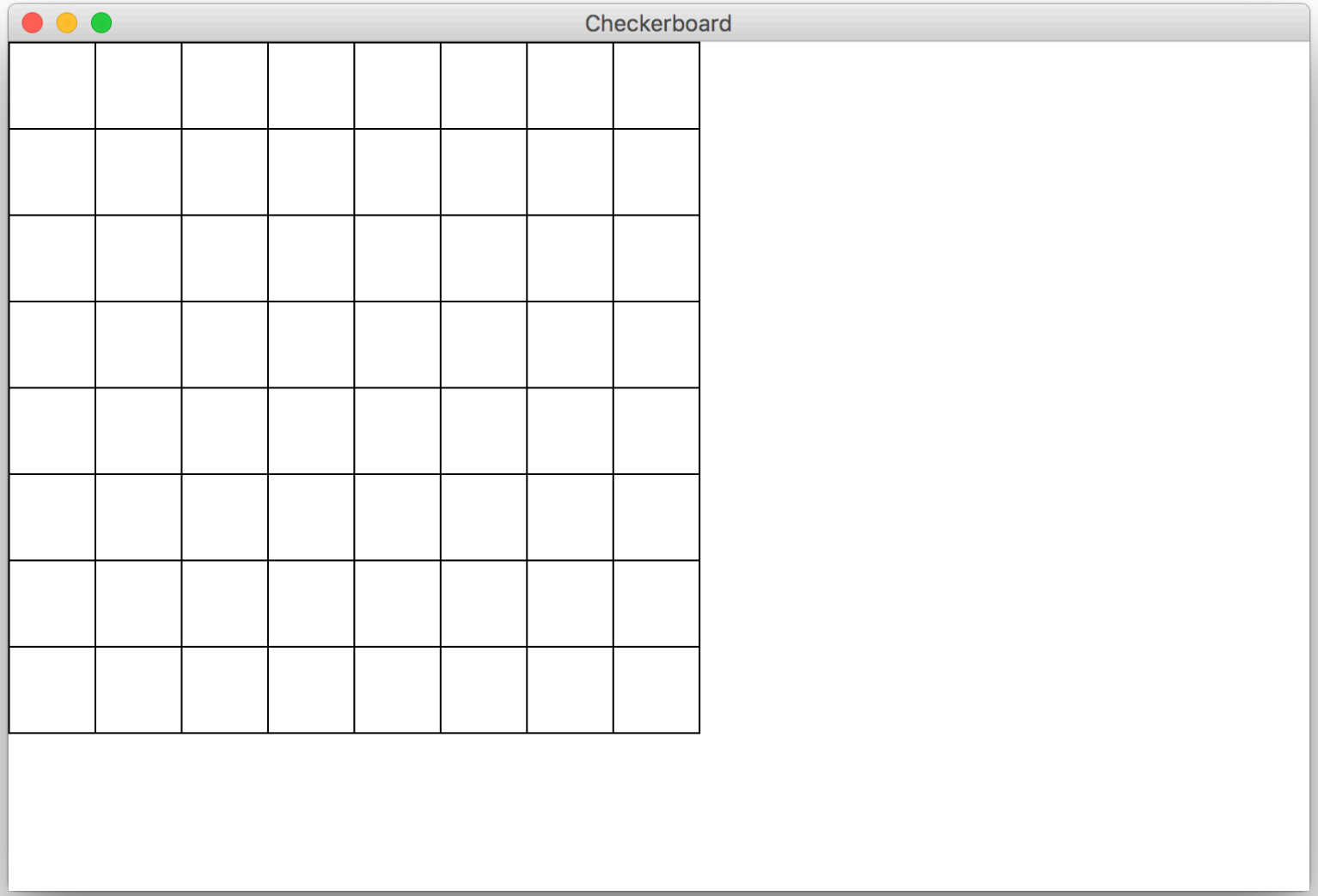
Write a graphical program named **`Checkerboard`** that draws a checkerboard pattern using GRects.



