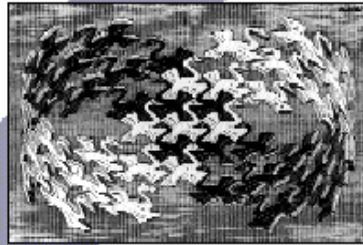# Design patterns

Admin

- Final exam time
- Milestone 2 deadline tomorrow!

Design Patterns

Elements of Reusable
Object-Oriented Software

Erich Gamma
Richard Helm
Ralph Johnson
John Vlissides

Foreword by Grady Booch

What are design patterns

- Solutions to specific problems in OO software design
- 23 patterns in 3 categories
  - Creational
  - Structural
    - Composite
    - …
  - Behavorial
    - Observer
    - Interpreter
    - …

Observer

- One to many relationship
  - The many need to know changes in "one" immediately

- Example
  - Facebook feed
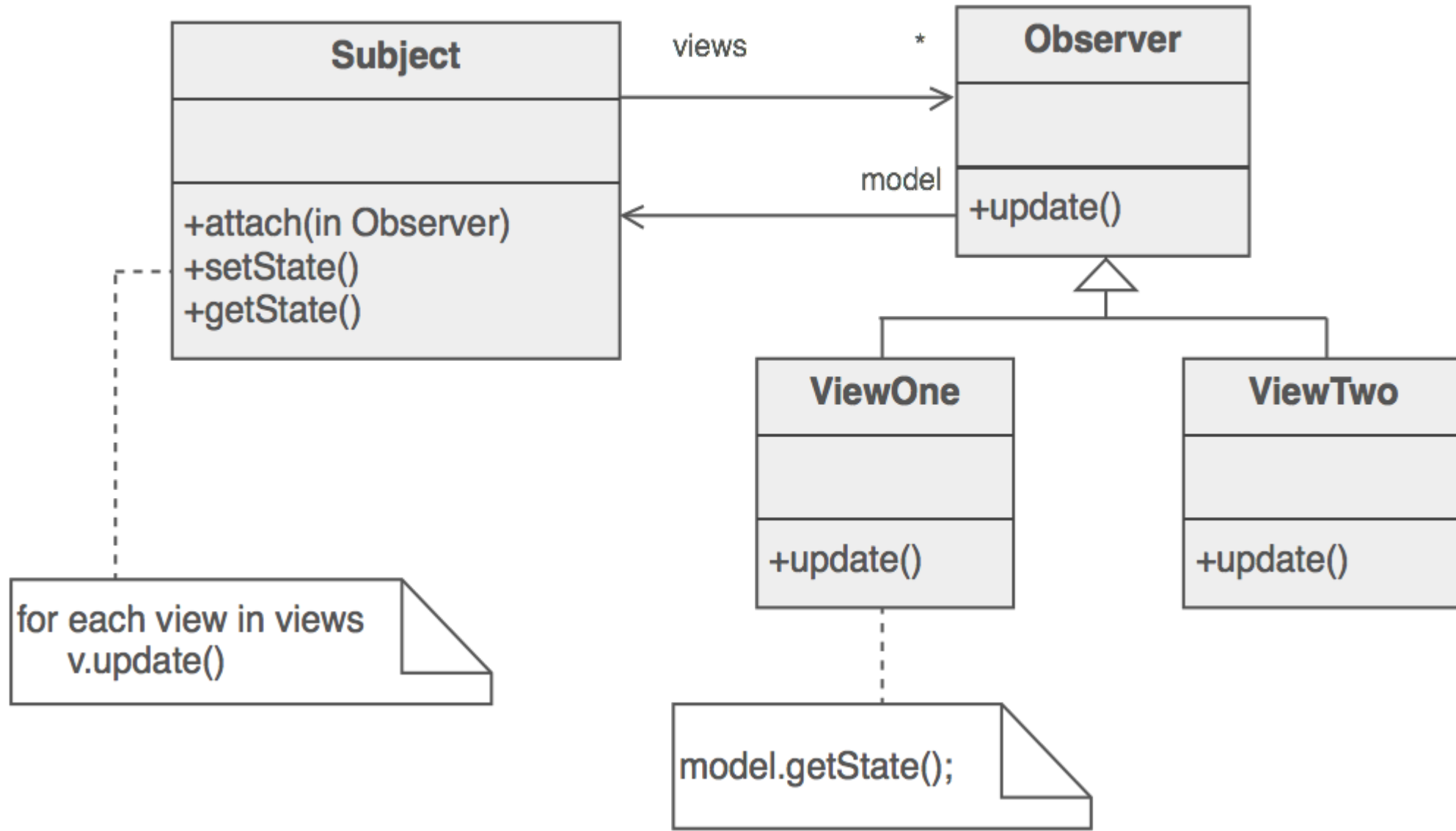 - Lines & rectangles
  - …

Example

- If a person changes its status, how to let all his "subscriber" knows?

