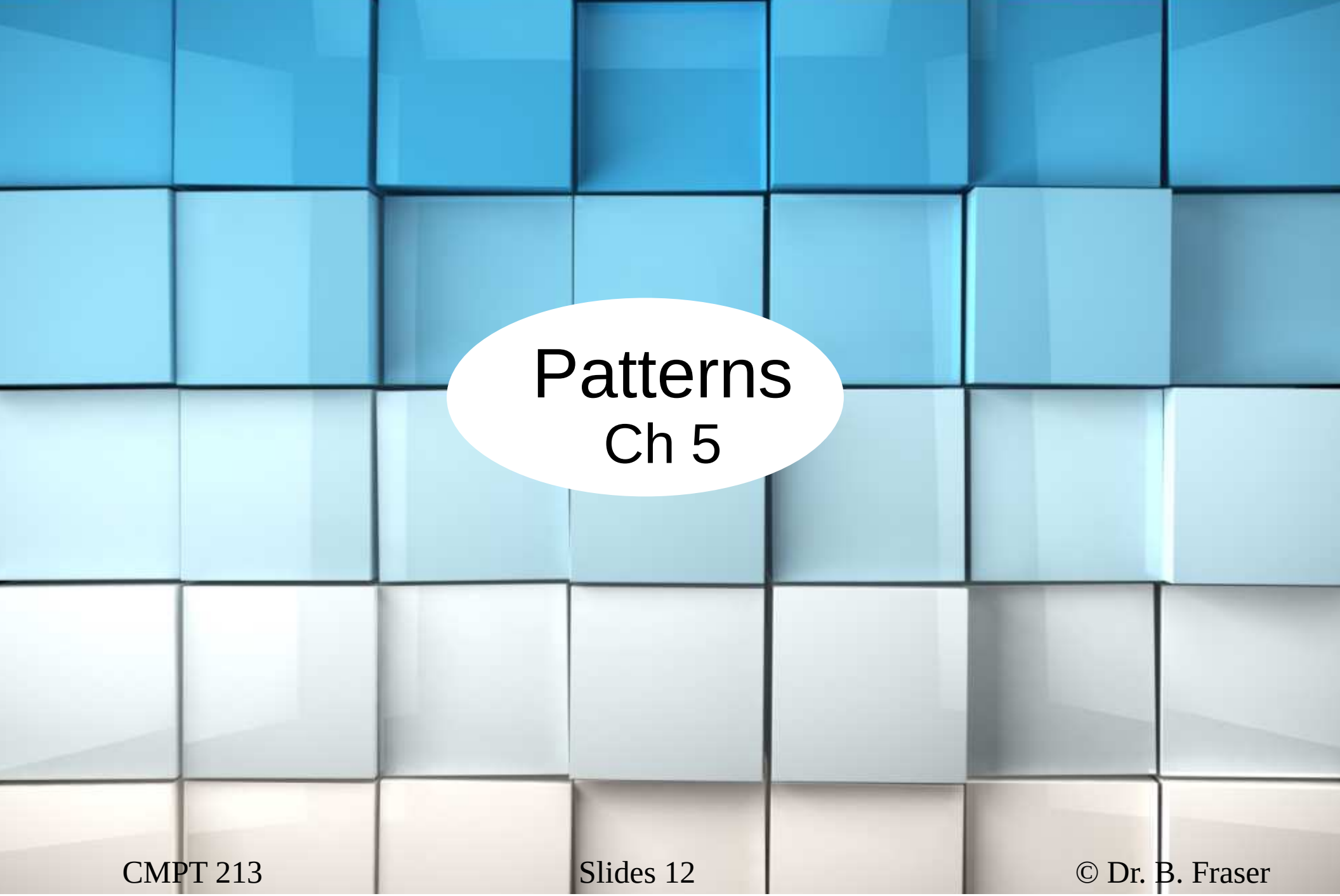


Topics

1) How to best loop through some items?
2) How to best notify an object of a change?
3) How to best organize classes in an application?
4) How can design ideas be reused?

Iterator

Accessing Items in a Collection

Java Iterator:

```
List<String> words = // <snip>

Iterator<String> iterator = words.iterator();
while (iterator.hasNext()) {
    String word = iterator.next();
    // <snip>
}
```

Direct Link List Code

```
Node current = words.head();
while (current != null) {
    String word = current.getData();
    current = current.nextNode();
}
```

- What changes when switch to an ArrayList?
  - Using an iterator:..
  - Direct access:..
- What changes when switch to an binary tree?
  - Using an iterator:..
  - Direct access:..

