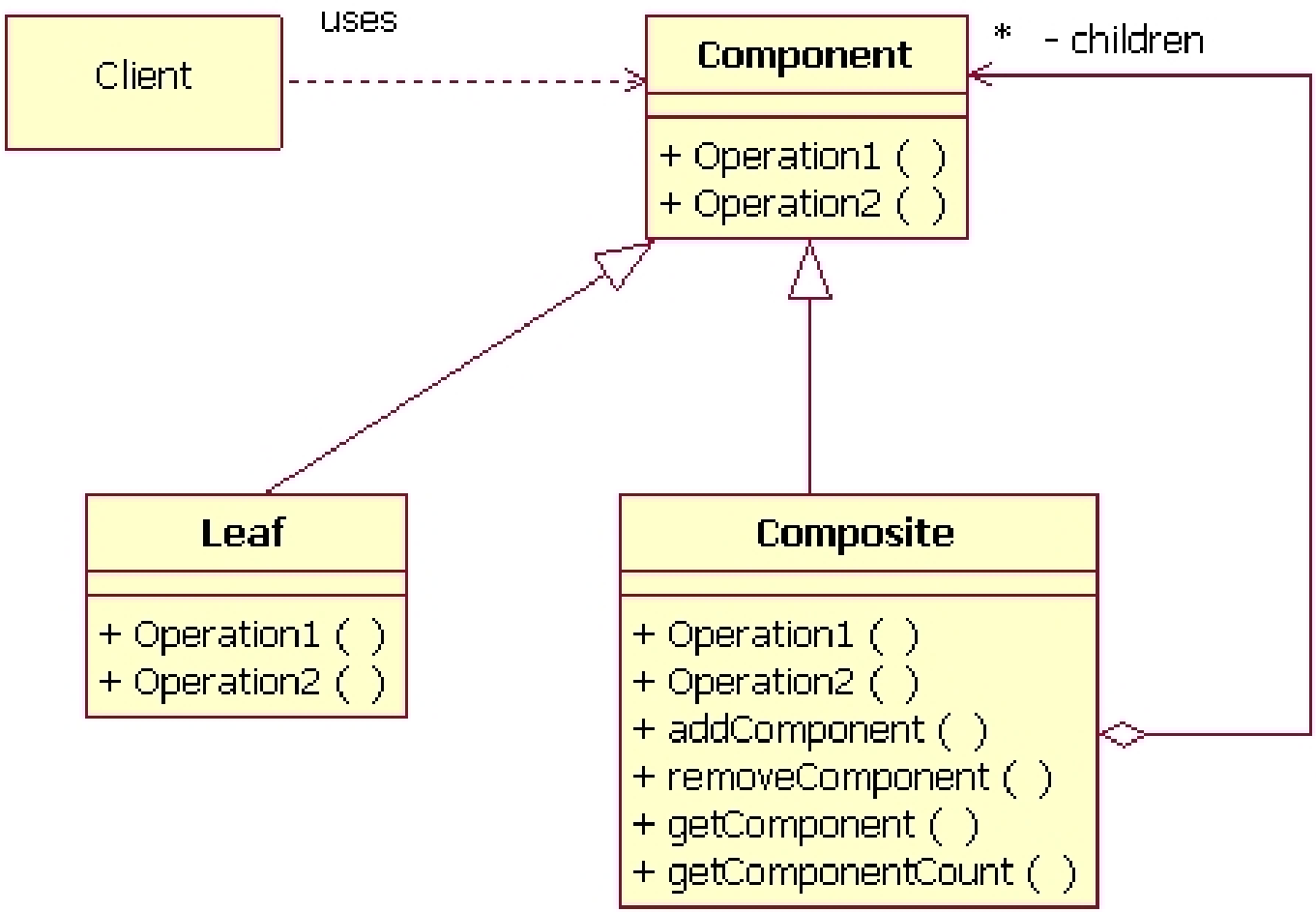
Composite Design Pattern

Rick Mercer

Composite Pattern

- Recurring problem:
  - Often complex structures are built with *container* and *primitive objects*. Container objects can contain other objects
  - How can code that uses these classes treat all the objects in the structure identically sometimes, yet differently when it matters?
- Solution:
  - Define an abstract class that represents primitives *and* containers
- Composite was used in the View class of Smalltalk MVC as well as most other GUI toolkits

General Form of Composite



Participants

- Component
  - Declares the interface for all objects in the composition
  - Implements default behavior, as appropriate
  - Declares an algorithm interface (set of methods) for accessing and managing child components
- Leaf: Has no children: it is a primitive
- Composite: Defines behavior for components having children
  - Also implements child-related operations of Component

Participants

- Component has operations that apply to all
  - The component can be a Composite or a Leaf
- Composite adds methods indicating a collection: add(), and remove()
- In each method, a Component is passed
  - Can add either a Child or a Component
- Component should not add itself
- Should not add a Component to a leaf

Usage Example

```
ArrayList<Object> a = new ArrayList<Object>();
a.add("abc");
a.add("cde");

ArrayList<Object> b = new ArrayList<Object>();
b.add(1.11);
b.add(2.22);

System.out.println("a: " + a);
System.out.println("b: " + b);

b.add(a);
b.add(b);
// a.add(b); Stack Overflow

System.out.println("a: " + a);
System.out.println("b: " + b);
```

- What types are the Leafs here?

