Bài 7

C TRONG MÁY TÍNH

ng Sơn

I DUNG

- ALU (Arithmetic and Logical Unit)
- nguyên (fixed point)
- ng (floating point)

ALU

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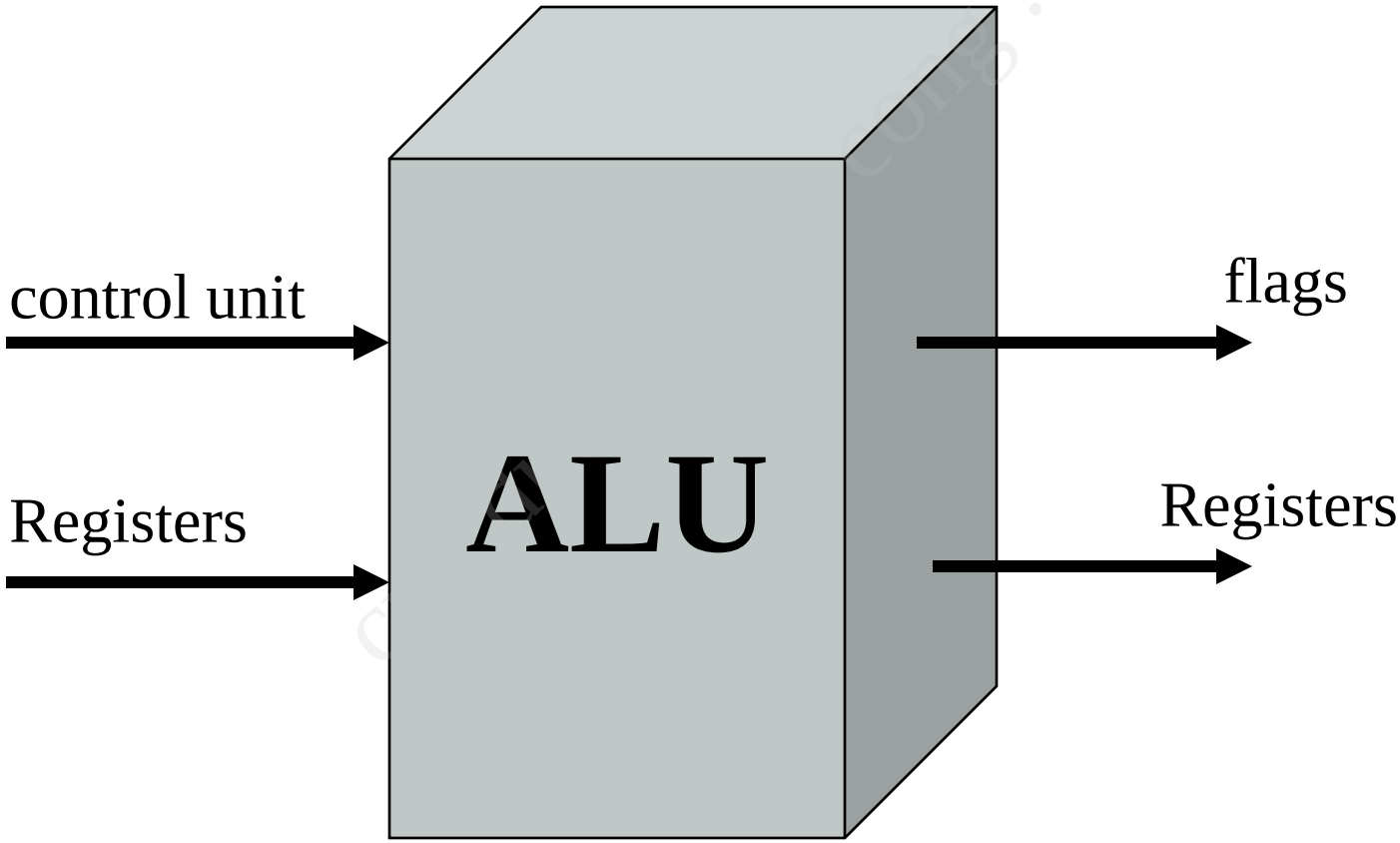
-

y ra.

ALU



NGUYÊN (fixed point)

- phân
- nguyên
- âm

n

- u
  - 0 = +
  - 1 = -
- +18 = 0 001 0010

  -18 = 1 001 0010
- 0 ($+0_{10}$=0 0000000; -0_{10}=1 0000000)
- m n bit

$$A = \begin{cases} \sum_{i=0}^{n-2} 2^i a_i & nê\ u\ a_{n-1} = 0 \\ -\sum_{i=0}^{n-2} 2^i a_i & nê\ u\ a_{n-1} = 1 \end{cases}$$

hai

- u
- n bit

$$A = -2^{n-1} a_{n-1} + \sum_{i=0}^{n-2} 2^i a_i$$

p phân	n	2
+8	-	-
+7	0111	0111
+6	0110	0110
+5	0101	0101
+4	0100	0100
+3	0011	0011
+2	0010	0010
+1	0001	0001
+0	0000	0000
-0	1000	-
-1	1001	1111
-2	1010	1110
-3	1011	1101
-4	1100	1100
-5	1101	1011
-6	1110	1010
-7	1111	1001
-8	-	1000

c nhau

-
-
  -
  -
-
  -
  -

m bit

n:

i

ng

2

i

ng

o

-
  u.
-
  c:
  - c bit
  - i 1
- : +18= 0001 0010

  1110 1101

  \+ 1

  11101110 = -18

a nhau

$$A = -2^{n-1} a_{n-1} + \sum_{i=0}^{n-2} 2^i a_i$$

$$B = -2^{n-1} \overline{a_{n-1}} + 1 + \sum_{i=0}^{n-2} 2^i \overline{a_i}$$

- u
- : X-Y = X+(-Y)
-
-

n.

