



9 - Event-Driven Programming

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Overview

- **Traditional vs. Event-Driven Programs**
- **Events**
- **Event Listeners:**
 - **CN1 ActionListener interface**
 - **Adding action/key/pointer listeners to components**
 - **Command design pattern, CN1 Command class, key bindings**
 - **Pointer handling**

Traditional vs. Event-Driven

- Traditional program organization:

```
loop {  
    get some input ;  
    process input ;  
    produce output ;  
}  
until (done);
```

- Event-driven program organization:

```
create a form ;  
create some controls (buttons, etc.) ;  
add controls to form ;  
make the form visible ;
```

Event-Driven Operation

Some
code...

Side Menu Item 1

Side Menu Item 2

Check Side Menu Component ☐

Some
code...

Different
code...

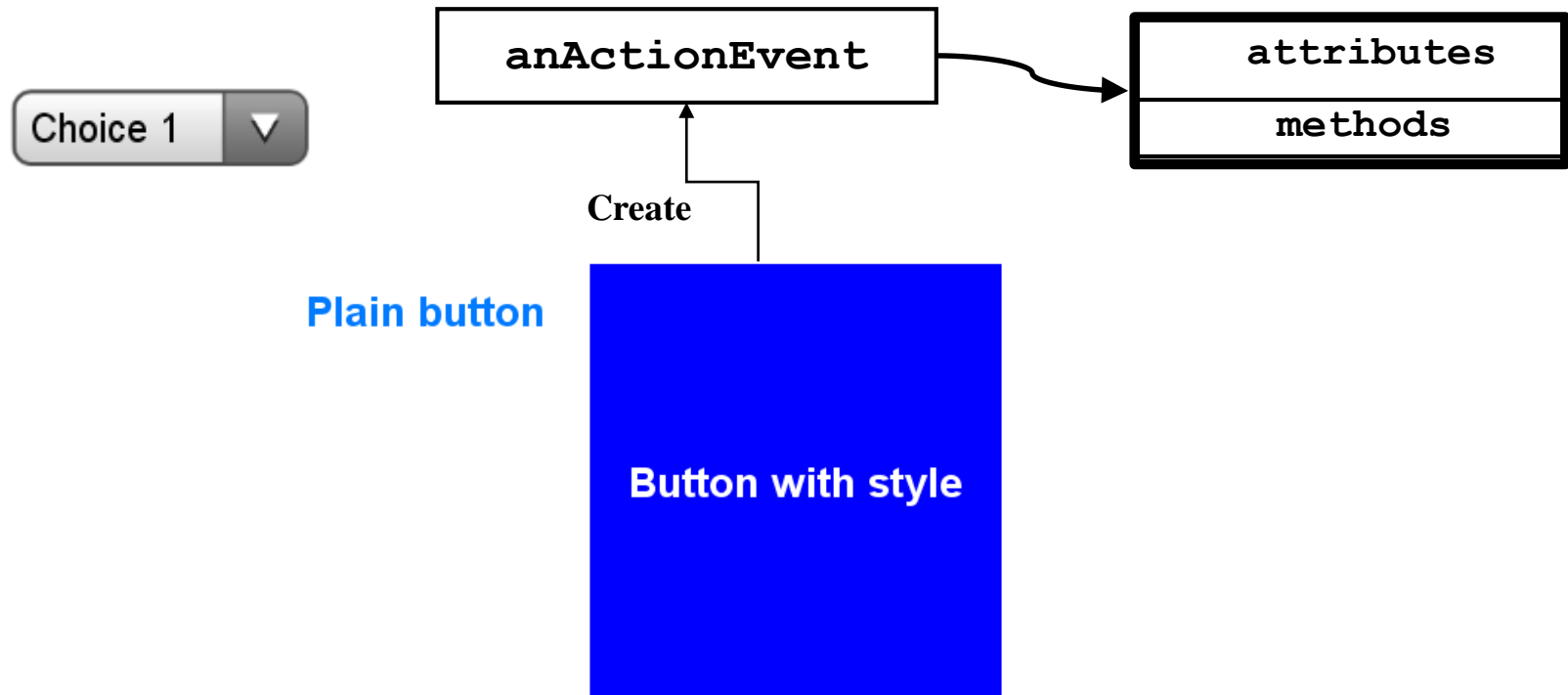
≡ Title Bar Area Item 2			Title Bar Area Item 1 Info ⋮
Read this (t)		Press Me (t)	
Text (l) Click Me (l) Choice 1 ▼ Enable Printing (l) <input type="checkbox"/>			Text (r) Click Me (r) Choice 4 ▼ Enable Printing (r) <input type="checkbox"/>
Read this (b)		Press Me (b)	

