

- People use decimal system
  - Computers use the binary or hexadecimal system
  - Negative numbers in binary are usually represented in two's complement form.
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## Unit 6

Number systems

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Dec	Bin	Hex	Octal
0	00000000 00000000	0	0
1	00000000 00000001	1	1
2	00000000 00000010	2	2
3	00000000 00000011	3	3
4	00000000 00000100	4	4
5	00000000 00000101	5	5
6	00000000 00000110	6	6
7	00000000 00000111	7	7
8	00000000 00001000	8	10
9	00000000 00001001	9	11
10	00000000 00001010	A	12
11	00000000 00001011	B	13
12	00000000 00001100	C	14
13	00000000 00001101	D	15
14	00000000 00001110	E	16
15	00000000 00001111	F	17
16	00000000 00010000	10	20
17	00000000 00010001	11	21
18	00000000 00010010	12	22
218	00000000 11011010	DA	332

## Conversion from hexadecimal to decimal

Rule is that the position of the digit indicates the power of the base which multiplies the digit.

$$\begin{aligned} 1A09_{\text{H}} &= 1 \times 16^3 + 10 \times 16^2 \\ &\quad + 0 \times 16^1 + 9 \times 16^0 \\ &= 6665_{\text{H}} \end{aligned}$$

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## Conversion from decimal to hexadecimal

Repeated division by 16.

Successively divide  $1357_{\text{D}}$  by 16 noting the remainder at each stage.

$$\begin{array}{r} 16 \overline{) 1357} \\ \underline{16 \overline{) 84}} \quad 13 = \text{D} \\ \underline{16 \overline{) 5}} \quad 4 = 4 \\ 0 \quad 5 = 5 \end{array}$$

So the equivalence is  $1357_{\text{D}} = 54\text{D}_{\text{H}}$ .

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Signed binary arithmetic

A leading sign bit does not work.

3A		00111010	
-3A	and	10111010	
00		11110100	= F4

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Use two's complement arithmetic.

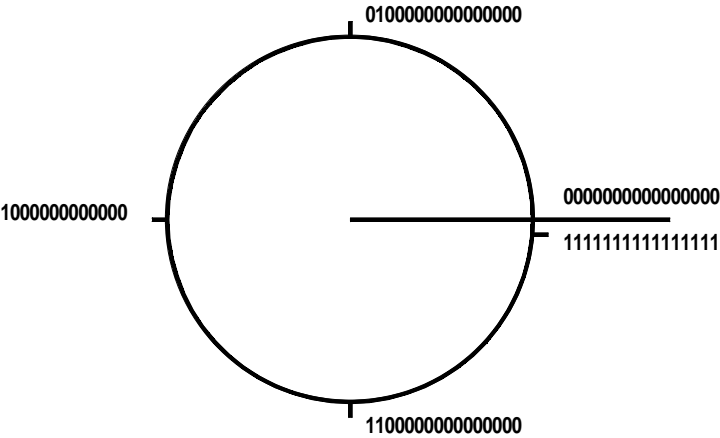
26D	=	0000	0010	0110	1101
1's complement	=	1111	1101	1001	0010
add 1					1
2's complement	=	1111	1101	1001	0011

Apply the test  $X + (-X) = 0$

26D	=	0000	0010	0110	1101
-26D	=	1111	1101	1001	0011
000	=1	0000	0000	0000	0000

The carry is now discarded

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Wraparound when the maximum is exceeded.

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