



SACRAMENTO STATE

EEE234

Digital IC Design

PROJECT NO. 2: Design, Simulation and Layout of a Synchronous 4-bit FIFO with Empty/Full Indicator

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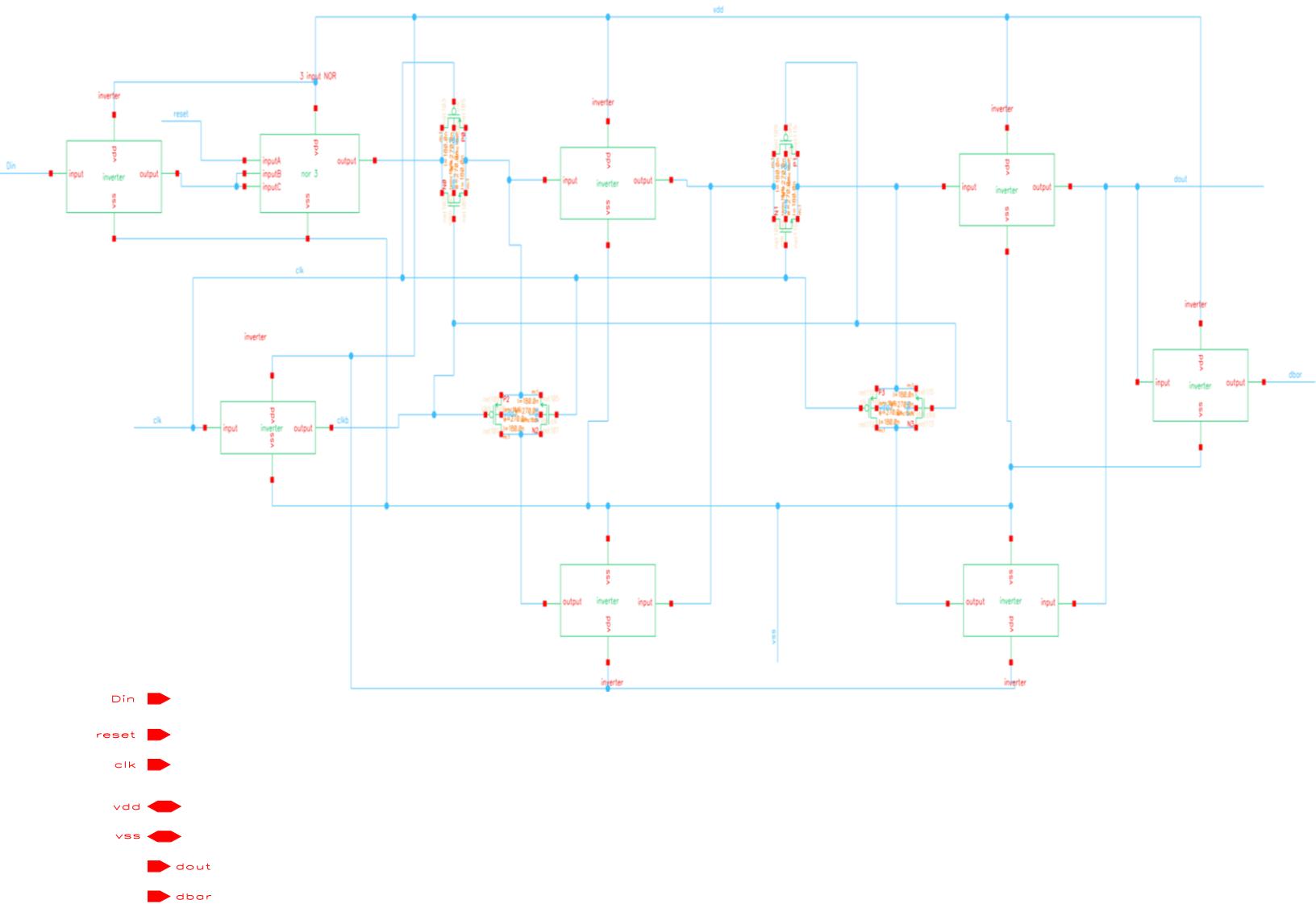
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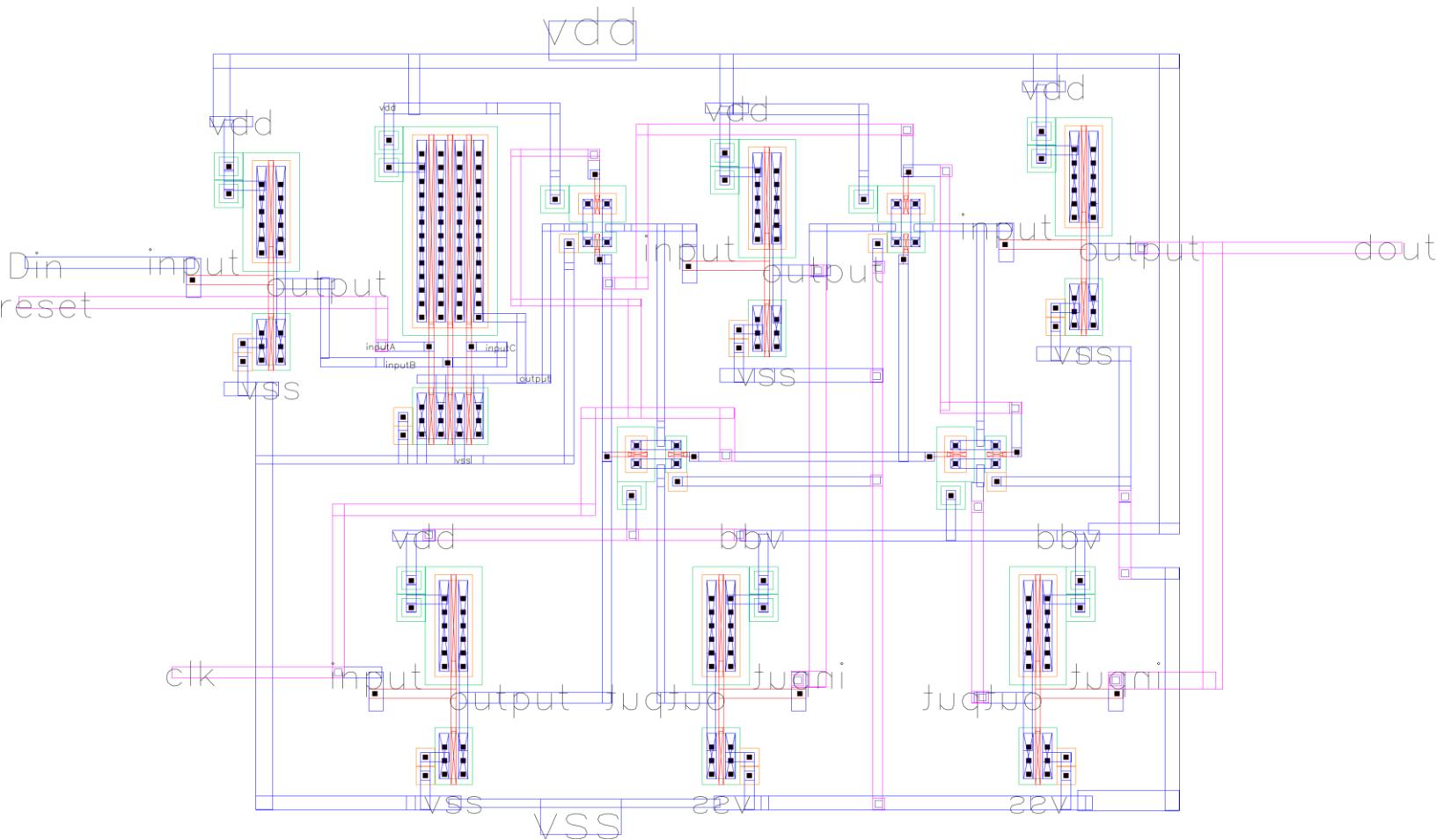
D Flip Flop with

Q Bar

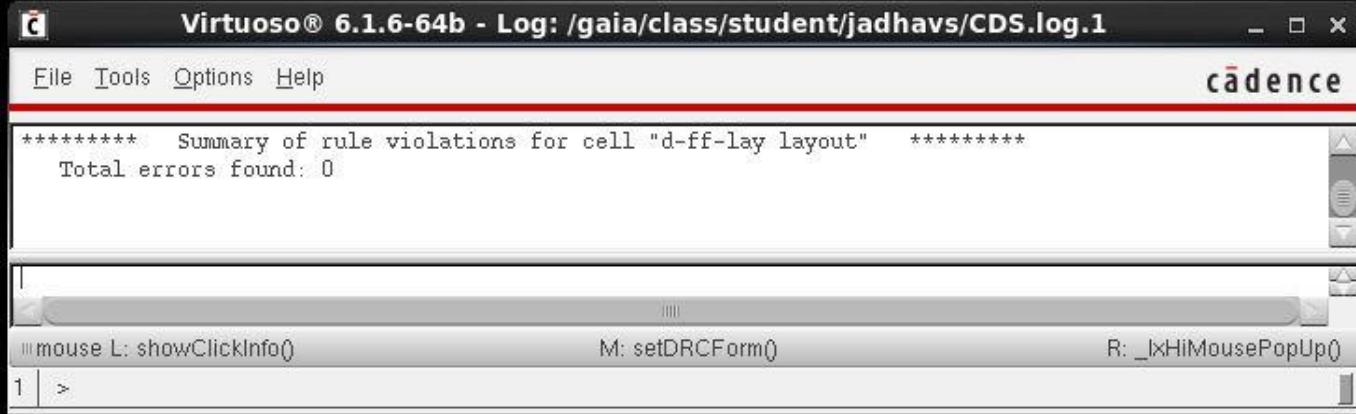
SCHEMATIC:



Layout



DRC



The screenshot shows a window titled "Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log.1". The menu bar includes "File", "Tools", "Options", and "Help". The main area displays a log message: "***** Summary of rule violations for cell \"d-ff-lay layout\" *****" followed by "Total errors found: 0". At the bottom, there is a status bar with the text "mouse L: showClickInfo()", "M: setDRCForm()", and "R: _IxHiMousePopUp()".

LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
17 nets  
0 terminals  
14 pmos  
14 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
17 nets  
7 terminals  
14 pmos  
14 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	28	28
total	28	28

	nets	
un-matched	0	0

merged	0	0
pruned	0	0
active	17	17
total	17	17
terminals		
un-matched	0	0
matched but different type	0	0
total	0	7

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

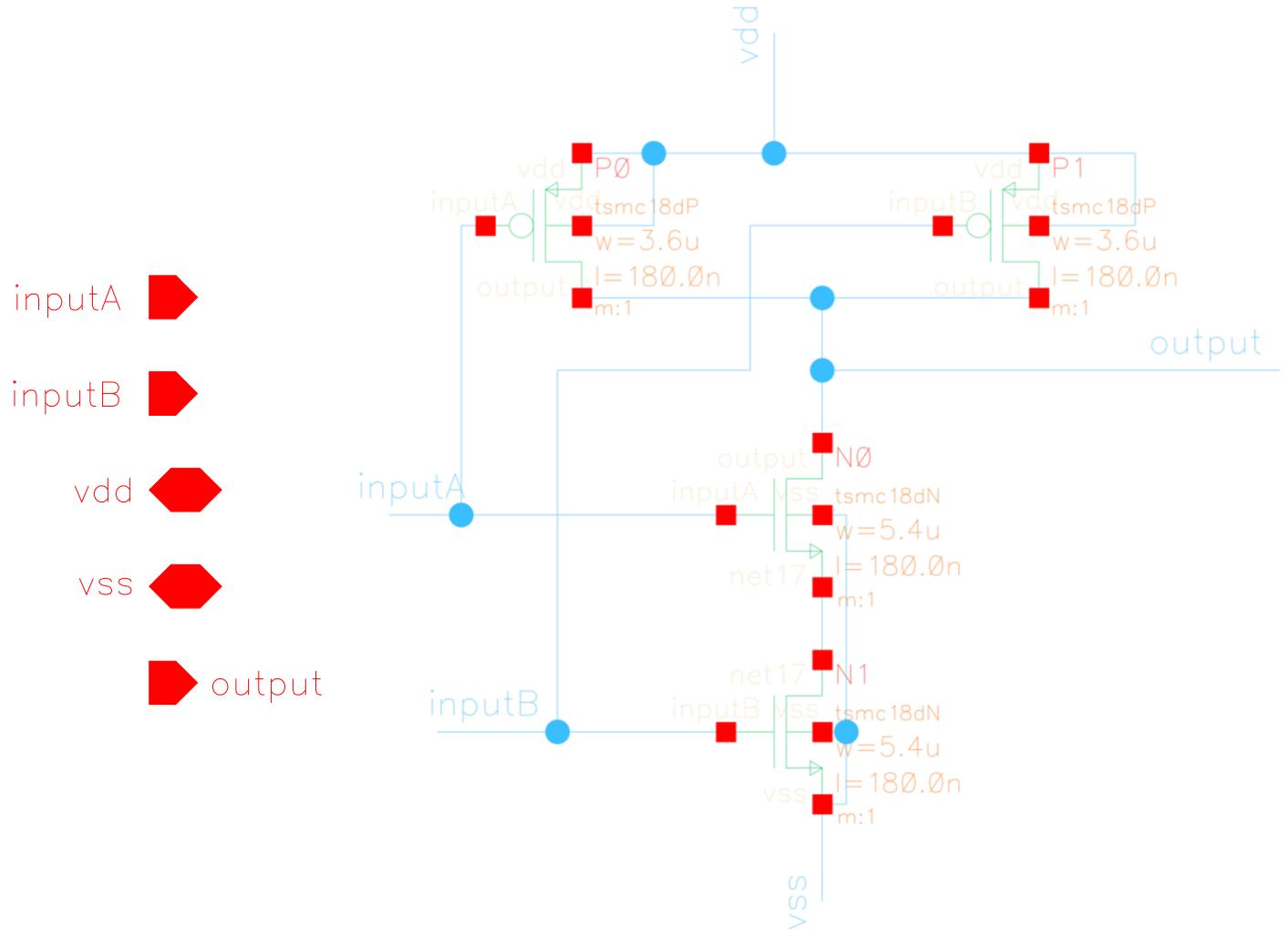
prunedev.out:

audit.out:

