

VERILOG 4: COMMON MISTAKES

Common Mistake #1a: assign in an always block

- There is no “assign” keyword in always blocks!
- The purpose of an always block → to define a **reg**
- See the slide titled **Describing Hardware** in the *Verilog 2 Handout*

```
reg out;  
always @(a or b) begin  
    out = a & b;  
    assign out2 = a ^ b;  
end
```

Common Mistake #1b: module instantiation in an `always` block

- There are no module instantiations in `always` blocks!
- The purpose of an `always` block → to define a `reg`
- See the slide titled **Describing Hardware** in the *Verilog 2 Handout*

```
reg out;
always @(a or b) begin
    out = a & b;
    add8 abc_add (
        .in1    (a),
        .in2    (b),
        .sum    (output) );
end
```

Common Mistake #2: Setting the same `reg` in multiple `always` blocks

- Simulators will typically do what you tell them to do
- Synthesis tools and lint checkers will typically give a warning
- Never do this in Hardware verilog
- You might be able to get away with it in testing verilog but don't do it

```
module
```

```
    always @(a or b) begin  
        x = a ^ b;  
    end
```

```
    always @(reset) begin  
        x = 1'b0;  
    end
```

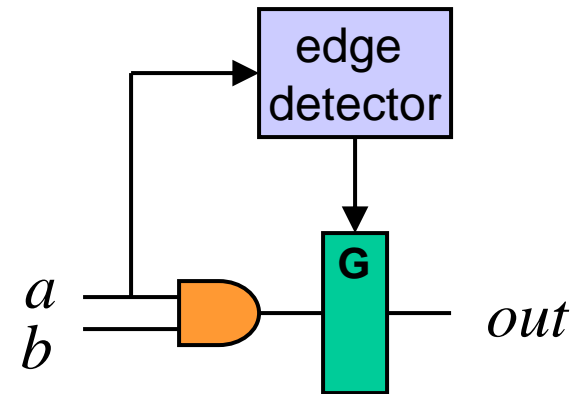
```
endmodule
```

Mistake #3: Inferring State In Combinational Circuits By: An Incomplete Sensitivity List

- ```
always @(a) begin // missing b
 out = a & b;
end
```
- *out* updates when *a* changes as expected
- *out* *does not update* when *b* changes!
  - Put another way, *b* can change all it wants but *out* will not update—this requires a memory element to remember the last value of *out*
- Synthesis tools and lint checkers will give a warning
- Using the construct new in Verilog 1364-2001:

```
always @(*)
or
always @*
```

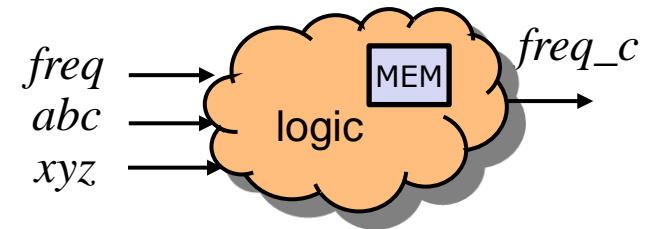
eliminates this type of bug, but it is not supported by all modern CAD tools



# Mistake #4: Inferring State In Combinational Circuits By: Not Setting a *reg* In All Paths

```
// this "always" block does not
// instantiate combinational logic
always @(freq or xyz or abc) begin
 if (xyz == 4'b0010) begin
 freq_c = abc;
 end

 case (freq) begin
 3'b000: freq_c = abc;
 3'b001: freq_c = abc + 3'b001;
 endcase
end
```



- Example: attempted combinational circuit
  - If  $xyz == 4'b0010$ ,  $freq\_c$  is a function of the inputs
  - If  $freq == 3'b000$  or  $3'b001$ ,  $freq\_c$  is a function of the inputs
  - Otherwise,  $freq\_c$  keeps its old value— which implies memory is needed! Which means our combinational circuit is broken.
  - A failure occurs when the inputs of a statement are different from the signals used for the **if** or **case** condition

# Mistake #4: Inferring State In Combinational Circuits By: Not Setting a reg In All Paths

```
// this "always" block does instantiate combinational logic
```

```
always @(freq or xyz or abc) begin
```

```
 // "default" section of always block
```

```
 freq_c = freq; // some default value
```

```
 // main logic block
```

```
 if (xyz==4'b0010) begin
```

```
 freq_c = abc;
```

```
 end
```

```
 else begin // perhaps not always applicable
```

```
 freq_c = ...;
```

```
 end
```

```
 case (freq) begin
```

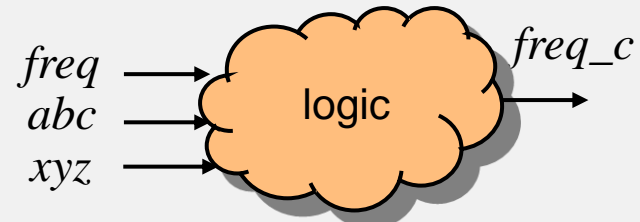
```
 3'b000: freq_c = abc;
```

```
 3'b001: freq_c = abc+3'b001;
```

```
 default: freq_c = ...; // perhaps you know freq should never be anything
```

```
 endcase // other than 000 or 001, or perhaps you do want
```

```
end // freq_c equal to something in these six cases
```



Fixes  
all

Fixes  
the  
if  
block

Fixes  
the  
case  
block

- Example: successful combinational circuit
  - Solution: *freq\_c* is set regardless of the values of all inputs
  - One solution: always declare default values at beginning of *always* blocks
  - If helpful, declare default case in case statements

# For Combinational Circuits: Avoid Inferring State by:

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1. Including **all input** variables in the sensitivity list!
  - Use **always @(\*)**
2. Set the value of all regs in **all** paths through every `always` block
  - A nice solution is to set default values for all output variables immediately after entering an `always` block
    - You will eliminate the chance of this bug if you do