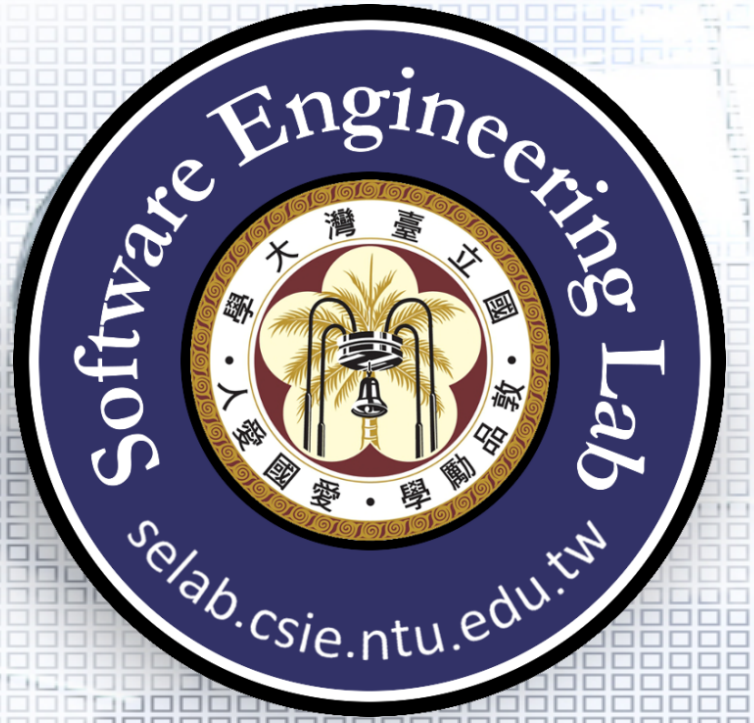
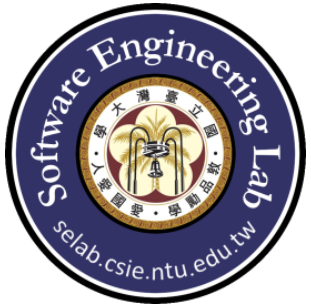


Observer Pattern

Prof. Jonathan Lee (李允中)
Department of CSIE
National Taiwan University



Design Aspect of Observer

Number of objects that depend on another object; how the dependent objects stay up to date

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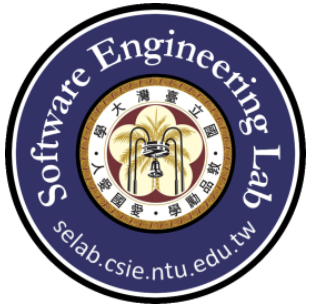

Outline

- Spreadsheet Application Requirements Statements
- Initial Design and Its Problems
- Design Process
- Refactored Design after Design Process
- Weather Monitoring Station System: Another Example
- Recurrent Problems
- Intent
- Observer Pattern Structure
- Homework

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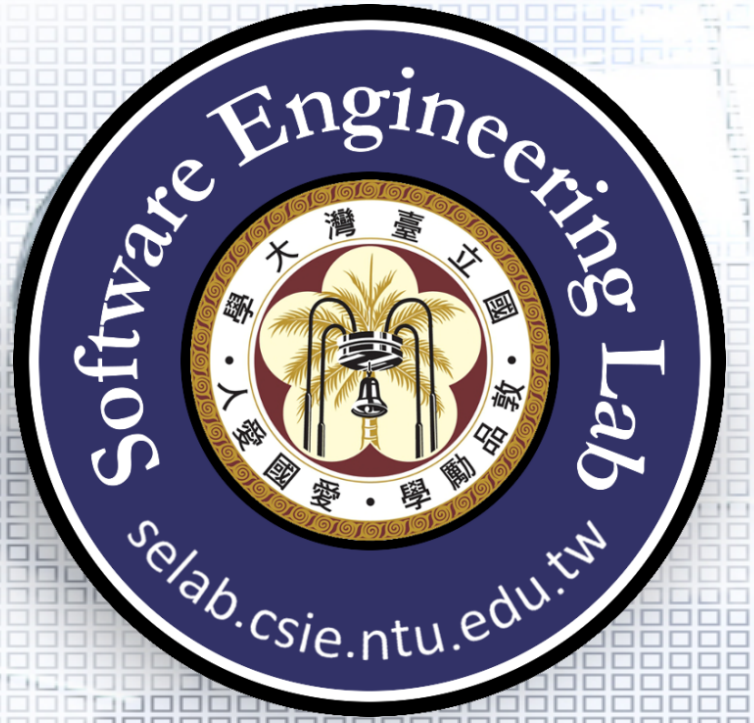


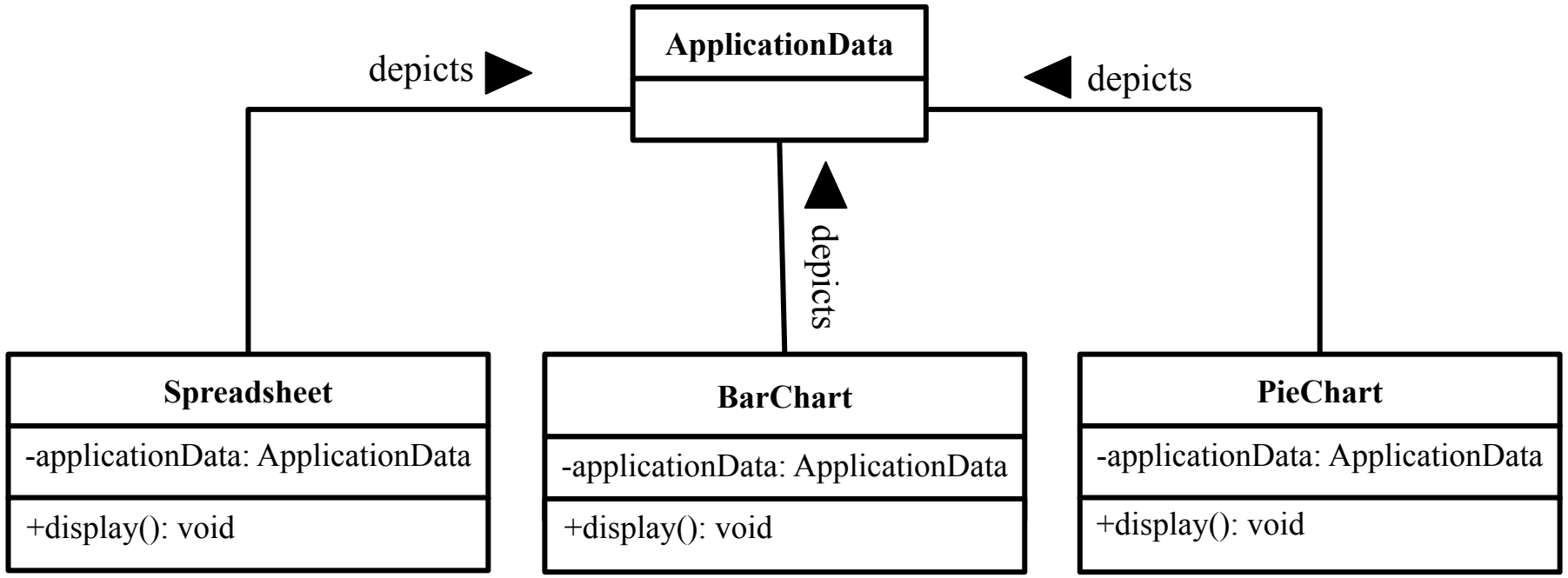
Spreadsheet Application (Observer)

Prof. Jonathan Lee (李允中)

Department of Computer Science and Information Engineering
National Taiwan University

Requirements Statements$_1$

- In a spreadsheet application,
  - A spreadsheet object, bar chart object, and pie chart object can depict information in the same application data object by using different presentations.



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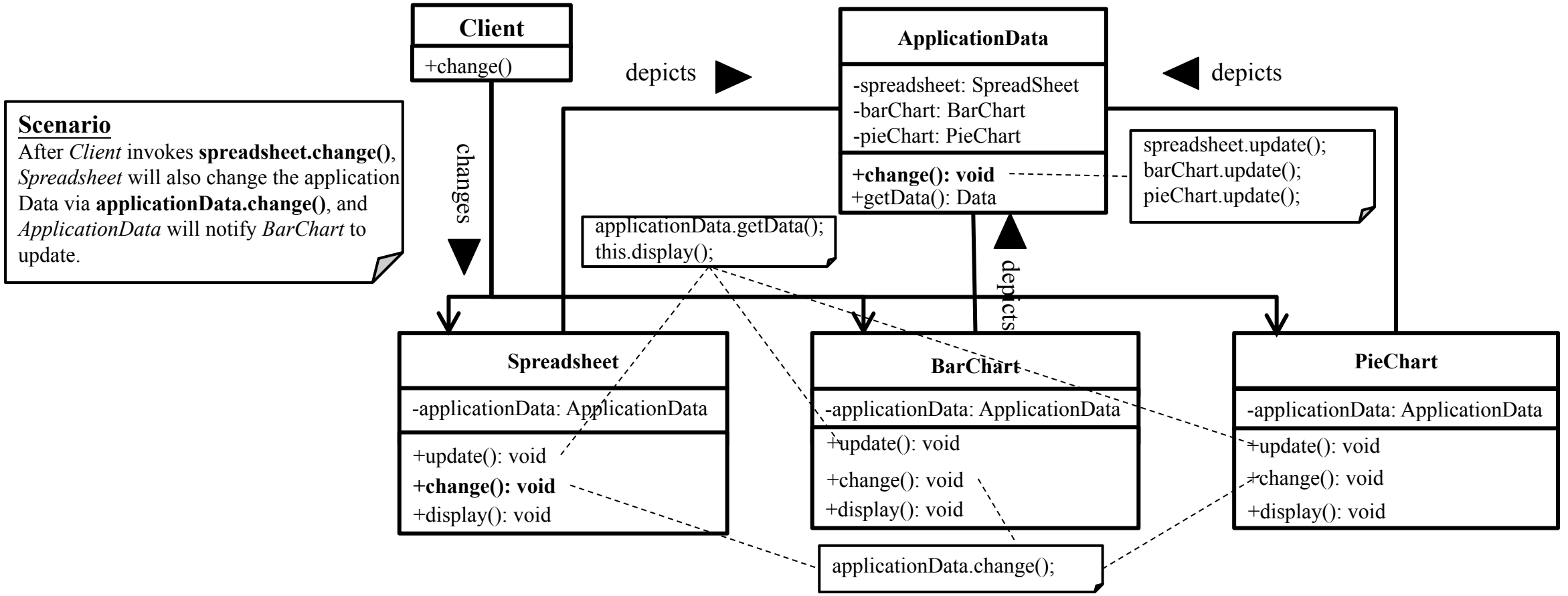
Requirements Statements$_2$

- When the user changes the information in the spreadsheet, the bar chart reflects the changes immediately, and vice versa.



