CSE 331 / Computer Organization

HW3 ALU Verilog Report

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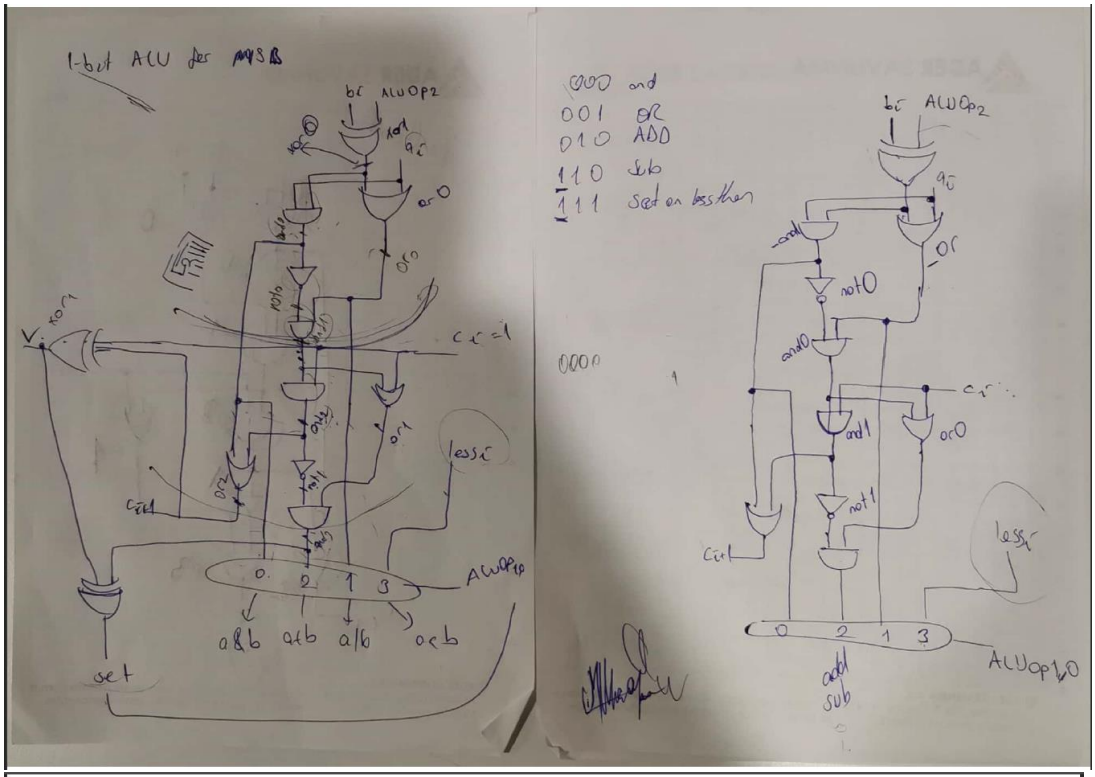
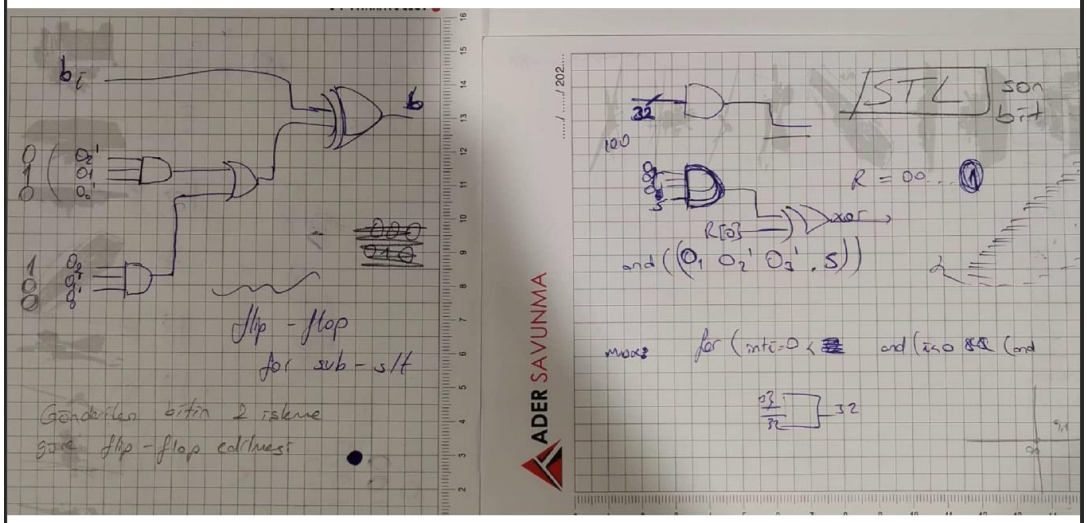
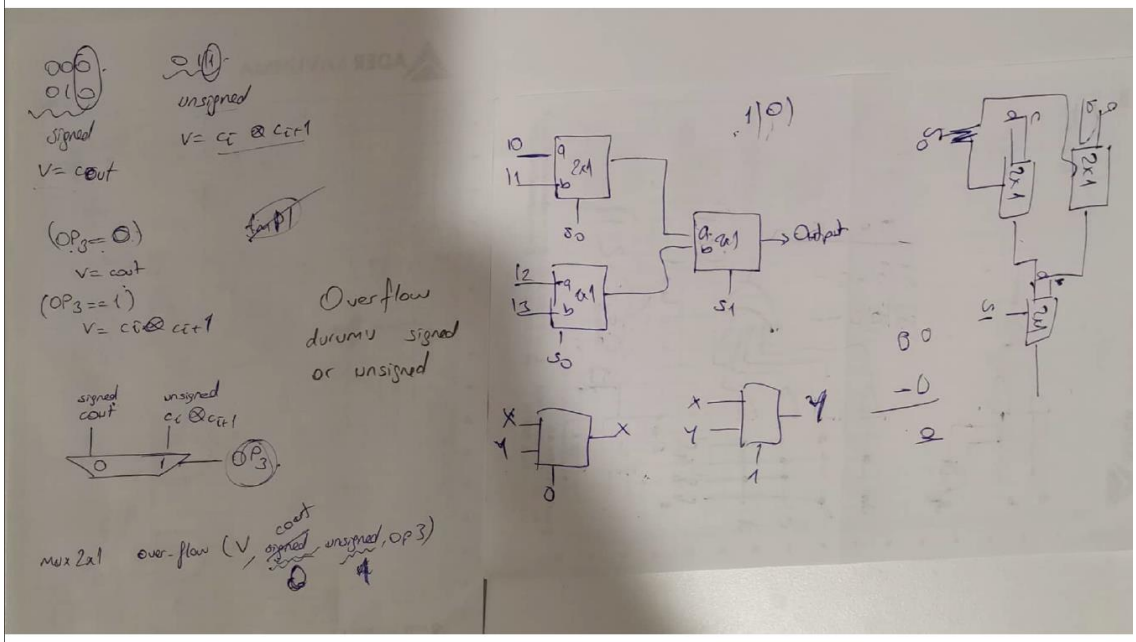
Work Notes:


1-bit ALU for MSB
bi
ALUOp2
not
ai
or0
xor
Vi
cin=1
and1
or1
cin
lessi
0 2 1 3
ALUOp1,0
a&b
a+b
a/b
a<b
set
000 and
001 OR
010 ADD
110 sub
111 set on less than
0001
and0
not0
or
cout
not1
sub


bi
b
flip - flop
for sub - slt
Genderilen bitin 2 tekrar
gore flip - flop edilmesi
ADER SAVUNMA
STL
son bit
R = 00...
R[0]
xor
and((O1 O2' O3' . S))
for (int i=0 < 32 and i>=0 (and
32
31
0



Studies on how the system works in general.

In the Alu and other system details making according to the slides in class.

Part 1 is missing.

Other parts in part 2 wroking as wanted.

S -> Set less than bit if a < b then it is 1 else 0

V -> Over flow bit if an over flow occurd in add or sub it is 1 other 1

Ex: 0101 + 1011 => R = 0000 V-> 1 so result = 10000

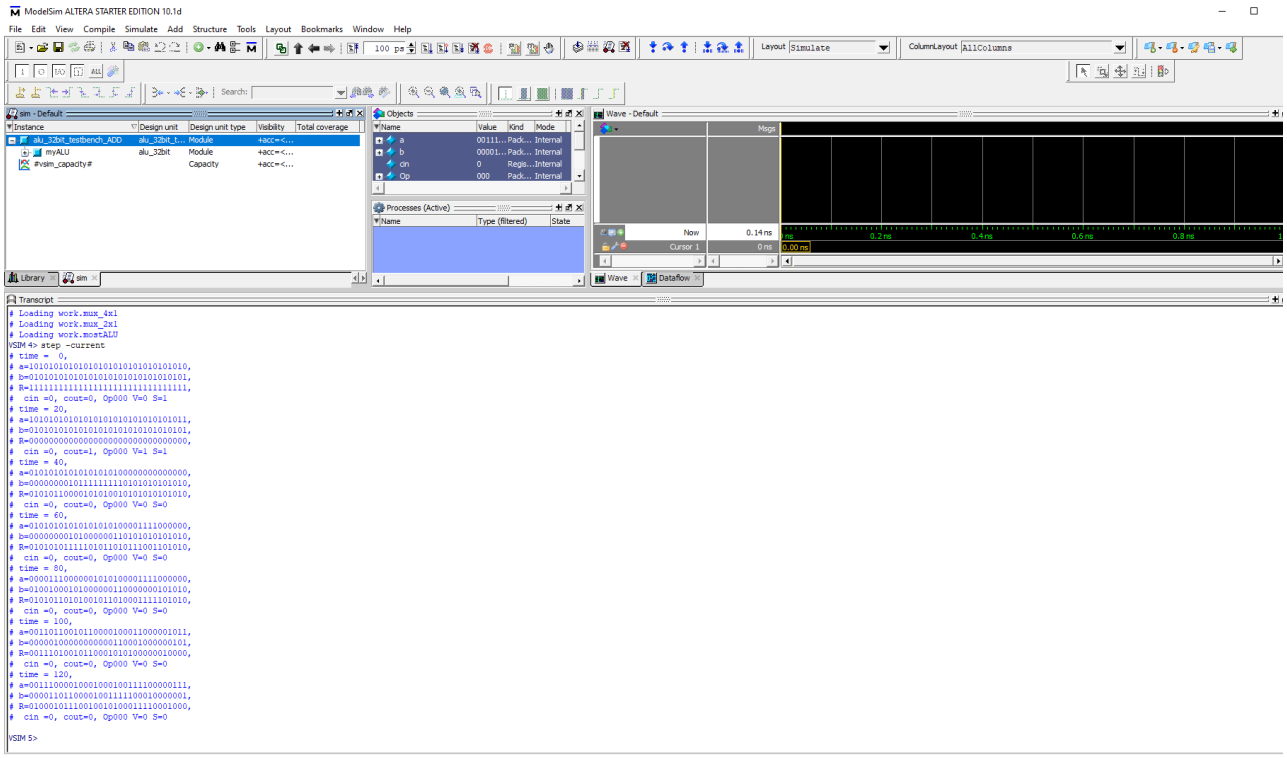
Cin is 1 sub operation

B value flip-flop in stl and sub operation for each bit.

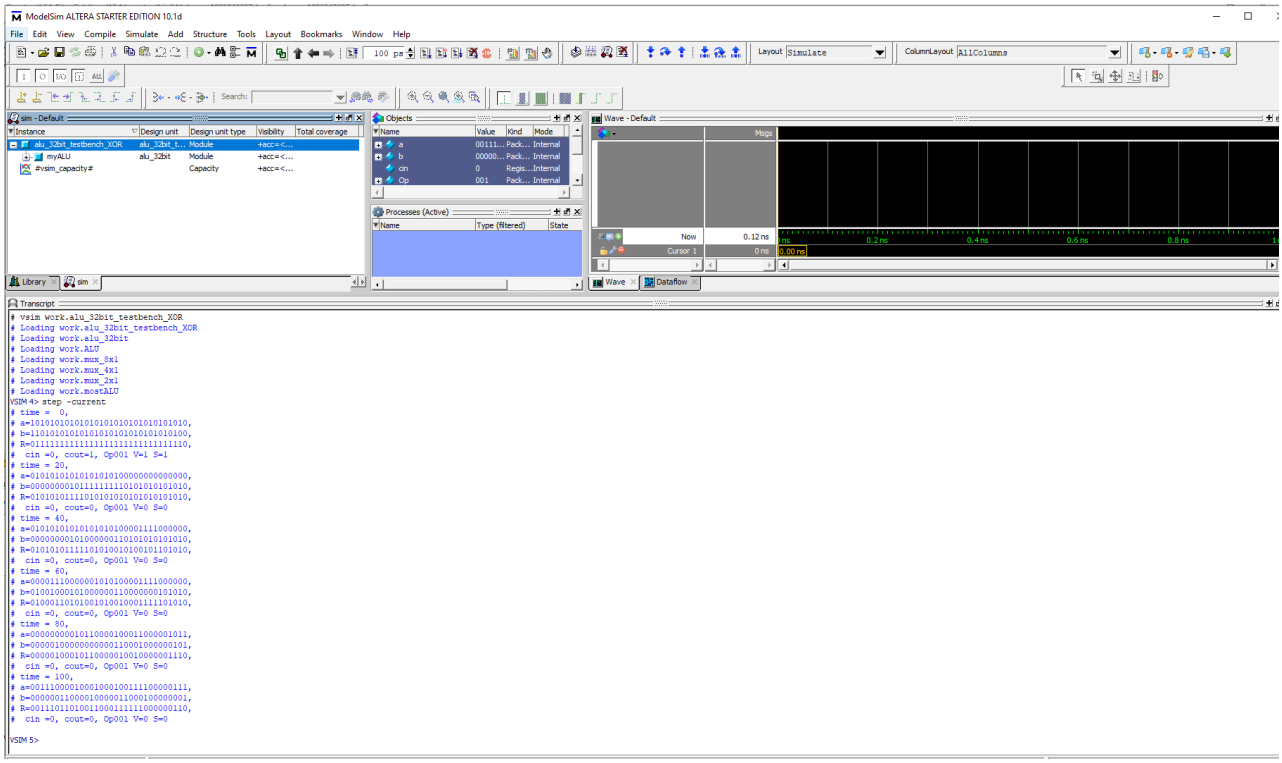
For stl operation after calculation R[0] bit rearrange the S's value after most significant bit operation

V is change using Op3, add and sub signed (V = cout), for mult (V = ci xor ci+1)