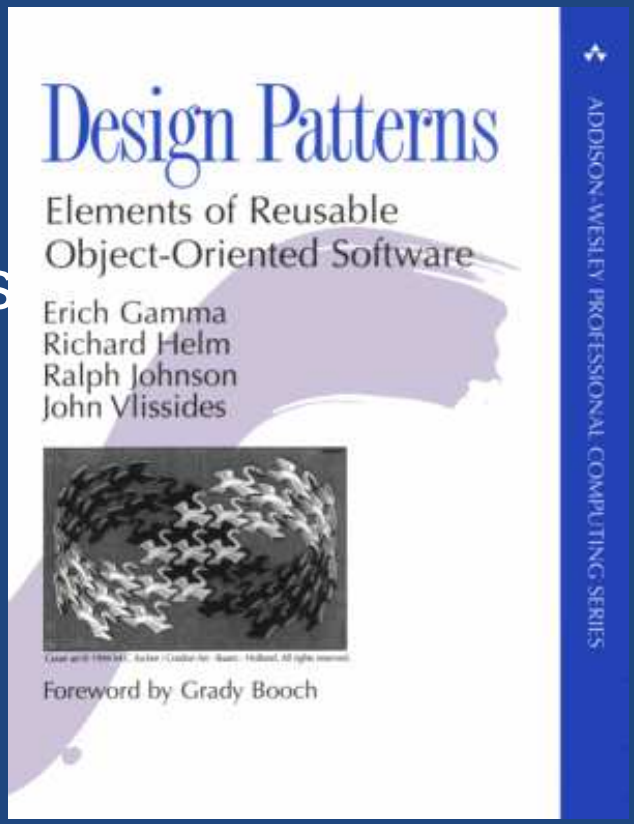
Iterator Idea

- Iterator Idea:
  - An object which allows iteration over items..
  - If details are hidden..
  - Can have multiple iterators for a collection without them interfering.

```
int count = 0;
Iterator<String> itr1 = cars.iterator()
while (itr1.hasNext()) {
        String car1 = itr1.next();
        Iterator<String> itr2 = cars.iterator();
        while (itr2.hasNext()) {
                String car2 = itr2.next();
                if (car1.equals(car2)) {
                        count++;
                }
        }
}
```

Pattern

- Software Design Pattern:
  -
  - Allows discussion, implementation, and reuse of proven software designs
- Gang of Four
  - A pioneering book on design patterns by 4 authors: Gamma, Helm, Johnson, Vlissides.



The Iterator Pattern

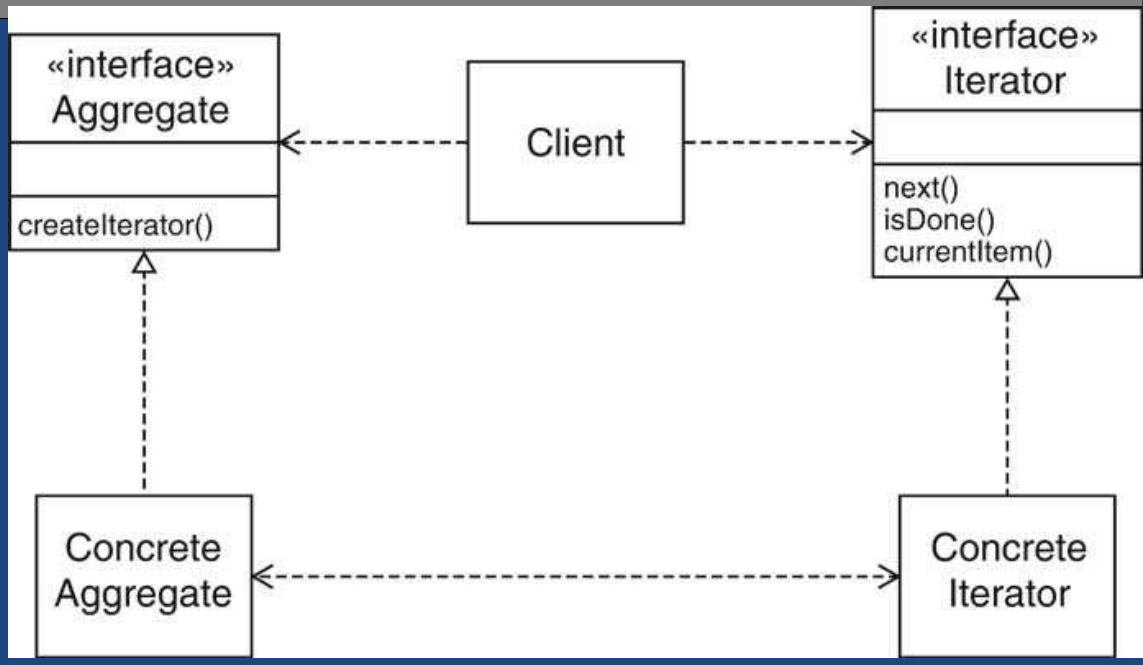
- Context
  - An aggregate object contains element objects
  - Clients need access to the element objects
  - The aggregate object should not expose its internal structure
  - Multiple clients may want independent access
- Solution
  - Iterator fetches one element at a time
  - Each iterator object..
  - Iterators use a common interface.

