



Tutorials for “Formal methods for Java”
Exercise sheet 8

Exercise 1: Dynamic Logic

For each of the following dynamic logic formulae find an equivalent formula without modalities.

- (a) $\langle \mathbf{while}(x \neq 0)\{x = x - 1; \} \rangle \mathbf{false}$
- (b) $[\mathbf{while}(x \neq 0)\{x = x - 1; \}] \mathbf{false}$
- (c) $\langle \mathbf{while}(x \neq 0)\{x = x - 1; \} \rangle x = 0$
- (d) $[\mathbf{while}(x \neq 0)\{x = x - 1; \}] x = 0$
- (e) $[\mathbf{if}(y = 0)\{x = x + 1; \} \mathbf{else}\{x = x - 1; \}] x = 5$
- (f) $[\mathbf{if}(y == 0)\{x = x + 1; \} \mathbf{else}\{x = x - 1; \}] x = 5$

Exercise 2: Integer square roots

Consider the following Java class:

```
class IntSqrt {
    /*@ requires n > 0;
       @ ensures \result * \result <= n
       @      && (\result + 1) * (\result + 1) > n
    @*/
    static int sqrt(int n){
        int result = 0;
        int s = 0;
        while (s < n) {
            result = result + 1;
            s = s + 2 * result - 1;
        }
        return result;
    }
}
```

Use the KeY prover to prove correctness of method `IntSqrt.sqrt`:

- (a) find an induction proof that proves partial correctness
- (b) find an invariant/variant proof that proves total correctness.