Other
code...

Some
other
code...

Event Objects

Activating a component and use of keys and the pointer create an object of type **ActionEvent**



Check Side Menu Component

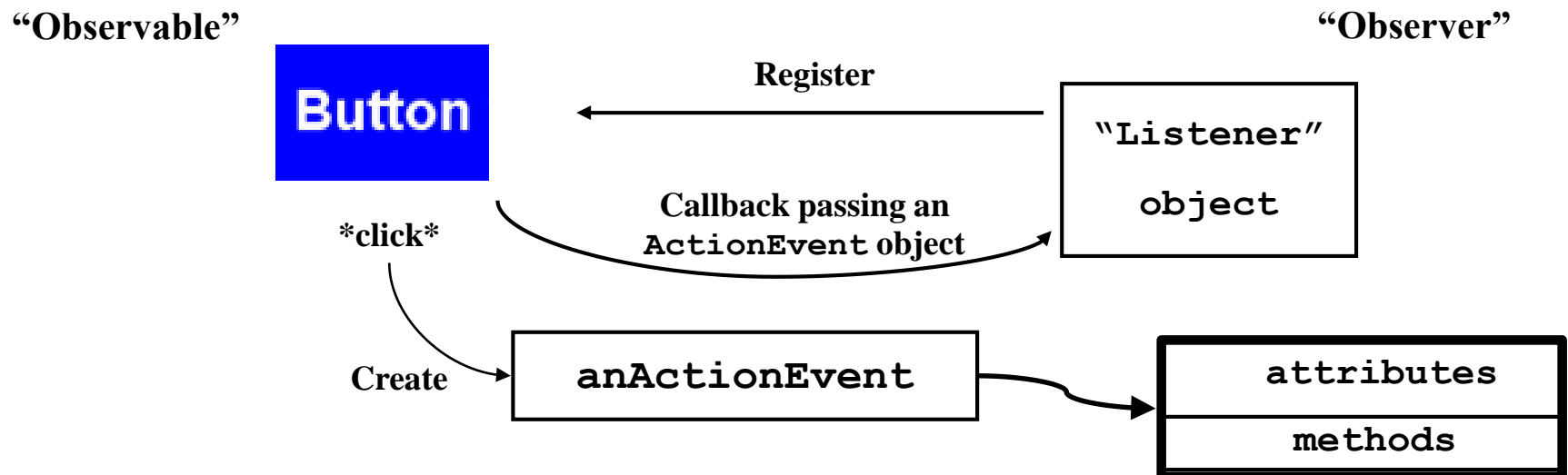


Event Objects (cont.)

- CN1 does not have different type of event objects as in Java (e.g. **ActionEvent**, **MouseEvent**, **KeyEvent**, etc.)
- Activating a component (e.g., pushing a button), using a key (pressing, releasing), or use of pointer (pressing, releasing, dragging, etc.) ALL produce an object of type **ActionEvent**.

Event Listeners

- Event-driven code attaches listeners to event-generators
- Event-generators make call-backs to listeners



ActionListener Interface

- **Listeners must implement interface ActionListener (build-in in CN1):**

```
interface ActionListener
{
    public void actionPerformed (ActionEvent e);
}
```


Approaches for Creating a Listener

- (1) Have a class that implements **ActionListener**. Two options:
 - (1a) Your listener is different than the class that creates the components
 - (1b) You make the class that creates components (e.g., the class that extends **Form**) your listener
- (2) Have a class that extends build-in **Command** class. This approach uses the Command design pattern.

