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A Sound Approximation of the Prevalence of the Observer Design Pattern

(in Java Applications)

BATAI

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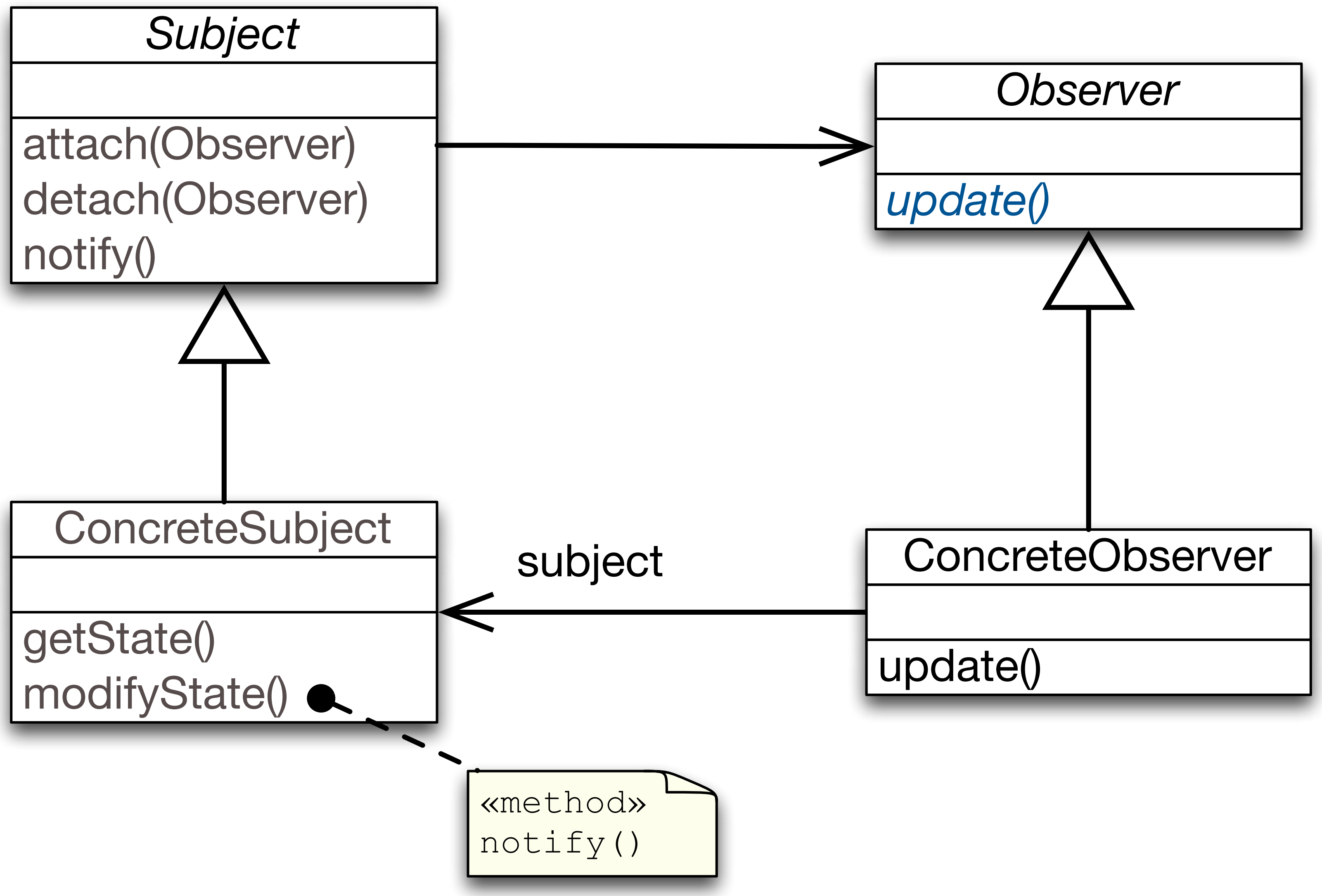
http://bitbucket.org/delors/bat