1001 = -7

+0101 = 5

1110 = -2

1100 = -4

+0100 = 4

10000 = 0

0011 = 3

+0100 = 4

0111 = 7

1100 = -4

+1111 = -1

11011 = -5

n

$$0101 = 5$$

$$+0100 = 4$$

$$\underline{\qquad\qquad\qquad}$$

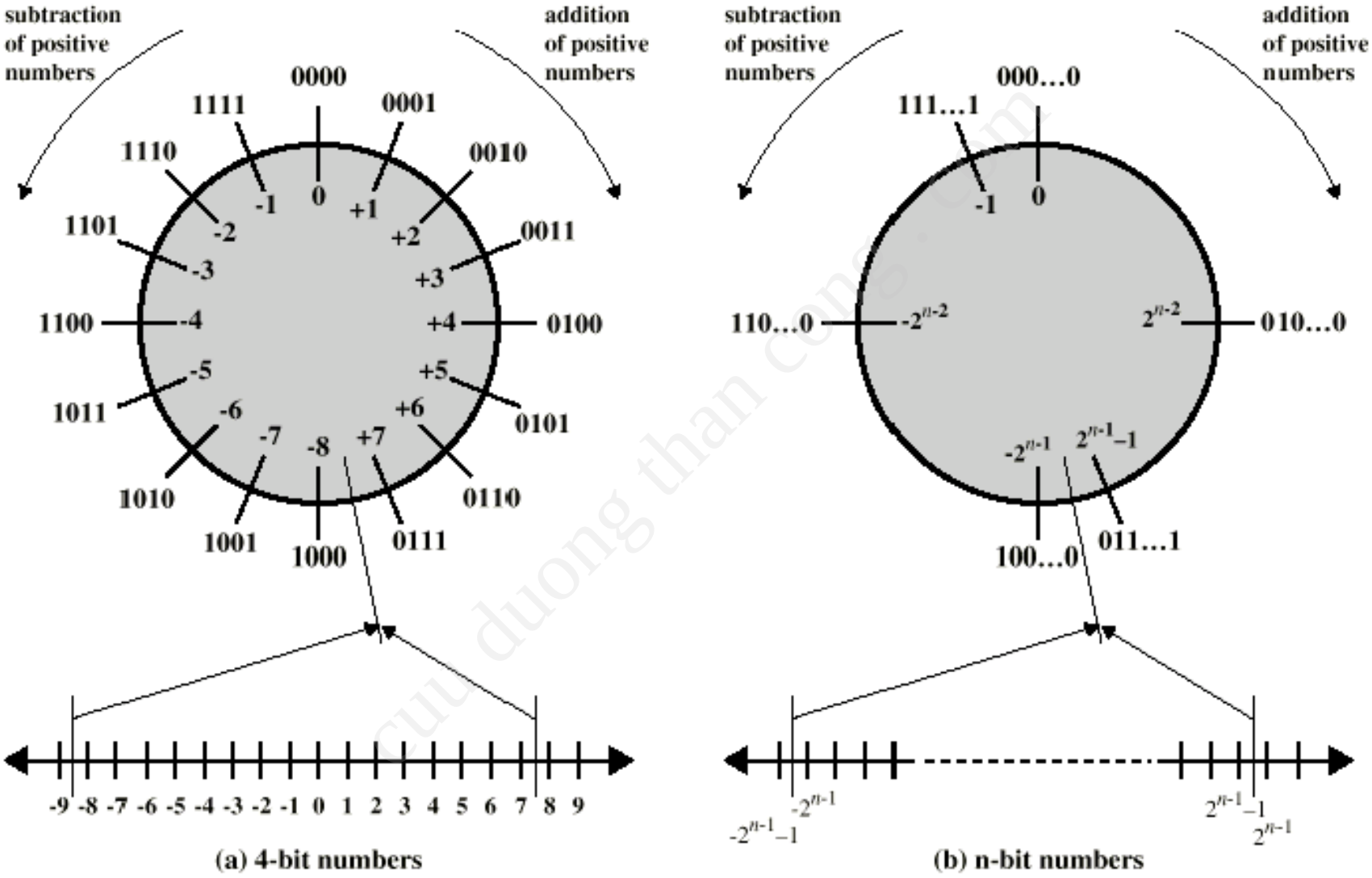
$$\text{n}$$

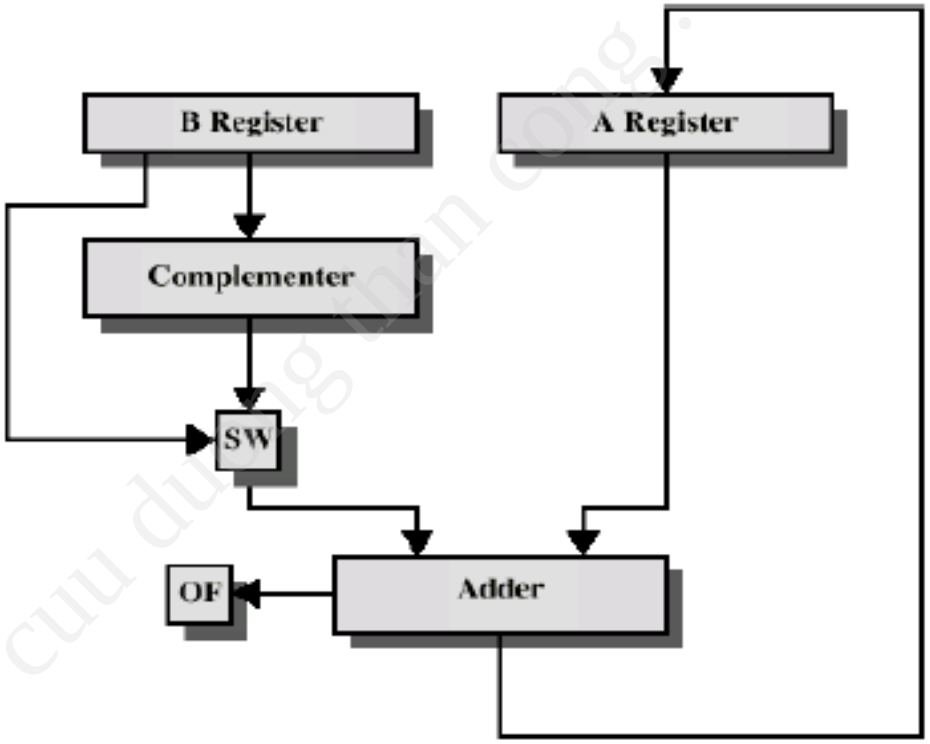
$$1001 = -7$$

$$+1010 = -6$$

$$\underline{\qquad\qquad\qquad}$$

$$1 \qquad\qquad \text{n}$$

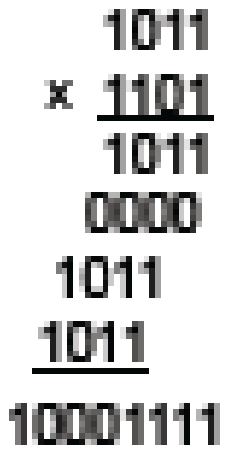




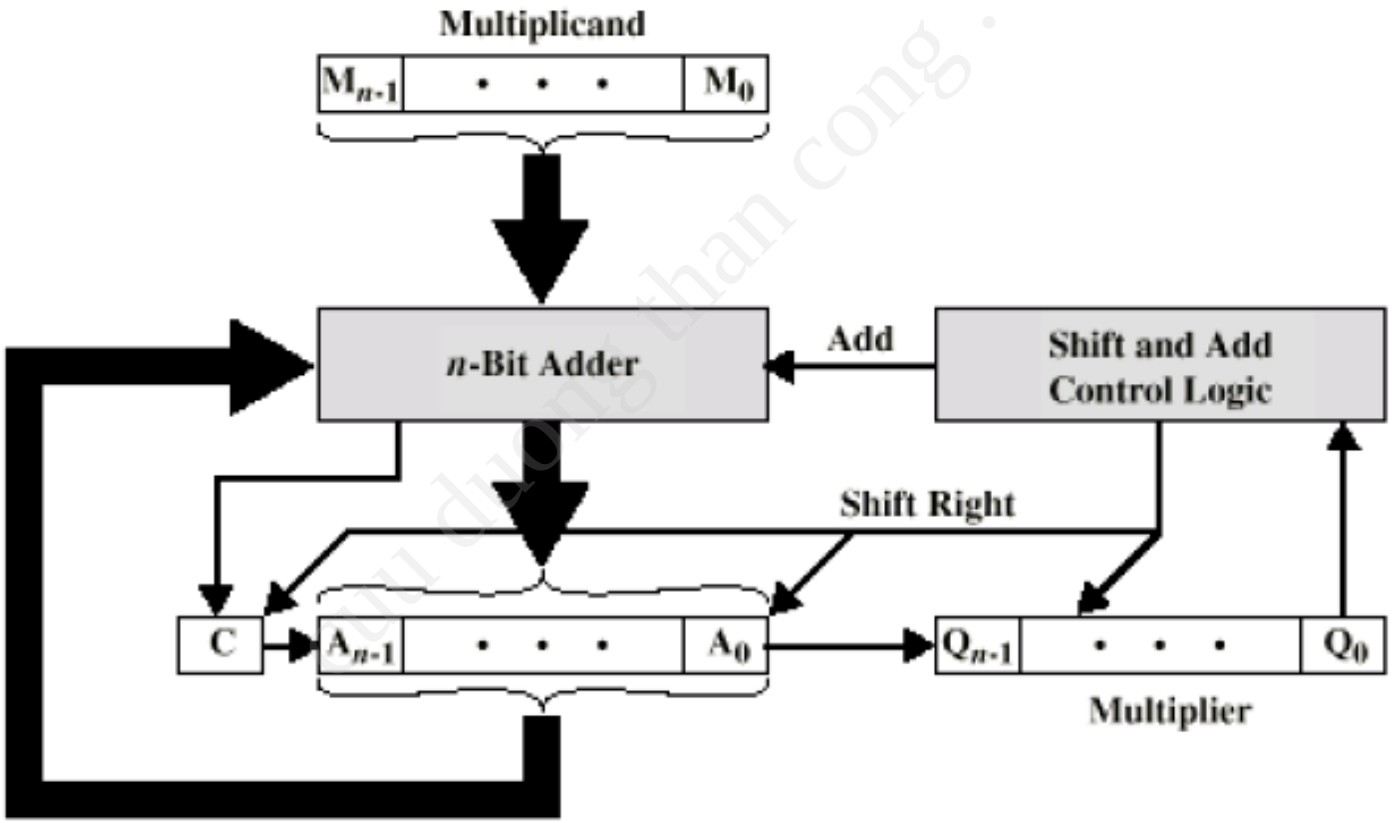
OF = overflow bit
SW = Switch (select addition or subtraction)

