CMSC 132: OBJECT-ORIENTED PROGRAMMING II

Iterator, Marker, Observer Design Patterns

Department of Computer Science
University of Maryland, College Park

Design Patterns

- Descriptions of reusable solutions to common software design problems (e.g, Iterator pattern)
- Captures the experience of experts
- Goals
  - Solve common programming challenges
  - Improve reliability of solution
  - Aid rapid software development
  - Useful for real-world applications
- Design patterns are like recipes – generic solutions to expected situations
- Design patterns are language independent
- Recognizing when and where to use design patterns requires familiarity & experience
- Design pattern libraries serve as a glossary of idioms for understanding common, but complex solutions
- Design patterns are used throughout the Java Class Libraries

Iterator Pattern

- **Definition**
  - Move through collection of objects without knowing its internal representation
- **Where to use & benefits**
  - Use a standard interface to represent data objects
  - Uses standard iterator built in each standard collection, like List
  - Need to distinguish variations in the traversal of an aggregate
- **Example**
  - Iterator for collection
  - Original
    - Examine elements of collection directly
  - Using pattern
    - Collection provides Iterator class for examining elements in collection

Iterator Example

```
public interface Iterator<V> {
    bool hasNext();
    V next();
    void remove();
}

Iterator<V> it = myCollection.iterator();

while ( it.hasNext() ) {
    V x = it.next();  // finds all objects
    …                 //   in collection
}
```

Marker Interface Pattern

- **Definition**
  - Label semantic attributes of a class
- **Where to use & benefits**
  - Need to indicate attribute(s) of a class
  - Allows identification of attributes of objects without assuming they are instances of any particular class
- **Example**
  - Classes with desirable property GoodProperty
  - ***Original***
    - Store flag for GoodProperty in each class
  - ***Using pattern***
    - Label class using GoodProperty interface
- **Examples from Java**
  - Cloneable
  - Serializable

Marker Interface Example

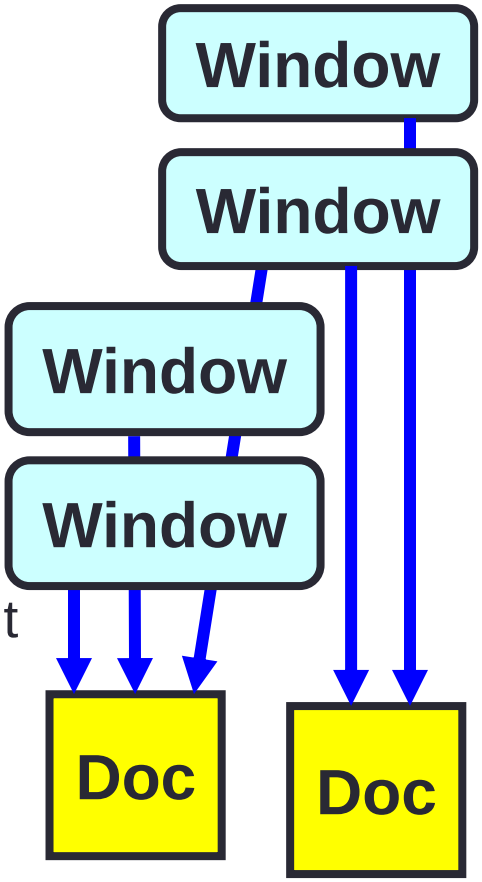
```
public interface SafePet { }      // no methods

class Dog implements SafePet { … }
class Piranha { … }

Dog dog  = new Dog();
Piranha piranha  = new Piranha();

if (dog instanceof SafePet) …          // True
if (piranha instanceof SafePet) …      // False
```

Observer Pattern

- **Definition**
  - Updates all dependents of object automatically once object changes state
- **Where to use & benefits**
  - One change affects one or many objects
  - Many objects behavior depends on one object state
  - Need broadcast communication
  - Maintain consistency between objects
  - Observers do not need to constantly check for changes

Observer Pattern

- **Example**
  - Multiple windows (views) for single document
  - ***Original***
    - Each window checks document
    - Window updates image if document changes
    - Think of window as asking “Are we there yet?”
  - ***Using pattern***
    - Each window registers as observer for document
    - Document notifies all of its observers when it changes



Observer Example

```
public interface Observer {
    // Called when observed object o changes
    public void update(Observable o, Object a)
}

public class Observable {
    protected  void setChanged()
    protected void clearChanged()
    boolean hasChanged()

    void addObserver(Observer o)
    void notifyObservers()
    void notifyObservers(Object a)
}
```

```
public class MyWindow implements Observer {
    public openDoc(Observable doc) {
        doc.addObservers(this); // Adds window to list
    }
    public void update(Observable doc, Object arg)  {
        redraw(doc);  // Displays updated document
    }
}

public class MyDoc extends Observable {
    public void edit() {
        …                          // Edit document
        setChanged();              // Mark change
        notifyObservers(arg);   // Invokes update()
    }
}
```