

ECSE 222 VHDL Assignment 1

1. Explain your VHDL code.

- For 2-to-1 MUX_structural: Firstly define the input ports A, B and S and the output port Y in the entity section. Then in the architecture section, use Boolean Function (AND, OR, NOT) to describe the equivalent circuit of 2-to-1 multiplexer.

For the testbench: Firstly the entity of testbench is empty. Then for the architecture part, insert MUX_structural as a component, and then define 4 std_logic signals (a_in, b_in, s_in, y_out) in order to demonstrate the inputs and outputs. Finally, connect the design to the test (DUT) and write out all the possibilities of input signals a, b and s

- For 2-to-1 MUX_behavioral: Firstly define the input ports A, B and S and the output port Y in the entity section. Then in the architecture section, use one single select statement. Output Y equals input A when s select 0, output Y equals input B when s select 1.

For the testbench: same as above testbench except change the component name to MUX_behavioral.

- For 4 bits barrel shifter_structural: Firstly define the three ports in the entity section: 4 bits input std_logic_vector x, 2 bits input std_logic_vector sel and 4 bits output std_logic_vector y. Then in the architecture section, define a 4 bits signal (sig), which is used to represent intermediate signals between the layer of MUX sel(0) and sel(1). Then repeat the Boolean Function from the MUX_structural file for 8 times.

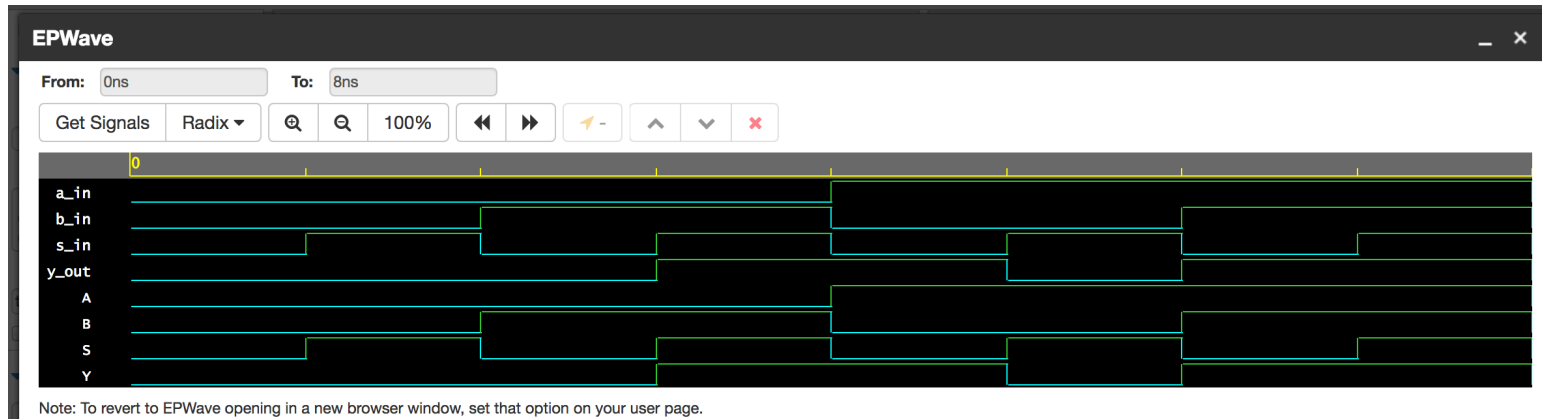
For the test bench: In the architecture section: Firstly insert barrel_shifter_structural as a component, then define 3 std_logic_vector signals to demonstrate the input signals and output signals, then connect the design to the test(DUT) and finally write out all the possibilities of input signals x and sel.

- For the 4 bits barrel shifter_behavioral: Firstly define the three ports in the entity section: 4 bits input std_logic_vector x, 2 bits input std_logic_vector sel and 4 bits output std_logic_vector y. Then in the architecture section, use a select statement, there are 5 cases:
 1. When sel <="00", the barrel shifter doesn't shift, so output y equal to input x
 2. When sel <="01", the barrel shifter shifts x(2) to the position y(3), x(1) to y(2), x(0) to y(1), x(3) to y(0)
 3. When sel <="10", the barrel shifter shifts x(1) to the position y(3), x(0) to y(2), x(3) to y(1), x(2) to y(0)
 4. When sel <="11", the barrel shifter shifts x(0) to the position y(3), x(3) to y(2), x(2) to y(1), x(1) to y(0)
 5. Y <= "0000" when others;

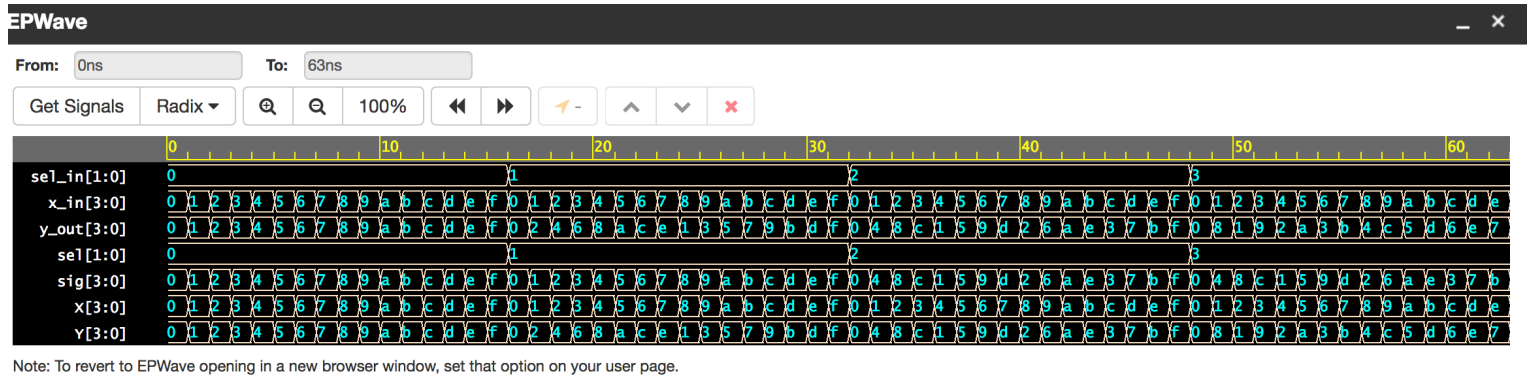
2.

	2-to-1 MUX		4-bit circular barrel shifter	
	Structural	Behavioral	Structural	Behavioral
Logic Utilization (in LUTs)	Used:1 Avail:63400	Used: 1 Avail: 63400	Used:4 Avail: 63400	Used:4 Avail: 63400
Total pins	Used: 4 Avail: 210	Used:4 Avail: 210	Used:10 Avail: 210	Used:10 Avail: 210

3.



4.



For example:

at 20ns, sel <= "01", x_in <= "0100", y_out <= "1000"