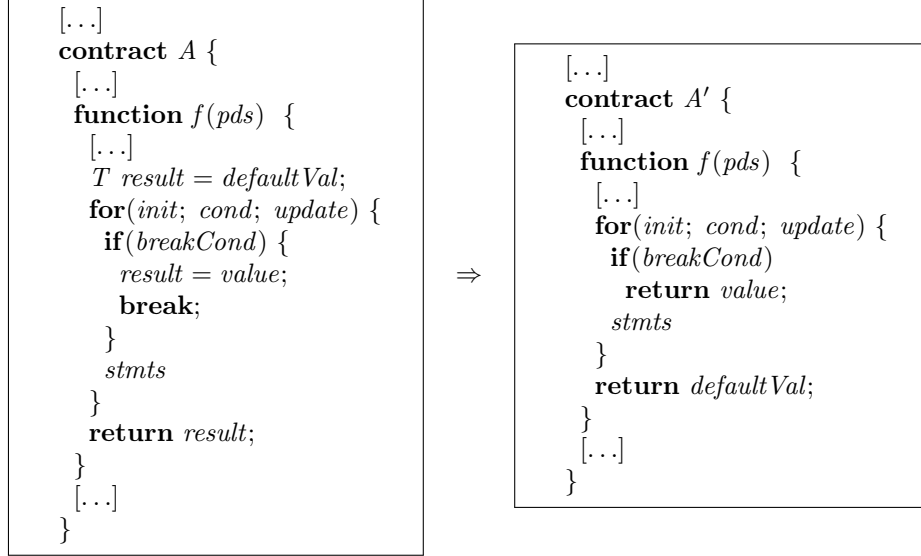

Rule 0.31 $\langle \text{Redundant Control Flow Removal (Break to Early Return)} \rangle$



where

- breakCond* is a boolean condition that triggers early loop termination;
- T* is the return type of function *f*;
- result* is a local variable of type *T* used to store the return value;
- value* is the expression assigned to *result* when *breakCond* is true;
- defaultVal* is the default return value when the loop completes normally;
- init*, *cond*, and *update* are the loop initialization, condition, and update expressions;
- stmts* represents the remaining statements in the loop body;
- is* is the return type declaration.

provided

- The only purpose of *result* is to store a value for return after the loop;
- result* is not read or modified elsewhere in the function after the loop;
- The **break** statement is immediately executed after assigning to *result*;
- No cleanup or finalization code exists between the loop and the return statement;
- breakCond*, *value*, and *defaultVal* have no side effects that affect program state.

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

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