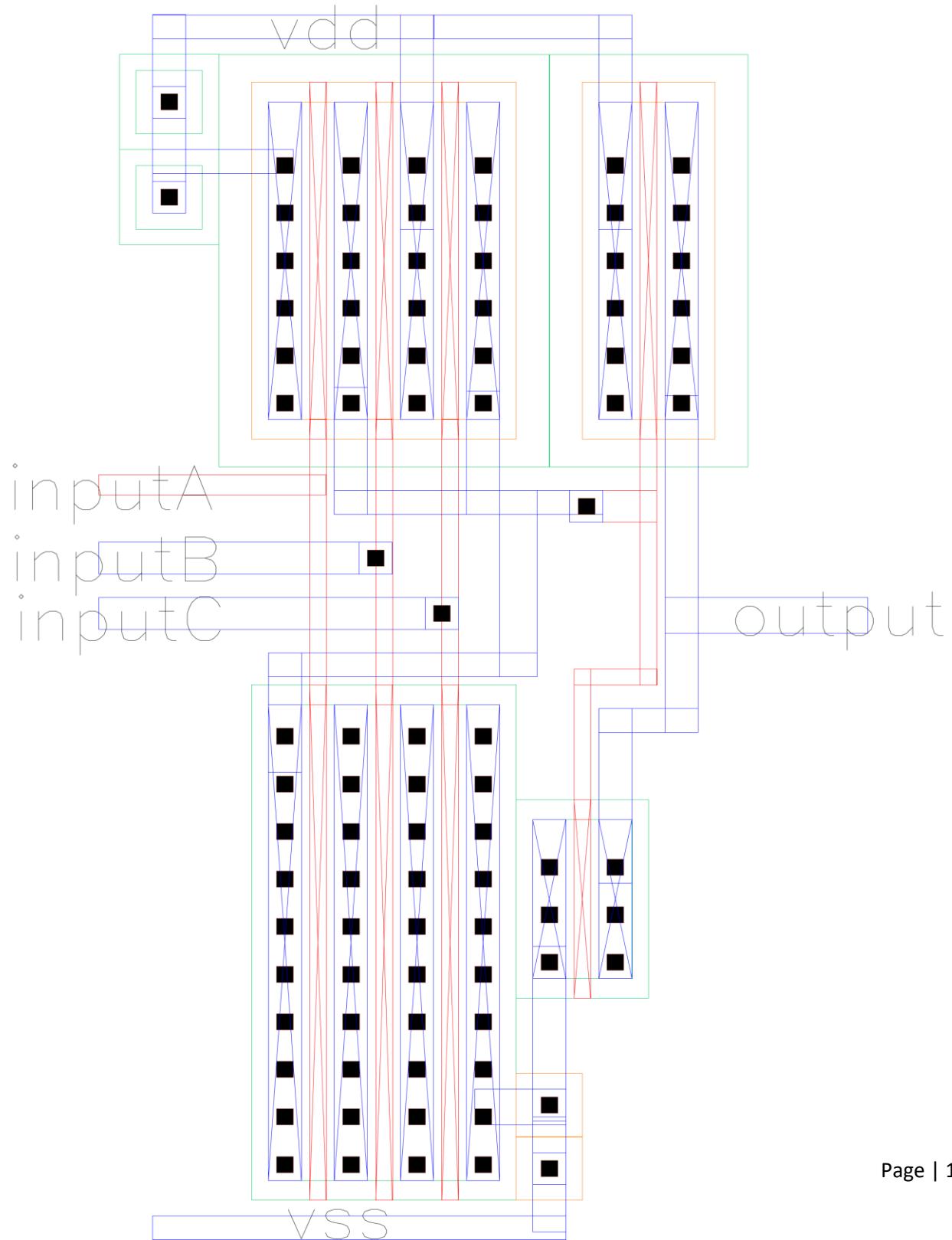
2:1 Mux

NAND:

Schematic



Layout



DRC

The screenshot shows the Virtuoso® 6.1.6-64b software interface with the title bar "Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log". The menu bar includes "File", "Tools", "Options", and "Help". The main window displays a log message: "***** Summary of rule violations for cell \"nand-3 layout\" *****" followed by "Total errors found: 0". Below this, a status bar shows "mouse L: showClickInfo()", "M: setDRCForm()", and "R: _IxHiMousePopUp()". A small number "1" is visible in the bottom left corner of the status bar.

LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
9 nets  
0 terminals  
4 pmos  
4 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
9 nets  
6 terminals  
4 pmos  
4 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

```
2 net-list ambiguities were resolved by random selection.
```

```
The net-lists match.
```

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	8	8
total	8	8

	nets
un-matched	0 0
merged	0 0
pruned	0 0
active	9 9
total	9 9

	terminals
un-matched	0 0
matched but different type	0 0
total	0 6

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

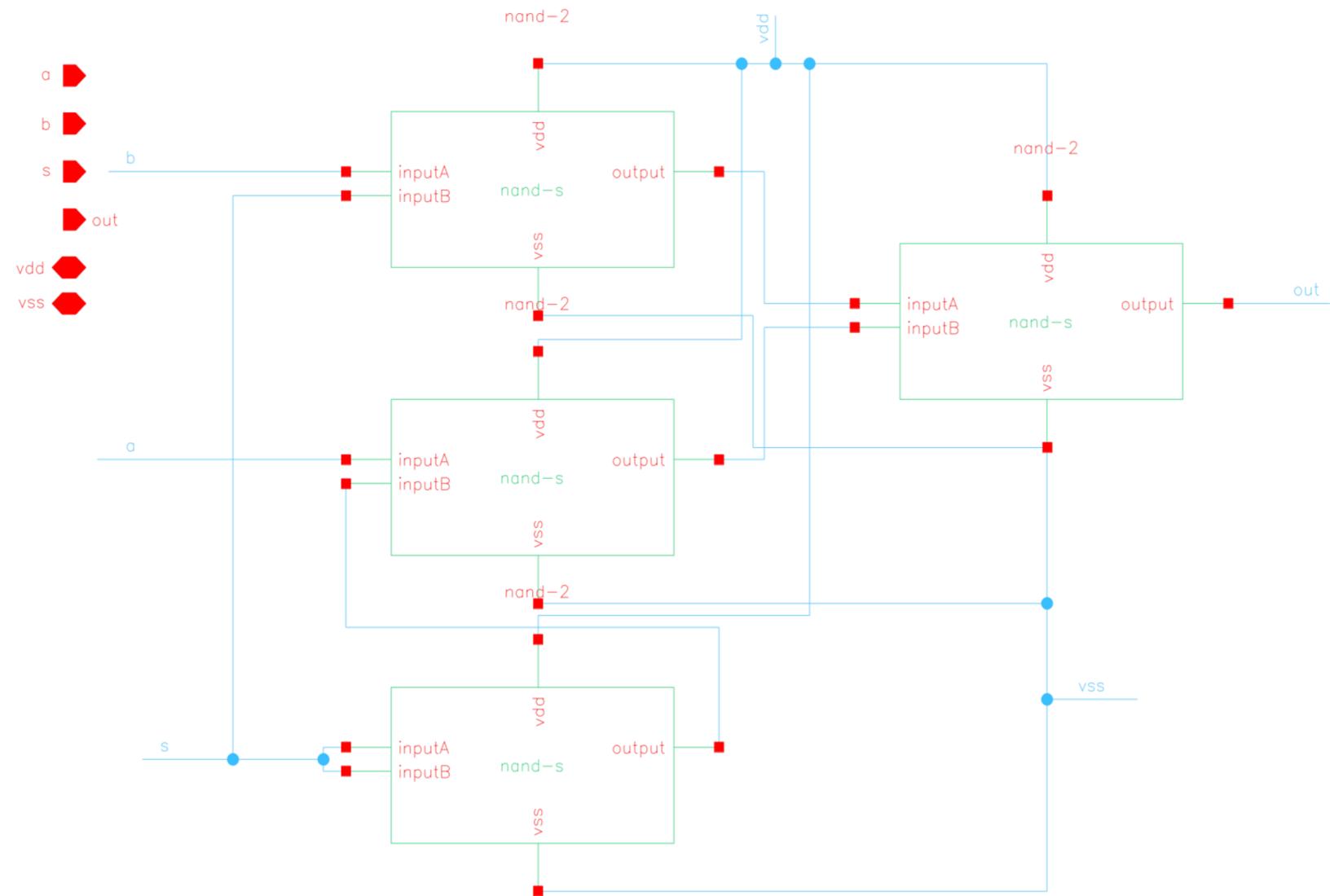
prunenet.out:

prunedev.out:

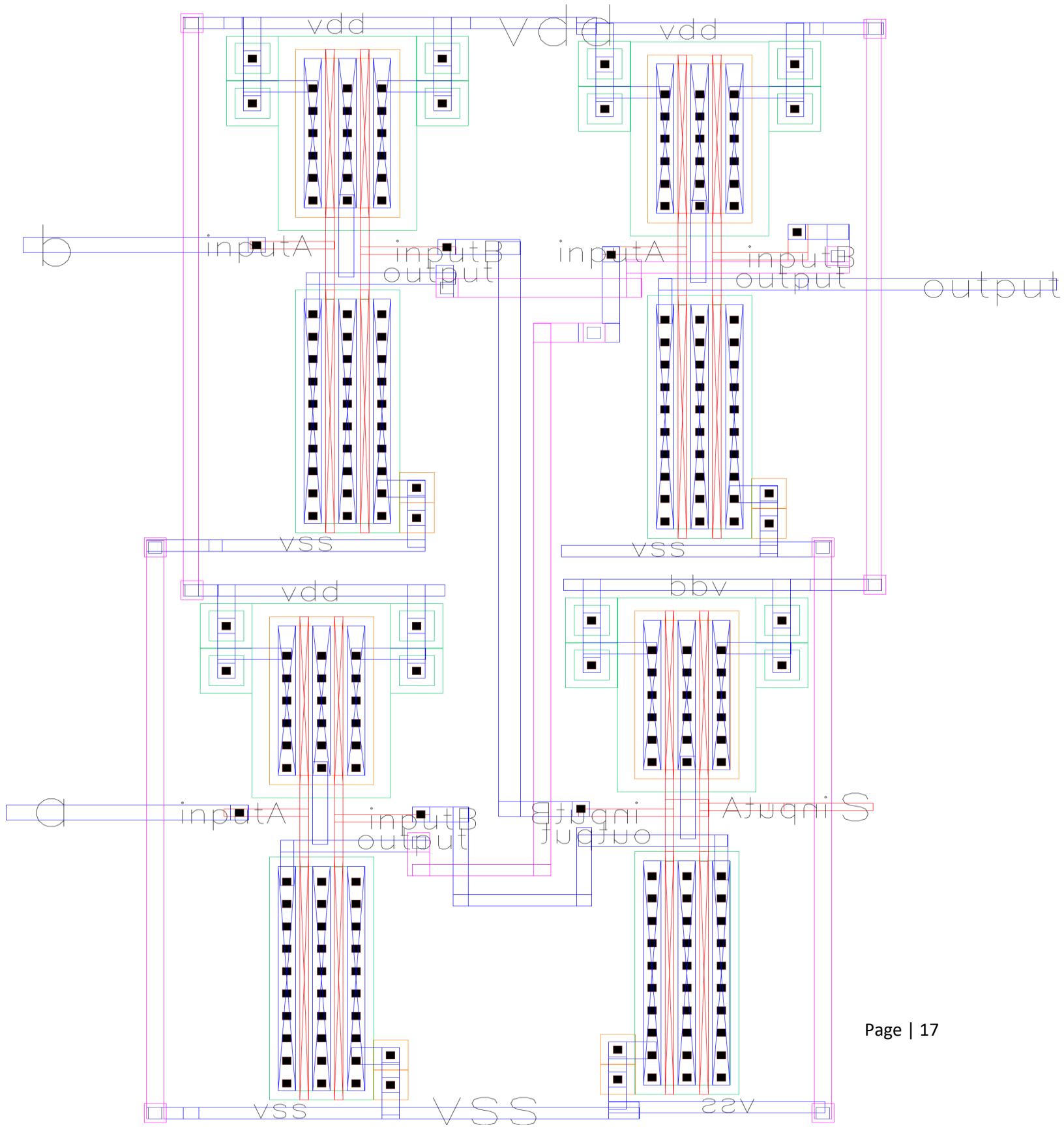
audit.out:

2:1 MUX

Schematic



Layout



DRC

The screenshot shows a window titled "Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log". The menu bar includes "File", "Tools", "Options", and "Help". The main area displays a log message: "***** Summary of rule violations for cell \"mux2_1 layout\" *****" followed by "Total errors found: 0". Below this, a status bar shows "m mouse L: showClickInfo()", "M: setDRCForm()", and "R: _lxHiMousePopUp()". A scroll bar is visible on the right side of the log window.

LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
13 nets  
0 terminals  
8 pmos  
8 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
13 nets  
6 terminals  
8 pmos  
8 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	16	16
total	16	16

	nets	
un-matched	0	0

merged	0	0
pruned	0	0
active	13	13
total	13	13
		terminals
un-matched	0	0
matched but		
different type	0	0
total	0	6

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

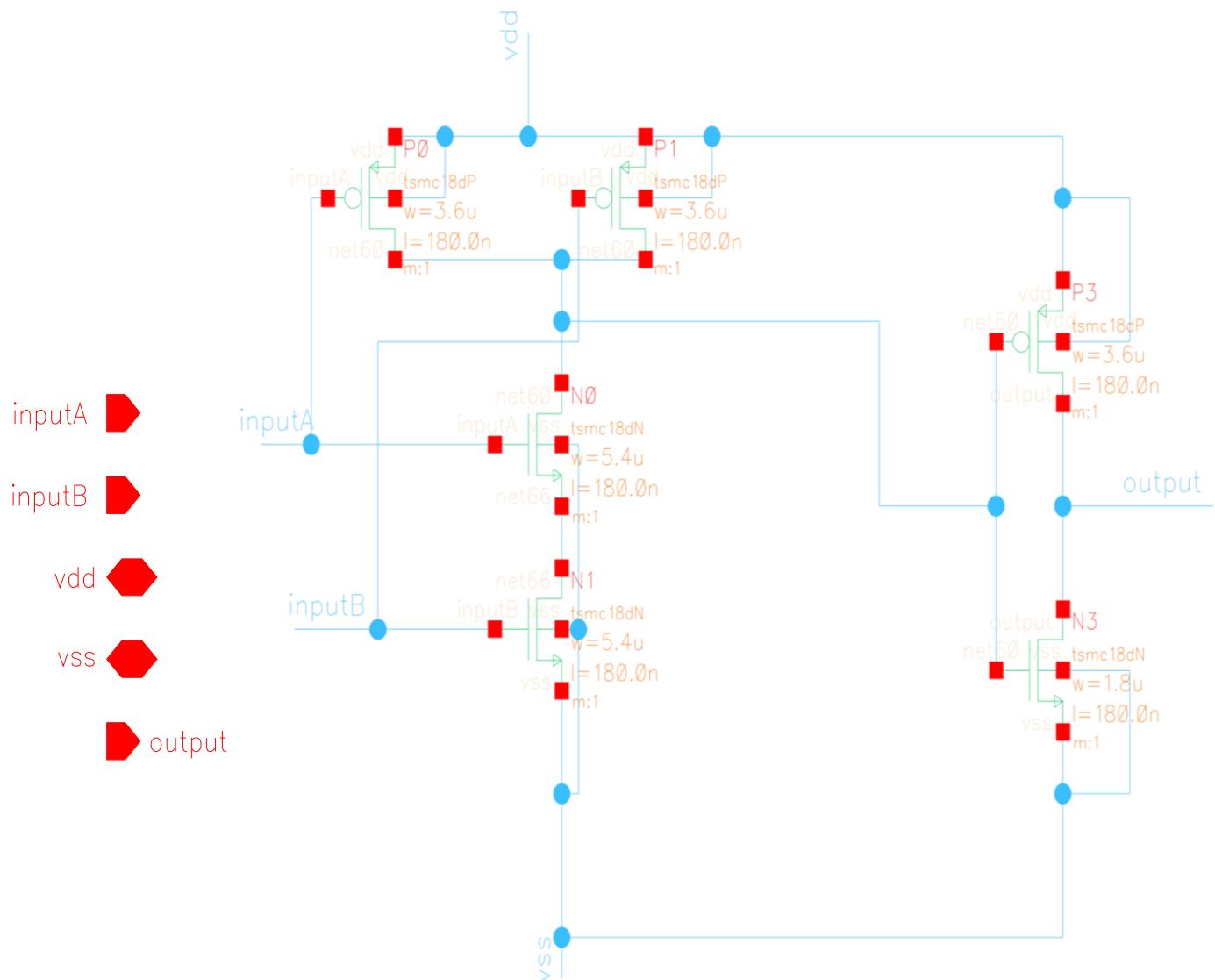
prunedev.out:

audit.out:

Single Memory

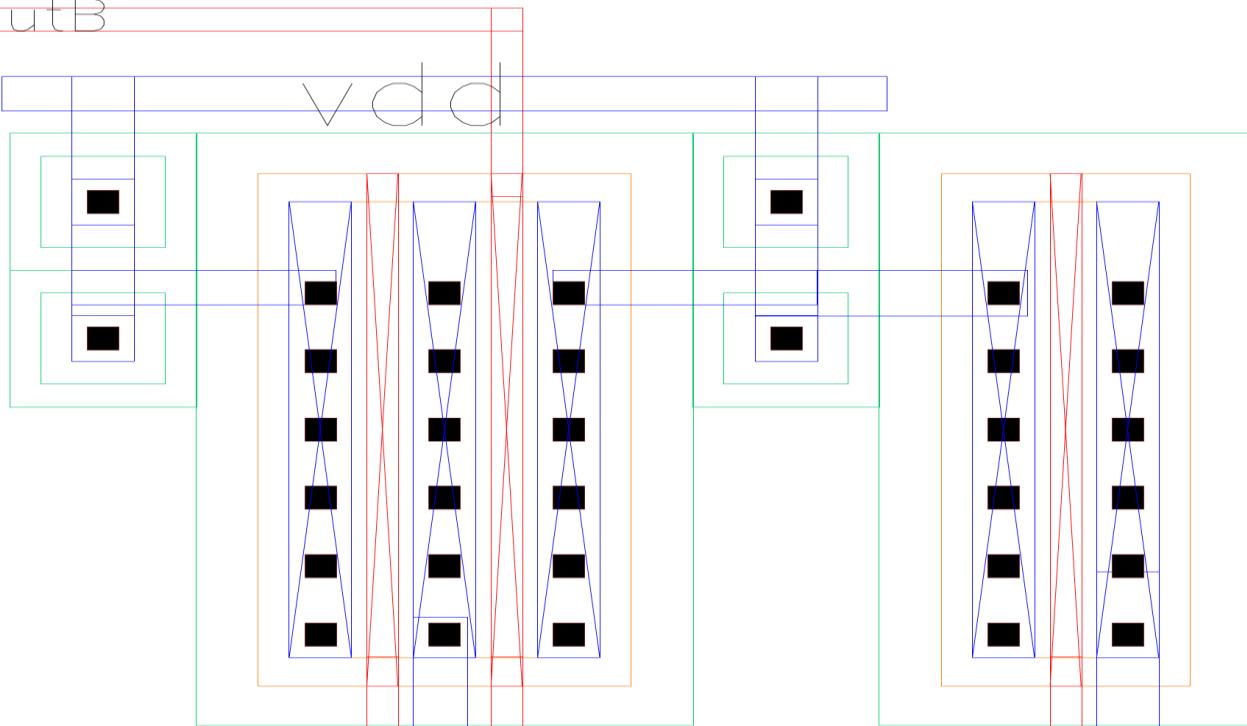
Unit

AND Schematic

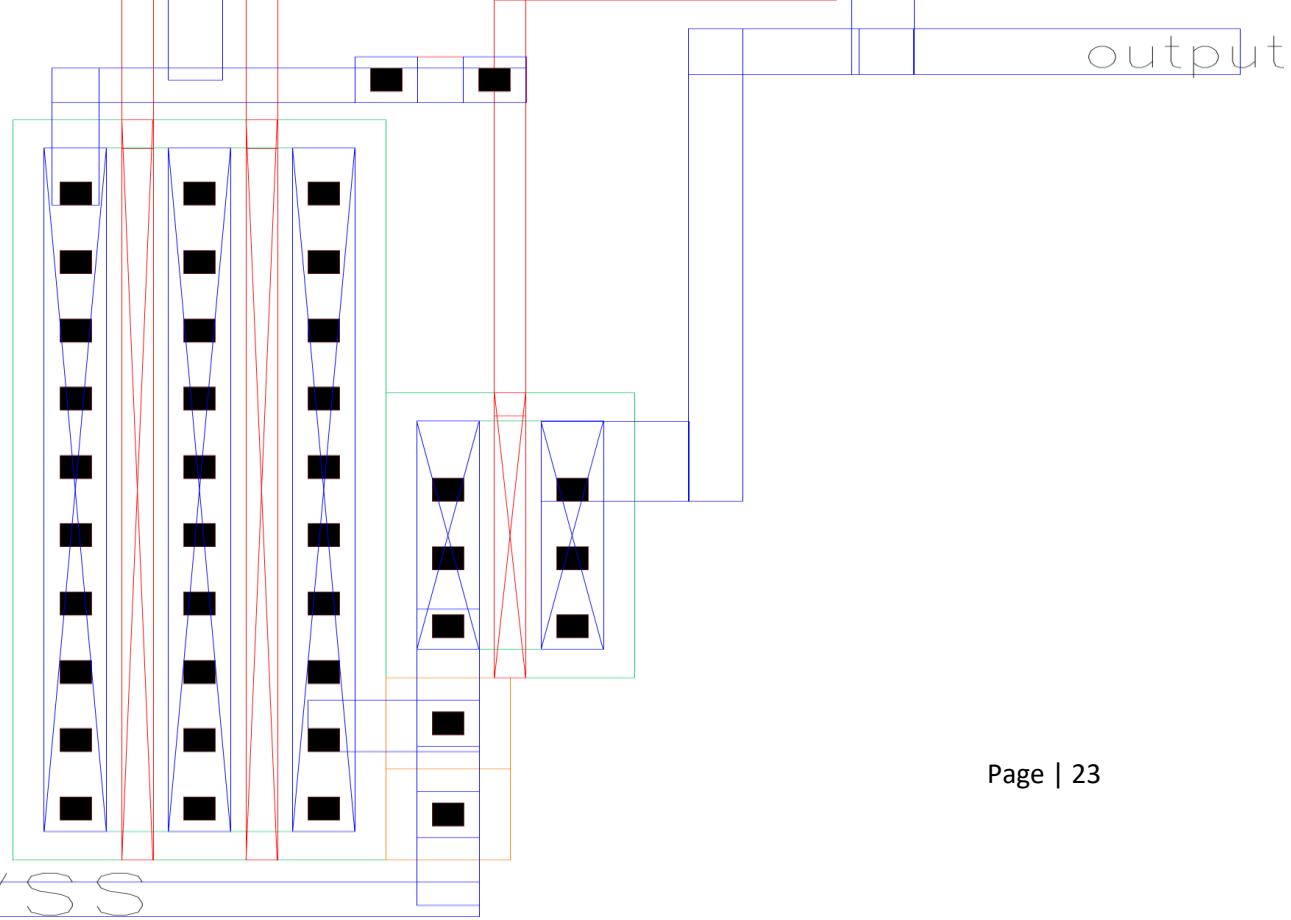


Layout

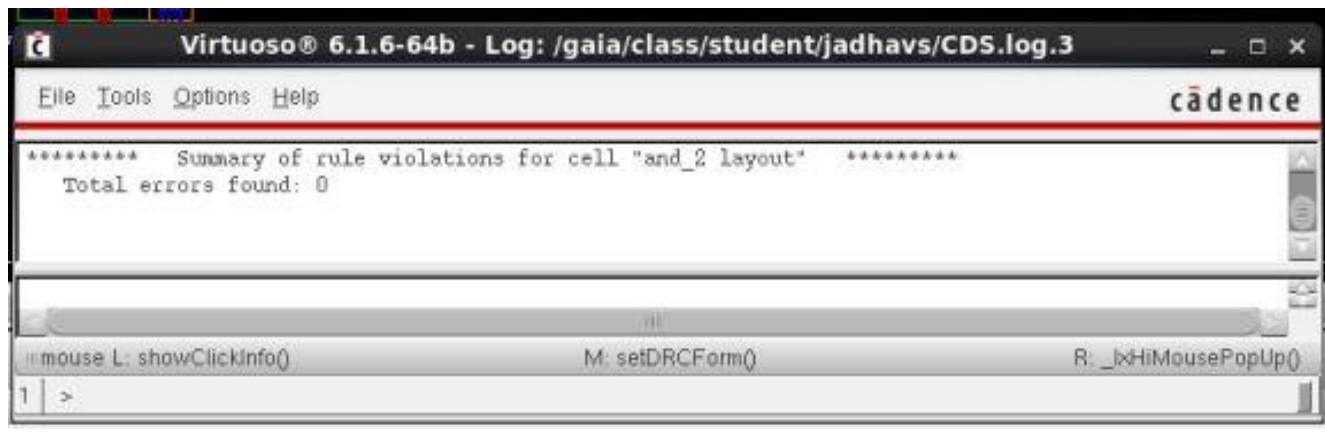
inputB



inputA



DRC



The screenshot shows the Virtuoso® 6.1.6-64b software interface. The window title is "Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log.3". The menu bar includes "File", "Tools", "Options", and "Help". The main area displays the following text:

```
***** Summary of rule violations for cell "and_2 layout" *****
Total errors found: 0
```

Below this, there is a status bar with three items: "Himouse L: showClickInfo()", "M: setDRCForm()", and "R: _lxHiMousePopUp()".

LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
7 nets  
0 terminals  
3 pmos  
3 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
7 nets  
5 terminals  
3 pmos  
3 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

```
1 net-list ambiguity was resolved by random selection.
```

```
The net-lists match.
```

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	6	6
total	6	6

	nets
un-matched	0 0
merged	0 0
pruned	0 0
active	7 7
total	7 7

	terminals
un-matched	0 0
matched but different type	0 0
total	0 5

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

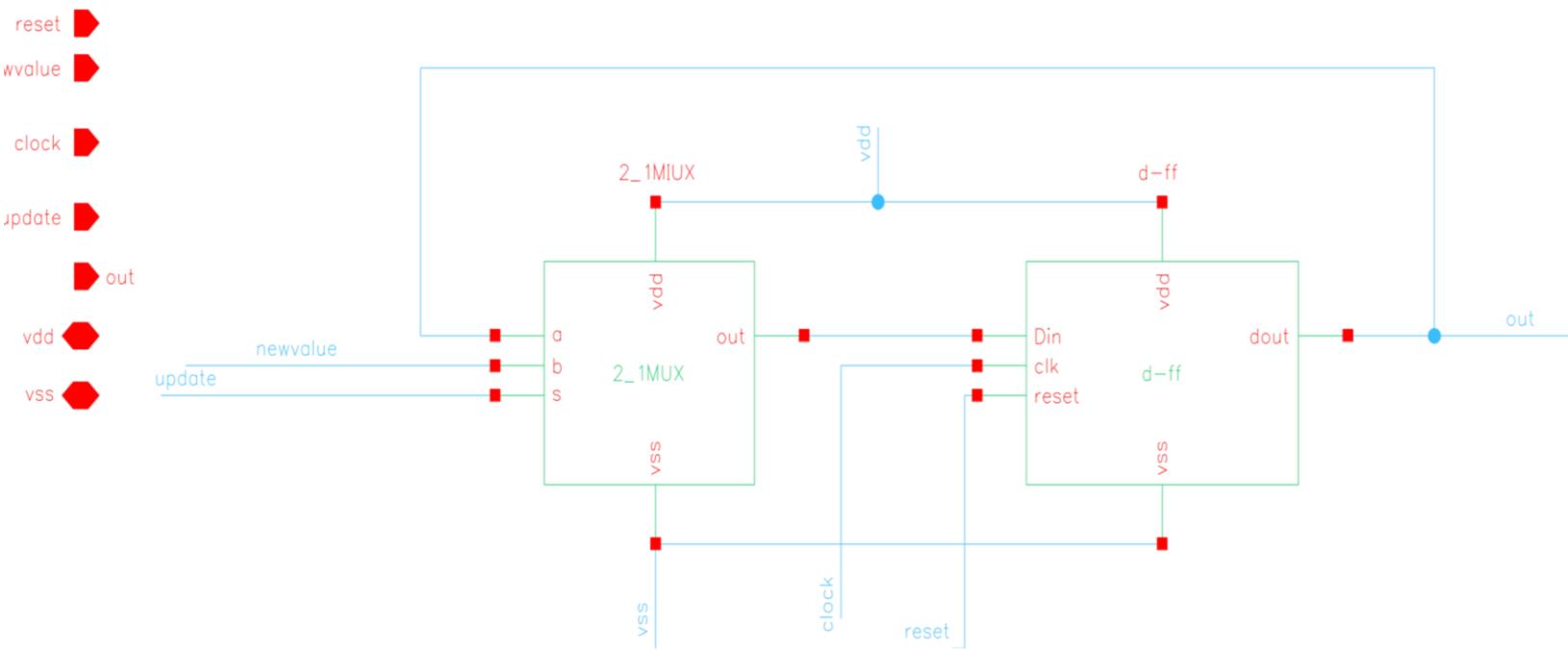
prunenet.out:

prunedev.out:

audit.out:

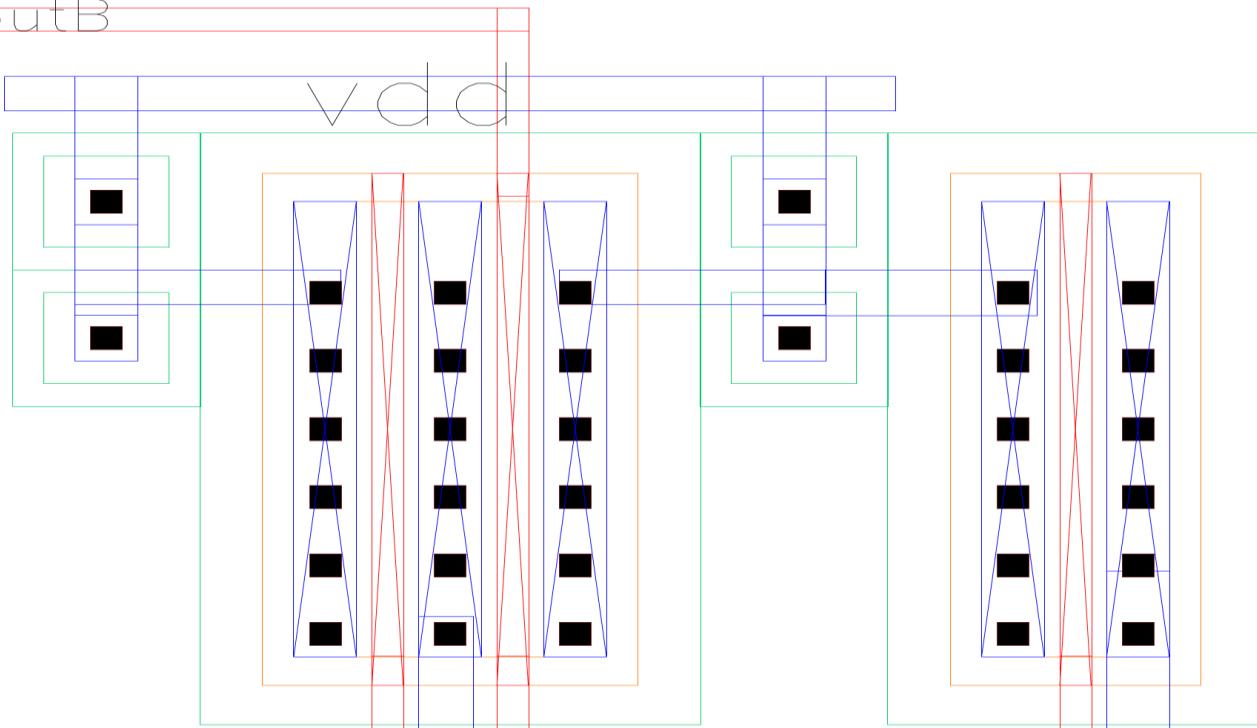
Single Memory Unit

Schematic:

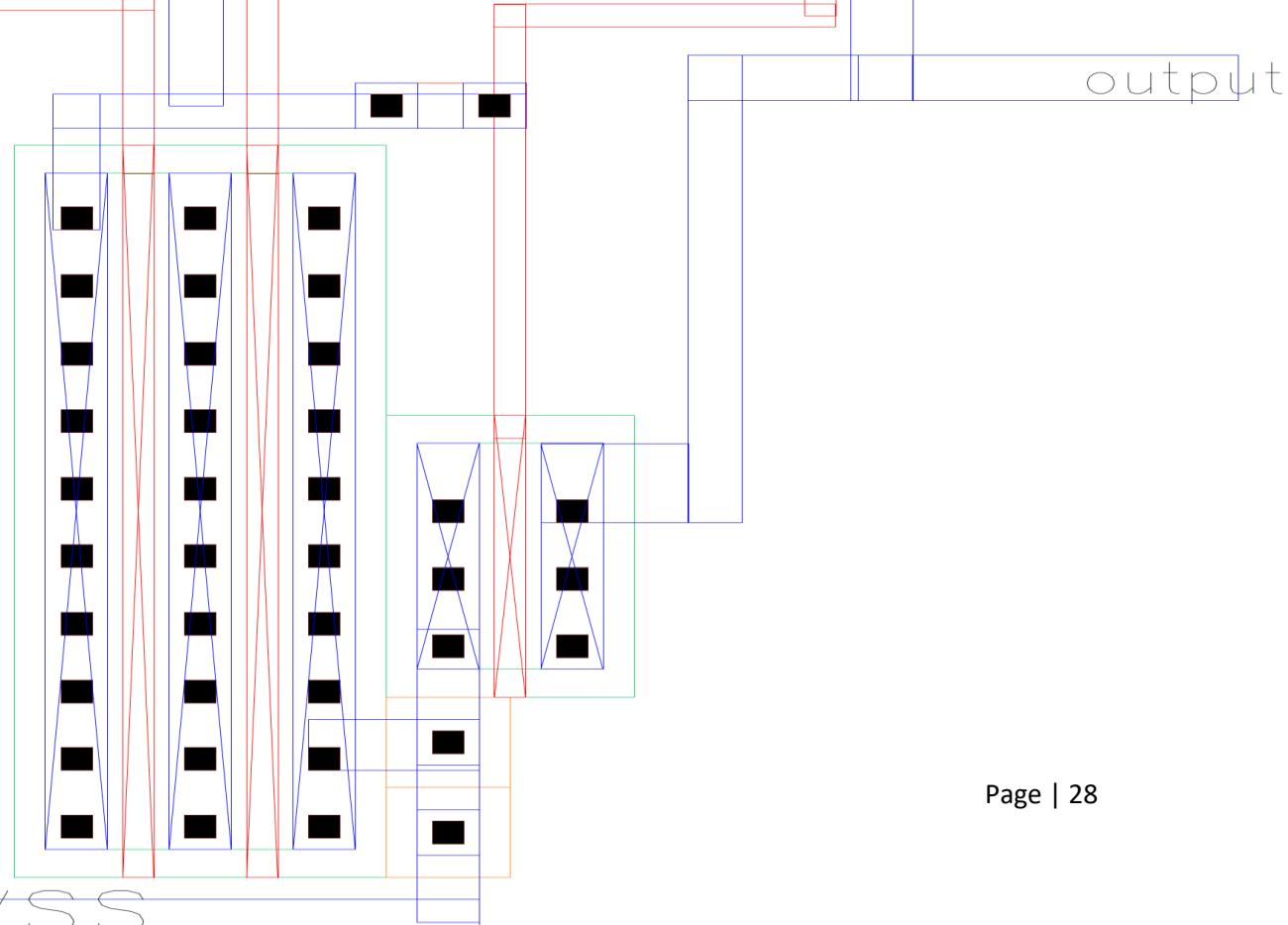


Layout

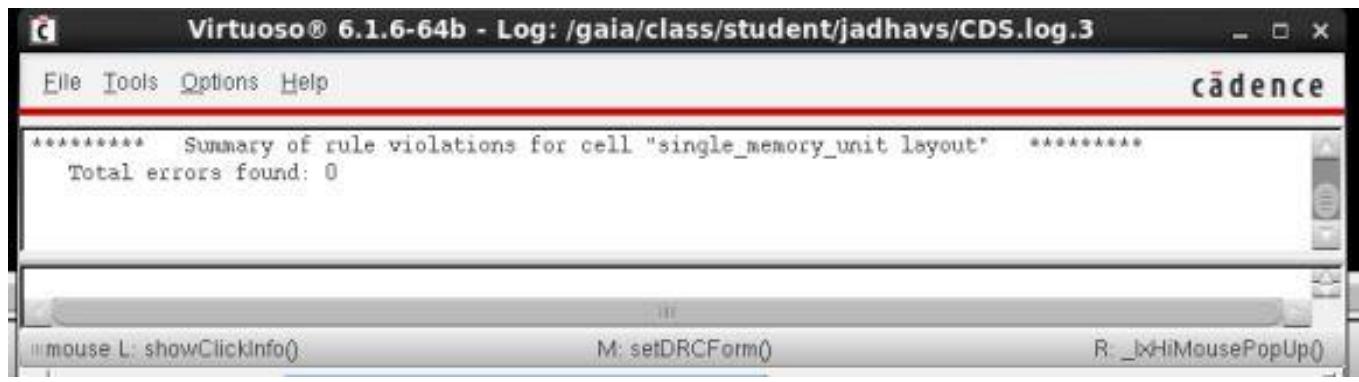
inputB



inputA



DRC



LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
25 nets  
0 terminals  
21 pmos  
21 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
25 nets  
7 terminals  
21 pmos  
21 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	42	42
total	42	42

	nets	
un-matched	0	0

merged	0	0
pruned	0	0
active	25	25
total	25	25
		terminals
un-matched	0	0
matched but		
different type	0	0
total	0	7

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

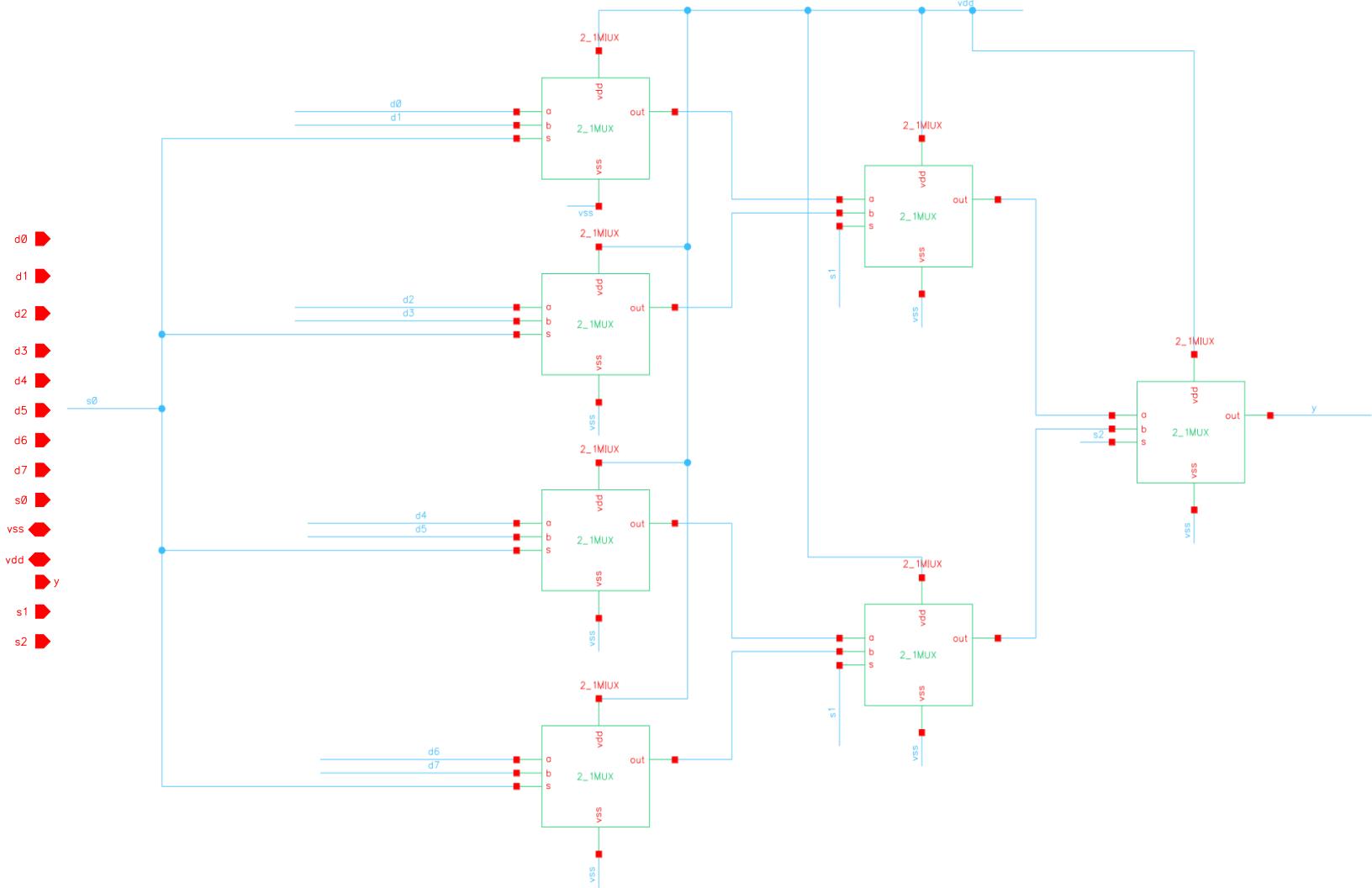
prunenet.out:

prunedev.out:

