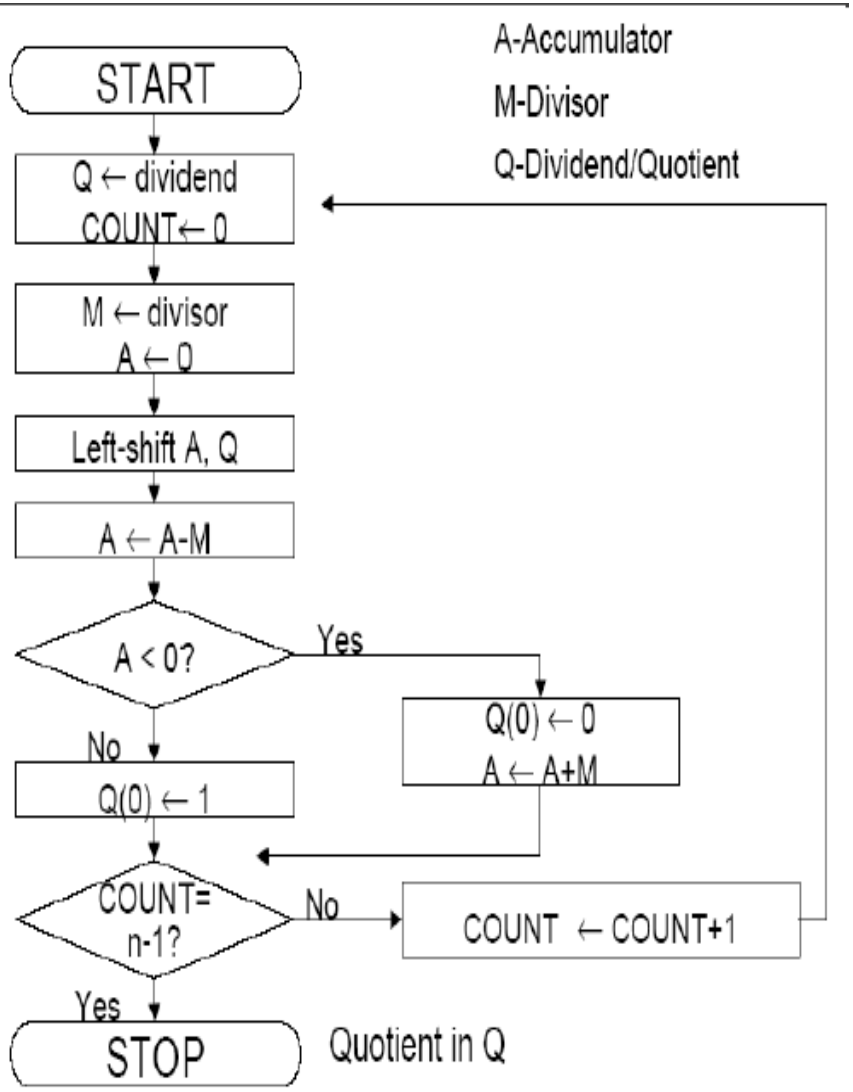
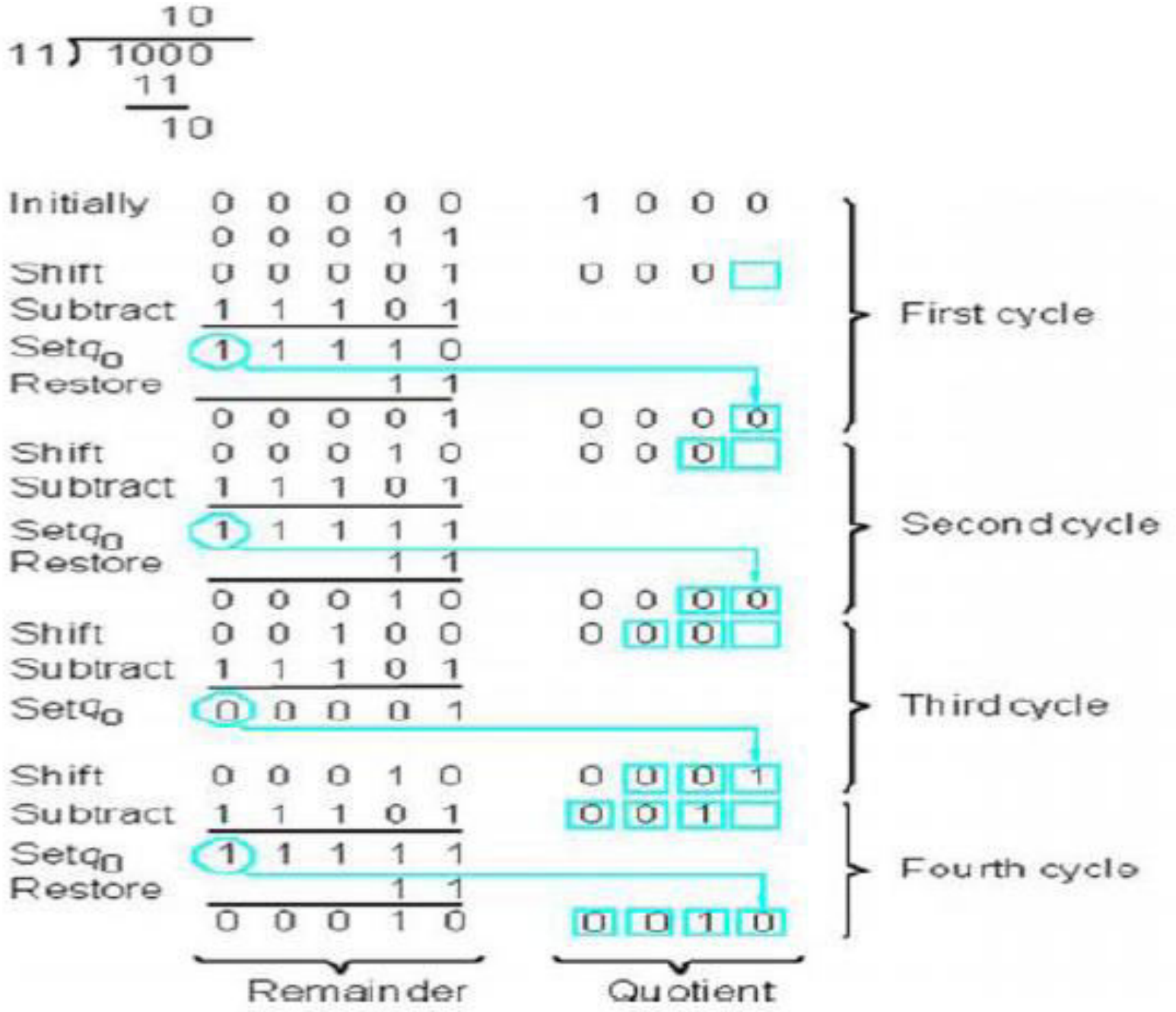
DIVISION ALGORITHMS

