# Programming Languages and Techniques (CIS120)

Lecture 32

April 6, 2012

Swing

# Swing

# Why study GUIs (again)

- Most common example of event-based programming
- Heavy and effective use of OO inheritance
  - Nice opportunity to compare our "hand-rolled objects" in OCaml with those supported by Java's rich object system
- Experience using references for communication
- Case study of library organization
- Fun!

# OCaml GUI review

- Graphics Context (gctx.ml)
  - Provides drawing operations
  - Translates coordinates so that they are relative to each widget
  - Keeps track of state necessary for drawing (pen color, line thickness)
- Widgets (widget.ml)
  - Abstract type for "things" on the screen
  - In OCaml, a record of three first-class functions

```
type t = {  repaint : Gctx.t -> unit,
            size    : Gctx.t -> int,
            handle  : event -> unit  }
```

  - basic widgets: buttons, canvas, scrollbars, labels, checkboxes, radiobuttons
  - container widgets: border, hpair, vpair, hlist, vlist
- Event Listeners
  - Functions that execute when events happen
  - Update the state of the application
  - Widgets reflect changes when they are redrawn

# Comparison overview

| | OCaml | Java |
|---|---|---|
| Graphics Context | Gctx.t | Graphics |
| Widget type | Widget.t | JComponent |
| Basic Widgets | button<br>label<br>checkbox | JButton<br>JLabel<br>JCheckBox |
| Container Widgets | hpair, vpair | JPanel, Layouts |
| Events | event | ActionEvent<br>MouseEvent<br>KeyEvent |
| Event Listener | mouse_listener<br>mouseclick_listener<br>(any function of type event -> unit) | ActionListener<br>MouseListener<br>KeyListener |

Concepts from OCaml GUI assignment have analogues in Java swing library

# Simple Drawing

DrawingCanvas.java

# How do we draw a picture?

- In OCaml, create a widget where the repaint function uses the graphics context to draw an image

```
let w_draw =
{
   repaint = (fun (gc:Graphics.t) ->
       Graphics.draw_line gc (0, 0) (100, 100);
       Graphics.draw_point gc (3,4)) ;

   size    = (fun (gc:Graphics.t) -> (200,200));

   handle  = (fun () -> ())
}
```

- In Java, extend from class JComponent….

# Fundamental class: JComponent

- Analogue to Widget.t (*Terminology*: widget == component)
- Subclasses *override* methods
  - paintComponent (like repaint, displays the component)
  - getPreferredSize (like size, calculates the size of the component)
  - (Events handled by subclasses)
- Much more functionality available
  - minimum/maximum size
  - font
  - foreground/background color
  - borders
  - what is visible
  - many more…

# Simple Drawing Component

```
public class DrawingPanel extends JComponent {

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

        // set the pen color to green
        gc.setColor(Color.GREEN);

        // draw a fractal tree
        fractal (gc, 75, 100, 270, 15);
    }

    // get the size of the drawing panel
    public Dimension getPreferredSize() {
        return new Dimension(150,150);
    }
```

Instead of a record with first-class functions, we use an object with methods

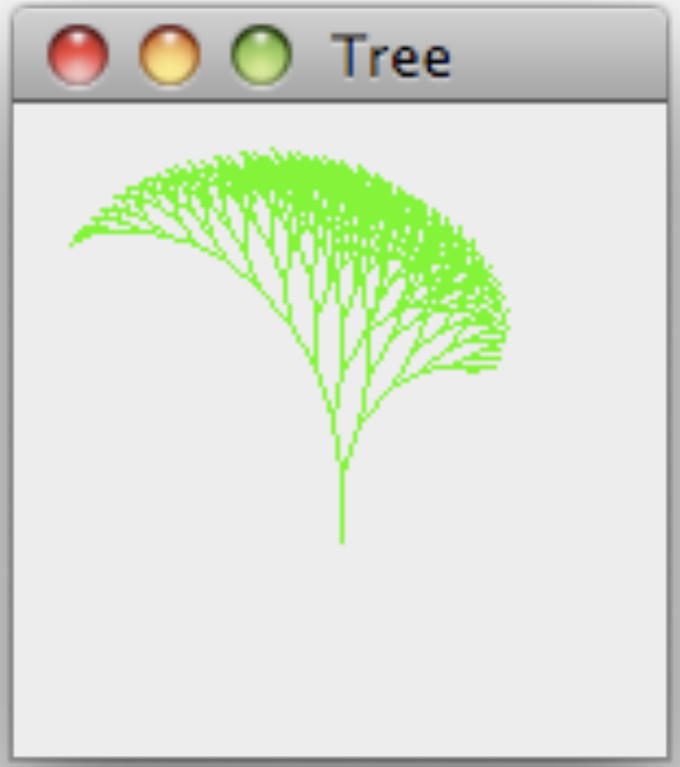
How to display this component?

# JFrame

- Represents a top-level window
- Displayed directly by OS (looks different on Mac, PC, etc.)
- Contains JComponents
- Can be moved, resized, iconified, closed