Iterator UML

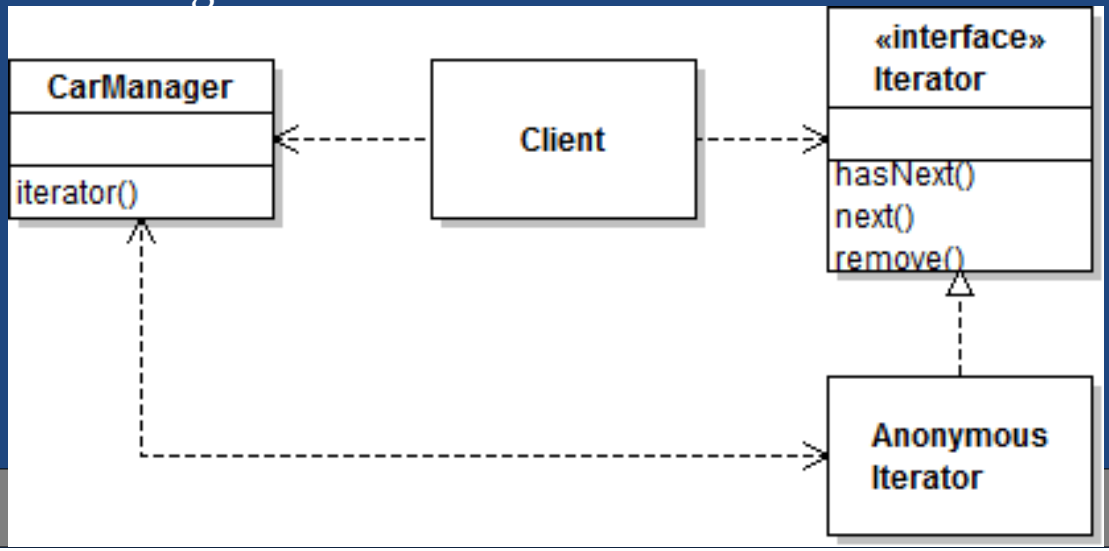
- Client only depends on..
  - It gets a concrete iterator, but knows only its generic type.
- Mapping pattern to CarManager example:

Design Pattern	CarManager Ex.
Concrete Iterator	Anon. Iterator
Concrete Aggregate	CarManager
Aggregate <<I>>	*nothing in this example.*
isDone()...	!hasNext()...

Iterator Pattern



CarManager Classes



Observer

Observer pattern motivation

For billionaires!

- Imagine you are writing an automatic day-planner:
  - It reads in the user's interests, plus information about the world, and suggest what they should do.
- Possible design idea:
  - You want to use different objects for cultural planning, sports planning, and sight-seeing.
  - Some objects bring in information about the world; your planning-objects use these info objects.
- Challenge:
  - All of these objects need to know the weather.
  - Your weather object gets updates now and then.
  - How do you tell..