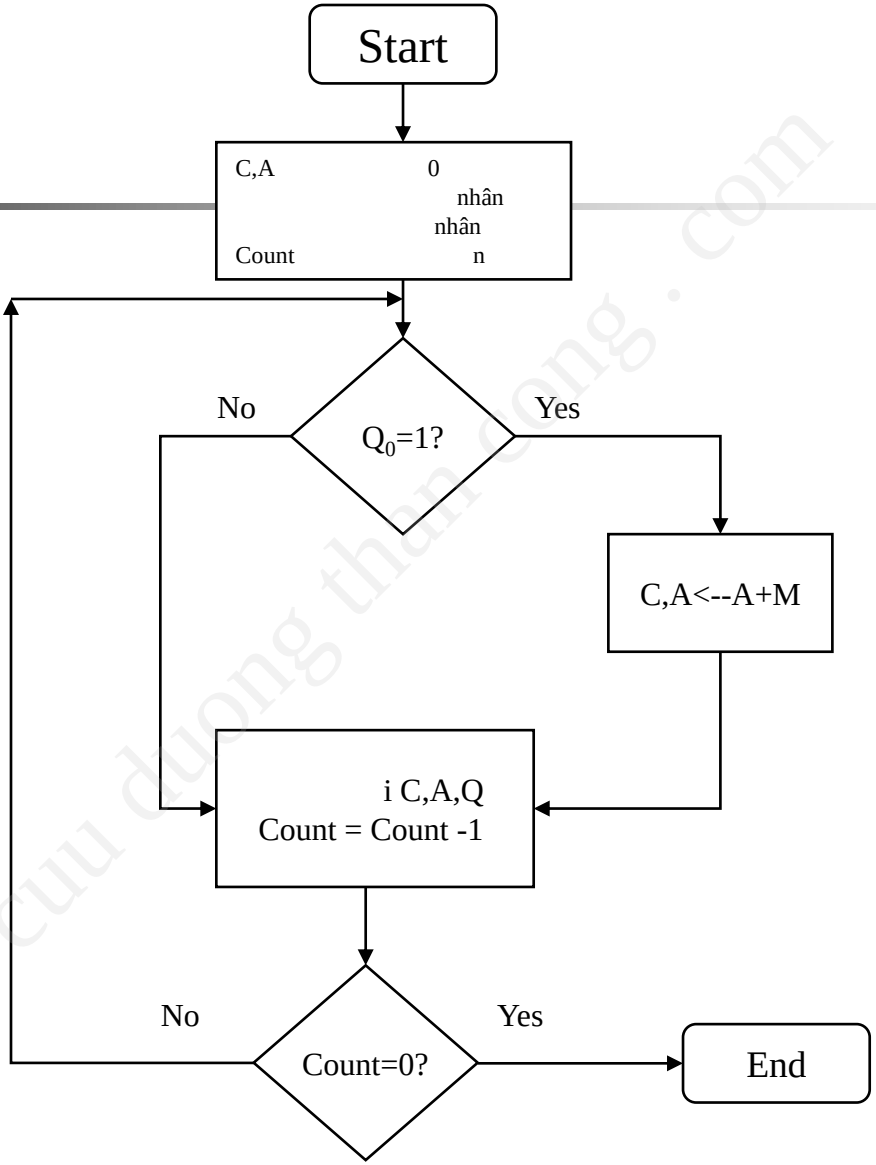
u

- c nhau.
- 2n bit



ch





nh nhân

C	A	Q	M		
0	0000	1101	1011	Initial Values	
0	1011	1101	1011	Add	First Cycle
0	0101	1110	1011	Shift	
0	0010	1111	1011	Shift	Second Cycle
0	1101	1111	1011	Add	Third Cycle
0	0110	1111	1011	Shift	
1	0001	1111	1011	Add	Fourth Cycle
0	1000	1111	1011	Shift	

2

-
  - *u* 11(1011) x 13 (1101) = 143 (10001111)
  - *2* 1011(-5) x 1101 (-3) = 10001111 (-113)
    -----> Sai
- âm

âm

- 0011
  - c 00011011 (9 x 3=27)
  - c 11101011 (-7 x 3 = -21)