Restoring Division

- Input:
  - M – positive divisor (n-bit)
  - Q – positive dividend (n-bit)
- Output:
  - Q – Quotient
  - A – Remainder
- Begin
  - A is set to 0.
  - Shift A and Q left one binary position
  - A ← A – M
  - If sign of A is 1
    - $q_0 \leftarrow 0$ and A ← A + M (Restore A)
  - Else
    - $q_0 \leftarrow 1$
- End




10
11) 1000
11
10
Initially 0 0 0 0 0 1 0 0 0
0 0 0 1 1
Shift 0 0 0 0 1 0 0 0
Subtract 1 1 1 0 1
Set q_0 1 1 1 1 0
Restore 1 1
0 0 0 0 1 0 0 0 0
First cycle
Shift 0 0 0 1 0 0 0 0
Subtract 1 1 1 0 1
Set q_0 1 1 1 1 1
Restore 1 1
0 0 0 1 0 0 0 0 0
Second cycle
Shift 0 0 1 0 0 0 0 0
Subtract 1 1 1 0 1
Set q_0 0 0 0 0 1
Third cycle
Shift 0 0 0 1 0 0 0 0 1
Subtract 1 1 1 0 1 0 0 1
Set q_0 1 1 1 1 1
Restore 1 1
0 0 0 1 0 0 0 1 0
Fourth cycle
Remainder
Quotient

