Comp-304 : Composite

Lecture 25

Alexandre Denault

Original notes by Hans Vangheluwe

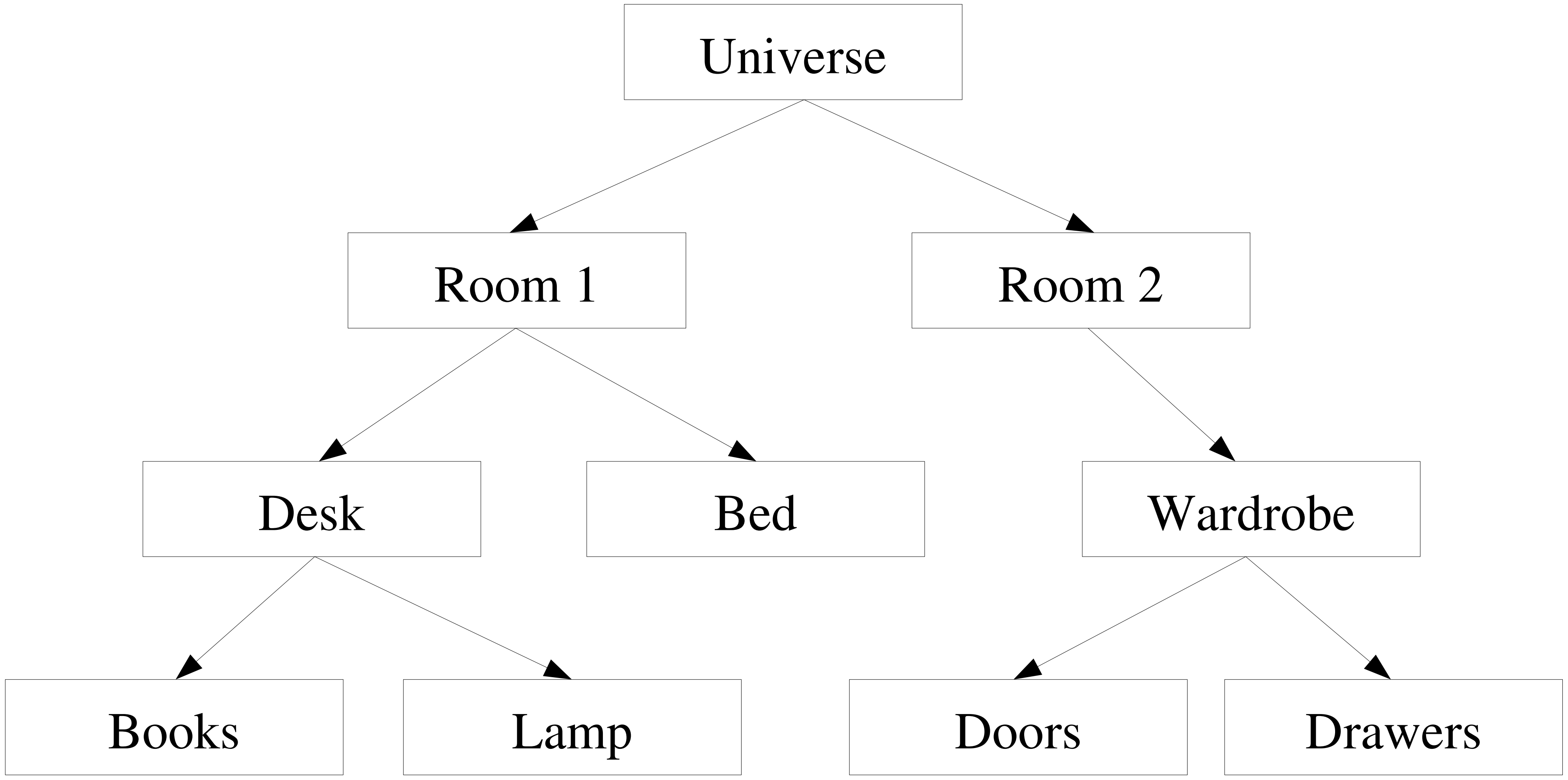
Computer Science

McGill University

Fall 2007

3D Room

Scene Graphs



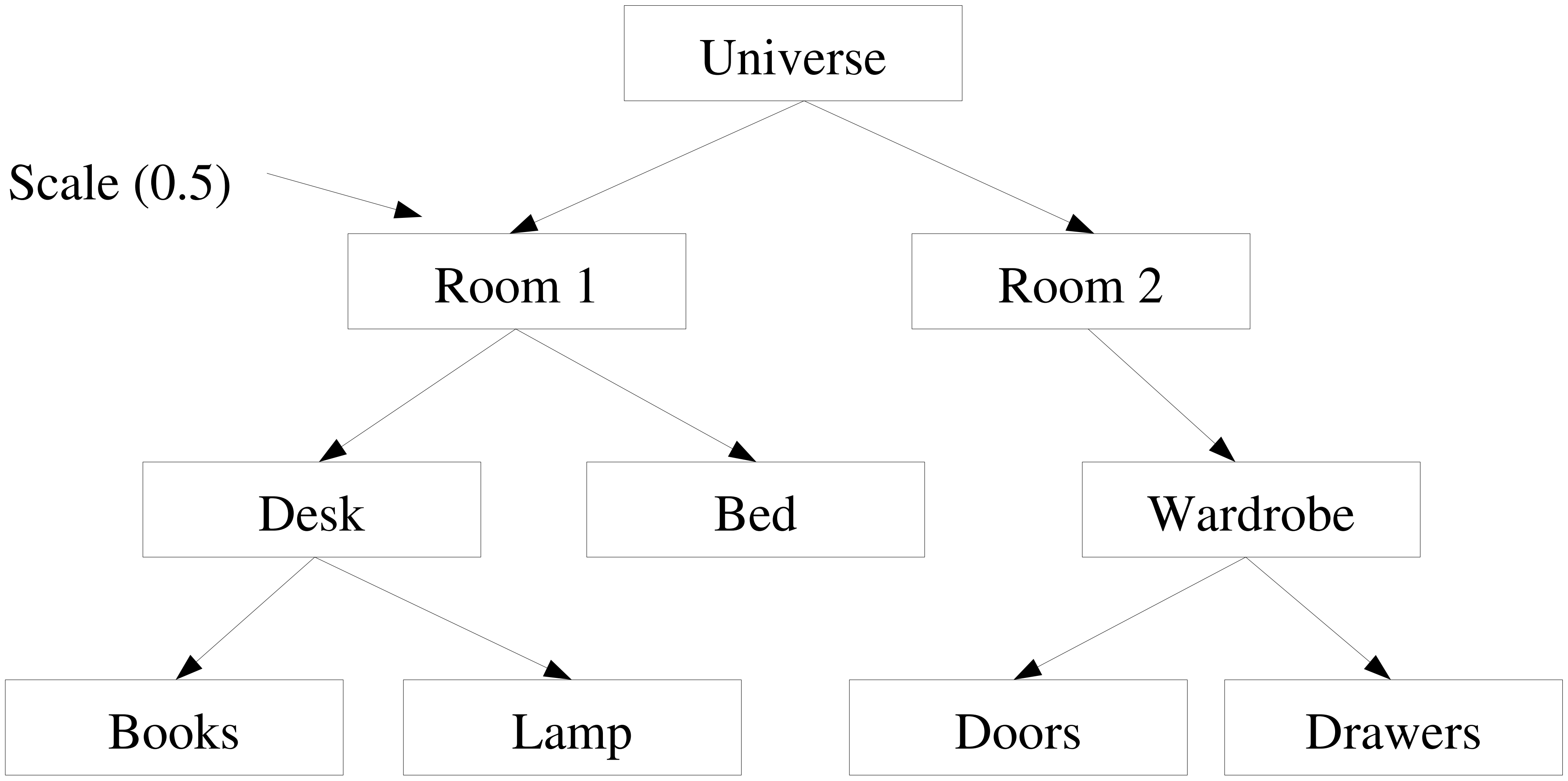
Hierarchy

- Elements are placed in a hierarchical structure.
  - 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 to represent part or whole hierarchies.
