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Advanced Aspects of Object-Oriented Programming (SS 2010)

Practice Sheet 9 (Hints and Comments)

Exercise 1 Behavioral Subtyping I

a) JML specifications are inherited by subclasses and classes implementing interfaces. A class inherits the visible invariants of its superclasses (-interfaces). See JML Reference Manual 8.2.4

b) *The also keyword indicates that the current specification is refining the specification inherited either from the superclass or from the previous declaration of the method in a refinement sequence. Therefore, it is an error if the specification of a non-refining method begins with also (unless it overrides an inherited method).* JML Reference Manual 16.4

c) Use the rules to construct the pre- and postconditions for subclasses.

```
public class Child extends Parent {
    //@ requires          i >= 0 || i <= 0
    //@ ensures           (\old(i>=0) => \result >= i)
                          && (\old(i<=0) => \result <= i);
    int m(int i){ ... }
}
```

A call to Child.m with `i = 0`, means that both parts of the precondition are fulfilled and therefor both parts of the postcondition have to be fulfilled too. As i is not assignable, pre- and post-values of i are the same and we get as only possible result 0.

d)
- Class A + Class B: ok
- Class C + Class D: No behavioural subtyping. The complete precondition of D.set() is `a > 0 || a > 10`, and the complete postcondition of D.get() is `(true => result > 10) && (true => result > 0)`.

  ```
  D d = new D();
  d. set (5);      // ok
  ... d.get();     // not ok, because of the conjunction.
  ```

  The invariant changes nothing.
- Class E + Class F: No behavioural subtyping, due to a possible overflow in F.increment(). The overflow breaks the part of the postcondition, that is inherited from E.increment().

Exercise 2 Behavioral Subtyping II

Works analogously to the Reader example of the lecture.