Lab 4: Integrating Patterns in the Architecture of the WMS

Figure 1 depicts a class diagram describing the static structure of the classes participating to the *Report weather data* scenario of the *Collect data* use case. The diagram consists of eight classes. Classes *WeatherStation*, *WeatherData*, *Instrument*, *GroundThermometer*, *Barometer*, and *Anemometer* describe the data collection functions carried by the weather stations and associated instruments. Classes *DataCollector* and *ArchivedData* describe data collection functions carried by the area computer.

- **WeatherStation:** provides the basic interface of a weather station with its environment.
- **WeatherData:** encapsulates the summarised data from the different instruments in a weather station.
- **Instrument, GroundThermometer, Barometer, and Anemometer:** represent corresponding weather instruments in the system.
- **DataCollector:** sends data collection requests to Weather stations, and stores the received data.
- **ArchivedData:** represents the data collected by the area computer from a weather station; it encapsulates the collected data, the collection date and time, and the identifier of the source station.
- ***Identifier, Date, Time, and Readings*** are user-defined types: *Identifier is a* user-defined type consisting of a sequence of 4 digits; *Readings* is a record type whose fields correspond to maximum, minimum, and average weather readings (e.g. temperature, pressure etc); *Date (day,month,year)* and *Time (hour,minute,second)* are also defined as record types.

Some of the patterns selected by the architecture team as structuring mechanisms for the software architecture, include the *pipes-and-filters* architectural pattern and the *factory* design pattern.

1. Based on the risk factors identified during the risk analysis (conducted in Lab1) explain (briefly) why these patterns are appropriate for handling some of the design issues underlying the development of the weather mapping system. (20%)
2. Re-organize the class diagram given in Figure 1 around the *Pipes-and-filter architectural pattern*: specify the filters, the data source and sink, and the model of pipes used for interconnection. Precisely, you must provide (in your report) the following information: (50%)
    a. *Filters*: indicate for each filter whether it is active or passive; specify corresponding classes (a filter may match one or several classes).
    b. *Data sink* and *source:* indicate whether they are active or passive; specify corresponding classes.
    c. *Pipes*: specify for each pair of filters (including data source and subsequent filter, or data sink and preceding filter) the model of pipes used for interconnection, either as direct call or synchronization pipeline. For synchronization pipelines, specify whether they use a push, a pull, or a mix model.

3. Use the *Factory design pattern* to re-design the class structure of the various classes corresponding to weather instruments, and update the class diagram accordingly. (10%)
4. Reusability, extensibility and maintainability are some the main quality factors that characterize the weather mapping system. Organizing the system into loosely coupled and highly cohesive subsystems (e.g. modules) is one of the strategies used to achieve these quality goals. Decomposition in three subsystems named *Sensors, Station,* and *DataCollection* is considered. Two possible grouping strategies are proposed in Tables 1 and 2. Select the most suitable one, and motivate your choice by computing a coupling metric such as CBO (Coupling Between Object Classes). Create the subsystems using Rational Rose, and relocate the classes in the Rose Browser. (20%)

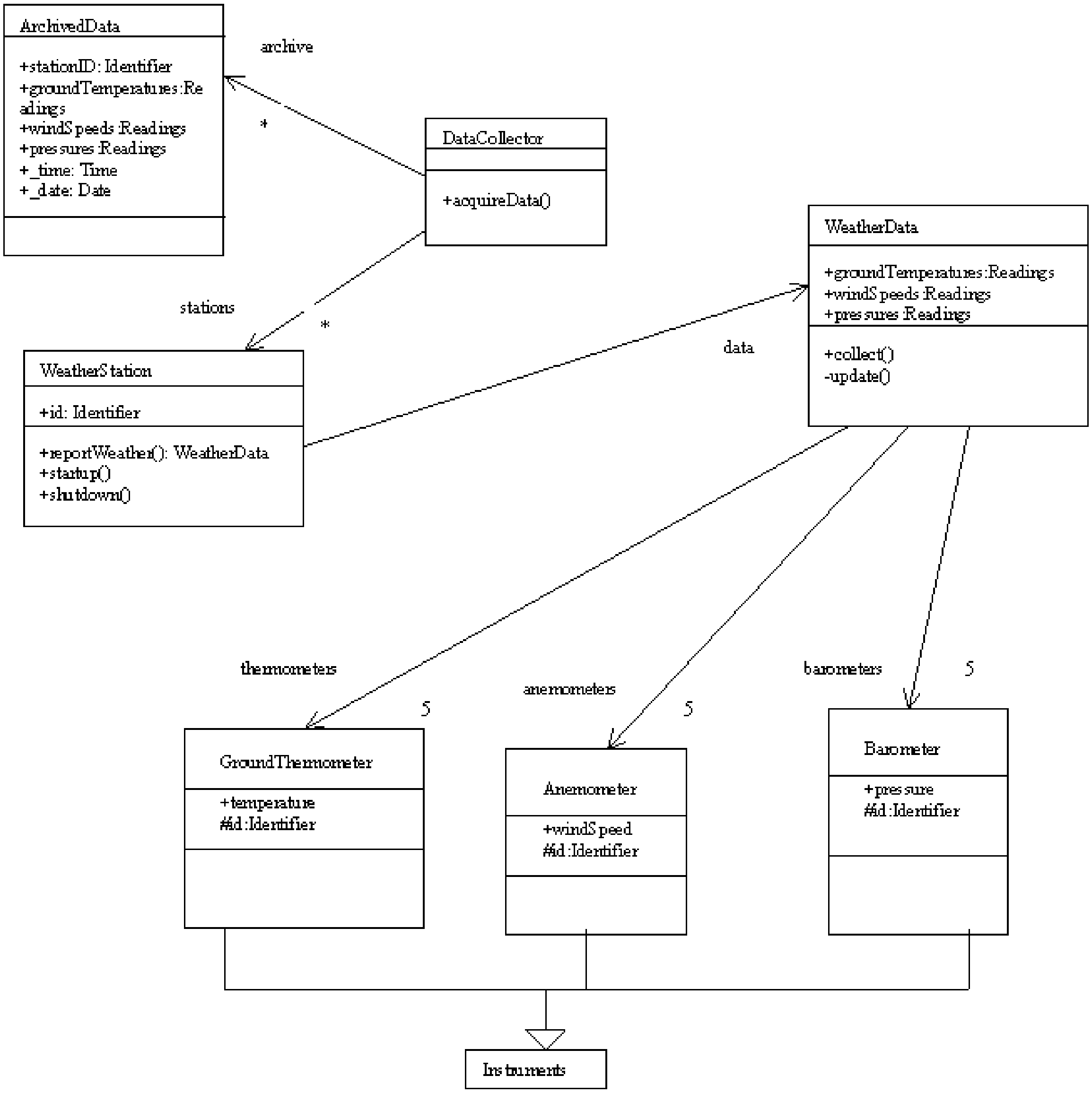

Figure 1: Class Diagram

Classes	Subsystems
Instrument, GroundThermometer Barometer, Anemometer	Sensor
WeatherStation, WeatherData	Station
DataCollector, ArchivedData	DataCollection

Table 1: Grouping 1

Classes	Subsystems
Instrument, GroundThermometer Barometer, Anemometer, WeatherData	Sensor
WeatherStation	Station
DataCollector, ArchivedData	DataCollection

Table 2: Grouping 2