- Allow for uniform treatment (by clients) of
  - Atomic/primitive Objects
  - Composite Objects

Scaling


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

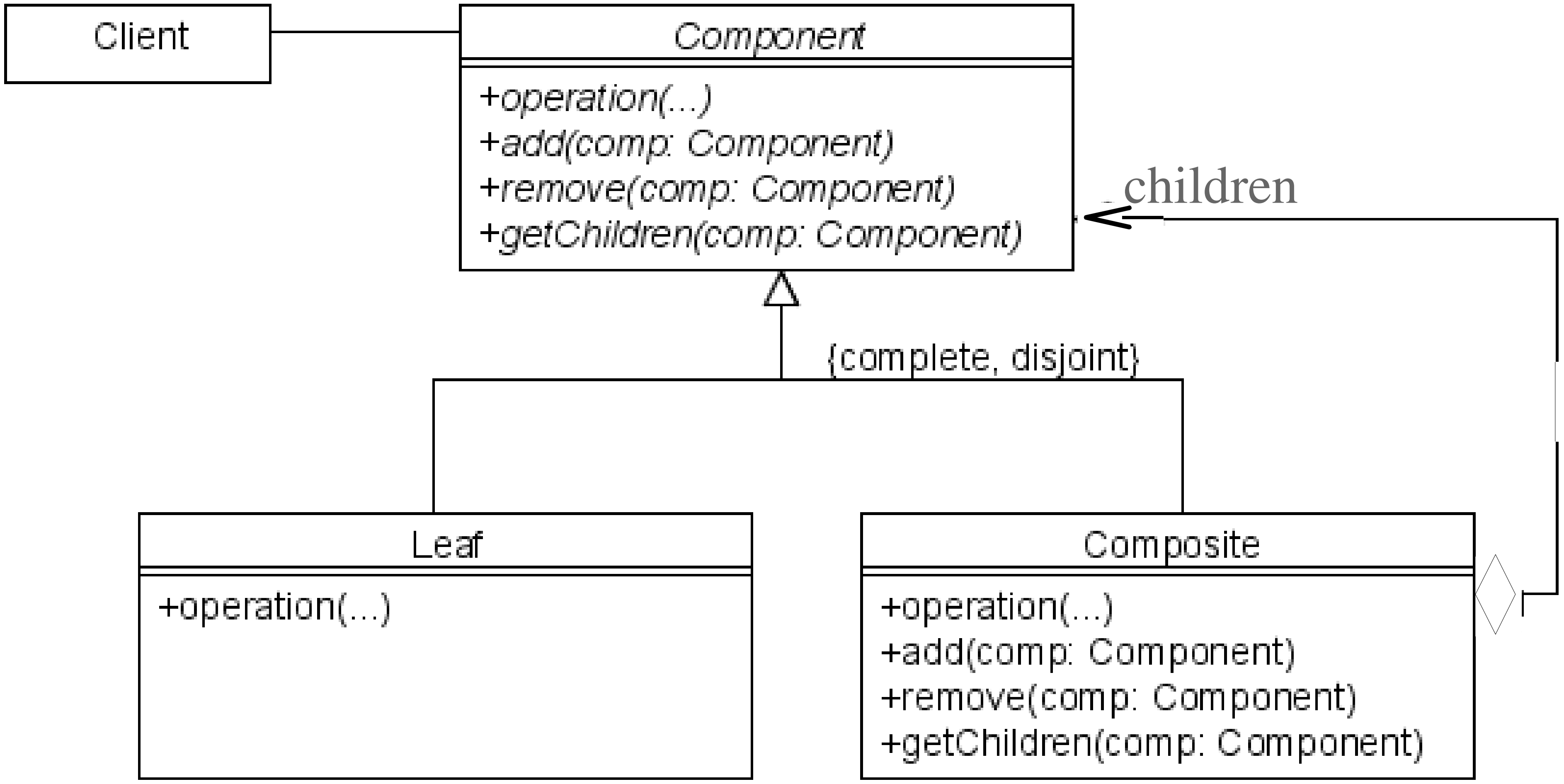
Scaling Explained

- 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.

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.