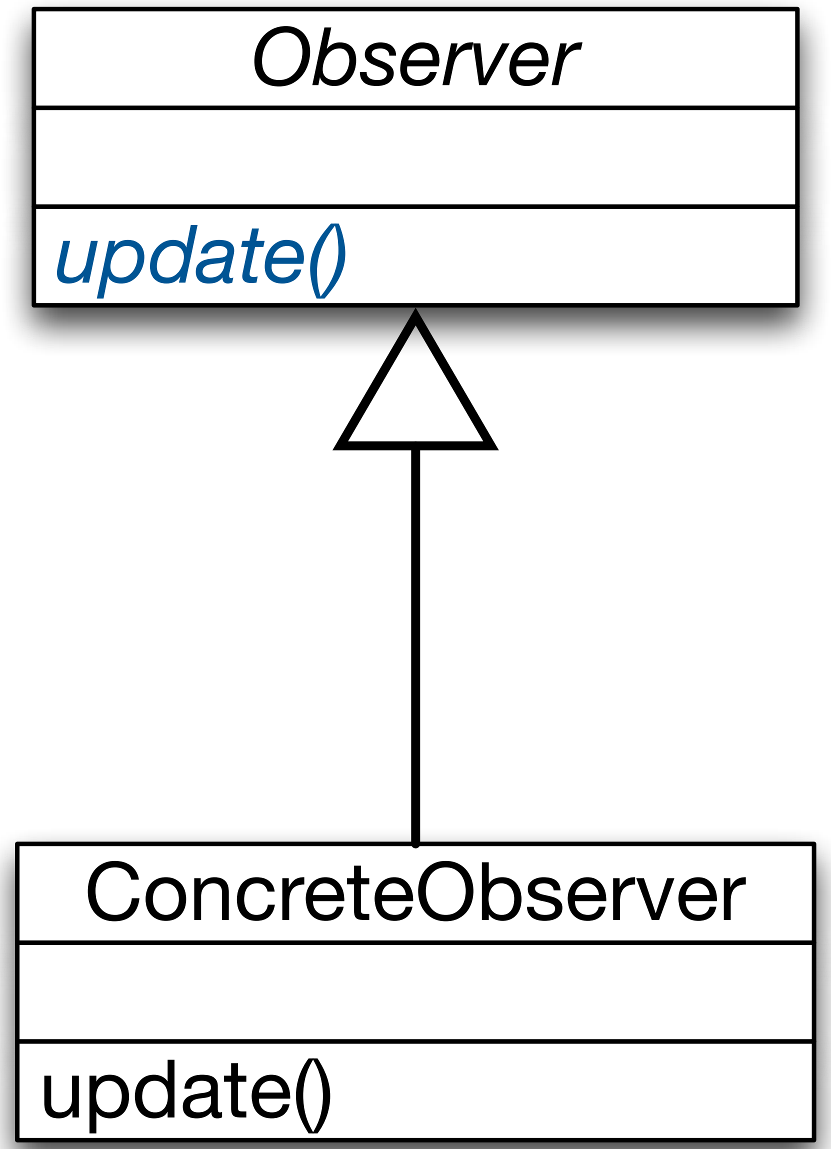
Observer Pattern



Identifying Observers

(i.e., classes that react on some event that happens somewhere else)

- the interface `java.util.EventListener`
- the interface `java.util.Observer`
- other classes and interfaces that ends with “Listener” or “Observer”
- *Observers* = { all classes and interfaces that are subtypes of the classes and interfaces identified using the above approaches }

