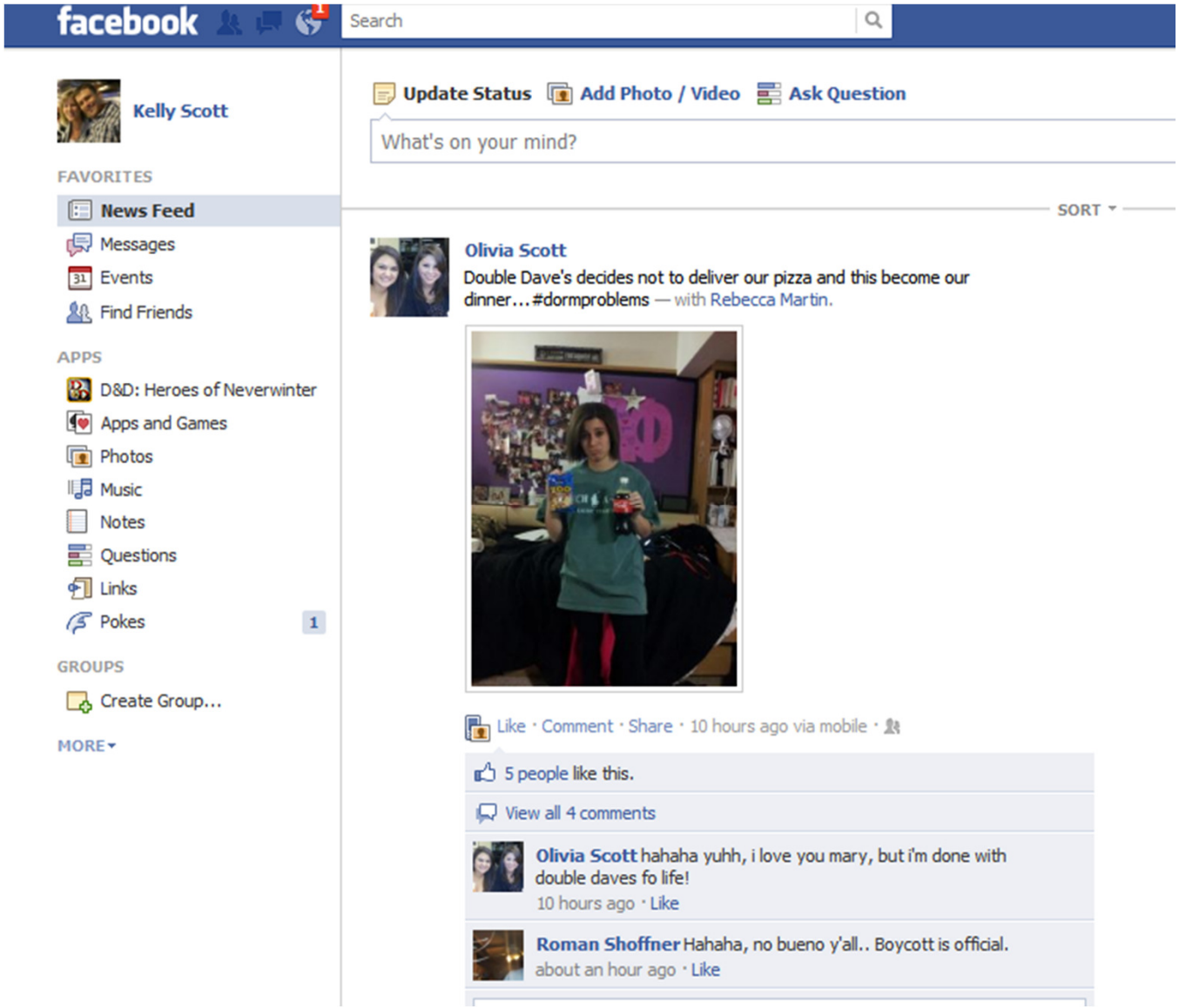
CS324e - Elements of Graphics and Visualization

Java GUIs - Event Handling

Event Driven Programming

- A "Programming Paradigm"
  - others: object-oriented, functional, data -flow, procedural, and more!
- Most early programs we write:
  - get data
  - perform computations
  - output results
  - CRUD programming (Create, Read, Update, Delete)
- That's not how most programs we use actually behave.