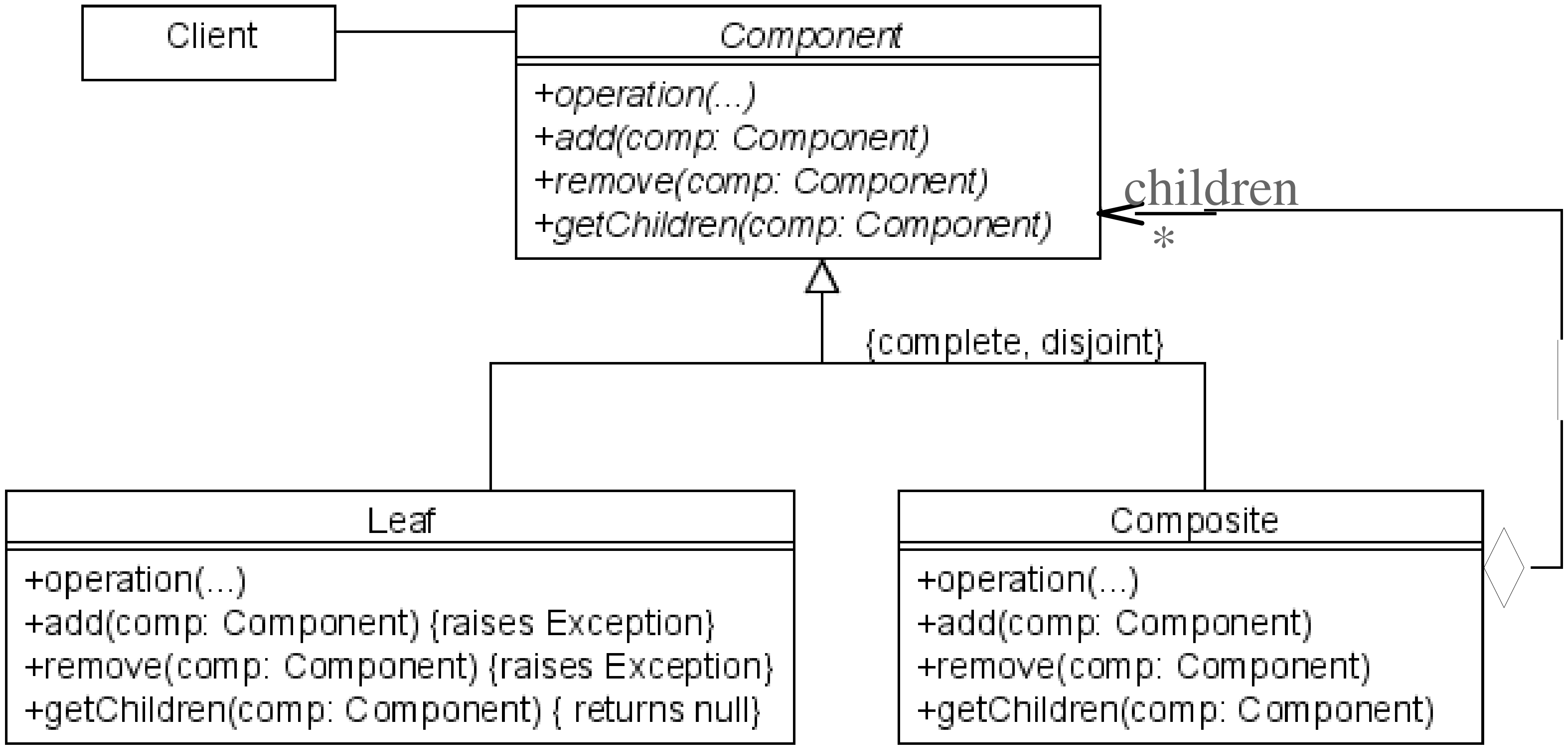
Class Diagram



Problems?

- 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 are called.
  - Bad design!

