Java Swing GUI Programming I

Georgia Tech

Java Questions

- What isn't clear or what is giving you difficulties?

Learning Objectives

- Java's toolkits for graphics and GUIs
- Fundamental drawing operations for different graphics objects
- Structure of a Swing application
  - Frame, Panel, components, painting, JLabel, ImageIcon concepts

Java GUI Programming

- For many years: AWT & Swing
- More recently: JavaFX

- We're going to do Swing
  - More straightforward
  - JavaFX uses some advanced concepts we haven't emphasized
  - Still communicates event-driven principles

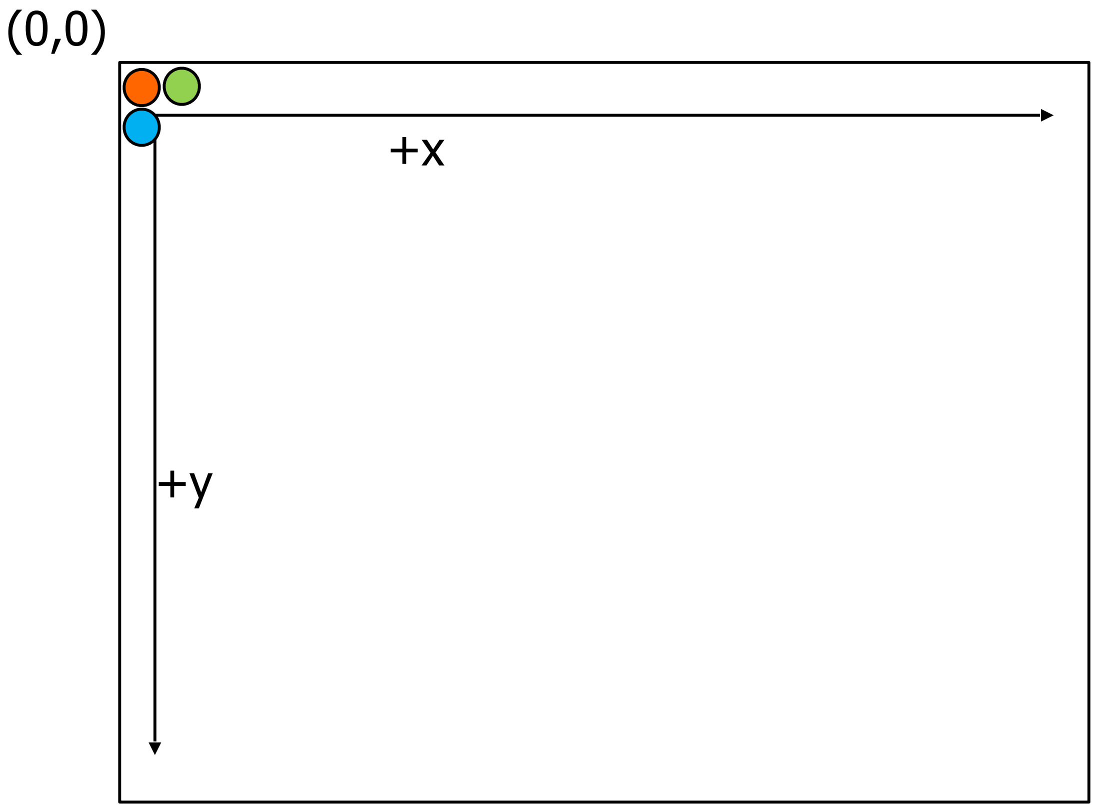
Java Application

- Stand-alone graphics program with main()

- Two main components:
  - Graphics operations
  - Program structure (containers)

