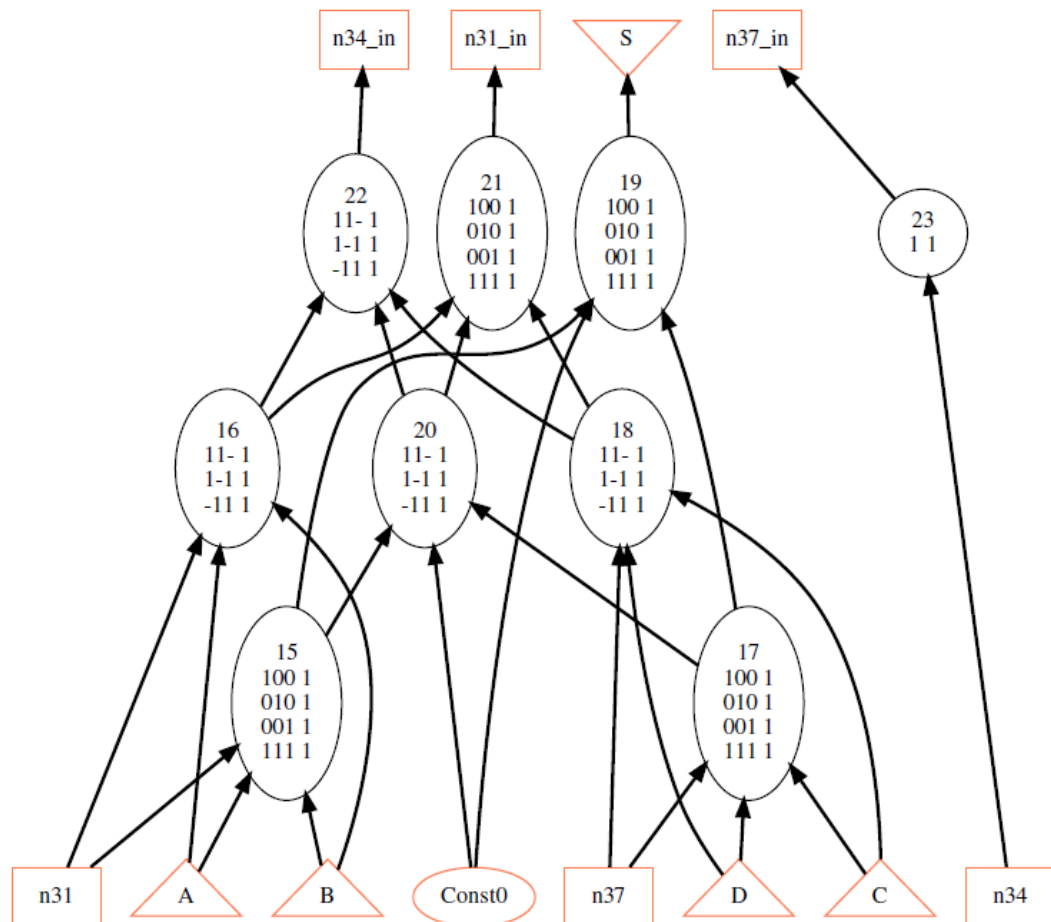


1 [Using ABC]

visualize the network structure (command "show")

Network structure visualized by ABC
Benchmark "HW_1". Time was Sun Oct 03 20:46:41 2021.

