Concepts of Object-Oriented Programming

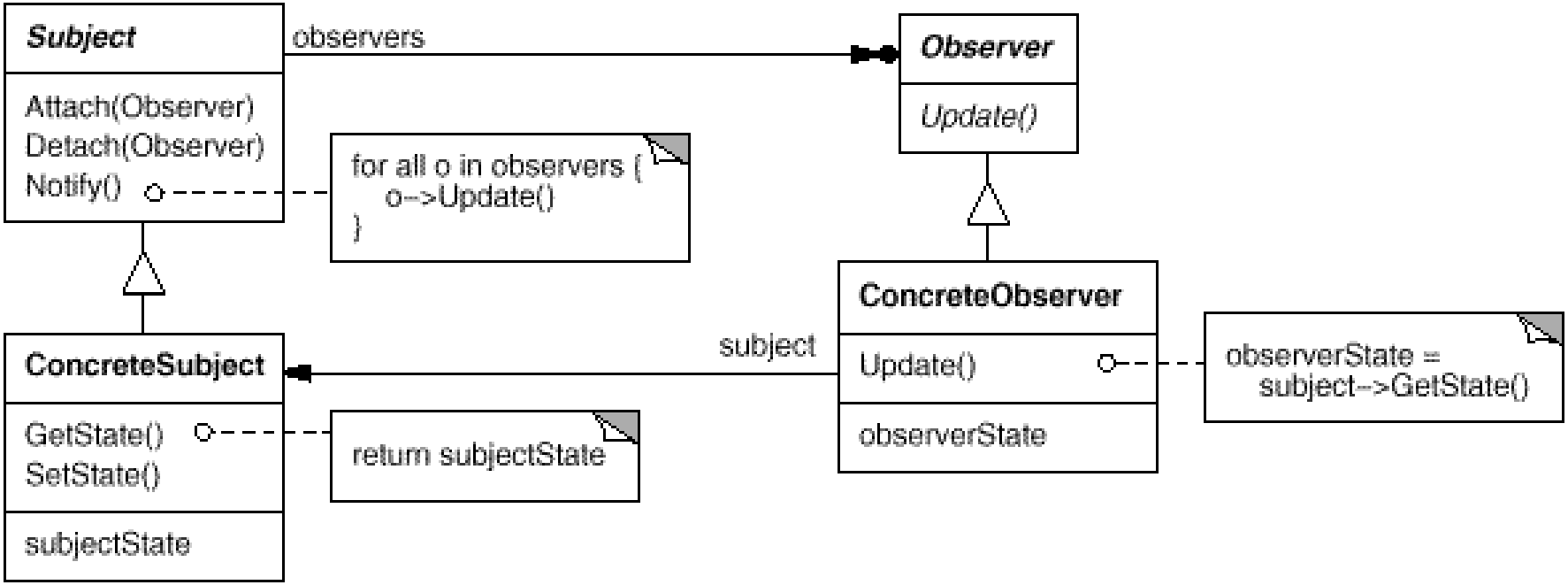
Prof. Dr. Peter Müller

Chair of Programming Methodology

Exercises 5: Frameworks

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Exercise 5.1 – Observer Pattern



From: Gamma, Helm, Johnson, Vlissides: “Design Patterns”

Java support for the Observer Pattern

- Subject → `java.util.Observable`
  - `void addObserver(Observer o)`
  - `void setChanged()`
  - `void notifyObservers(Object arg)`
- Observer → `java.util.Observer`
  - `void update(Observable o, Object arg)`
- Events → `java.util.EventObject`
  - `EventObject(Object source)`
  - `Object getSource()`

Events

```
abstract public class ChangeEvent
  extends java.util.EventObject {

  public ChangeEvent( Object source,
                      int v, int c ) {
     super(source); value = v; change = c; }

  public int getValue() { return value; }

  public int getChange() { return change; }

  private int value;
  private int change;
}
```

