CA Lab: Lab 5

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Task Description

1. In the module file use always statement with case. (20 points)
2. Write the testbench. (20 points)
3. Use RTL viewer and show the drawing of 2-t0-4 decoder. (5 points)
4. Simulate the testbench and make the analyze of timing diagram. (10 points)
5. Run the code on the board. (40 points)

Solution

1. The code:

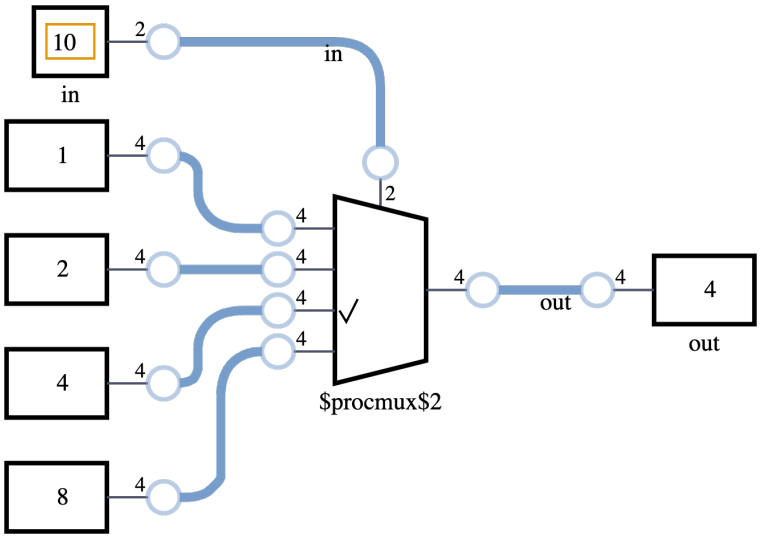
```
module decoder (
    input [1:0] in,
    output reg [3:0] out);

always @ (in)
begin
    case (in)
        2'b00 : out = 4'b0001;
        2'b01 : out = 4'b0010;
        2'b10 : out = 4'b0100;
        2'b11 : out = 4'b1000;
    endcase
end

endmodule
```

   As you see, I have ommited the `default` case, which is optional. In this case, the cases are exhaustive, so there's no point to having a default case — it will never be entered.

2. The code:

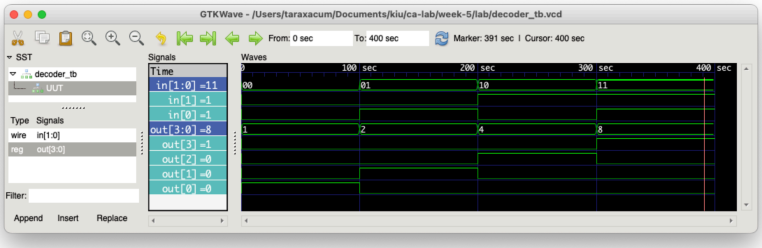
```
`include "decoder.v"

module decoder_tb();

reg [1:0] in;
wire [3:0] out;

decoder UUT(.in(in), .out(out));

initial begin
                                    // These two lines are
    $dumpfile("decoder_tb.vcd");    // used for logging
    $dumpvars(0, decoder_tb);       // the data, quartus
                                    // doesn't need them.
    in = 2'b00;
    #100;
    in = 2'b01;
    #100;
    in = 2'b10;
    #100;
    in = 2'b11;
    #100;
end

endmodule
```

3. I don't have quartus, but this is something that should be equivalent to what the RTL viewer would produce. I've give the schematic a test input of 01



This visualization was made using `DigitalJS` plugin for VSCodium.

4. I used `vvp` for simulation and `GTKWave` for visualization. Here's the result:



It's clear that the program is doing just what we wanted it to do. Given input `11` (which is 3 in decimal), the 3-rd bit (counting from 0) is set, while others are not.

Conclusion

Since I don't have the ability to run Quartus on my laptop and am using FOSS alternatives for doing everything I would have done with quartus, other than being able to run my code on physical hardware, I will be using a friend's laptop (or any laptop I can get a hold of which has quartus installed) to run my code on a board.

Reference

- Where I learned about the always block
- Where I learned about the case statement