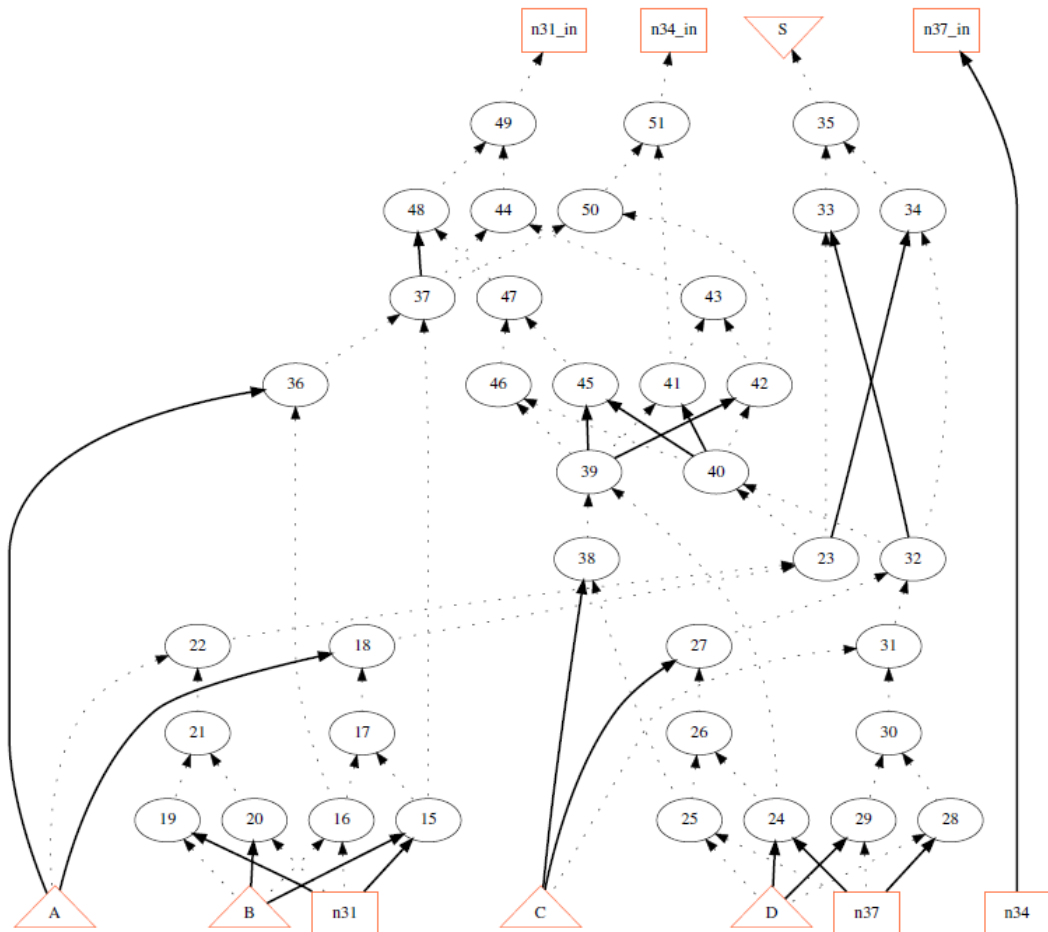
The network contains 10 logic nodes and 3 latches.