Event Driven Programming



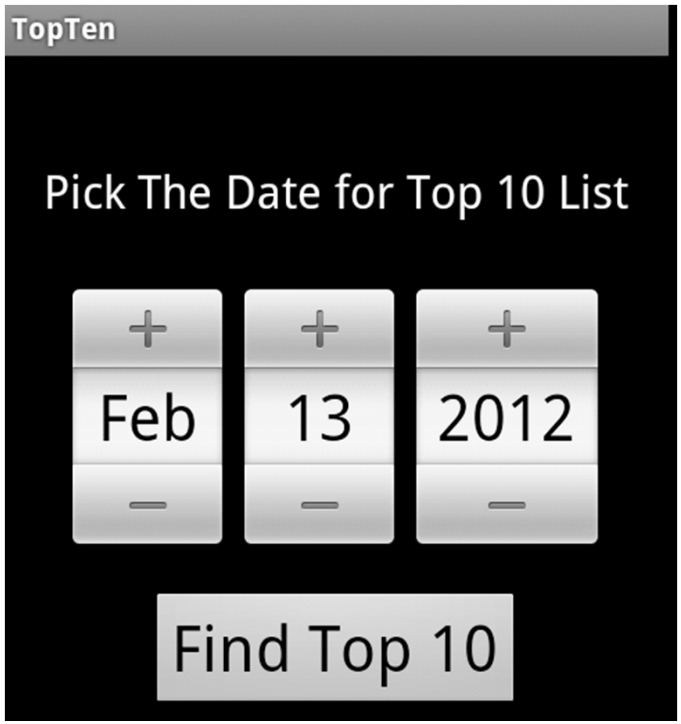
GUIs and Events

- Most programs sit there and wait for the user to respond
- Flow of control is based on user actions
- User action is an *event* that the program responds to
- Different languages have different levels of support for doing event driven programming

Events Handling

- High level approach:
  - fixes set of events and can attach code to the event: android:onclick
- Low level approach
  - must write code to check if events have occurred and deal with them in other code
  - Big old switch statement

```
<Button
    android:id="@+id/button1"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_gravity="center"
    android:layout_margin="20dp"
    android:onClick="showTop10"
    android:text="Find Top 10"
    android:textSize="30sp" />
```



Java Event Handling

- Java is in between the high level and low level approaches
- Built in GUI components in Swing:
  - buttons, check box, combo box, lists, menus, radio buttons, sliders, spinners, text fields, password text fields, labels, trees, color chooser, file chooser, separators, progress bars, trees, tables, and more

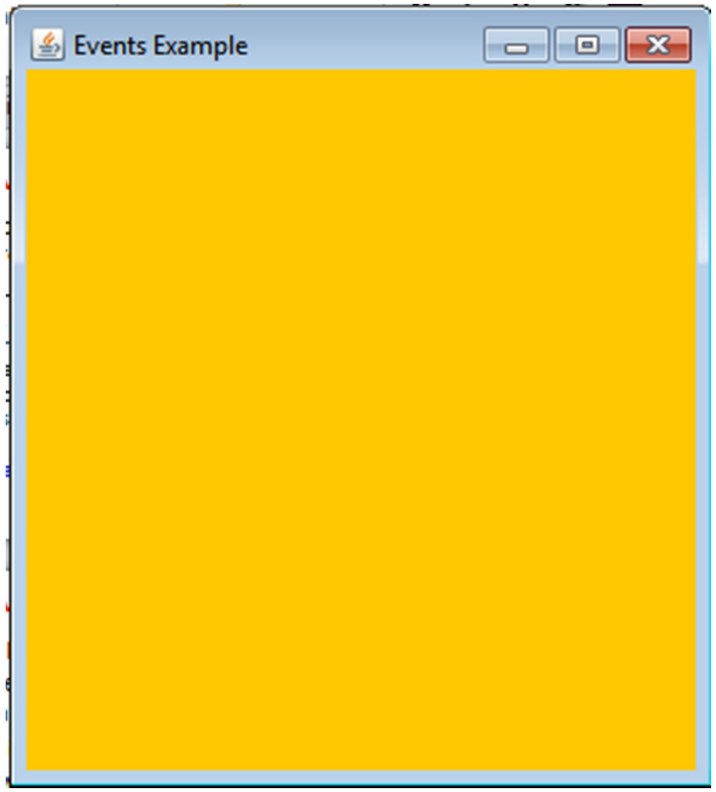
http://docs.oracle.com/javase/tutorial/ui/features/components.html