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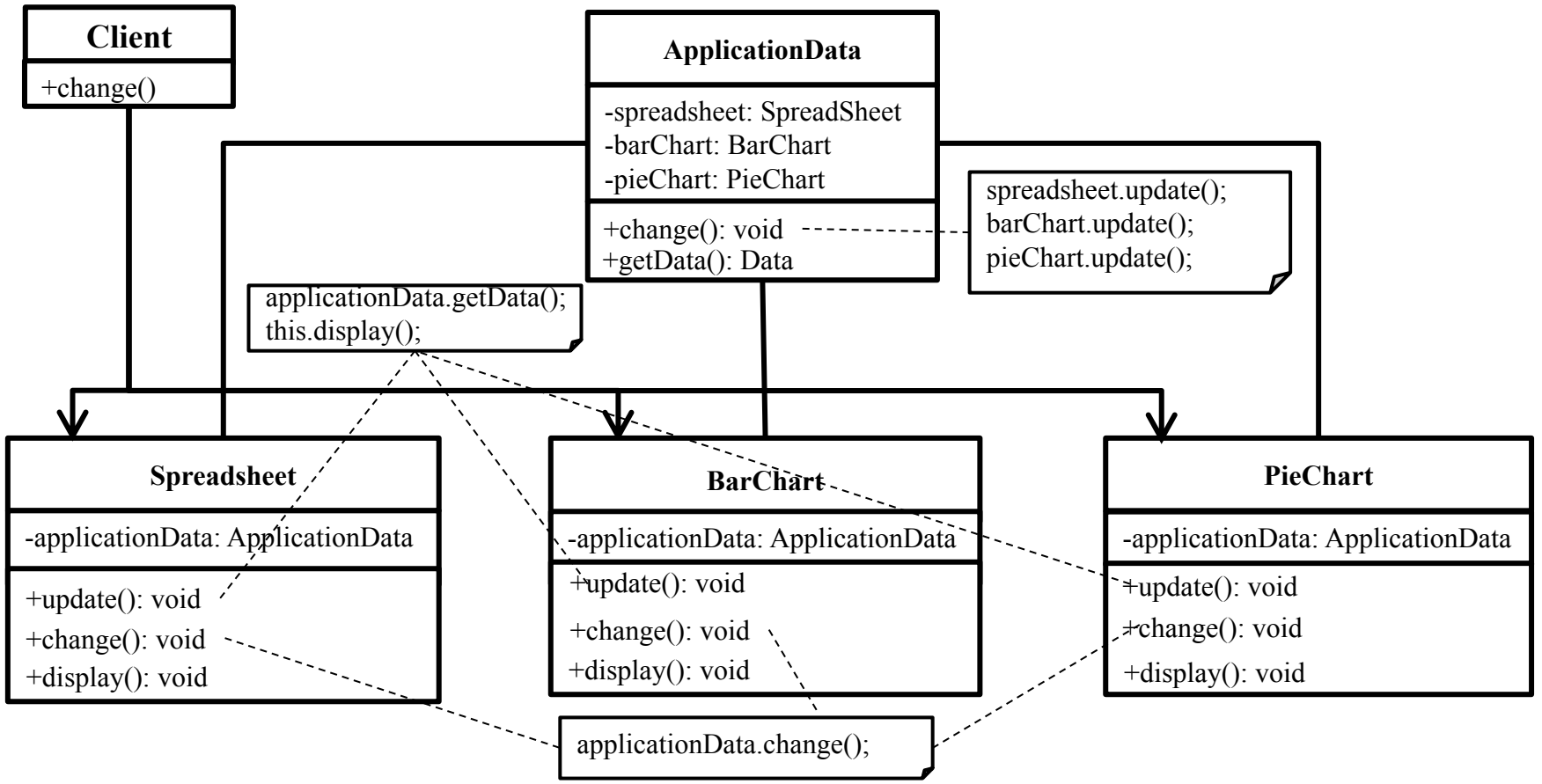
Initial Design



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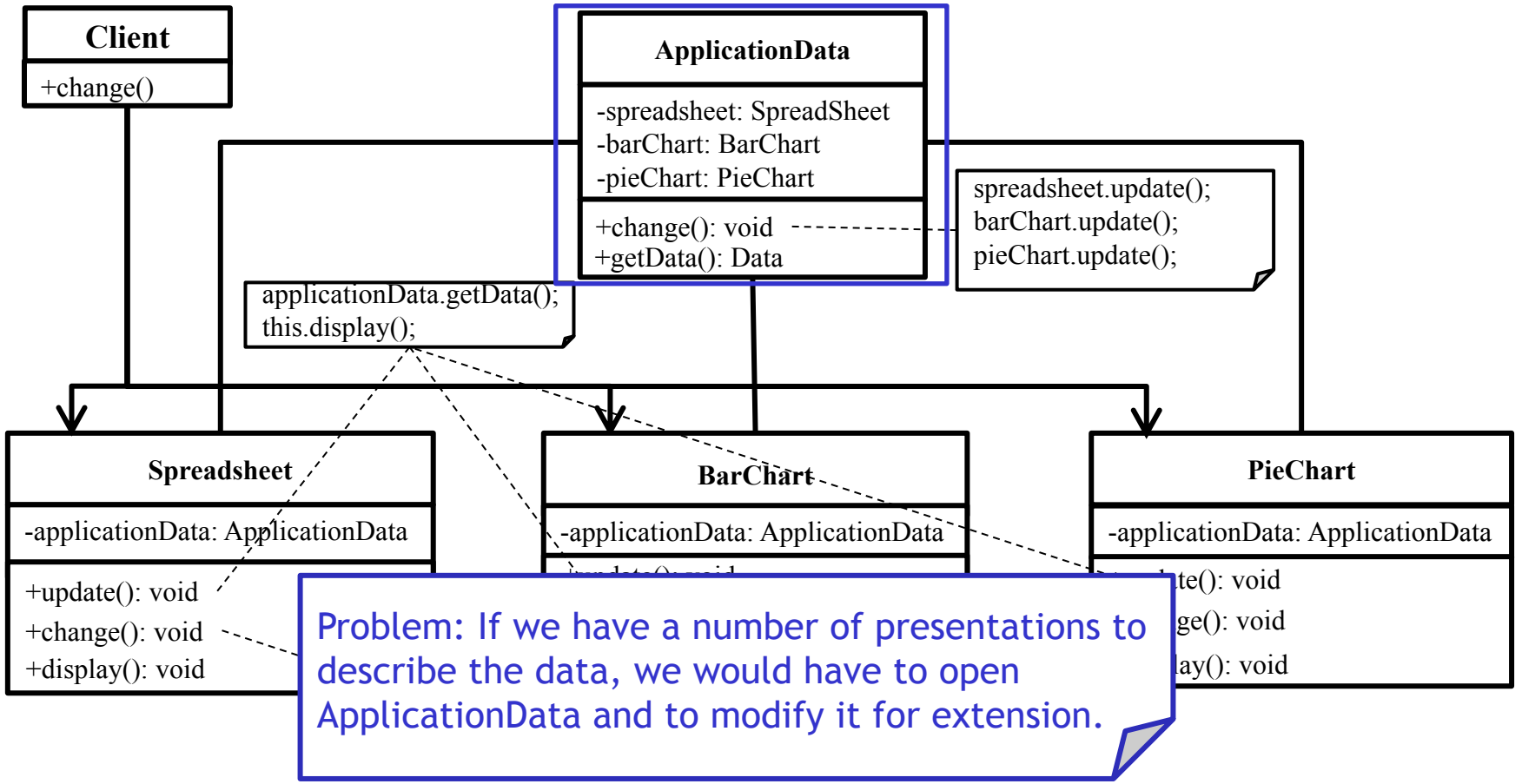
Problems with Initial Design