Graphics

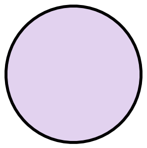
Pixel – picture element



1280 x 1024

Colors
red, green, blue

0 -> 255

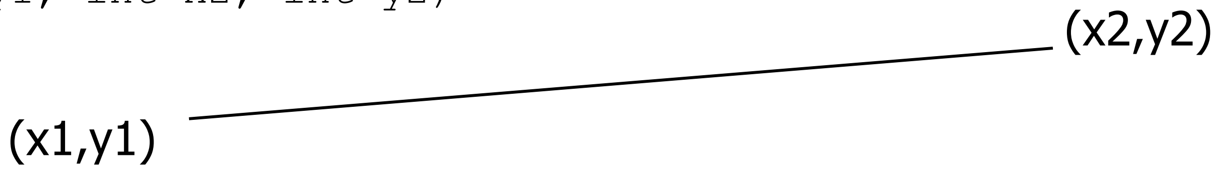


226, 210, 239

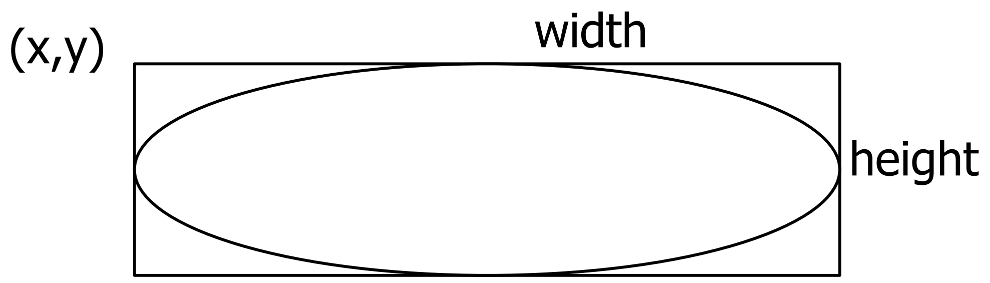
Drawing Operations

Graphics class – provided by Java

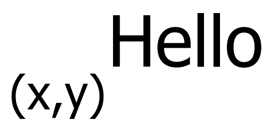
```
void drawLine(int x1, int y1, int x2, int y2)
```



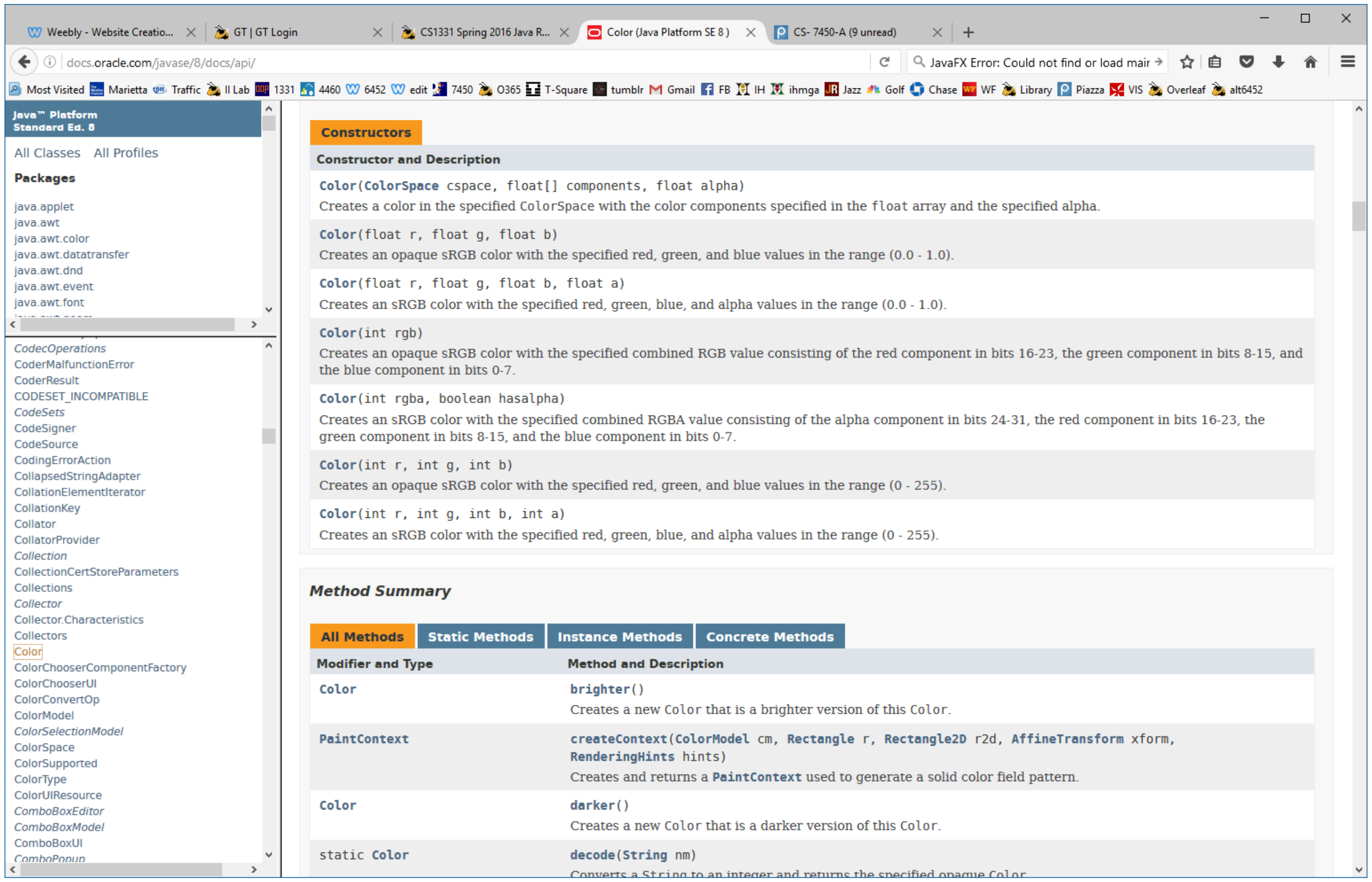
```
void drawRect(int x, int y, int width, int height)
void fillRect(int x, int y, int width, int height)
void drawOval(int x, int y, int width, int height)
void fillOval(int x, int y, int width, int height)
void drawArc(int x, int y, int width, int height, int startAngle, int arcAngle)
```



```
void drawString(String str, int x, int y)
```