Specialized Events

```
public class IncreaseEvent
    extends ChangeEvent {
   public IncreaseEvent(Object s,int v,int c) {
    super(s, v, c);
   }
}

public class DecreaseEvent
    extends ChangeEvent {
   public DecreaseEvent(Object s,int v,int c) {
    super(s, v, c);
   }
}
```

ActiveValue – Setup

```
public class ActiveValue
   extends java.util.Observable {

  private int myval;

  public void run() {
   int change;
   Random crnd = new Random();

   myval = 0;

   while( true ) {  …  }
  }
}
```

ActiveValue – Main Loop

```
while( true ) {
    change = crnd.nextInt( 11 ) - 5;

    myval += change;

    sendEvent( change );

    Thread.sleep( 1000 );
}
```

ActiveValue – Event Notification

```
public void sendEvent( int change ) {
   java.util.EventObject e;

   if( change >= 0 ) {
      e = new IncreaseEvent(this,myval,change);
   } else {
      e = new DecreaseEvent(this,myval,change);
   }

   setChanged();
   notifyObservers( e );
}
```

ActiveValue – Changing the Value

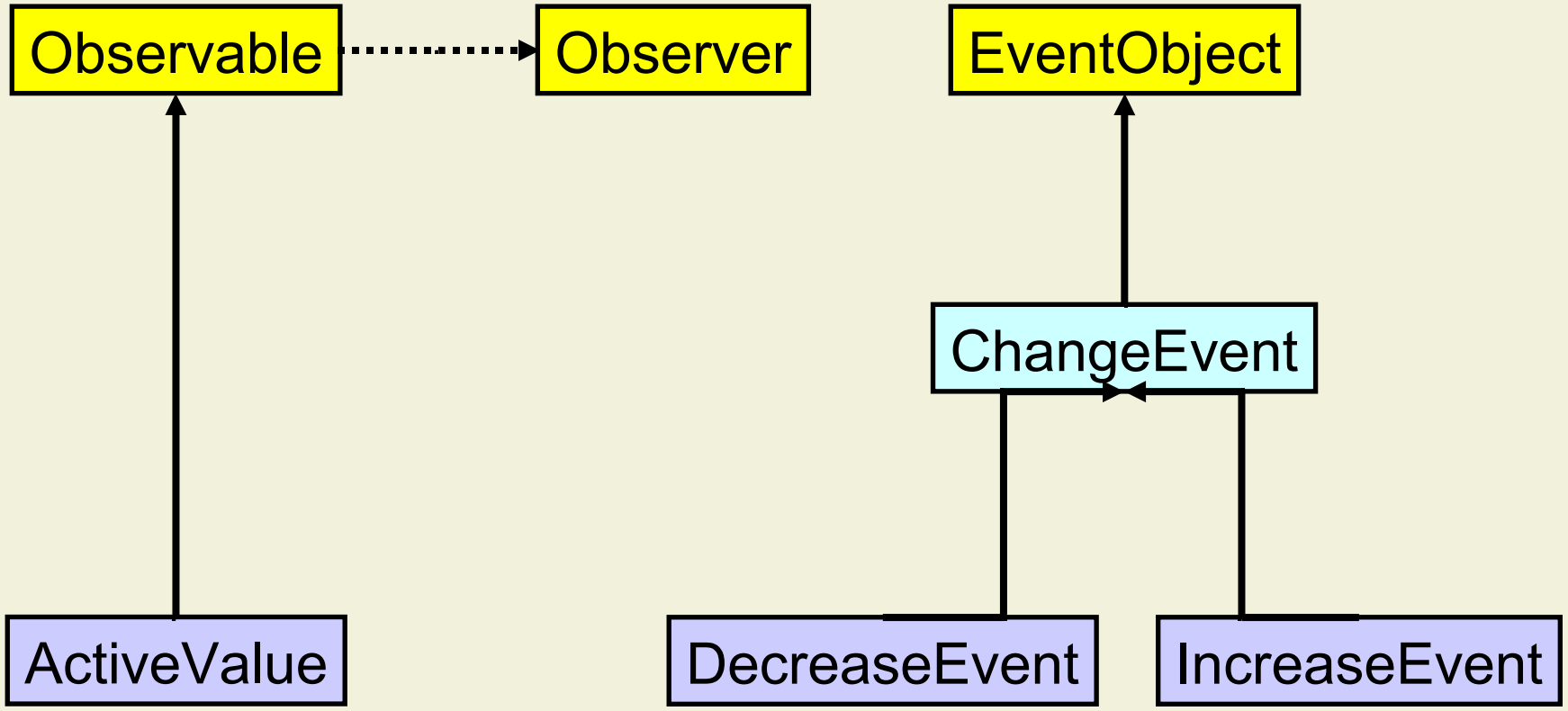
```
public void reset() {
    setValue( 0 );
}


public void setValue( int value ) {
    int change;

    change = value - myval;
    myval = value;

    sendEvent( change );
}
```