Approach (1a)

```
import com.codename1.ui.events.ActionEvent;
import com.codename1.ui.events.ActionListener;

/** This class acts as a listener for ActionEvents.
 *  It was designed to be attached and respond
 *  to button-push events.
 */

public class ButtonListener implements ActionListener{

    // Action Listener method:  called from the object being observed
    // (e.g. a button) when it generates an "Action Event"
    // (which is what a button-click does)

    public void actionPerformed(ActionEvent evt) {
        // we get here because the object being observed
        // generated an Action Event
        System.out.println ("Button Pushed...");
    }
}
```

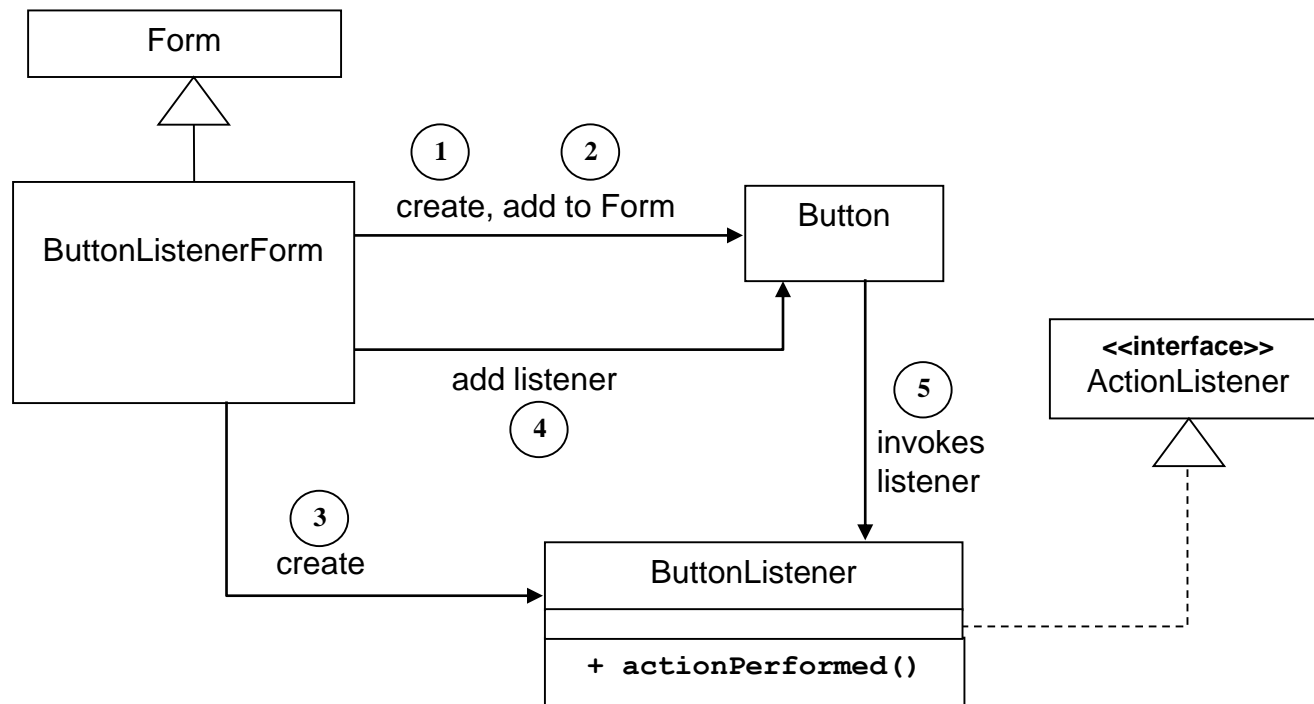
Using the Listener

Inside a class that extends from Form:

```
/** Code for a form ((ButtonListenerForm) with a single Button to which is attached an
 * ActionListener. The button action listener is invoked whenever the
 * button is pushed.
 */
//create a button
Button myButton = new Button("Button");
//...[style the button and add it to the form]
//create a separate ActionListener for the button
ButtonListener myButtonListener = new ButtonListener ();
//register the myButtonListener as an Action Listener for
//action events from the button
myButton.addActionListener(myButtonListener);
```

Listener Class Organization

- UML for the previous code:



Approach (1b)

Forms can listen to their own components!

