Comp-304 : Composite
Lecture 24

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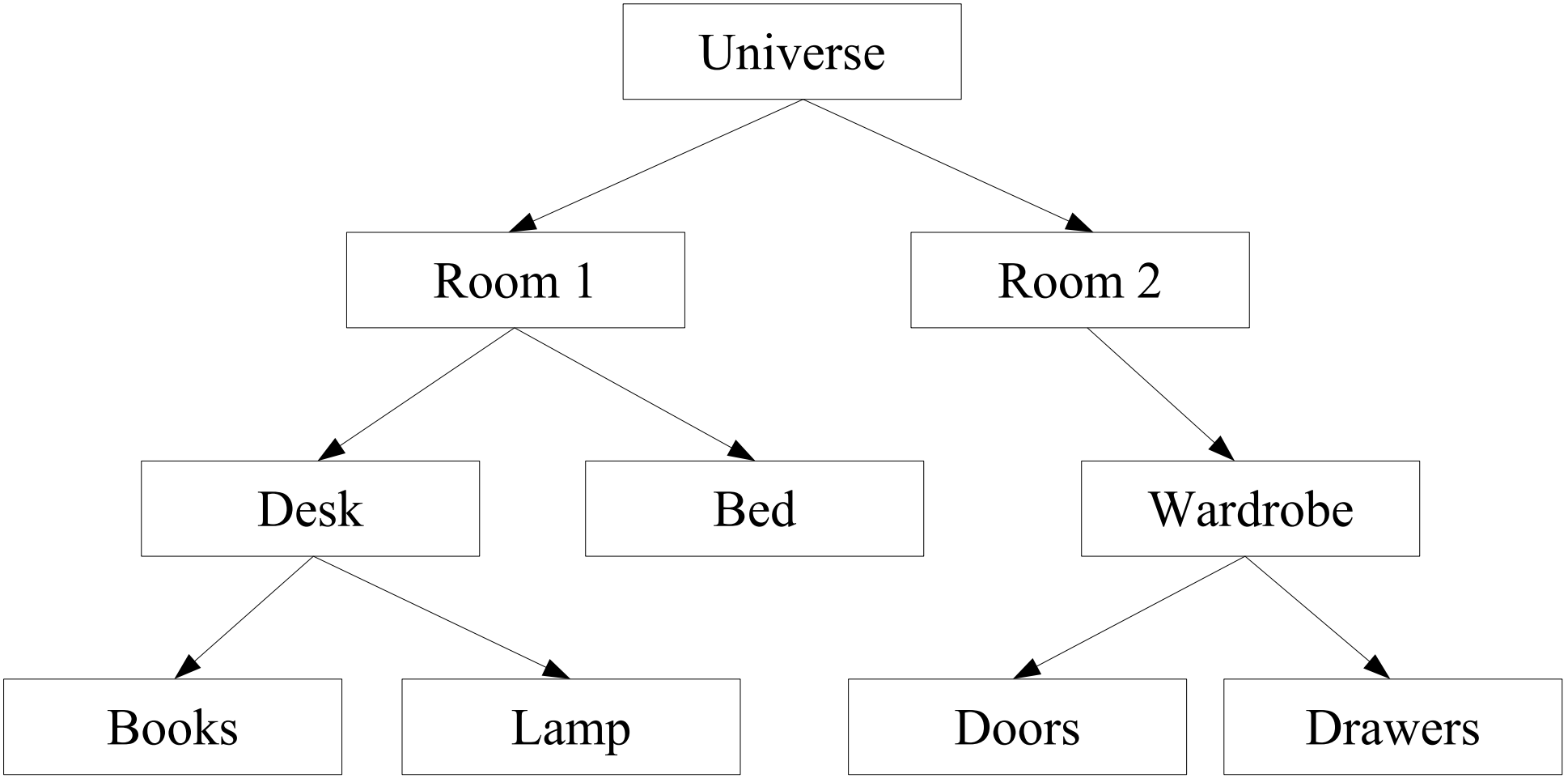
3D Room

Scene Graphs



Hierarchy

- Elements are place in a hierarchical structure for efficiency reasons.
  - Makes culling faster and easier.
- In such a structure, we want to manipulate the composite nodes and the leaf nodes in a similar way.
  - Bounding Boxes
  - Scaling, Rotation, Translation

