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2 [Using ABC]

- The two-bit unsigned multiplier is written in the file "mul.blif".
- Figures 1. shows the screenshot of the commands. With the given 7 commands, we can obtain another 3 figures, which is the visualization of the network structure(Figure 2), AIG(Figure 3) and BDD(Figure 4), respectively.

```
abc 01> read /tmp/pai/mul.blif
abc 02> print_stats
1 /o = 4/ 4 lat = 0 nd = 4 edge = 14 cube = 8 lev = 1
rel
abc 02> show
abc 02> Warning: Cannot convert string "--Helvetica-Medium-R-Normal--148--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--120--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--180--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Bold-R-Normal--120--P--ISO8859-1" to type Fontstruct
abc 02> show
abc 02> Warning: Cannot convert string "--Helvetica-Medium-R-Normal--148--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--120--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--180--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Bold-R-Normal--120--P--ISO8859-1" to type Fontstruct
abc 02> strash
abc 03> show
abc 03> Warning: Cannot convert string "--Helvetica-Medium-R-Normal--148--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--120--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--180--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Bold-R-Normal--120--P--ISO8859-1" to type Fontstruct
abc 03> collapse
abc 04> show_bdd_g
abc 04> Warning: Cannot convert string "--Helvetica-Medium-R-Normal--148--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--120--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Medium-R-Normal--180--P--ISO8859-1" to type Fontstruct
Warning: Cannot convert string "--Helvetica-Bold-R-Normal--120--P--ISO8859-1" to type Fontstruct
abc 04>
```

Figure 1: Screenshot of the commands

Network structure visualized by ABC
Benchmark "mul". Time was Sun Sep 17 13:02:35 2023.

The network contains 4 logic nodes and 0 latches.

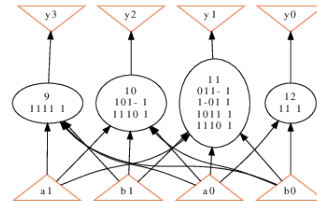


Figure 2: Visualization of network structure

Network structure visualized by ABC
Benchmark "mul". Time was Sun Sep 17 13:05:20 2023.

The network contains 17 logic nodes and 0 latches.

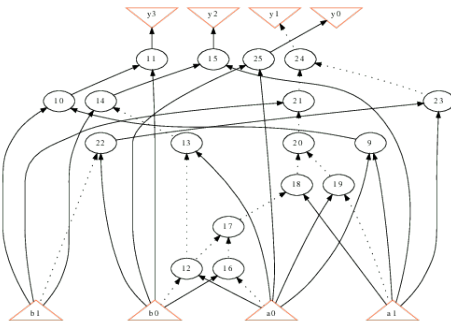


Figure 3: Visualization of AIG

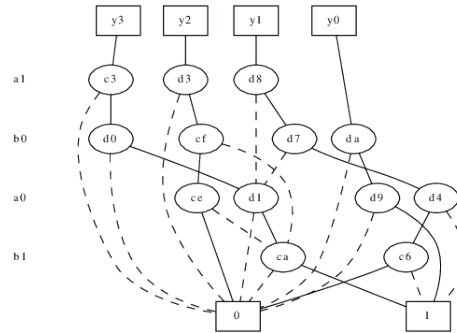


Figure 4: Visualization of BDD

3 [ABC Boolean Function Representations]

Network structure visualized by ABC
Benchmark "mul". Time was Sun Sep 17 13:13:29 2023.

The network contains 4 logic nodes and 0 latches.

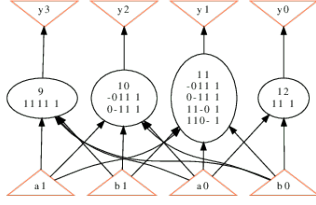


Figure 5: logic network in AIG

Network structure visualized by ABC
Benchmark "mul". Time was Sun Sep 17 13:05:20 2023.

The network contains 17 logic nodes and 0 latches.

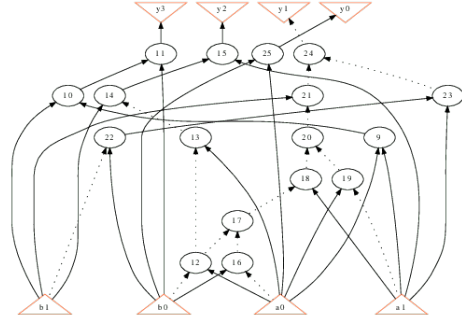


Figure 6: structurally hashed AIG

Network structure visualized by ABC
Benchmark "mul". Time was Sun Sep 17 13:14:06 2023.

The network contains 4 logic nodes and 0 latches.

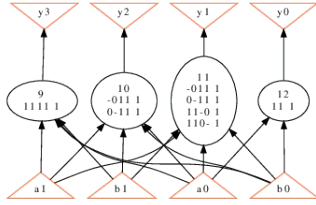


Figure 7: logic network in BDD

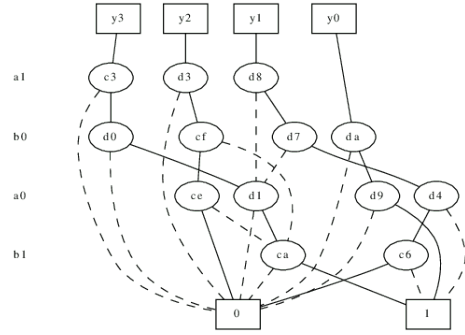


Figure 8: collapsed BDD

- (a) 1. Figure 5. and Figure 6. shows the logic network in AIG and structurally hashed AIG, respectively. From the previous two figures, we may observe that there are differences between two networks since the command "aig" is used to convert logic function of the nodes to AIGs while the command "strash" is to transform the current network into an AIG.
2. Figure 7. and Figure 8. shows the logic network in BDD and collapsed BDD, respectively. Similar to the relation between command "aig" and "strash", the command "bdd" transforms the network to BDD locally while the other one transforms globally.
- (b) Given a structurally hashed AIG, we may use the command "logic" and "show" to visualize the logic network with node function expressed in SOP, which is shown in Figure 9.

Network structure visualized by ABC
Benchmark "mul". Time was Sun Sep 17 13:16:09 2023.

The network contains 17 logic nodes and 0 latches.

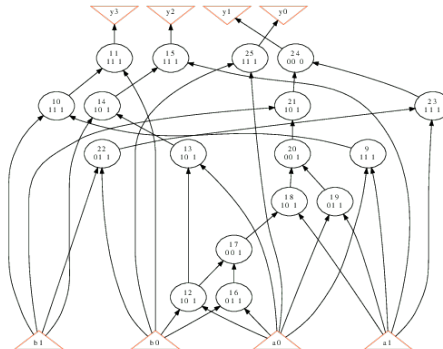


Figure 9: logic network with node function expressed in SOP