Class Hierarchy so far



AlertObserver

```
public class AlertObserver
   implements java.util.Observer {

 public void update( java.util.Observable s,
                     Object e ) {

    if( !(e instanceof ChangeEvent)) return;
    ChangeEvent ce = (ChangeEvent) e;

    if( ce.getValue() >= 40 ) {
      System.out.println("A: "+ce.getValue());
    }
 }
}
```

SignChangeObserver

```
public class SignChangeObserver
   implements java.util.Observer {

  public void update( java.util.Observable s,
                      Object e ) {

    if( !(e instanceof ChangeEvent)) return;
    ChangeEvent ce = (ChangeEvent) e;

    if( ce instanceof IncreaseEvent ) {
        System.out.println("+");
    } else {
        System.out.println("-");
    }
  }
}
```

TextChangeObserver

```
public class TextChangeObserver
   implements java.util.Observer {

  public void update(Observable s, Object e) {
    if( !(e instanceof ChangeEvent)) return;
    ChangeEvent ce = (ChangeEvent) e;
    if( ce instanceof IncreaseEvent ) {
        System.out.print("++++ ");
    } else {
        System.out.print("---- ");
    }
    System.out.println("New Value: "+ce.getValue() +
      " Change: " + ce.getChange() );
  }
}
```

TextMain

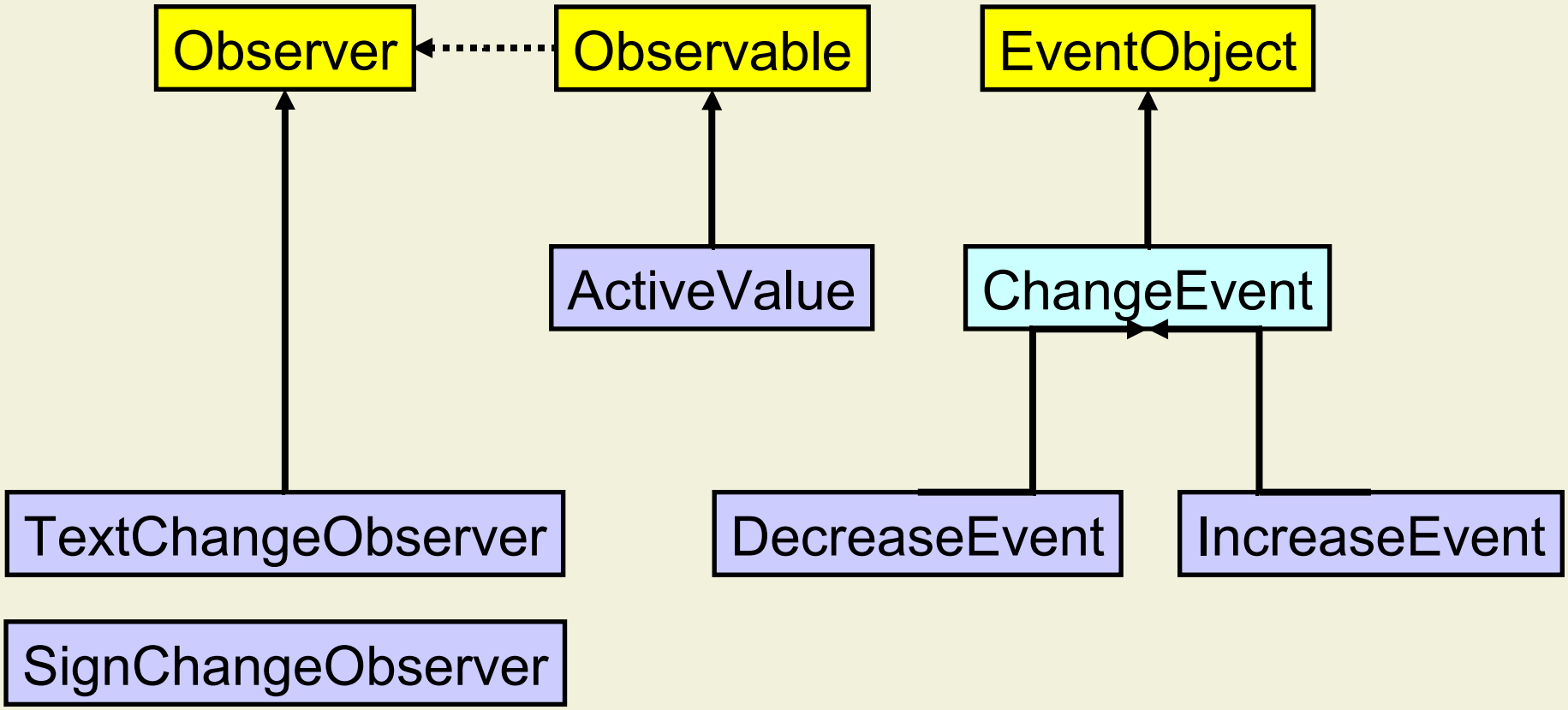
```
public class TextMain {
   public static void main( String[] args ) {
      ActiveValue v = new ActiveValue();

      Observer o1 = new TextChangeObserver();
      Observer o2 = new SignChangeObserver();

      v.addObserver( o1 );
      v.addObserver( o2 );

      v.run();
   }
}
```

Class Hierarchy



GuiMain – Adding a Graphical UI

```
public class GuiMain {
  public static void main( String[] args ) {

    ActiveValue v = new ActiveValue();

    Observer o1 = new GuiChangeObserver();
    Observer o2 = new GuiSignChangeObserver();

    v.addObserver( o1 );
    v.addObserver( o2 );

    v.run();
  }
}
```

GuiChangeObserver – Update

```
public class GuiChangeObserver
  implements java.util.Observer {
 public void update( Observable s, Event e ) {
    if( ! (e instanceof ChangeEvent) ) return;
    ChangeEvent ce = (ChangeEvent) e;
    if( ce instanceof IncreaseEvent ) {
        sign.setForeground( Color.RED );
        sign.setText("++++");
    } else { … }
    value.setText("New Value: " + ce.getValue());
    change.setText("Change: " + ce.getChange());
 }
  …
```

