Sign Magnitude

Last updated 11/29/22

These slides introduce sign-magnitude binary number concepts

Sign Magnitude

- 3 variations of signed binary numbers
  - Sign-Magnitude
  - One's Complement
  - Two's Complement

- A variation of Sign Magnitude is used in floating point numbers

Sign Magnitude

- Sign Magnitude
  - Binary representation for a number that is can be positive or negative
  - Characterized by n-bits → n bit sign magnitude binary number

Sign Magnitude

- Bit Values
  - MSB used to represent the sign of the value
    - MSB = 0 → positive
    - MSB = 1 → negative
  - Remaining bits represent the magnitude of the value

50	→	0011 0010	→	+(32+16+2)
-50	→	1011 0010	→	-(32+16+2)

Sign Magnitude

- Decimal to Signed Magnitude

convert -37 decimal to 8 bit signed magnitude

8 bits → bit values of s | 64 | 32 | 16 | 8 | 4 | 2 | 1

s = negative — 1

|-37| = 37

greatest bit value ≤ 37 = 32 — 1 0 1

37 – 32 = 5

greatest bit value ≤ 5 = 4 — 1 0 1 0 0 1

5 – 4 = 1

greatest bit value ≤ 1 = 1 — 1 0 1 0 0 1 0 1

1 – 1 = 0

Sign Magnitude

- Convert Signed Magnitude to Decimal

convert 10010110 signed magnitude to decimal

8 bits → 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 → -22

10010110_b signed magnitude → -22

Sign Magnitude

- Limits
  - Maximum values: (non fractional)
    - 4 bits (s111) = ±7 = 2^3-1
    - 8 bits (s111 1111) = ±127 = 2^7-1
    - 16 bits (s111 1111 1111 1111) = ±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

Sign Magnitude

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