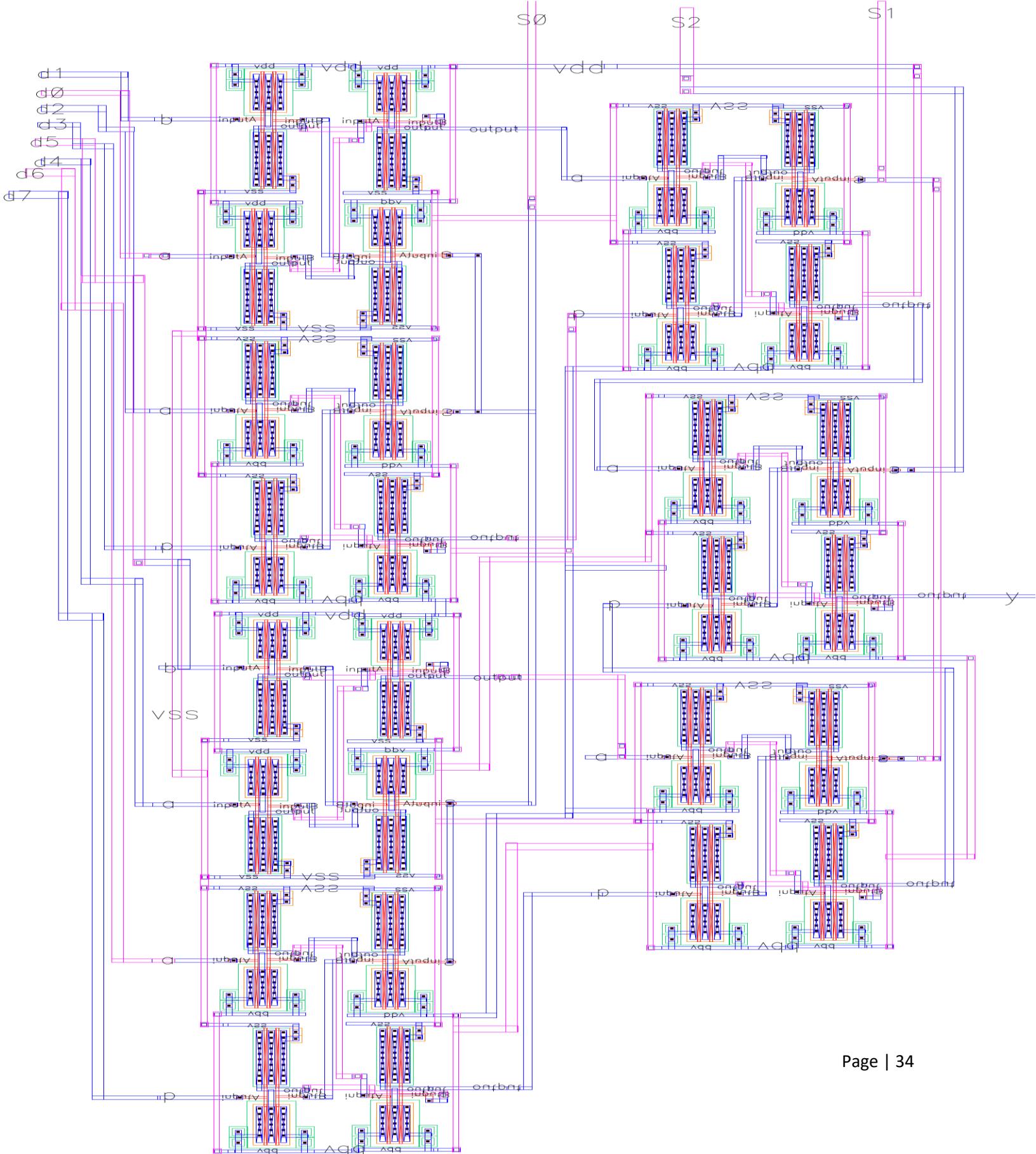
audit.out:

8:1 Mux

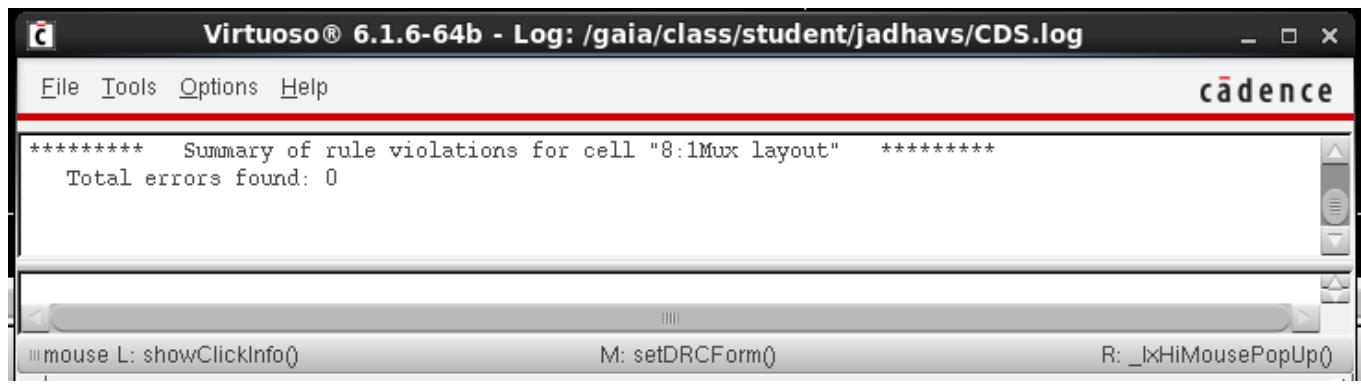
Schematic



Layout



DRC



LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
69 nets  
0 terminals  
56 pmos  
56 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
69 nets  
14 terminals  
56 pmos  
56 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	112	112
total	112	112

	nets
un-matched	0

merged	0	0
pruned	0	0
active	69	69
total	69	69
		terminals
un-matched	0	0
matched but		
different type	0	0
total	0	14

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

3:6 Decoder

Inverter

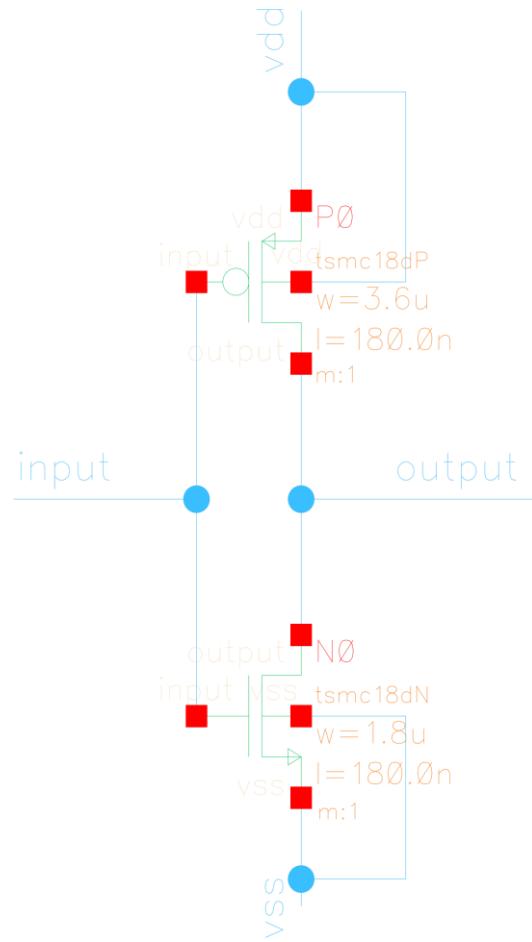
Schematic

input 

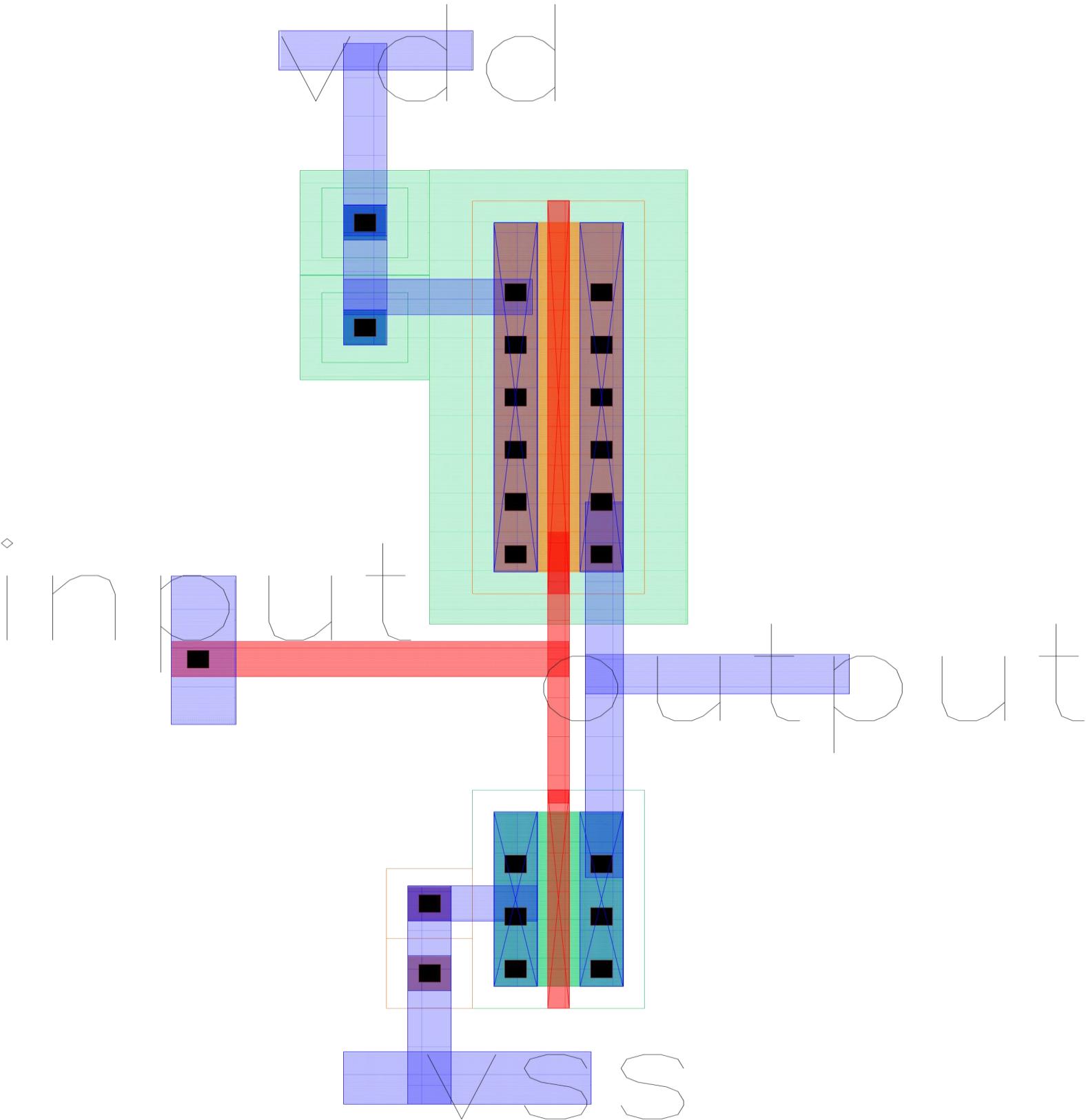
 output

vdd 

vss 



Layout



DRC

The screenshot shows a software interface for Virtuoso 6.1.6-64b. The title bar reads "Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log.1". The menu bar includes "File", "Tools", "Options", and "Help". The main window displays a log message: "***** Summary of rule violations for cell \"inverterFIN-lay layout\" *****" followed by "Total errors found: 0". At the bottom, there is a status bar with three items: "mouse L: showClickInfo()", "M: setDRCForm()", and "R: _lxHiMousePopUp()". A vertical scroll bar is visible on the right side of the main window.

LVS

@(#)\$CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) \$

Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir
/gaia/class/student/jadhavs/Desktop/harsha/LVS -l -s -t
/gaia/class/student/jadhavs/Desktop/harsha/LVS/layout
/gaia/class/student/jadhavs/Desktop/harsha/LVS/schematic

Like matching is enabled.

Net swapping is enabled.

Using terminal names as correspondence points.

Compiling Diva LVS rules...

Net-list summary for

		count
4	nets	
0	terminals	
1	pmos	
1	nmos	

Net-list summary for

		count
4	nets	
4	terminals	
1	pmos	
1	nmos	

Devices in the rules but not in the netlist: cap nfet pfet nmos4
pmos4

The net-lists match.