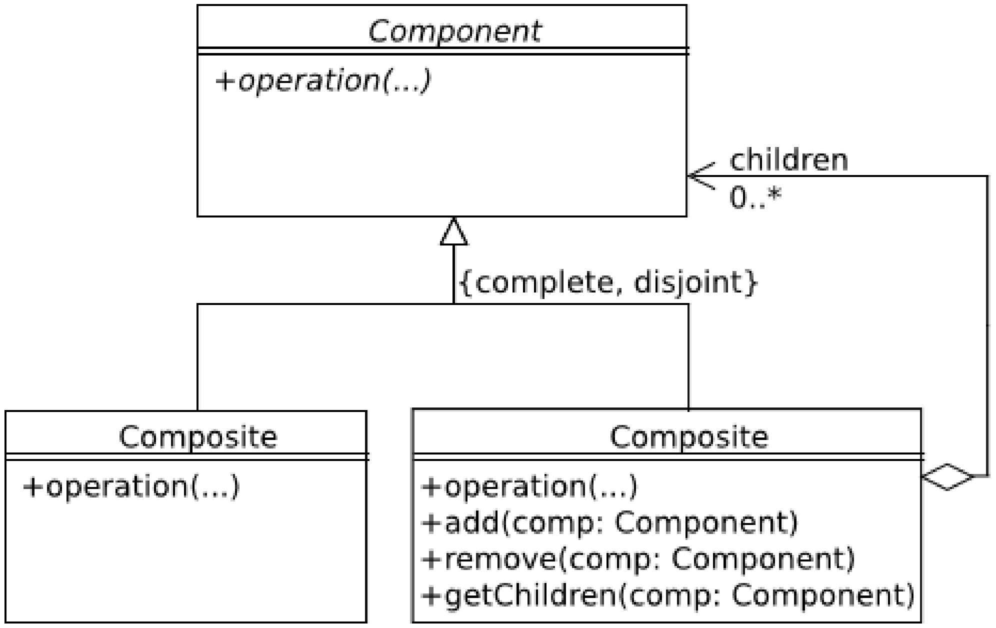
Class Diagram, Take 2



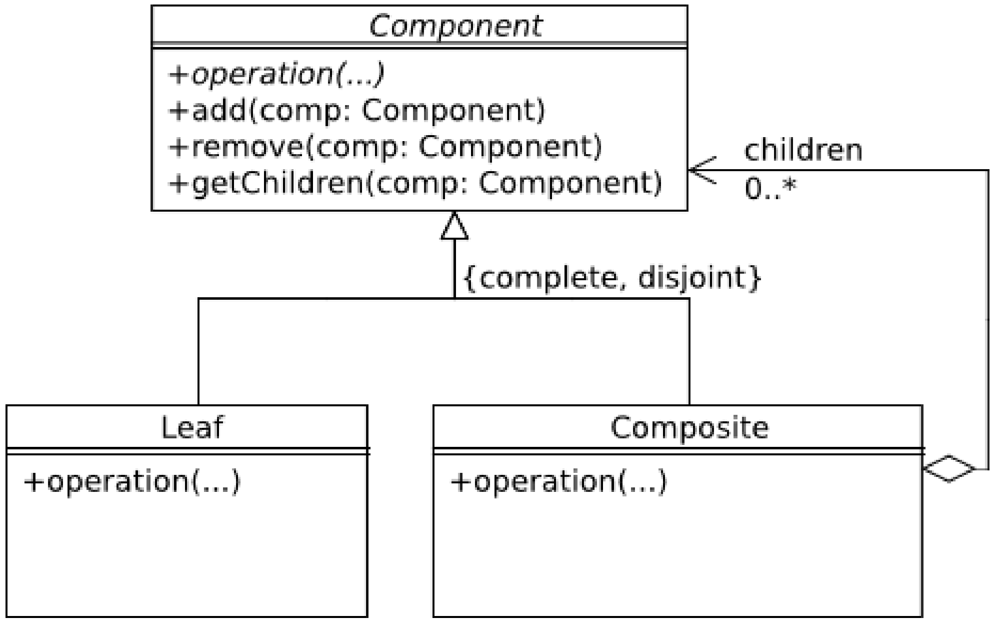
Add/Remove

- **Where** should the add/remove methods be declared?
  - If we declare it in component (component-level), then the leaves 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**?
  - At the component level, this would be bad design.
  - There will be a memory penalty since leaves will now also have a structure to keep track of children.