Colors



Packages

java.applet
java.awt
java.awt.color
java.awt.datatransfer
java.awt.dnd
java.awt.event
java.awt.font

CodecOperations
CoderMalfunctionError
CoderResult
CODESET_INCOMPATIBLE
CodeSets
CodeSigner
CodeSource
CodingErrorAction
CollapsedStringAdapter
CollationElementIterator
CollationKey
Collator
CollatorProvider
Collection
CollectionCertStoreParameters
Collections
Collector
Collector.Characteristics
Collectors
Color
ColorChooserComponentFactory
ColorChooserUI
ColorConvertOp
ColorModel
ColorSelectionModel
ColorSpace
ColorSupported
ColorType
ColorUIResource
ComboBoxEditor
ComboBoxModel
ComboBoxUI
ComboPopup

Constructors

Constructor and Description
`Color(ColorSpace cspace, float[] components, float alpha)` Creates a color in the specified `ColorSpace` with the color components specified in the `float` array and the specified alpha.
`Color(float r, float g, float b)` Creates an opaque sRGB color with the specified red, green, and blue values in the range (0.0 - 1.0).
`Color(float r, float g, float b, float a)` Creates an sRGB color with the specified red, green, blue, and alpha values in the range (0.0 - 1.0).
`Color(int rgb)` Creates an opaque sRGB color with the specified combined RGB value consisting of the red component in bits 16-23, the green component in bits 8-15, and the blue component in bits 0-7.
`Color(int rgba, boolean hasalpha)` Creates an sRGB color with the specified combined RGBA value consisting of the alpha component in bits 24-31, the red component in bits 16-23, the green component in bits 8-15, and the blue component in bits 0-7.
`Color(int r, int g, int b)` Creates an opaque sRGB color with the specified red, green, and blue values in the range (0 - 255).
`Color(int r, int g, int b, int a)` Creates an sRGB color with the specified red, green, blue, and alpha values in the range (0 - 255).

Method Summary

Modifier and Type	Method and Description
`Color`	`brighter()` Creates a new `Color` that is a brighter version of this `Color`.
`PaintContext`	`createContext(ColorModel cm, Rectangle r, Rectangle2D r2d, AffineTransform xform, RenderingHints hints)` Creates and returns a `PaintContext` used to generate a solid color field pattern.
`Color`	`darker()` Creates a new `Color` that is a darker version of this `Color`.
`static Color`	`decode(String nm)` Converts a `String` to an integer and returns the specified opaque `Color`

