CS2110. GUIS: Listening to Events

Download the demo zip file from course website and look at the demos of GUI things: sliders, scroll bars, combobox listener, etc

Listening to events: mouse click, mouse movement into or out of a window, a keystroke, etc.

- An event is a mouse click, a mouse movement into or out of a window, a keystroke, etc.
- To be able to "listen to" a kind of event, you have to:

1. Have some class C implement an interface IN that is connected with the event.
2. In class C, override methods required by interface IN; these methods are generally called when the event happens.
3. Register an object of class C as a *listener* for the event. That object's methods will be called when event happens.

We show you how to do this for clicks on buttons, clicks on components, and keystrokes.

What is a JButton?

Instance: associated with a "button" on the GUI, which can be clicked to do something

```
jb1= new JButton()           // jb1 has no text on it
jb2= new JButton("first")    // jb2 has label "first" on it

jb2.isEnabled()              // true iff a click on button can be
                             // detected
jb2.setEnabled(b);           // Set enabled property

jb2.addActionListener(object);   // object must have a method,
          // which is called when button jb2 clicked (next page)
```

At least 100 more methods; these are most important

JButton is in package javax.swing

Listening to a JButton

1. Implement interface ActionListener:

```
public class C extends JFrame  implements
    ...                              ActionListener {
}
```

2. In class C override actionPerformed, which is to be called when button is clicked:

```
/** Process click of button */
public void actionPerformed(ActionEvent e) {
    ...
}
```

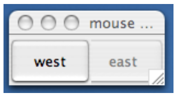
3. Add an instance of class C an "action listener" for button:

```
button.addActionListener(this);
```

red: listening

blue: placing

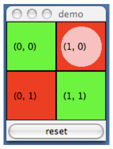
```
/** Object has two buttons. Exactly one is enabled. */
class ButtonDemo1 extends JFrame
                 implements ActionListener {
  /** Class inv: exactly one of eastB, westB is enabled */
  JButton westB= new JButton("west");
  JButton eastB= new JButton("east");

  public ButtonDemo1(String t) {
    super(t);
    Container cp= getContentPane();
    cp.add(westB, BLayout.WEST);
    cp.add(eastB, BLayout, EAST);
    westB.setEnabled(false);
    eastB.setEnabled(true);
    westB.addActionListener(this);
    eastB.addActionListener(this);

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



```
  public void actionPerformed
                  (ActionEvent e) {
     boolean b=
             eastB.isEnabled();
     eastB.setEnabled(!b);
     westB.setEnabled(b);
  }
}
```

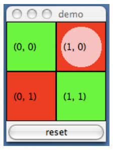
Listening to a Button

A JPanel that is painted (MouseDemo2)



- The JFrame content pane has a JPanel in its CENTER and a "reset" button in its SOUTH.
- The JPanel has a horizontal box b, which contains two vertical Boxes.
- Each vertical Box contains two instances of class Square.
- Click a Square that has no pink circle, and a pink circle is drawn. Click a Square that has a pink circle, and the pink circle disappears. Click the reset button and all pink circles disappear.
- This GUI has to listen to:
  (1) a click on Button reset
  (2) a click on a Square (a Box)

these are different kinds of events, and they need different listener methods



Class Square

```
/** Instance: JPanel of size (WIDTH, HEIGHT).
             Green or red: */
public class Square extends JPanel {
  public static final int HEIGHT= 70;
  public static final int WIDTH= 70;
  private int x, y; // Panel is at (x, y)
  private boolean hasDisk= false;
  /** Const: square at (x, y). Red/green? Parity of x+y.  */
 public Square(int x, int y) {
    this.x= x;        this.y= y;
   setPreferredSize(new Dimension(WIDTH,HEIGHT));
 }
 /** Complement the "has pink disk" property */
 public void complementDisk() {
    hasDisk= ! hasDisk;
    repaint(); // Ask the system to repaint the square
 }
```

continued on later

Class Graphics

An object of abstract class Graphics has methods to draw on a component (e.g. on a JPanel, or canvas).

Major methods:

drawString("abc", 20, 30);	drawLine(x1, y1, x2, y2);
drawRect(x, y, width, height);	fillRect(x, y, width, height);
drawOval(x, y, width, height);	fillOval(x, y, width, height);
setColor(Color.red);	getColor()
getFont()	setFont(Font f);

More methods

You won't create an object of Graphics; you will be given one to use when you want to paint a component

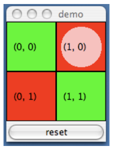
Graphics is in package java.awt

continuation of class Square

Class Square

