

# NPTEL Workshop: Experiment 2

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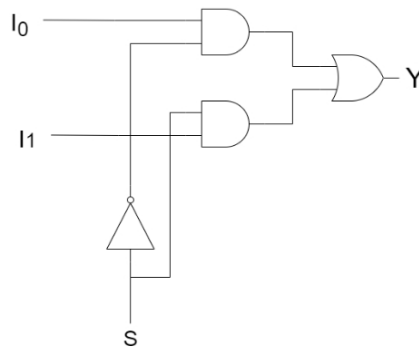
## Instructions:

1. Use structural modelling for this experiment; means instantiate components and use port map to connect those components.
2. Perform RTL and Gate-level simulation using the provided testbench and tracefile.
3. Demonstrate the simulations to your TA.

## Problem Statement:

### 1. Part-A: 2x1 Mux

- (a) VHDL description: Write the VHDL description of a 2x1 multiplexer as shown in figure below.  
INFO: Multiplexer is a combinational circuit that has maximum of  $2^n$  data inputs, 'n' selection lines and single output lines.



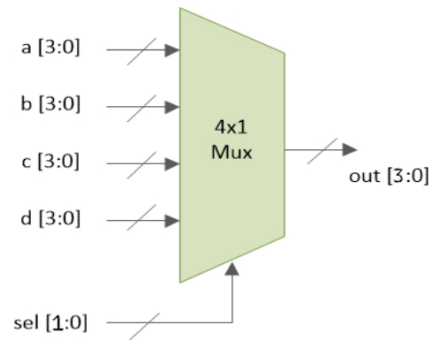
- (b) Write Truth table and boolean expression for output Y.
- (c) Simulation: Simulate the 2x1 multiplexer using the generic testbench to confirm the correctness of your description.  
NOTE: To do this, use the tracefile given below and modify the testbench given to you appropriately.  
Tracefile format: (< In1 >< In0 >< S > < Y > 1) Tracefile

### 2. Part-B: 4x1 Mux

- (a) Design: Design 4x1 Mux using only 2x1 Mux  
INFO:  $2^2 = 4$  data inputs, 2 select lines, 1 output line
- (b) VHDL description: Write the VHDL description of a 4x1 multiplexer designed using 2x1 Mux.
- (c) Simulation: Simulate the 4x1 multiplexer using the generic testbench to confirm the correctness of your description.  
NOTE: To do this, use the given tracefile and modify the testbench given to you appropriately.  
Tracefile format: (< In4 >< In3 >< In2 >< In1 >< S2 >< S1 > < Y > 1) Tracefile

### 3. Part-C: 4-bit 4x1 Mux

- (a) Design: Design 4-bit wide 4x1 Mux using only 4x1 Mux designed in part B.



- (b) VHDL description: Write the VHDL description of a 4-bit wide 4x1 multiplexer designed using 4x1 Mux.
- (c) Simulation: Simulate the 4-bit 4x1 multiplexer using the generic testbench to confirm the correctness of your description.

NOTE: To do this, use the tracefile given below and modify the testbench given to you appropriately.

Tracefile format:

(d3 d2 d1 d0 >< c3 c2 c1 c0 >< b3 b2 b1 b0 >< a3 a2 a1 a0 >< sel1 sel0 > < Y3 Y2 Y1 Y0 > 1111)

Tracefile