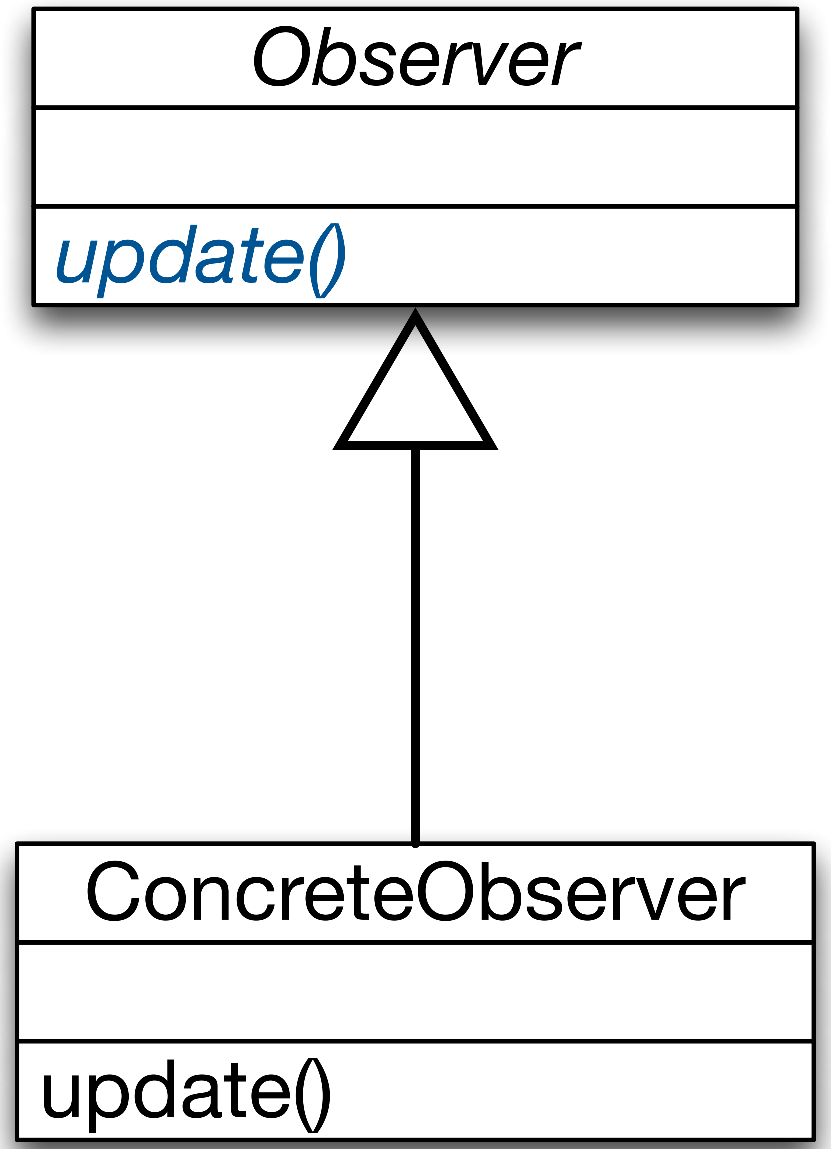


Identifying Update Methods

(methods that are called by the observable to notify the observer)

- *UpdateMethods = {* methods declared by an interface *i* ∈ *Observers }*

- The methods defined by classes that implement an Observer interface are not considered. They are typically not related to the pattern. E.g., the class javax.swing.JButton is an Observer, but only the methods defined by the interface EventListener are related to it.

