Applying the Observer Design Pattern

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About Myself

- **Degree**
  - **B.S. in Computer Science**
  - **Rutgers University (go Scarlet Knights!)**
- **ExxonMobil Research & Engineering**
  - **Clinton, New Jersey**
  - **Senior Research Technician (1988-1998, 2004-present)**
  - **Systems Analyst (1998-2002)**
- **Ai-Logix, Inc.**
  - **Somerset, New Jersey**
  - **Technical Support Engineer (2003-2004)**

About Myself (continued)

- ACGNJ
  - Java Users Group Leader
  - Secretary
- Publications
  - "Avoid Excessive Subclassing with the Decorator Design Pattern"
    - Barry Burd and Michael Redlich
    - *Java Boutique*, January 27, 2006
  - "James: The Java Apache Mail Enterprise Server"
    - Barry Burd and Michael Redlich
    - *Java Boutique*, September 30, 2005

Example Source Code

- The example source code was adapted from:
  - Head First Design Patterns
    - + Eric & Elisabeth Freeman (with Kathy Sierra & Bert Bates)
- Download example source code from:
  - http://tcf.redlich.net/

Gang of Four (GoF)

- **Erich Gamma**
- **Richard Helm**
- **Ralph Johnson**
- **John Vlissides**
- **Design Patterns – Elements of Reusable Object-Oriented Software**
  - **ISBN 0-201-63361-2**
  - **1995**

Gang of Four (GoF) Next Generation?

- **Eric Freeman**
- **Elisabeth Freeman**
- **Kathy Sierra**
- **Bert Bates**
- **Head First Design Patterns**
  - **ISBN 0-596-00712-4**
  - **2004**

What are Design Patterns?

- **A <u>pattern</u> is a solution to a problem in a context**
- **The <u>context</u> is the situation in which the pattern applies**
- **The <u>problem</u> refers to the desired goal in the context, but also refers to any constraints that may occur**
- **The <u>solution</u> is a general design that anyone can apply**

"If you find yourself in a context with a problem that has a goal that is affected by a set of constraints, then you can apply a design that resolves the goal and constraints and leads to a solution."

What are Design Patterns? (continued)

- **Recurring <u>solutions</u> to software design <u>problems</u> that are <u>repeatedly</u> found in real-world application development**
- **All about the <u>design</u> and <u>interaction</u> of objects**
- **Four essential elements:**
  - **The pattern name**
  - **The problem**
  - **The solution**
  - **The consequences**

How Design Patterns Solve Design Problems

- **Find appropriate objects**
  - **Helps identify less obvious abstractions**
- **Design for change**
  - **Avoid creating objects directly**
  - **Avoid dependencies on specific operations**
  - **Avoid algorithmic dependencies**
  - **Avoid tight coupling**

Thinking in Design Patterns

- **Keep it simple**
  - **Goal should be simplicity**
- **Design patterns are not a magic bullet**
  - **No “plug and play”**
- **Know when to apply a design pattern**
  - **Ensure that a pattern fits the design**
- **Consider patterns during refactoring**
  - **Goal is to improve structure, not behavior**
- **Don’t be afraid to remove a design pattern**
  - **Especially if design has become too complex**

Design Pattern Categories

- **Creational**
  - **Abstracts the instantiation process**
  - **Dynamically create objects so that they don’t have to be instantiated directly**
- **Structural**
  - **Composes groups of objects into larger structures**
- **Behavioral**
  - **Defines communication among objects in a given system**
  - **Provides better control of flow in a complex application**

Creational Patterns

- Abstract Factory
  - Provides an interface for creating related objects without specifying their concrete classes
- Builder
  - Reuses the construction process of a complex object
- Factory Method
  - Lets subclasses decide which class to instantiate from a defined interface
- Prototype
  - Creates new objects by copying a prototype

Creational Patterns (continued)

- **Singleton**
  - **Ensures a class has only one instance with a global point of access to it**

Structural Patterns

- **Adapter**
  - **Converts the interface of one class to an interface of another**
- **Bridge**
  - **Decouples an abstraction from its implementation**
- **Composite**
  - **Composes objects into tree structures to represent hierarchies**
- **Decorator**
  - **Attaches responsibilities to an object dynamically**

Structural Patterns (continued)

