Object Oriented Programming and Design in Java

Session 9

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Announcements

- Homework 2 due Mar. 3rd, 11 AM
  - one week to go
- Midterm review Monday, Mar. 8th
- Midterm exam Wednesday, Mar. 10th

Review

- More Swing components
  - JTextArea, JSplitPane
- Listeners in Swing
  - Change listener
  - Focus listener
  - Mouse listeners

Today's Plan

- More LayoutManager examples
  - BorderLayout, BoxLayout, GridLayout
- Discussion of Inheritance

Layout Managers

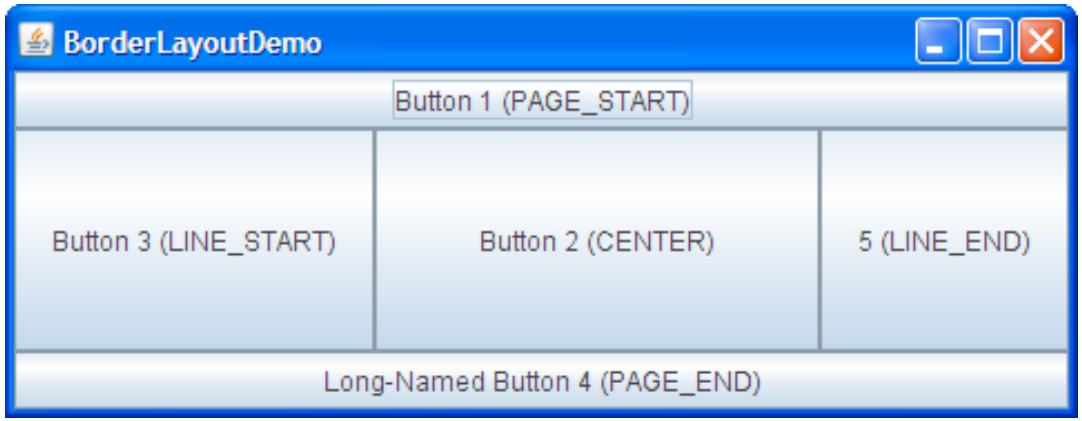
- LayoutManager is an interface in AWT
- Container objects call methods to add components and lay them out
- Responsibilities:
  - Calculate the minimum and preferred size of the Container
  - Lay out the Container's children

LayoutManager Methods

- `addLayoutComponent(String name, Component comp)`
- `layoutContainer(Container parent)`
- `Dimension minimumLayoutSize(Container parent)`
- `Dimension preferredLayoutSize(Container parent)`
- `removeLayoutComponent(Component comp)`

BorderLayout

- Doesn't fit the Strategy pattern
- You specify where you add components
- container.add(Component, LOCATION)
  - BorderLayout.PAGE_START (NORTH)
  - BorderLayout.LINE_START (WEST)
  - BorderLayout.CENTER
  - BorderLayout.LINE_END (EAST)
  - BorderLayout.PAGE_END (SOUTH)




```
JButton button = new JButton("Button 1 (PAGE_START)");
pane.add(button, BorderLayout.PAGE_START);

//Make the center component big, since
//that's the typical usage of BorderLayout.
button = new JButton("Button 2 (CENTER)");
button.setPreferredSize(new Dimension(200, 100));
pane.add(button, BorderLayout.CENTER);

button = new JButton("Button 3 (LINE_START)");
pane.add(button, BorderLayout.LINE_START);

button = new JButton("Long-Named Button 4 (PAGE_END)");
pane.add(button, BorderLayout.PAGE_END);

button = new JButton("5 (LINE_END)");
pane.add(button, BorderLayout.LINE_END);
```

BoxLayout

- Left-to-right or top-to-bottom
- Obeys alignment field of container
- ```
  JComponent.setAlignmentX(float) // takes value
  JComponent.setAlignmentY(float) // between 0 to 1
  ```
- ```
  Component.LEFT_ALIGNMENT
  Component.RIGHT_ALIGNMENT
  Component.CENTER_ALIGNMENT
  Component.BOTTOM_ALIGNMENT
  Component.TOP_ALIGNMENT
  ```