Possible Idea

- Have the weather object call each info. object:

```
class Weather
    void newDataUpdate() {
        String weatherData = ...;
        culturePlanner.update(weatherData);
        sportsPlanner.update(weatherData);
        sightseeingPlanner.update(weatherData);
        // Change here EVERY time you get a new planner.
    }
```

- Bad because:
  - Weather object is...
  - Every new planner you get, you'll have to change the weather object's code, recompile, and re-run.

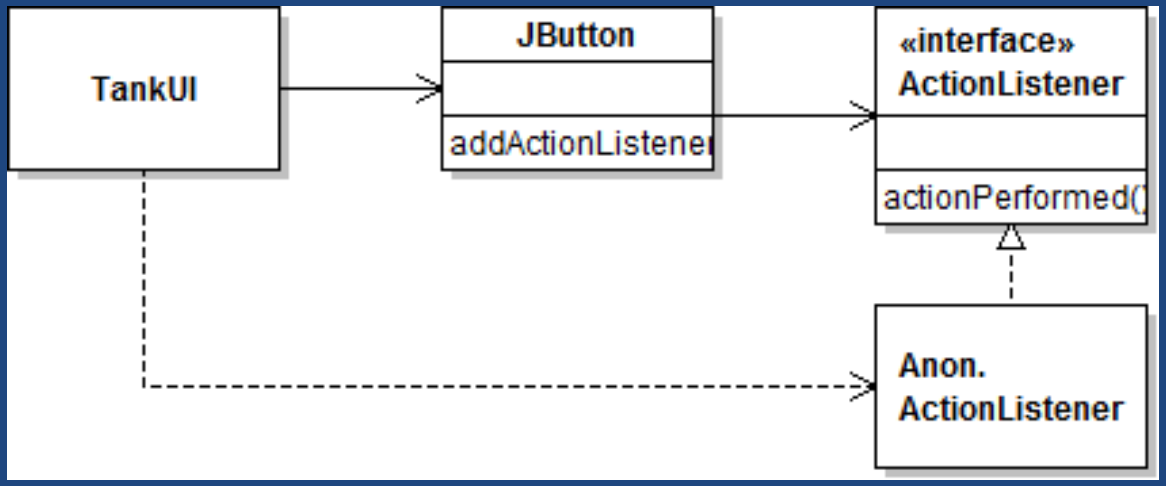
The observer pattern

- Observer Pattern:

- Produces a one to many relationship:
  - one object observed (called the subject)
  - many objects observing (called the observers).
- Great because it loosely couples objects:
  - Object with something to report does not need a hard-coded list of who to tell; ...

Observer

- Button Example
  - Button knows of a click; TankUI *wants* to know.
  - TankUI creates anonymous ActionListener
    - TankUI registers it with button as a listener for..
    - Benefit:..



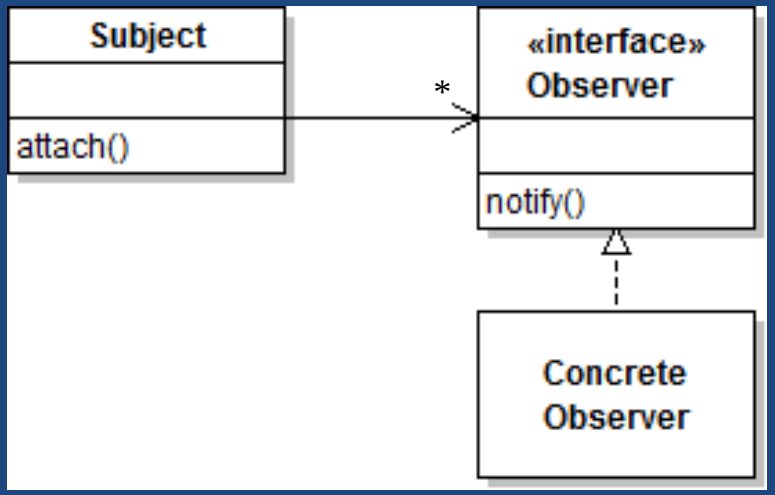
Observer Pattern

- Context
  - An object, called the subject, is source of events
  - One or more observer objects want to be notified when such an event occurs.
- Solution
  - Define an observer interface type.
    All..
  - Subject maintains a collection of observers.
  - Subject supplies methods for attaching and detaching observers.
  - Whenever an event occurs, the subject..