```
/* paint this square using g. System calls
     paint whenever square has to be redrawn.*/
  public void paint(Graphics g) {
    if ((x+y)%2 == 0) g.setColor(Color.green);
    else g.setColor(Color.red);

    g.fillRect(0, 0, WIDTH-1, HEIGHT-1);

    if (hasDisk) {
      g.setColor(Color.pink);
      g.fillOval(7, 7, WIDTH-14, HEIGHT-14);
    }

    g.setColor(Color.black);
    g.drawRect(0, 0, WIDTH-1 ,HEIGHT-1);
    g.drawString("("+x+", "+y+")", 10, 5+HEIGHT/2);
  }
}
```

```
/** Remove pink disk
     (if present) */
public void clearDisk() {
   hasDisk= false;
   // Ask system to
   // repaint square
   repaint();
}
```



Listen to mouse event (click, press, release, enter, leave on a component)

In package java.awt.event

```
public interface MouseListener {
     void mouseClicked(MouseEvent e);
     void mouseEntered(MouseEvent e);
     void mouseExited(MouseEvent e);
     void mousePressed(MouseEvent e);
     void mouseReleased(MouseEvent e);
}
```

Having to write all of these in a class that implements MouseListener, even though you don't want to use all of them, can be a pain. So, a class is provided that implements them in a painless way.

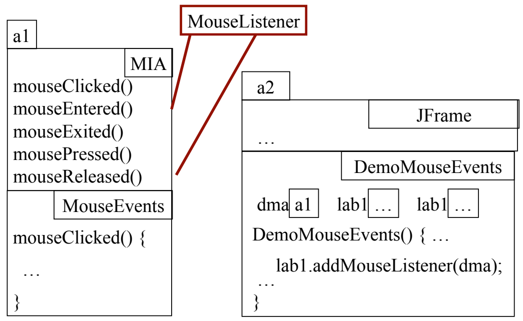
Listen to mouse event (click, press, release, enter, leave on a component)

In package java.swing.event

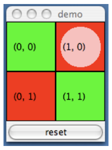
```
public class MouseInputAdapter
        implements MouseListener, MouseInputListener {
  public void mouseClicked(MouseEvent e) {}
  public void mouseEntered(MouseEvent e) {}
  public void mouseExited(MouseEvent e) {}
  public void mousePressed(MouseEvent e) {}
  public void mouseReleased(MouseEvent e) {}
  … others …
}
```

So, just write a subclass of MouseInputAdapter and override only the methods appropriate for the application

Javax.swing.event.MouseInputAdapter implements MouseListener



A class that listens to a mouseclick in a Square



red: listening

blue: placing

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

/** Contains a method that responds to a
    mouse click in a Square */
public class MouseEvents
             extends MouseInputAdapter {
  // Complement "has pink disk" property
  public void mouseClicked(MouseEvent e) {
    Object ob= e.getSource();
    if (ob instanceof Square) {
      ((Square)ob).complementDisk();
    }
  }
}
```

This class has several methods (that do nothing) that process mouse events:

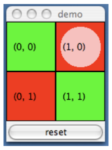
mouse click
mouse press
mouse release
mouse enters component
mouse leaves component
mouse dragged beginning in component