Safety vs. Transparency



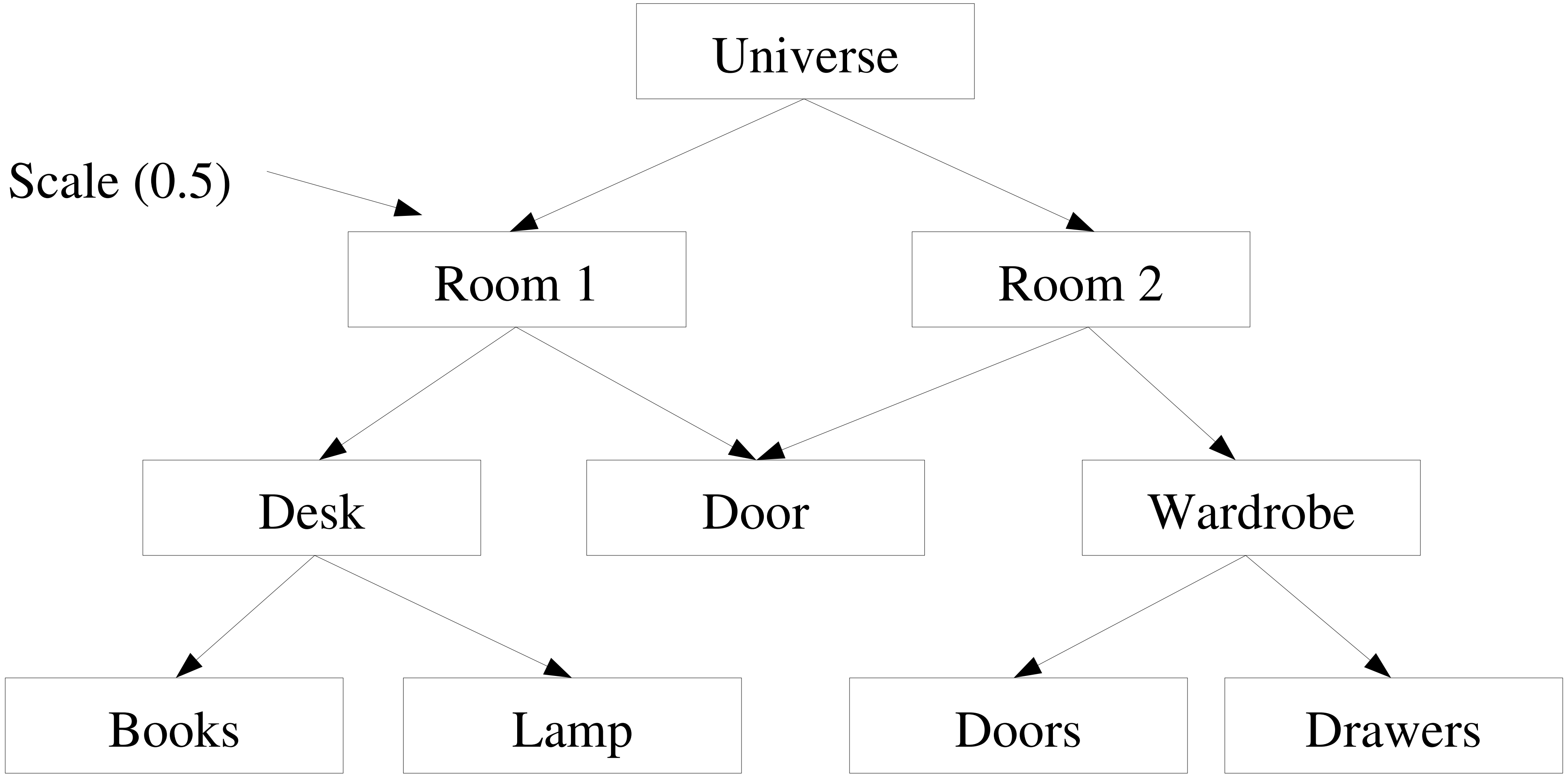
Safety



Transparency

Multiple Parents

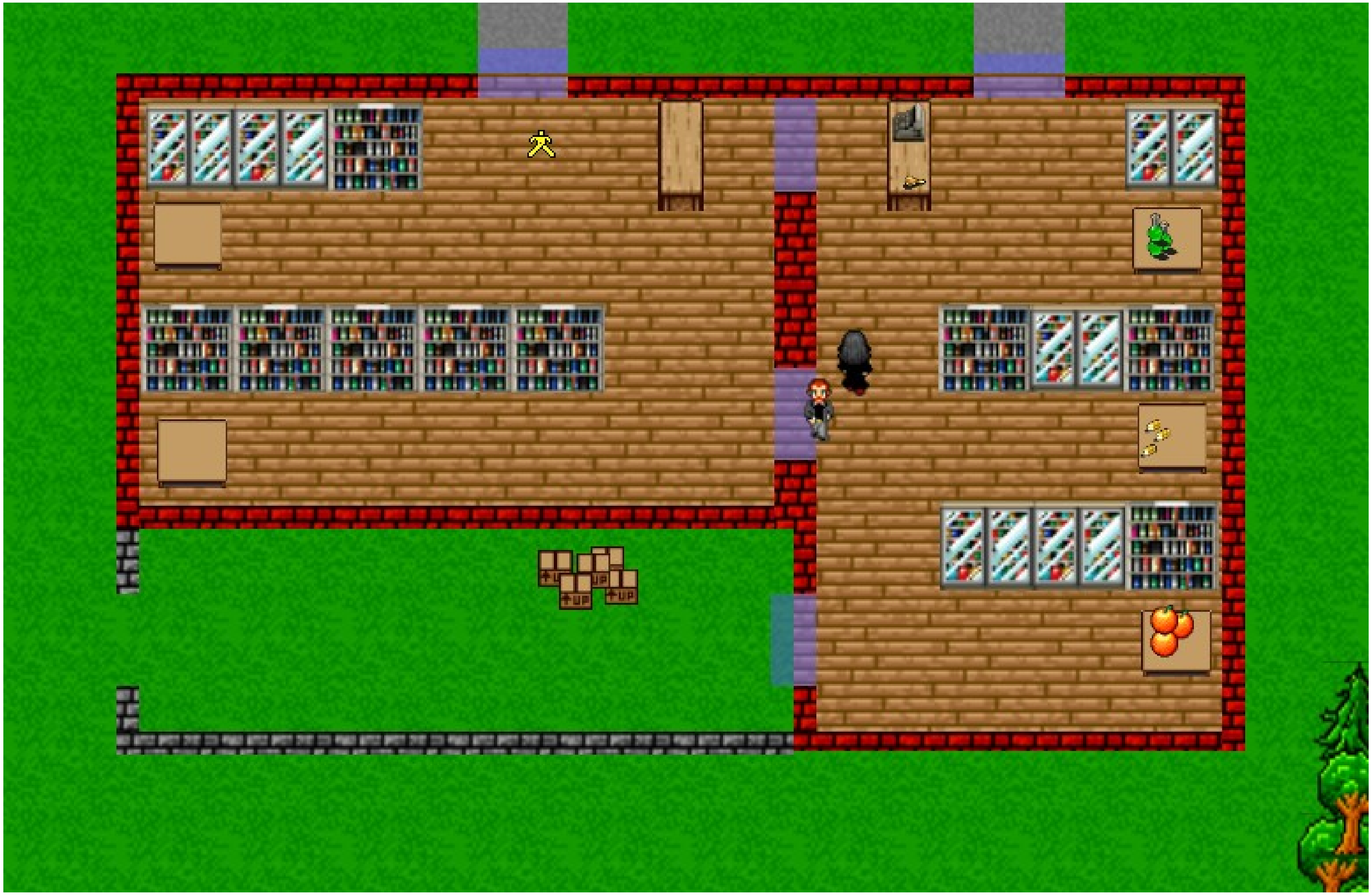
- What happens if a child has multiple parents?



