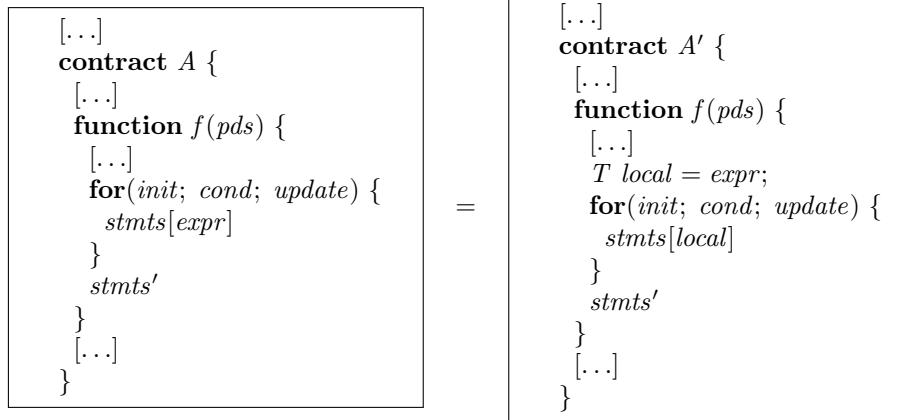

Rule 0.4 *(Refactoring Loops with Repeated Computations)*



where

expr is an expression that is loop-invariant (yields the same result in every iteration);
T is the type of the computed expression *expr*;
local is a local variable of type *T* used to cache the computation result;
stmts[expr] represents statements inside the loop that use *expr*;
stmts[local] represents the same statements with *expr* replaced by *local*;
init, *cond*, and *update* are the loop initialization, condition, and update expressions;
stmts' represents statements following the loop.

provided

expr does not depend on the loop variable or any value modified within the loop;
expr is side-effect free (does not modify state or call external functions);
The value of *expr* remains constant throughout all loop iterations;
No variable in *expr* is modified between the assignment to *local* and the loop execution.

Invariant:

Let s_i and s'_i be the initial state of A and A' , respectively.
Let s_f and s'_f be the state reached by A and A' , respectively, after $A.f()$ and $A'.f()$ are executed from s_i and s'_i , respectively.
Then, the coupling invariant is

$$\forall s_i, s'_i . (s_i = s'_i) \rightarrow (s_f = s'_f)$$
