P37) Implement a variable-width barrel shifter in Verilog. Design a module that accepts a 6-bit input (A), a 3-bit shift amount (Shift), and a control signal (Direction). If Direction is 0, the shifter should perform a left shift; if it's 1, it should perform a right shift. Generate a 6-bit output (Result) accordingly.

Logic Used

A simple for loop was used. In every iteration of the loop, the MSB/LSB was checked depending upon whether it was a left/right shift. If it was a 1, the shifted result was ORed with 000001/100000 accordingly. If it was 0, the shifted result was left as it is. At the end of the for loop, appropriately barrel shifted result is available to us.

Source Code

```
‘timescale 1ns / 1ps

module barrelshifter(input wire [5:0] A,         // 6-bit input
  input wire [2:0] Shift,     // 3-bit shift amount
  input wire Direction,       // Control signal for direction (0 for left, 1 for right)
  output wire [5:0] Result    // 6-bit output
);
  reg [5:0] shifted_result;
  integer i;
  always @(*) begin
    shifted_result=A;
    if (Direction == 0) begin
      for (i=0;i<Shift;i=i+1) begin
        if (shifted_result[5]==0) begin
          shifted_result = (shifted_result << 1);
        end
        else begin
          shifted_result = (shifted_result << 1) | (6'b000001);
        end
      end
    end
    else begin
      for (i=0;i<Shift;i=i+1) begin
        if (shifted_result[0]==0) begin
          shifted_result = (shifted_result >> 1);
        end
        else begin
          shifted_result = (shifted_result >> 1) | (6'b100000);
        end
      end
    end
  end
```

```
  assign Result = shifted_result;
endmodule
```

Testbench

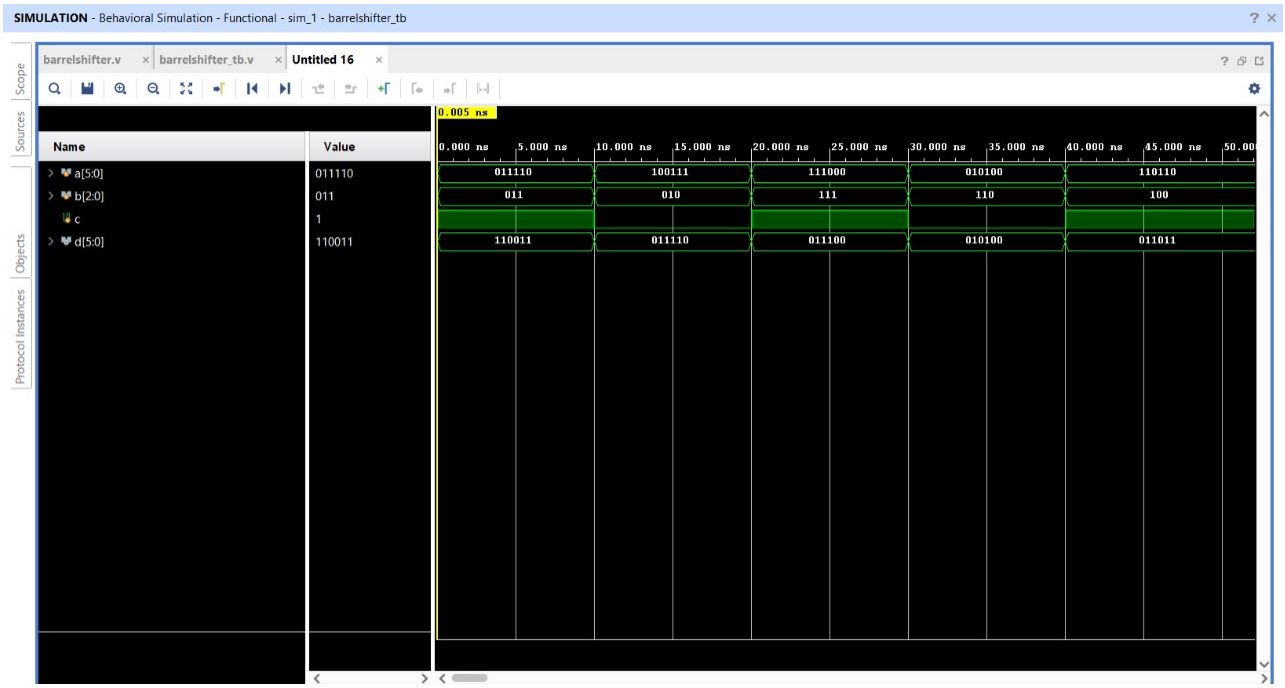
```
‘timescale 1ns / 1ps
module barrelshifter_tb(

    );
reg [5:0] a;
reg [2:0] b;
reg c;
wire [5:0] d;

barrelshifter dut (a,b,c,d);

initial begin
a=6’b011110; b=3’b011; c=1;
#10;
a=6’b100111; b=3’b010; c=0;
#10;
a=6’b111000; b=3’b111; c=1;
#10;
a=6’b010100; b=3’b110; c=0;
#10;
a=6’b110110; b=3’b100; c=1;
end
endmodule
```

Results


SIMULATION - Behavioral Simulation - Functional - sim_1 - barrelshifter_tb
barrelshifter.v
barrelshifter_tb.v
Untitled 16
Scope
Sources
Objects
Protocol Instances
Name
Value
a[5:0]
011110
b[2:0]
011
c
1
d[5:0]
110011
0.005 ns
0.000 ns
5.000 ns
10.000 ns
15.000 ns
20.000 ns
25.000 ns
30.000 ns
35.000 ns
40.000 ns
45.000 ns
011110
100111
111000
010100
110110
011
010
111
110
100
110011
011110
011100
010100
011011