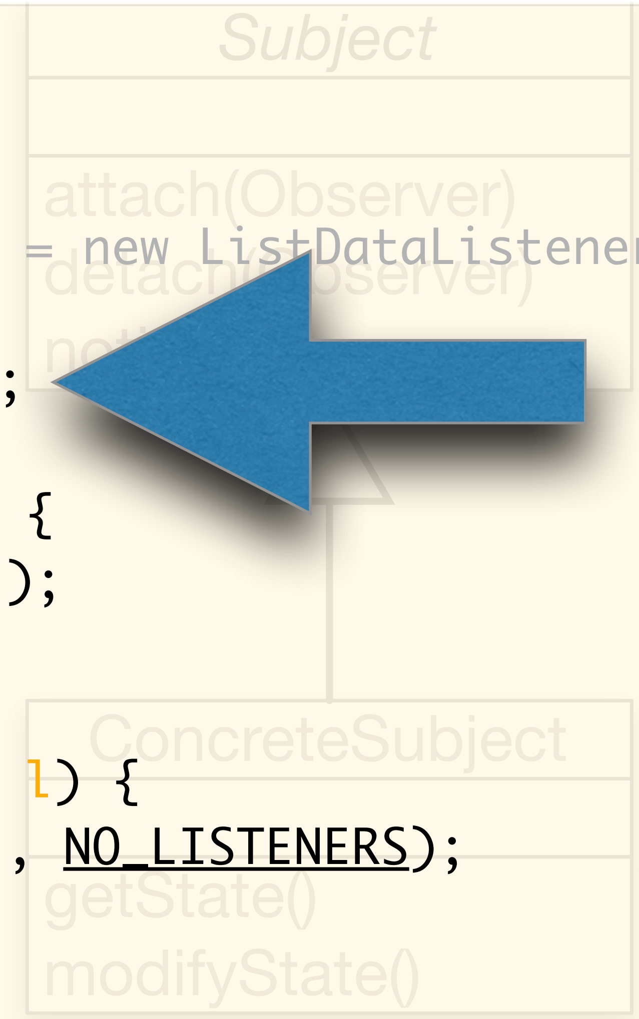


Part I

Managing Observers

(code to manage observers - storing observers)

```
public abstract class AbstractFlashcardSeries
        implements FlashcardSeries {

    public final static ListDataListener[] NO_LISTENERS = new ListDataListener[0];

    private ListDataListener[] listeners = NO_LISTENERS;

    public void addListDataListener(ListDataListener l) {
        this.listeners = Arrays.append(this.listeners, l);
    }

    public void removeListDataListener(ListDataListener l) {
        this.listeners = Arrays.remove(this.listeners, l, NO_LISTENERS);
    }

    …
}
```



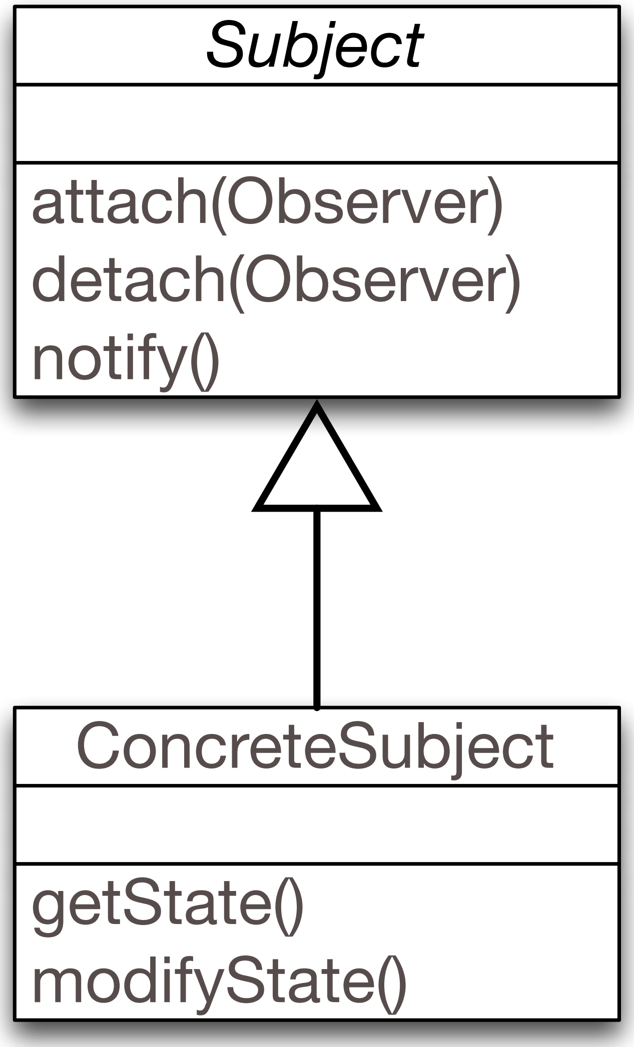
Part I

Managing Observers

(code to manage observers - storing observers)

