SNS COLLEGE OF TECHNOLOGY

Coimbatore-35.

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COURSE NAME : 19ITT202 – COMPUTER ORGANIZATION AND ARCHITECTURE

II YEAR/ III SEMESTER

UNIT – II Arithmetic Operations

Topic: Addition & Subtraction of signed numbers

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Representation of Signed Numbers

- In computer, everything are binary numbers,
  - 0 represents positive number
  - 1 represents Negative numbers

- Left most bit represent the sign bit

Example

01001 +9

11001 - 9

Representation of Signed Numbers

- Following 3 representations

Signed magnitude representation
Signed 1's complement representation
Signed 2's complement representation

Example: Represent +9 and -9 in 7 bit-binary number

Only one way to represent + 9 ==> 0 001001

Three different ways to represent - 9:

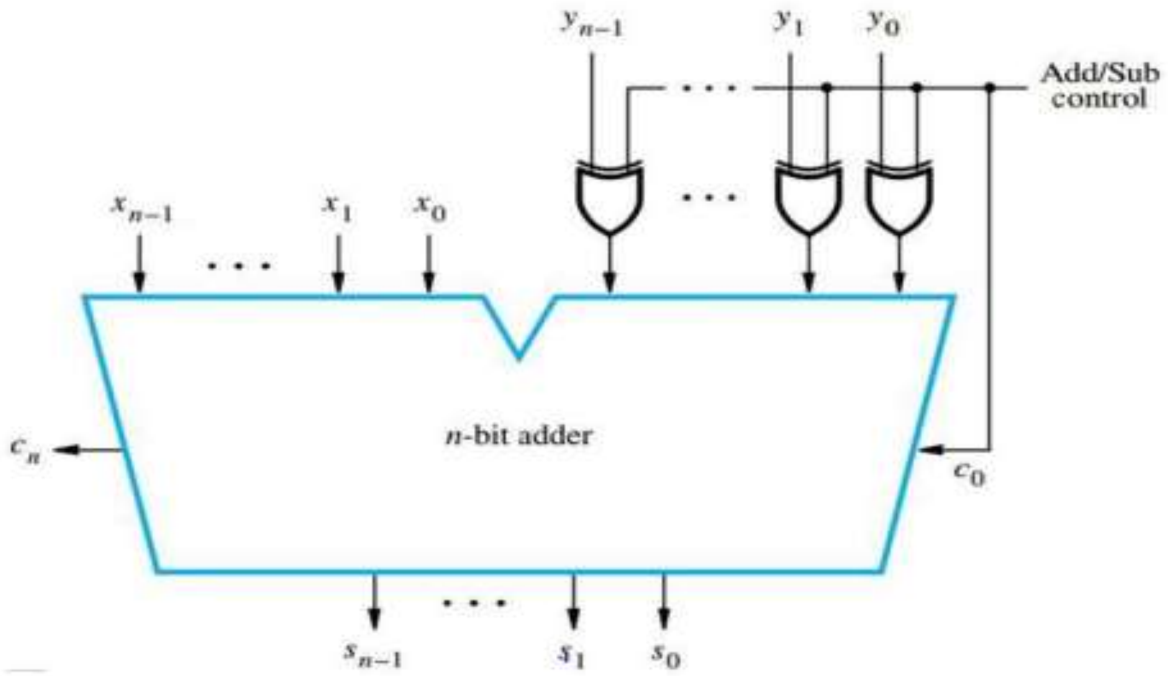
In signed-magnitude:	1 001001
In signed-1's complement:	1 110110
In signed-2's complement:	1 110111

1's & 2's Complement

- To get the 1's complement of a binary number, simply invert the given number. (all 1 to 0 and 0 to 1)

- To get 2's complement of a binary number, simply invert the given number and add 1 to the least significant bit(LSB).

Addition & Subtraction of Signed numbers



- Addition ➔ Add/sub control = 0.
- Subtraction ➔ Add/sub control = 1

Binary Addition/Subtraction Logic Network

Addition Algorithm

- Adding two numbers with same sign, add the values & keep the same sign for result.
- Adding two numbers with different sign, subtract the two values & keep the sign of larger value to the result.