	layout		schematic		instances		un-
matched	0	0	rewired		0	0	size errors
0 0	pruned		0	0	active		2 2
total	2 2						

	nets		un-matched		0 0	merged	
0 0	pruned		0	0	active		4 4
total	4 4						

	terminals		un-matched		0 0
matched but					
different type	0	0	total		0 4

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

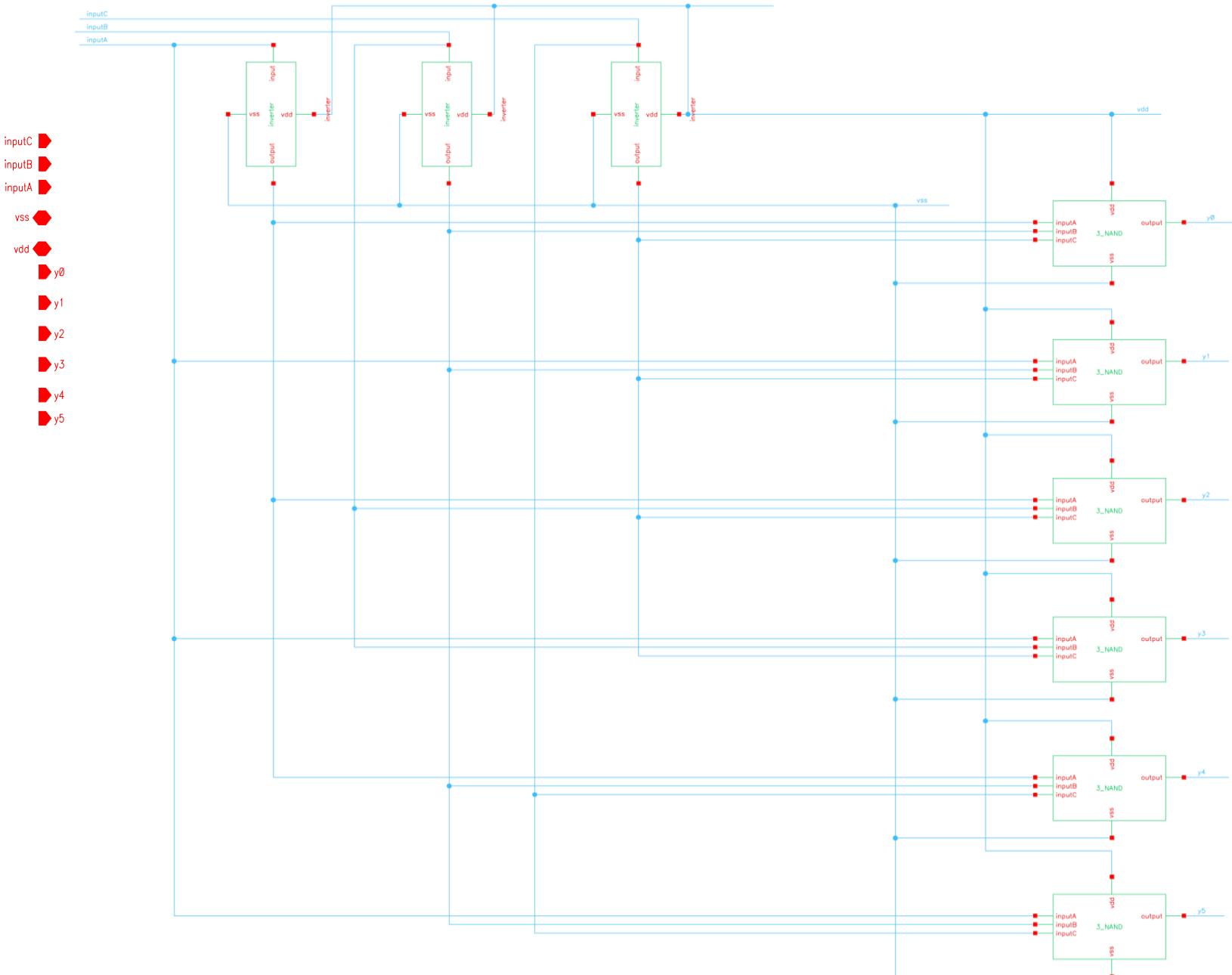
prunenet.out:

prunedev.out:

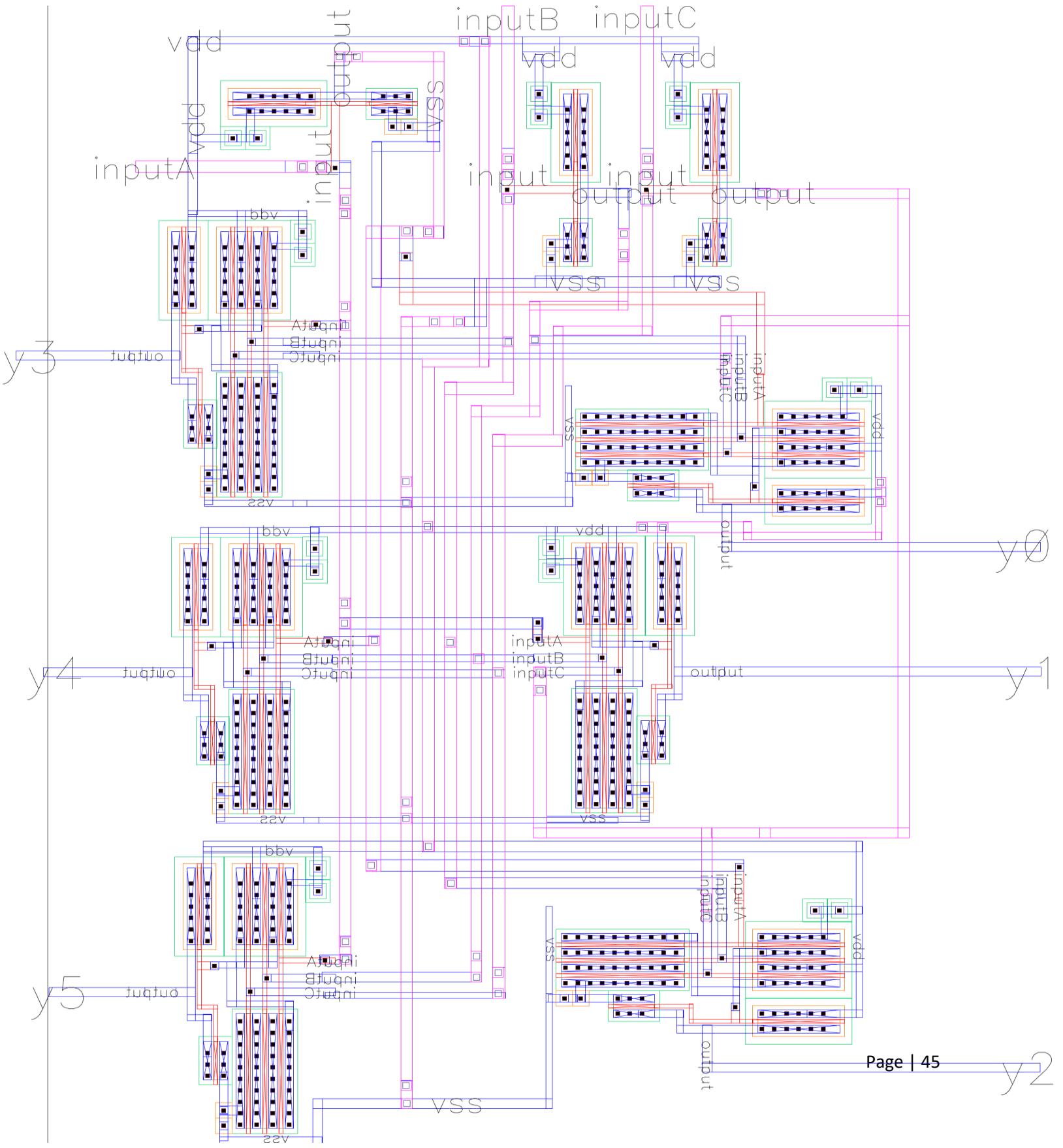
audit.out:

3:6 decoder

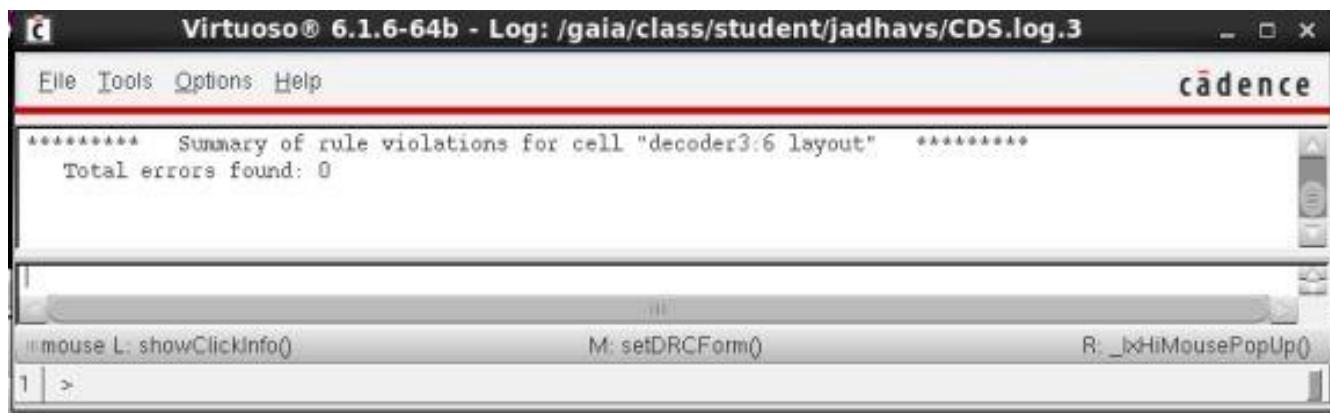
Schematic



Layout



DRC



LVS

```
@(#)$CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
32 nets  
0 terminals  
27 pmos  
27 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
32 nets  
11 terminals  
27 pmos  
27 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

```
1 net-list ambiguity was resolved by random selection.
```

```
The net-lists match.
```

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	54	54
total	54	54

	nets	
un-matched	0	0
merged	0	0
pruned	0	0
active	32	32
total	32	32

	terminals	
un-matched	0	0
matched but different type	0	0
total	0	11

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

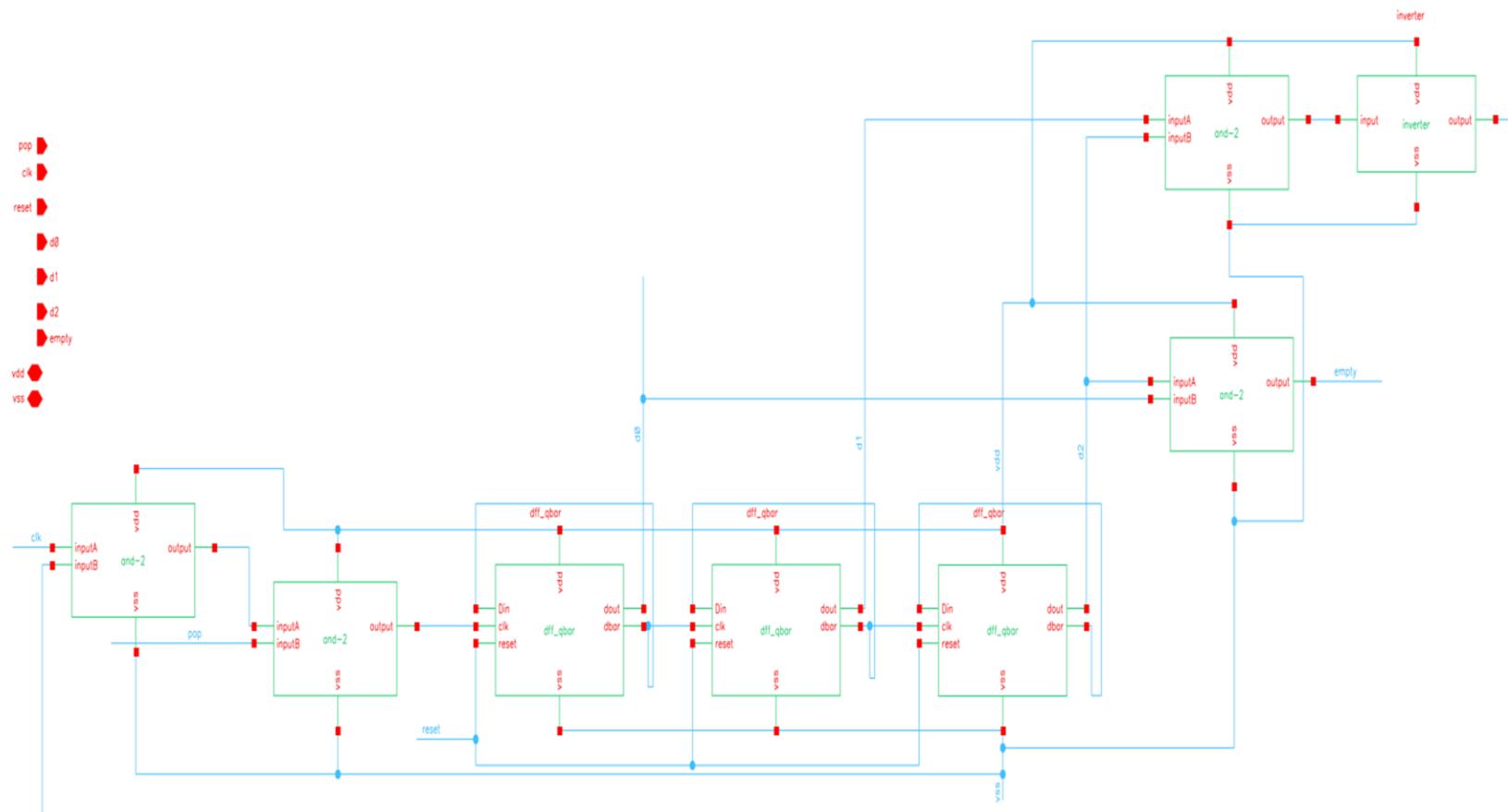
prunenet.out:

prunedev.out:

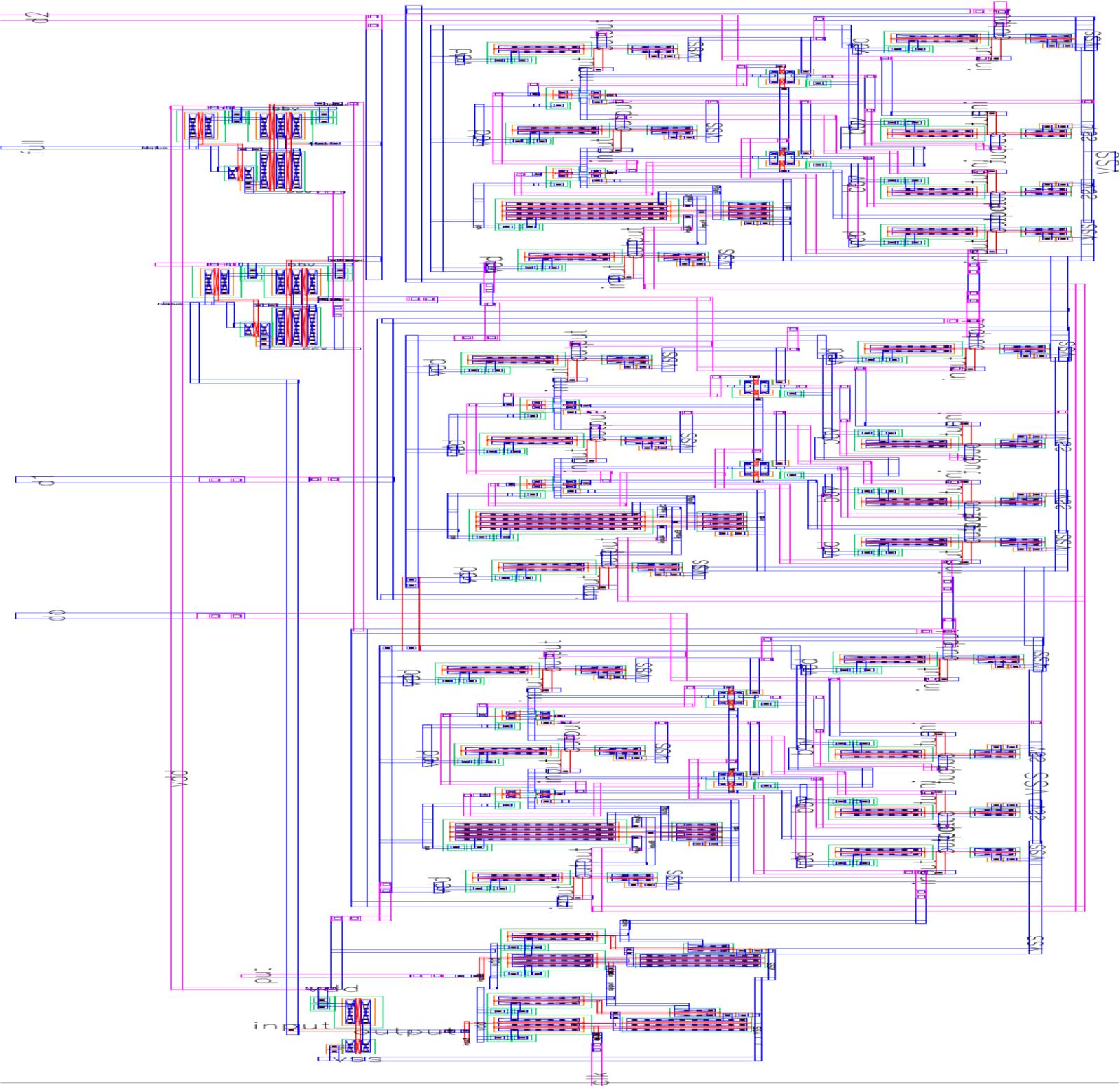
audit.out:

Counter

Schematic



Layout



DRC

The screenshot shows the Virtuoso 6.1.6-64b software interface with the title bar "Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log.3". The menu bar includes "File", "Tools", "Options", and "Help". The main window displays a summary of rule violations for the cell "counter_write layout". It shows "Total errors found: 0". Below this, there is a table with three columns: "L" (Left), "M" (Middle), and "R" (Right). The table contains one row with the values: "U:mouse L: showClickInfo()", "M: setDRCForm()", and "R: _JxHiMousePopUp()". A vertical scrollbar is visible on the right side of the main window.

L	M	R
U:mouse L: showClickInfo()	M: setDRCForm()	R: _JxHiMousePopUp()

LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.
```

```
Net swapping is enabled.
```

```
Using terminal names as correspondence points.
```

```
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist
```