- *OMCandFields* = { (c,f) | f* is a field of a class ***c*** that has a field with type ***t*** or that is an array of type ***t*** or that has a field that is parameterized using an type ***t*** and ***t*** ∊ *Observers }*

- This enables us to identify subjects that enable the registration of one or more observers (e.g. `List<Observer>`)

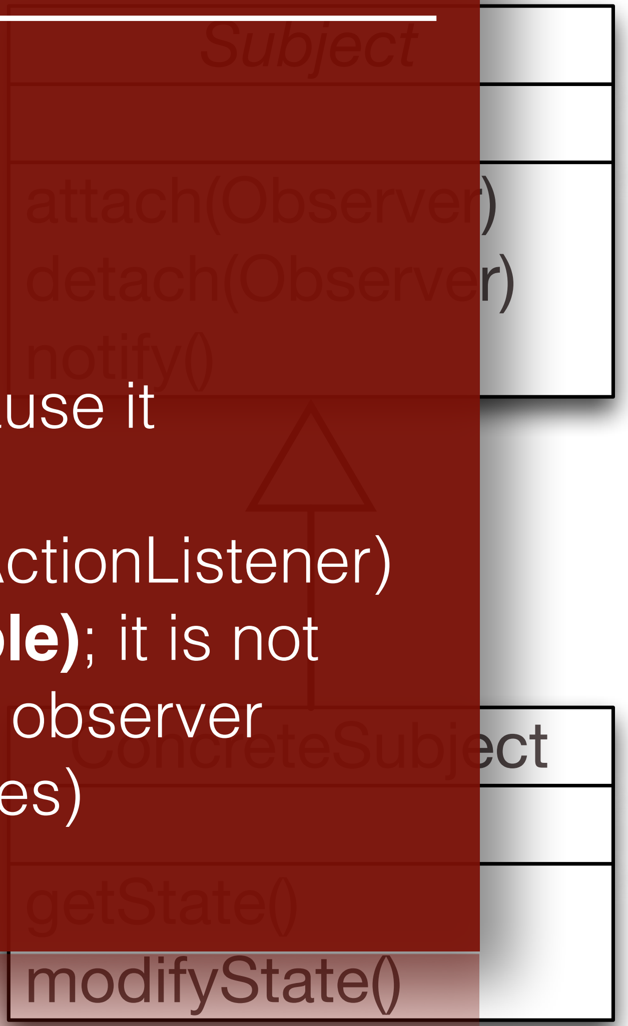


* *OMCandFields* ≜ Fields potentially related to the management of observers.

Managing Observers

(code to manage observers - storing observers)

- *OMCandFields* = { (c,f) | f is a field of a class *c* that has a field with type *t* or that has a field that is parameterized using an type *t* and *t* ∈ *Observers*}
- This enables to identify subjects that enable the registration of one or more observers (e.g. List<Observer>)



Issue

```
class C {
    private JButton b = new JButton();
}
```

- JButton is classified as an observer because it implements java.awt.ImageObserver
- JButton is also observable (add/removeActionListener)
- But, **class C is not a Subject (Observable)**; it is not participating in the implementation of the observer pattern (it does not react on button presses)