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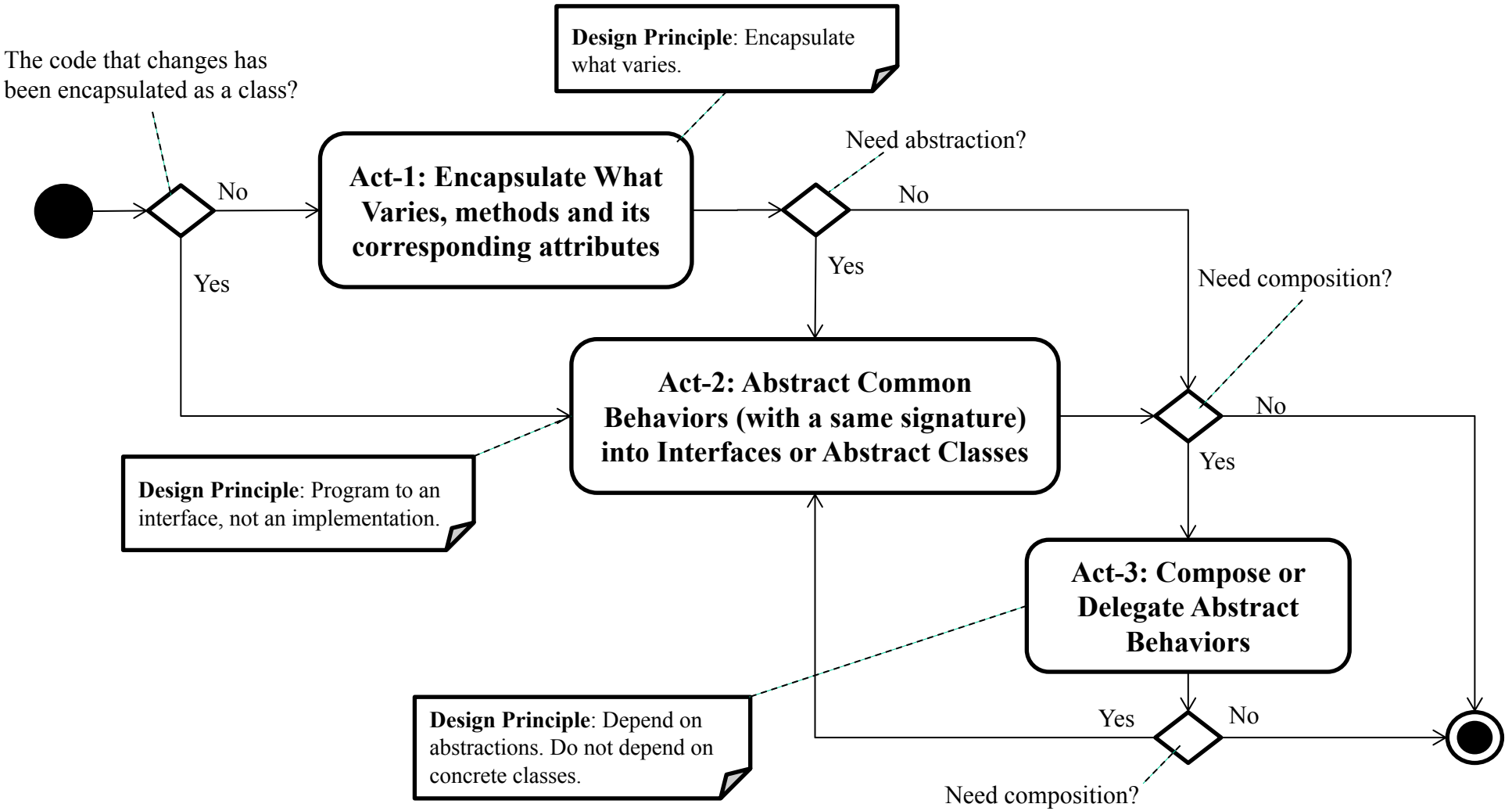
Design Process for Change



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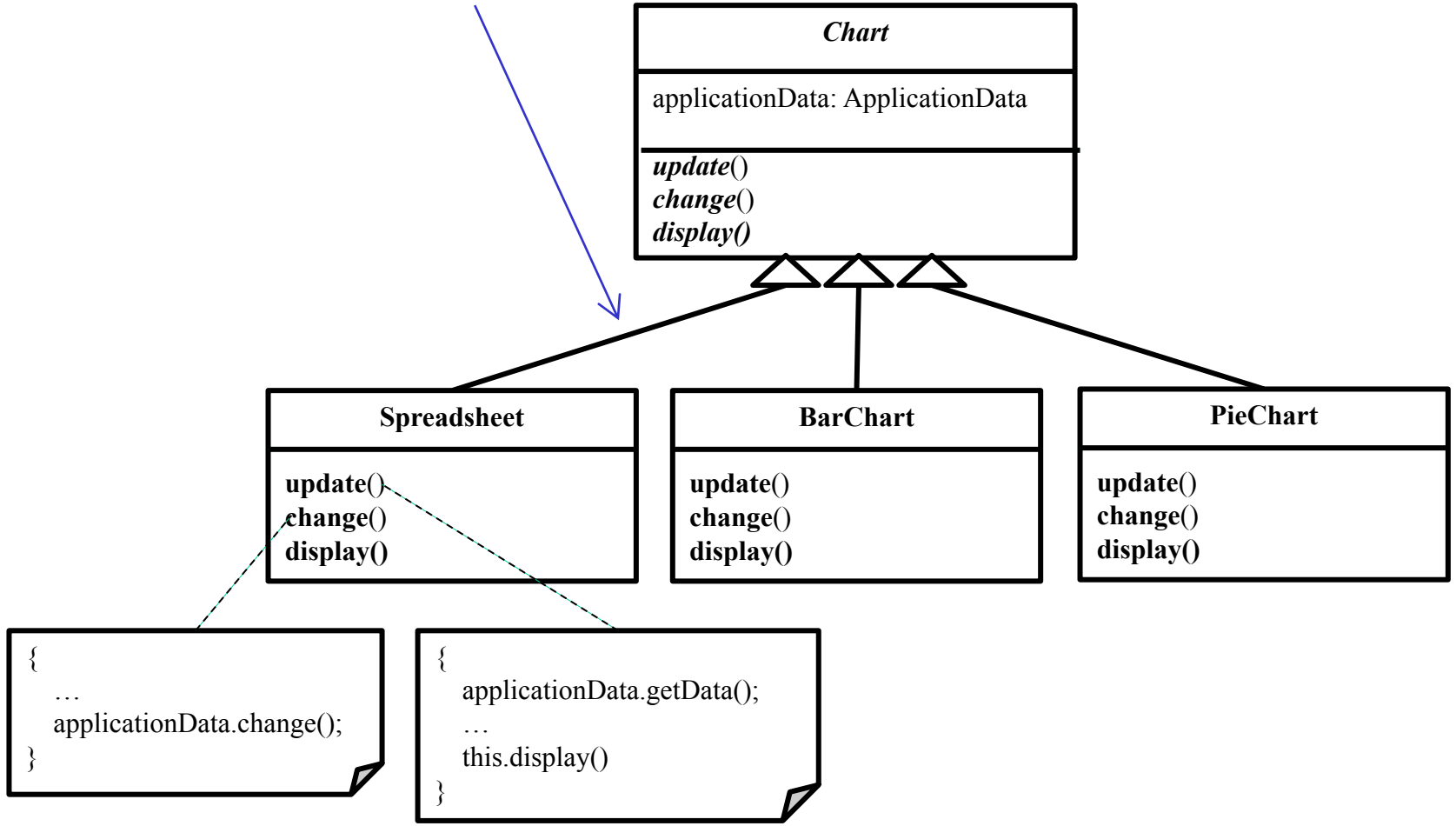
Act-2: Abstract Common Behaviors

Act-2.2: Abstract common behaviors with a same signature into abstract class through inheritance



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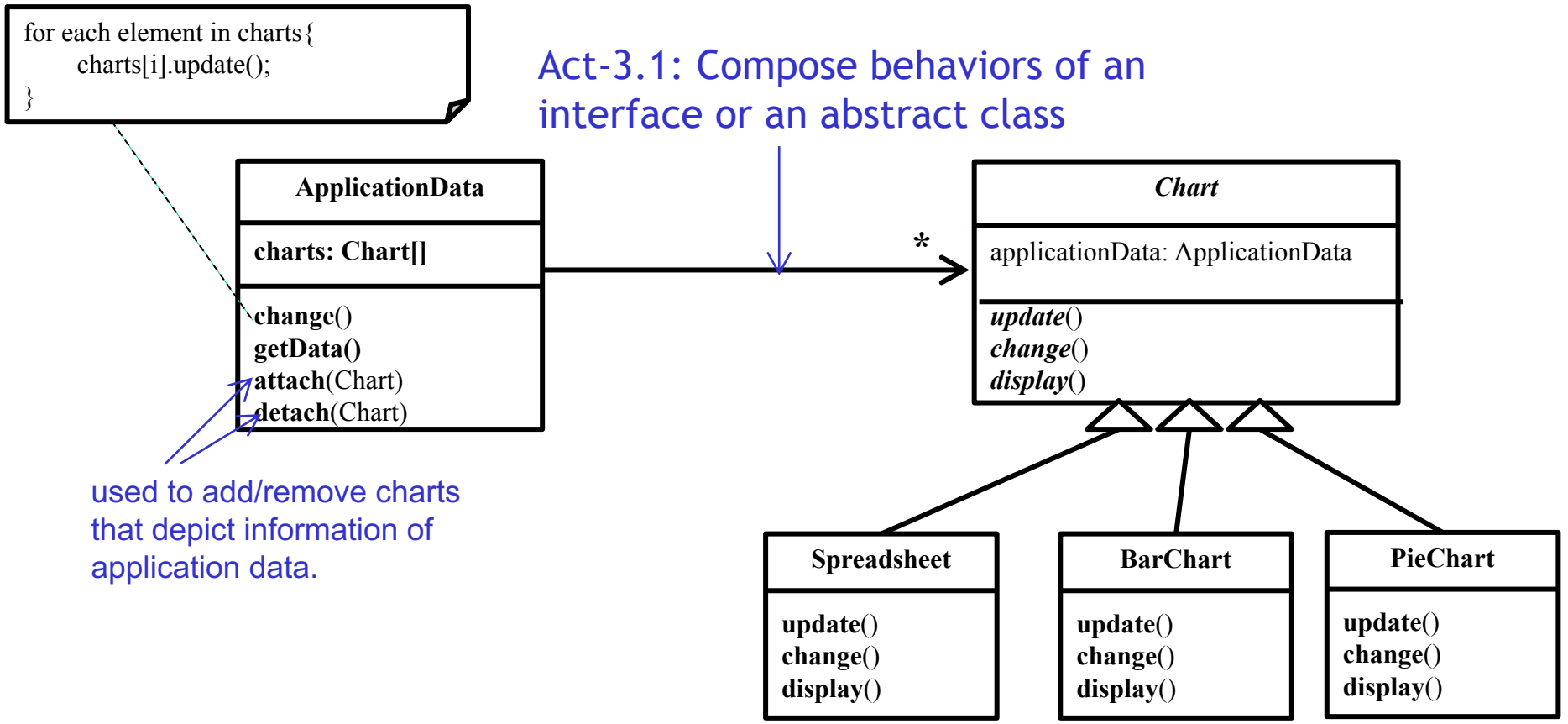
Act-3: Compose Abstract Behaviors



