Rule 0.7 (Boolean Packing)

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 \begin{bmatrix} [\ldots] \\ \mathbf{contract} \ A \ \{ \\ \mathbf{bool} \ b_1; \\ \mathbf{bool} \ b_2; \\ \ldots \\ \mathbf{bool} \ b_n; \\ [\ldots] \\ \} \end{bmatrix} = \begin{bmatrix} [\ldots] \\ \mathbf{contract} \ A' \ \{ \\ \mathbf{uint256} \ packedBools; \\ [\ldots] \\ \mathbf{function} \ pack(\ldots) \ \{ \\ packedBools = \ldots; \\ \} \\ \mathbf{function} \ unpack() \ \{ \\ \ldots \\ \} \\ [\ldots] \\ \}
```

where

 b_i are boolean state variables for $i=1,\ldots,n$ where $n\leq 32$; packedBools is a **uint256** variable that stores up to 32 boolean values; $mask_i=1\ll (i-1)$ is the bit mask for the *i*-th boolean; pack is a function that sets boolean values in packedBools using bitwise operations; unpack is a function that retrieves boolean values from packedBools using bitwise operations.

provided

The number of boolean variables $n \leq 32$;

All accesses to b_i in A are replaced with appropriate calls to pack and unpack in A';

The packing operation uses: $packedBools = (packedBools \& \sim mask_i) \mid (b_i ? mask_i : 0);$

The unpacking operation uses: $b_i = (packedBools \& mask_i) \neq 0$;

No concurrent modifications occur that would violate atomicity of pack/unpack operations.

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

$$\forall s_i, s_i' : (s_i = s_i') \rightarrow (s_f = s_f')$$