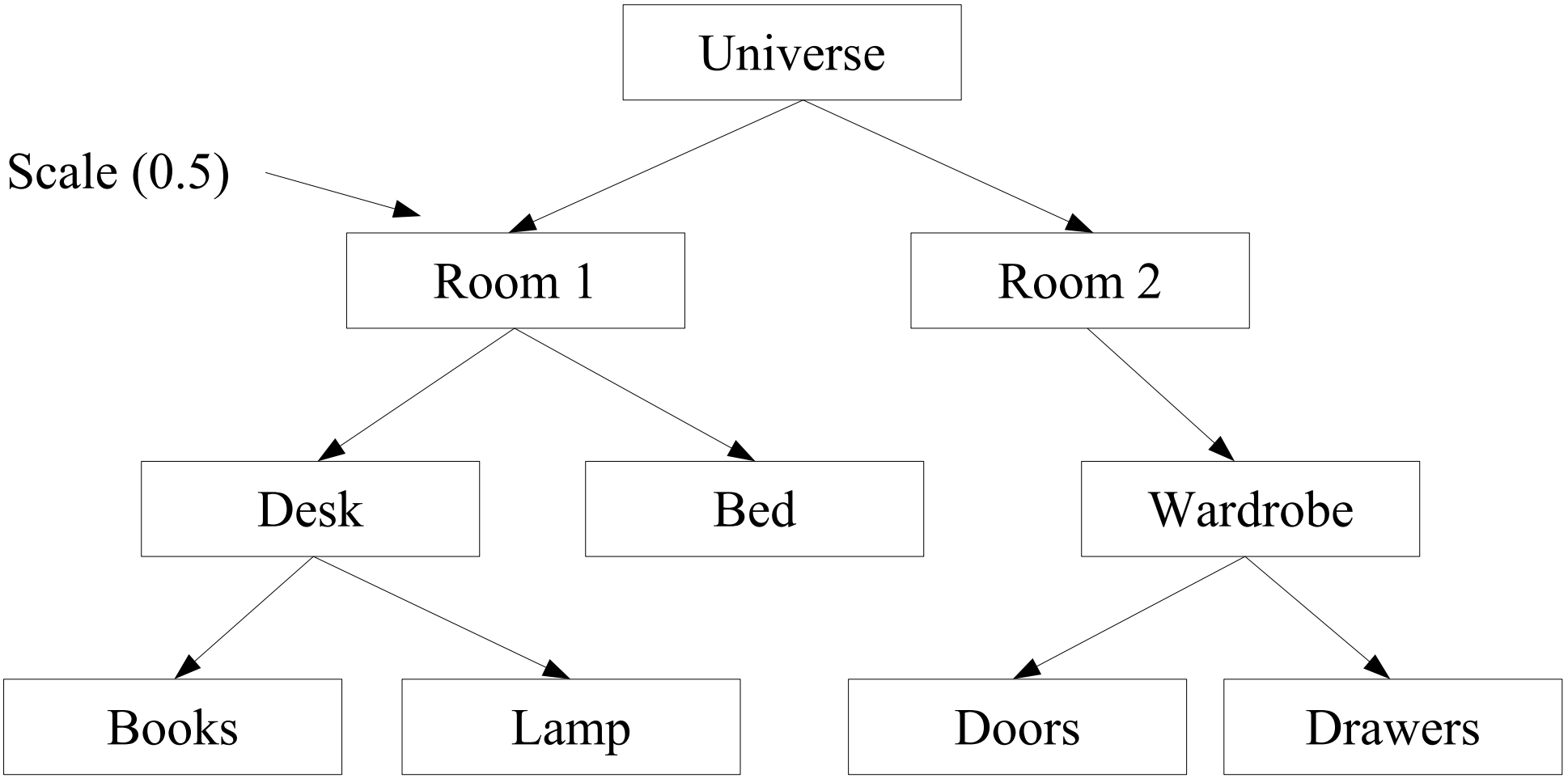
Composite Pattern

- Compose objects into tree structures.
- Allow for uniform treatment of
  - Atomic/primitive Objects
  - Composite Objects

Composite Pattern

- Compose objects into tree structures to represent part or whole hierarchies.
- Composite lets clients treat individual objects and compositions of objects uniformly. This is called recursive composition.

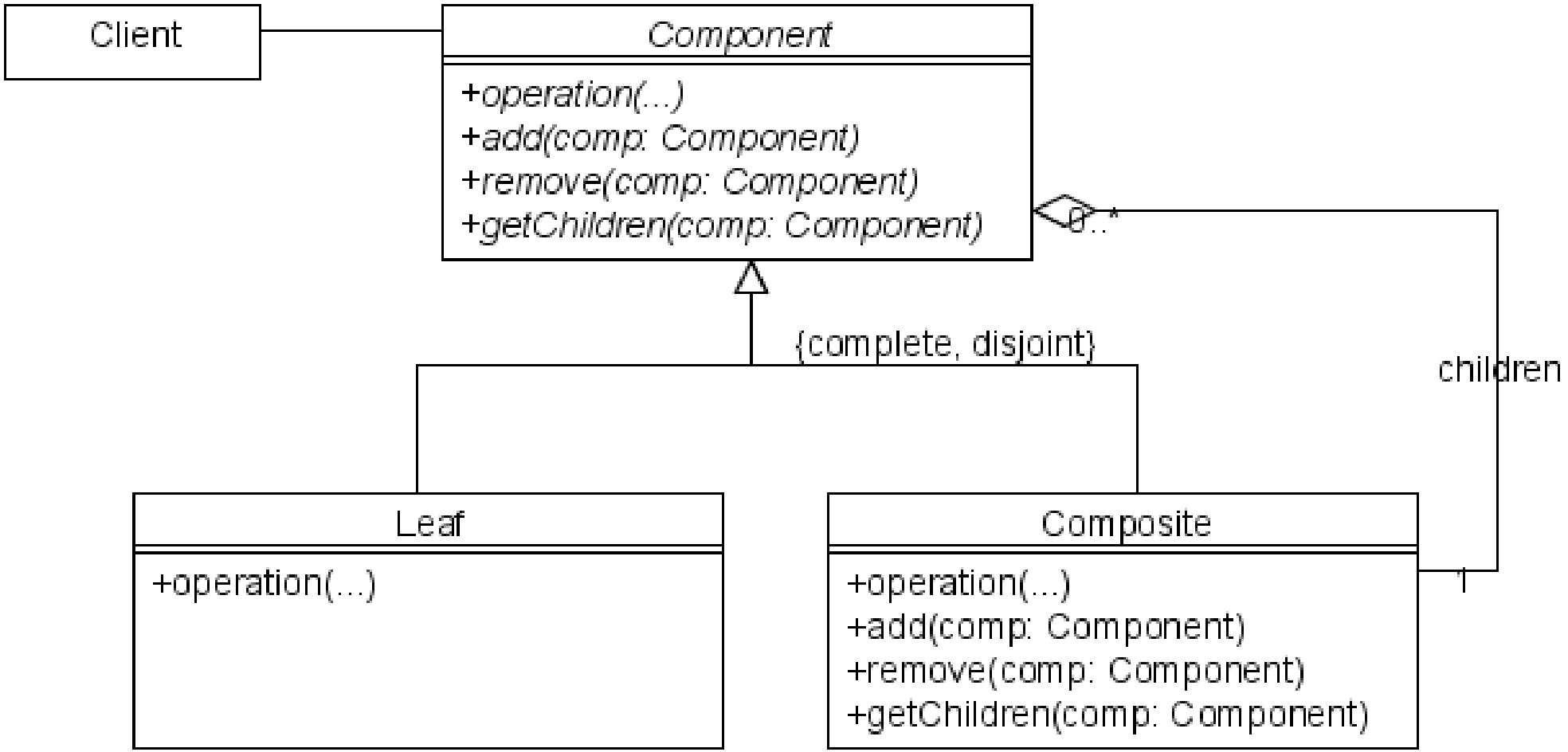
Scaling


Universe
Scale (0.5)
Room 1
Room 2
Desk
Bed
Wardrobe
Books
Lamp
Doors
Drawers

Scaling Explained

- Clients can use the scale command on any node, sub-components will also be scaled.
- The user doesn't need to worry about the type of object he is dealing with.
- To make this work, all components must implement the scale command.
  - Must have the same interface.