Observer UML

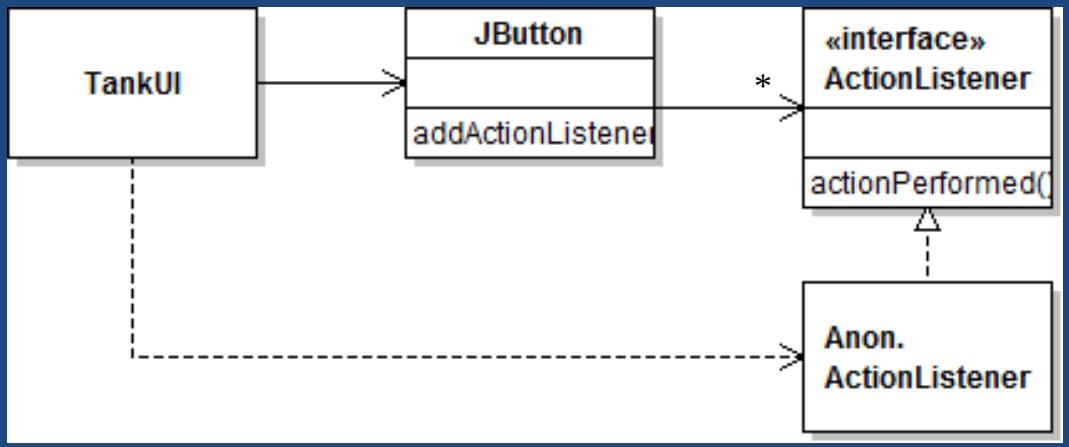
- Subject object knows nothing about class observing it.
  - ..

Observer Pattern



Design Pattern	TankUI Ex.
Subject	JButton
attach()	addActionListener()
Observer <<I>>	ActionListener<<I>>
notify()	actionPerformed()
Concrete Observer	Anon. ActionListener

JButton



Model View Controller Pattern
and
Facade Pattern

Terminology

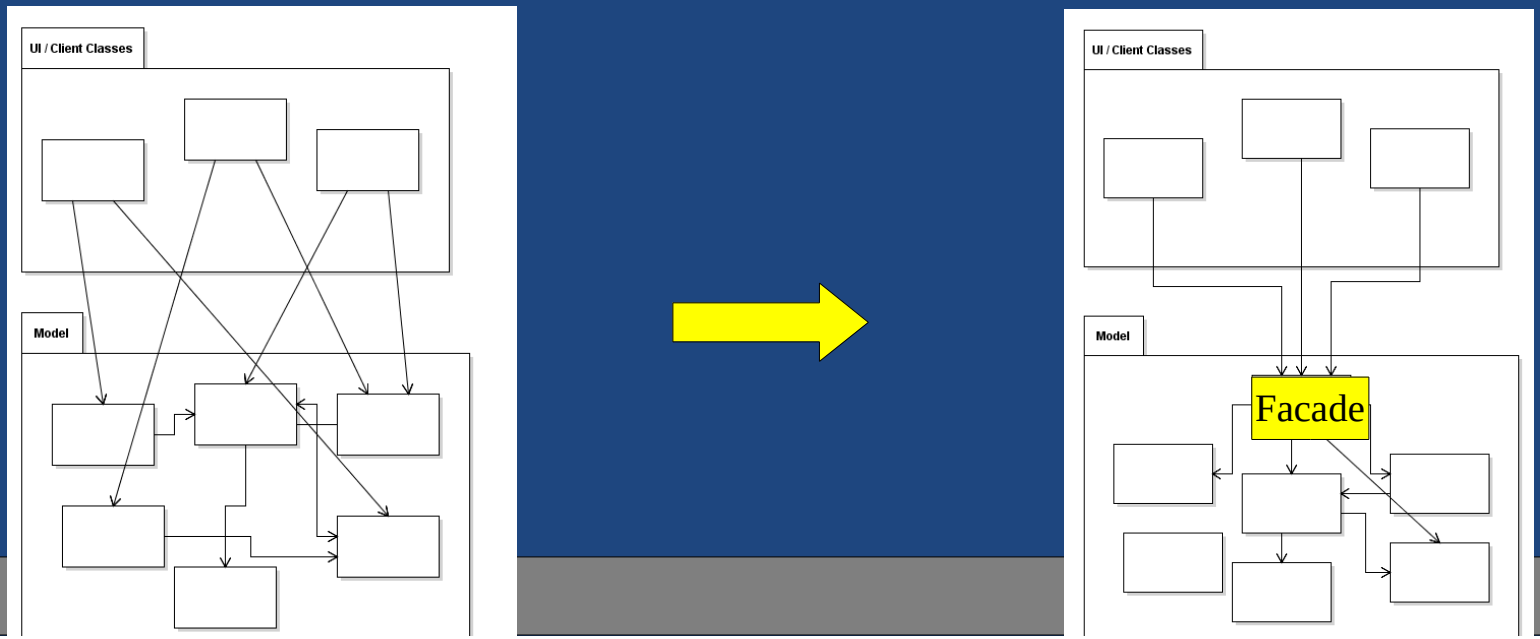
- Model:
  - Not like a "model airplane": it's the brains of your system.
- View:
  - Numerous views (parts of UI) may register as observers to a model.