- **Façade**
  - **Provides a unified interface to a set of interfaces**
- **Flyweight**
  - **Supports large numbers of fine-grained objects by sharing**
- **Proxy**
  - **Provides a surrogate for another object to control access to it**

Behavioral Patterns

- **Chain of Responsibility**
  - **Passes a request along a chain of objects until the appropriate one handles it**
- **Command**
  - **Encapsulates a request as an object**
- **Interpreter**
  - **Defines a representation and an interpreter for a language grammar**
- **Iterator**
  - **Provides a way to access elements of an object sequentially without exposing its implementation**

Behavioral Patterns (continued)

- **Mediator**
  - **Defines an object that encapsulates how a set of objects interact**
- **Memento**
  - **Captures an object's internal state so that it can be later restored to that state if necessary**
- **Observer**
  - **Defines a one-to-many dependency among objects**
- **State**
  - **Allows an object to alter its behavior when its internal state changes**

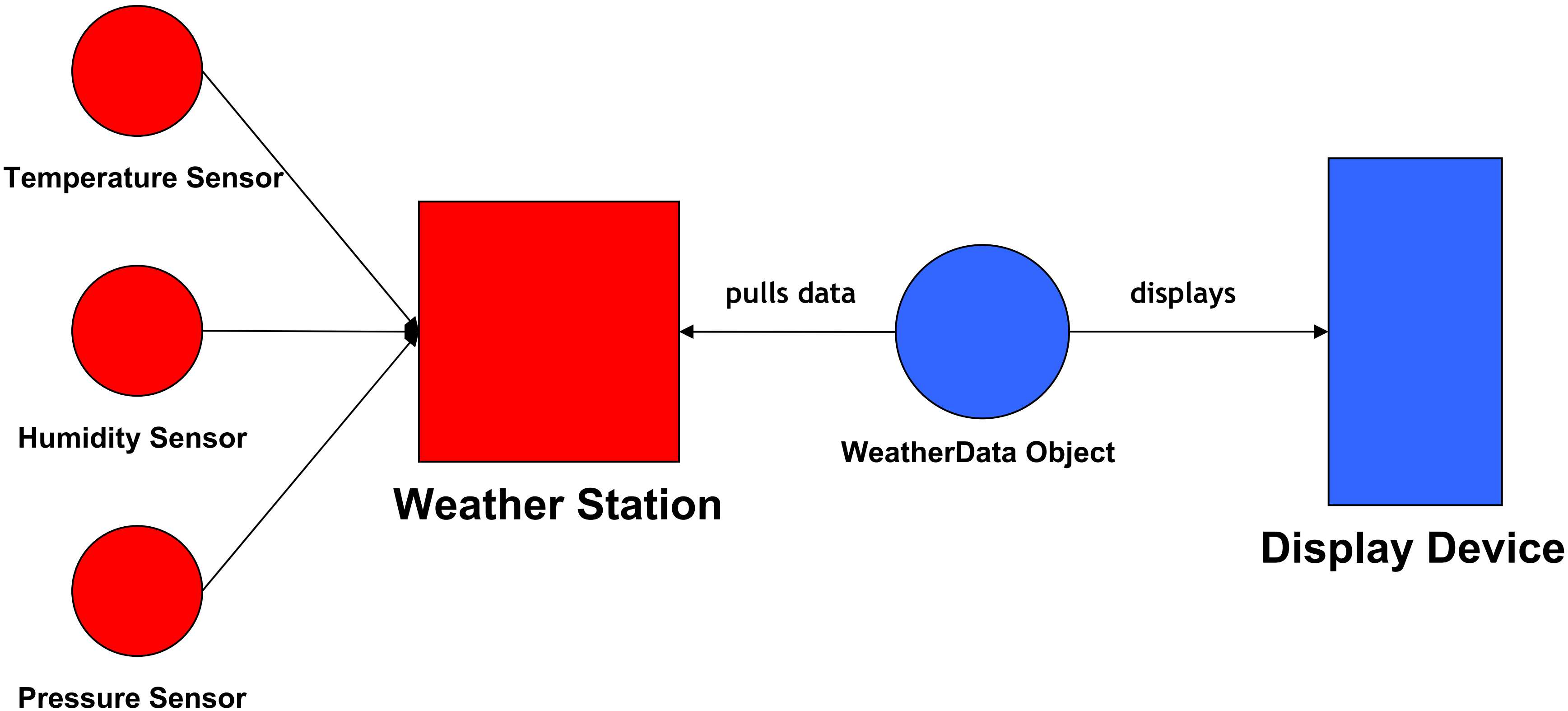
Behavioral Patterns (continued)

