

# COL215L: Digital Logic & System Design

## Lecture 11: Binary Arithmetic (Cont.)



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# Signed Numbers

- Sign-and-Magnitude ←

- MSB bit – sign

- 1' Complement -

- Neg - complementing bits

- $N = \underline{1111} - P$

- 2' Complement ←

- Complement and add one

- $N = 10000 - P$

$$(N)_B = (2^n - 1) - (P)_B$$

*n-bit*

$$(N)_B = 2^n - (P)_B$$

$$\begin{array}{r} 1010 \\ 0001 \\ \hline 1011 \end{array}$$

$b_3b_2b_1b_0$	Sign and magnitude	1's complement	2's complement
0111	+7	+7	+7
0110	+6	+6	+6
0101	+5	+5	+5
0100	+4	+4	+4
0011	+3	+3	+3
0010	+2	+2	+2
0001	+1	+1	+1
0000	+0	+0	+0
1000	-0	-7	-8
1001	-1	-6	-7
1010	-2	-5	-6
1011	-3	-4	-5
1100	-4	-3	-4
1101	-5	-2	-3
1110	-6	-1	-2
1111	-7	-0	-1

# 2's Complement Addition/Subtraction

- Circular

- Overflow