Form

Constructor:

```
{
    Create event-generating component
      (for example, a Button);
    Add component to this (form);
    Register this (form) as a listener;
    Wait for an event...
}
```

EventHandler code:

```
{
    ...
}
```

Create

Button

click event

addListener(this)

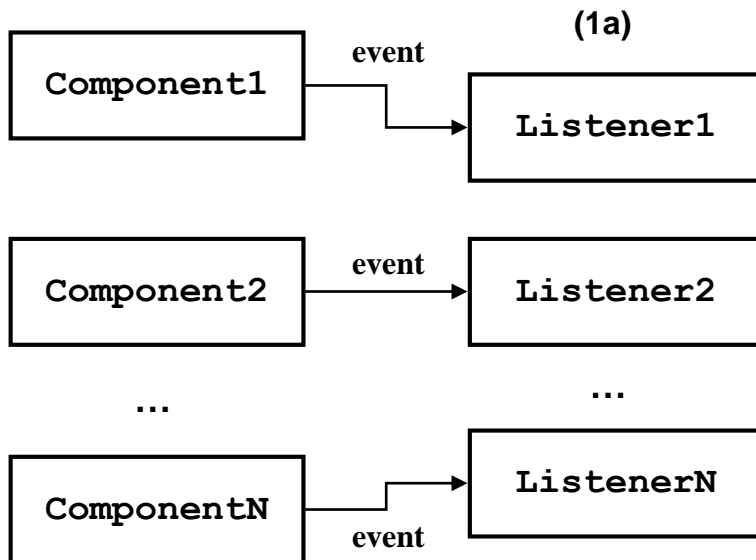
Callback

ActionListener Frame Example

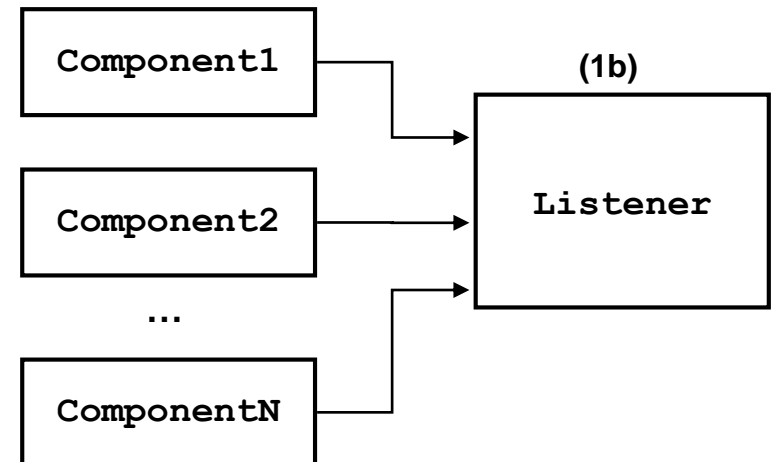
```
/** Code for a form with a single button which the form listens to. */  
  
public class SelfListenerForm extends Form implements ActionListener {  
    public SelfListenerForm () {  
        // create a new button  
        Button myButton = new Button ("Button");  
  
        // add the button to the content pane of this form  
        add(myButton);  
  
        // register THIS object (the form) as an Action Listener for  
        // action events from the button  
        myButton.addActionListener(this);  
  
        show();  
    }  
  
    // Action Listener method: called from the button because  
    // this object -- the form -- is an action listener for the button  
    public void actionPerformed (ActionEvent e) {  
        System.out.println ("Button Pushed (printed from the form)...");  
    }  
}
```

Multiple Event Sources

- *Approaches:*
 - (1a) requires multiple separate listeners
 - (1b) requires one listener
 - it would need to be able to *distinguish event source*



or



Let's consider this second option ...

