



# Lab 5 Preparation

# Lab 5 Components

- **Part I:** Create a Finite State Machine
  - Make a clocked sequence recognizer.
- **Part II:** Control a datapath
  - Combine datapath + FSM to perform ALU functions.
- **Part III:** Divider (**optional!**)
  - Dividing number using a simple adder/subtractor
  - Bonus, for those who thinks the labs are not difficult enough!

# New Verilog Syntax

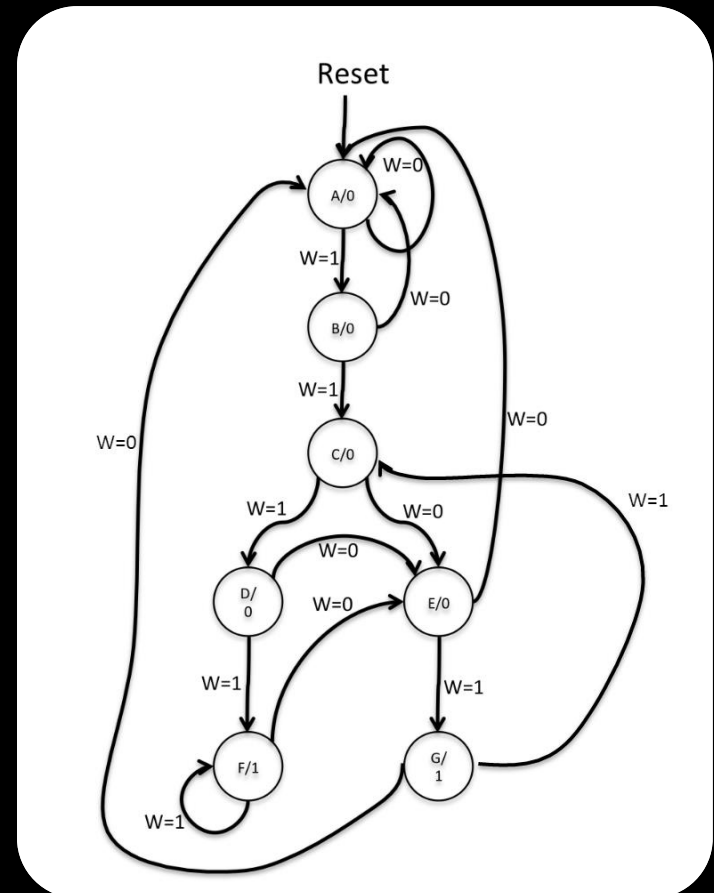
- The `localparam` keyword:

```
localparam A = 3'b000;
```

- Defines values that are replaced at compile time.
- Like a constant!
- Good for assigning flip-flop values to states.
- Makes the state table easy to read.

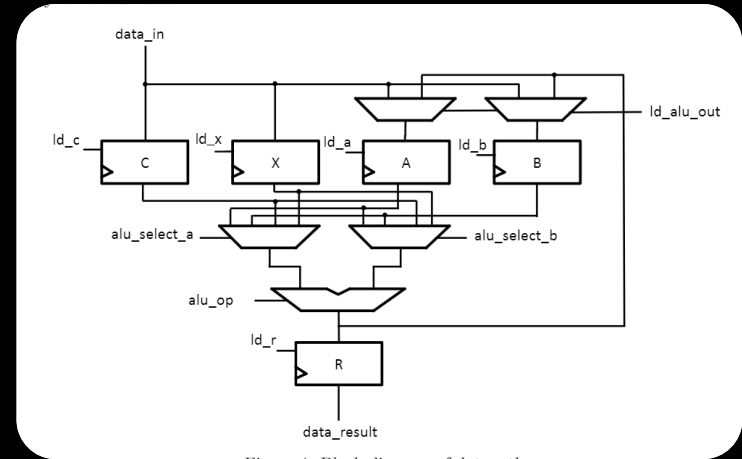
# Part I: Finite State Machine

- Recognize 1111 or 1101 sequence.
- Starter code provided.
  - Case statement that updates flip-flop values (stored in a 3-bit register).
  - You fill in the missing case conditions.



# Part II: Controlling datapath

- Remember the ALU datapath example we did in class?
  - This is another! 😊
- We provide the code for the datapath, you provide the controller FSM.
  - Send signals to the datapath components to move the data around, and make the computation happen.
  - Provide state diagram in prelab, and compare with Quartus-generated one.



# Part III: Divider Circuit

- Note: This part is optional, but is excellent practice!
- Basic idea from decimal long division:
  - From left to right, find where the divisor can be subtracted from the dividend.
  - Doing this in binary is simpler, except that we keep the divisor static, and move everything else!

A handwritten long division problem on yellow lined paper. The problem is  $6 \overline{)250}$ . The quotient is written as 041. The first step shows 6 multiplied by 4 (24) subtracted from 25, leaving a remainder of 10. The second step shows 6 multiplied by 1 (6) subtracted from 10, leaving a remainder of 4. The final remainder 40 is circled in red. A small watermark in the bottom right corner reads "wiki How to Do Long Divis".

$$\begin{array}{r} 041. \\ 6 \overline{)250} \\ \underline{-24} \phantom{0} \\ 10 \\ \underline{-6} \\ 40 \end{array}$$