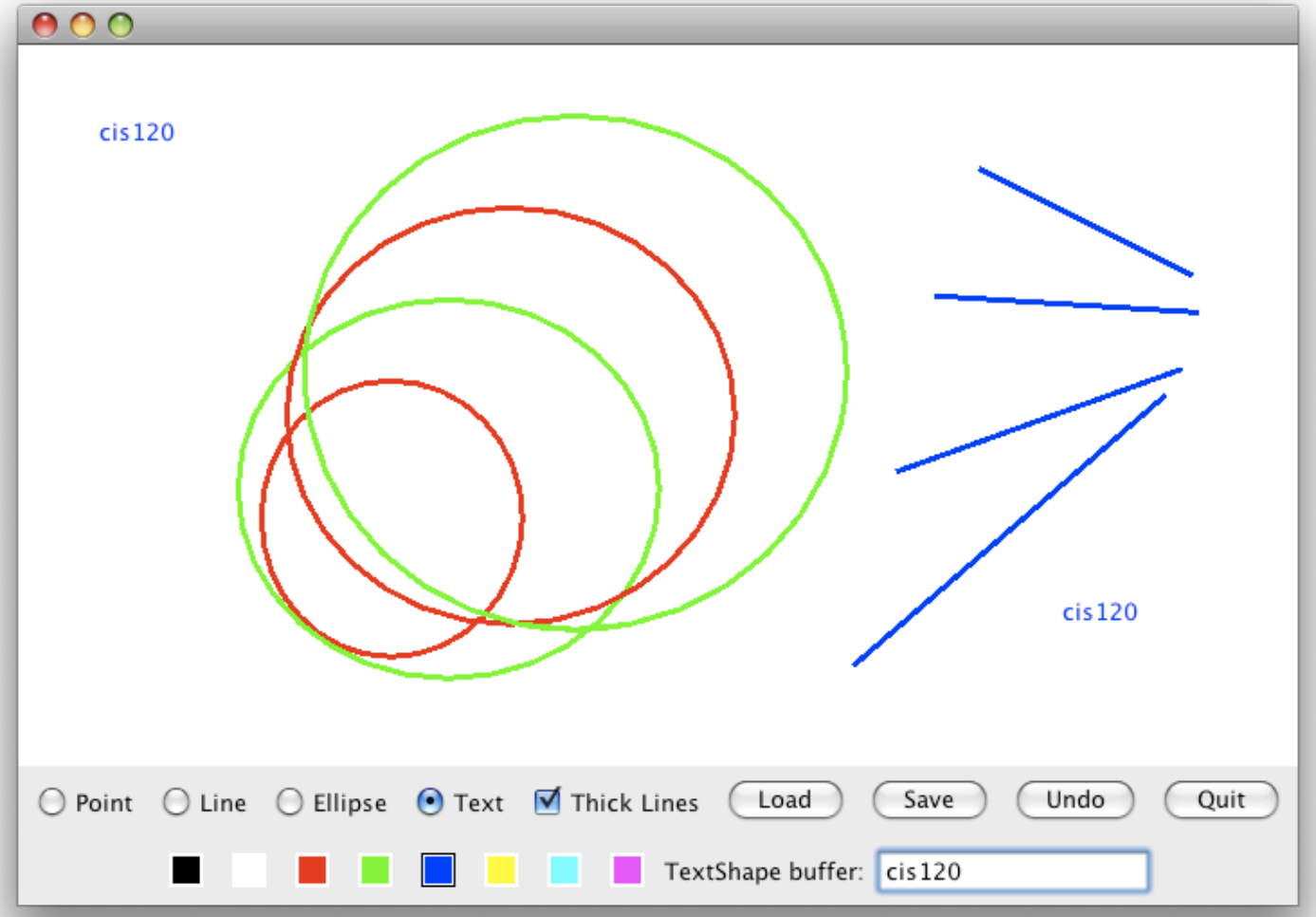
```
public static void main(String[] args) {
    JFrame frame = new JFrame("Tree");
    // set the content of the window to be the drawing
    frame .add(new DrawingPanel());

    // make sure the application exits when the frame closes
    frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);

    // resize the frame based on the size of the panel
    frame.pack();

    // show the frame
    frame.setVisible(true);
}
```

# Fractal Drawing Demo



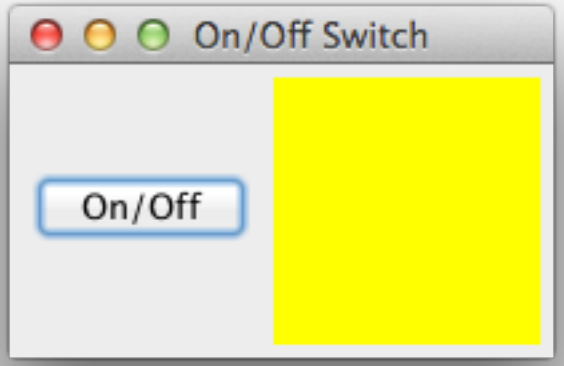
# User Interaction

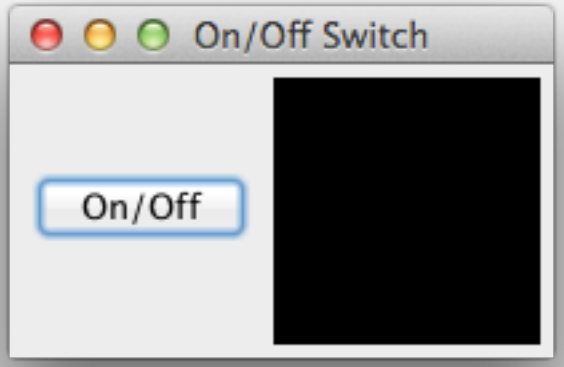
# JavaPaint Demo



# Start Simple: Lightswitch Revisited

Task: Program an application that displays a button. When the button is pressed, it toggles a “lightbulb” on and off.



# OnOffDemo

The Lightswitch GUI program in Java.

See: OnOff*.java

# Swing practicalities

- Java library for GUI development
  - javax.swing.*
- Built on existing library: AWT
  - java.awt.*
  - If there are two versions of something, use Swing's. (e.g., java.awt.Button vs. javax.swing.JButton)
  - The "Jxxx" version is usually the one you want, rather than "xxx".
- Portable
  - Communicates with OS's native window system
  - Same Java program looks different when run on PC, Linux and Mac
- Components as Containers
  - Use JPanel to organize and position other components (like vpair, hpair)