Multiple Component Listener

```
/* Code for a form with multiple buttons which have action handlers in the form */  
public class MultipleComponentListener extends Form implements ActionListener{  
    private Button buttonOne = new Button("Button One"); //need to make this button a class field  
    public MultipleComponentListener() {  
        setTitle("Multiple Component Listener");  
        Button buttonTwo = new Button("Button Two");  
        //...[set styles of the buttons and add them to form]  
        buttonOne.addActionListener(this);  
        buttonTwo.addActionListener(this);  
        show();  
    }  
    public void actionPerformed(ActionEvent evt) {  
        if(evt.getComponent().equals(buttonOne)){ //buttonOne must be a class field  
            System.out.println ("Button One Pushed (printed from the form using  
                                getComponent())...");  
        }  
        else if((Button)evt.getComponent()).getText().equals("Button Two")){  
            //if we change the label of the button, this code would not work  
            System.out.println ("Button Two Pushed (printed from the form using  
                                getComponent().getText())...");  
        }  
        else if   
    }  
    public void actionPerformed  
}  
public class
```


Multiple Component Listener (cont.)

- ***actionPerformed()*** would get bigger and bigger... more and more unwieldy as we have more components in the form.
- A better approach is using combination of approaches (1a) and (1b):

Command Design Pattern

which is the Approach (2).

(use one listener for all related components,
but you can have multiple listeners for
different groups of components)

Anonymous Command Sub-Class

We can extend from `Command` in a separate .java file and then instantiate an object of this sub-class in a separate .java file.

Or... we generate an object of an anonymous sub-class of `Command` in the same .java file.

First option (which is used in the “Command Design Pattern” code example) is recommended...

See the next slide for the second option...But do **NOT use** the second approach (**anonymous sub-classing**) in the assignments!

Anonymous Command Sub-Class (cont.)

```
/* Code for a form that creates an object of anonymous sub-class of the Command */  
//create a Toolbar called myToolBar and add it to the form  
//create the object (called infoTitleBarAreaItem) of anonymous sub-class of Command  
Command infoTitleBarAreaItem = new Command("Info") {  
    public void actionPerformed(ActionEvent ev) {  
        String Message = "I provide information.";  
        Dialog.show("Info", Message, "Ok", null);  
    }  
};  
myToolBar.addCommandToRightBar(infoTitleBarAreaItem);
```

Adding a Command to Side Menu Component

```
/* Code for a form which has a CheckBox as a side menu item*/
public class SideMenuItemCheckForm extends Form{
    private Label checkStatusVal = new Label("OFF");
    public SideMenuItemCheckForm() {
        //...[add a Toolbar and some side menu items]

        CheckBox checkSideMenuComp = new CheckBox("Check Side Menu Component");
        //...[change style of the check box]
        //create a command object and set it as the command of check box

        Command mySideMenuItemCheck = new SideMenuItemCheck(this);
        checkSideMenuComp.setCommand(mySideMenuItemCheck);
        //set "SideComponent" property of the command object to the check box

        mySideMenuItemCheck.putClientProperty("SideComponent", checkSideMenuComp);
        //add the command to the side menu, this places its side component (check box) in the side menu

        myToolbar.addToSideMenu(mySideMenuItemCheck);
        //add a label to indicate the check box value on the form, divide the label to two parts, text
        //and value, and add padding to value part so that the labels looks stable when value changes

        Label checkStatusText = new Label("Check Box Status:");
        checkStatusVal.getAllStyles().setPadding(LEFT, 5);
        checkStatusVal.getAllStyles().setPadding(RIGHT,5);
        //...[add labels to the form and show the form]

    }
```

