

Radices

Dec	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Oct	0	1	2	3	4	5	6	7	10	11	12	13	14	15	16	17	20	21
Hex	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11

Binary Arithmetic (Examples)

Signed (8 Bit)	1's Comp (8 Bit)	2's Comp (8 Bit)	No.
10100111	11011000	11011001	-39
10101101	11010010	11010011	-55
11000101	10111010	10111011	-69

2's Comp: Flipped Binary when -ve, +1

1's Comp: Flipped Binary when -ve

(2 Zeros: 0000 and 1111)

Signed: MSB Flipped when -ve

Binary Formats: N-Bit Number

Excess- $2^{(N-1)}$: $-2^{(N-1)} \leq x \leq (2^{(N-1)} - 1)$

2's Comp: $-2^{(N-1)} \leq x \leq (2^{(N-1)} - 1)$

1's Comp: $-(2^{(N-1)} - 1) \leq x \leq (2^{(N-1)} - 1)$

Signed-Mag: $-(2^{(N-1)} - 1) \leq x \leq (2^{(N-1)} - 1)$

Unsigned-Mag: $0 \leq x \leq 2^N - 1$

Binary Coded Decimal (BCD)

Structure:

- Each decimal digit (0–9) is represented by a 4-bit binary number.

- BCD represents multi-digit numbers by encoding each digit individually in binary.

- Valid BCD values: 0000 to 1001 (0–9).

- Invalid BCD values: 1010 to 1111 (10–15).

Conversion:

Decimal to BCD

1. Split number into individual digits

2. Convert each digit to 4-bit binary

e.g. 3579 → 3 5 7 9 → 0011 0101 0111 1001

BCD to Decimal

1. Group the BCD bits into 4 chunks

2. Convert each chunk to a decimal digit

e.g. 0011 0101 0111 1001 → 3 5 7 9 → 3579

Minimum D Flip-Flops

- 1 D flip-flop stores 1 bit.

- Each BCD digit = 4 bits.

- For an N-digit decimal number:

-- Minimum flip-flops = $4 \times N$

e.g. 3579 = 4 digits → $4 \times 4 = 16$ flip-flops



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