1001	(9)		1001	(-7)
x 0011	(3)		x 0011	(3)
00001001	1001 x 2^0		11111001	(-7) x 2^0 = -7
00010010	1001 x 2^1		11110010	(-7) x 2^1= -14
00011011	(27)		11101011	(-21)

u 2

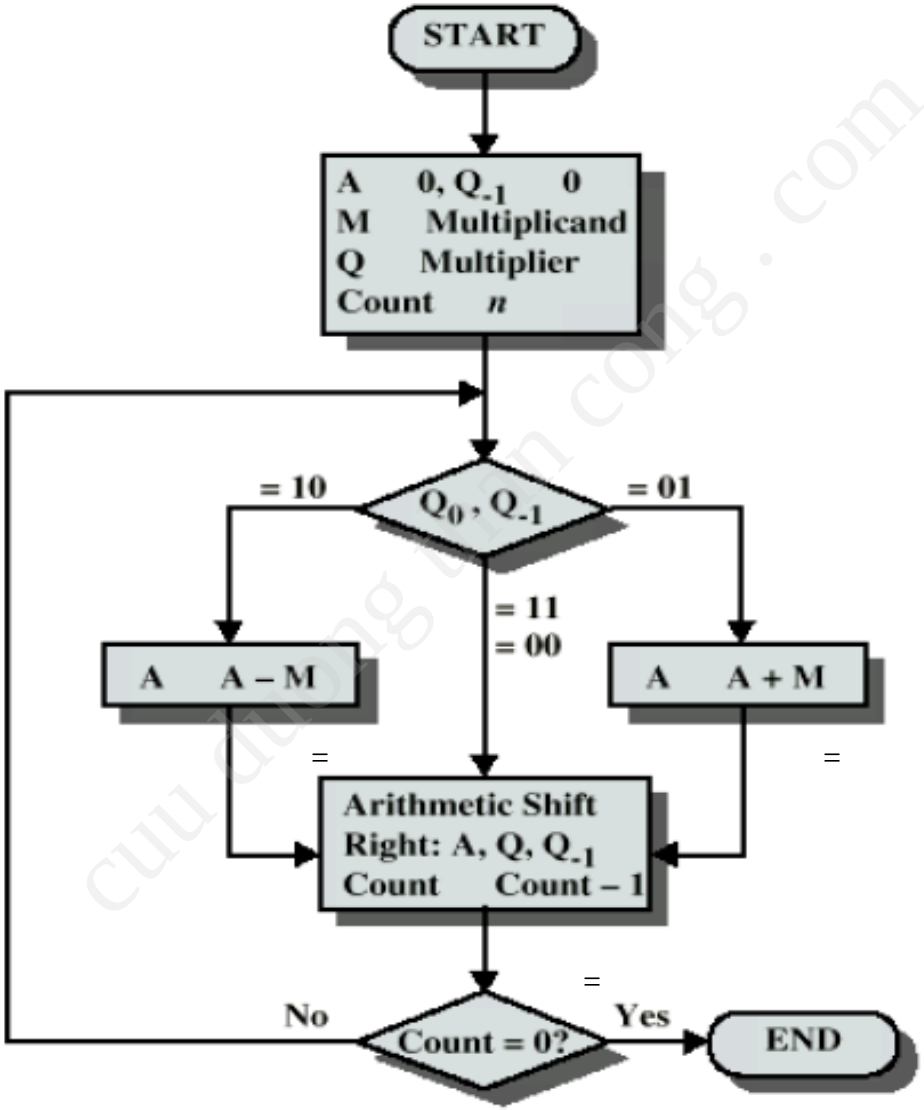
âm (tt)

- p:
  - u.
  - ng hơn

t Booth

-
  Q_{-1} i Q
- i A=0, Q_{-1} Count = n
- While Count>0
  - switch (Q_0Q_{-1})
    - Case 01 A=A+M
    - Case 10 A=A-M
  - rsht (A,Q,Q_{-1} i.
  - Count = Count - 1