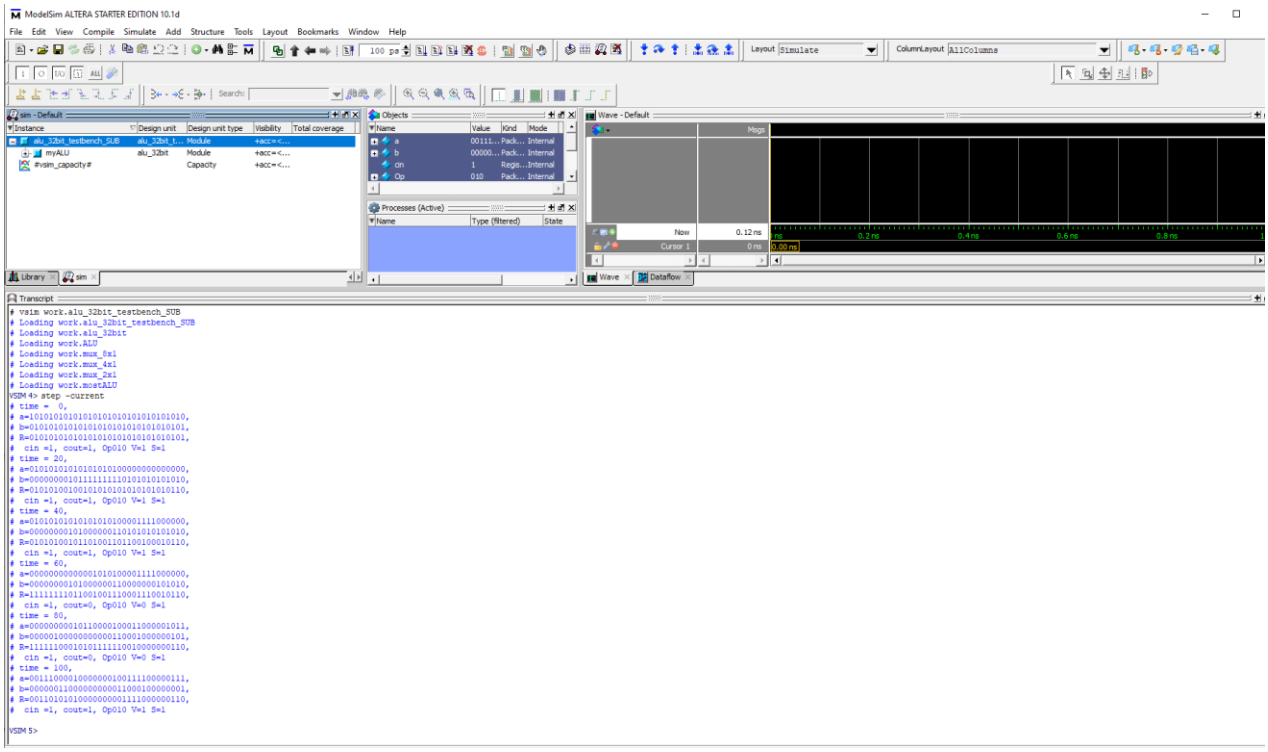
ADD:


ModelSim ALTERA STARTER EDITION 10.1d
File Edit View Compile Simulate Add Structure Tools Layout Bookmarks Window Help
Transcript
Loading work.mux_4x1
Loading work.mux_2x1
Loading work.mostALU
VSIM 4> step -current
time = 0,
a=10101010101010101010101010101010,
b=01010101010101010101010101010101,
R=11111111111111111111111111111111,
cin =0, cout=0, Op000 V=0 S=1
time = 20,
a=10101010101010101010101010101011,
b=01010101010101010101010101010101,
R=00000000000000000000000000000000,
cin =0, cout=1, Op000 V=1 S=1
time = 40,
a=01010101010101010100000000000000,
b=00000000101111111111010101010101,
R=01010110000010101001010101010101,
cin =0, cout=0, Op000 V=0 S=0
time = 60,
a=01010101010101010100001111000000,
b=00000000101000000110101010101010,
R=01010111111010101011100101010101,
cin =0, cout=0, Op000 V=0 S=0
time = 80,
a=00001110000001010100001111000000,
b=01001000101000000110000000101010,
R=01010111010010111010001111101010,
cin =0, cout=0, Op000 V=0 S=0
time = 100,
a=00110110010011000010001100000011,
b=00000100000000000110001000000101,
R=00111010010110001010100000010000,
cin =0, cout=0, Op000 V=0 S=0
time = 120,
a=00111000010001000100111100000111,
b=00001101110000100111110010000001,
R=01000101110010010000111100001000,
cin =0, cout=0, Op000 V=0 S=0
VSIM 5>