Subtraction Algorithm

- To subtract the +ve or _ve numbers just change the sign of the number being subtracted and then perform addition algorithm.

Addition (subtraction) Algorithm

- When the sign of A and B are identical (different) , add the magnitudes and attach the sign of A to the result.
- When the signs of A and B are different (identical), compare the magnitudes and subtract the smaller number from the larger.
  - ➢ Choose the sign of result to be same as A if A>B
  - ➢ or the complement of sign of A if A<B
  - ➢ if A=B subtract B from A and make the sign of result positive

Operation	Add Magnitudes	Subtract Magnitudes		
		A>B	A<B	A=B
(+ A) + (+ B)	+ (A + B)			
(+ A) + (- B)		+ (A - B)	- (B - A)	+ (A - B)
(- A) + (+ B)		- (A - B)	+ (B - A)	+ (A - B)
(- A) + (- B)	- (A + B)			
(+ A) - (+ B)		+ (A - B)	- (B - A)	+ (A - B)
(+ A) - (- B)	+ (A + B)			
(- A) - (+ B)	- (A + B)			
(- A) - (- B)		- (A - B)	+ (B - A)	+ (A - B)

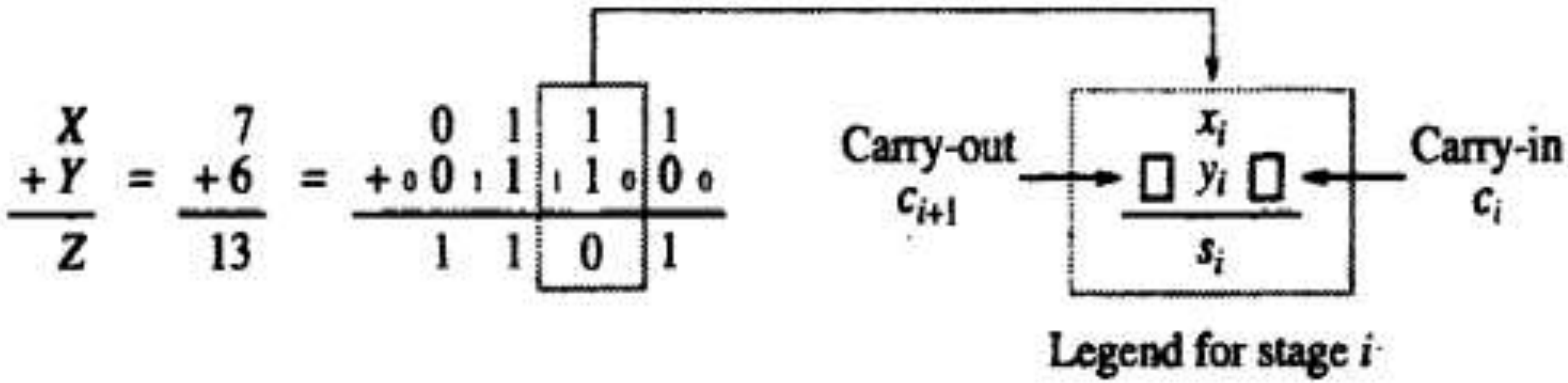


Figure 6.1 Logic specification for a stage of binary addition.