Class Diagram



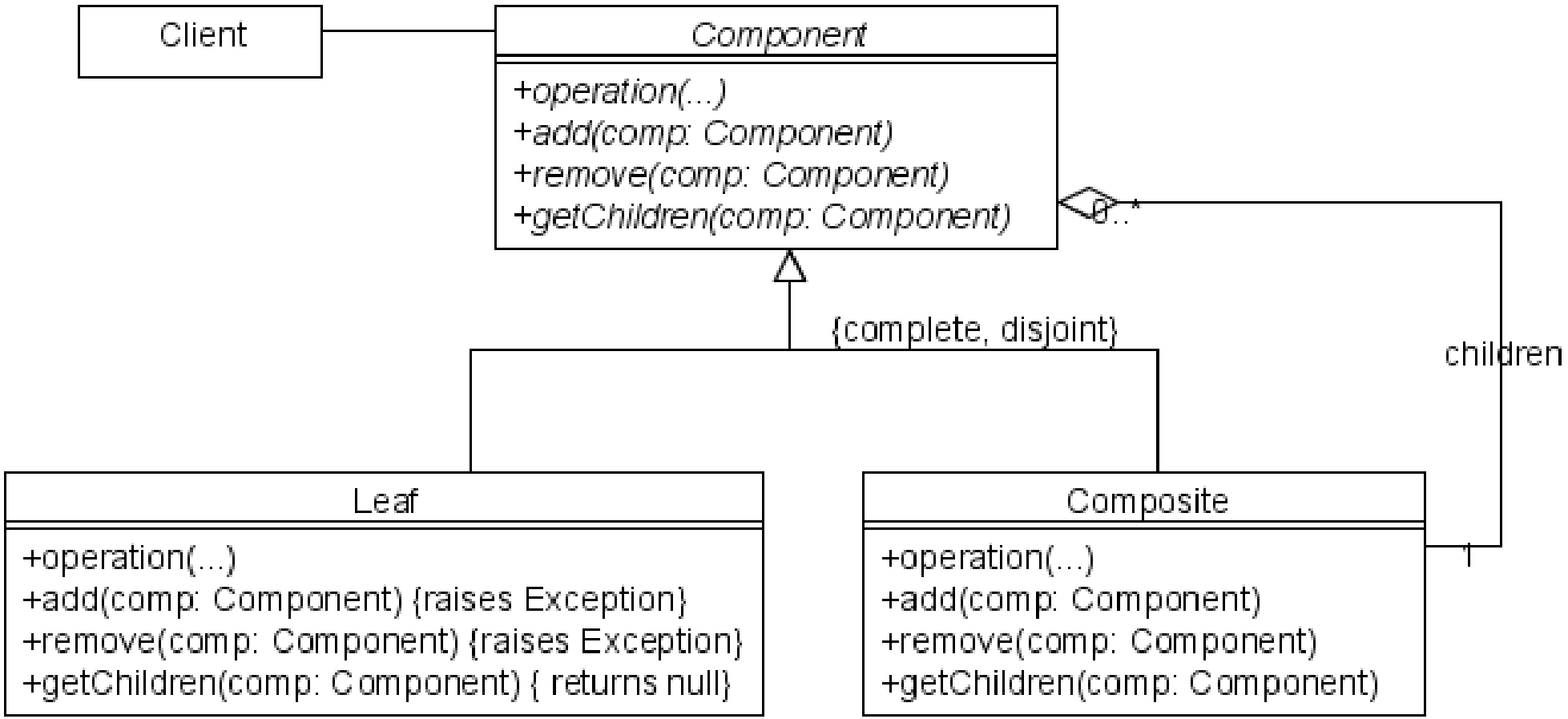
Consequences

- Makes the client simple.
  - Client doesn't need to check if it's dealing with a composite or a leaf.
- Easier to add new kinds of components.
  - Either composite or leaves.
- Makes your design overly general.
  - This has the disadvantage of making it difficult to control which components can be part of a composite.
  - You will most likely need to do runtime checks.

Problem?

- We already have problems with this diagram.
- Component is an abstract method, so leaf must implement the add/remove methods.
- But does leaf need those methods?
- Simplest solution is to raise an exception when those methods a called.
  - Bad design!