Adding Components

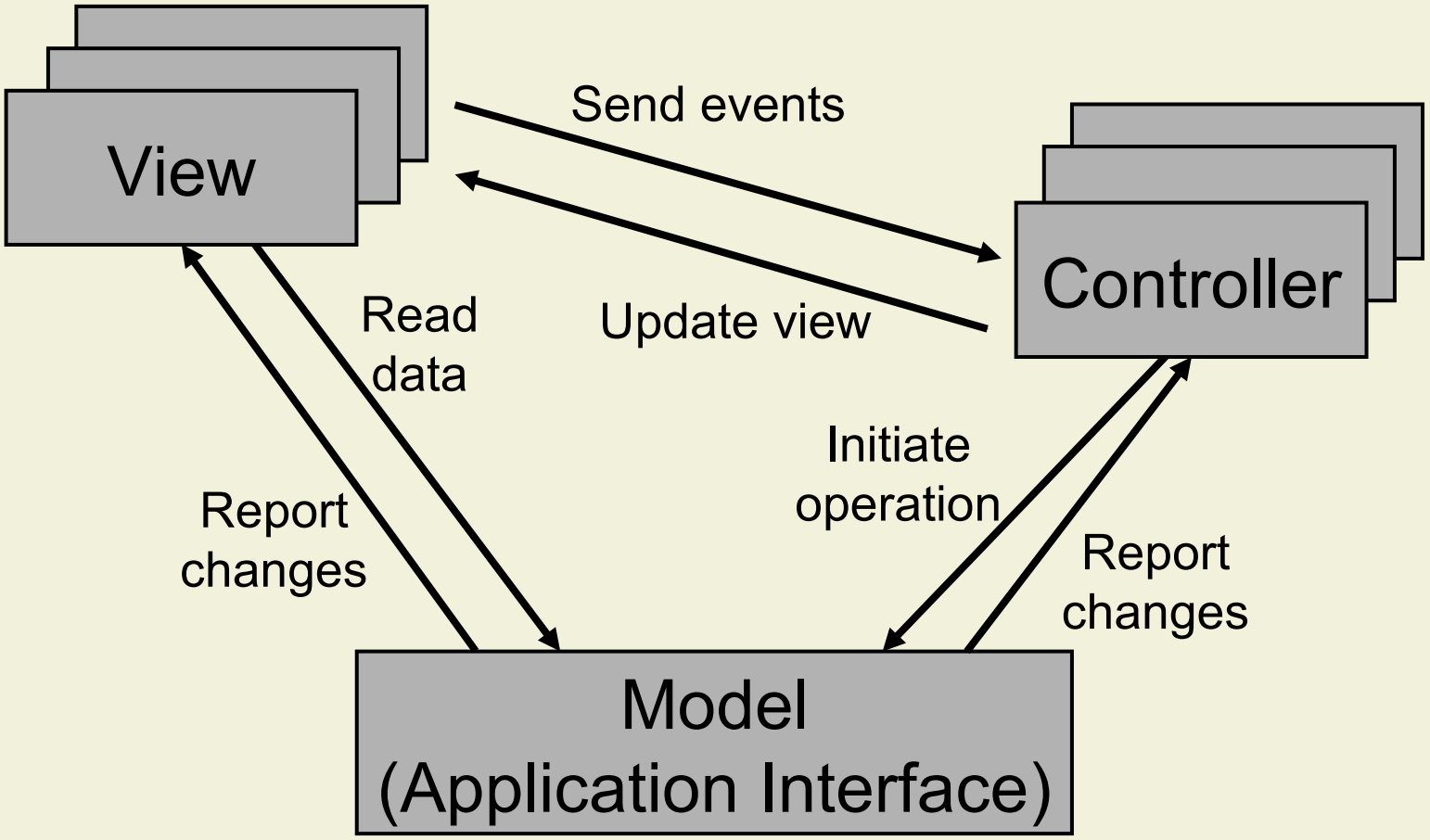
```
public Component createComponents() {
   JPanel pane = new JPanel();
   pane.setBorder(
    BorderFactory.createEmptyBorder(
       30, 30, // top, left
          30, 30) // bottom, right
   );
   pane.setLayout(new GridLayout(0, 3));

   pane.add(sign);
   pane.add(value);
   pane.add(change);

   return pane;
}
```

