Binary numbers reprezentation

Binary numbers can be represented in two forms:

- fixed – point representation
- floating – point representation

We also need to represent negative and positive numbers for computations. The signed binary numbers can be represented in 3 systems:

- signed – magnitude system
- one’s complement system
- two’s complement system

Fixed – point representation

- Unsigned integers

	128	64	32	16	8	4	2	1
34								
102								
255								

- Unsigned fractionals

	.	0.5	0.25	0.125	0.0625	0,03125		
0,75	0.							
0.825	0.							
0,84	0.							

Fixed – point representation

Signed numbers

- signed – magnitude system
- one’s complement system
- two’s complement system

In all these systems an extra bit position is used to represent the sign. That’s why the MSB of a bit string is used as the sign (0=plus, 1=minus).

Signed – magnitude system (Direct code)

$$N_{CC} = \begin{cases} 0\ b_{n-1}b_{n-2}b_{n-3}\ldots b_1 b_0 & ; N \geq 0 \\ 1\ \overline{b_{n-1}}\,\overline{b_{n-2}}\,\overline{b_{n-3}}\ldots\overline{b_1}(\overline{b_0}+1) & ; N < 0 \end{cases}$$

	Sg	64	32	16	8	4	2	1
34								
102								
-102								
127								
-127								
0+								
0-								

$-(2^n-1) \leq N_{DC} \leq 2^n-1$

$-(1-2^{-m}) \leq N_{DC} \leq (1-2^{-m})$

One's complement system (Inverse code)

$$N_{IC}= \begin{cases} 0\ b_{n-1}b_{n-2}b_{n-3}\ldots b_1b_0 & ;N\geq 0 \\ 1\ \overline{b_{n-1}}\,\overline{b_{n-2}}\,\overline{b_{n-3}}\ldots \overline{b_1}\,\overline{b_0} & ;N<0 \end{cases}$$

$$(r^n-1)-N.$$

	Sg	64	32	16	8	4	2	1
34								
102								
-102								
127								
-127								
0+								
0-								

$$-(2^n-1) \leq N_{DC} \leq 2^n-1$$

$$-(1-2^{-m}) \leq N_{DC} \leq (1-2^{-m})$$

Two’s complement system (Complement code)

$$N_{CC} = \begin{cases} 0\ b_{n-1}b_{n-2}b_{n-3}\ldots b_1 b_0 & ; N \geq 0 \\ 1\ \overline{b_{n-1}}\,\overline{b_{n-2}}\,\overline{b_{n-3}}\ldots\overline{b_1}(\overline{b_0}+1) & ; N<0 \end{cases}$$

$$r^n\text{-}N$$

	Sg	64	32	16	8	4	2	1
34								
102								
-102								
127								
-127								
0+								
0-								

$-2^n \leq N_{CC} \leq 2^n$

$-1 \leq N_{CC} \leq 1\text{-}2^{-m}$