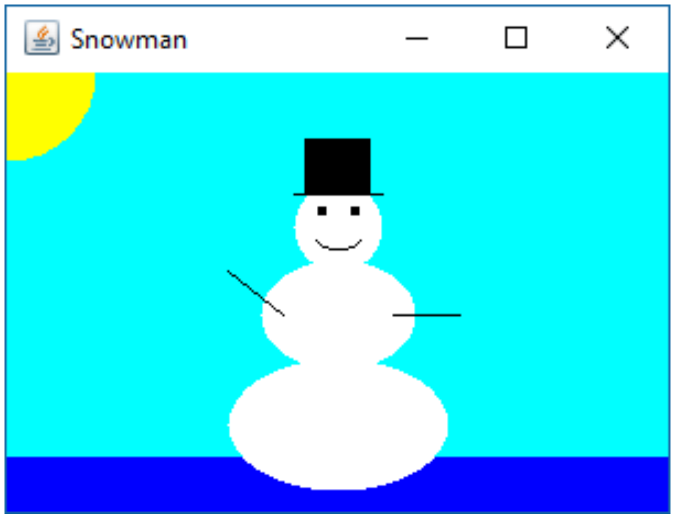
Also constants
Color.RED
Color.BLUE
…

Drawing Color

- Java uses concept of active foreground color
  - Anything drawn is shown in that color
- Change the active color via
  - `setColor(col);`

Example Program

- Snowman (just focus on graphics)



How do it?

Examine Snowman program

GUI Components

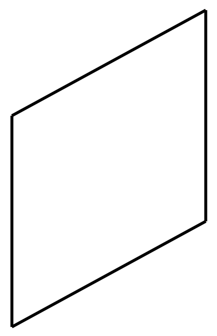
- Container – Special component for holding and organizing other components
  - Frame – Stand-alone window that is movable and resizable with title and corner buttons

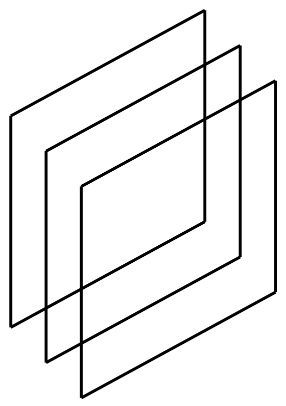
    `JFrame` class (heavyweight)
  - Panel – Container too, but must be added to another container

    `JPanel` class (lightweight)

GUI Components

Frame





Multiple panes (not panels)

One is content pane that holds all visible components

Back to Snowman

```
import javax.swing.JFrame;

public class Snowman
{
   public static void main (String[] args)
   {
      JFrame frame = new JFrame ("Snowman");
      frame.setDefaultCloseOperation (JFrame.EXIT_ON_CLOSE);

      SnowmanPanel panel = new SnowmanPanel();

      frame.getContentPane().add(panel);

      frame.pack();
      frame.setVisible(true);
   }
}
```

Your main should always look like this

Back to Snowman

```
import javax.swing.JPanel;
import java.awt.*;

public class SnowmanPanel extends JPanel
{

   public SnowmanPanel()
   {
      setPreferredSize (new Dimension(300, 200));
   }


   public void paintComponent (Graphics page)
   {
      super.paintComponent (page);

      // Graphics code here
   }
}
```

Top panel on the Frame

More Components

- Instead of doing graphics calls, we'll add component objects to be displayed

- `JLabel` – text label string

Examine Label program

Panel Class

```
import java.awt.*;
import javax.swing.*;

public class LabelPanel extends JPanel
{
   public LabelPanel()
   {
      setPreferredSize(new Dimension(250,75));
      setBackground (Color.yellow);

      JLabel label1 = new JLabel ("Question authority,");
      JLabel label2 = new JLabel ("but raise your hand first.");

      add(label1);
      add(label2);
   }

   public void paintComponent (Graphics page)
   {
      super.paintComponent (page);
   }
}
```

Program Structure

$$\begin{tikzcd}
\texttt{JFrame} \arrow[d, dash] \\
\texttt{JPanel} \arrow[d, dash] \\
\texttt{JLabel}
\end{tikzcd}$$

has-a relationships

Images

- Java can use jpg, gif, png image files from disk
- Graphics class has `drawImage` call or the image can be put in a `JLabel`
- Label can have text, image, or both