MVC

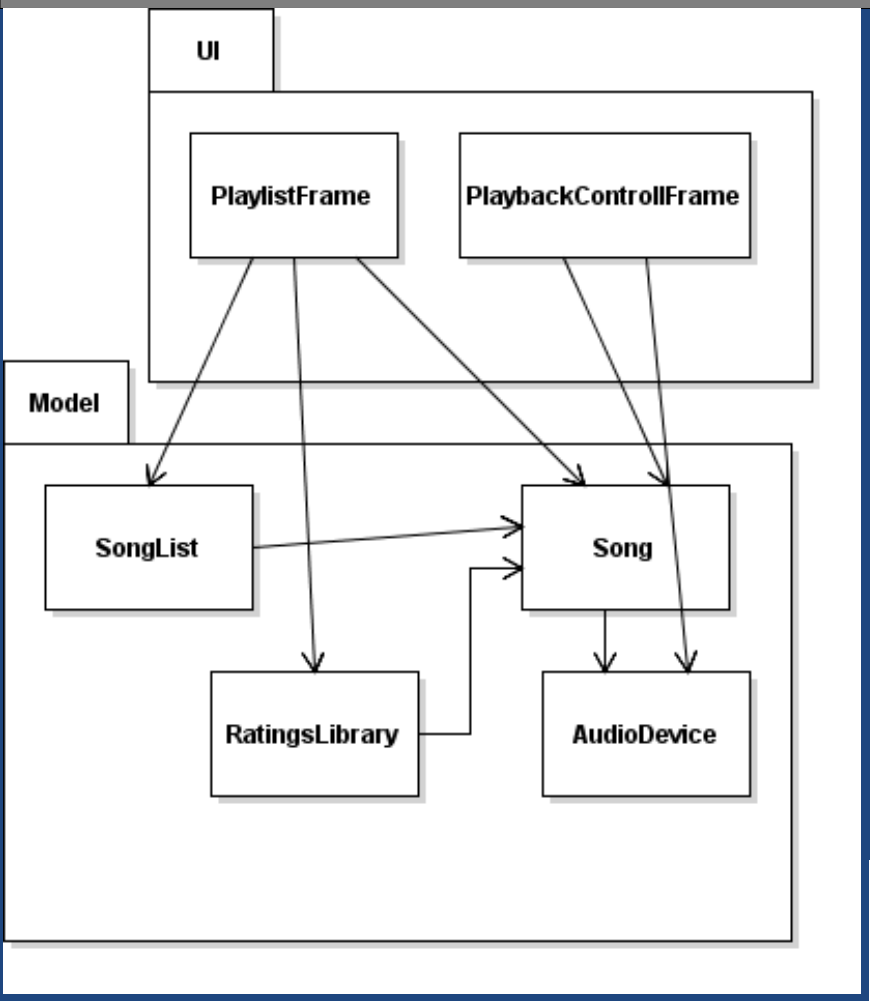
- Clean design
  Split business logic into..
- Model View Controller Pattern
  MVC splits off 3 things:
  - Hold data and logic
    - Ex: Histogram
  - Present information to user
    - Ex: HistogramIcon, UI components
  - Handles user interaction.
    - Ex: ActionListeners for buttons.