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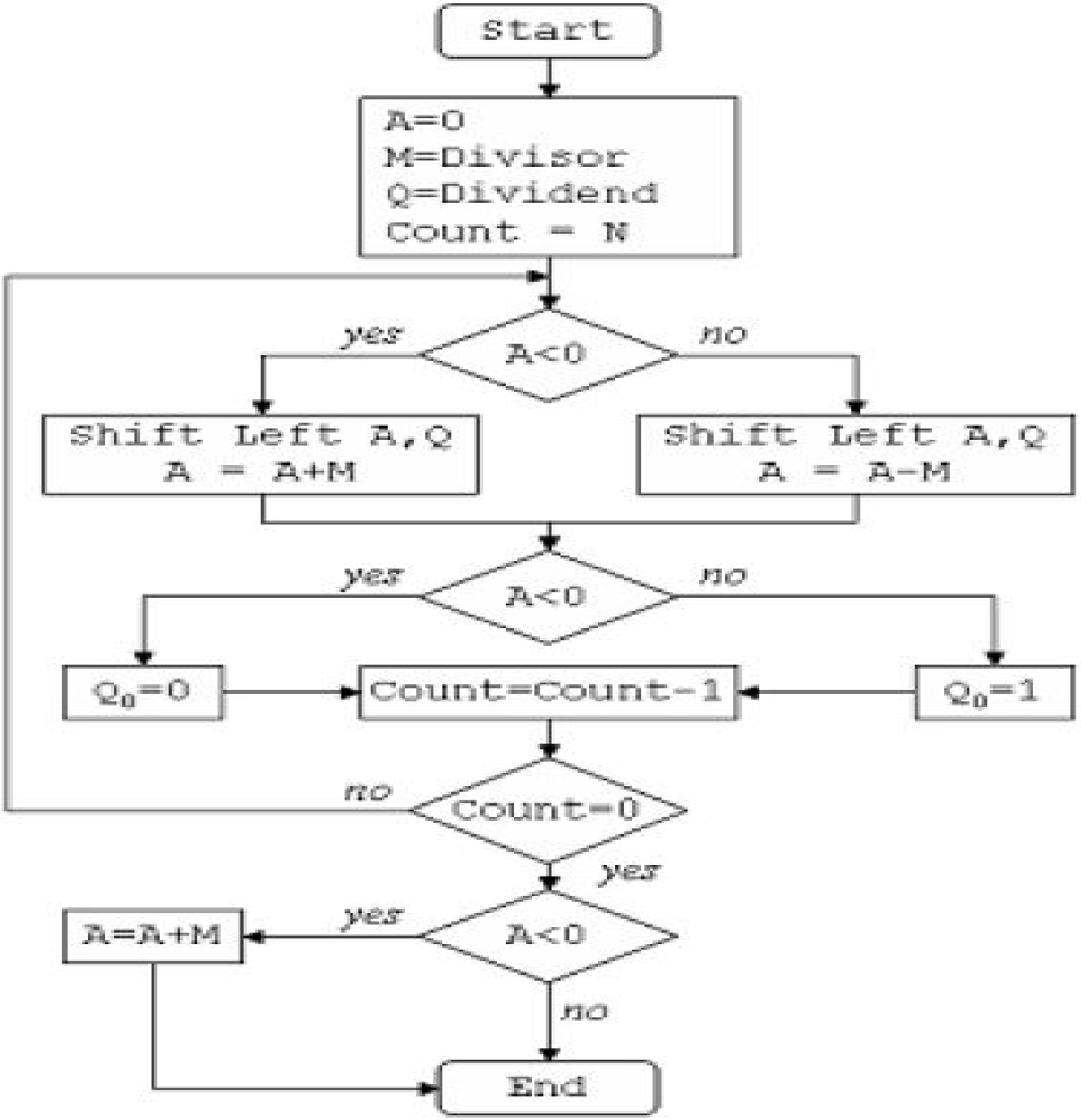
A	Q	M = 0011	
0000	0111	Initial values	
0000	1110	Shift	1
1101		A = A - M	
0000	1110	A = A + M	
0001	1100	Shift	2
1110		A = A - M	
0001	1100	A = A + M	
0011	1000	Shift	3
0000		A = A - M	
0000	1001	$Q_0 = 1$	
0001	0010	Shift	4
1110		A = A - M	
0001	0010	A = A + M	

Non-Restoring Division

- Input:
  - M – positive divisor (n-bit)
  - Q – positive dividend (n-bit)
- Output:
  - Q – Quotient
  - A – Remainder
- Begin
  - $A \leftarrow 0$
  - Do n times
    - If the sign of A is 0
      - Shift A and Q left one bit position and $A \leftarrow A - M$
    - else
      - Shift A and Q left one bit position and $A \leftarrow A + M$
    - If Sign of A is 0
      - $q_0 \leftarrow 1$
    - Else
      - $q_0 \leftarrow 0$
  - If sign of A is 1
    - $A \leftarrow A + M$
- End


Start
A=0
M=Divisor
Q=Dividend
Count = N
yes
A<0
no
Shift Left A,Q
A = A+M
Shift Left A,Q
A = A-M
yes
A<0
no
Q0=0
Count=Count-1
Q0=1
no
Count=0
yes
yes
A<0
A=A+M
no
End