- **Strategy**
  - **Encapsulates a set of algorithms individually and makes them interchangeable**
- **Template Method**
  - **Lets subclasses redefine certain steps of an algortithm**
- **Visitor**
  - **Defines a new operation without changing the classes on which it operates**

Weather Monitoring Station Application

- **Objective:**
  - **Design an internet-based Weather Monitoring Station application that pulls weather-related data from a weather station and displays it onto a device**
  - **Temperature, humidity, and barometric pressure data is sent to the weather station**

Weather Monitoring Station Application



WeatherData Object

WeatherData
temperature humidity pressure
getTemperature getHumidity getPressure measurementsChanged

IS THIS A GOOD APPROACH?

```java
public class WeatherData {

  // instance variables...

  public void measurementsChanged() {

    float temperature = getTemperature();

    float humidity = getHumidity();

    float pressure = getPressure();

    currentConditions.update(temperature,humidity,pressure);

    statisticsDisplay.update(temperature,humidity,pressure);

    forecastDisplay.update(temperature,humidity,pressure);

  }

  // other methods here...

}
```

Area we expect to change

Use of a common interface

Coding to concrete implementations

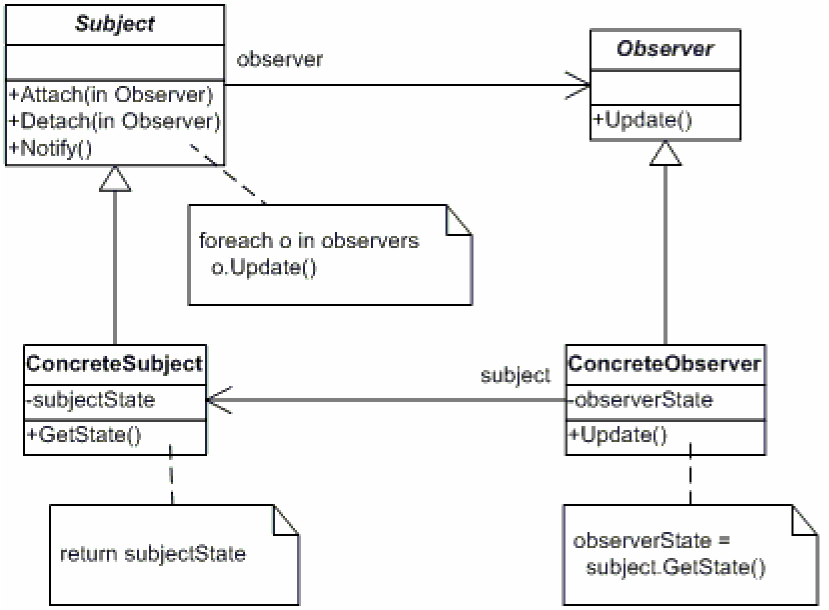
Observer

- **Intent**
  - **Defines a one-to-many dependency among objects so that when one object changes state, all its dependents are notified and updated automatically**
  - **A way of notifying change to a number of classes**
- **Also known as**
  - **Dependents**
  - **Publish-Subscribe**
- **Motivation**
  - **To avoid making classes tightly coupled that would reduce their reusability**