Class Diagram, Take 2



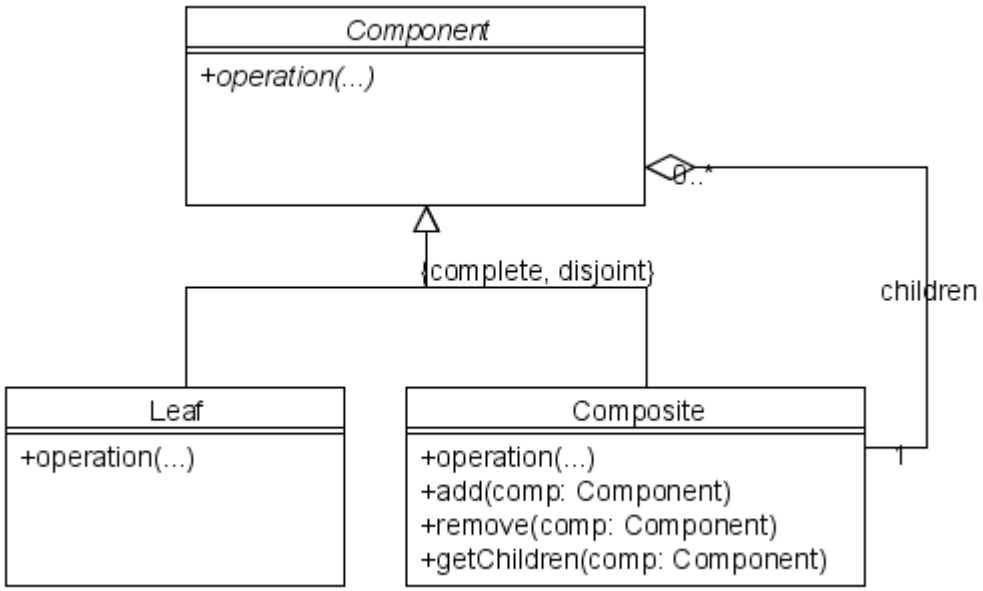
Imp. Conc.: Add/ Remove

- So, where should the add/remove methods be declare?

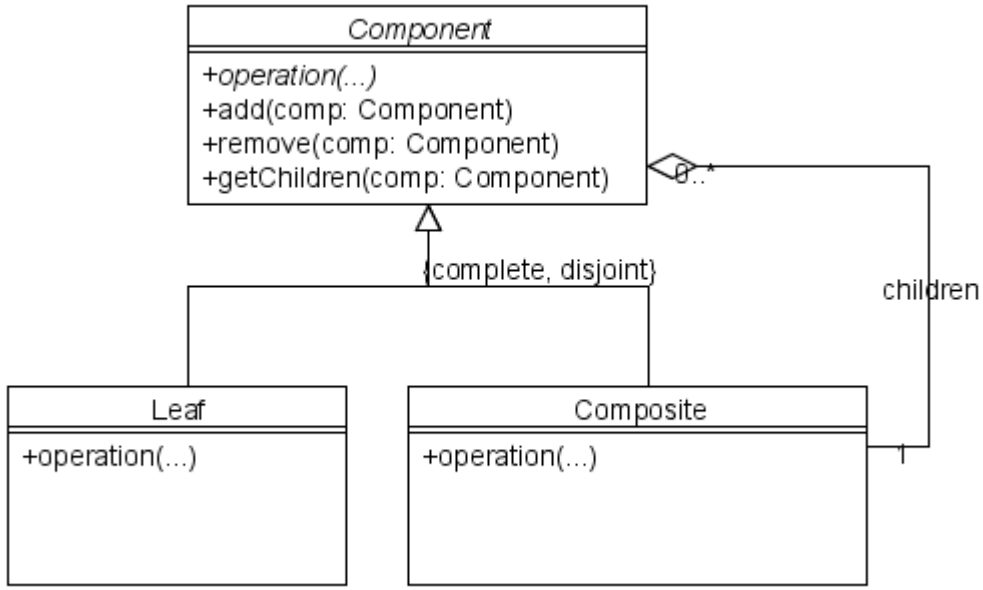
Add/Remove

- So, where should the add/remove methods be declare?
- If we declare it in component (component-level), then the leafs will have meaningless methods.
  - Bad Design!
- If we declare the methods only in the composite (composite-level), then we break the abstraction.
  - Client needs to know the difference between composite and leaf.
- Who keeps references to the children, the component or the composite?
  - At the component level, this would be bad design.
  - In addition, there is a memory penalty since leaf will also have a list for children.