Adding a Command to Side Menu Component

continued...

```

public void setCheckStatusVal(boolean bVal){
    if (bVal)
        checkStatusVal.setText("ON");
    else
        checkStatusVal.setText("OFF");} //call repaint(), if cannot see values properly
} // SideMenuItemCheckForm class ----- below is the code for the command class

public class SideMenuItemCheck extends Command {
    private SideMenuItemCheckForm myForm;

    public SideMenuItemCheck (SideMenuItemCheckForm fForm){
        super("Side Menu Item Check"); //do not forget to set the "command name"
        myForm = fForm;}

    @Override
    public void actionPerformed(ActionEvent evt){
        if (((CheckBox)evt.getComponent()).isSelected()) //getComponent() returns the component
                                                         //that generated the event

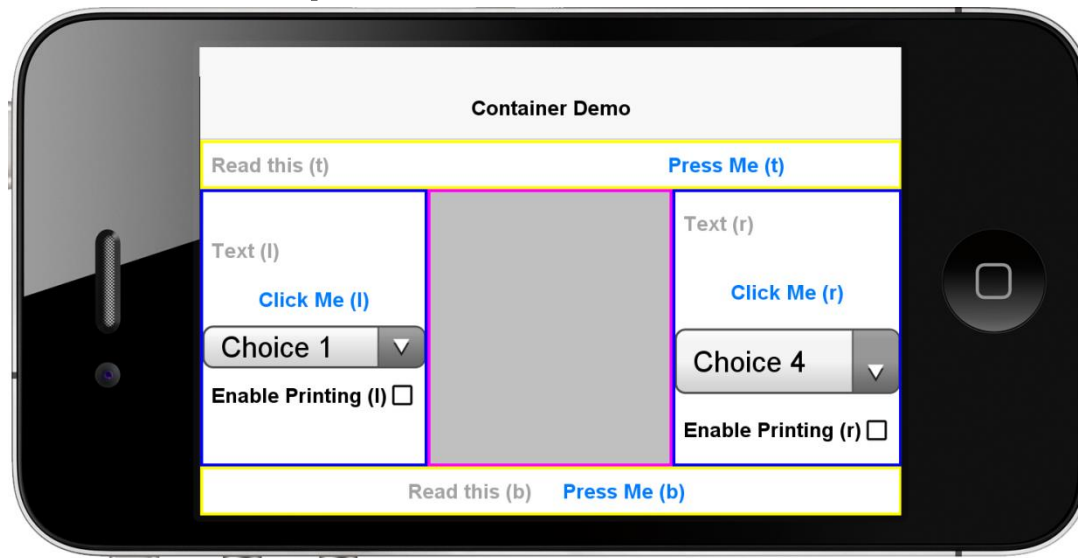
            myForm.setCheckStatusVal(true);
        else
            myForm.setCheckStatusVal(false);

        SideMenuBar.closeCurrentMenu(); //do not forget to close the side menu
    } //actionPerformed
} // SideMenuItemCheck class

```

Component Width and Height

- Layout managers automatically place and size the components.
- Hence, we can only get their correct width and height values after calling **show()**.
- Remember the “Container Example” from the “GUI Basics” chapter:



Component Width and Height (cont.)

```

public class FormWithMultipleContainers extends Form{
    Container centerContainer;
    public FormWithMultipleContainers(){
        //create the center container and add it to form
        centerContainer = new Container();
        //... [add the centerContainer to the from, create bottomContainer]
        //create a button and add it to bottomContainer
        Button bPressMeB = new Button("Press Me (b)");
        bottomContainer.add(bPressMeB);
        //...[add the bottom Container to the from,
        //create/add other containers and components and style them all]
        //below line prints incorrect values: 0,0
        System.out.println("Center container width/height (printed BEFORE show()):
            " + centerContainer.getWidth() + " " + centerContainer.getHeight());
        show();
        //below line prints correct width and height
        System.out.println("Center container width/height (printed AFTER show()): "
            + centerContainer.getWidth() + " " + centerContainer.getHeight());
        bPressMeB.addActionListener(new Command("Print center"){
            public void actionPerformed(ActionEvent ev){
                //below line also prints correct width and height
                System.out.println("Center container width/height (printed after
                    button click): " + centerContainer.getWidth() + " " +
                    centerContainer.getHeight());
            }
        });
        //actionperformed() {
        //new Command() {
        //; //addActionListener(
        //constructor
    }
}
}