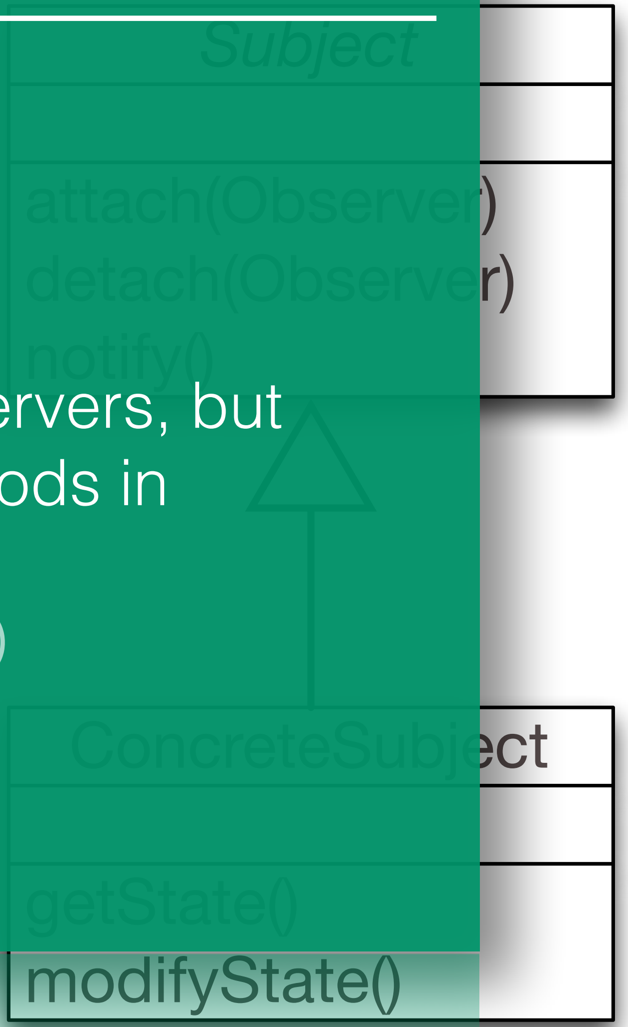
Part I

Managing Observers

(code to manage observers - storing observers)

- *OMCandFields* = { (*c*,*f*) / *f* is a field of a class *c* that has a field with type *t* or that has a field that is parameterized using an type *t* and *t* ∈ *Observers*)

- This enables to identify subjects that enable the registration of one or more observers (e.g. List<Observer>)



Solution

```
class C {
    private JButton b = new JButton();
}
```

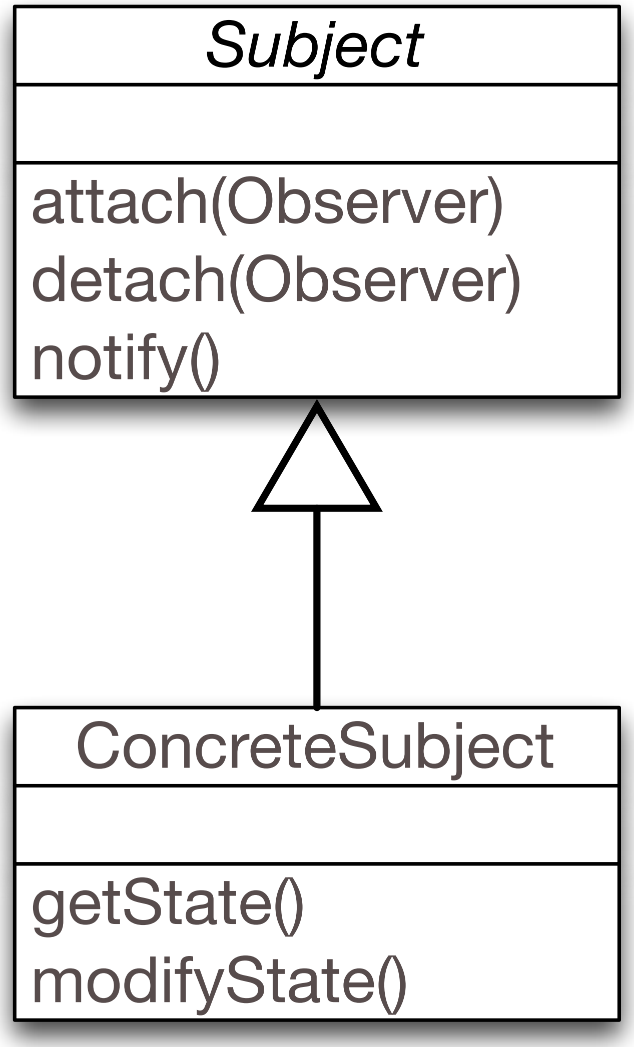
- ignore fields that store references to observers, but which are not used to make calls to methods in *UpdateMethod*
  (uses intra-procedural data-flow analysis)