BoxLayout

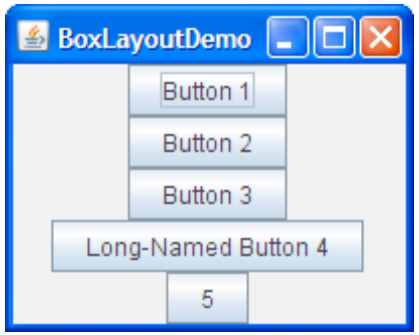
- Unusual constructor:
  new BoxLayout(Container, int axis)
- BoxLayout.X_AXIS, BoxLayout.Y_AXIS
- BoxLayout tries to grow components to fill the space, subject to maximum size

BoxLayout Example

```
public static void addComponentsToPane(Container pane) {
    pane.setLayout(new BoxLayout(pane, BoxLayout.Y_AXIS));

    addAButton("Button 1", pane);
    addAButton("Button 2", pane);
    addAButton("Button 3", pane);
    addAButton("Long-Named Button 4", pane);
    addAButton("5", pane);
}

private static void addAButton(String text, Container container) {
    JButton button = new JButton(text);
    button.setAlignmentX(Component.CENTER_ALIGNMENT);
    container.add(button);
}
```



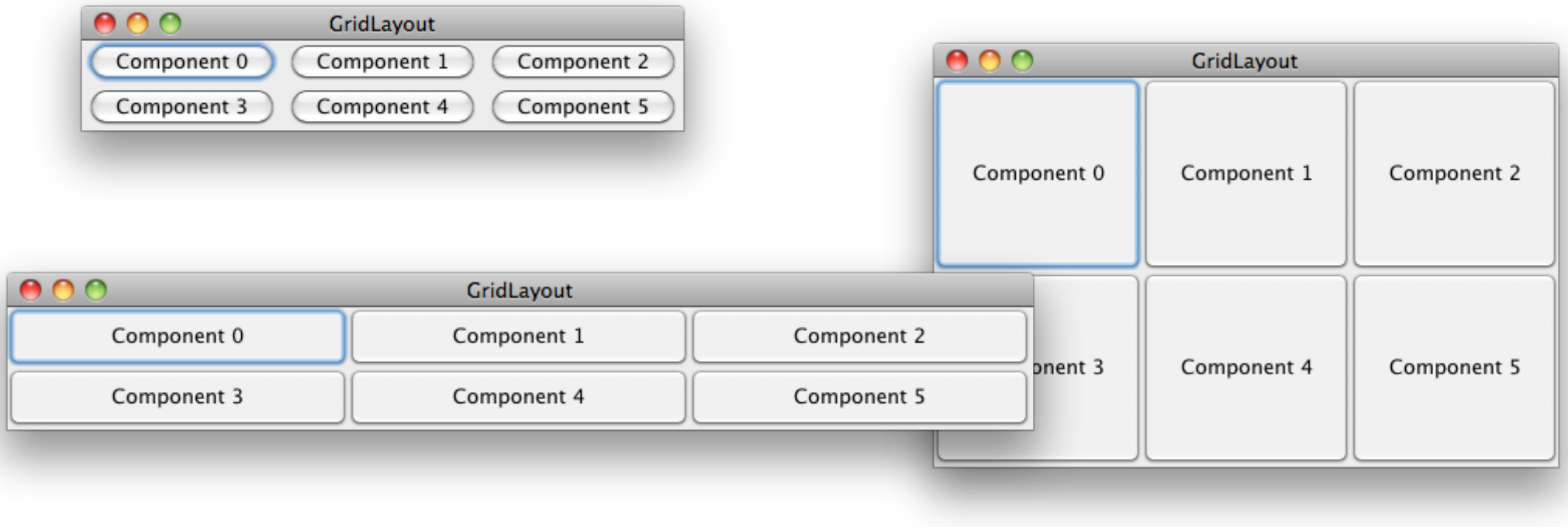
GridLayout

- Lays out components on a grid from left to right in rows from top to bottom
- Grows components to fill available space if container is bigger than preferred size
- You specify grid size in constructor:
  new GridLayout(int rows, int columns)
- One of rows or columns may be 0, which tells AWT to add as many as needed