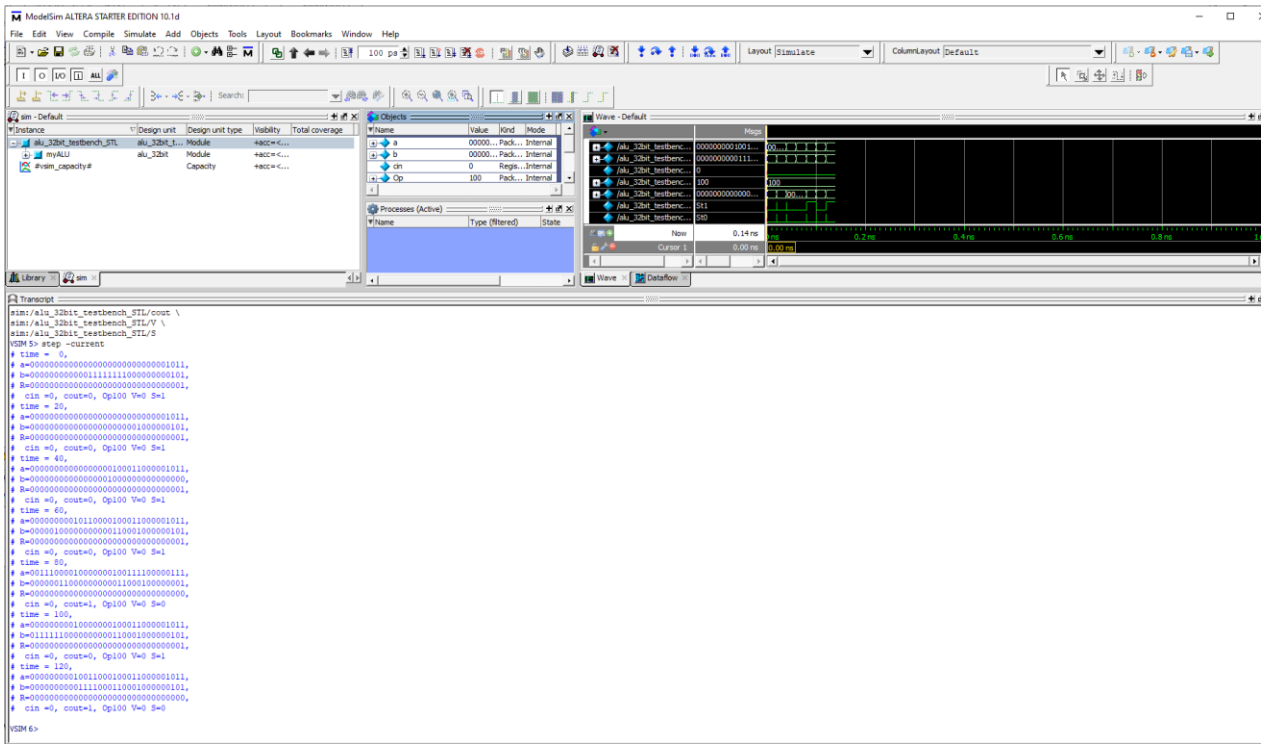
XOR:


ModelSim ALTERA STARTER EDITION 10.1d
File Edit View Compile Simulate Add Structure Tools Layout Bookmarks Window Help
Transcript
vsim work.alu_32bit_testbench_XOR
Loading work.alu_32bit_testbench_XOR
Loading work.alu_32bit
Loading work.ALU
Loading work.mux_8x1
Loading work.mux_4x1
Loading work.mux_2x1
Loading work.mostALU
VSIM 4> step -current
time = 0,
a=10101010101010101010101010101010,
b=11010101010101010101010101010100,
R=01111111111111111111111111111110,
cin =0, cout=1, Op001 V=1 S=1
time = 20,
a=01010101010101010100000000000000,
b=00000000101111111101010101010101,
R=01010101111101010101010101010101,