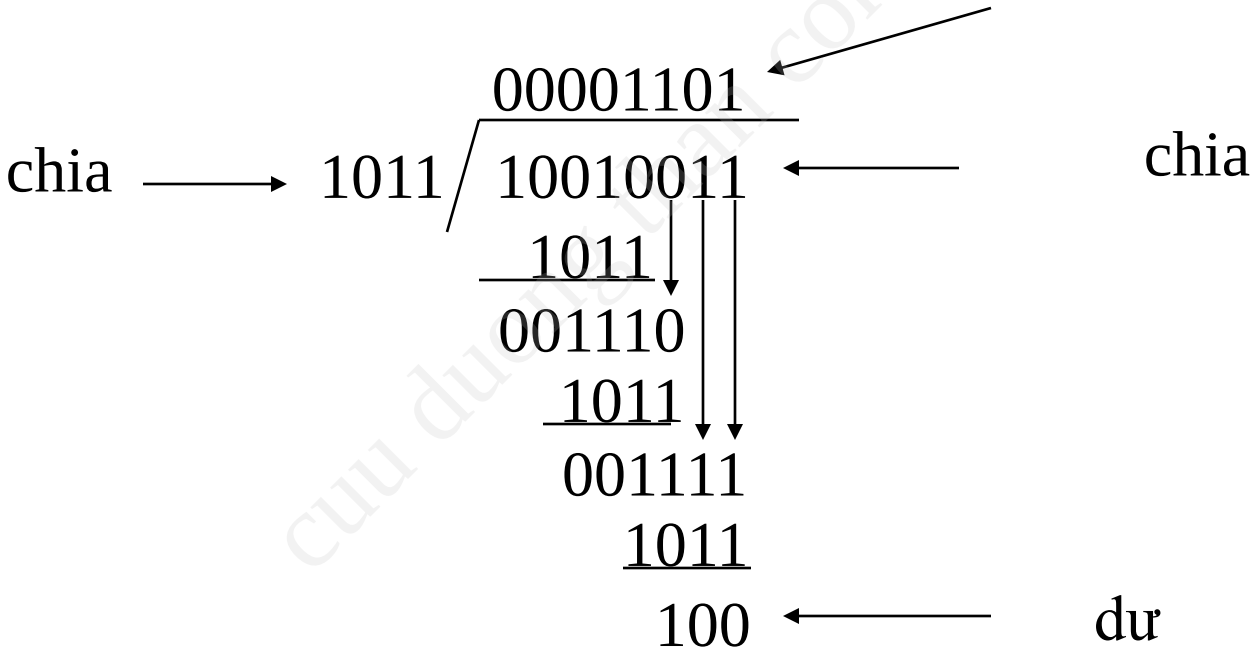
t Booth



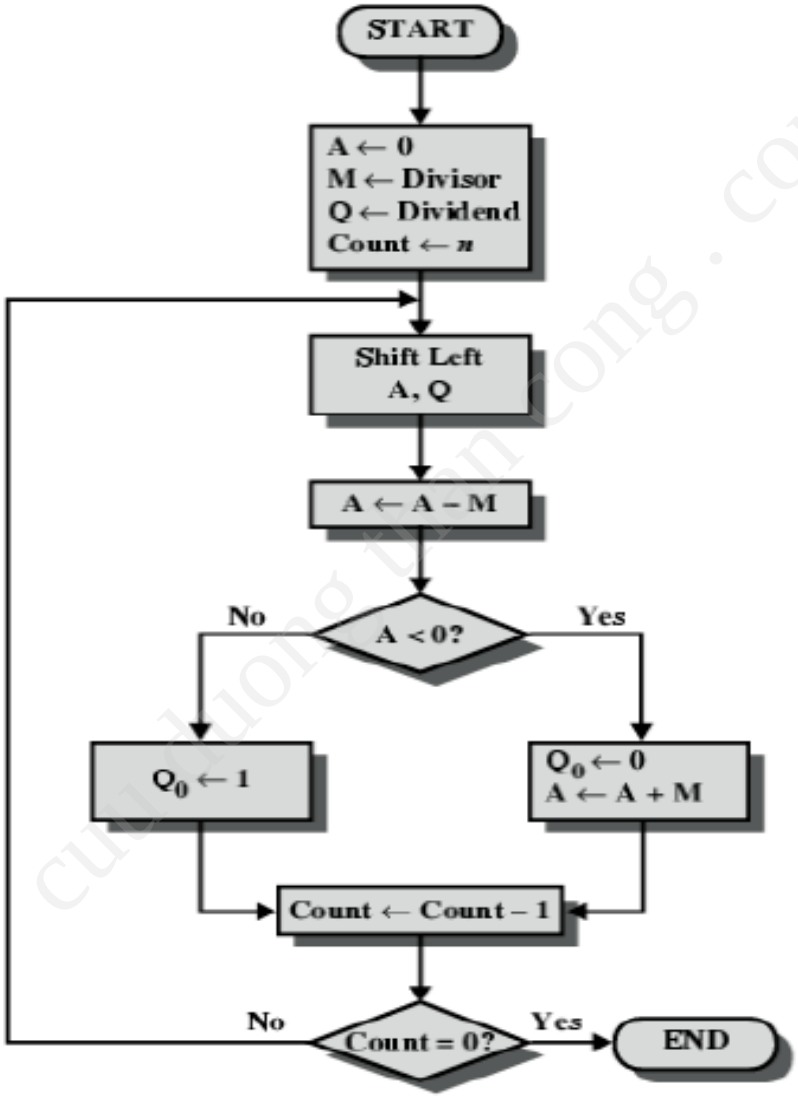
t Booth

A	Q	Q_{-1}	M		
0000	0011	0	0111	Initial Values	
1001	0011	0	0111	A A - M	First Cycle
1100	1001	1	0111	Shift	
1110	0100	1	0111	Shift	Second Cycle
0101	0100	1	0111	A A + M	Third Cycle
0010	1010	0	0111	Shift	
0001	0101	0	0111	Shift	Fourth Cycle

phân

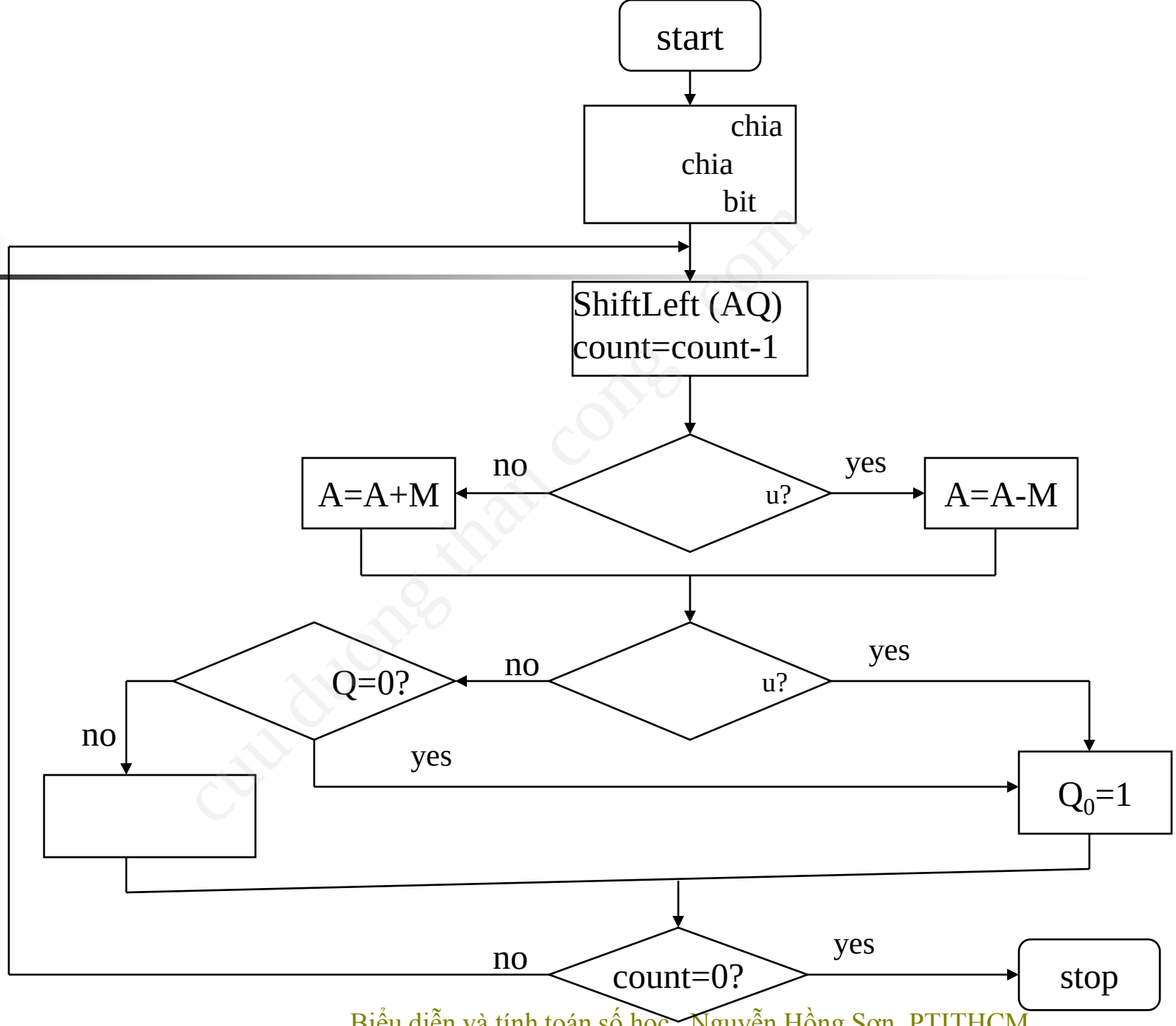


u



dư

- chia, Count = n
- While Count>0
  - i 1 bit
  - u
    - A=A-M
  - else
    - A=A+M
  - u
    - Q_0=1
  - else
    - Q=0
      - Q_0=1
    - else
      - nh.
  - Count = Count -1



A	Q = 0111 (7)	M=1101 (-3)
0000	0111	u
0000	1110	shift
1101		add
0000	1110	restore
0001	1100	shift
1110		add
0001	1100	restore
0011	1000	shift
0000		add
0000	1001	set Q_0=1
0001	0010	shift
1110		add
0001	0010	restore