Safety vs Transparency



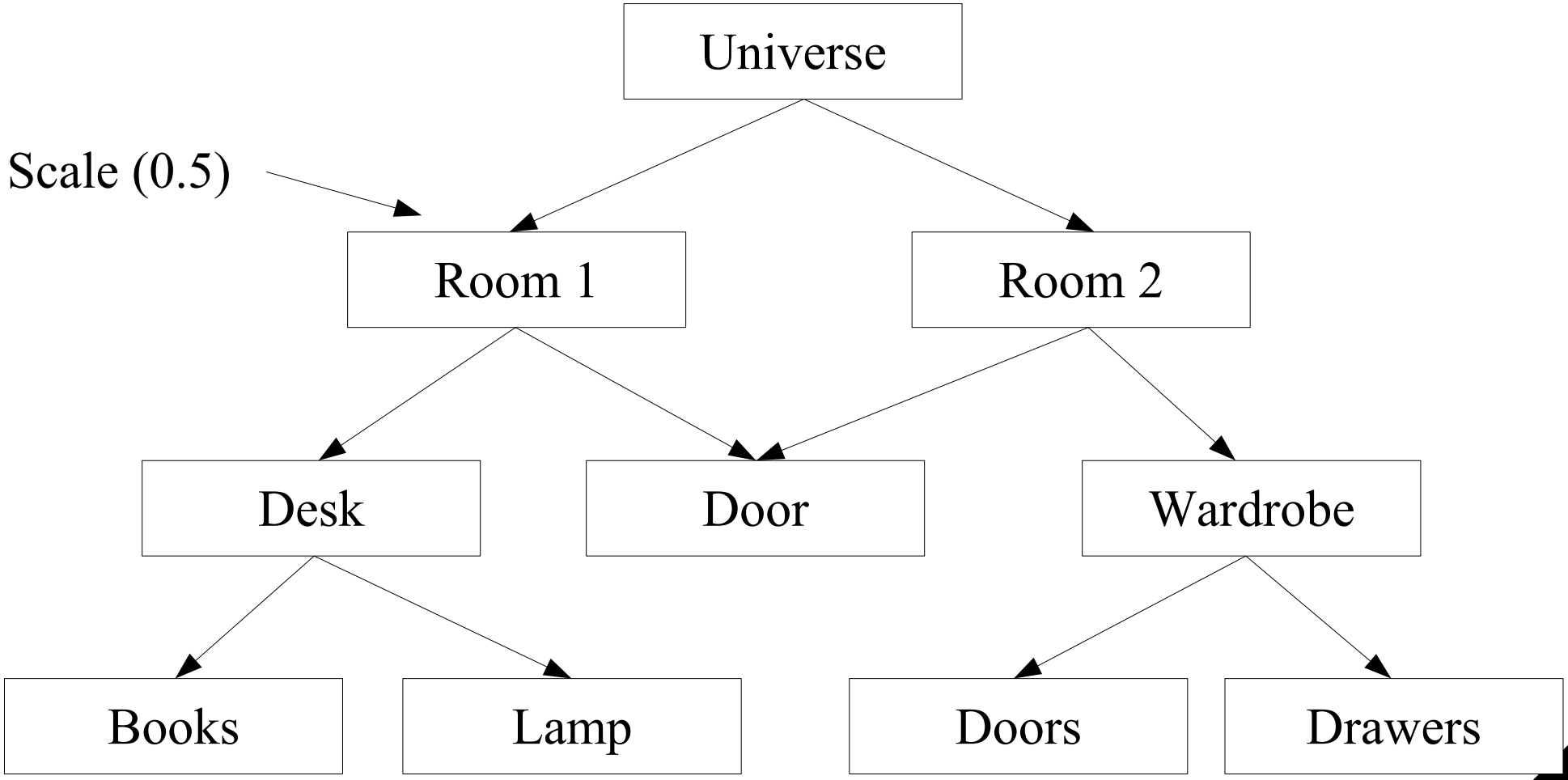
Safety



Transparency

Multiple Parents

- What happens if a child has multiple parents?

