

# Number Systems

## Signed Magnitude

Last updated 8/20/20

# Number Systems

- Signed Magnitude
  - MSB used to represent the sign of the value
    - MSB = 0 → positive
    - MSB = 1 → negative
  - Remaining bits represent the magnitude of the value
  - Used in most floating point number representations

50 → 0011 0010

-50 → 1011 0010

-37 →

10010110<sub>b</sub> signed magnitude →

# Number Systems

- Signed Magnitude

convert -37 decimal to 8 bit signed magnitude

8 bits  $\rightarrow$  bit values of s | 64 | 32 | 16 | 8 | 4 | 2 | 1

s = negative

$$|-37| = 37$$

greatest bit value  $\leq 37 = 32$

$$37 - 32 = 5$$

greatest bit value  $\leq 5 = 4$

$$5 - 4 = 1$$

greatest bit value  $\leq 1 = 1$

$$1 - 1 = 0$$

1

1 0 1

1 0 1 0 0 1

1 0 1 0 0 1 0 1

# Number Systems

- Signed Magnitude

convert 10010110 signed magnitude to decimal

8 bits  $\rightarrow$  bit values of s | 64 | 32 | 16 | 8 | 4 | 2 | 1

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

$$16 + 4 + 2 = 22$$

sign = 1 = negative  $\rightarrow$  -22

10010110<sub>b</sub> signed magnitude  $\rightarrow$  -22

# Number Systems

- Signed Magnitude

- Maximum values: (non fractional)

- 4 bits (s111) =  $\pm 7 = 2^3 - 1$

- 8 bits (s111 1111) =  $\pm 127 = 2^7 - 1$

- 16 bits (s111 1111 1111 1111) =  $\pm 32,767 = 2^{15} - 1$

7	6	5	4	3	2	1	0	0	-1	-2	-3	-4	-5	-6	-7
0111	0110	0101	0100	0011	0010	0001	0000	1000	1001	1010	1011	1100	1101	1110	1111

# Number Systems

- Signed Magnitude
  - Issues
    - Binary math is difficult with sign magnitude representation
    - 2 zeros really causes a lot of problems

7	6	5	4	3	2	1	0	0	-1	-2	-3	-4	-5	-6	-7
0111	0110	0101	0100	0011	0010	0001	0000	1000	1001	1010	1011	1100	1101	1110	1111