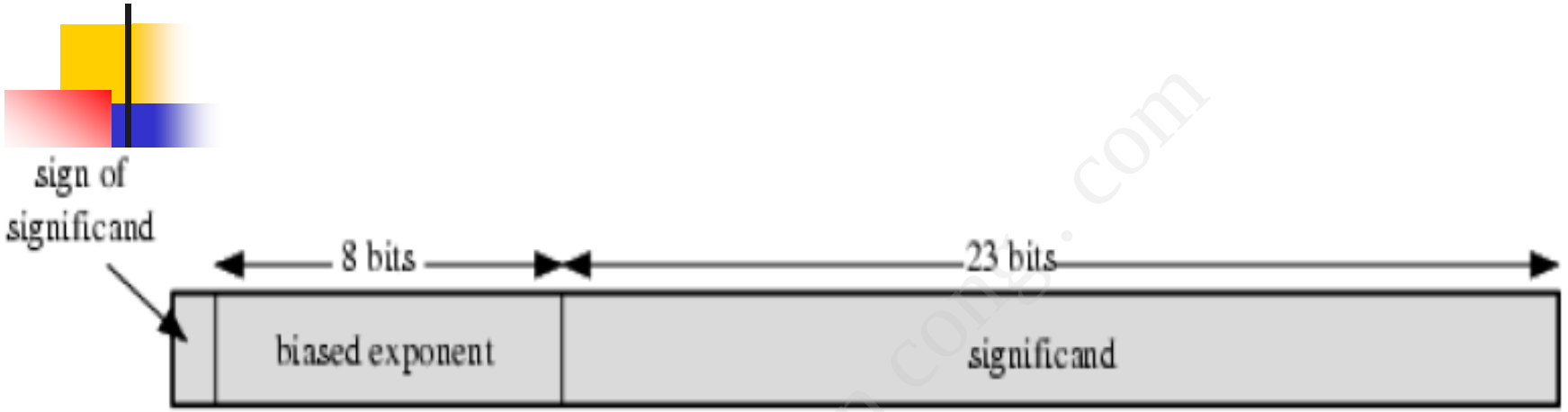
ng

(floating point)

- .
- : 168 000 000 000 000 = 1.68×10^{14}

  $0.0000000000000168 = 1.68 \times 10^{-14}$
- !
- ng:

$$S \times B^{E}$$



- dương sign = 0
- c = Biased Exponent - Bias
- Bias = $2^{k-1}-1 = 2^{(8-1)}-1 = 2^7-1 = 127$
- m
- :

0 11000100 11100000000000000000000

u +

= 1/2 + 1/4 + 1/8 = 0.875

= 69

a

- n:

  1.bbb…b 2 E

- – nh (không âm)
- o?
  - u (sign bit)
  - nh)
  - ng
  - a (bias)
  -

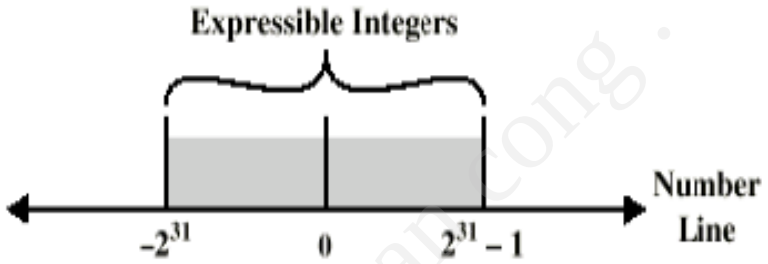
$1.1010001 \times 2^{10100} = 0\ 10010011\ 10100010000000000000000 = 1.6328125 \times 2^{20}$

$-1.1010001 \times 2^{10100} = 1\ 10010011\ 10100010000000000000000 = -1.6328125 \times 2^{20}$

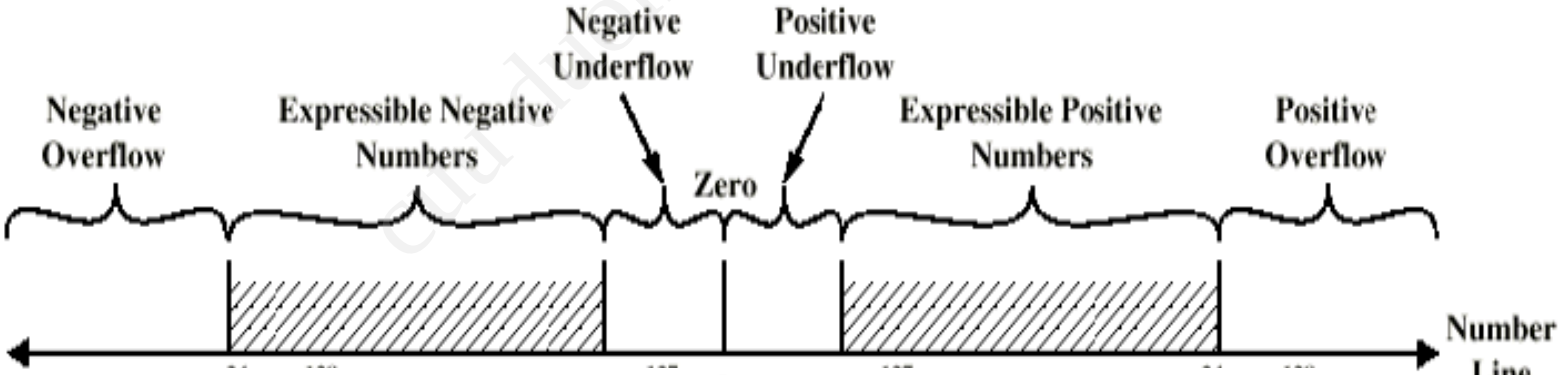
$1.1010001 \times 2^{-10100} = 0\ 01101011\ 10100010000000000000000 = 1.6328125 \times 2^{-20}$

$-1.1010001 \times 2^{-10100} = 1\ 01101011\ 10100010000000000000000 = -1.6328125 \times 2^{-20}$

i 32-bit word

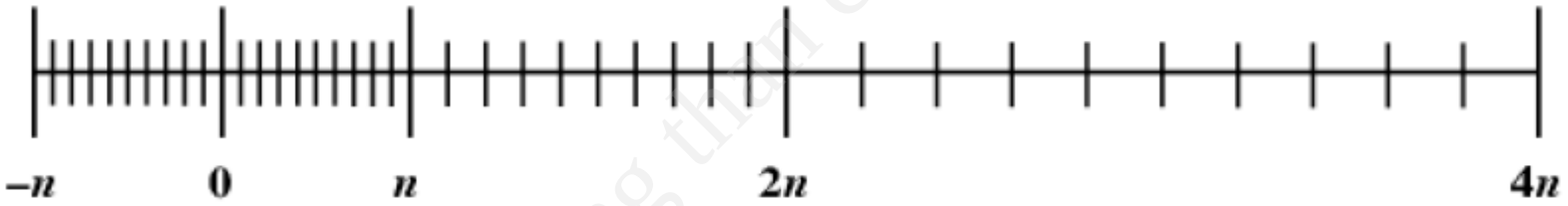


(a) Twos Complement Integers



(b) Floating-Point Numbers

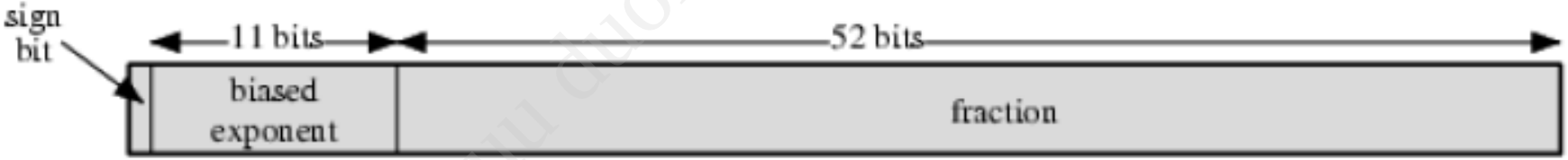
- ng cao.