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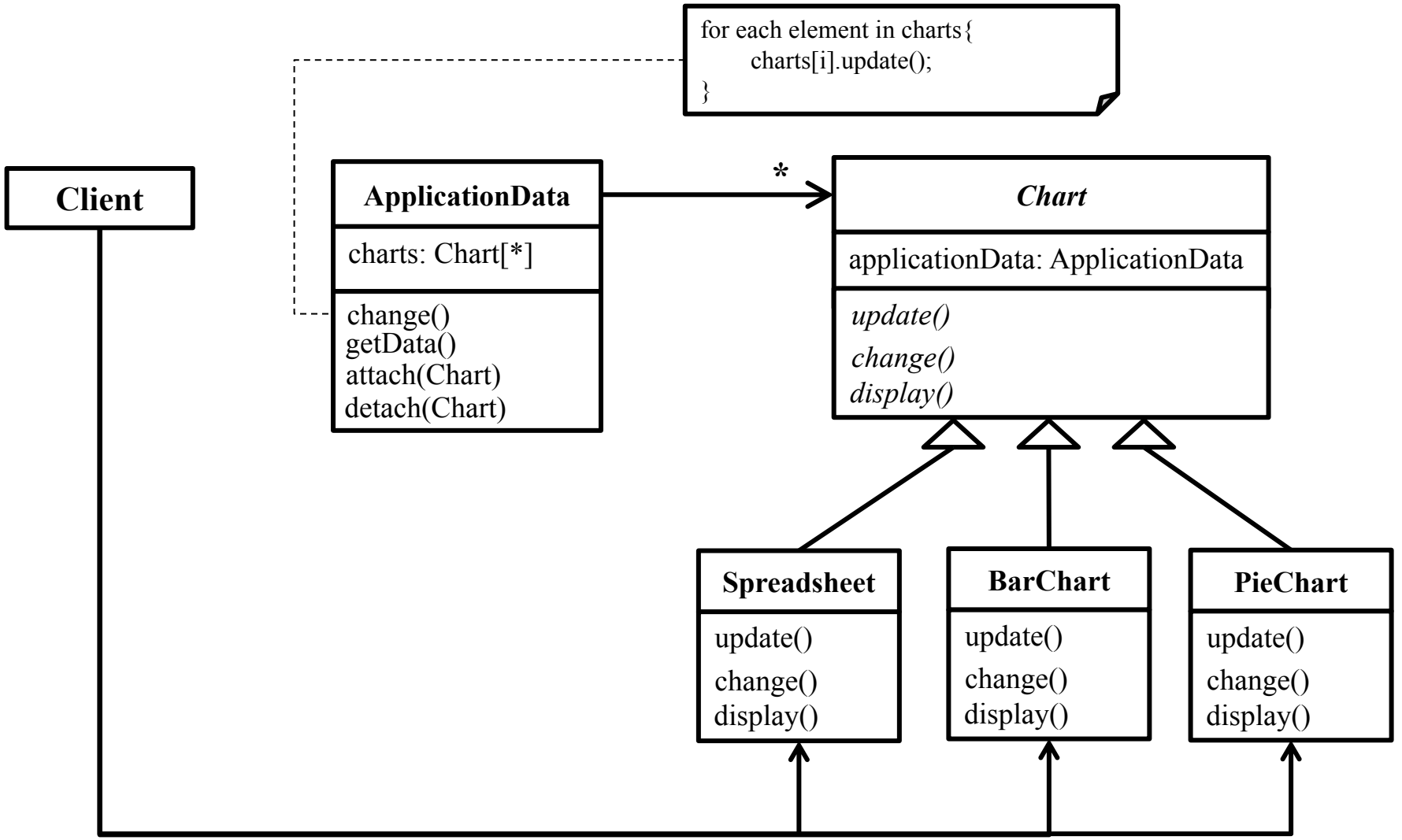
Refactored Design



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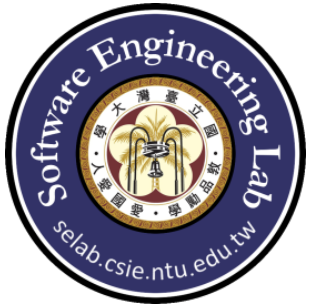

Recurrent Problem

- The code will be modified if a new display/presentation is to be added.
  - Many graphical user interface toolkits **separate** the presentational aspects of the user interface from the underlying application data.
  - Classes defining application data and presentations can be reused independently.

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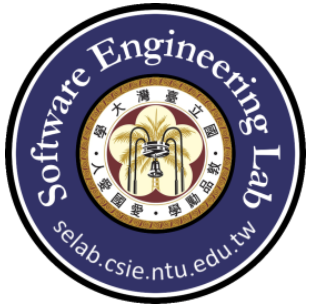

Observer Pattern

- Intent
  - Define a one-to-many dependency between objects so that when one object changes state, all its dependents are **notified and updated** automatically.

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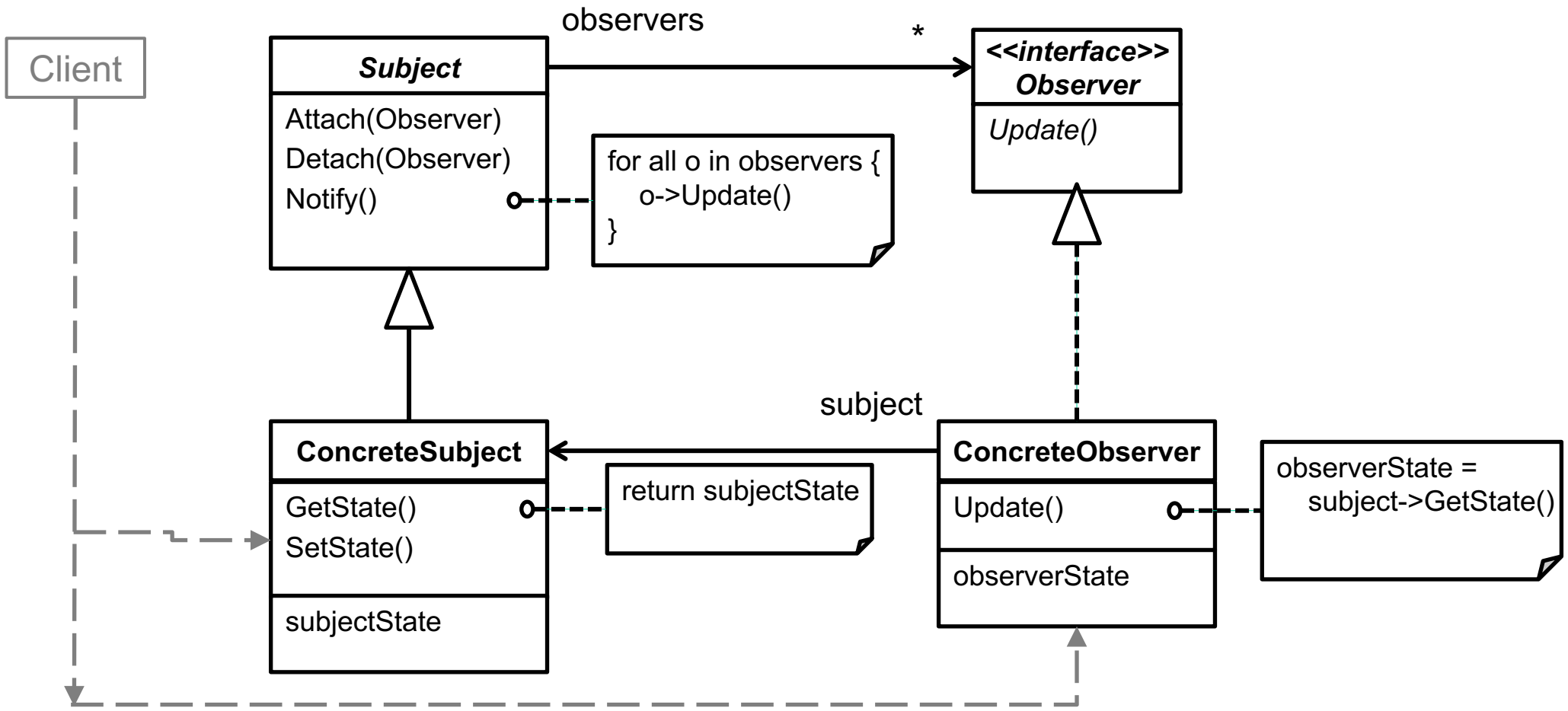
Observer Pattern Structure$_1$