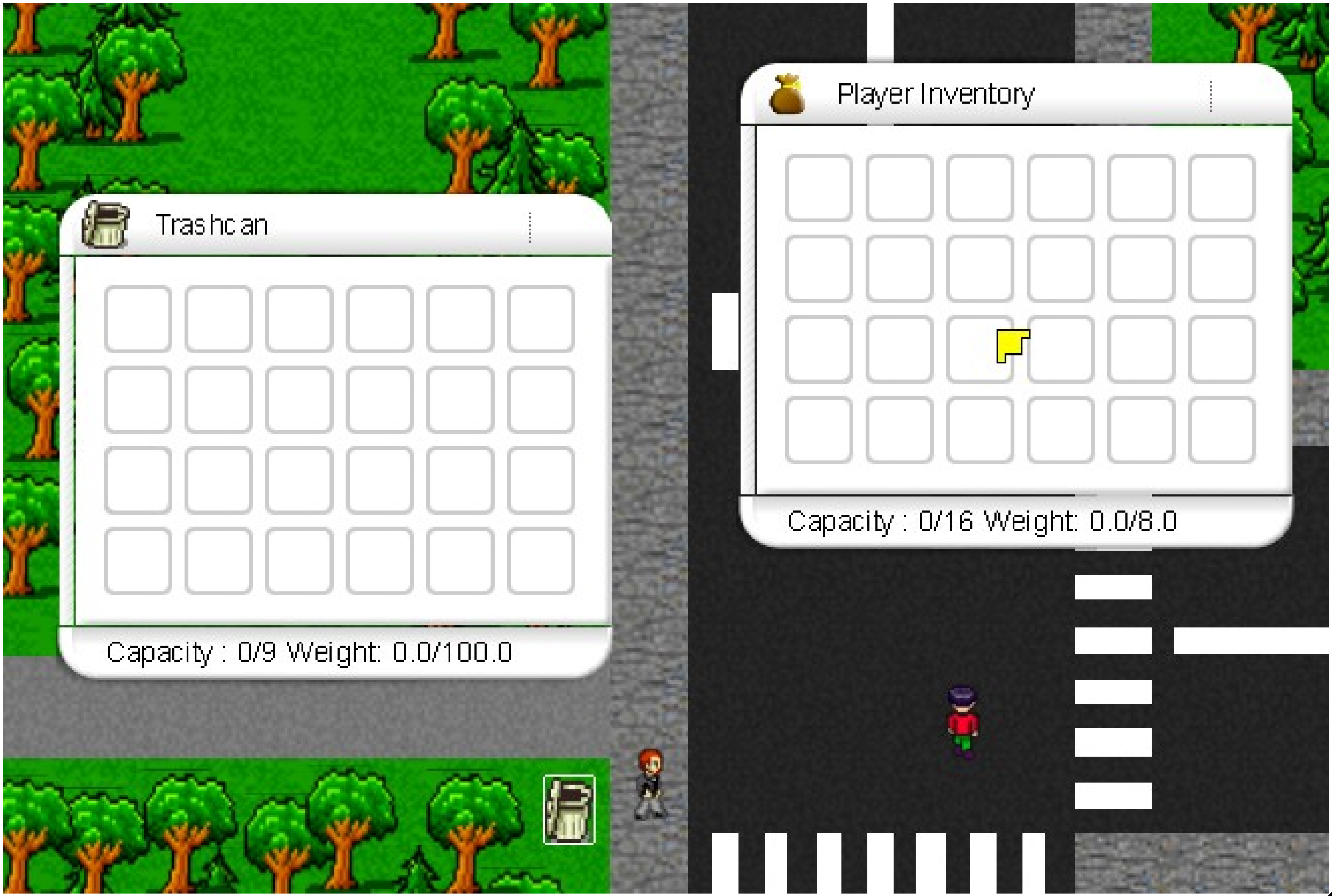
Other Implementation Concerns

- 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 its 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?