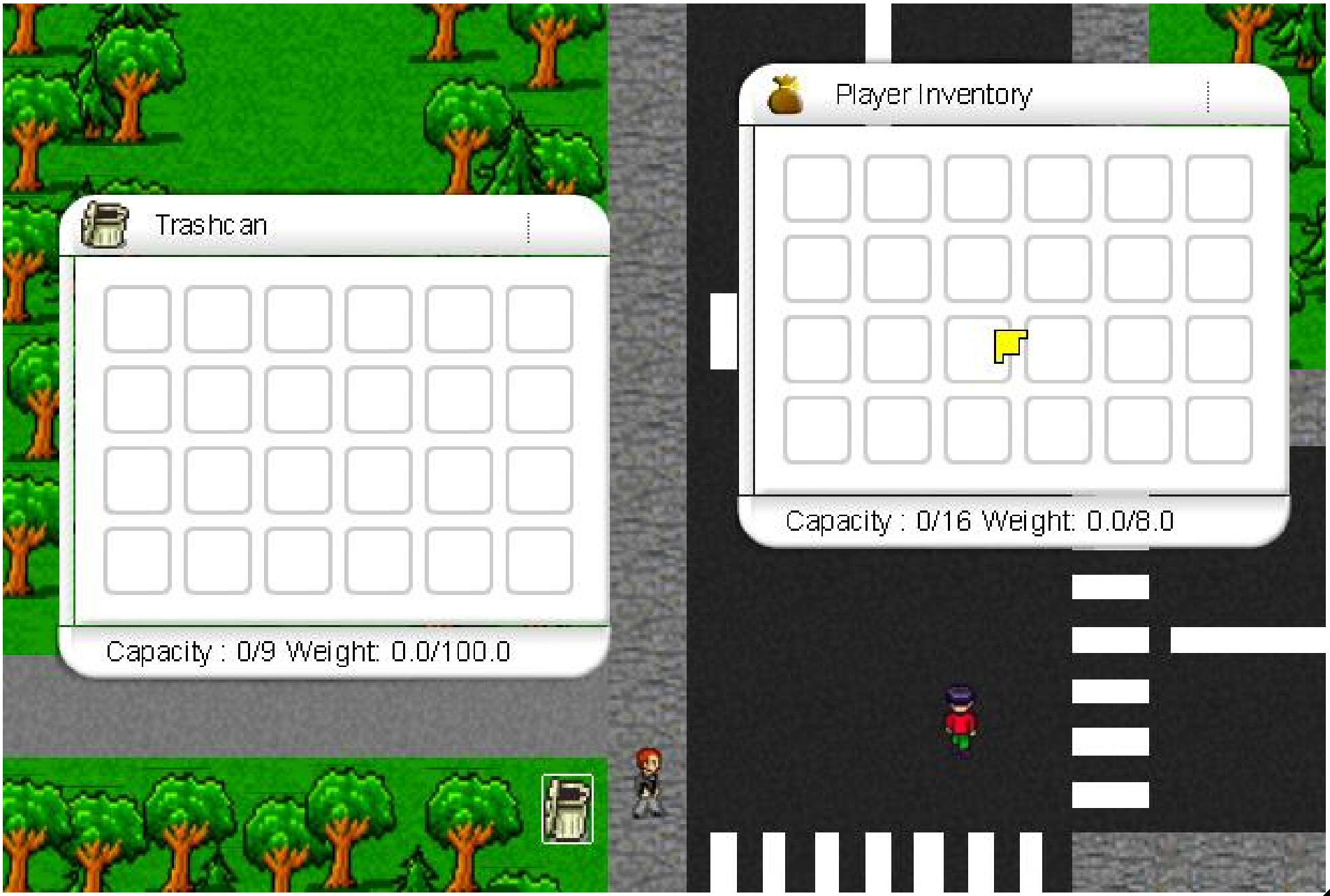


Other Implementation Concerns

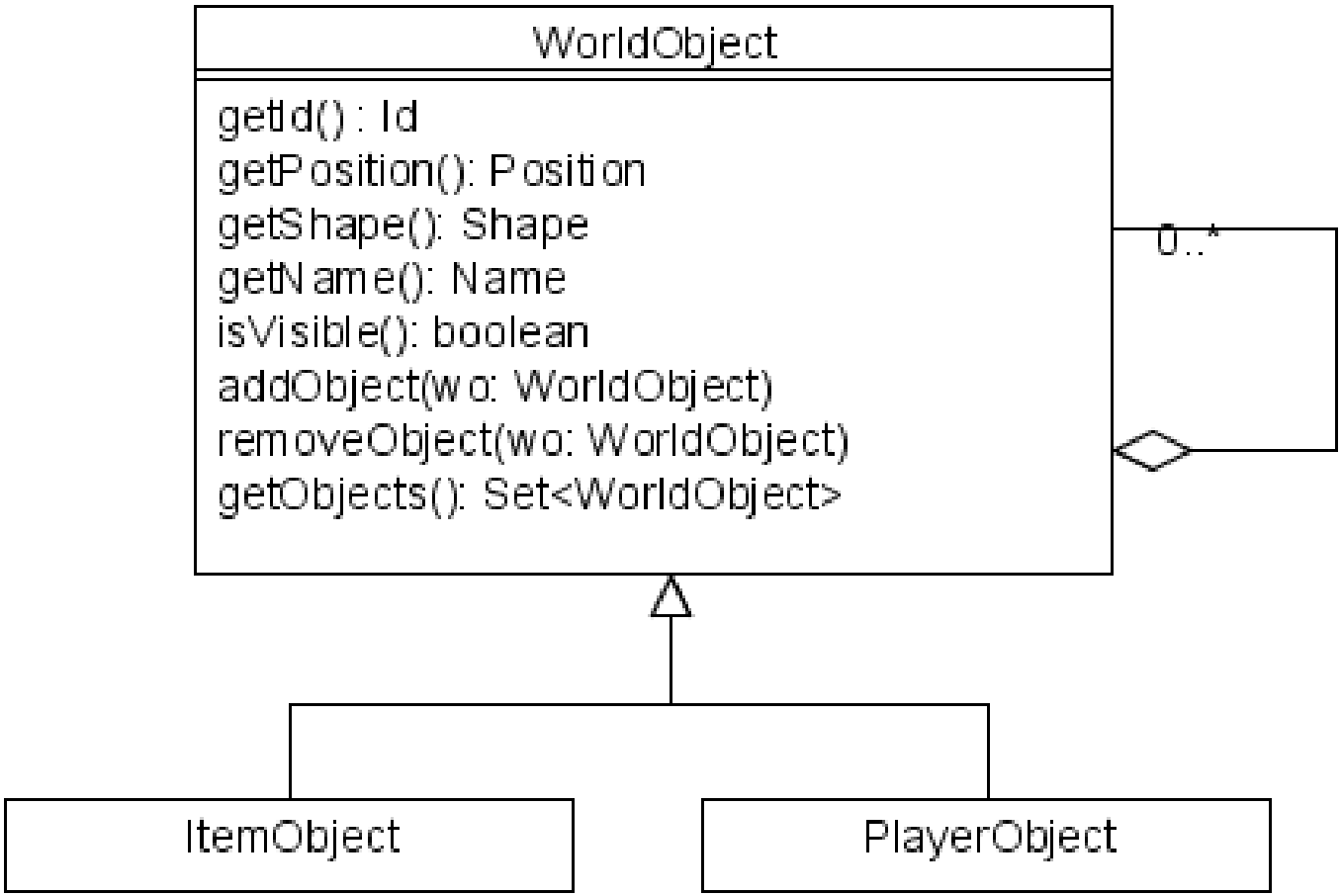
- Child Ordering : if we draw shapes, we need to know which shape is above other shapes.
  - We can just store the children in order, but we need the proper data structure for that.
- Caching children lookup: Each composite caches it's number of children.
  - If a new composite is added, we can easily compute the number of children.
  - Again, memory vs speed.
- Who should delete?
  - Sending delete to a component, should we cascade delete or not.

