

cv32e40p

Formal Verification Status Update

2 July 2020



High level update

Formal verification for ISA compliance

- ISA compliance testing ongoing
- Latest RTL branch: Checked out on 1 July
 - ISA formal proof kit properties run on the latest RTL
 - Tested with Cadence Jaspergold:
 - Total properties: 110 asserts, 110 witness covers
 - Asserts
 - Proven: 86
 - Ongoing [inconclusive so far, session still running]: 24
 - Witness Covers:
 - Unreachable: 0
 - Covered: 110
- An unreachable cover on LOAD BYTE [2'b00 alignment] on the RTL checked out "18 June" has become reachable on the latest RTL. The cover describes the trigger condition for a LOAD BYTE to have been issued, a legitimate data_gnt_i to have been seen, and data_rvalid_l with payload to occur. Tricky to isolate why.



Verification Flow

Formal compliance of ISA instructions

We have a library of formal properties (asserts and covers) in ISA formal proof kit[®]

Each property can be traced back to an instruction in the ISA

Aligned the setup file of the ISA formal proof kit to this core's arch state and interfaces

Run the properties in different formal tools

We have tested the user-mode ISA checks for RV32IC instructions

We have not yet tested FENCES, CSRs, EBREAK/ECALL yet (overall 10 instructions)

Obtain coverage through standard covers, ISA coverage analyzer[®]



Instructions and Properties

Mapping between instructions and formal properties

Each instruction normally is mapped to at least one assert and one cover property with exceptions of:

BRANCHES, JUMPS

There are a total of 47 instructions in the base ISA with 37 instructions so far tested

Each instruction check is mapped to “necessary” properties checking the relevant behaviour e.g., a check for a LOAD instruction will check all the variants LH, LB, LW and their alignments, which gives us 12 assertions and 12 witness covers.



Verification plan

ISA compliance based

Our verification plan is an executable set of assertions and covers for instructions in the ISA

We provide a table of instructions and a property map – this will be the reference for ISA compliance (show table)

We will from now take the latest RTL once a week and provide an updated weekly set of results

We will soon test checks for:

- CSR
- EBREAK
- FENCES