Example

- What if there are different types of subscribers?

Class diagram

Subject

+attach(in Observer)
+setState()
+getState()

views   *

Observer

model

+update()

for each view in views
   v.update()

ViewOne

+update()

ViewTwo

+update()

model.getState();

Can you think of some examples?

Composite pattern

- Tree hierarchy

How to build a tree and traverse it?

```
struct node{
    struct node* left;
    struct node* right;
    int val;
    int sum(){
        …
    }
}
```
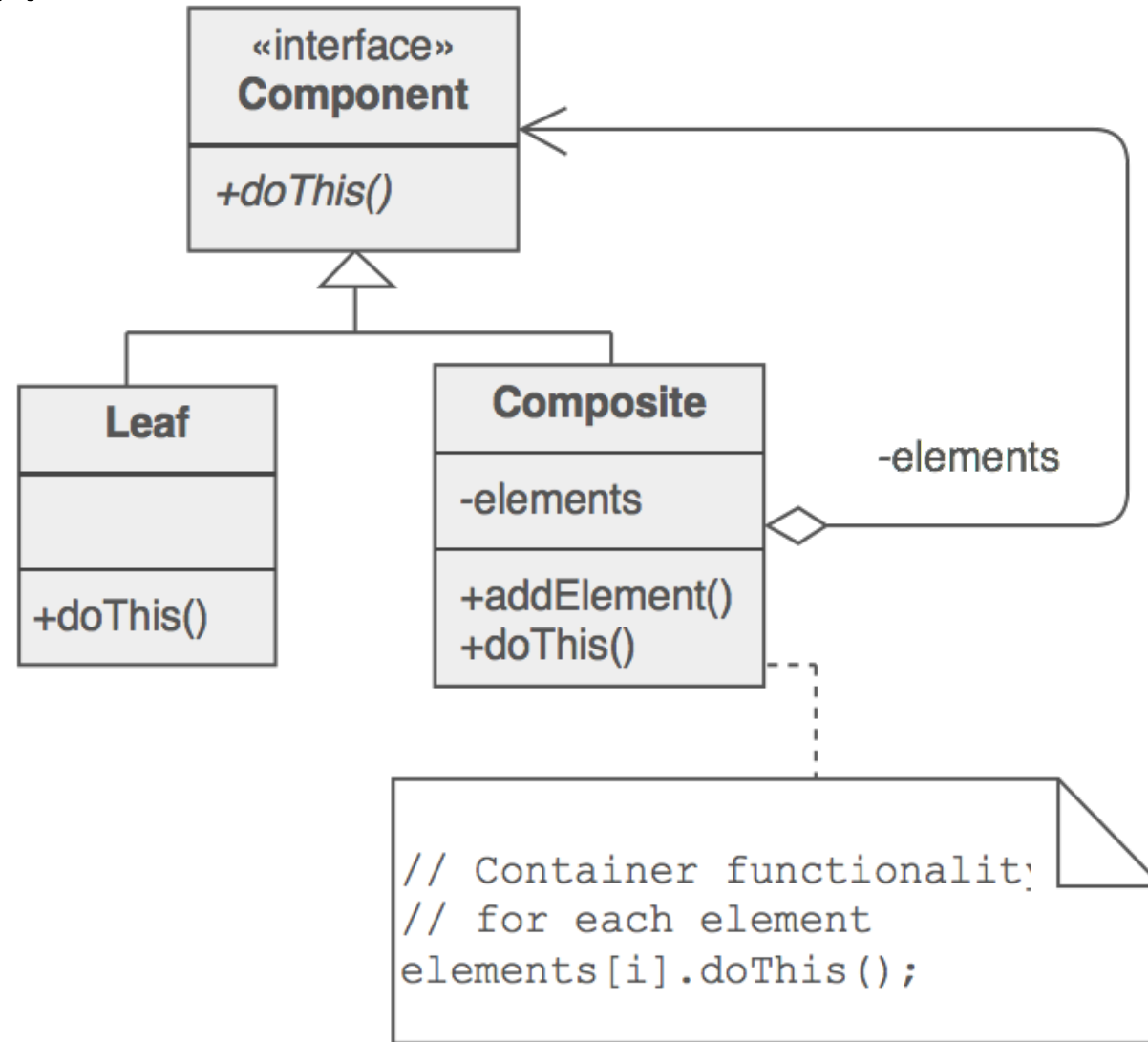
How to differentiate leaves and others?

```
struct leaf{
    int val;
    int sum(){ return val;}
}
```

How to accommodate different types of internal nodes?

- Examples
  - struct node or struct leaf?
  - Book
  - Graphics

Class diagram

Can you think of some examples?

Interpreter

- What is an interpreter
  - Language, compiler

- Example
  - Boolean expression
    - Abstract syntax tree

      a && b || !c

      a parser will turn this into an abstract syntax tree, and then an interpreter will evaluate the tree. How to write a program to do the tree-based evaluation?

Class diagram