Example

Inventories

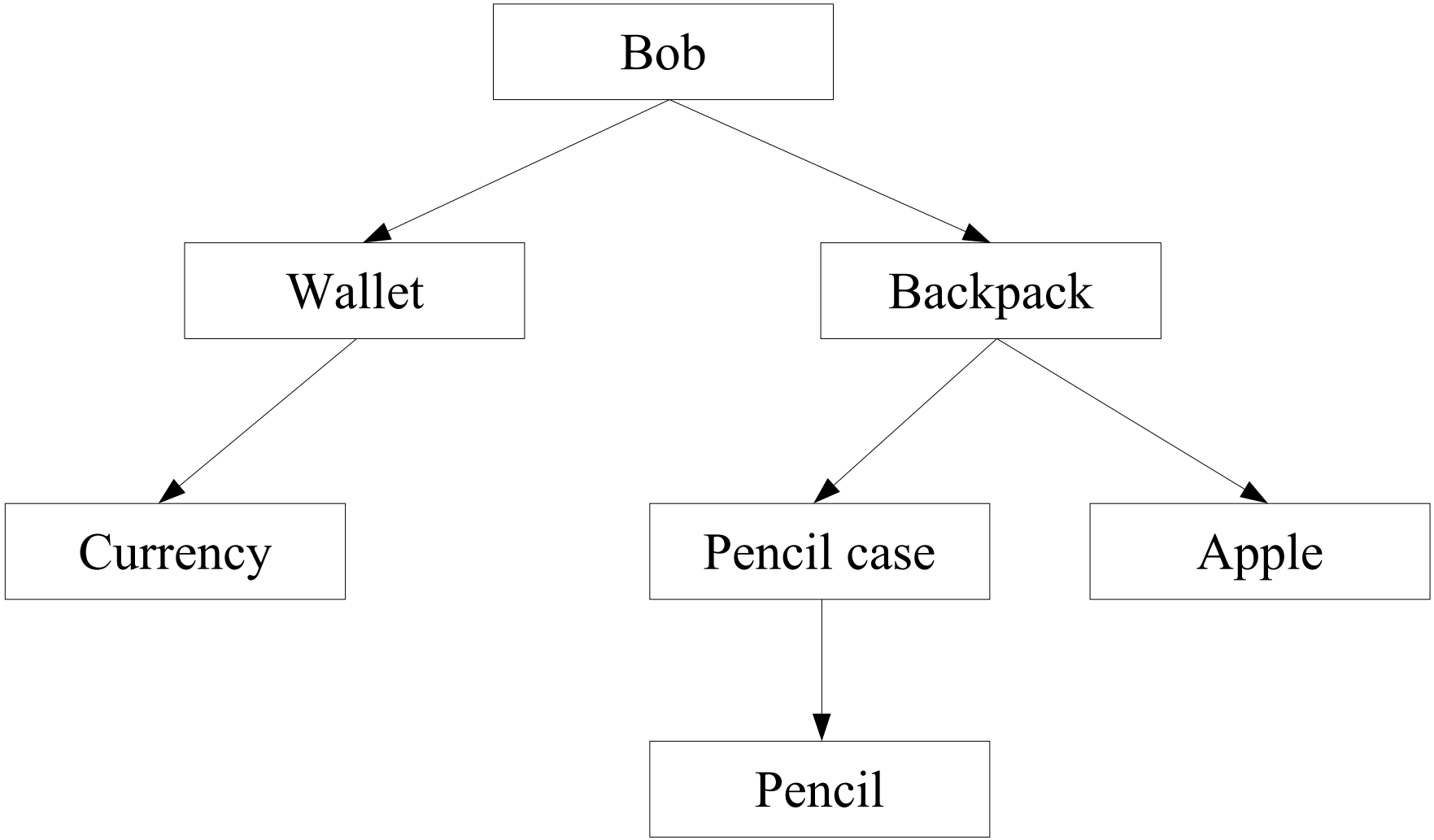


WorldObjects

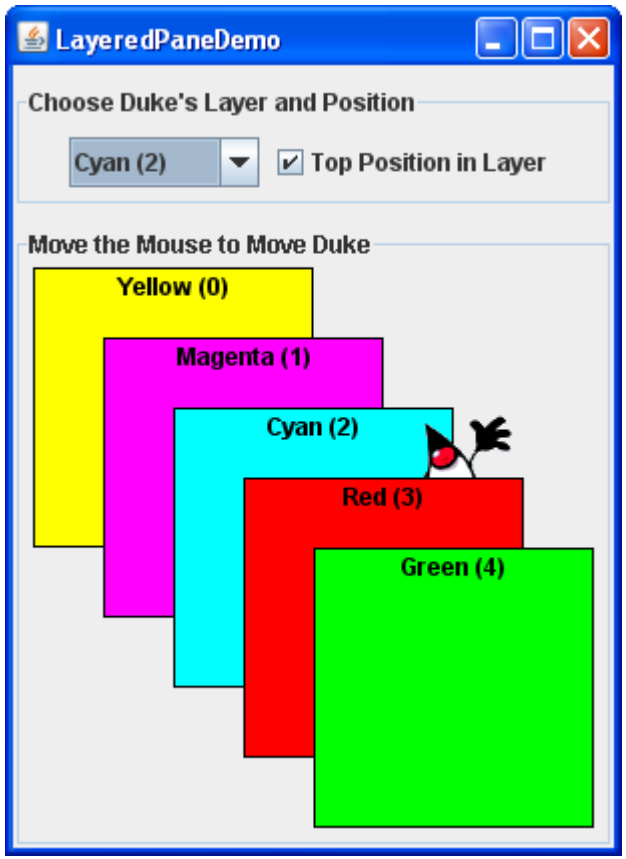


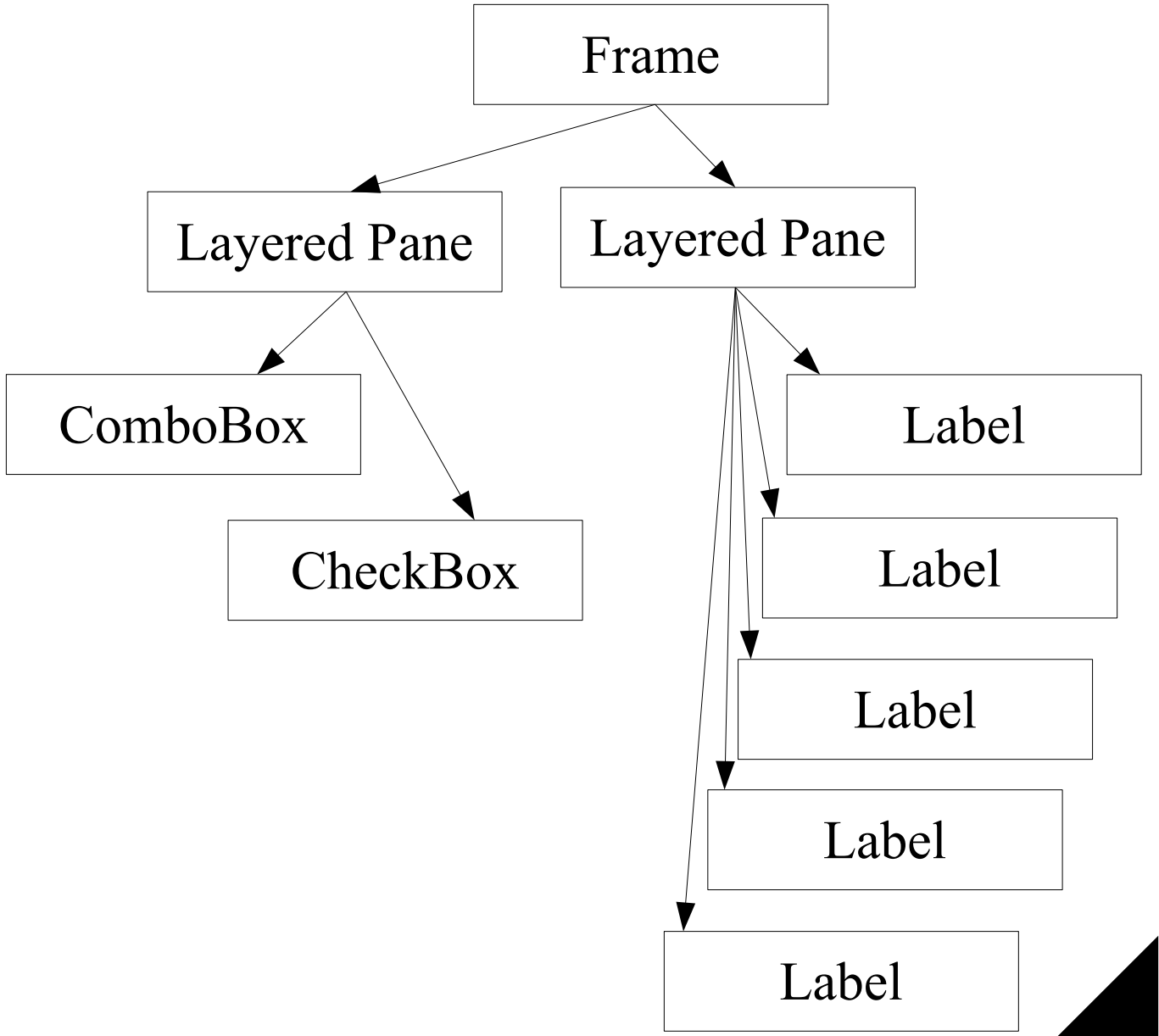
Which cohesion problem can be found here?

