Joaquin Salas
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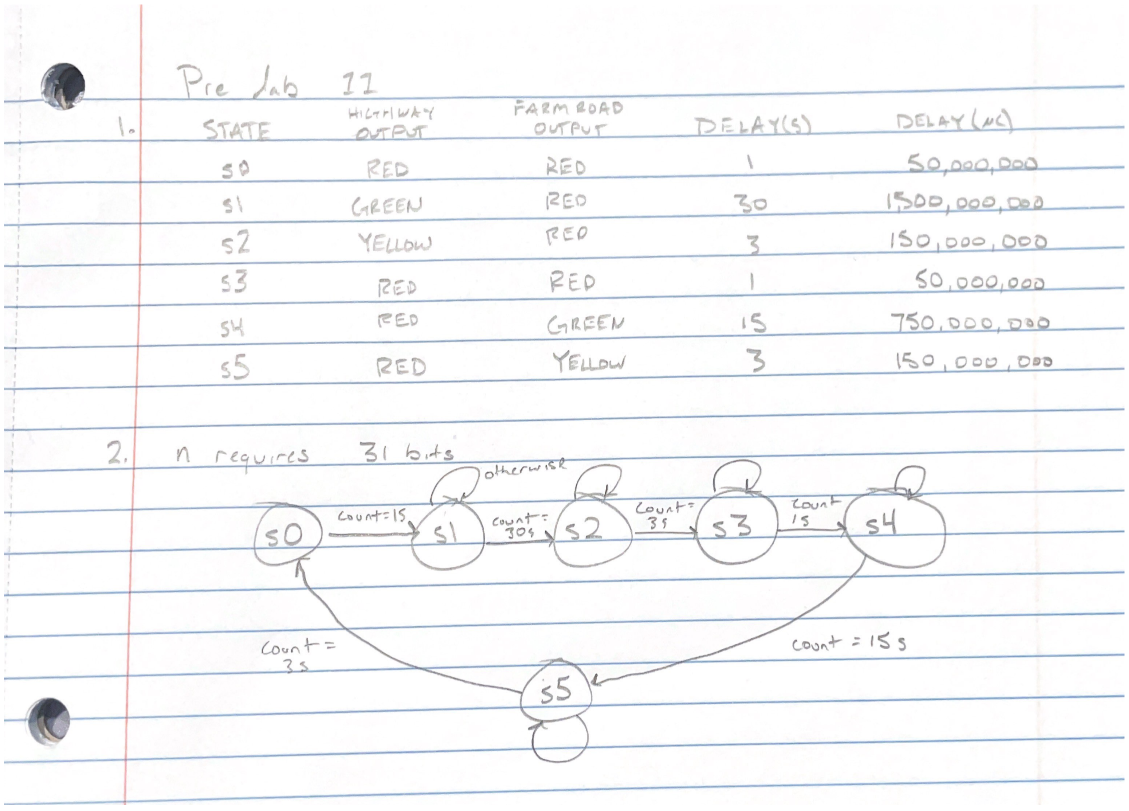
Pre-Lab #11



Pre lab 11

1.

STATE	HIGHWAY OUTPUT	FARM ROAD OUTPUT	DELAY(S)	DELAY (NC)
s0	RED	RED	1	50,000,000
s1	GREEN	RED	30	1,500,000,000
s2	YELLOW	RED	3	150,000,000
s3	RED	RED	1	50,000,000
s4	RED	GREEN	15	750,000,000
s5	RED	YELLOW	3	150,000,000

