



Specifications: Grade

In addition to the obvious specifications illustrated in the UML class diagram, the Grade class must satisfy the following specifications.

1. Grade objects must be immutable.
2. If a constructor is passed a key that is null or empty (i.e., "") then the constructor must throw an `IllegalArgumentException`.
3. The `Grade(String key)` constructor must construct a Grade object with a value attribute of 0.0.
4. The `compareTo(Grade other)` method must return the result of comparing `this.value` and `other.value` accounting for missing (i.e., null) values appropriately.
 - 4.1. If `this.value` is null and `other.value` is non-null then it must return -1.
 - 4.2. If `this.value` is null and `other.value` is null then it must return 0.
 - 4.3. If `this.value` is non-null and `other.value` is null then it must return 1.
 - 4.4. If both `this.value` and `other.value` are non-null then it must return the result of calling `compareTo()` on `this.value` and passing it `other.value` (though it need not be implemented this way).
5. The `toString()` method must return a String representation of the Grade object.
 - 5.1. If the value attribute is not null then the String must contain the key attribute, followed by the String literal ":", followed by a single space, followed by the value attribute (in a field of width 5 with 1 digit to the right of the decimal point).
 - 5.2. If the value attribute is null then the String must contain the key attribute, followed by the String literal ":", followed by a single space, followed by the String literal " NA" (which is in a field of width 5).

Note that, while null key attributes are invalid (i.e., every Grade object must have a non-null, non-empty key attribute), null value attributes are valid (and are used to indicate that the Grade is missing).