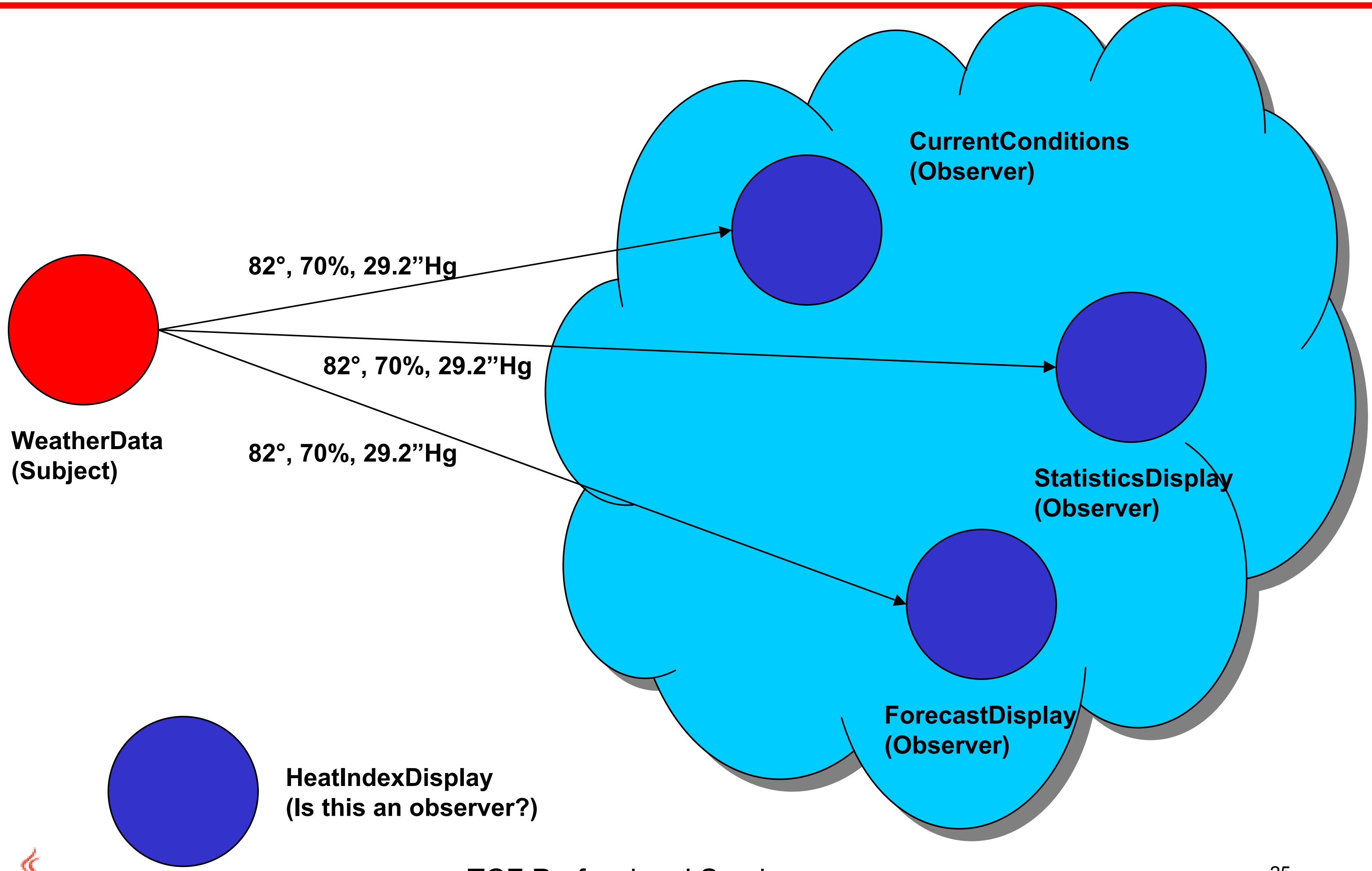
Observer (continued)

- **Design Principle**
  - **Strive for loosely coupled designs among objects that interact**
- **Use this pattern when:**
  - **A change to one object requires changing others, and the number of objects to be changed is unknown**
  - **An object should be able to notify other objects without making assumptions about who these objects are**
    - + **Avoids having these objects tightly coupled**