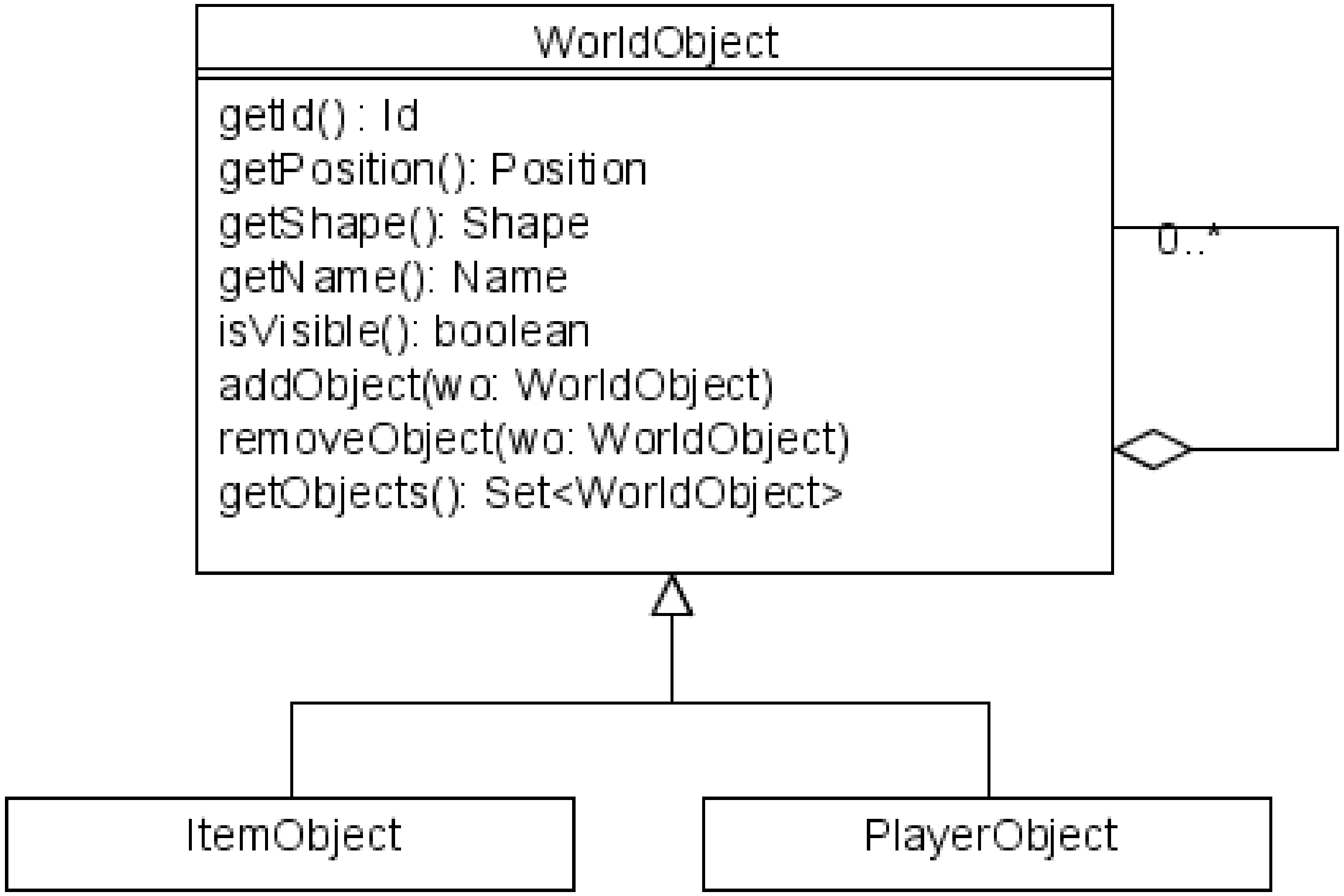
Example



Inventories

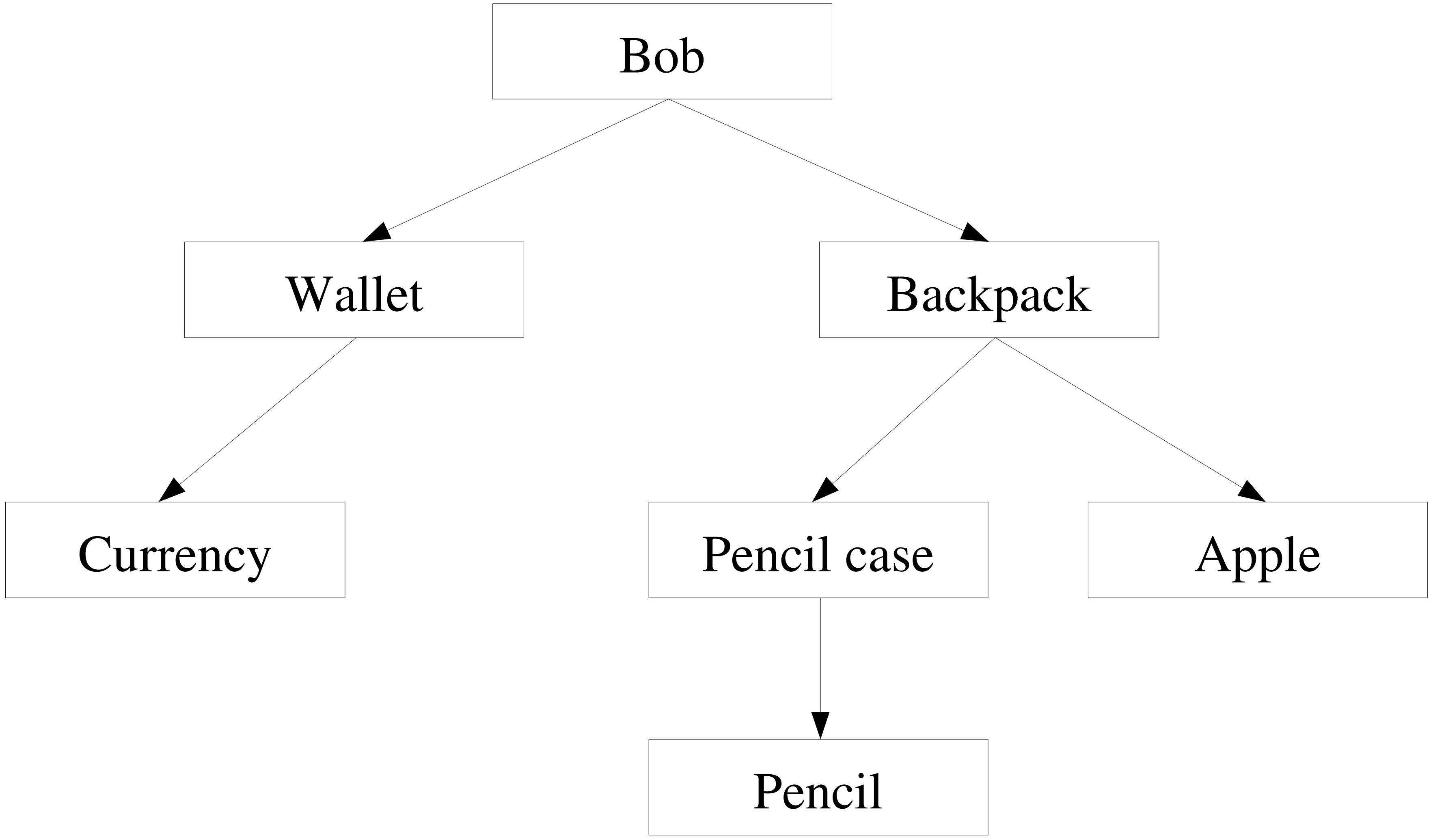

Trashcan
Capacity : 0/9 Weight: 0.0/100.0
Player Inventory
Capacity : 0/16 Weight: 0.0/8.0