Our class overrides only the method that processes mouse clicks

```
public class MD2 extends JFrame
         implements ActionListener {
  Box b= new Box(…X_AXIS);
  Box leftC= new Box(…Y_AXIS);
  Square b00, b01= new squares;
  Box riteC= new Box(..Y_AXIS);
  Square b10, b01= new squares;
  JButton jb= new JButton("reset");

  MouseEvents me=
         new MouseEvents();
/** Constructor: … */
public MouseDemo2() {
  super(t);
  place components on content pane;
  pack, make unresizeable, visible;

  jb.addActionListener(this);
  b00.addMouseListener(me);
  b01.addMouseListener(me);
  b10.addMouseListener(me);
  b11.addMouseListener(me);
}

public void actionPerformed (
              ActionEvent e) {
   call clearDisk() for
   b00, b01, b10, b11
}
```

red: listening

blue: placing



Class MouseDemo2

Listening to the keyboard

red: listening

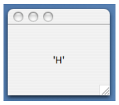
blue: placing

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

public class AllCaps extends KeyAdapter {
 JFrame capsFrame= new JFrame();
 JLabel capsLabel= new JLabel();

 public AllCaps() {
  capsLabel.setHorizontalAlignment(SwingConstants.CENTER);
  capsLabel.setText(":)");
  capsFrame.setSize(200,200);
  Container c= capsFrame.getContentPane();
  c.add(capsLabel);
  capsFrame.addKeyListener(this);
  capsFrame.show();
 }

 public void keyPressed (KeyEvent e) {
  char typedChar= e.getKeyChar();
  capsLabel.setText(("'" + typedChar + "'").toUpperCase());
 }
}
```

1. Extend this class.

3. Add this instance as a key listener for the frame

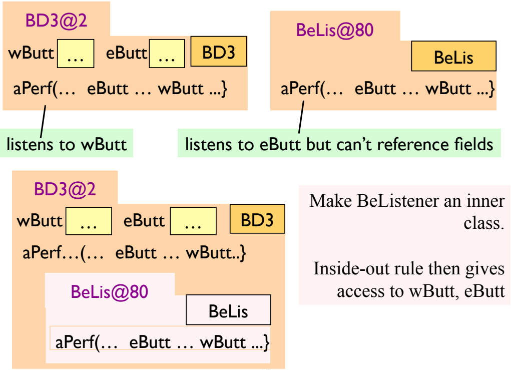
2. Override this method. It is called when a key stroke is detected.



```
public class BDemo3 extends JFrame  implements ActionListener {
  private JButton wButt, eButt …;

  public ButtonDemo3() {
     Add buttons to content pane, enable
        ne, disable the other
     wButt.addActionListener(this);
     eButt.addActionListener(new BeListener());  }

  public void actionPerformed(ActionEvent e) {
     boolean b= eButt.isEnabled();
     eButt.setEnabled(!b); wButt.setEnabled(b);  }
}
 A listener for eastButt
class BeListener implements ActionListener {
   public void actionPerformed(ActionEvent e) {
     boolean b= eButt.isEnabled();
     eButt.setEnabled(!b); wButt.setEnabled(b);
  }
```

Have a different listener for each button

Doesn't work! Can't reference eButt, wButt


BD3@2
wButt
…
eButt
…
BD3
aPerf(… eButt … wButt ...}
BeLis@80
BeLis
aPerf(… eButt … wButt ...}
BD3@2
wButt
…
eButt
…
BD3
aPerf…(… eButt … wButt..}
BeLis@80
BeLis
aPerf(… eButt … wButt ...}

listens to wButt

listens to eButt but can't reference fields

Make BeListener an inner class.

Inside-out rule then gives access to wButt, eButt

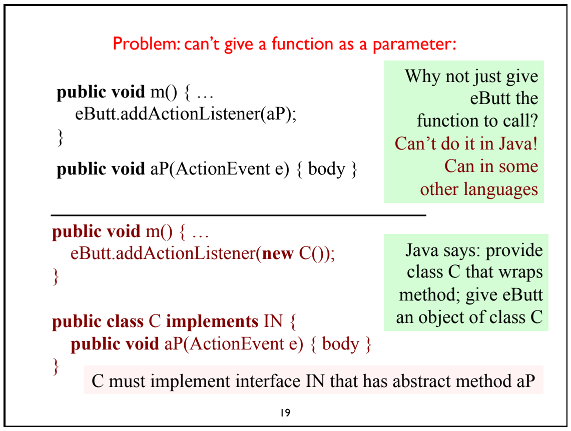
Solution to problem: Make BeListener an inner class.