Images

- ImageIcon class used for images in labels

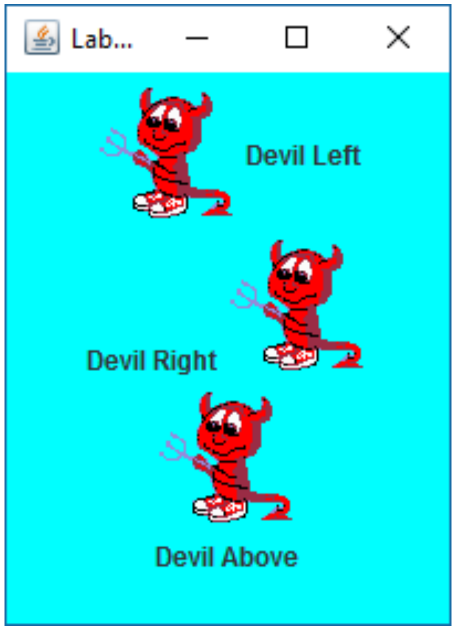
Where whole label goes in panel

```
ImageIcon ii = new ImageIcon("face.gif");
JLabel label = new JLabel("Text part", ii, SwingConstants.CENTER);
label.setHorizontalPosition(SwingConstants.LEFT);
```

Orientation between image and text

Default is text right
and vertically centered

Image Demo



Examine ImageDemo program

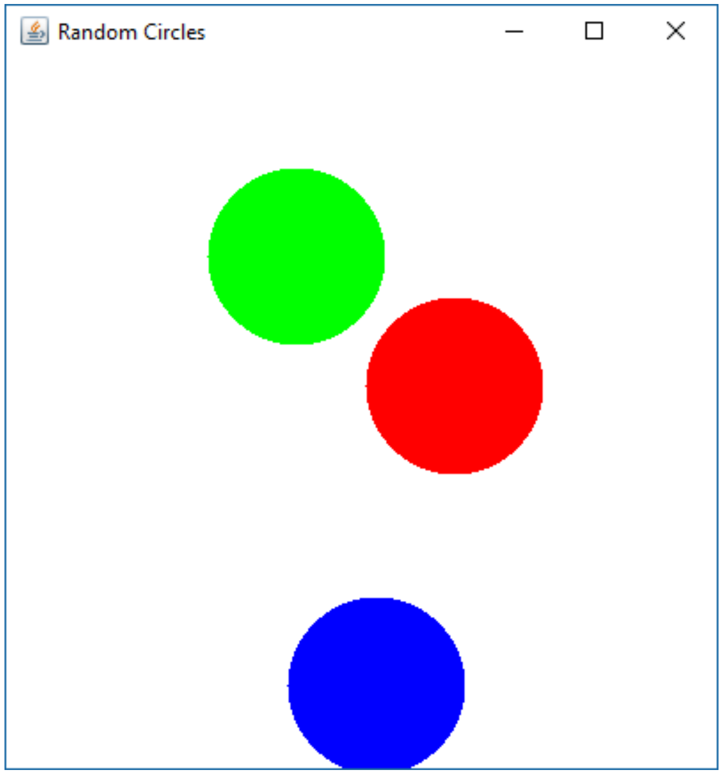
Panel Class

```
public class ImageDemoPanel extends JPanel
{
   public ImageDemoPanel()
   {
      ImageIcon icon = new ImageIcon ("devil.gif");
      JLabel label1, label2, label3;

      label1 = new JLabel ("Devil Left", icon, SwingConstants.CENTER);

      label2 = new JLabel ("Devil Right", icon, SwingConstants.CENTER);
      label2.setHorizontalTextPosition (SwingConstants.LEFT);
      label2.setVerticalTextPosition (SwingConstants.BOTTOM);

      label3 = new JLabel ("Devil Above", icon, SwingConstants.CENTER);
      label3.setHorizontalTextPosition (SwingConstants.CENTER);
      label3.setVerticalTextPosition (SwingConstants.BOTTOM);

      setBackground (Color.cyan);
      setPreferredSize (new Dimension (200, 250));
      add (label1);
      add (label2);
      add (label3);
   }

    public void paintComponent(Graphics page)
   {
       super.paintComponent(page);
   }
}
```

Programming Challenge

- Design a program that randomly positions 3 colored circles

Let's do it together



Questions

- What happens if you rerun it?
- What happens if you minimize it?
- How would you count the calls to the paintComponent method?
- Can you keep the circles in the same place all the time?

Going O-O

- Program that draws circles and remembers them
- Make Circle class

Examine Splat program

Learning Objectives

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Next Time

- Handling simple interaction events