Part I

Managing Observers

(code to manage observers - storing observers)

- *OMFields** = { (c,f) | (c,f) ∈ *OMCandFields* where the object referenced by the field is the receiver of a method call *m* where *m* ∈ *UpdateMethods* }



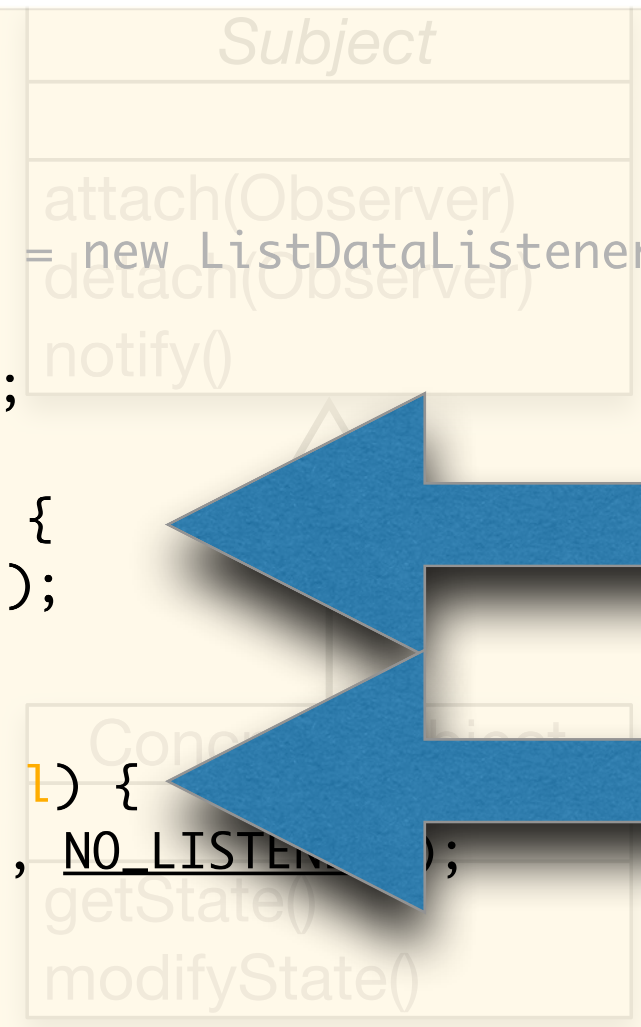
* *OMFields* ≜ Fields that are related to the management of observers.

Part II

Managing Observers

(code to manage observers - registration and notification of observers)

```
public abstract class AbstractFlashcardSeries
        implements FlashcardSeries {

    public final static ListDataListener[] NO_LISTENERS = new ListDataListener[0];

    private ListDataListener[] listeners = NO_LISTENERS;

    public void addListDataListener(ListDataListener l) {
        this.listeners = Arrays.append(this.listeners, l);
    }

    public void removeListDataListener(ListDataListener l) {
        this.listeners = Arrays.remove(this.listeners, l, NO_LISTEN    );
    }

    …
}
```