Screenshot & Demo

Model-View-Controller Architecture

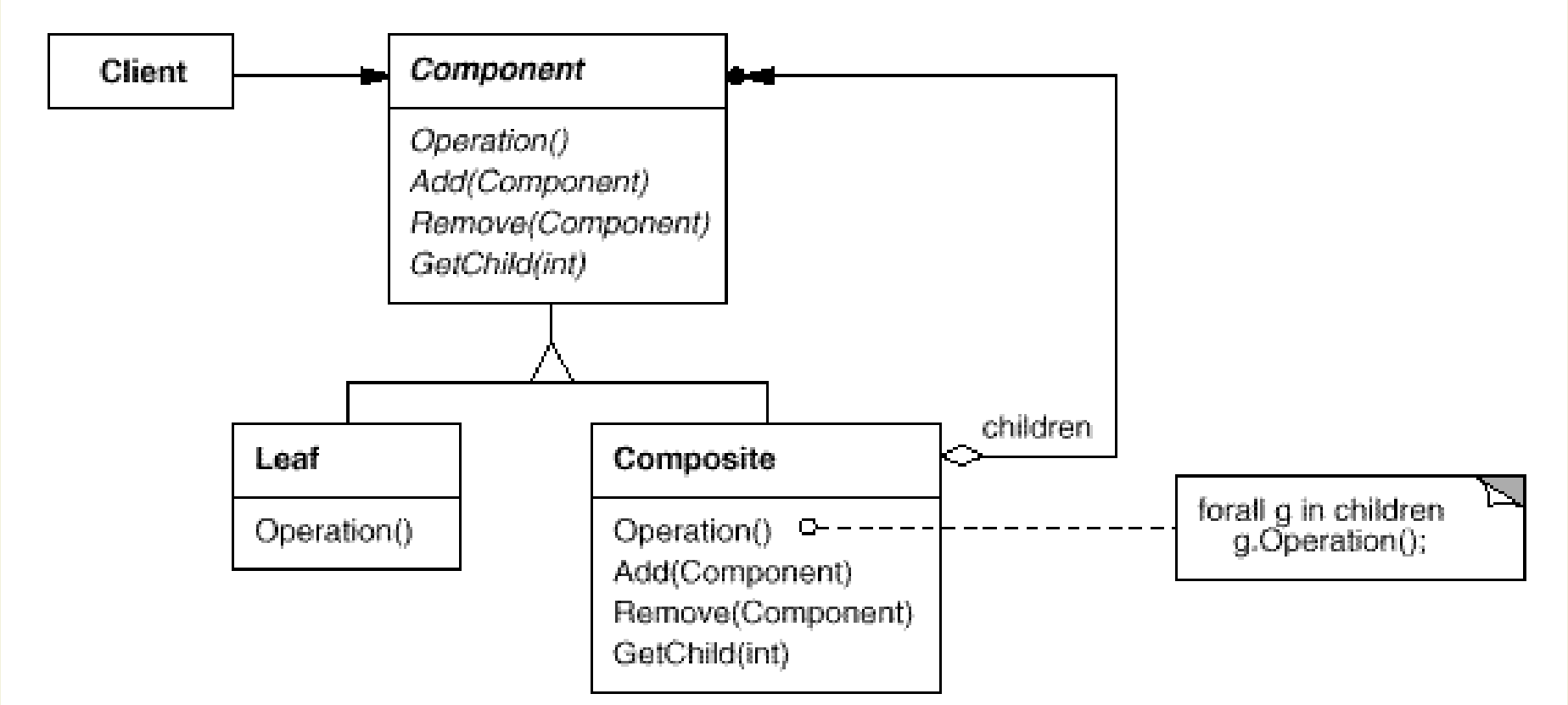


Adding a Simple Reset Controller

```
button = new JButton();
button.addActionListener(
    new ActionListener() {
        public void actionPerformed(
                                ActionEvent e) {
            theValue.reset();
        }
    } );

pane.add(button, BorderLayout.CENTER);
```