```

Pointer Handling

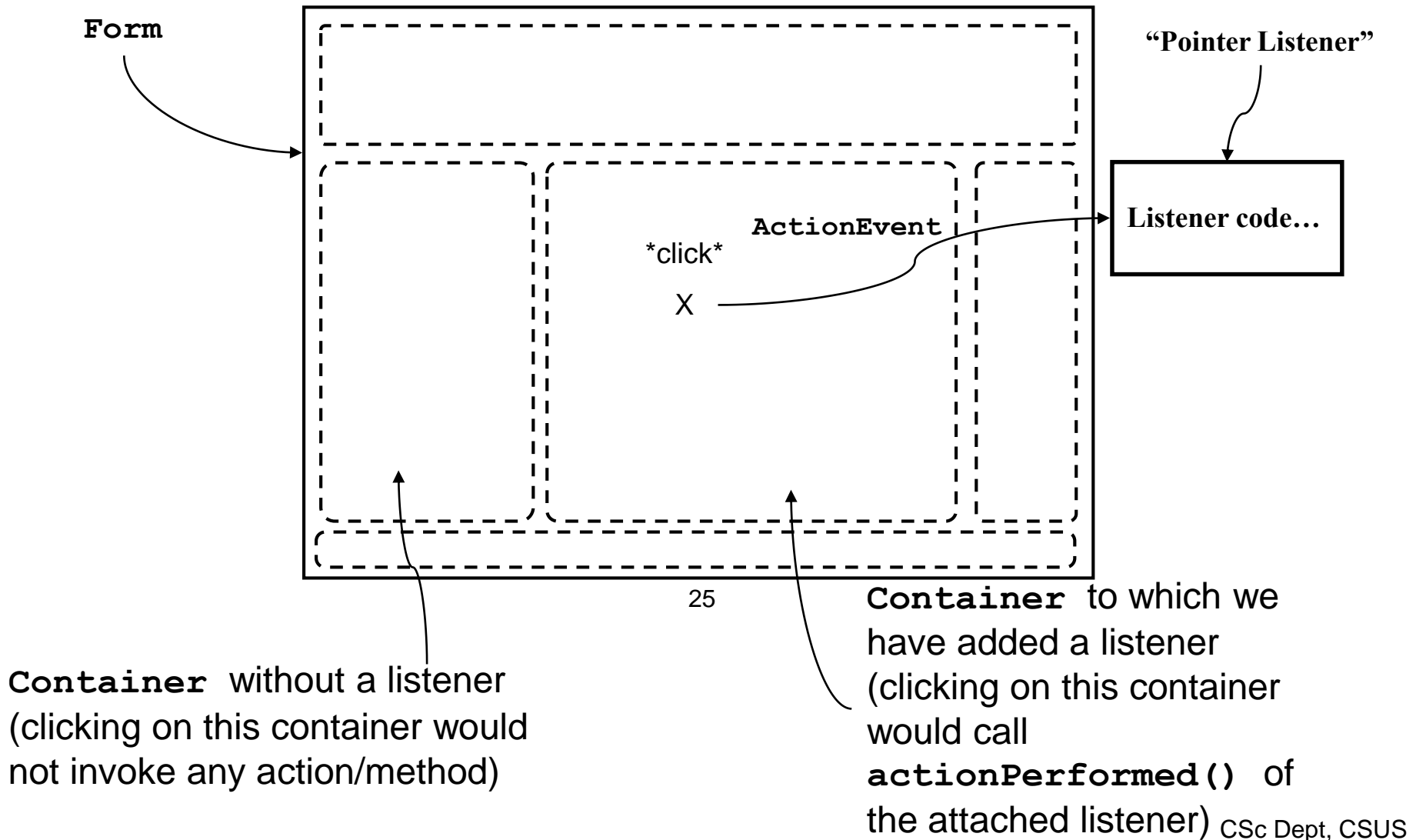
- Components also generate an **ActionEvent** when a pointer is pressed/released or dragged on them.
- **Component** class provides:

```
addPointerPressedListener( )  
addPointerReleasedListener( )  
addPointerDraggedListener( )
```

...all of which take a parameter of **ActionListener** ...