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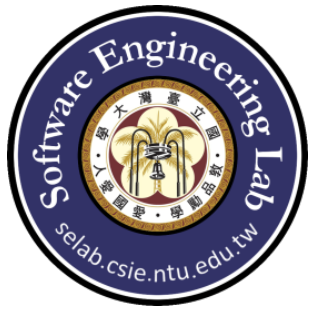
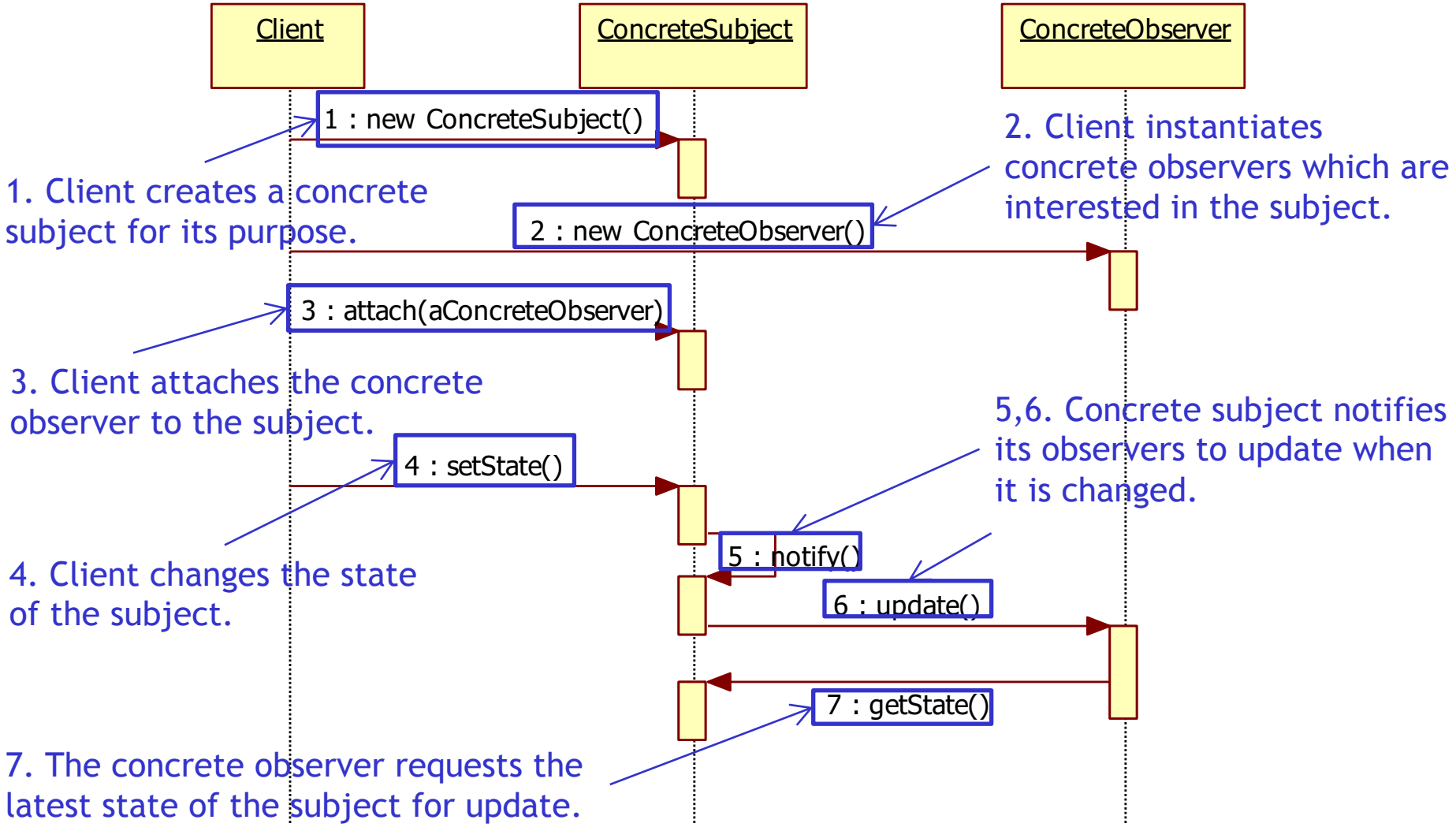


Observer Pattern Structure$_2$



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Observer Pattern Structure$_3$

	Instantiation	Use	Termination
Client	Other class except classes in observer pattern	Other class except classes in the observer pattern	Other class except classes in the observer pattern
Subject	X	Client uses this abstract class to attach and detach ConcreteObserver	X
Concrete Subject	The client class or other class except classes in the observer pattern	ConcreteObserver or other classes use this class to set/get state of ConcreteSubject	Classes who hold the reference of ConcreteSubject
Observer	X	Subject uses this interface to notify ConcreteObserver to update the state of ConcreteSubject through polymorphism	X
Concrete Observer	The client class or other class except classes in the observer pattern	Subject notifies this class which is attached by client to update the state of ConcreteSubject through polymorphism	Classes who hold the reference of ConcreteObserver

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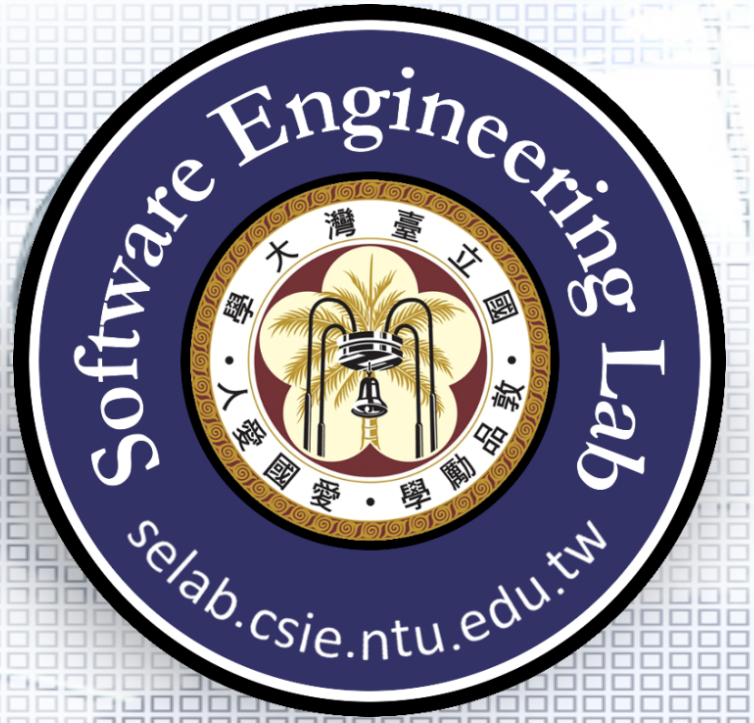
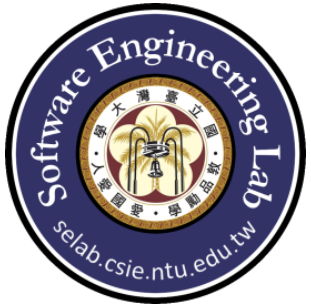


Weather Monitoring Station System

Prof. Jonathan Lee (李允中)

Department of Computer Science and Information Engineering
National Taiwan University



Requirements Statements

- Weather Monitoring Station System
  - The system will be based on WeatherData object, which tracks current weather conditions (temperature, humidity, and barometric pressure) in a specific area (e.g. U.S. or Asia).
  - The system initially provides three display elements: current conditions, weather statistics and a simple forecast, all updated in real time as the WeatherData object acquires the most recent measurements.
  - The system should supply an API so that other developers can write their own weather displays and plug them right in.

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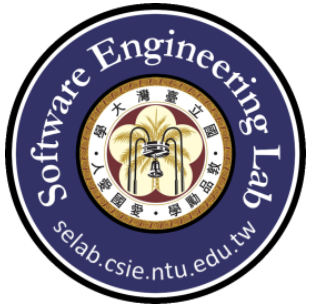
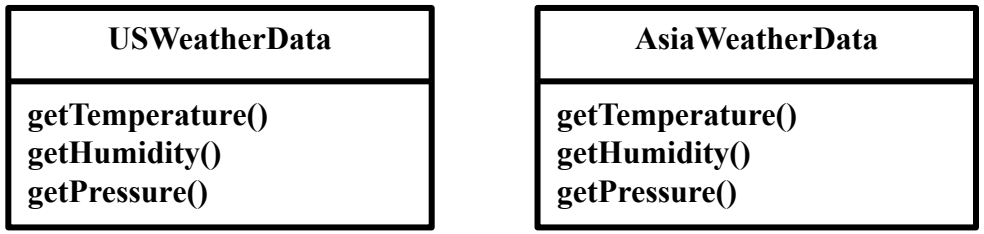


Requirements Statements$_1$

- The system will be based on WeatherData object to track current weather conditions, including temperature, humidity, and barometric pressure, in a designated area (e.g. U.S. or Asia).



