

# ECEN 240

## Fundamentals of Digital Systems Lab

SystemVerilog - Counters

# Agenda

- SystemVerilog Behavioral Coding
  - Synchronous VS Asynchronous reset
  - Priority of inputs
  - Combined Combinational and Sequential
  - Separate Combinational Logic (IFL)
  - Counter Approaches

## 4-Bit Clearable Up-Counter Combined Combinational and Sequential

```
module upCnt(  
    input clk, reset, inc,  
    output logic [3:0] q  
);  
  
    always_ff @(posedge clk, posedge reset)  
        if (reset)  
            q <= 0;  
        else if (inc)  
            q <= q + 1;  
endmodule
```

Make sure to declare "q" type  
"logic"

Synchronous or Asynchronous  
reset? inc?

What happens if reset == 1 and  
inc == 1?

# 4-Stage Ring Shift Register

## Separate Combinational Logic

```
module delay4(  
    input clk, reset  
    output logic [3:0] Q  
);  
    logic [3:0] Next_Q;  
    always_ff @(posedge clk, posedge reset)  
        if (reset)  
            Q <= 4'b1000;  
        else  
            Q <= Next_Q;  
  
    always_comb  
        Next_Q = {Q[0], Q[3:1]};  
endmodule
```

Make sure to declare "Q" type  
"logic"

Does it shift right or left?  
right

# Counter Using a Case Statement Separate Combinational Logic

```
module delay4(  
    input clk, reset,  
    output logic [1:0] Q  
);  
    logic [1:0] Next_Q;  
  
    always_ff @ (posedge clk)  
        if (reset)  
            Q <= 3; // I like 3!  
        else  
            Q <= Next_Q;  
  
    always_comb  
        case (Q)  
            2'h0: Next_Q = 2'h3;  
            2'h1: Next_Q = 2'h2;  
            2'h2: Next_Q = 2'h0;  
            2'h3: Next_Q = 2'h1;  
        endcase  
endmodule
```

Make sure to declare "Q" type  
"logic"

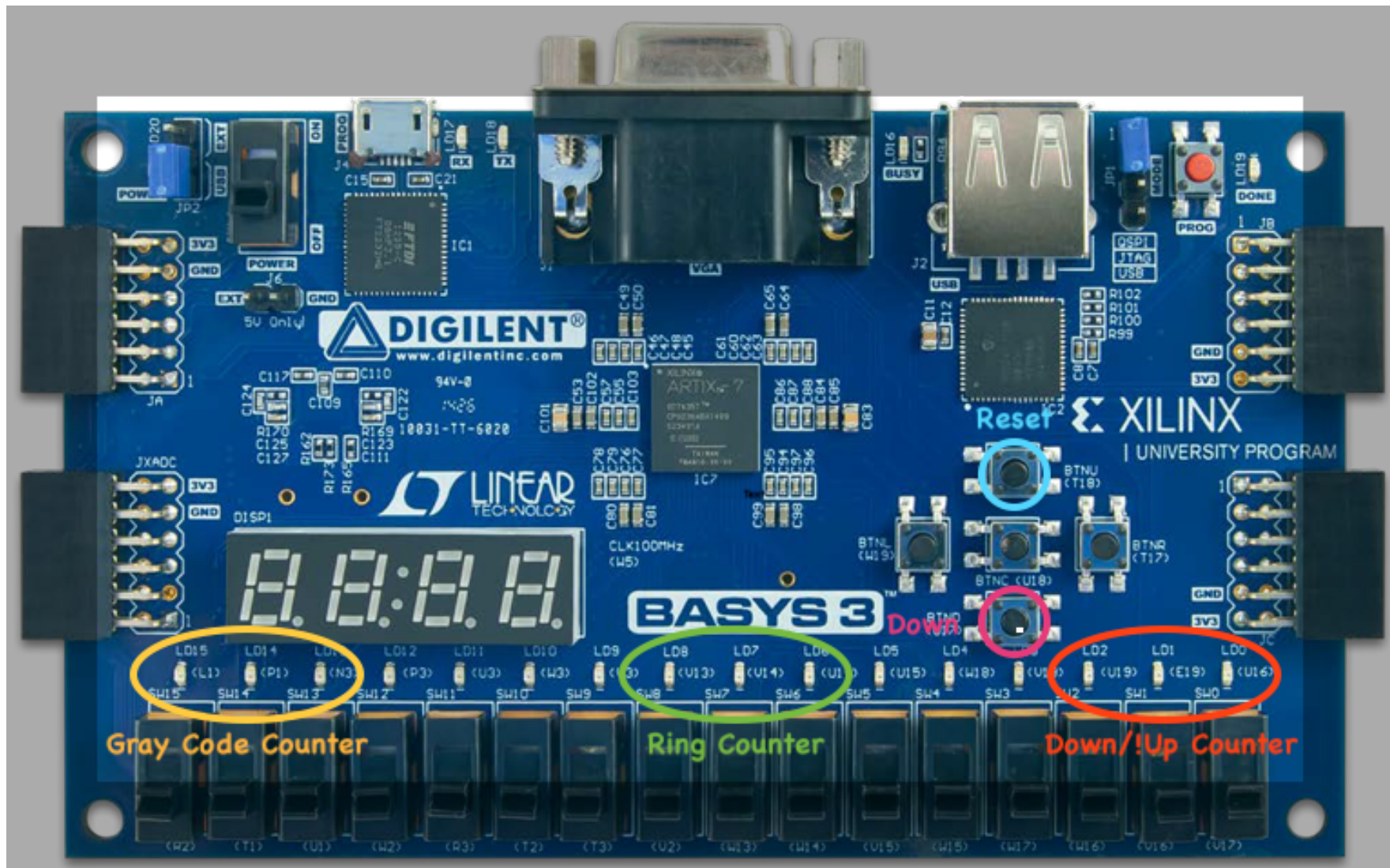
Is the reset synchronous or  
asynchronous?

What is the count sequence?

3 -> 1 -> 2 -> 0 -> 3 -> 1 ...



# Counter Lab



The background of the slide features a large, semi-transparent seal of Brigham Young University. The seal is circular with the text "BRIGHAM YOUNG UNIVERSITY" around the top and "REXBURG, IDAHO" around the bottom. In the center, the year "1888" is at the top, "BYU" is in the middle, and "IDAHO" is at the bottom. The word "Backup" is written in white serif font across the center of the seal.

# Backup