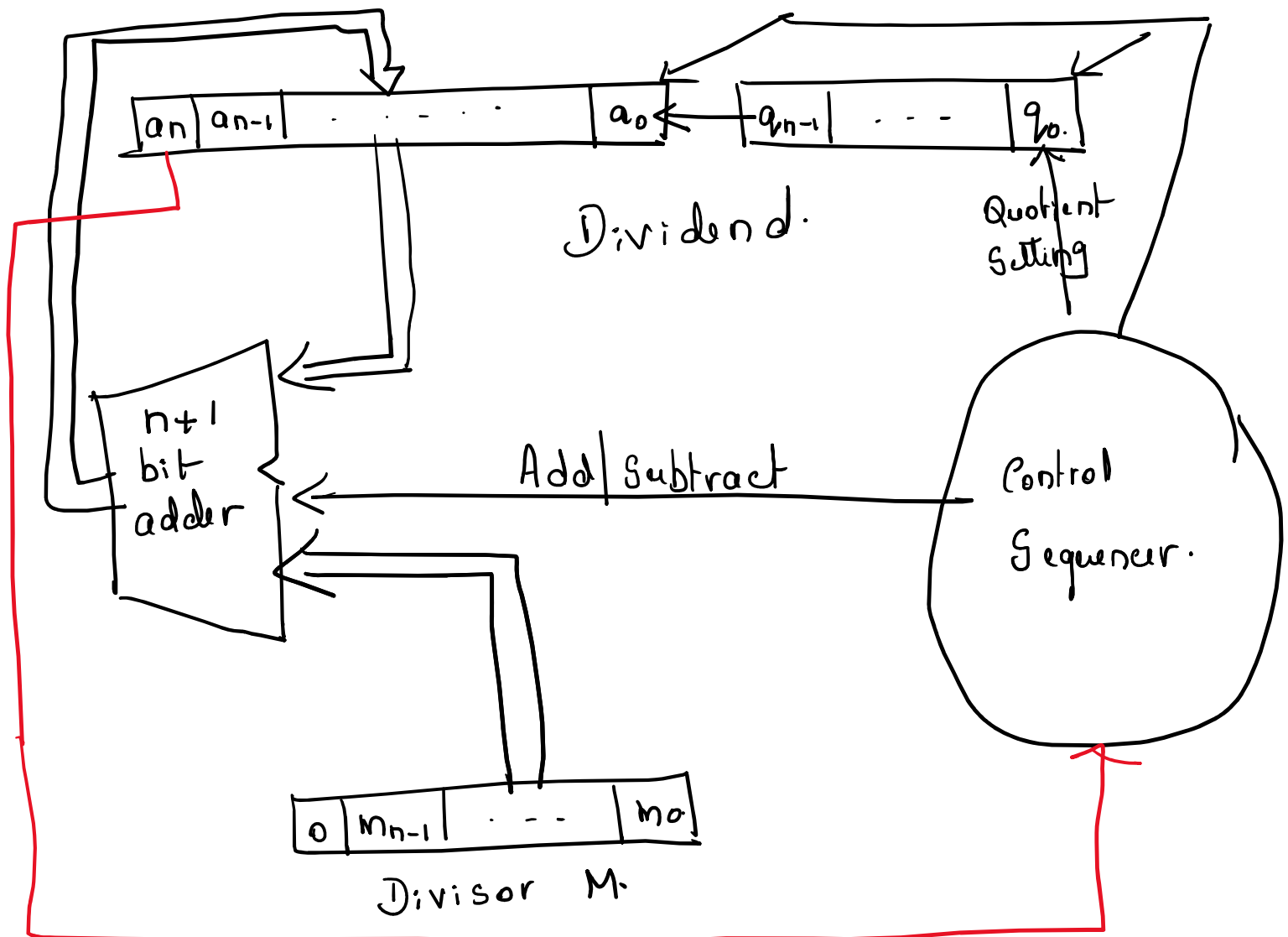


## Circuit for binary division



→ Every cycle.  
— Subtraction  
— Addition.

## Non-restoring division

Step 1: Do the following n times

1. If the sign bit of A is 0: Shift A & Q to left one bit position and Subtract M from A

Otherwise  $[A_n = 1]$  : Shift A and Q to left one bit position and add M to A

2. Now if the sign bit of A is 0,  $\Rightarrow q_0 = 1$   
otherwise set  $q_0 = 0$ .

## Step 2

If the sign bit of A is 1, add M to A

Restoring

## Example 1

Initialize. 0 0 0 0 0 1 0 0 0

Shift 0 0 0 0 1 0 0 0   

Subtract 1 1 1 0 1

Set  $q_0$  1 1 1 1 0 0 0 0 0

First cycle.

Shift 1 1 1 0 0 0 0 0   

Add 0 0 0 1 1

Set  $q_0$  1 1 1 1 1 0 0 0 0

Second cycle.

Shift      1   1   1   1   0   0   0 0    

Add      0   0   0   1   1

---

Set  $q_0$    0   0   0   0   1   0   0 0   1

} Third Cycle.

Shift      0   0   0   1   0   0 0 1    

Subtract      1   1   1   0   1

---

Set  $q_0$    1   1   1   1   1   0 0 1   0

} Fourth Cycle

1   1   1   1   1

0   0   0   1   1

---

0   0   0   1   0   0 0 1 0

Remainder                      Quotient.

} Restore.

## Example 2

A

Q.

Initialize. 0 0 1 0 0 0 1 0 0 1 0

Shift      0   1   0   0   0   1   0   0   1   0    

Subtract      1   1   0   0   1   1

---

Set  $q_0$    0   0   0   1   0   0   0   0   1   0   1

} First cycle.

Shift      0   0   1   0   0   0   0   1   0   1  

Subtract      1   1   0   0   1   1

---

Set  $q_0$    1   1   1   0   1   1   0   1   0   1 0

} Second Cycle.

Shift      1   1   0   1   1   0   1   0   1   0   0   0  
 Add.      0   0   1   1   0   1  
 Set q<sub>0</sub>    0   0   0   0   1   1   1   0   1   0   1

Third Cycle.

Shift      0   0   0   1   1   1   0   1   0   1   0  
 Subtract   1   1   0   0   1   1  
 Set q<sub>0</sub>    1   1   1   0   1   0   0   1   0   1   0

Fourth Cycle.

Shift      1   1   0   1   0   0   1   0   1   0   0  
 Add      0   0   1   1   0   1  
 Set q<sub>0</sub>    0   0   0   0   0   1   1   0   1   0   1

Fifth Cycle.

Remainder.      Quotient.

## Signed number division

→ Division

→ Both dividend & divisor may be transformed to be positive numbers

— Unsigned number division

$$\frac{+ve}{+ve}$$

$$\frac{5}{2}$$

$$Q = 2$$

$$R = 1$$

$$\frac{-ve}{+ve}$$

$$\frac{-5}{2}$$

$$Q = -2$$

$$R = -1$$

$$D = -2 \times 2 - 1 = -5$$

$$\frac{+ve}{-ve}$$

$$\frac{5}{-2}$$

$$Q = -2$$

$$R = 1$$

$$D = -2 \times -2 + 1 = 5$$

$$\frac{-ve}{-ve}$$

$$\frac{-5}{-2}$$

$$Q = 2$$

$$R = -1$$

$$D = 2 \times (-2) - 1 = -5$$

Quotient sign: Whenever Dividend and divisor are of different sign, quotient negative.



Remainder sign = Dividend sign