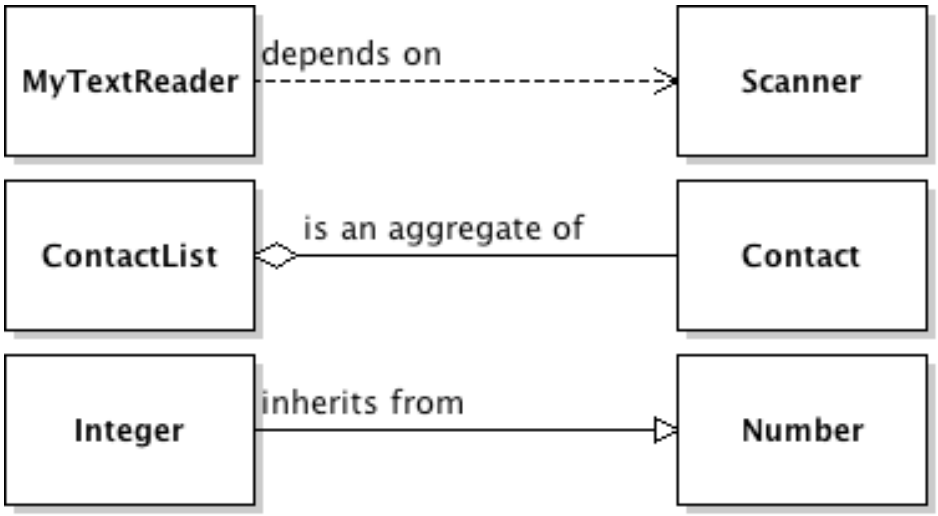
GridLayout Example

```
JFrame gridFrame = new JFrame("GridLayout");
gridFrame.setLayout(new GridLayout(2,3));

for (int i=0; i<6; i++)
   gridFrame.add(new JButton("Component "+i));
```



Inheritance



- Describes a relationship between classes in which a *subclass* is a more specific form of a *superclass*
- Declared in Java with the keyword `extends`

Why Extend Classes?

- Inheritance may happen naturally
  - AWT's Component first introduced in 1995
  - Swing's JComponent in 1997
- Or it can be by design:
  - we know we want to use fully functioning objects of a general superclass
  - but we also want more specific functionality of some subclasses

Subclasses

- Subclasses often provide additional methods and fields
  - or they may *override* the superclass's methods
- Java allows special keyword `super` to refer to superclass
  - used to invoke superclass's methods, including constructor