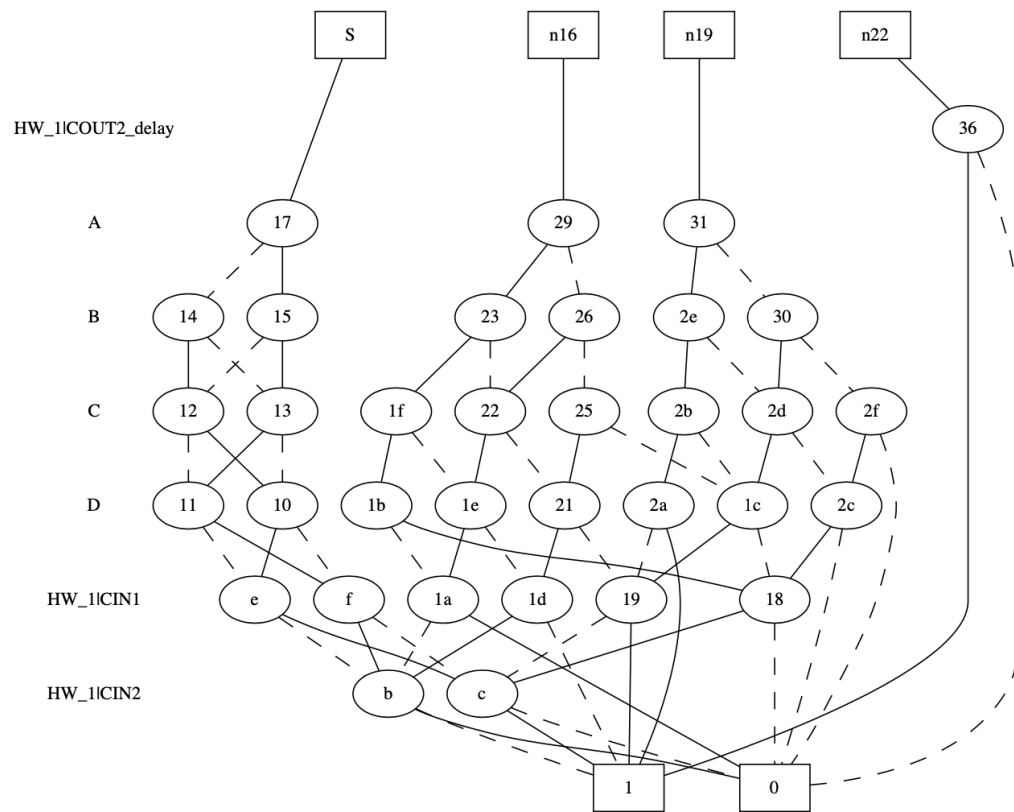
Visualize the AIG (command "show")

Network structure visualized by ABC
Benchmark "HW_1". Time was Sun Oct 03 20:46:55 2021.

The network contains 37 logic nodes and 3 latches.



Visualize the BDD (command “show bdd -g”



2 [ABC Boolean Function Representations]

(a) Compare the following differences with the four-number serial adder example.

1. logic network in AIG vs. structurally hashed AIG

ANS:

“aig”: Only converts local functions of the nodes to AIGs.

“strash”: Transforms the current network into an AIG by one-level structural hashing. The resulting AIG is a logic network composed of two-input AND gates and inverters represented as complemented attributes on the edges. Structural hashing is a purely combinational transformation, which does not modify the number and positions of latches.

```
UC Berkeley, ABC 1.01 (compiled Feb 13 2011 19:06:26)
abc 01> read HW_1.blif
UC Berkeley, ABC 1.01 (compiled Feb 13 2011 19:06:26)
abc 01> read HW_1.blif
Warning: The network contains hierarchy.
Hierarchy reader flattened 8 instances of logic boxes and left 0 black boxes.
abc 02> aig
abc 02> print_stats
HW_1      : i/o =   4/   1 lat =   3 nd =   10 edge =   25 aig =   52 lev =   3
abc 02> strash
abc 03> print_stats
HW_1      : i/o =   4/   1 lat =   3 and =   37 lev =   9
abc 03>
```

2. logic network in BDD (by command “bdd”) vs. collapsed BDD (by command “collapse”)

ANS:

“bdd”: Only converts local functions of the nodes to BDDs.

“collapse”: Recursively composes the fanin nodes into the fanout nodes resulting in a network, in which each CO is produced by a node, whose fanins are CIs. Collapsing is performed by building global functions using BDDs and is, therefore, limited to relatively small circuits. After collapsing, the node functions are represented using BDDs.

```
abc 01> read HW_1.blif
Warning: The network contains hierarchy.
Hierarchy reader flattened 8 instances of logic boxes and left 0 black boxes.
abc 02> bdd
abc 02> print_stats
HW_1      : i/o =   4/   1 lat =   3 nd =   10 edge =   25 bdd =   28 lev =   3
abc 02> collapse
Shared BDD size =   33 nodes. BDD construction time =   0.00 sec
abc 03> print_stats
HW_1      : i/o =   4/   1 lat =   3 nd =   4 edge =   19 bdd =   28 lev =   1
abc 03>
```

(b) Given a structurally hashed AIG, find a sequence of ABC commands to covert it to a logic network with node function expressed in sum-of-products (SOP).

ANS:

Command "logic"