Java Event Handling

- These built in components can be added to top level containers such as frames (menus) and panels
  - Position is handled via a *layout manager*
  - initially we will use default layout manager FlowLayout
    - components added one after another in a line
- Components are drawn and generate events

New Sample Program

- Program with buttons
  - background color changes when button pressed
- Main program -> frame -> panel
- Panel has an instance variable currentColor
- When paint component called, background set to currentColor
- demo



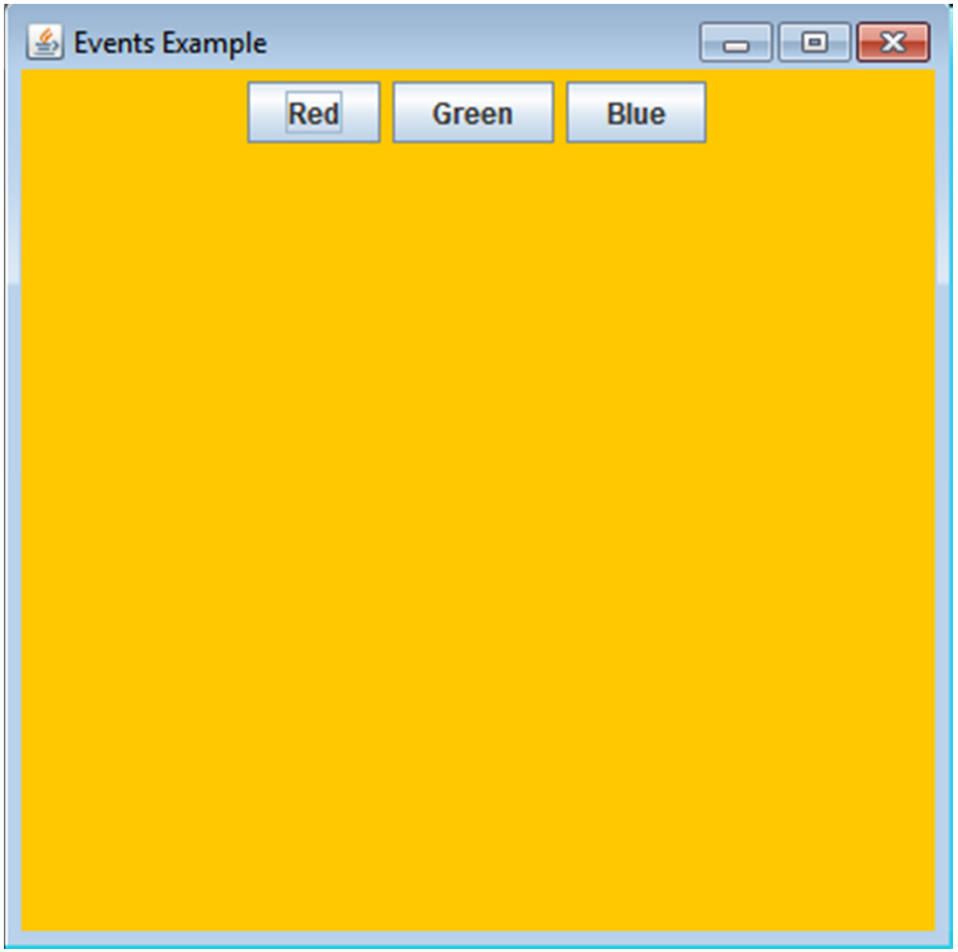
Add Buttons

- Add Buttons to the panel

```
class EventExamplePanel extends JPanel {

    private Color currentColor;

    private static String[] buttonNames
        = {"Red", "Green", "Blue"};

    private JButton[] buttons;

    public EventExamplePanel(){
        currentColor = Color.ORANGE;
        buttons = new JButton[buttonNames.length];

        for(int i = 0; i < buttonNames.length; i++) {
            buttons[i] = new JButton(buttonNames[i]);
            add(buttons[i]);
        }
    }
```

Result of Adding Buttons

- Notice order of buttons
- What happens if change order of names?
- What happens if add more buttons?
- What happens if resize Frame?
- What happens if Button pressed?