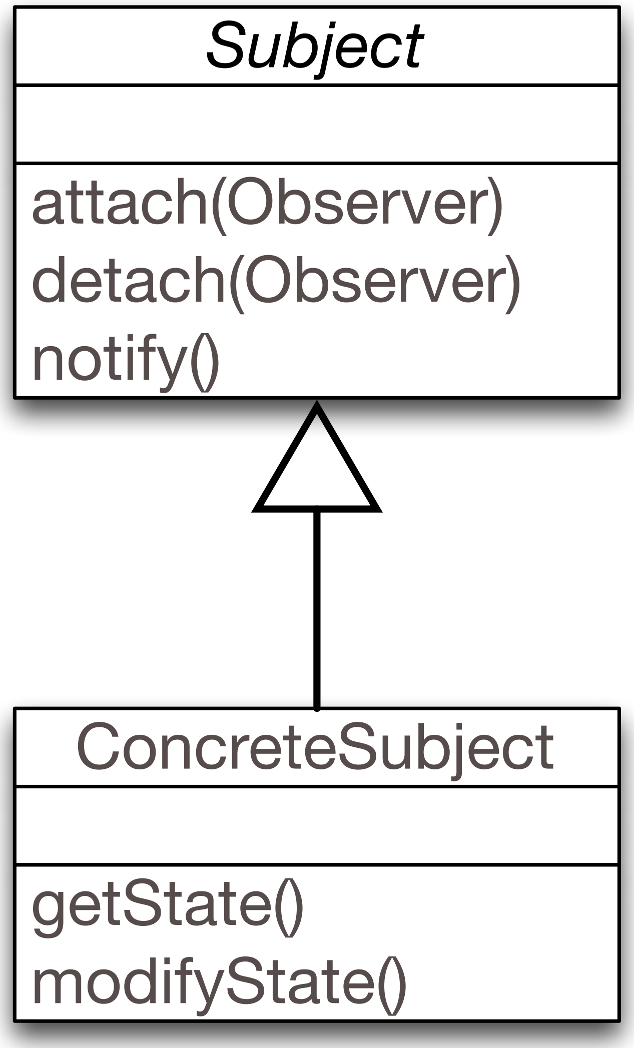


Part II

Managing Observers

(code to manage observers - registration and immediate notification of observers)

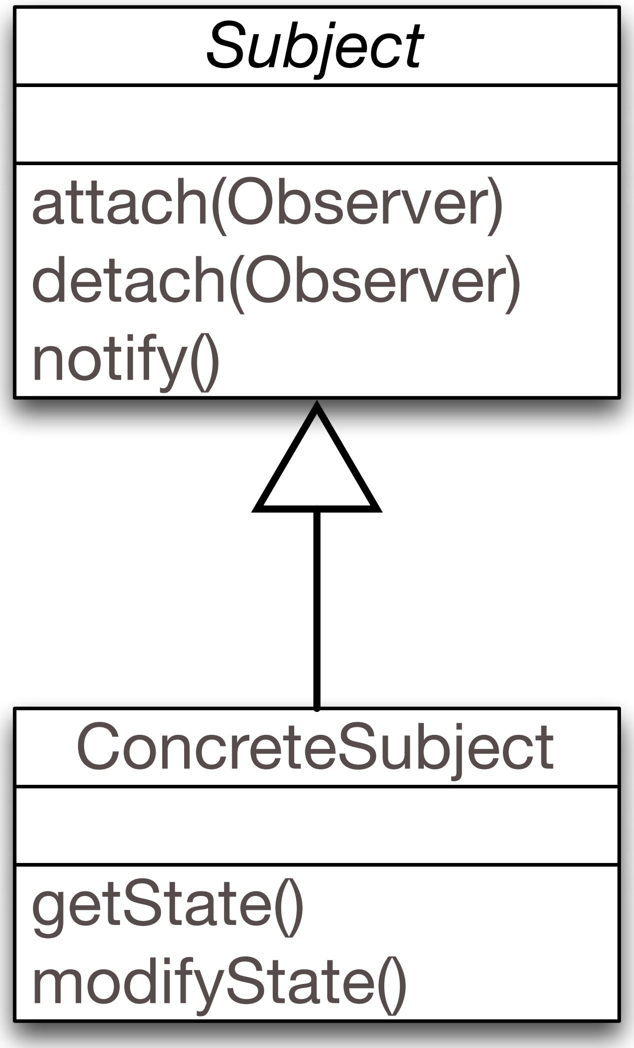
- *OMMethods = { (c,m) | m* is a method of a class ***c*** that reads or writes a field ***f*** of that class that is also in *OMFields* }



Identifying Observables

(classes that can be observed and will call back observers)

- *Observables* = *{ c* | *c* has a field *f* that is in *OMField }*
- If the subject defines a field: “List<T> listeners…”, then this class can be considered to be observable.



Overview

- *Observers*
- *Observables*
- *OMFields*
- *OMMethods*
- Next step: estimating the amount of code that is used to instantiate the classes and to call the observers