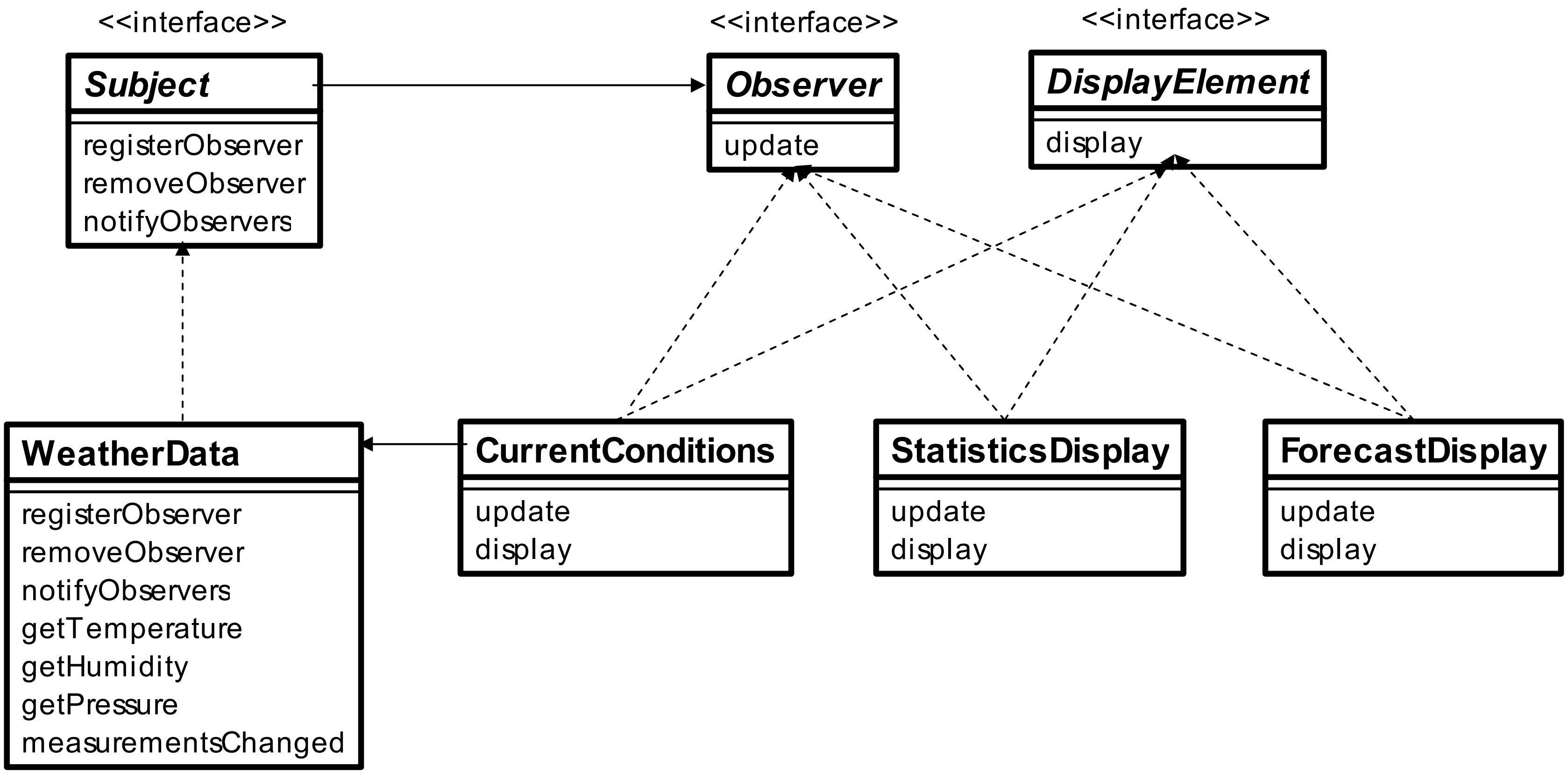
Observer (continued)



Publisher + Subscriber = Observer



Weather Monitoring Station Application



And Now…

- **…for the code review and demonstration!**

Resources

- **Design Patterns – Elements of Reusable Object-Oriented Software**
  - **Erich Gamma, et. al**
  - **ISBN 0-201-63361-2**
- **Head First Design Patterns**
  - **Eric & Elisabeth Freeman (with Kathy Sierra & Bert Bates)**
  - **ISBN 0-596-00712-4**
  - **http://www.wickedlysmart.com/**
- **Java Design Patterns**
  - **James W. Cooper**
  - **ISBN 0-201-48539-7**
  - **http://www.patterndepot.com/put/8/JavaPatterns.htm**

Resources (continued)

- **UML Distilled**
  - **Martin Fowler (with Kendall Scott)**
  - **ISBN 0-201-32563-2**
- **Data & Object Factory**
  - http://www.dofactory.com/