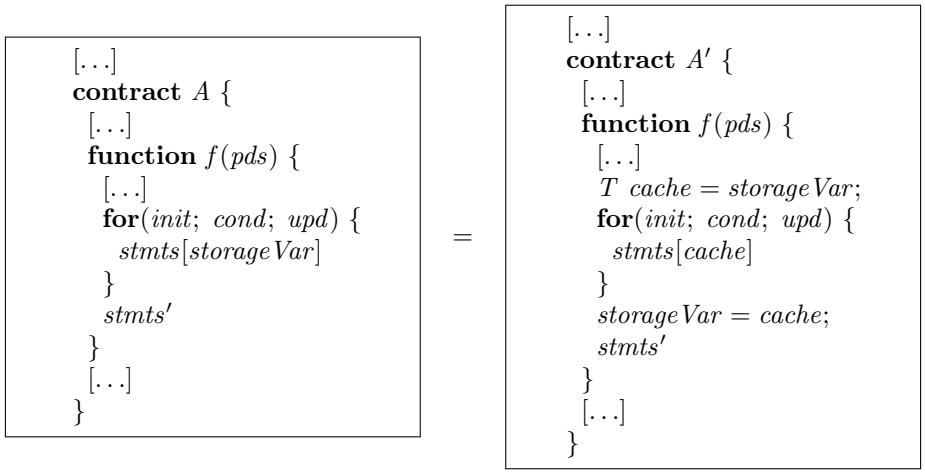
Rule 0.24 ⟨*Cache Storage Variables in Loops*⟩



where

storageVar is a storage variable accessed repeatedly within the loop;

cache is a local memory variable of type T that caches *storageVar*;

T is the type of the storage variable;

stmts[*storageVar*] represents loop body statements that access *storageVar*;

stmts[*cache*] represents the same statements with *storageVar* replaced by *cache*;

init, *cond*, and *upd* are the loop initialization, condition, and update expressions;

pds are the parameter declarations of function f;

stmts′ represents statements following the loop.

provided

The storage variable *storageVar* is accessed multiple times within the loop;

No external calls or state-modifying operations within the loop affect *storageVar*;

The cached value is written back to storage after the loop completes;

All modifications to *storageVar* within the loop can be safely performed on *cache*;

The loop does not modify *storageVar* through aliasing or indirect references.

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

$$\forall\, s_i, s_i' \;.\; (s_i = s_i') \rightarrow (s_f = s_f')$$