2. n requires 31 bits

$$\begin{tikzcd}
s0 \arrow[r, "Count=1s"] & s1 \arrow[loop above, "otherwise"] \arrow[r, "Count=30s"] & s2 \arrow[loop above] \arrow[r, "Count=3s"] & s3 \arrow[loop above] \arrow[r, "Count\ 1s"] & s4 \arrow[loop above] \arrow[dll, bend left, "Count=15s"] \\
 & & s5 \arrow[loop below] \arrow[ull, bend left, "Count=3s"] & &
\end{tikzcd}$$

```
`define one_sec 50000000
`define three_sec 150000000
`define thirty_sec 1500000000
`define fifteen_sec 750000000

module tlc_fsm(
    output reg [2:0] state, //output for debugging
    output reg RstCount, //use an always block
    /*another always block for these as well*/
    output reg [1:0] highwaySignal, farmSignal;
    input wire [30:0] Count, //use n(31) computed earlier
    input wire Clk, Rst //clock and reset
    );

    //defining states
    parameter s0 = 3'b000;
    parameter s1 = 3'b001;
    parameter s2 = 3'b010;
    parameter s3 = 3'b011;
    parameter s4 = 3'b100;
    parameter s5 = 3'b101;

    /*intermediate nets*/
    reg [2:0] nextState;
    reg [1:0] state;

    //defining colors
    parameter green = 2'b00;
    parameter yellow = 2'b01;
    parameter red = 2'b10;

    /*describing next state logic*/
    always@(state or Count)
        case(state)
            //Srst: nextState = s0;
            s0: begin
                if(Count == one_sec) //if count reached
                    nextState = s1; //transition
                else //otherwise remain in current state
                    nextState = s0;
            end

            s1: begin
                if(Count == thirty_sec) //if this count is reached
                    nextState = s2; //transition
                else //remain in current state
            end

            s2: begin
                if(Count == three_sec) //if count reached
                    nextState = s3; //transition
                else //otherwise
                    nextState = s2; //remain in current state
            end

            s3: begin
                if(Count == one_sec) //if count reached
                    nextState = s4; //transition
                else //otherwise
                    nextState = s3; //remain in current state
            end

            s4: begin
                if(Count == fifteen_sec) //if count reached
                    nextState = s5; //transition
                else //otherwise
                    nextState = s4; //remain in current state
            end

            s5: begin
                if(Count == three_sec) //if count reached
                    nextState = s0; //transition
                else //otherwise
                    nextState = s5; //remain in current state
            end

            default: //avoid latches
                nextState = s0;
        endcase

    /*describe output logic*/
    always@(state or Count)
        case(state)
            s0: begin
                highwaySignal = red;
                farmSignal = red;
                if(Count == one_sec) //if count reached
                    RstCount = 1; //reset counter
                else //otherwise
                    RstCount = 0; //let counter run
            end

            s1: begin
                highwaySignal = green;
                farmSignal = red;
                if(Count == thirty_sec) //if count reached
                    RstCount = 1; //reset counter
                else //otherwise
                    RstCount = 0; //let counter run
            end

            s2: begin
                highwaySignal = yellow;
                farmSignal = red;
                if(Count == three_sec) //if count reached
                    RstCount = 1; //reset counter
                else //otherwise
                    RstCount = 0; //let counter run
            end

            s3: begin
                highwaySignal = red;
                farmSignal = red;
                if(Count == one_sec) //if count reached
                    RstCount = 1; //reset counter
                else //otherwise
                    RstCount = 0; //let counter run
            end

            s4: begin
                highwaySignal = red;
                farmSignal = green;
                if(Count == fifteen_sec) //if count reached
                    RstCount = 1; //reset counter
                else //otherwise
                    RstCount = 0; //let counter run
            end

            s5: begin
                highwaySignal = red;
                farmSignal = yellow;
                if(Count == three_sec) //if count reached
                    RstCount = 1; //reset counter
                else //otherwise
                    RstCount = 0; //let counter run
            end

            default: begin
                highwaySignal = red;
                farmSignal = red;
                RstCount = 1;
            end
        endcase

    /*behavior for input clock*/

    always@(posedge Clk)
        case(state)
            if(Rst)
                state <= s0;
            else
                state <= nextState;
        endcase
endmodule
```