cin =0, cout=0, Op001 V=0 S=0
time = 40,
a=01010101010101010100001111000000,
b=00000000101000000110101010101010,
R=01010101111110101001001011010101,
cin =0, cout=0, Op001 V=0 S=0
time = 60,
a=00001110000001010100001111000000,
b=01001000101000000110000000101010,
R=01000111010010010000111111010101,
cin =0, cout=0, Op001 V=0 S=0
time = 80,
a=00000000010110000100011000001011,
b=00000100000000000110001000000101,
R=00001000101110000010000000001110,
cin =0, cout=0, Op001 V=0 S=0
time = 100,
a=00110000010001000100111100000111,
b=00000011000010000011100010000001,
R=00111011010011000011111000000110,
cin =0, cout=0, Op001 V=0 S=0
VSIM 5>

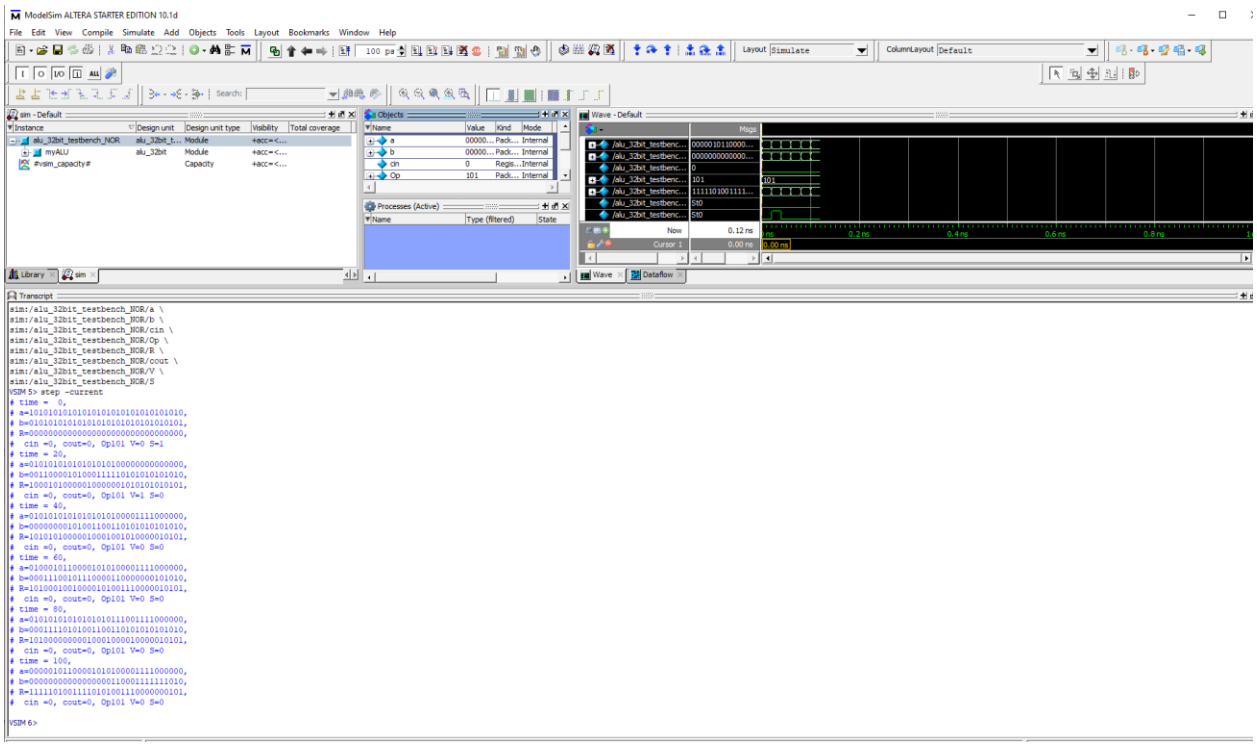
SUB:


ModelSim ALTERA STARTER EDITION 10.1d
File Edit View Compile Simulate Add Structure Tools Layout Bookmarks Window Help
Transcript
vsim work.alu_32bit_testbench_SUB
Loading work.alu_32bit_testbench_SUB
Loading work.alu_32bit
Loading work.ALU
Loading work.mux_8x1
Loading work.mux_4x1
Loading work.mux_2x1
Loading work.mux8ALU
VSIM 4> step -current
time = 0,
a=10101010101010101010101010101010,
b=01010101010101010101010101010101,
R=01010101010101010101010101010101,
cin =1, cout=1, Op010 V=1 S=1
time = 20,
a=01010101010101010000000000000000,
b=00000000101111111111010101010010,
R=01010100100101010101010101010110,
cin =1, cout=1, Op010 V=1 S=1
time = 40,
a=01010101010101010000111100000000,
b=00000000101000000111010101010010,
R=01010100101101001101100100010110,
cin =1, cout=1, Op010 V=1 S=1
time = 60,
a=00000000000001010100001111000000,
b=00000000101000000111000000010010,
R=11111110110010111000111010110,
cin =1, cout=0, Op010 V=0 S=1
time = 80,
a=00000000010110000100011000001011,
b=00000100000000000111000100000101,
R=11111100010101111110010000000110,
cin =1, cout=0, Op010 V=0 S=1
time = 100,
a=00111000010000000100111100000111,
b=00000011000000000111000100000001,
R=00110101010000000001111000000110,
cin =1, cout=1, Op010 V=1 S=1
VSIM 5>

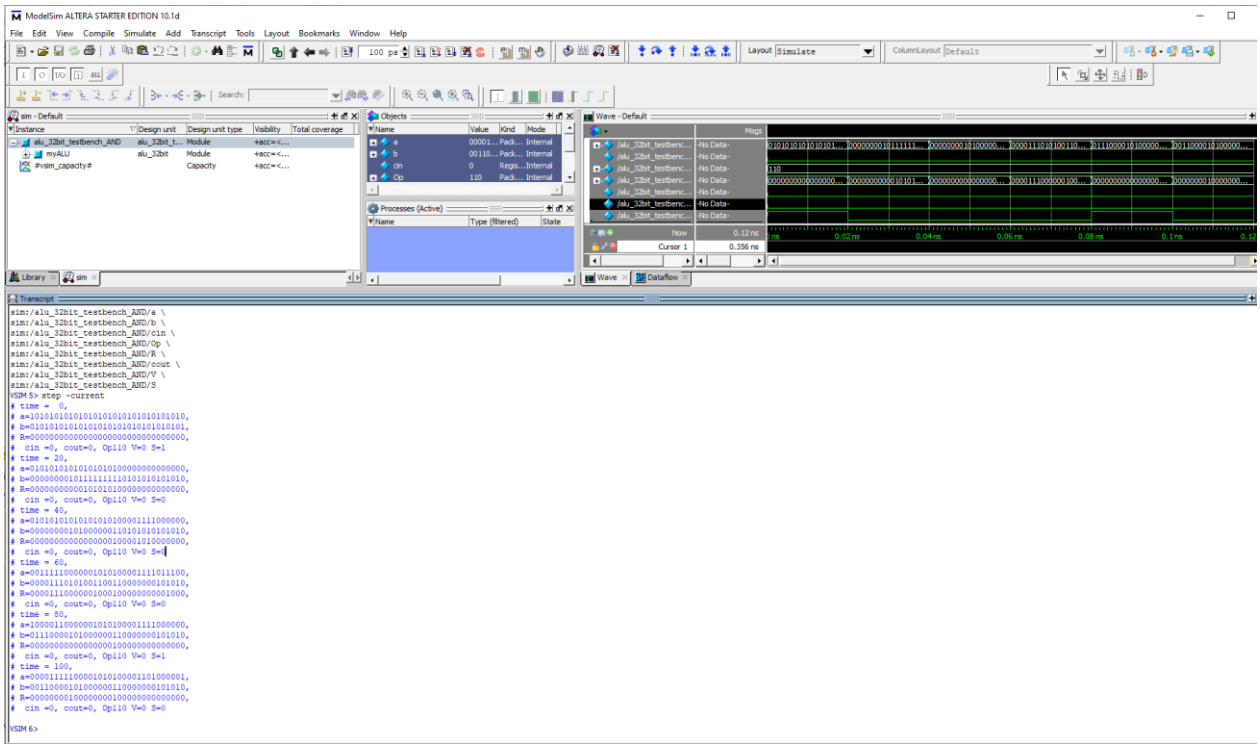
SLT:


ModelSim ALTERA STARTER EDITION 10.1d
File Edit View Compile Simulate Add Objects Tools Layout Bookmarks Window Help
Transcript
sim:/alu_32bit_testbench_STL/cout \
sim:/alu_32bit_testbench_STL/V \
sim:/alu_32bit_testbench_STL/S
VSIM 5> step -current
time = 0,
a=00000000000000000000000000001011,
b=00000000000011111111100000000101,
R=00000000000000000000000000000001,
cin =0, cout=0, Op100 V=0 S=1
time = 20,
a=00000000000000000000000000001011,
b=00000000000000000100000000000101,
R=00000000000000000000000000000001,
cin =0, cout=0, Op100 V=0 S=1
time = 40,
a=00000000000000000100011000001011,
b=00000000000000000100000000000000,
R=00000000000000000000000000000001,
cin =0, cout=0, Op100 V=0 S=1
time = 60,
a=00000000010110000100011000001011,
b=00000100000000000111000100000101,
R=00000000000000000000000000000001,
cin =0, cout=0, Op100 V=0 S=1
time = 80,
a=00111000010000000100111100000111,
b=00000011000000000111000100000001,
R=00000000000000000000000000000000,
cin =0, cout=1, Op100 V=0 S=0
time = 100,
a=00000000100000001000110000001011,
b=01111111000000000111000100000101,
R=00000000000000000000000000000001,
cin =0, cout=0, Op100 V=0 S=1
time = 120,
a=00000000010011000100011000001011,
b=00000000001111000111000100000101,
R=00000000000000000000000000000000,
cin =0, cout=1, Op100 V=0 S=0
VSIM 6>

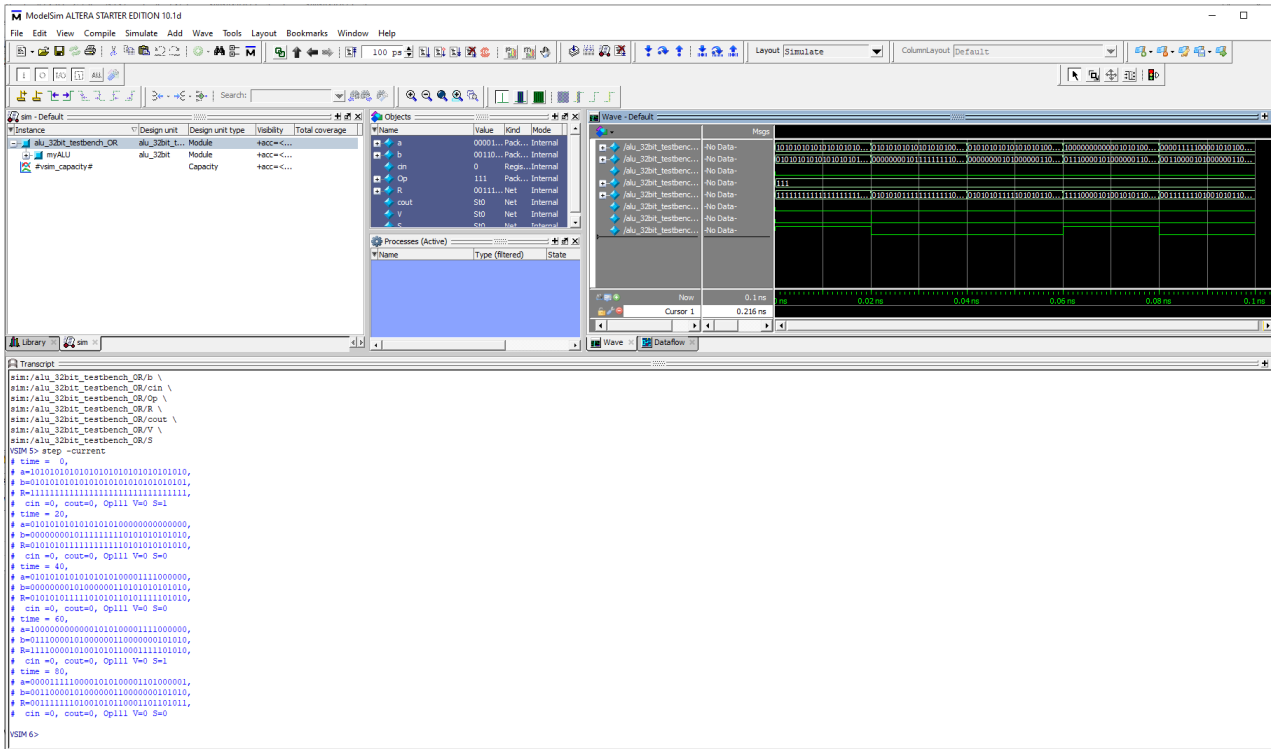
NOR:


