4 Object-Oriented Programming (RKH)

A Lecturer wishes to create a program that lists his students sorted by the number of practical assignments they have completed. The listing should be greatest number of assignments first, sub-sorted by name in lexicographical order (A to Z).

A class `StudentInfo` stores the name and number of assignments completed for a student. Amongst other methods, it contains a `void setCompleted(int n)` method that allows changes to the number of completed assignments.

(*a*) Provide a definition of `StudentInfo` with an `equals()` method and a natural ordering that matches the given requirement. [9 marks]

(*b*) A `TreeSet` is used to maintain the `StudentInfo` objects in appropriate order. When `setCompleted(...)` is called on a `StudentInfo` object it is necessary to remove the object from the set, change the value and then reinsert it to ensure the correct ordering. This is to be automated by applying the Observer design pattern via classes `UpdatableTreeSet` and `SubscribableStudentInfo`. A partial definition of `UpdatableTreeSet` is provided below.

```
public class UpdatableTreeSet extends
             TreeSet<SubscribableStudentInfo> {
  // To be called just before the StudentInfo object is updated
  public void beforeUpdate(SubscribableStudentInfo s) {
    remove(s);
  }
  // To be called just after the StudentInfo object is updated
  public void afterUpdate(SubscribableStudentInfo s) {
    add(s);
  }
}
```

(*i*) Extend `StudentInfo` to create `SubscribableStudentInfo` such that: multiple `UpdatableTreeSet` objects can subscribe and unsubscribe to receive updates from it; and the `beforeUpdate(...)` and `afterUpdate(...)` methods are called appropriately on the subscribed `UpdatableTreeSet` objects whenever `setCompleted(...)` is called. [6 marks]

(*ii*) Give a complete definition of `UpdatableTreeSet` that overrides the inherited methods `boolean add(SubscribableStudentInfo)` and `boolean remove(Object)` to automatically subscribe and unsubscribe to their arguments, as appropriate. You may ignore all other methods inherited from `TreeSet`. [5 marks]