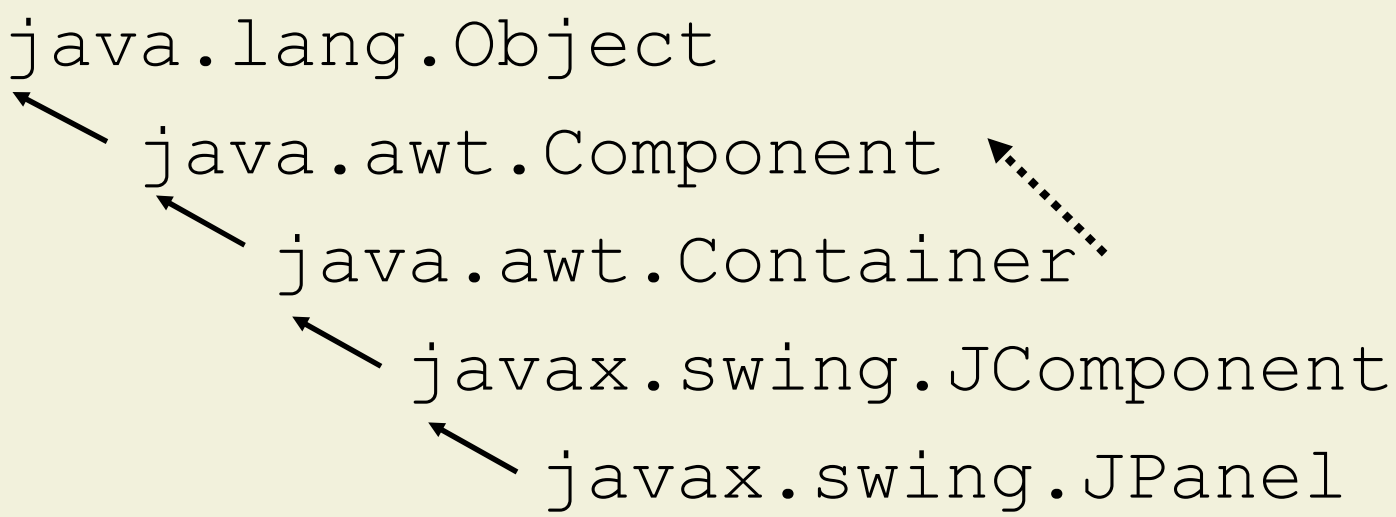
Composite Pattern



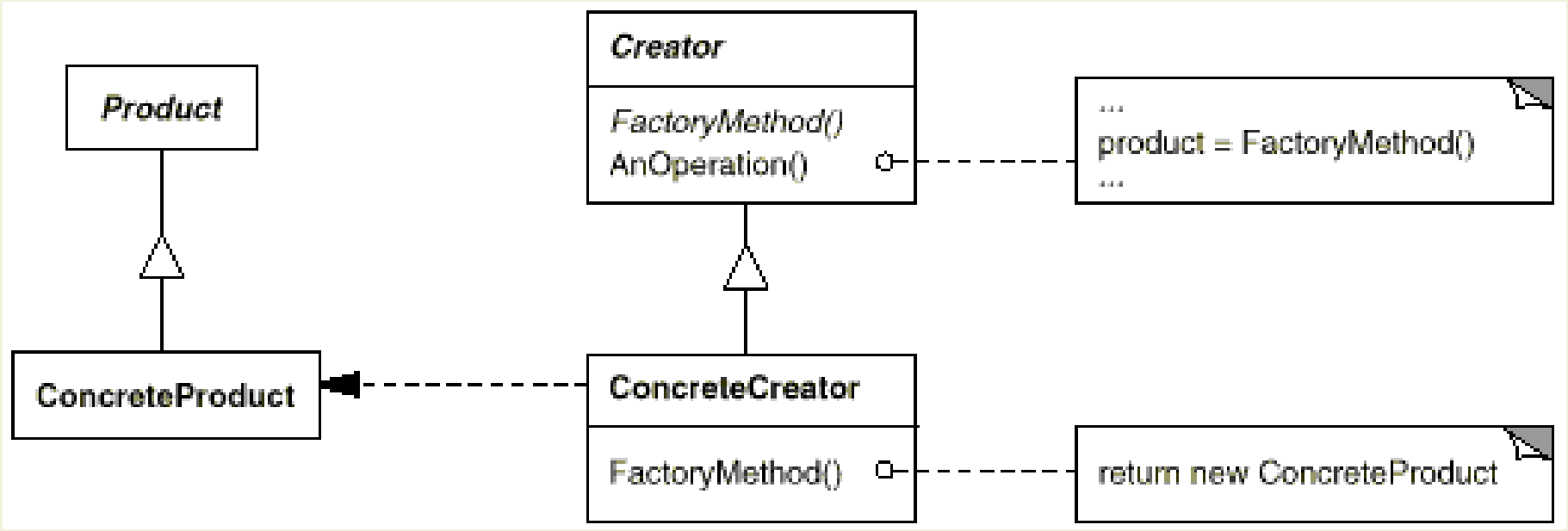
From: Gamma, Helm, Johnson, Vlissides: “Design Patterns”