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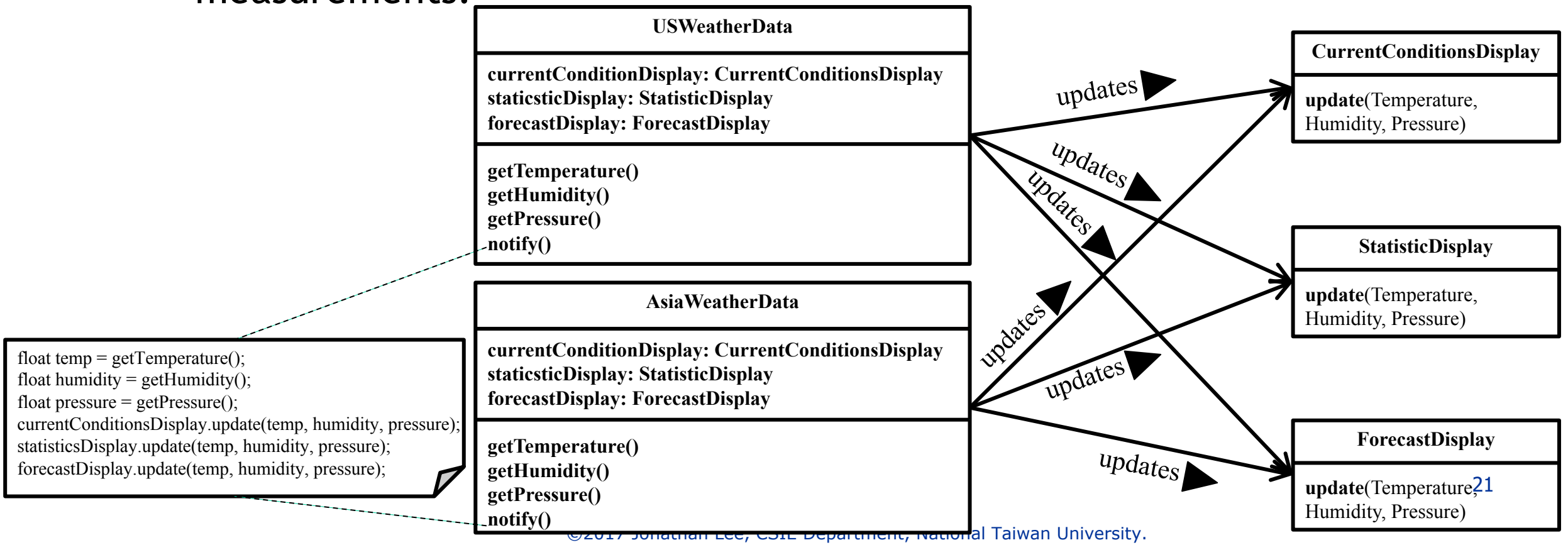
Requirements Statements$_2$

- The system initially provides three display elements: current conditions, weather statistics, and a simple forecast, all updated in real time as the WeatherData object acquires the most recent measurements.



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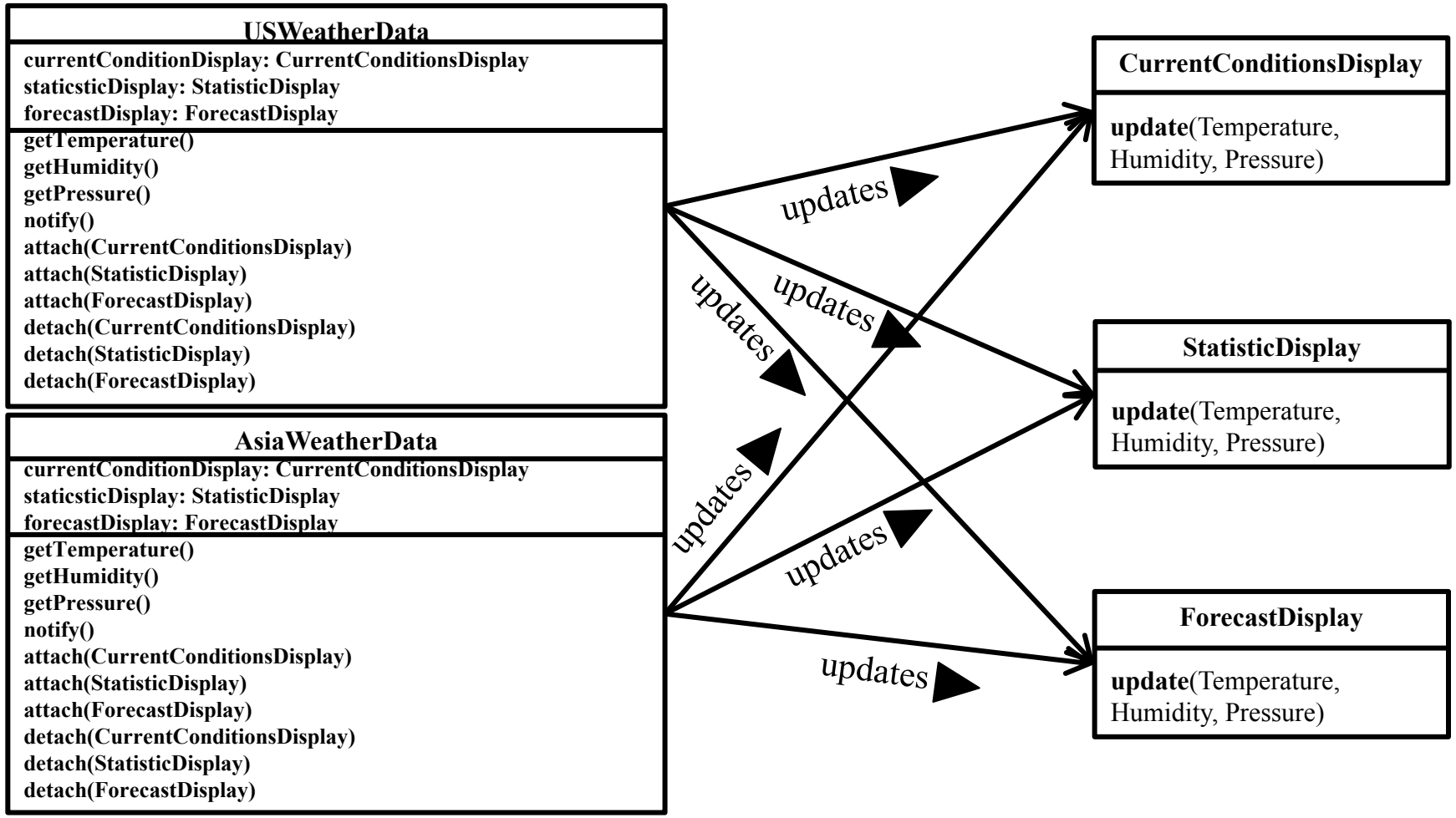
Requirements Statements$_3$

- The system supplies methods to plug the three displays in or out.



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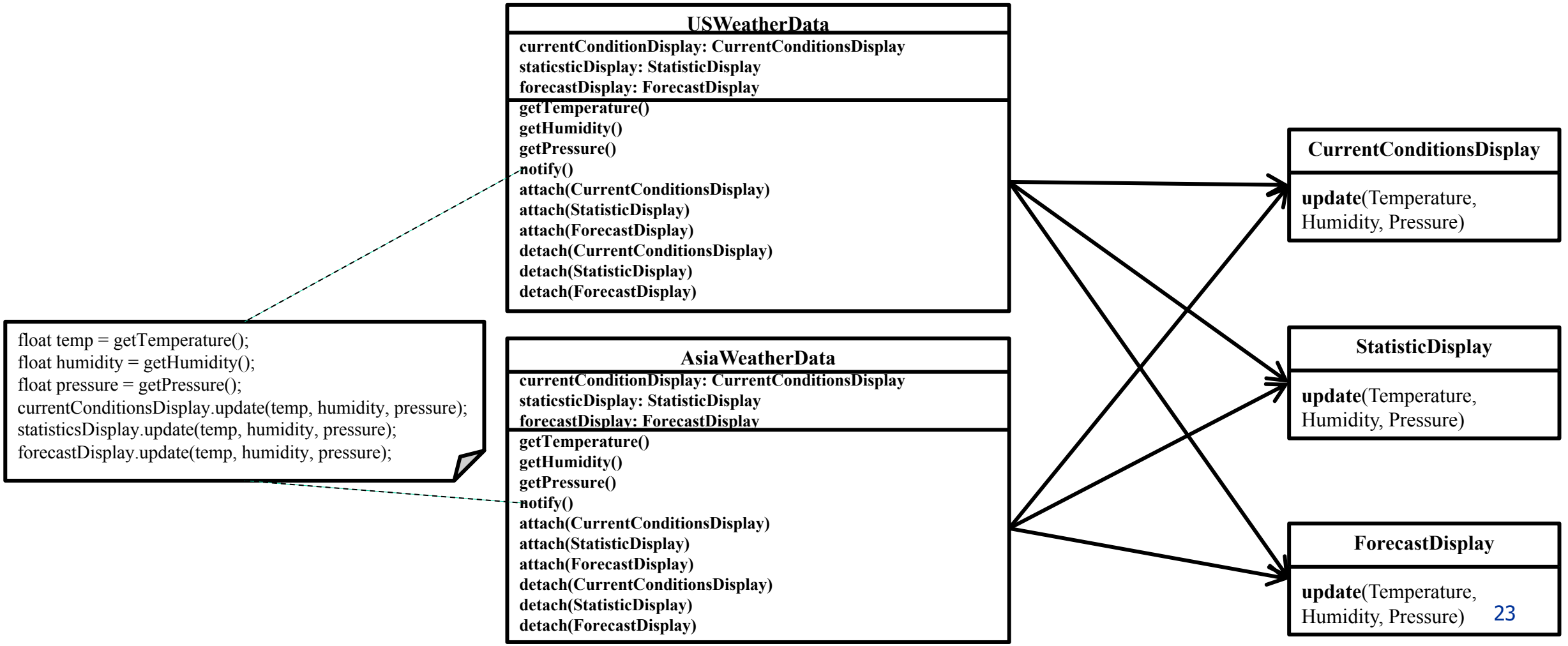
Initial Design - Class Diagram



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Problems with Initial Design

Problem: Code will be modified if a new display is added.