In action

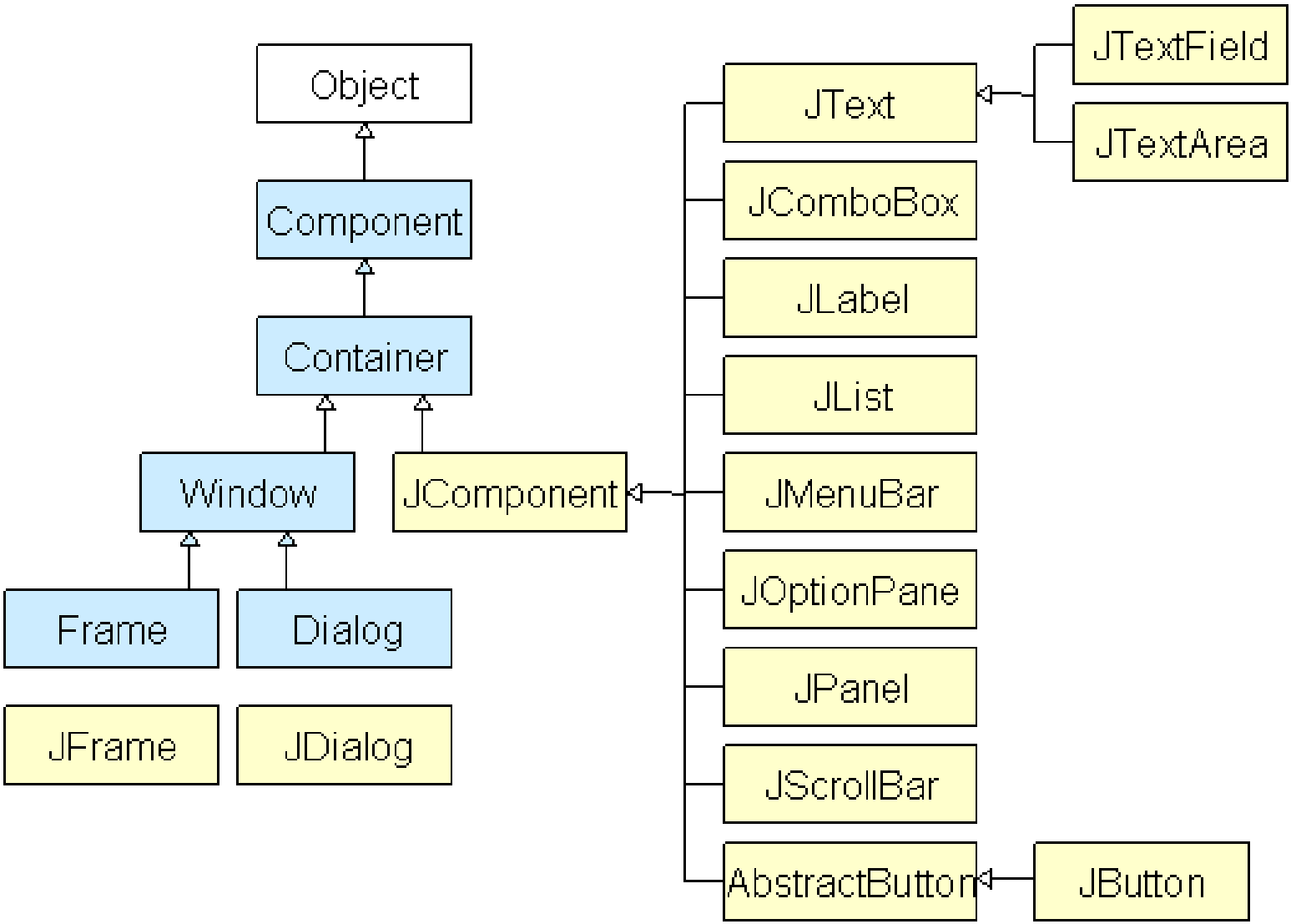


Second Example





Swing


Object
Component
Container
Window
JComponent
Frame
Dialog
JFrame
JDialog
JText
JTextField
JTextArea
JComboBox
JLabel
JList
JMenuBar
JOptionPane
JPanel
JScrollBar
AbstractButton
JButton