WorldObjects

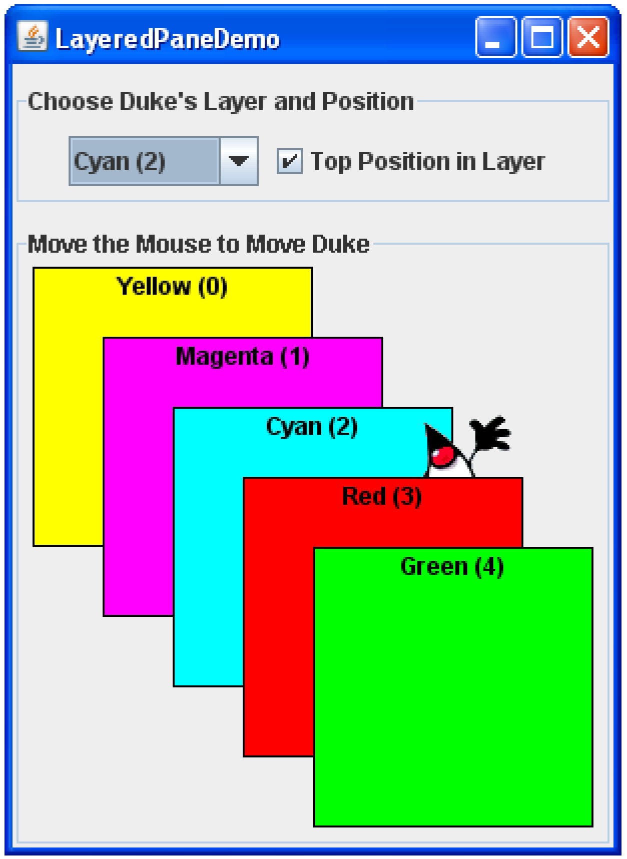


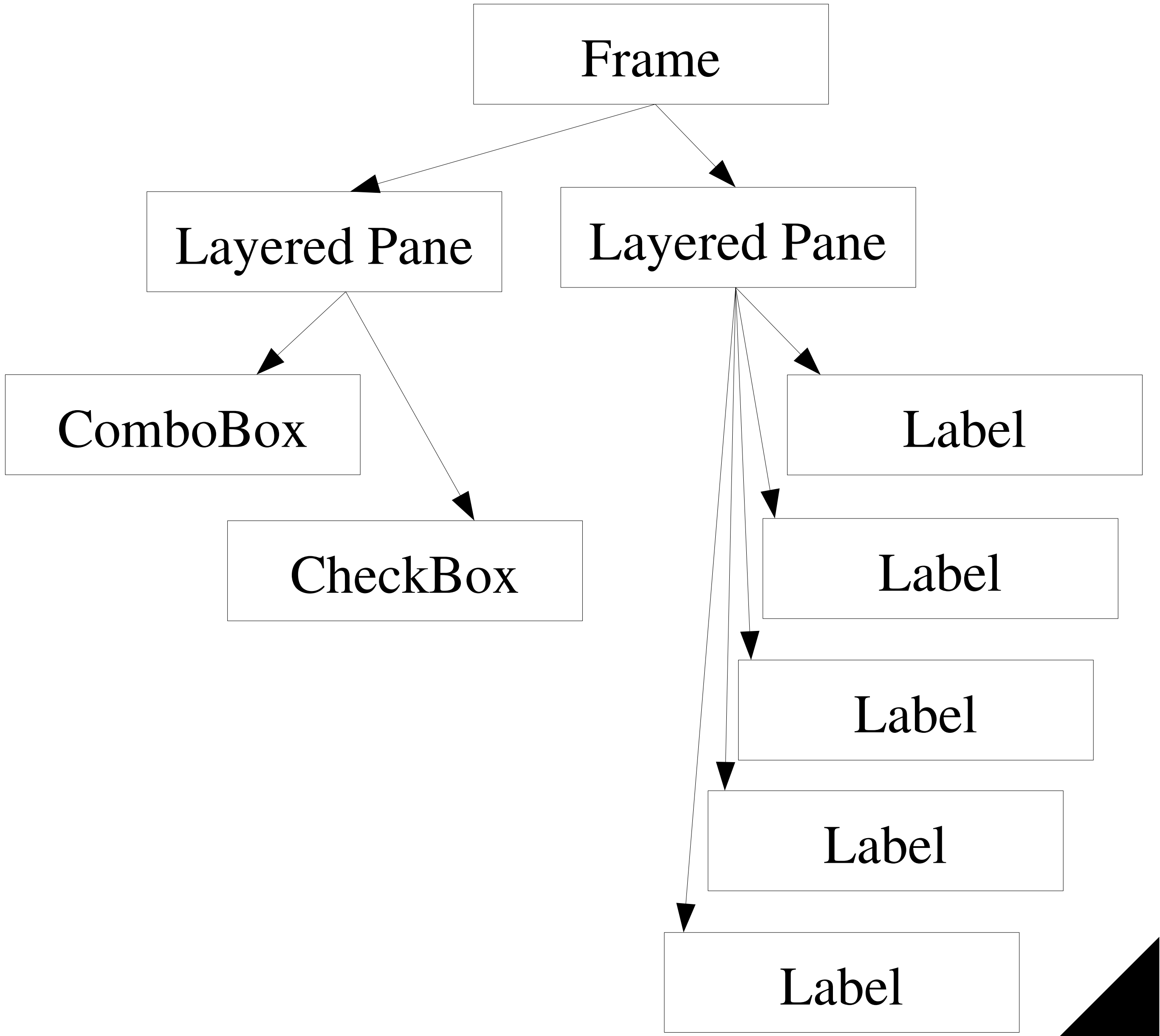
Which cohesion problem can be found here?

In action

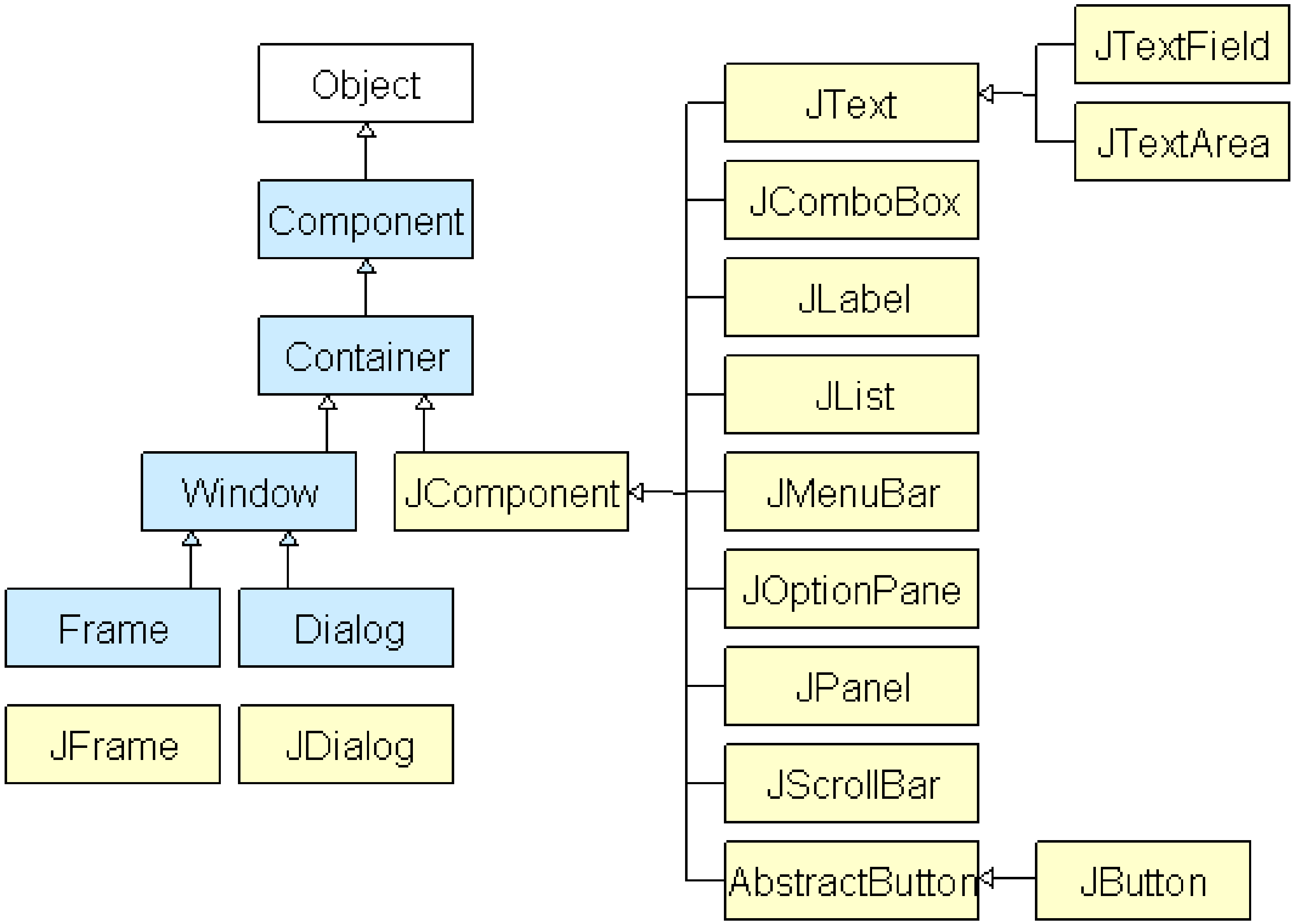


Second Example





Swing


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