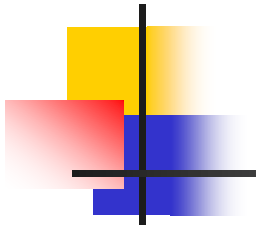
- p
  - -- --
    m.
  - double-precision (64bit))
  - thay $2^{10100} = 16^{101}$

n IEEE 754

(a) Single format



(b) Double format



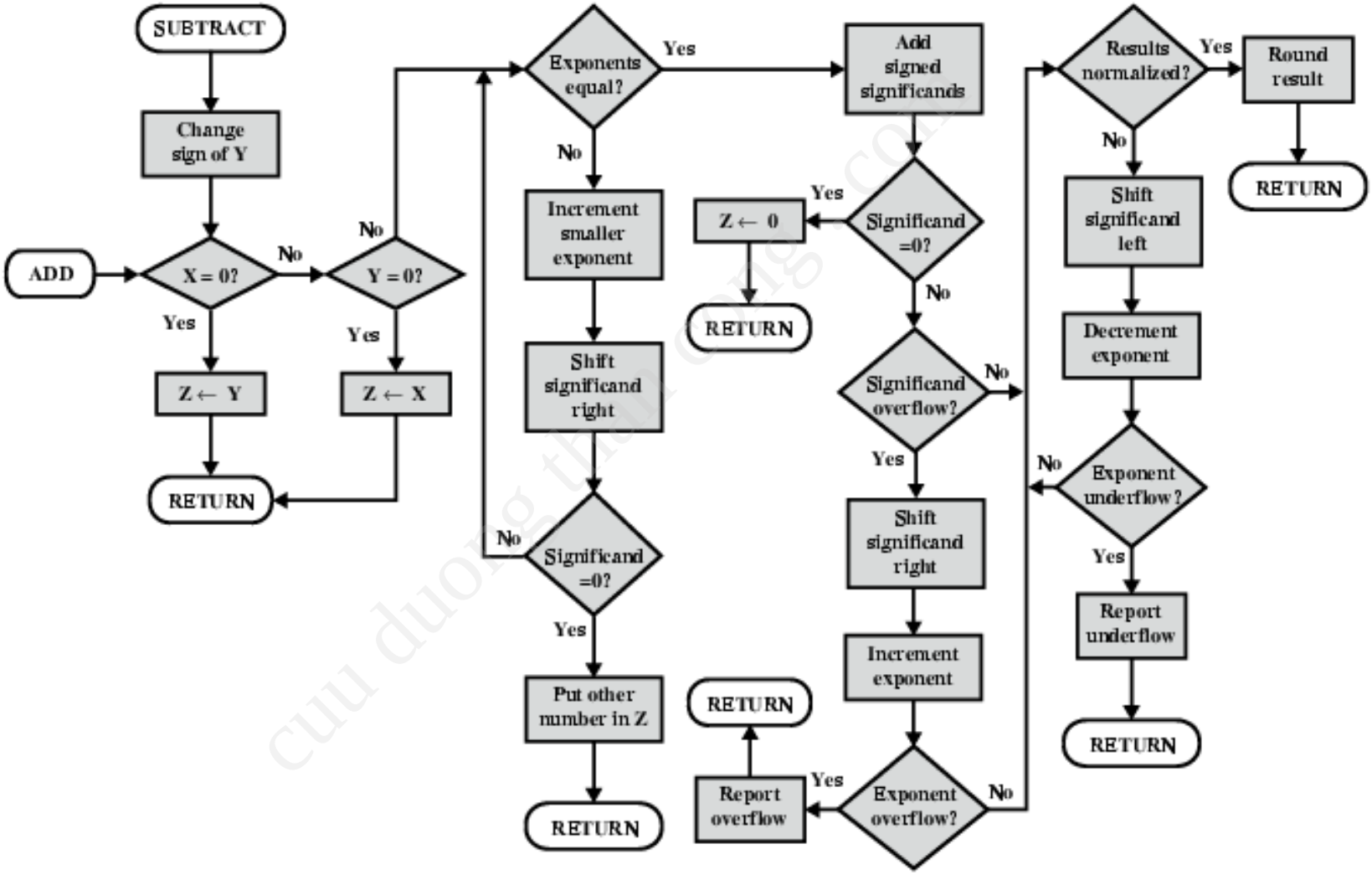
n IEE 754

[1]http://www.eecs.berkeley.edu/~wkahan/ieee754status/IEEE754.PDF
[2] http://babbage.cs.qc.edu/courses/cs341/IEEE-754references.html

ng

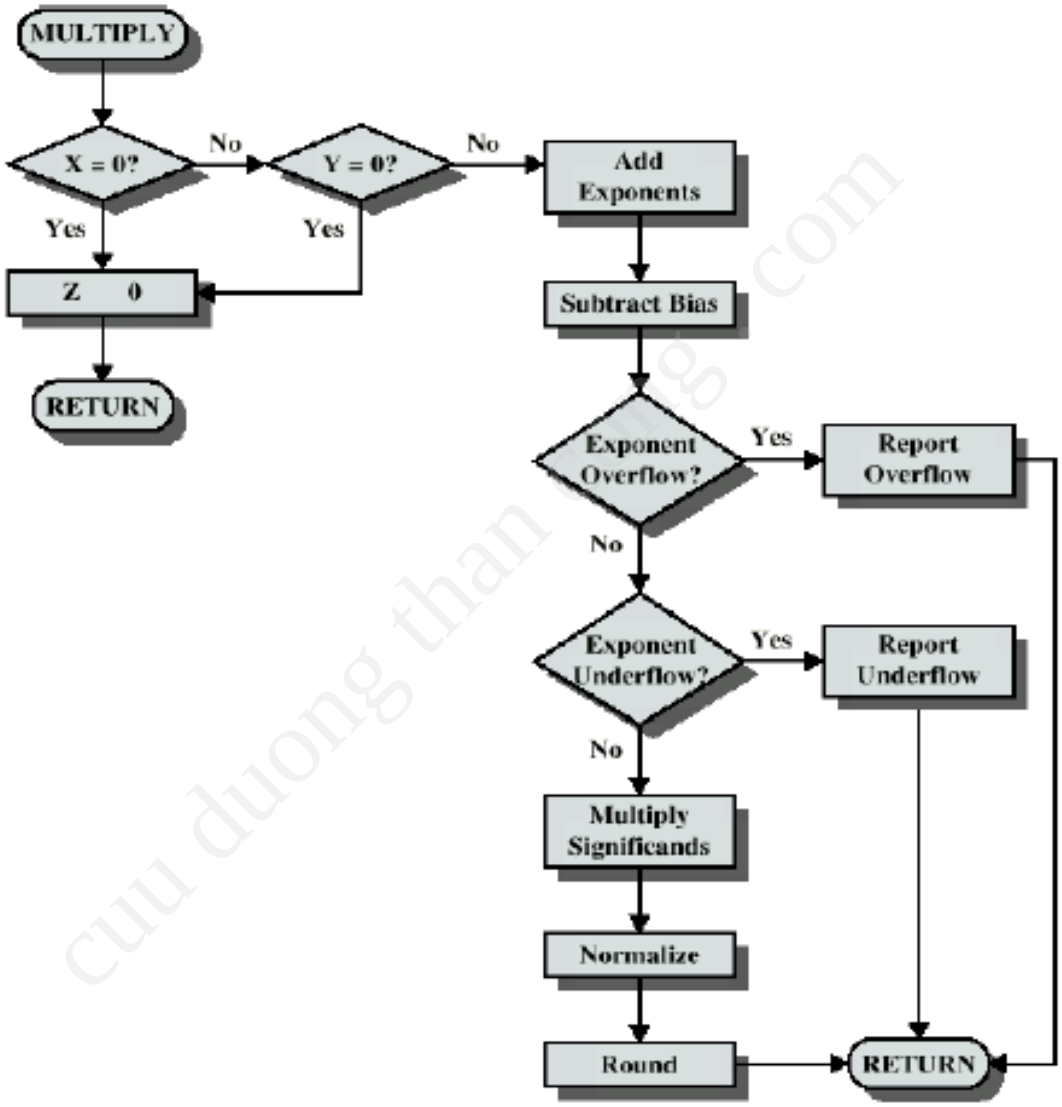
-
  - ng zero hay không
  -
  -
  - n)