```
public class BDemo3 extends Jframe
         implements ActionListener {
  private JButton wButt, eButt …;
  public ButtonDemo3() { … }
  public void actionPerformed(ActionEvent
  private class BeListener implements ActionListener { … }
```

Just as you can declare variables and methods within a class, you can declare a class within a class

Inside-out rule says that methods in here Can reference all the fields and methods

We demo this using ButtonDemo3



Problem: can't give a function as a parameter:

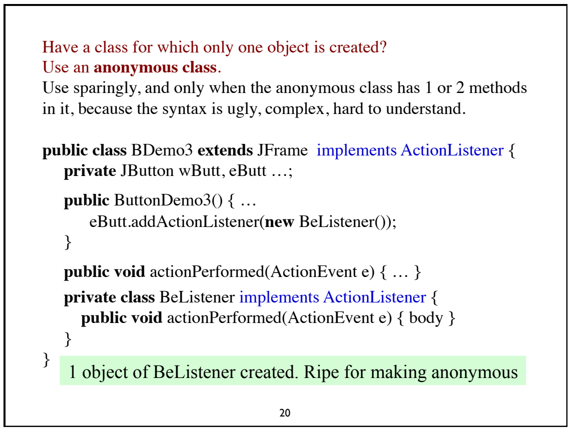
```
public void m() { …
   eButt.addActionListener(aP);
}
public void aP(ActionEvent e) { body }
```

Why not just give eButt the function to call? Can't do it in Java! Can in some other languages

```
public void m() { …
   eButt.addActionListener(new C());
}

public class C implements IN {
   public void aP(ActionEvent e) { body }
}
```

Java says: provide class C that wraps method; give eButt an object of class C

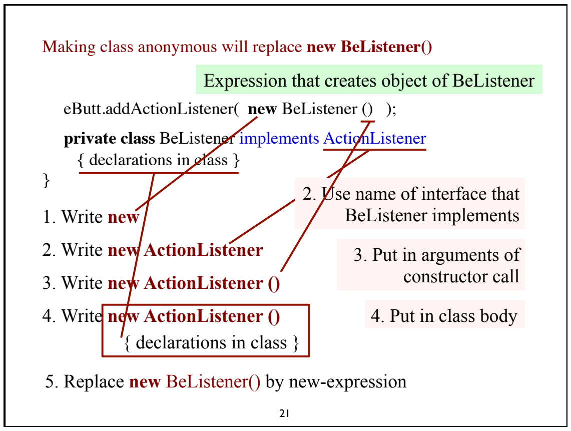
C must implement interface IN that has abstract method aP



Have a class for which only one object is created?
Use an **anonymous class**.
Use sparingly, and only when the anonymous class has 1 or 2 methods in it, because the syntax is ugly, complex, hard to understand.

```
public class BDemo3 extends JFrame  implements ActionListener {
   private JButton wButt, eButt …;
   public ButtonDemo3() { …
      eButt.addActionListener(new BeListener());
   }
   public void actionPerformed(ActionEvent e) { … }
   private class BeListener implements ActionListener {
      public void actionPerformed(ActionEvent e) { body }
   }
}
```

1 object of BeListener created. Ripe for making anonymous



Making class anonymous will replace **new BeListener()**

Expression that creates object of BeListener

```
   eButt.addActionListener( new BeListener ()   );
   private class BeListener implements ActionListener
      { declarations in class }
}
```

1. Write **new**
2. Write **new ActionListener**
3. Write **new ActionListener ()**
4. Write **new ActionListener ()**
   { declarations in class }

2. Use name of interface that BeListener implements

3. Put in arguments of constructor call

4. Put in class body

5. Replace **new** BeListener() by new-expression