

Carry Save Addition

Integer Division

→ Unsigned numbers

Decimal division

$$\begin{array}{r} 021 \leftarrow \text{Quotient} \\ 13 \overline{) 274} \leftarrow \text{Dividend} \\ \underline{26} \\ 14 \\ \underline{13} \\ 1 \leftarrow \text{Remainder} \\ \hline \hline \end{array}$$

Divisor → 13

Binary division

$$\begin{array}{r} 100 \\ - 85 \\ \hline 15 \end{array}$$

9 10
↓ ↓

$$\begin{array}{r} 100 \\ 11 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 0101 \\ 1101 \overline{) 100010010} \\ \underline{1101} \\ 10001 \\ \underline{1101} \\ 01000 \\ \underline{1101} \\ 10000 \\ \underline{1101} \\ 1111 \\ \underline{1101} \\ 1110 \\ \underline{1101} \\ 1 \end{array}$$

Restoring Division

Registers

M : n -bit : Divisor.

Q : n -bit : dividend.

A : $n+1$ bit : Initially set to 0

Dividend \rightarrow n -bits

AQ : Dividend.

After the division is completed

n -bit quotient $\rightarrow Q$

Remainder $\rightarrow A$

$(n+1)^{\text{th}}$ bit of A : Sign during subtraction

Algorithm

— Initialise registers

— Do the following n -times
(Repeat)

① Shift A and Q - left one binary position

② Subtract M from A , and place the answer back in A

③. $(n+1)^{\text{th}}$ bit of $A = 1 \Rightarrow$ Subtraction not possible.
(Sign)

$q_0 = 0$

Add M back to A

Restoring
 A / dividend.

$(n+1)^{\text{th}}$ bit of $A = 0 \Rightarrow$ Subtraction possible.
 $q_0 = 1$

Ex 1

$$\begin{array}{r} 10 \\ 11 \overline{) 1000} \\ \underline{11} \\ 10 \end{array}$$

$$n=4.$$

$$M' 00011$$

$$M'' 111001$$

$$\begin{array}{r} 1101 \end{array}$$

A-(n+)

A

Q.

Initialize.

0 0 0 0 0 1 0 0 0

0 0 0 0 1 0 0 0 0

1 1 1 0 1

1 1 1 0

Shift left.

Subtract M

First cycle.

Add M to restore.

0 0 0 0 1 0 0 0 0

0 0 0 1 0 0 0 0 0

1 1 1 0 1

1 1 1 1

Shift

Subtract M

Second cycle.

Add M to restore A

0 0 0 1 0 0 0 0 0

0 0 1 0 0 0 0 0 0

1 1 1 0 1

0 0 0 0 1

0 0 0 0 1 0 0 0 1

0 0 0 1 0 0 0 1 1

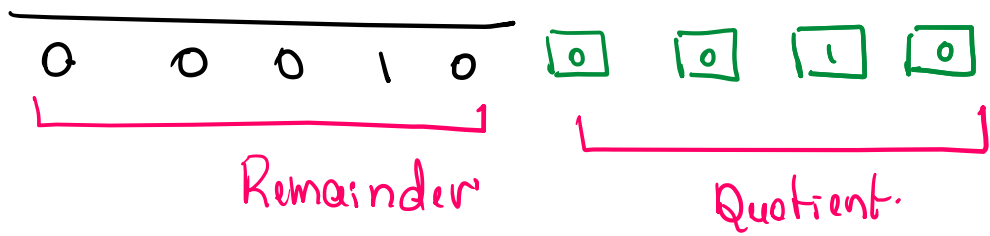
1 1 1 0 1

1 1 1 1

Shift left.