Keyword super

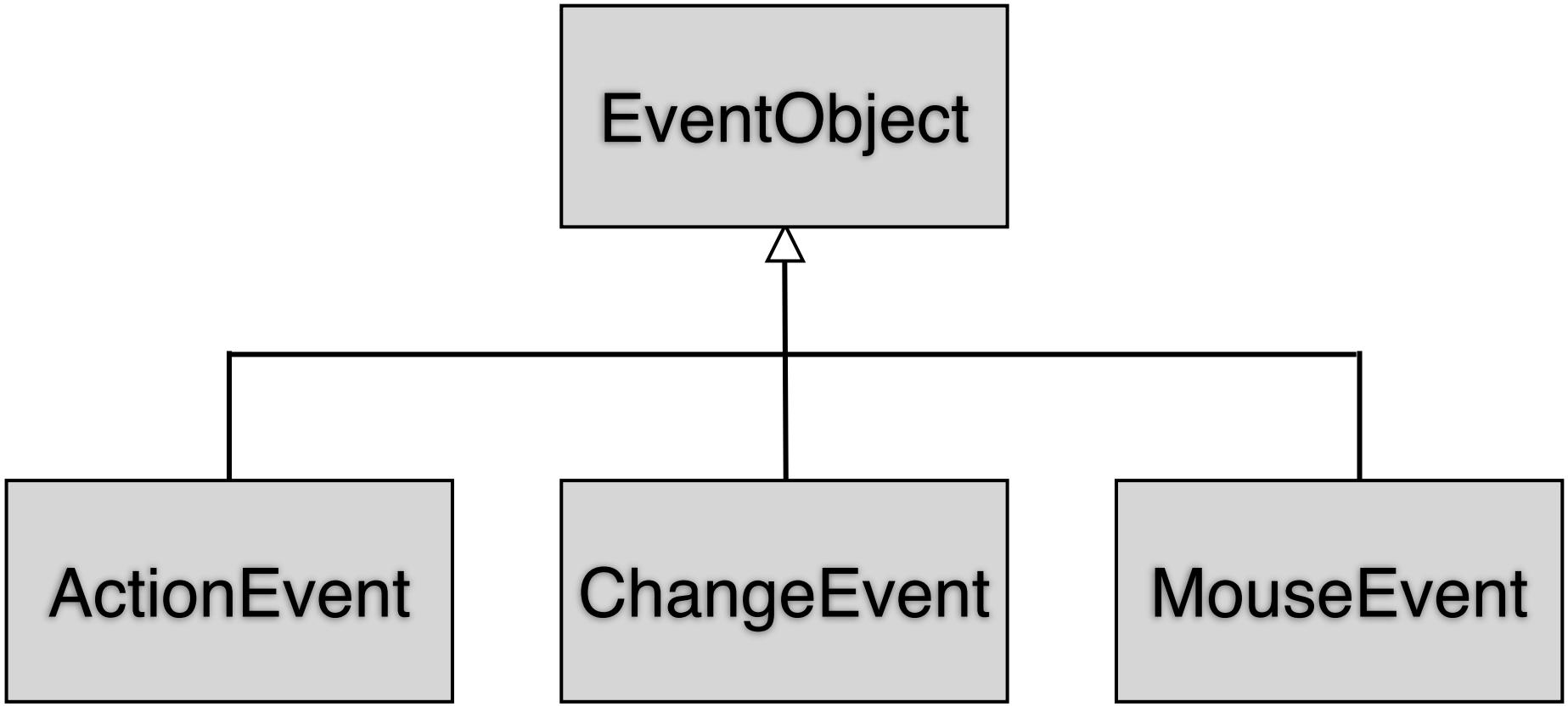
- We saw this example last class
- MouseAdapter is the superclass

```
private static class MyMouseListener extends MouseAdapter
{
   public MyMouseListener(MousePanel panel)
   {
      super();
      myPanel = panel;
   }
   public void mouseClicked(MouseEvent event)
   {
       ...
```

Liskov's Substitution Principle

- Let *q(x)* be a property provable about objects *x* of type *T*. Then *q(y)* should be true for objects *y* of type *S* where *S* is a subtype of *T*. (Liskov)
- You can substitute subclass objects whenever a superclass object is expected
  - but not always vice versa (never)

EventObject Hierarchy



Polymorphism and Inheritance

- Overriding methods can cause some confusion if we're unclear on how inheritance works
- We extended MouseAdapter to make MyMouseListener
- ```
  MouseAdapter ma = new MyMouseListener();
  ma.mouseClicked(); // what happens?
  ```
- Actual types of objects, not declared types, determine which methods are called
  ```

Encapsulation and Inheritance

- Public and private modifiers apply even to subclasses
  - Extending a class doesn't grant you access to its private methods
- Otherwise, implementations would not be interchangeable, since subclasses would depend on private class code
- Subclasses must implement their added functionality using only public interface of superclass

Preconditions and Postconditions

- Subclass methods cannot have stricter preconditions than superclass methods
- Subclass methods cannot have looser postconditions than superclass methods
- Because all subclass objects must fit Liskov substitution; they must be viewable as superclass objects

Reading

- Layout examples from: http://java.sun.com/docs/books/tutorial/uiswing/layout/index.html
- Horstmann Ch. 6