2s complement bonus review

Wednesday, September 2, 2020

2s complement : represent negative numbers (integers)

Sign magnitude: sign bit

1s complement : complement each bit

2s complement : most convenient for addition | subtraction

Focus on Negative numbers!

Decimal → 2s complement

−5 ① Form binary rep of ± number (magnitude)

0 101

$2^2 + 2^0 = 5$

4 bit rep: 0101

8-bit : 0000 0101 sign extension

② Use the "trick":

4-bit : 0101 start here: +5

complement ↓ copy Right to left, find first "1"

$\boxed{1011}$ 2s complement rep. of −5

2s complement → Decimal

Verify: 1011 2s complement number.

$-2^3 + 2^1 + 2^0 = -8 + 2 + 1 = -5$

negative weight

8-bit version of a 2s compl. for −5 :

Sign extend $\underbrace{1111}_{\text{arbitrary \# of 1s}}$ 1011 → Same number

analogous to positive case

+5 0101 4-bit

0000 0101 8-bit

Trick : 2s Comp → decimal w/ leading 1's → you can ignore all but the last.

Example: 1011 =

$-2^3 + 2^1 + 2^0 = -8 + 2 + 1 = -5$

5-bit 11011

using all bits: $-2^4 + 2^3 + 2^1 + 2^0 = \underbrace{-16 + 8} + 2 + 1 = -5$

Getting comfortable with 2s comp representations for negative numbers:

Positive:
4-bit

Positive		Negatives:	
+0	0000	1111	-1
+1	0001	1110	-2
+2	0010	1101	-3
	0011	1100	-4
	0100	1011	-5
	0101	1010	-6
	0110	1001	-7
+7	0111	1000	-8

4 bits → 16 diff #s.

use "trick" to go from (+) to (−)

00|10
comp ↓ copy
11 10

$\left.\begin{matrix}0010 \\ 1110\end{matrix}\right\}$ +2 → −2

+3 0011
−3 1101 → −8+4+1 = −3
101 −4+1 = −3