Exercise 1: 4-bit Divider

You don't need to hand in the design.

Objective

1 Design a 4-bit divider by using **exercise1.v** as the template with the testbench **exercise1_tb.v**.

Action Items

1 Passed or failed

a. If the simulation passes, you will see the following message:

```
>>>> [PASS] Congratulations!
```

b. If the simulation fails, you will see the following message:

```
>>>> [ERROR] Try it again!
```

2 I/O Signals and Description

Signal name	I/O	Description
A	Input	Input source for the division
B	Input	Input source for the division
C	Input	Input source for the division
D	Input	Input source for the division
select	Input	Source selection for the division
out	Output	The division result
error	Output	Error indicator if the divisor is zero

a. Source selection:

select	Function
2'b00	out = A / B
2'b01	out = B / C
2'b10	out = C / D
2'b11	out = D / A

- ✓ Example:
  A=8'd88, B=8'd12, and select=2'b00, then the result (out) should be 8'd7
- ✓ All the input and output numbers are unsigned integers,
  i.e., A, B, C, D, and out >= 0

b. Error condition:

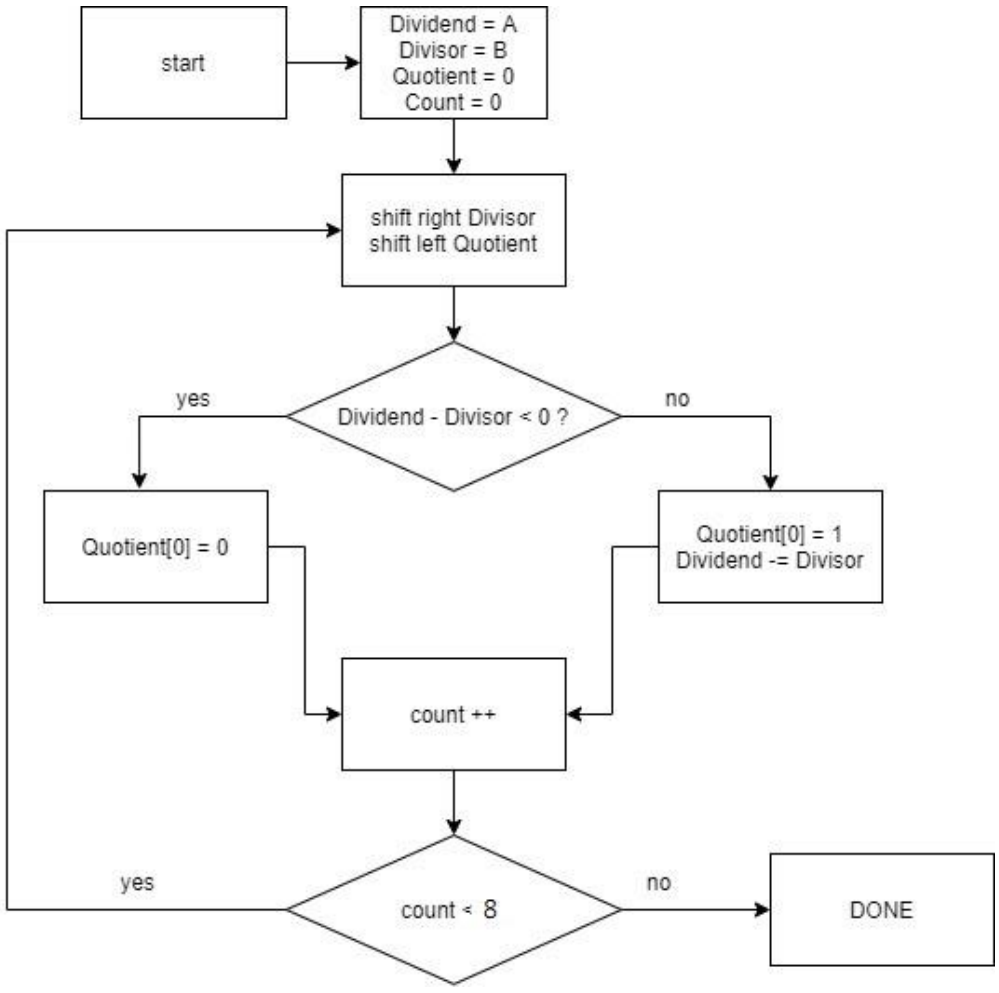
- ✓ Error indicator (error) = 1 when the divisor is 0.
  Ex: select=2'b00 and B=0 => error = 1; otherwise, error = 0.

c. Requirement: you CAN NOT use the divide operator "/" in your design.
That is, the following expression is forbidden:
out = A / B;

d. You can use the following algorithm to implement the divider.

e. It would help if you traced the testbench for debugging and learning the way to write a testbench.

f. Algorithm:



Here is an example:

D = 1 1 1 1, S = 0 0 1 0, D is dividend, S is Divisor

Initial: D = 0 0 0 0 1 1 1 1, S = 0 0 1 0 0 0 0 0, Q = 0 0 0 0

1 D = 0 0 0 0 1 1 1 1, S = 0 0 0 1 0 0 0 0, Q = 0 0 0 0

2 D = 0 0 0 0 0 1 1 1, S = 0 0 0 0 1 0 0 0, Q = 0 0 0 1

3 D = 0 0 0 0 0 0 1 1, S = 0 0 0 0 0 1 0 0, Q = 0 0 1 1

4 D = 0 0 0 0 0 0 0 1, S = 0 0 0 0 0 0 1 0, Q = 0 1 1 1

⇨ **out = Q = 0 1 1 1 (15 / 2 = 7)**

Question

- ✓ Can you design the multiplier without using the multiply operator “*”?

Good luck with your midterm exam :D