  _____

- What type is the Composite?

  _____

- What type is the Component?

  _____

- Output?

  _____

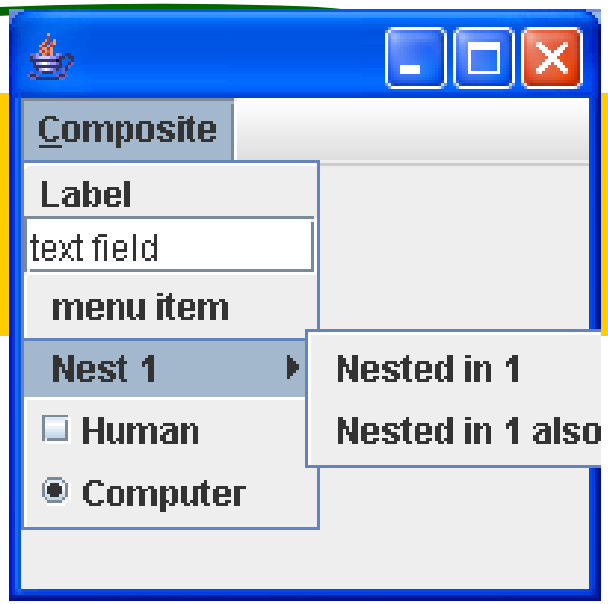
  _____

Use Example: Java Swing

- Java Swing has four major pieces:
  - Events and EventListeners
  - Layouts
  - Drawing
  - Graphical Components
    - The root of all is also named Component
- Component utilizes the Composite pattern in several ways, here's one you'll need for the new project

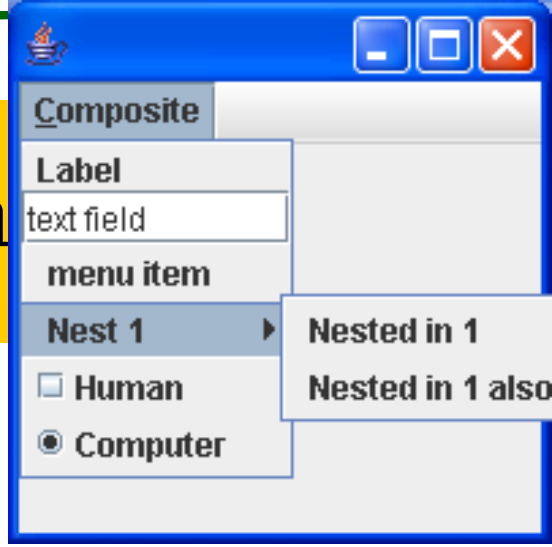
JMenus in Java Swing

- Java menus use the Composite Design Pattern
- **`JMenuBar`** is a composite extending **`JComponent`**
- **`JMenuBar`** is a composite extending **`JComponent`**
  - Can add others like **`JLabel`**, **`JTextField`**
  - Can also add **`JMenuItem`** to **`JMenuItem`**
- **`JMenuItem`** has three subclasses
  - **`JMenu`**
  - **`JRadioButtonMenuItem`**
  - **`JCheckboxMenuItem`**




```
JMenuItem menu = new JMenu("Composite");
menu.setMnemonic('C');//Open with alt-C
// Create two leafs
JLabel label = new JLabel("Label");
JTextField textF = new JTextField("text field");
menu.add(label);
menu.add(textF);
// Add a Composite
JMenuItem menuItem = new JMenuItem("menu item");
menu.add(menuItem);
// Add two Composites to a Composite
JMenuItem jmi1Nest = new JMenu("Nest 1");
menu.add(jmi1Nest);
JMenuItem jmiNested1 = new JMenuItem("Nested in 1");
jmi1Nest.add(jmiNested1);
JMenuItem jmiNested2 = new JMenuItem("Nested in 1 also");
jmi1Nest.add(jmiNested2);
```

JMenuItemDemoCom




```
// Add two more Composites
JMenuItem checkBox
      = new JCheckBoxMenuItem("Human", false);
JMenuItem radioButton
      = new JRadioButtonMenuItem("Computer", true);
menu.add(checkBox);
menu.add(radioButton);
// Add two more Composites
JMenuBar menuBar = new JMenuBar();
setJMenuBar(menuBar);
menuBar.add(menu);
```

Run JMenuItemDemoComposite.java

See code demo page