USWeatherData

currentConditionDisplay: CurrentConditionsDisplay
staticsticDisplay: StatisticDisplay
forecastDisplay: ForecastDisplay

getTemperature()
getHumidity()
getPressure()
notify()
attach(CurrentConditionsDisplay)
attach(StatisticDisplay)
attach(ForecastDisplay)
detach(CurrentConditionsDisplay)
detach(StatisticDisplay)
detach(ForecastDisplay)

```
float temp = getTemperature();
float humidity = getHumidity();
float pressure = getPressure();
currentConditionsDisplay.update(temp, humidity, pressure);
statisticsDisplay.update(temp, humidity, pressure);
forecastDisplay.update(temp, humidity, pressure);
```

AsiaWeatherData

currentConditionDisplay: CurrentConditionsDisplay
staticsticDisplay: StatisticDisplay
forecastDisplay: ForecastDisplay

getTemperature()
getHumidity()
getPressure()
notify()
attach(CurrentConditionsDisplay)
attach(StatisticDisplay)
attach(ForecastDisplay)
detach(CurrentConditionsDisplay)
detach(StatisticDisplay)
detach(ForecastDisplay)

CurrentConditionsDisplay

update(Temperature, Humidity, Pressure)

StatisticDisplay

update(Temperature, Humidity, Pressure)

ForecastDisplay

update(Temperature, Humidity, Pressure)

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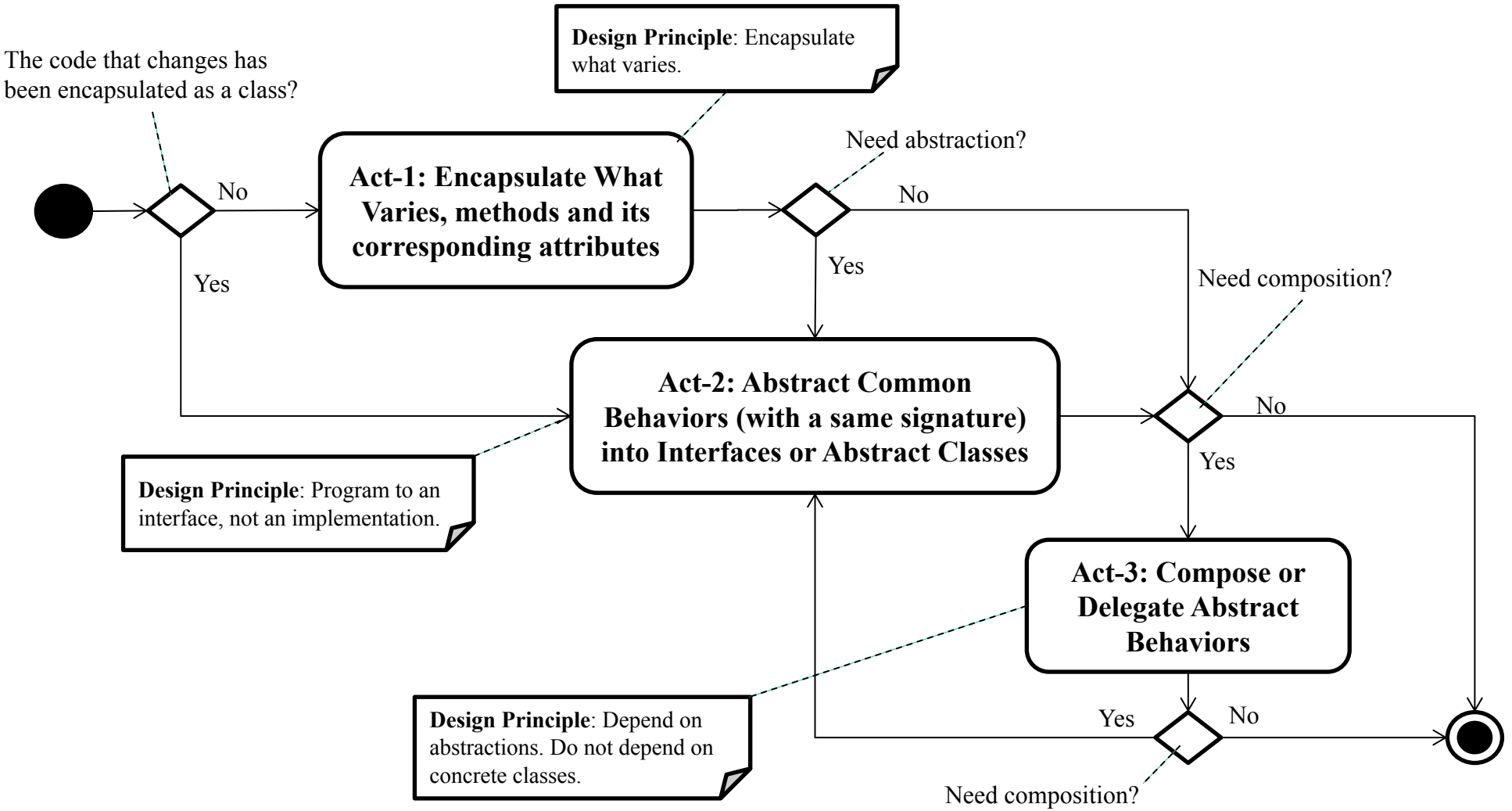
Design Process for Change



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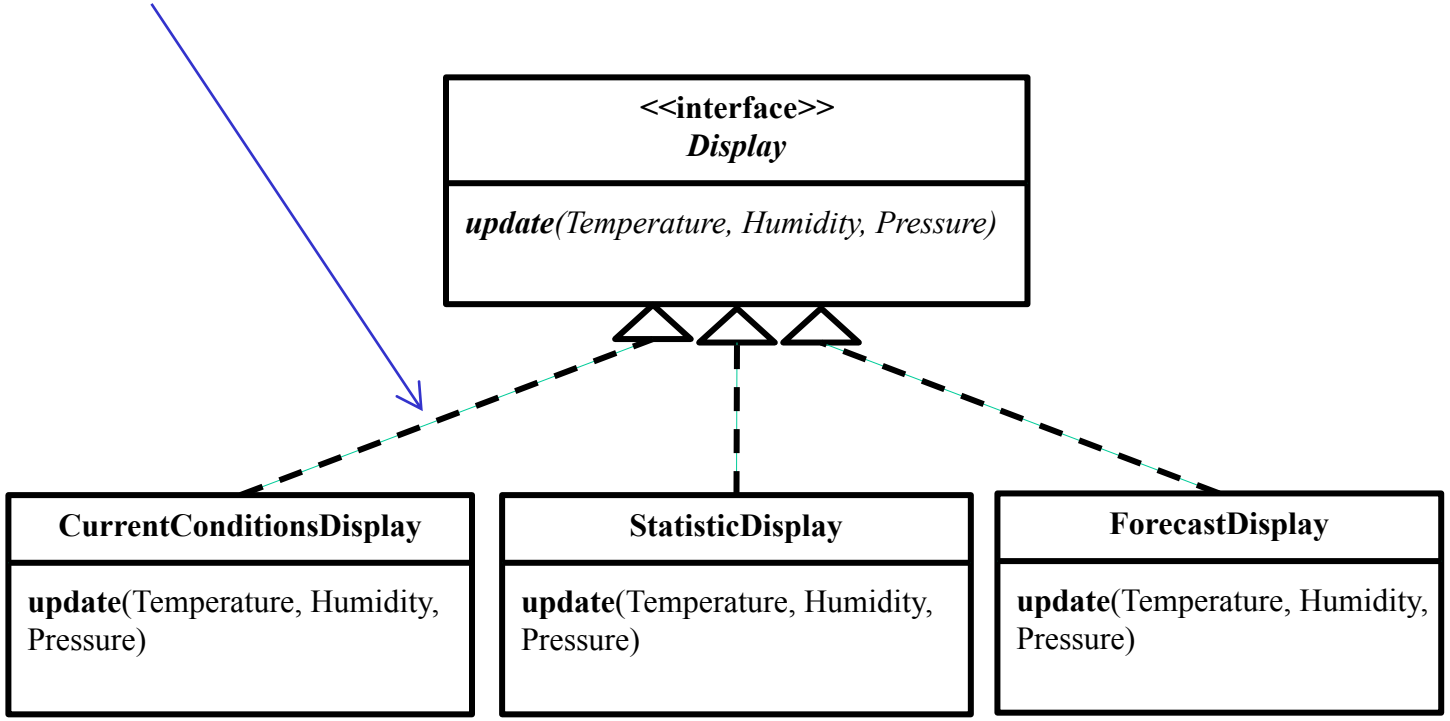
Act-2: Abstract Common Behaviors

Act-2.1: Abstract common behaviors with a same signature into interface through polymorphism



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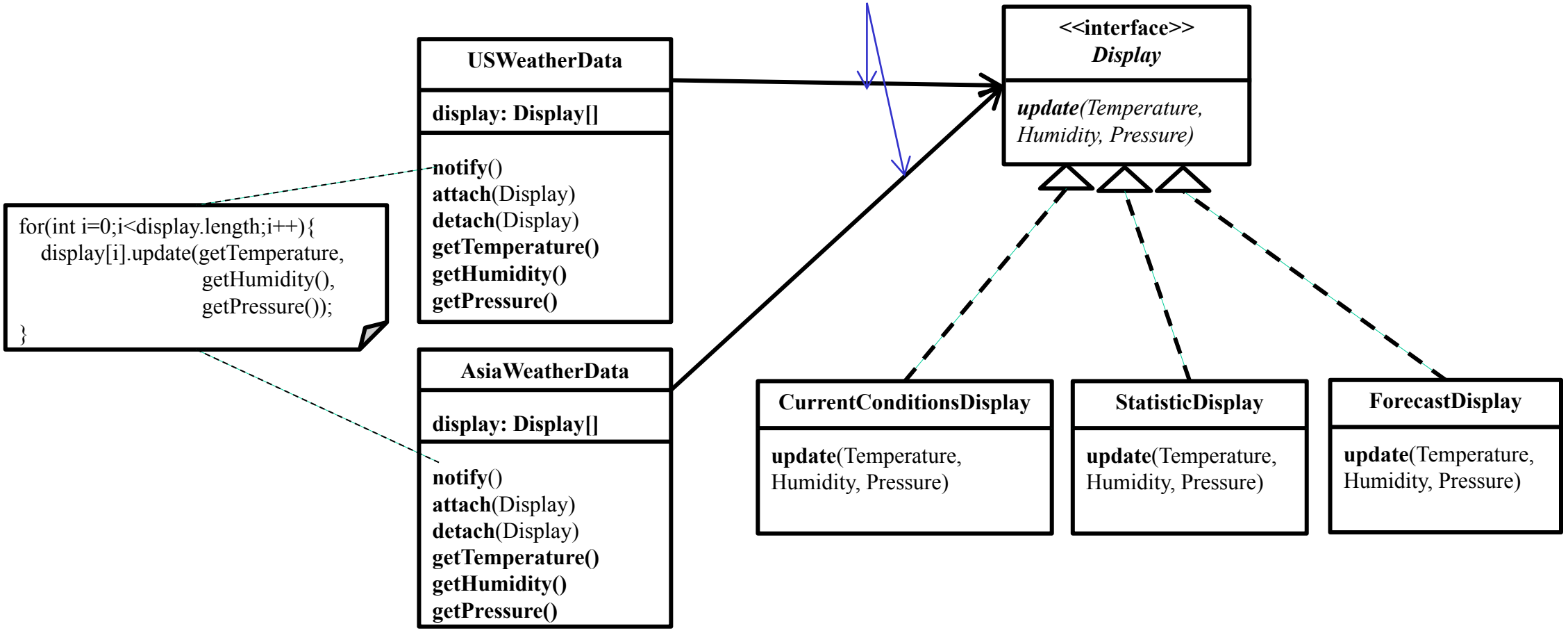
Act-3: Compose Abstract Behaviors