count	
54	nets
0	terminals
55	pmos
55	nmos

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist
```

count	
54	nets
9	terminals
55	pmos
55	nmos

```
Devices in the rules but not in the netlist:
```

```
cap nfet pfet nmos4 pmos4
```

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	110	110
total	110	110

	nets	
un-matched	0	0
merged	0	0
pruned	0	0
active	54	54

total	54	54
	terminals	
un-matched	0	0
matched but		
different type	0	0
total	0	9

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

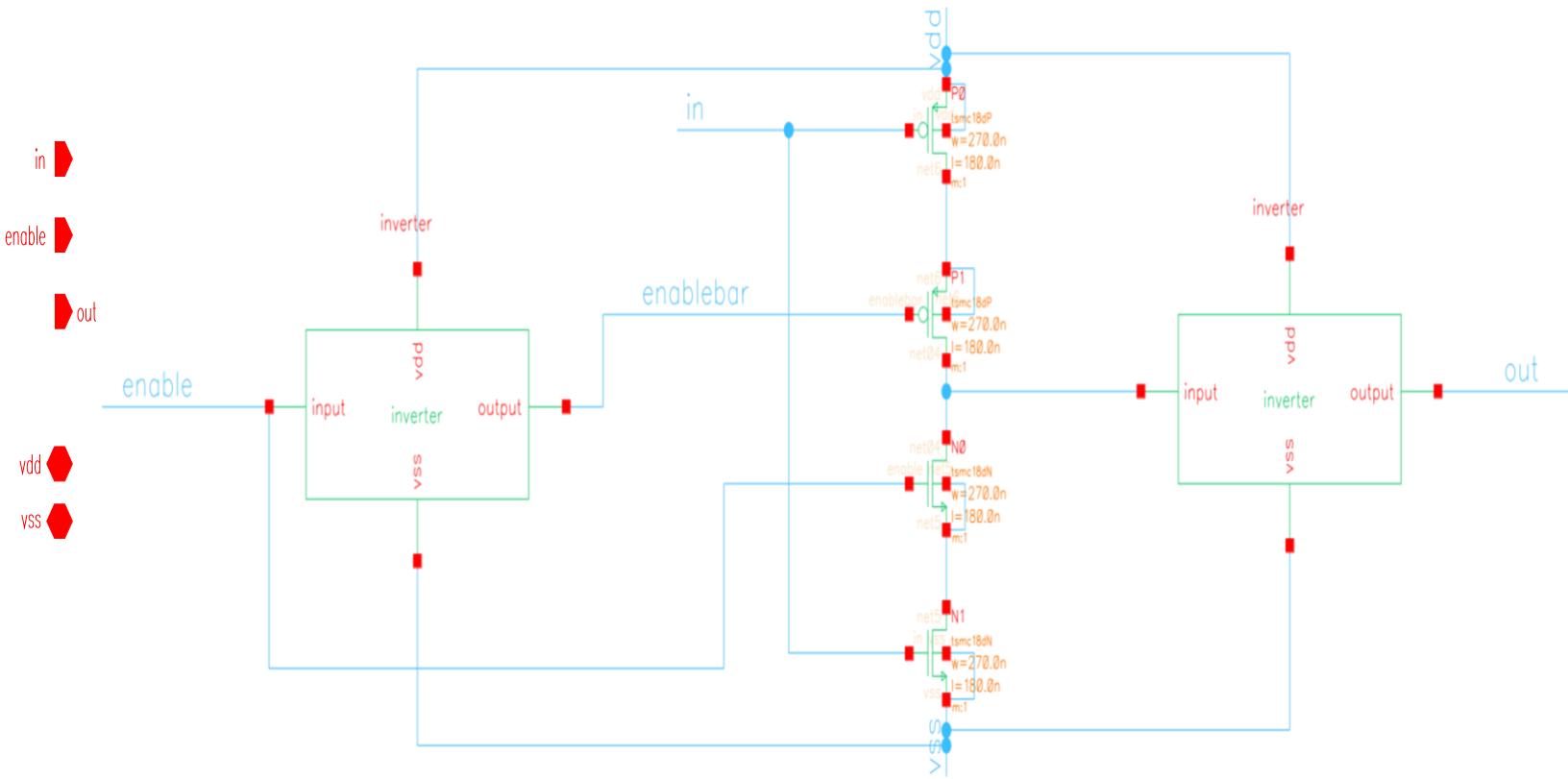
prunenet.out:

prunedev.out:

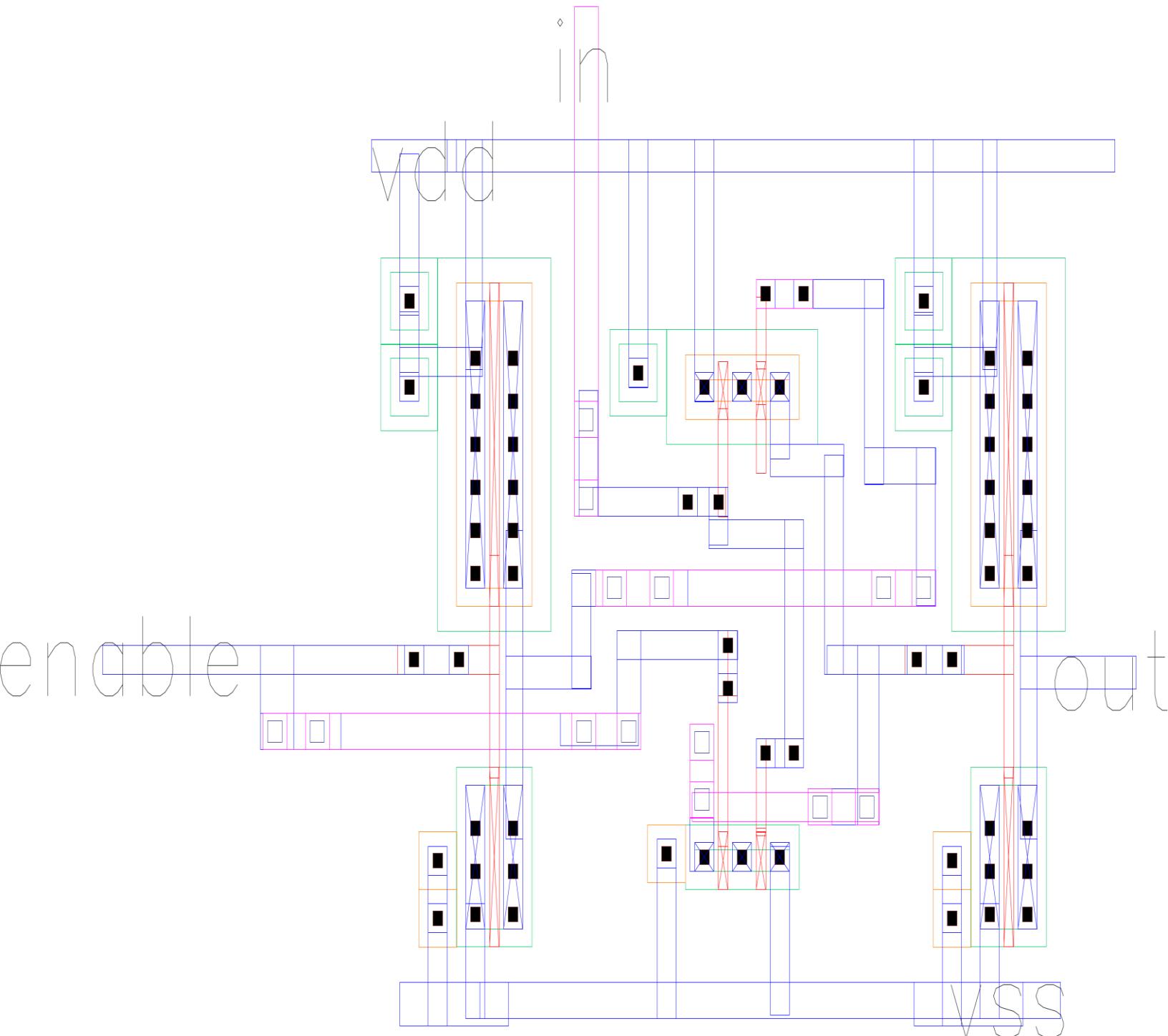
audit.out:

Tri-gate Buffer

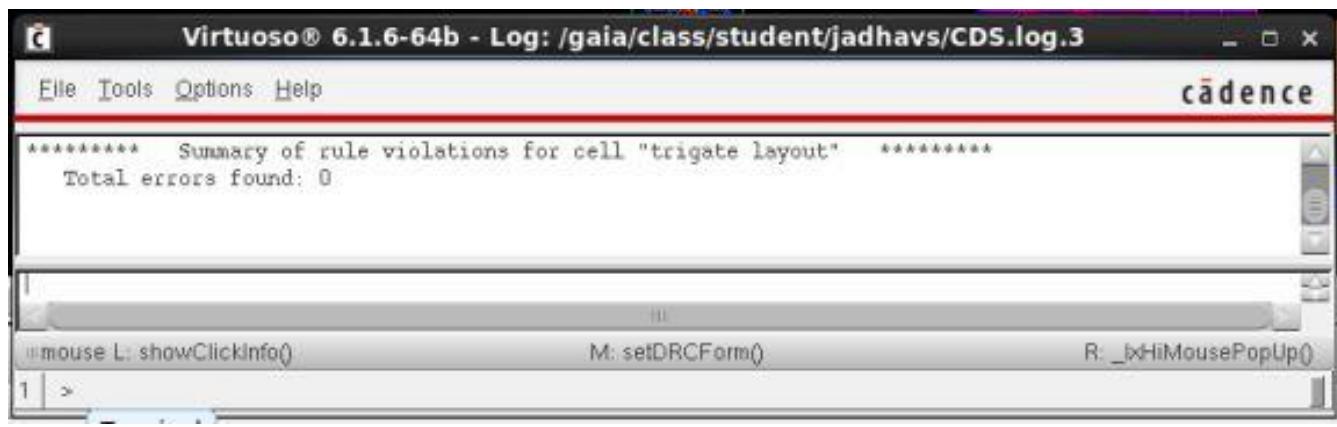
Schematic



Layout



DRC



The screenshot shows a window titled "Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log.3". The menu bar includes "File", "Tools", "Options", and "Help". The main area displays a summary of rule violations for a cell named "trigate layout". It states "Total errors found: 0". Below this, there is a scrollable list of log entries. The visible entries are:

L	M	R	
imouse	L: showClickInfo()	M: setDRCForm()	R: _JxHiMousePopUp()
1 >			

LVS

```
@(#) $CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
9 nets  
0 terminals  
4 pmos  
4 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
9 nets  
5 terminals  
4 pmos  
4 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	8	8
total	8	8

	nets	
un-matched	0	0

merged	0	0
pruned	0	0
active	9	9
total	9	9
		terminals
un-matched	0	0
matched but different type	0	0
total	0	5

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

FIFO

DESCRIPTION:

A FIFO is a storage structure which is used to receive incoming data, and it is guaranteed to be read out of the buffer in the order it was received. It is typically used between two communicating blocks to ensure that data transfers can happen regardless of whether the receiving block can use the data immediately.

For this project the FIFO is a 4-bits wide (all incoming and outgoing words will be 4-bits wide) and the FIFO has 6 entries.

1. The FIFO has an input port Put and Get.
2. The FIFO only has 6 entries, so that only 6 data words can be stored at any given time. Every time a data word is put in the FIFO it occupies a single entry. Every time a data word is retrieved it frees a single entry.
3. If all entries in the FIFO are occupied (6 data words have been put without any “get”) then the FIFO indicates “Full” and it cannot take any more data.
4. If no entries are occupied (all 6 entries are free), then the FIFO indicates “Empty” and no data is available for getting.
5. The FIFO is synchronous. All “puts” and “gets” are done on the rising edge of a clock.