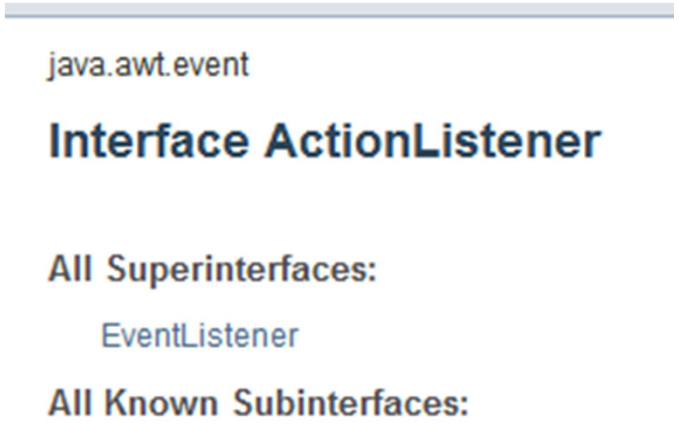


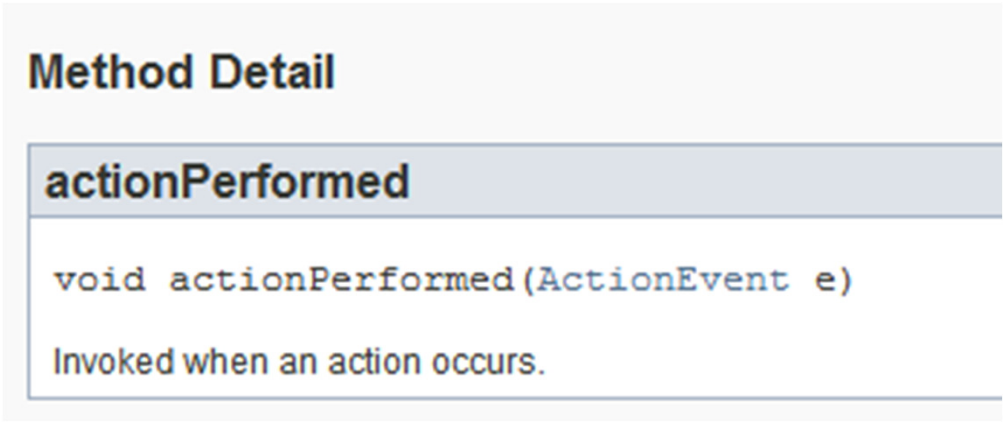
Listeners

- When the buttons are pressed events are being generated, but *no one is listening*
- In other words we don't have any code that responds to the events
- We need to create listeners for each button to listen for the event and respond by changing background color

ActionListener

- LOTS of kinds of listeners
- All extend or implement the EventListener interface
- http://docs.oracle.com/javase/7/docs/api/java/util/EventListener.html
- We will create a class that implements the ActionListener interface





Try a Separate Class

- Create a ColorAction class
  - instance vars
  - constructor
  - actionPerformed method
- repaint -> request an entire component be repainted. Don't call paintComponent
- array of colors
- build ColorAction and attach to each button

ColorAction class

```
class ColorAction implements ActionListener {
    private EventExamplePanel panel;
    private Color color;

    public ColorAction(EventExamplePanel p, Color c) {
        panel = p;
        color = c;
    }

    public void actionPerformed(ActionEvent e) {
        System.out.println(e);
        panel.setColor(color);
        panel.repaint();
    }
```

Change Panel Class

- create setColor method
- add array of colors
- change constructor
  - call addActionListener on each button and add an appropriate ColorAction

Changes to EventExamplePanel

```
private Color currentColor;

private static String[] buttonNames
    = {"Red", "Green", "Blue"};
private static Color[] colors = {Color.RED, Color.GREEN, Color.BLUE};

private JButton[] buttons;

public EventExamplePanel(){
    currentColor = Color.ORANGE;
    buttons = new JButton[buttonNames.length];

    for(int i = 0; i < buttonNames.length; i++) {
        buttons[i] = new JButton(buttonNames[i]);
        buttons[i].addActionListener(new ColorAction(this, colors[i]));
        add(buttons[i]);
    }
```

- Demo -> Examine output of ActionPerformed
- Add more buttons and colors