10

IV



Ex 2

Divisor (M)

0 1 1 0 1

M¹¹

0 0 1 1 0 1

1 1 0 0 1 0 +

1 1 0 0 1 1

A

Q

0 0 1 0 0 0 1 0 0 1 0
 0 1 0 0 0 1 0 0 1 0
 1 1 0 0 1 1

0 0 0 1 0 0

0 0 0 1 0 0 0 0 1 0

0 0 1 0 0 0 0 1 0

1 1 0 0 1 1

1 1 1 0 1 1

0 0 1 1 0 1 0 1 0

0 0 1 0 0 0 0 1 0

0 1 0 0 0 0 1 0

1 1 0 0 1 1

0 0 0 0 1 1

0 0 0 0 1 1

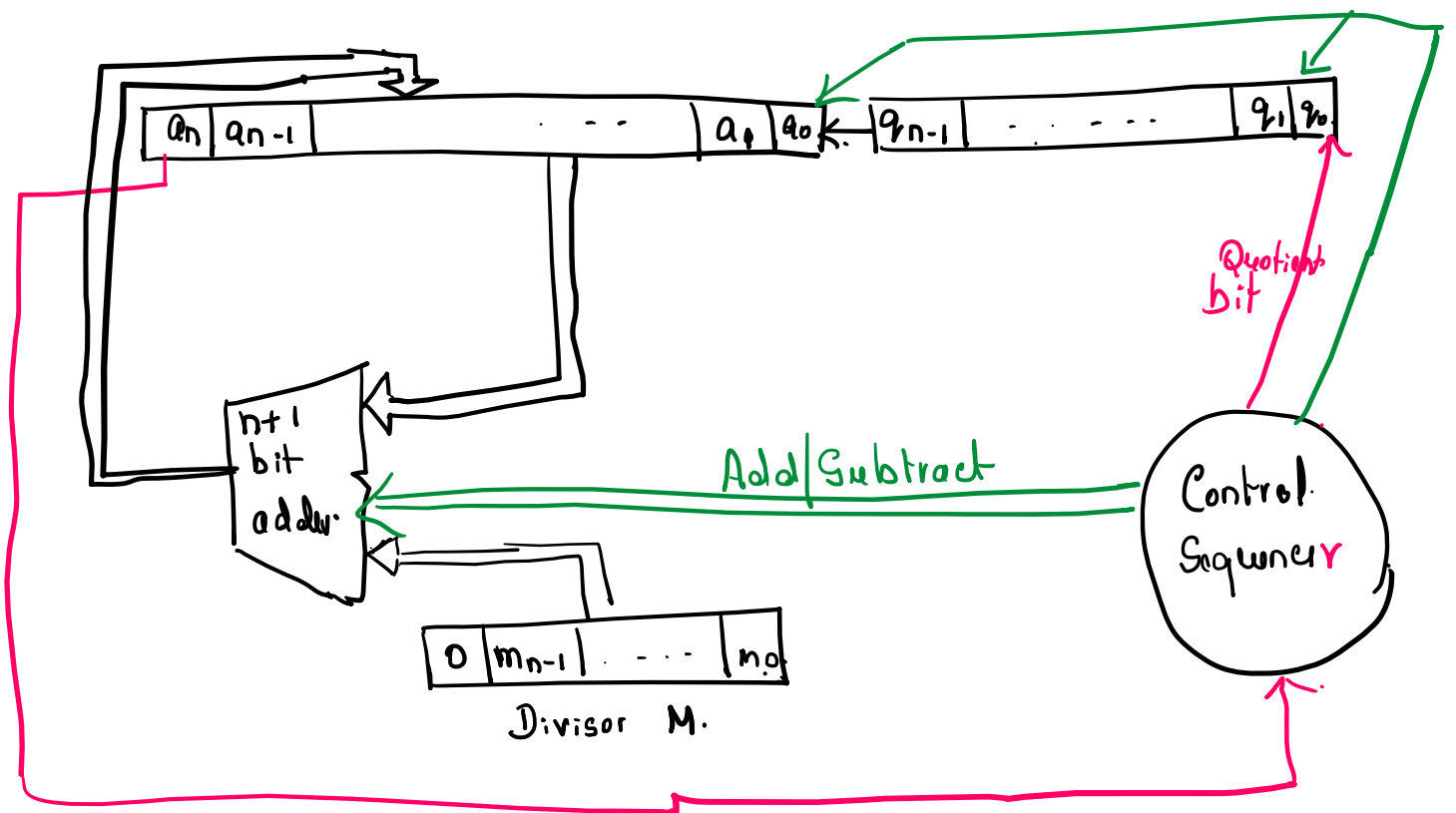
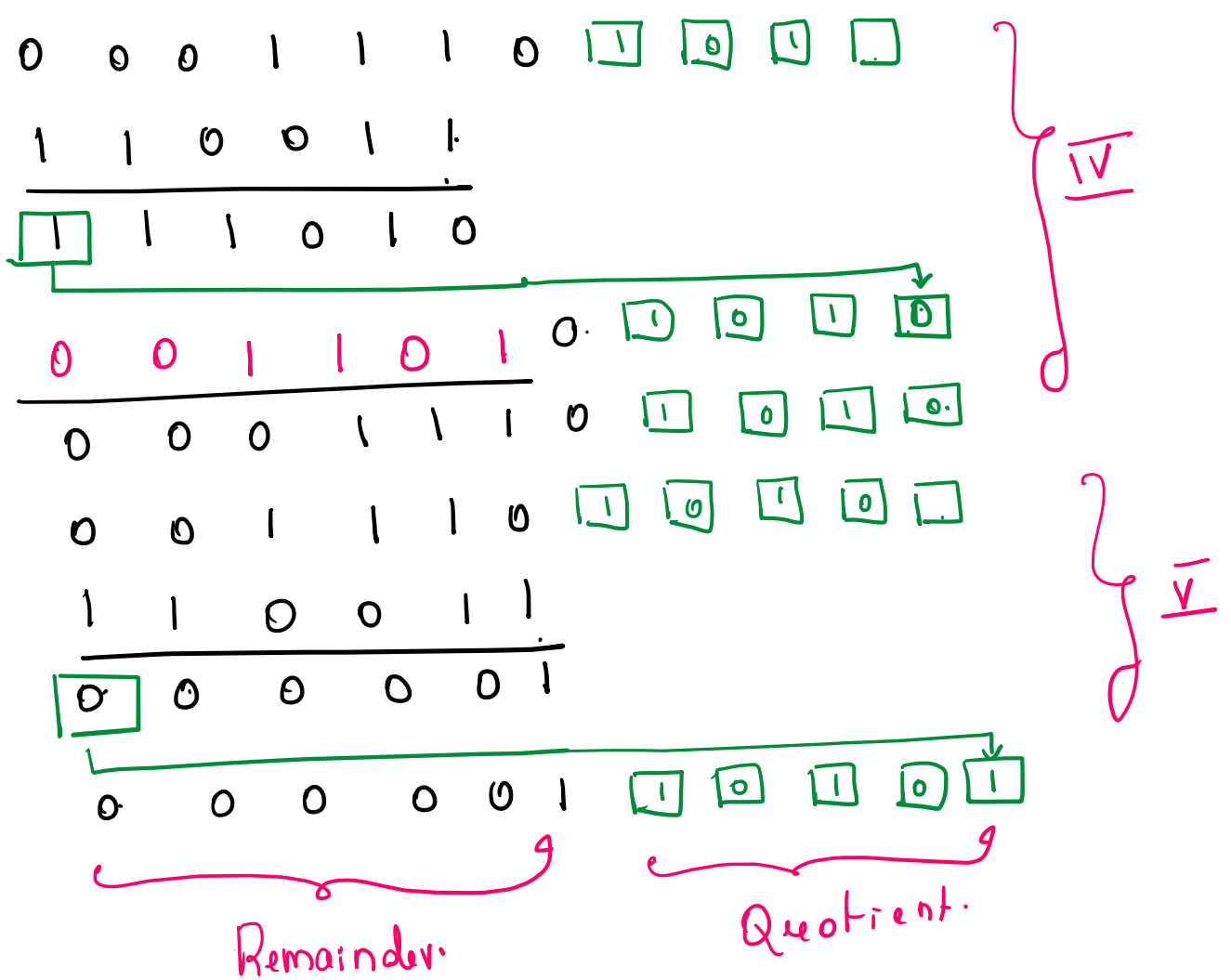
0 0 0 0 1 1 1 0 1

I

Shift

II

III



→ Restoration → every byte.

Non-Restoring division