Example

Adding 6_{10} to 7_{10} in binary

Solution

6	0110
7	0111
13	1101

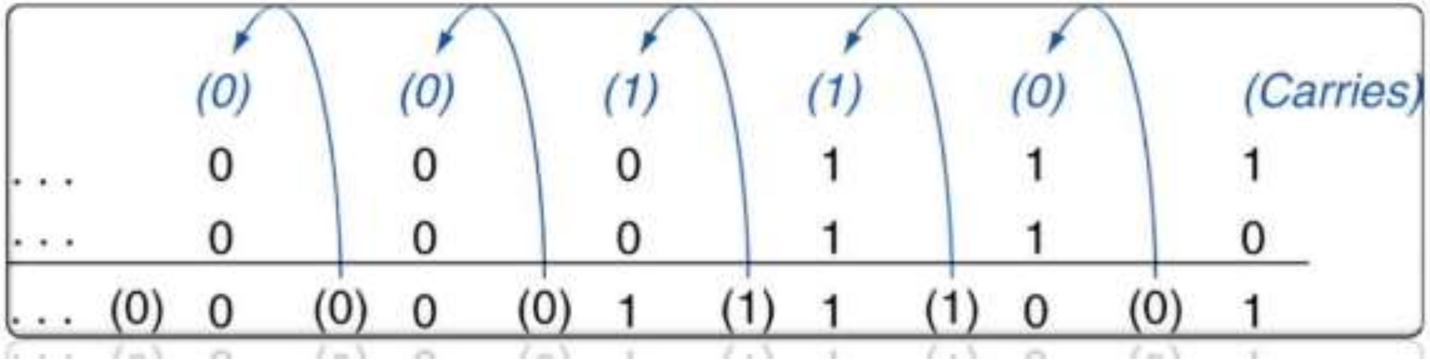
Computer Addition

- Can be taken place in 32 bit formats

$$0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 0111_2 = 7_{10}$$

$$0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 0110_2 = 6_{10}$$

$$0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000\ 1101_2 = 13_{10}$$



Example

- Consider a two 4 bit positive number
- +9 and +8 = 01001 + 01000 = 10001
- Consider a two 8 bit positive number
- +98 and +87

    01001 1000

    01000 0111

    10001 1111

Example

- Consider a two 4 bit Negative number
- -9 and -6 = 11001 + 10110 = 101111
  - 1's complement - to avoid overflow
- Consider a two 8 bit positive number
- -83and -24

11000 0011
10010 0100
101010 0111

Subtract the following.