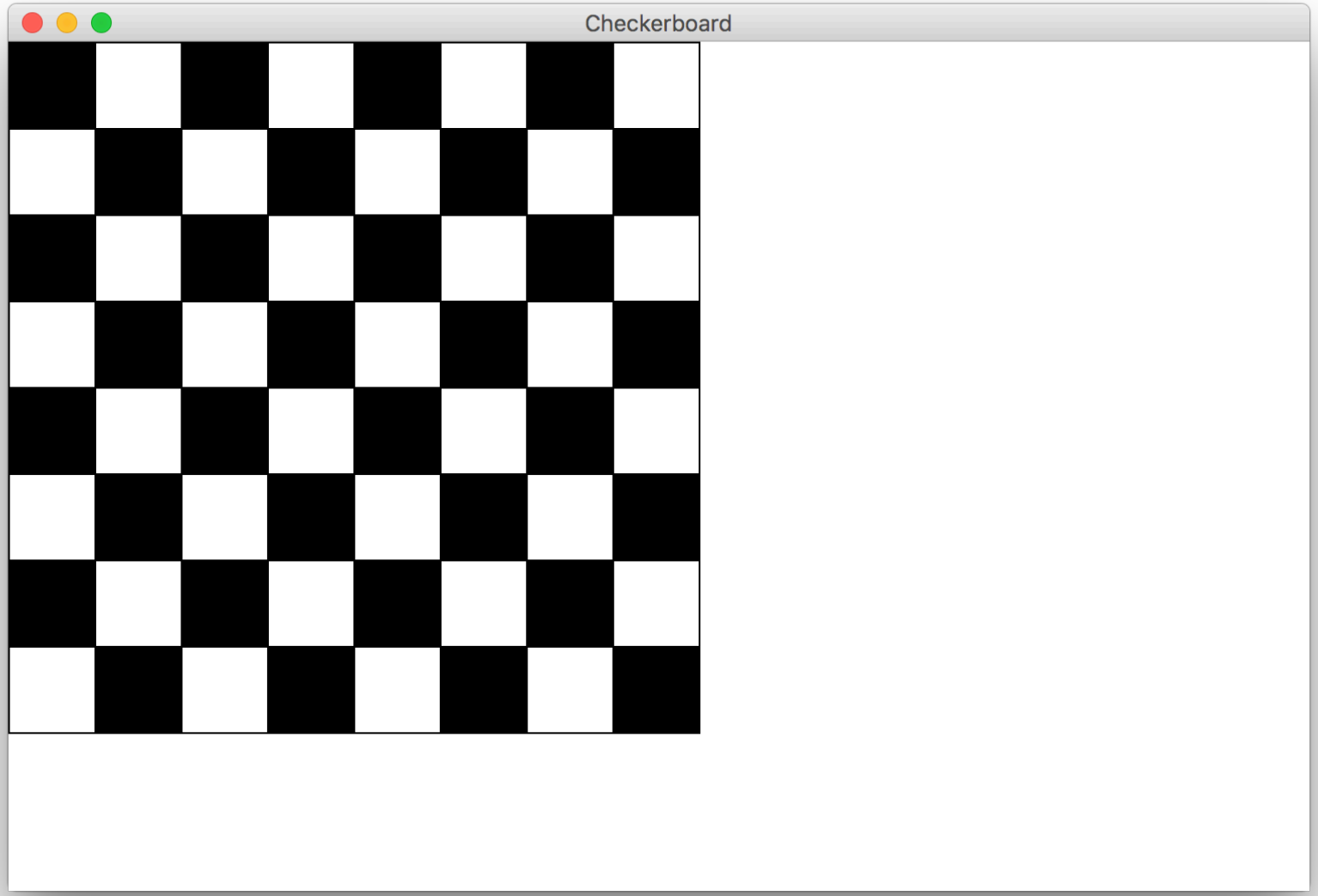
Milestone 1



Milestone 2

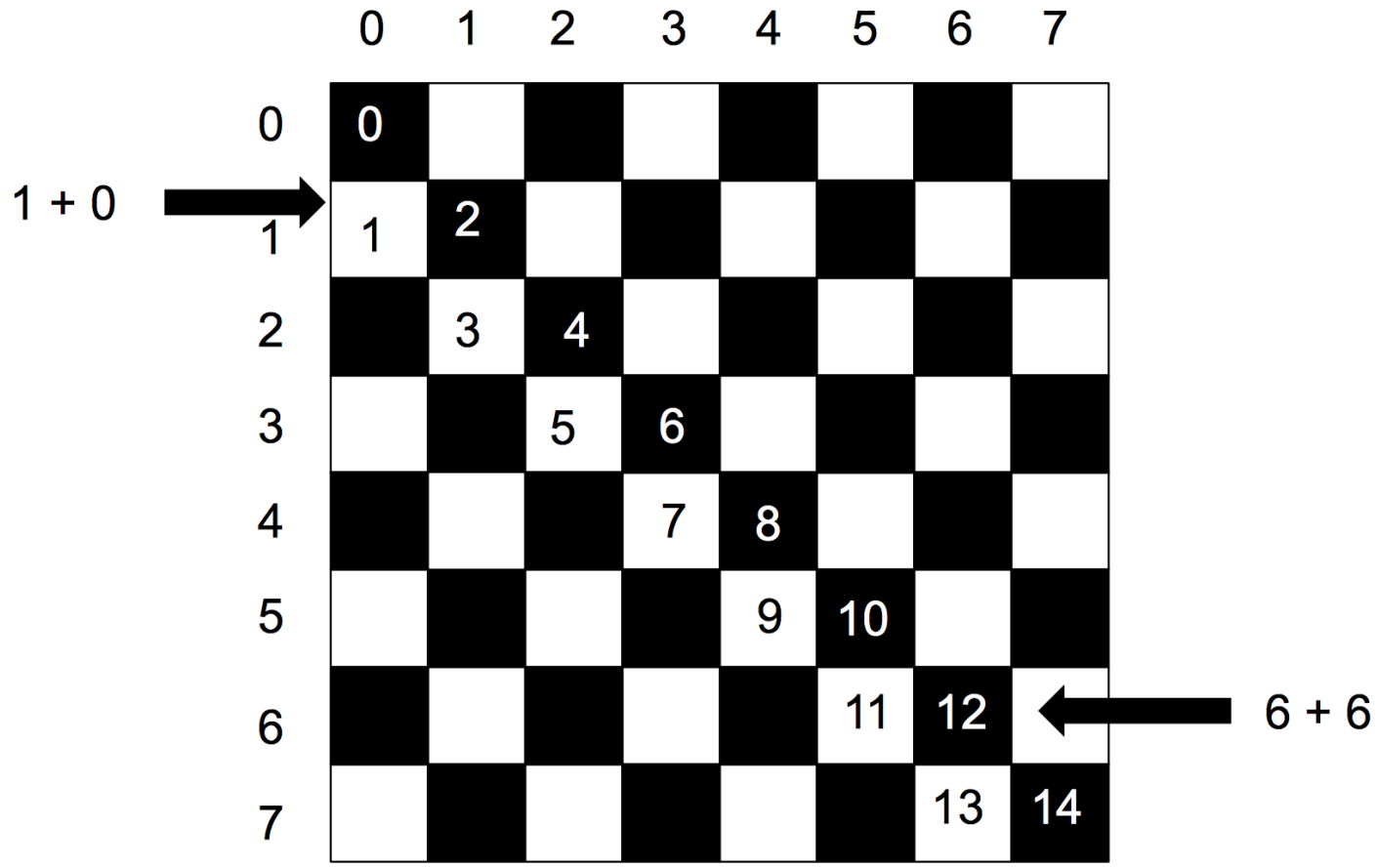


Milestone 3



Milestone 3

- Notice the pattern if we add the row and column indexes…



Recap

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Next time: Animation