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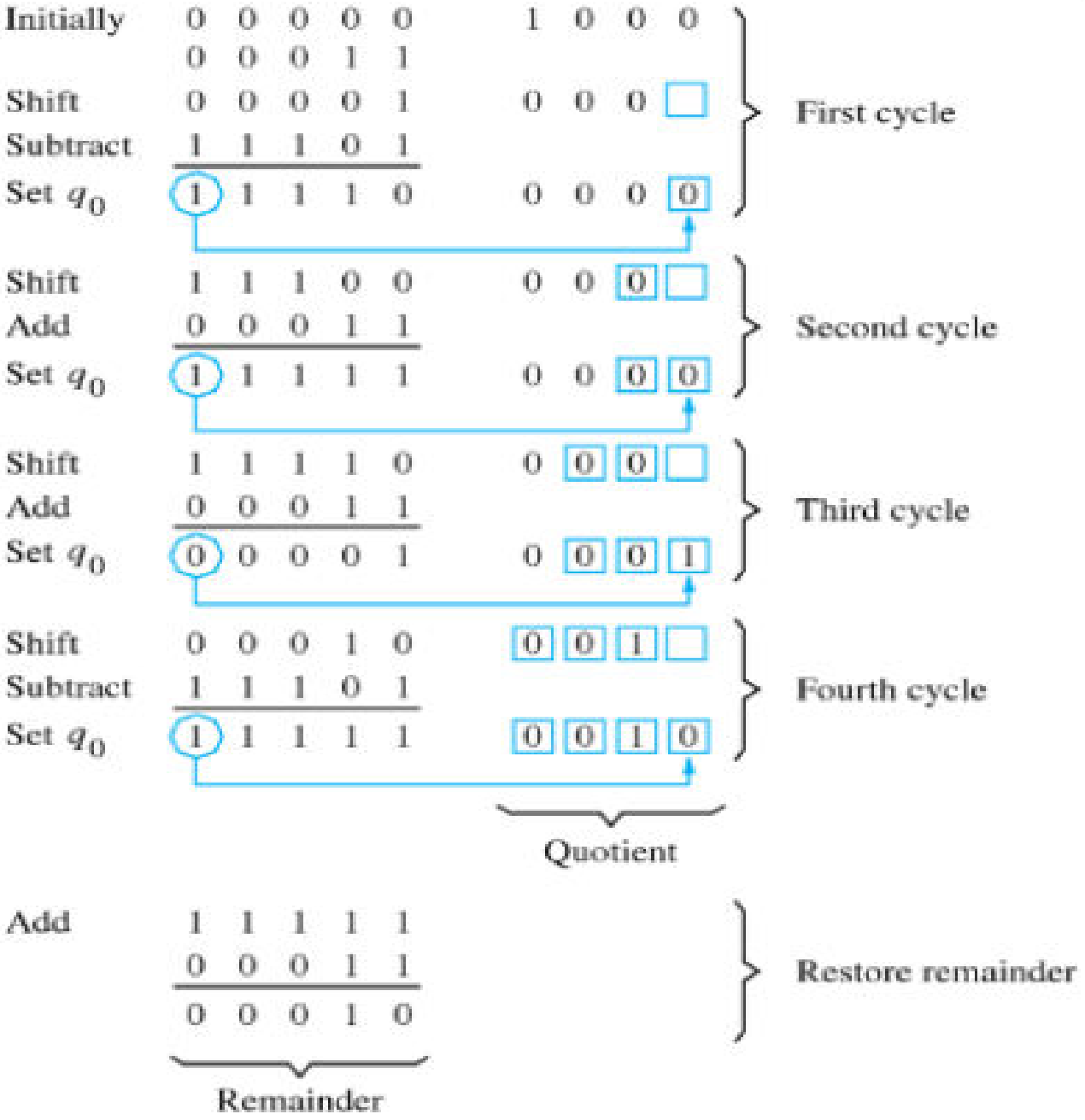
Initially 0 0 0 0 0 1 0 0 0
0 0 0 1 1
Shift 0 0 0 0 1 0 0 0
Subtract 1 1 1 0 1
Set q_0 1 1 1 1 0 0 0 0 0
First cycle
Shift 1 1 1 0 0 0 0 0
Add 0 0 0 1 1
Set q_0 1 1 1 1 1 0 0 0 0
Second cycle
Shift 1 1 1 1 0 0 0 0
Add 0 0 0 1 1
Set q_0 0 0 0 0 1 0 0 0 1
Third cycle
Shift 0 0 0 1 0 0 0 1
Subtract 1 1 1 0 1
Set q_0 1 1 1 1 1 0 0 1 0
Fourth cycle
Quotient
Add 1 1 1 1 1
0 0 0 1 1
0 0 0 1 0
Restore remainder
Remainder