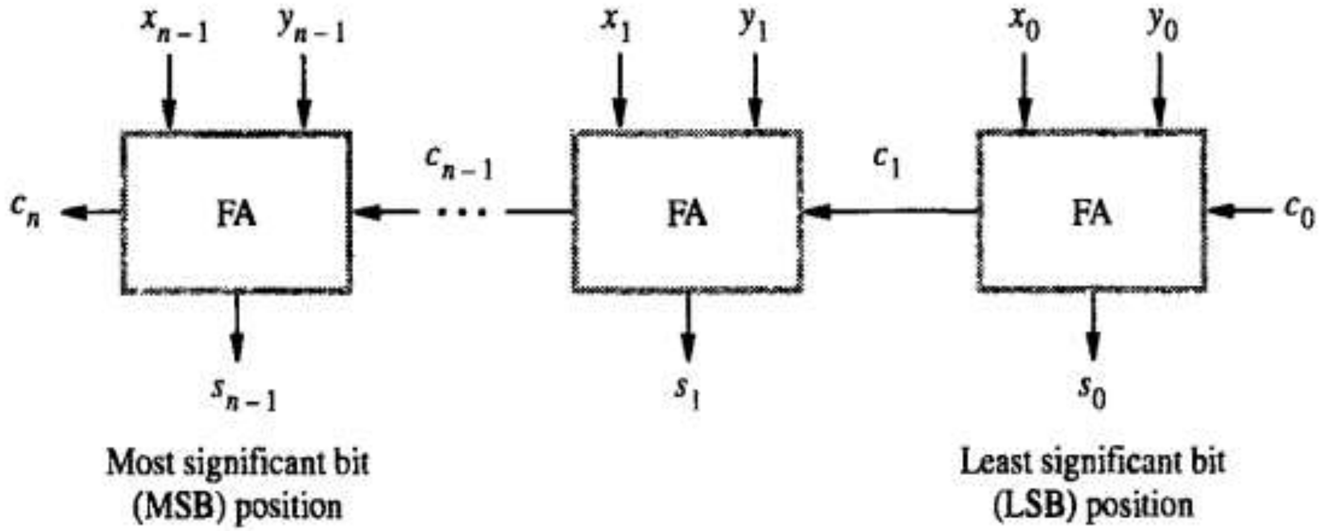
1. $+12 - (+4) = +12 + (-4) = 8$

2. $+16 - (-6) = +16 + (+6) = 22$

3. $-20 - (+3) = -20 + (-3) = -23$

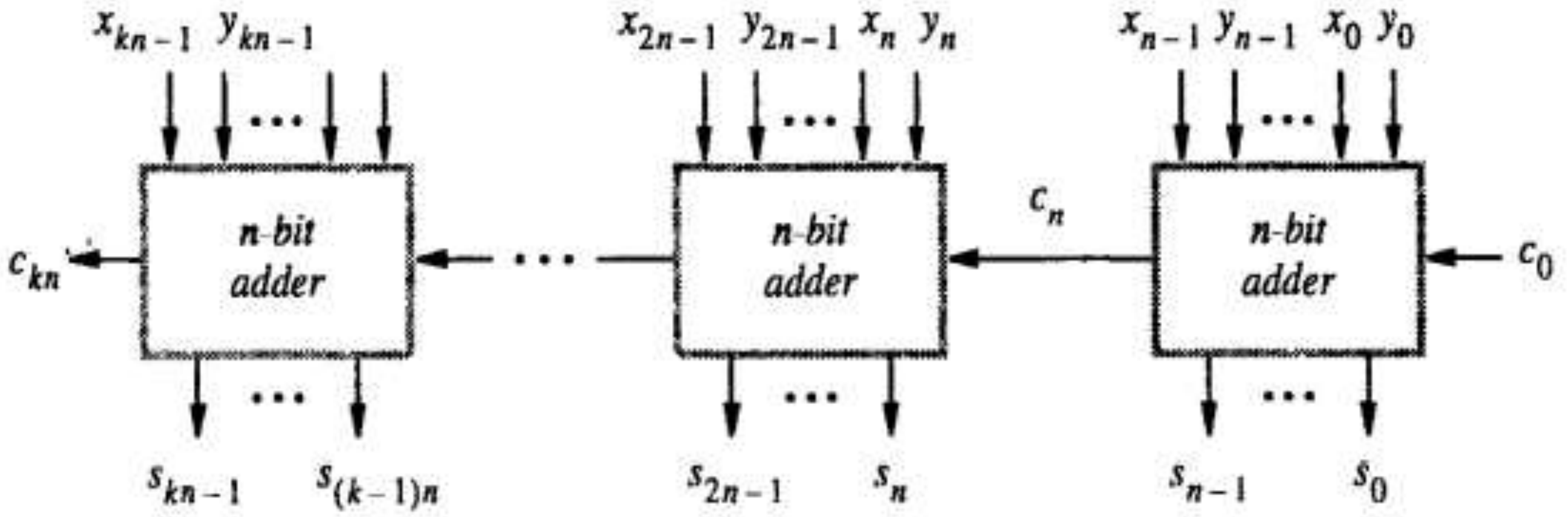
4. $-5 - (-2) = -5 + (+2) = -3$

n-bit ripple-carry adder



(b) An *n*-bit ripple-carry adder

A cascaded connection of ***n*** full adder blocks, as shown in Figure 6.2*b*, can be used to add two ***n***-bit numbers. Since the carries must propagate, or ripple, through this cascade, the configuration is called an ***n-bit ripple-carry adder***.



(c) Cascade of *k* *n*-bit adders

Figure 6.2 Logic for addition of binary vectors.

Reference link

Cliffsnotes.com

https://www.cliffsnotes.com/study-guides/algebra/algebra-i/signed-numbers-fractions-and-percents/signed-numbers-positive-numbers-and-negative-numbers#:~:text=When%20adding%20two%20numbers%20with%20different%20signs%20(one%20positive%20and,with%20the%20larger%20absolute%20value.&text=Add%20the%20following.,-Example%203&text=Add%20the%20following.,-15&text=To%20subtract%20positive%20and%2For,being%20subtracted%20and%20then%20add.


THANK
YOU!