

Instruction-Level Abstraction Synthesis Template Definition

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1 Template for Instructions

Template provides human insights for abstraction.

A template should specify module input W and the architectural states S including both registers and memories. These states should be visible from the outside the module interface. The visibility here can be direct, meaning its value is accessible from the outside, or indirect. In the latter case, some directly visible states are updated according to the value of indirect ones.

Fetch function F inside the template specifies what an abstract instruction is made of. It is a function that maps states and inputs to a bitvector (or the instruction). The fetch valid function V gives the condition when there is truly an instruction for the module. It is designed to help model accelerators which do not always have an instruction to execute.

Each type of instruction is associated with a decode function. This function gives a 1 if the bitvector generated by fetching is the type of instruction it represents. The set of decode functions describes the instruction set.

Unlike ILA, the template does not have a set of state update functions, but a unified one with “holes” or unknown parameters in it. The template state update function maps the current vectors of states and inputs to the vector of future values.

The template is defined as,

$$\begin{aligned} T &= \langle S, W, F, V, D, P, T \rangle, \text{ where} \\ S &\text{ is the vector of state variables,} \\ W &\text{ is the vector of input variables,} \\ V &: (S \times W) \mapsto \mathbb{B} \text{ is the valid function,} \\ F &: (S \times W) \mapsto bvec_w \text{ is the fetch function,} \\ D &= \{\delta_i : bvec_w \mapsto \mathbb{B}\} \text{ is the set of decode functions,} \\ P &= \{p_j\} \text{ is the set of parameters,} \\ &\quad \text{whose values depends solely on the assignment of } D, \text{ and} \\ N &= (S \times W \times P) \mapsto S \text{ is the template of next state functions.} \end{aligned}$$

The parameters $\{p_j\}$ here are the “holes” we allow in the our template. They appear in the form of unknown constants within a range, undetermined choices, slicing certain bits

from a bitvector and so on. The value of these parameters should be determined once an assignment to the set decode functions (D) is given. In other word, the unknown constants, the choices, and etc. should be fixed for a given kind of instructions.

2 Template for Child-Instructions