Act-3.1: Compose behaviors of an interface or an abstract class



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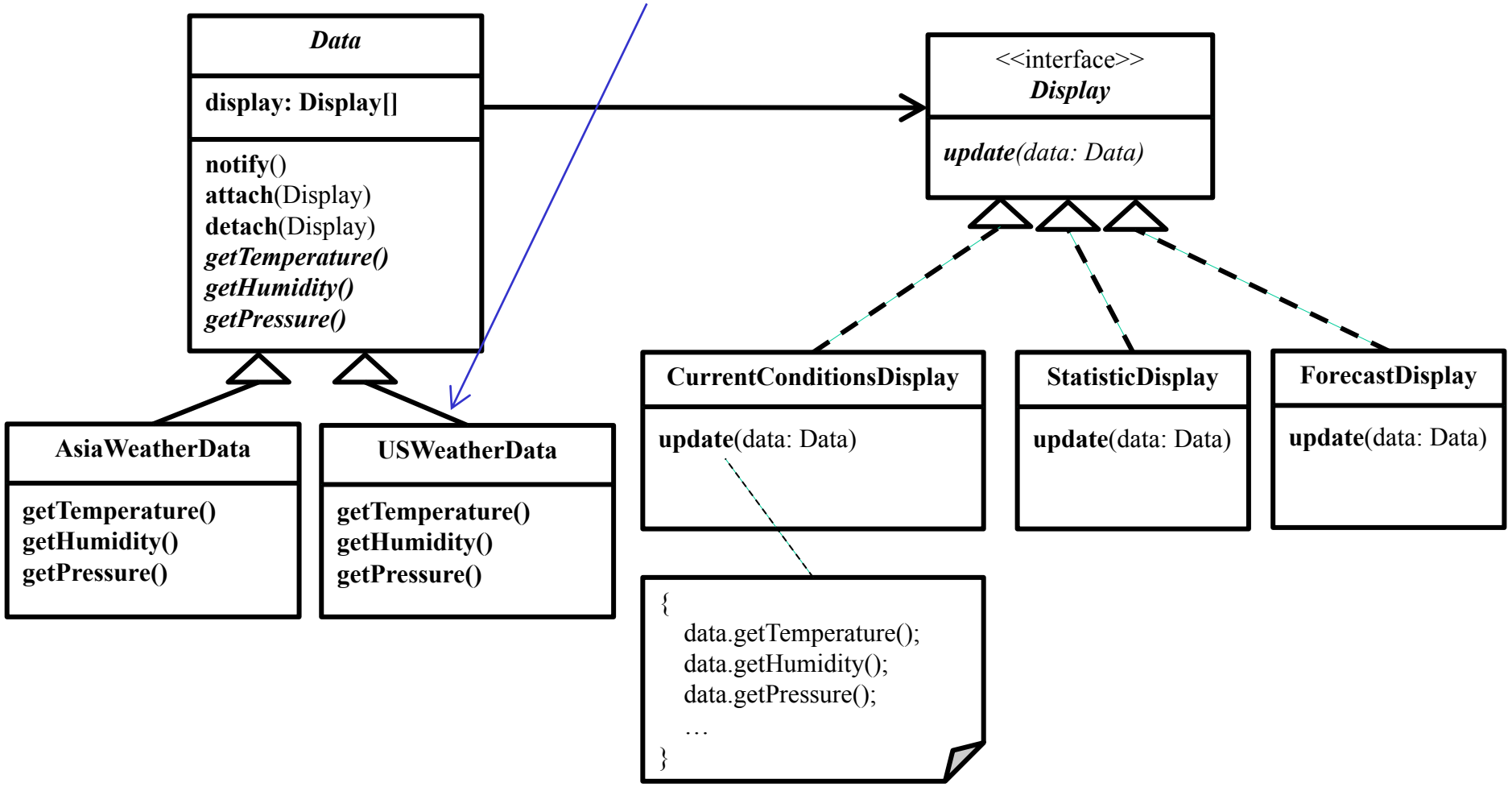
Act-2: Abstract Common Behaviors

Act-2.2: Abstract common behaviors with a same signature into abstract class through inheritance



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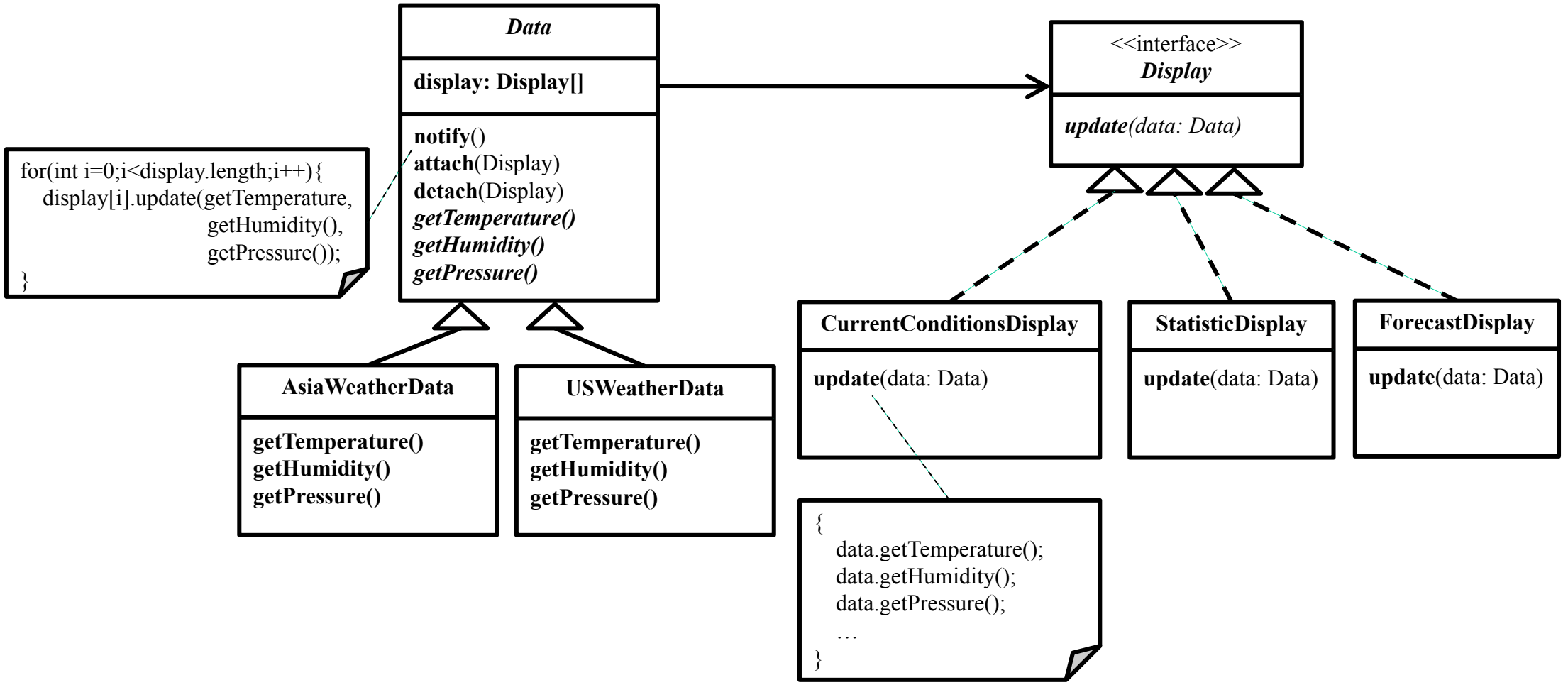
Refactored Design after Design Process



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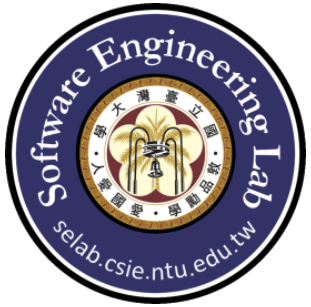

Homework 1: Requirements Statements

- In FileViewer,
  - We have a TextView object that displays text in a window.
  - TextView has no scroll bars by default, because we might not always need them.
  - We can also add a thick black border around the TextView.
  - It is highly likely that we will support various file formats for display in the future.

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