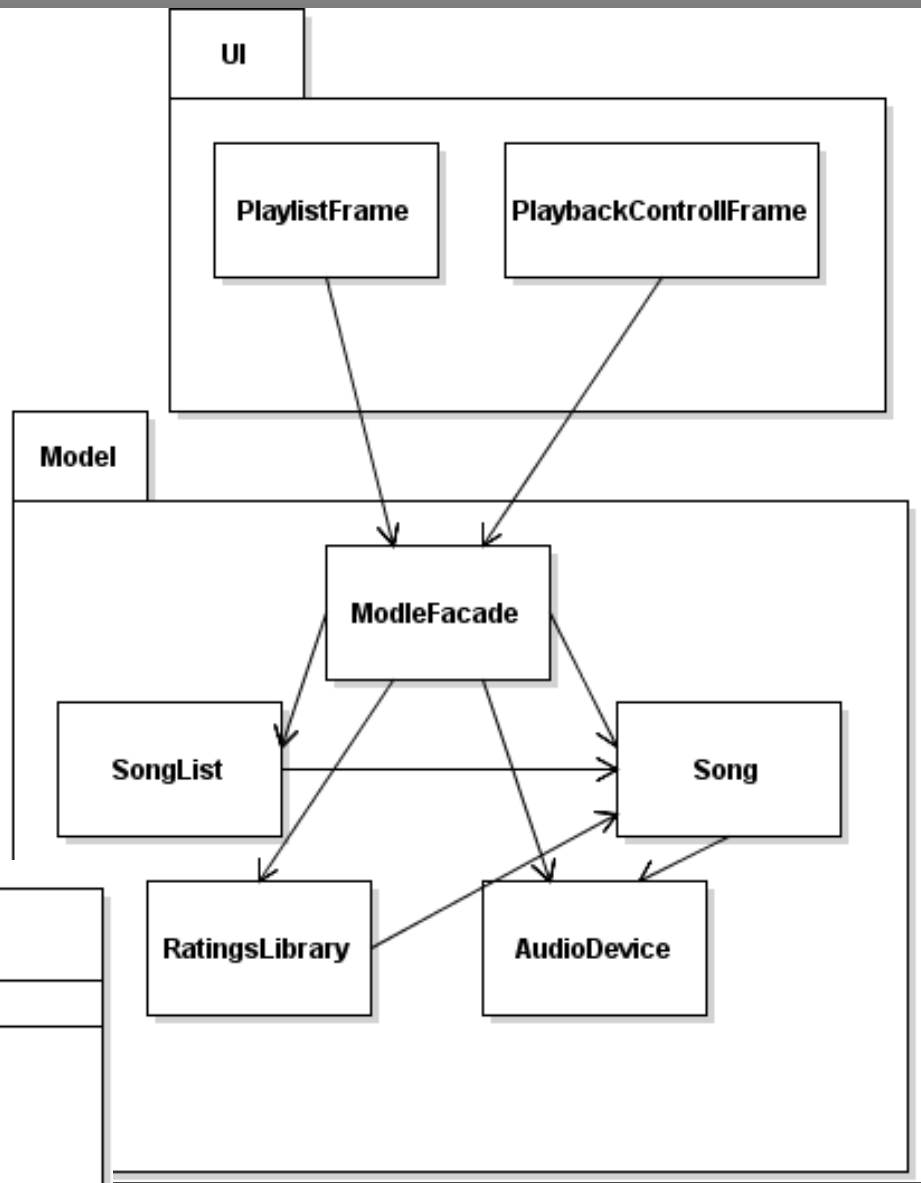
Facade Pattern

- Separate your model from your UI!
  - What if the model is complicated?
    UI gets.. to many classes in the model.
- Facade Pattern
  - Introduce a new class to the model to..



Facade Pattern Example: Music Player





Recognizing Patterns

Applying Patterns

- Recognize a pattern by..
  - Iterator: cycle through a collection
  - Observer: register for events
  - Strategy: wrap part of an algorithm into a class
- Helps to remember examples
  - Pattern name a hint, but it's not always applicable.
- Ex: What strategy applies to..
  - Strategy?
  - Observer?
  - Iterator?

Summary

- Design patterns allow reuse of design ideas.
- Iterator: An object which abstracts iteration through items in a collection.
  - Decoupled: change collection without changing client code.
- Observer: Notify observing objects of a change without being coupled to those objects.
- MVC: Separate the model from the view.
  - Consider Facade Pattern to decouple UI from model complexity.
- Apply patterns based on patterns intention (not name or UML diagram).