
Rule 0.2 *⟨Optimize Loops with Repeated Storage Calls⟩*

<pre> [...] contract A { [...] function f(pds) { [...] for(init; cond; update) { storageVar op = expr; stmts } stmts' } [...] } </pre>	=	<pre> [...] contract A' { [...] function f(pds) { [...] T local = storageVar; for(init; cond; update) { local op = expr; stmts } storageVar = local; stmts' } [...] } </pre>
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where

storageVar is a storage variable being accessed in each loop iteration;

T is the type of *storageVar*;

local is a local variable of type *T* used to cache the storage value;

op is a compound assignment operator (e.g., $+=$, $-=$, $*=$, etc.);

expr is an expression computed in each iteration;

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

stmts represents statements inside the loop body;

stmts' represents statements following the loop.

provided

storageVar is only accessed within the loop via the compound assignment *storageVar op = expr*;

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

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

stmts does not read or write *storageVar* except through the compound assignment.

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

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