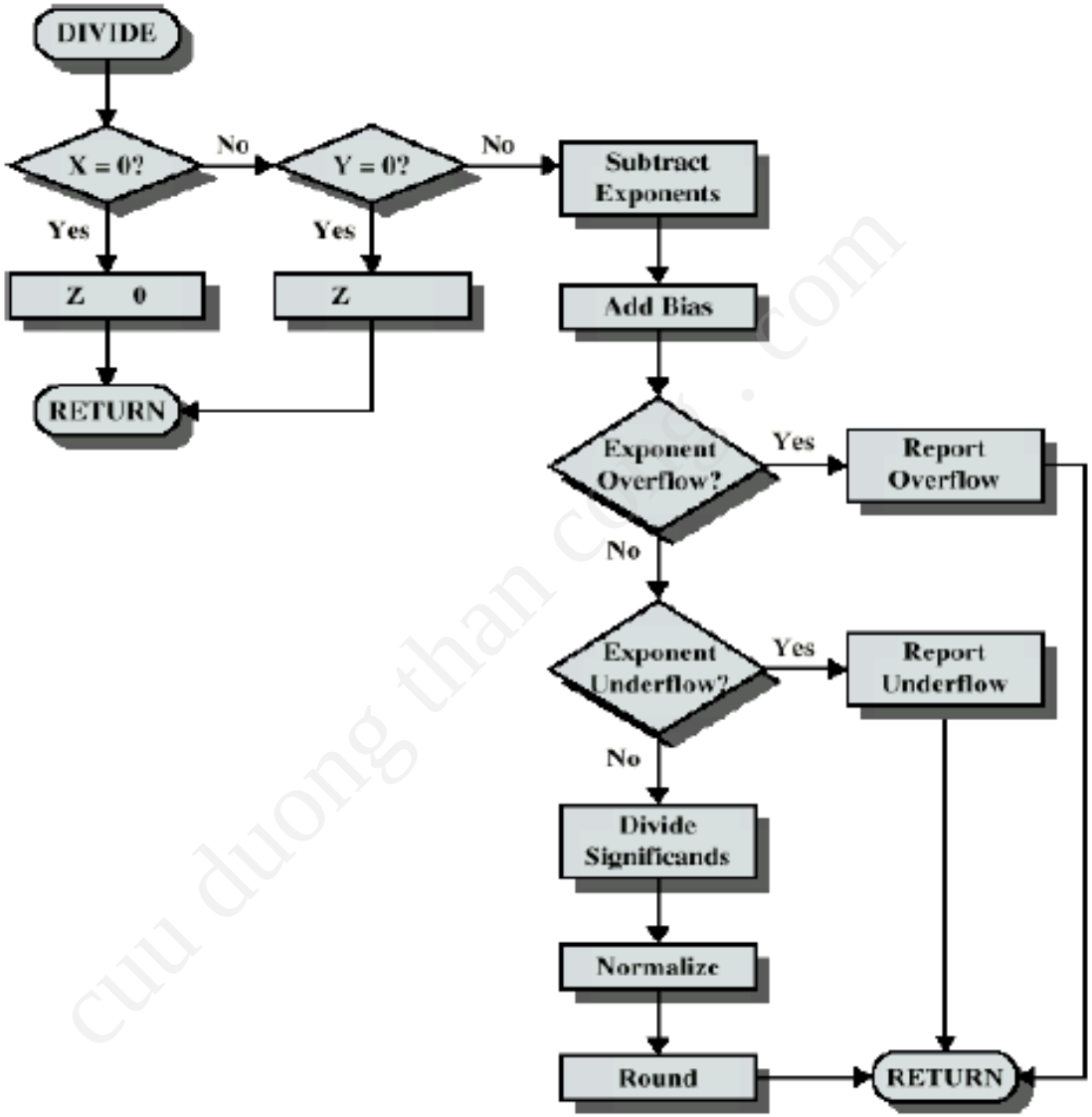
$(123 \times 10^0) - (456 \times 10^{-2}) = (123 \times 10^0) + (4.56 \times 10^0) = 127.56 \times 10^0$



(tt)

- chia
  - ng zero hay không
  -
  - i
  -
  - a
  - n





- X = 0.3 10^2 = 30
- Y = 0.2 10^3 = 200

nh

- X + Y=(0.3 x 10^{2-3} + 0.2) x 10^3 = 0,23 x 10^3
- X – Y=(0.3 x 10^{2-3} - 0.2) x 10^3 = - 0,17 x 10^3
- X Y= (0.3 x 0.2) x 10^{2+3} = 0.006 x 10^5
- X Y = (0.3 0.2) x 10^{2-3} = 1.5 x 10^{-1}

phân

- c
  - - $n < +\infty$
  - c

$5 + (+\infty)$	$=$	$+\infty$	$5 \div (-\infty)$	$=$	$+0$
$5 - (+\infty)$	$=$	$-\infty$	$(+\infty) + (+\infty)$	$=$	$+\infty$
$5 + (-\infty)$	$=$	$-\infty$	$(-\infty) + (-\infty)$	$=$	$-\infty$
$5 - (-\infty)$	$=$	$+\infty$	$(-\infty) - (+\infty)$	$=$	$-\infty$
$5 \times (+\infty)$	$=$	$+\infty$	$(+\infty) - (-\infty)$	$=$	$+\infty$

- Quiet and signaling NaNs (NaN = Not a Number)
- –

)

p

t

Booth.

2.

-

-

a:

a. -720

b. 0,645

p phân:

a. $0.5566 \times 10^3 + 0.7777 \times 10^3$

b. $0.3344 \times 10^2 - 0.8877 \times 10^{-1}$