ModelSim ALTERA STARTER EDITION 10.1d
sim:/alu_32bit_testbench_NOR/a \
sim:/alu_32bit_testbench_NOR/b \
sim:/alu_32bit_testbench_NOR/cin \
sim:/alu_32bit_testbench_NOR/Op \
sim:/alu_32bit_testbench_NOR/R \
sim:/alu_32bit_testbench_NOR/cout \
sim:/alu_32bit_testbench_NOR/V \
sim:/alu_32bit_testbench_NOR/S
VSIM 5> step -current
time = 0,
a=10101010101010101010101010101010,
b=01010101010101010101010101010101,
R=00000000000000000000000000000000,
cin =0, cout=0, Op101 V=0 S=1
time = 20,
a=01010101010101010000000000000000,
b=00110000101000011110101010101010,
R=10001010000010000001010101010101,
cin =0, cout=0, Op101 V=1 S=0
time = 40,
a=01010101010101010000111100000000,
b=00000000101000110011010101010101,
R=10101010000010001001010000010101,
cin =0, cout=0, Op101 V=0 S=0
time = 60,
a=01000101110000101010000111100000,
b=00011100101111000011000000101010,
R=10100001001000010100111000000101,
cin =0, cout=0, Op101 V=0 S=0
time = 80,
a=01010101010101010111001111000000,
b=00011110101001100110101010101010,
R=10100000000010000010000000010101,
cin =0, cout=0, Op101 V=0 S=0
time = 100,
a=00000101110000101010000111100000,
b=00000000000000000011000111111010,
R=11111010011110101001110000000101,
cin =0, cout=0, Op101 V=0 S=0
VSIM 6>

AND:


ModelSim ALTERA STARTER EDITION 10.1d
sim:/alu_32bit_testbench_AND/a \
sim:/alu_32bit_testbench_AND/b \
sim:/alu_32bit_testbench_AND/cin \
sim:/alu_32bit_testbench_AND/Op \
sim:/alu_32bit_testbench_AND/R \
sim:/alu_32bit_testbench_AND/cout \
sim:/alu_32bit_testbench_AND/V \
sim:/alu_32bit_testbench_AND/S
VSIM 5> step -current
time = 0,
a=10101010101010101010101010101010,
b=01010101010101010101010101010101,
R=00000000000000000000000000000000,
cin =0, cout=0, Op110 V=0 S=1
time = 20,
a=01010101010101010000000000000000,
b=00000000101111111111010101010101,
R=00000000001010100000000000000000,
cin =0, cout=0, Op110 V=0 S=0
time = 40,
a=01010101010101010000111100000000,
b=00000000101000000110101010101010,
R=00000000000000000010000101000000,
cin =0, cout=0, Op110 V=0 S=0
time = 60,
a=00111110000001010100001111011100,
b=00001110101001100110000000101010,
R=00001110000001000100000000001000,
cin =0, cout=0, Op110 V=0 S=0
time = 80,
a=10000110000001010100001111000000,
b=11110000101000001100000000101010,
R=00000000000000000100000000000000,
cin =0, cout=0, Op110 V=0 S=1
time = 100,
a=00001111100001010100001101000001,
b=00110000101000000110000000101010,
R=00000000100000000100000000000000,
cin =0, cout=0, Op110 V=0 S=0
VSIM 6>

OR:


ModelSim ALTERA STARTER EDITION 10.1d
File Edit View Compile Simulate Add Wave Tools Layout Bookmarks Window Help
sim - Default
Objects
Wave - Default
Processes (Active)
Transcript
sim:/alu_32bit_testbench_OR/b \
sim:/alu_32bit_testbench_OR/cin \
sim:/alu_32bit_testbench_OR/Op \
sim:/alu_32bit_testbench_OR/R \
sim:/alu_32bit_testbench_OR/cout \
sim:/alu_32bit_testbench_OR/V \
sim:/alu_32bit_testbench_OR/S
VSIM 5> step -current
time = 0,
a=10101010101010101010101010101010,
b=01010101010101010101010101010101,
R=11111111111111111111111111111111,
cin =0, cout=0, Op111 V=0 S=1
time = 20,
a=01010101010101010100000000000000,
b=00000000101111111111010101010101,
R=01010101111111111111010101010101,
cin =0, cout=0, Op111 V=0 S=0
time = 40,
a=01010101010101010100001111000000,
b=00000000101000000111010101010101,
R=01010101111111010101111101010101,
cin =0, cout=0, Op111 V=0 S=0
time = 60,
a=10000000000001010100001111000000,
b=01110000101000000111000000101010,
R=11110000101001010111000111101010,
cin =0, cout=0, Op111 V=0 S=1
time = 80,
a=00001111100001010100001101000001,
b=00110000101000000111000000101010,
R=00111111110100101011100011010011,
cin =0, cout=0, Op111 V=0 S=0
VSIM 6>