Logical Design

Lecture 7

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Example of the three representations

Example: Express the decimal number (−39) as the 8 bits number in the following forms:

1- Sing-magnitude.

2- 1’s complement.

3- 2’s complement.

Solution:

Find out the Binary number of (+39) (+39)10 = 00100111

1- In the sign magnitude form, (−39) can be produced by changing the sign bit only to ”1” and leave the magnitude bits as they are. So (−39) will be 10100111.

2- In the 1’s complement, change each ”1” to ”0” and each ”0” to ”1”. So (−39) will be 11011000

3- In the 2’s complement, get 1’s complement of (−39) and add ”1” to it. So (−39) will be 11011001

Decimal number of Signed number (Sign-Magnitude (S&M))

Sign-Magnitude (S&M): Decimal values of +ve and −ve number in the SM form can be determined by getting the summation of the weights in the magnitude part. To calculate the weights, we consider those bits that have ones only ”1”, and ignoring those bits that have zeros ”0”.

Example:

Define the decimal value in sign magnitude form of the following binary number: 10010011

The seven magnitude bits and their weights as follows:

$64 * 0 + 32 * 0 + 16 * 1 + 8 * 0 + 4 * 0 + 2 * 1 + 1 * 1 = +19$

If the sign bit is ”1”, so the binary number of (−19) = 1010011

Decimal number of Signed number(1’s complement)

2- 1’s complement:

Decimal values of +ve numbers in 1’s complement form are determined by summing the weights in all bit position that have Ones and ignoring those bit positions that have zeros.

Decimal values of −ve numbers are determined by assigning a −ve values to the weight of the sign bit, then summing all weights where there are Ones, and adding 1 to the result.

Example: Determine the decimal values of the following signed binary numbers using 1’s complement:
00010111

128∗0+64∗0+32∗0+16∗1+8∗0+4∗1+2∗1+1∗1=

= 16 + 4 + 2 + 1 = +23

Decimal number of Signed number(1’s complement)

11101000

$-128*1+64*1+32*1+16*0+8*1+4*0+2*0+1*0=$

$= -128 + 64 + 32 + 8 = -24$

Adding ”1” to the result, the final decimal number is −23

Decimal number of Signed number(2’s complement)

3- **2’s complement:**
Decimal values of +ve and −ve numbers in 2’s complement form are determined by getting the summation the weight in bits position where there are oncs and ignoring those bit positions having zeros.

Example: Determine the decimal value of the following singed numbers using 2’s complement:

01010110

$-128*0+64*1+32*0+16*1+8*0+4*1+2*1+1*0=$

$= 64 + 16 + 4 + 2 = +86$

10101010

$-128*1+64*0+32*1+16*0+8*1+4*0+2*1+1*0=$

$= -128 + 32 + 8 + 2 = -86$

The range of unsigned and signed number.

- The 8 bit is used to illustrate a number because the storage unit in the computer is known as a Byte.
- The maximum decimal number that can be represented with 1 Byte is 255 or 11111111. An 8-bit word greatly restricts the range of numbers that can be accommodated. The maximum number of values is 256 or 0 through 255.
- The maximum decimal number that can be represented with 2 Bytes (Word) is 65536. The represented value could be 0, 1, 2, 3, through 65535.
- The maximum decimal number that can be represented with 4 Bytes (Double word) is $4.295 * 109$

The range numbers of different combinations

- **Unsigned number:** For 8 bits
  Minimum:0 0 0 0 0 0 0 0 Maximum:1 1 1 1 1 1 1 1
- **Signed number- Signed & Magnitude (SM):**

➢ For +ve number

Minimum: 0 0000000=+0 Maximum: 0 1111111=+127

➢ For −ve number S

Minimum: 1 0000000=−0 Maximum: 1 1111111=−127

Range ==> -127 ——> +127

The range numbers of different combinations

Signed number- 1’s complement:

For +ve number

Minimum:0 0 0 0 0 0 0 0=+0 Maximum:0 1 1 1 1 1 1 1=+127

• For −ve number

Minimum:1 0 0 0 0 0 0 0=−127 Maximum:1 1 1 1 1 1 1 1=−0

Range ==> -127 ——> +127

The range numbers of different combinations

Signed number- 2’s complement:

• For +ve number

Minimum:0 0 0 0 0 0 0 0=0 Maximum:0 1 1 1 1 1 1 1=+127

• For −ve number

Minimum:1 0 0 0 0 0 0 0=−128 Maximum:1 1 1 1 1 1 1 1=−1

Range ==> -128 ——> +127

Binary Coded Decimal (BCD).

A code used to represent each decimal digit of a number by a 4-Bit Binary Value, the following table represents a conversion of decimal number to BCD.

Decimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001