Composite Pattern in Swing

- Used many times
- Composite is called Container

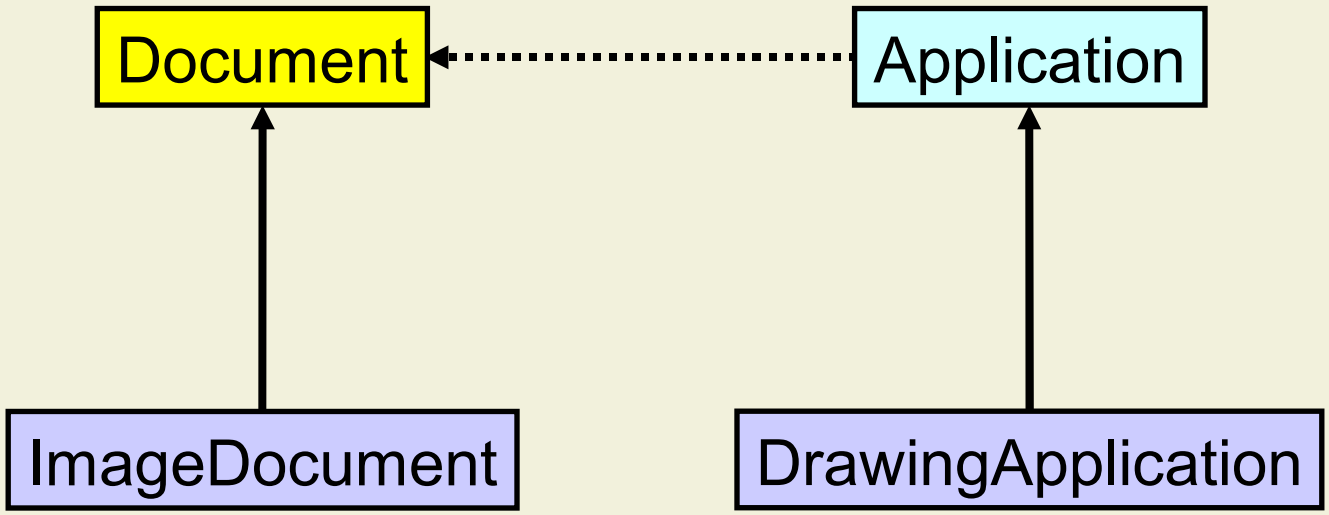


Exercise 5.2 – Factory Method Pattern



From: Gamma, Helm, Johnson, Vlissides: “Design Patterns”

Example Classes



Abstract Class Application

```
public abstract class Application {
  public Application() {
    documents = new ArrayList<Document>();
  }

  // the factory method!
  protected abstract Document createDocument();

  public void newDocument() {
    Document toadd = createDocument();
    documents.add( toadd );
    toadd.open();
  }
...
```

Interface Document

```
public interface Document {
  void open();
  void save();
  void reload();
  void close();
}
```

Class ImageDocument

```
public class ImageDocument
    implements Document {
  public void open() {
     System.out.println("ImageDocument.open");
  }

  public void save() {
     System.out.println("ImageDocument.save");
  }
...
```

Class DrawingApplication

```
public class DrawingApplication
      extends Application {
  public DrawingApplication() { super(); }

  // the overridden factory method returns
  // a concrete object of type ImageDocument.
  protected Document createDocument() {
      return new ImageDocument(); }

  public static void main( String[] args ) {
      DrawingApplication appl =
            new DrawingApplication();
  appl.newDocument();     appl.newDocument();
  appl.newDocument();     appl.saveAll();
  appl.closeAll(); }
}
```

Example Classes