(this means you can attach a **Command** and pointer actions can also become a part of Command Design Pattern)

Pointer Handling (cont.)



Pointer Handling (cont.)

- Like action listeners, pointer listeners must also implement **ActionListener** interface:

```
interface ActionListener
{
    public void actionPerformed (ActionEvent e);
}
```

- ActionEvent** passed to **actionPerformed()** method has **getX()** and **getY()** methods which returns the “screen coordinate” of the pointer location.

Pointer Listener Example

```
/** A Form with a simple pointer-responding container */  
  
public class PointerListenerForm extends Form{  
    public PointerListenerForm() {  
        //...[set the form layout to borderlayout, generate and style buttons and  
        //add them to on north and south containers]  
        //have an empty container in the center and add a pointer pressed  
        //listener to it  
  
        Container myContainer = new Container();  
  
        PointerListener myPointerListener = new PointerListener ();  
  
        myContainer.addPointerPressedListener(myPointerListener);  
  
        this.add(BorderLayout.CENTER,myContainer);  
  
        //...[add other containers and components to the form]  
    }  
}  
  
-----  
  
public class PointerListener implements ActionListener {  
    public void actionPerformed(ActionEvent evt) {  
        System.out.println("Pointer x and y: " + evt.getX() + " " + evt.getY());  
    }  
}  
}
```

Pointer Listener Example

Question:

What happens if I add the listener to the form instead of the container in the form?

```
public class PointerListenerForm extends Form{  
    public PointerListenerForm() {  
        PointerListener mypointerListener = new PointerListener();  
        this.addPointerPressedListener(mypointerListener);  
        //...[add containers and components to the form]  
    }  
}
```

Answer:

Clicking anywhere on the form (including the title bar area) would print out the values...

Adding Listeners for Different Pointer Actions

- There are two approaches:

- You can add a separate listener for pressed/released/dragged

```
myContainer.addPointerPressedListener(myPressedListener)
```

```
myContainer.addPointerReleasedListener(myReleasedListener)
```

```
myContainer.addPointerDraggedListener(myDraggedListener)
```

- This approach requires us to have three separate listener classes.
- You can have a single listener for all (e.g., self listener) and distinguish between different actions by using **ActionEvent**'s **getEventType()** method.
 - You need to have if-then-else structure which can get unwieldy if the form is also listening for other event types

Adding Pointer Listener vs Overriding Pointer Methods

- **Component** class also has following methods:

`pointerPressed()`

`pointerReleased()`

`pointerDragged()`

....all of which gets the parameters which indicate screen location of the pointer...

- If you are extending from a **Component** (e.g. **Form**, **Container**), you can override these functions. This is the recommended approach since it is easier than adding a listener for each separate pointer action.

Overriding Pointer Methods

```
/* Center container of the form is a PointerContainer which extends from Container */
```

```
public class PointerListenerForm extends Form{  
    public PointerListenerForm() {  
        PointerContainer myPointerContainer = new PointerContainer();  
        this.add(BorderLayout.CENTER,myPointerContainer);  
        //...[add other containers and components to the form]    }  
}
```

```
/* We can override the pointer methods in the Container */
```

```
public class PointerContainer extends Container{  
    @Override  
    public void pointerPressed(int x,int y){  
        System.out.println("Pointer PRESSED x and y: " + x + " " + y);    }  
    @Override  
    public void pointerReleased(int x,int y){  
        System.out.println("Pointer RELEASED x and y: " + x + " " + y);    }  
    @Override  
    public void pointerDragged(int x,int y){  
        System.out.println("Pointer DRAGGED x and y: " + x + " " + y);    }  
}
```