The Figure 1 below shows the interfaces to the FIFO with the required pin names.

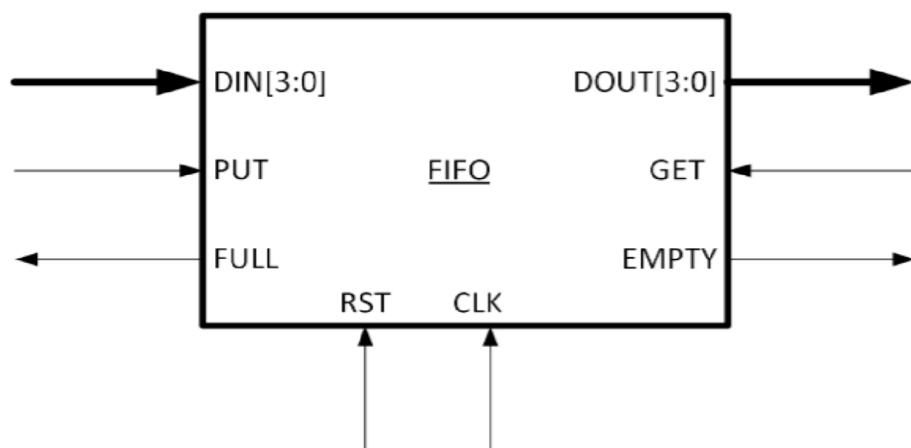
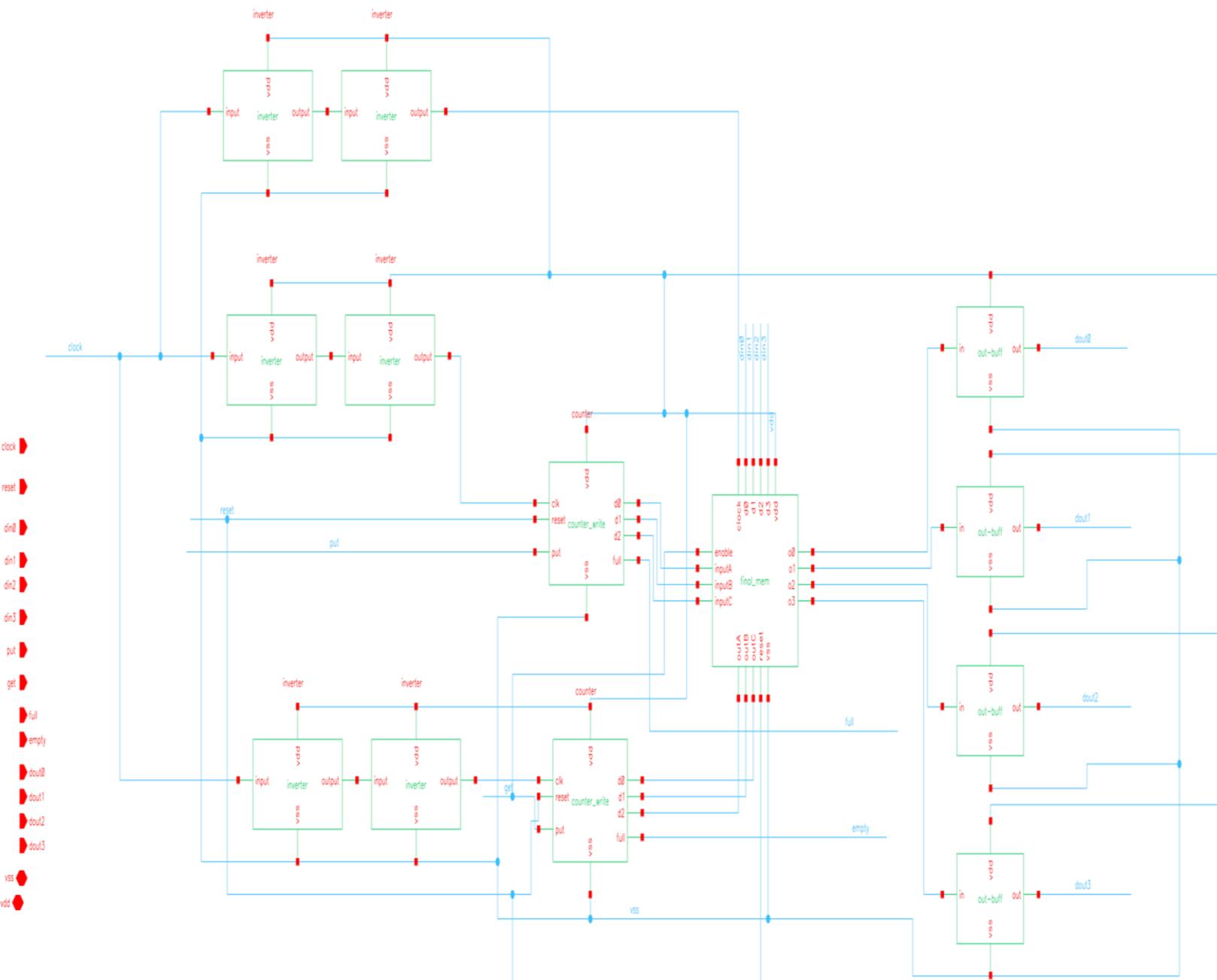


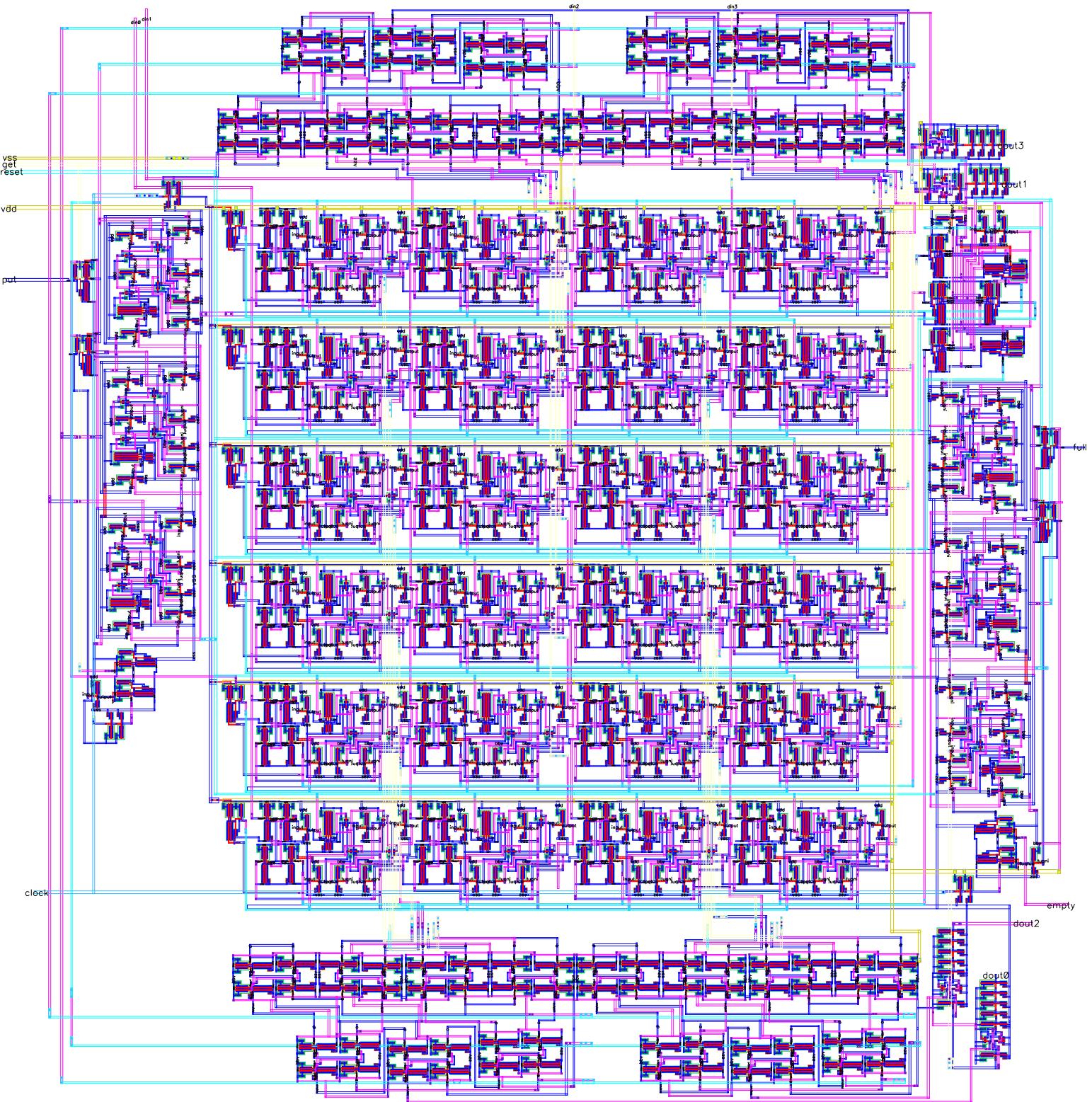
Figure 1

Pin description:

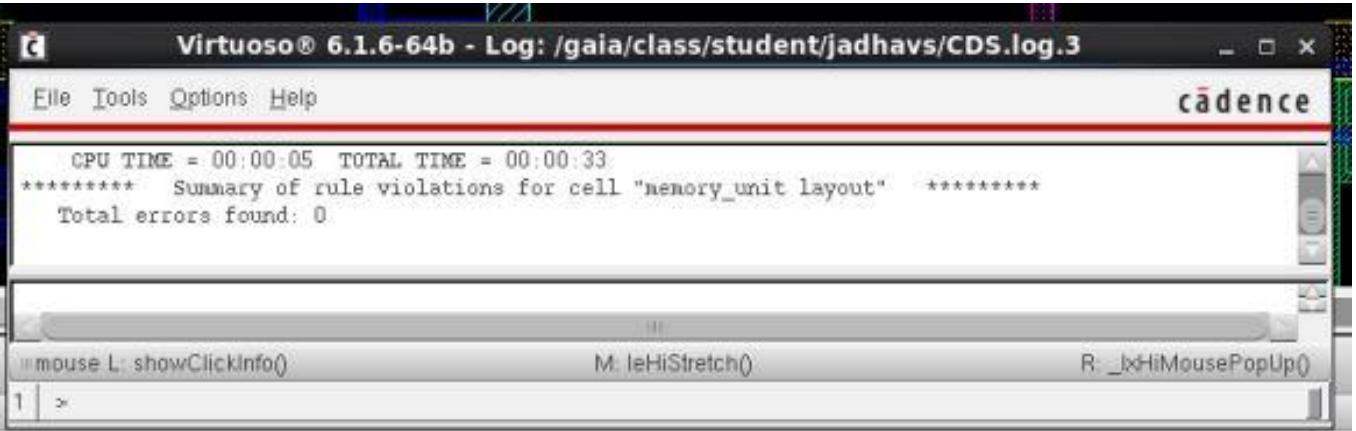
Signal	Description
CLK	Clock input
DIN[3:0]	4-bit Input Data Bus.
PUT	This signal is “put” signal from the sending block. If this signal is High on the rising edge of CLK, and the FULL signal is low, then the value on DIN[3:0] will be stored in the next available location in the FIFO.
FULL	If this signal is sampled high on the rising edge of CLK, then the FIFO is full and will ignore any put request.
DOUT[3:0]	4-bit Output Data Bus
GET	This is the “get” signal from the receiving block. If this signal is High on the rising edge of CLK and the Empty signal is low, then value DOUT[3:0] is the next available data from the FIFO.
EMPTY	If this signal is sampled high on the rising edge of CLK, then the FIFO is empty and there is no valid data on DOUT[3:0]
RST	This is the synchronous reset. If this signal is high on the rising edge of clock then the FIFO must be reset such that it is empty. The contents of the FIFO should be reset to all 0's.

Schematic





DRC



Virtuoso® 6.1.6-64b - Log: /gaia/class/student/jadhavs/CDS.log.3

File Tools Options Help

cadence

```
CPU TIME = 00:00:05 TOTAL TIME = 00:00:33
***** Summary of rule violations for cell "memory_unit layout" *****
Total errors found: 0
```

mouse L: showClickInfo() M: lxEHiStretch() R: _lxHiMousePopUp()

1 >

LVS

```
@(#)$CDS: LVS version 6.1.6-64b 09/01/2015 22:33 (sjfnl138) $
```

```
Command line: /software/IC616/tools.lnx86/dfII/bin/64bit/LVS -dir  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS -l -s -t  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout  
/gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic  
Like matching is enabled.  
Net swapping is enabled.  
Using terminal names as correspondence points.  
Compiling Diva LVS rules...
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/layout/netlist  
count  
874 nets  
0 terminals  
921 pmos  
921 nmos
```

```
Net-list summary for  
/gaia/class/student/jadhavs/Desktop/harsha/project-  
2/LVS/schematic/netlist  
count  
874 nets  
16 terminals  
921 pmos  
921 nmos
```

```
Devices in the rules but not in the netlist:  
cap nfet pfet nmos4 pmos4
```

The net-lists match.

	layout	schematic
	instances	
un-matched	0	0
rewired	0	0
size errors	0	0
pruned	0	0
active	1842	1842
total	1842	1842

	nets
un-matched	0
	0

merged	0	0
pruned	0	0
active	874	874
total	874	874
		terminals
un-matched	0	0
matched but		
different type	0	0
total	0	16

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Probe files from /gaia/class/student/jadhavs/Desktop/harsha/project-2/LVS/layout

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:

prunedev.out:

audit.out:

Conclusion

We successfully design and FIFO (First-In First-Out) Buffer that is 4-bits wide and 6 entries deep. Using universal gates, we built various small circuits, which were later integrated and applied to make the final stage, FIFO. The Rise and Fall time of each circuit was calculated and observed. The mid points for Logic gates were calculated upon which the circuit's logic was based.

<u>Task</u>	<u>SriHarsha Jadhav</u>	<u>Ankita Saxena</u>
2:1 mux		✓
Single memory unit	✓	
8:1 Mux	✓	✓
3:6 decoder	✓	
Counter		✓
Trigate		✓
FIFO	✓	