CS 208

M, 12 Jan 2026

int

What integers can you fit in one int?

32 bits (4 bytes)

2^{32} different possible integers

If we assume int is always ≥ 0

000 —— 0 take ten 0

.
.
.

1111 ---- 1 $2^{32}-1$

(Estimation trick:

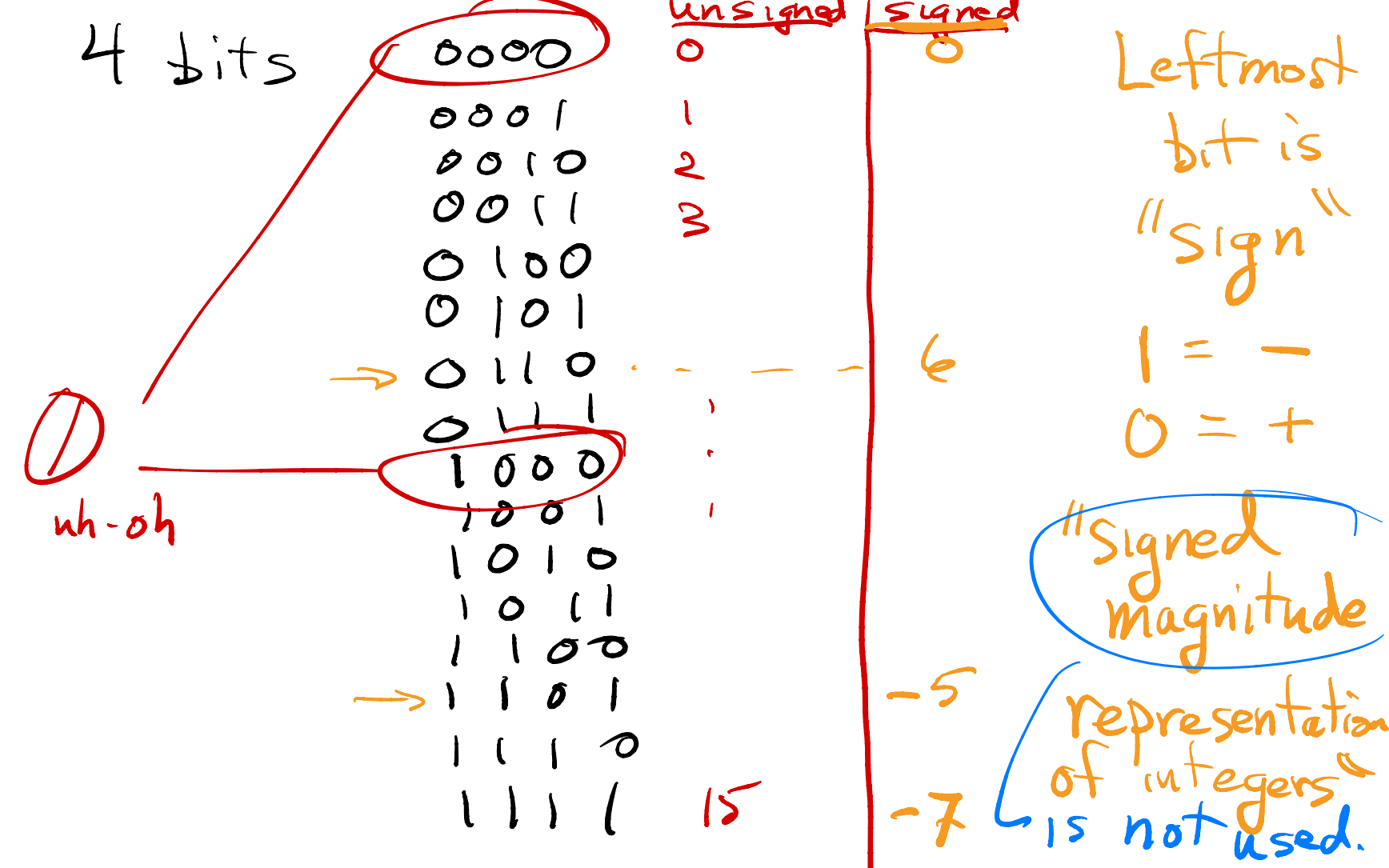
$2^{10} \sim 1000 = 10^3$

$2^{20} \sim (1000)^2 = 1 \text{ million} = 10^6$

$2^{30} \sim (1000)^3 = 1 \text{ billion} = 10^9$

$\vdots$

$2^{32} \sim 4 \text{ billion}$)


4 bits
unsigned
signed
0000
0
0
0001
1
0010
2
0011
3
0100
0101
0110
6
0111
1000
1001
1010
1011
1100
1101
-5
1110
1111
15
-7
uh-oh
Leftmost bit is "sign"
1 = −
0 = +
"Signed magnitude" representation of integers is not used.

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

4-bit two's Complement representation

:)

+1 seems to work

Easy to see ≥0 vs. <0

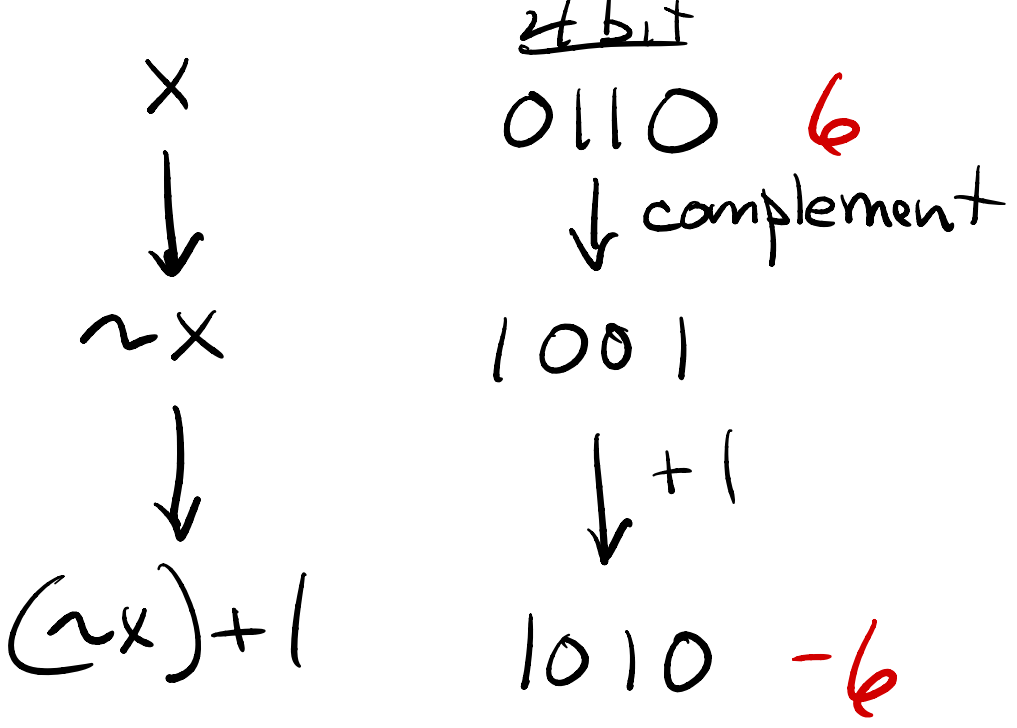
:(

magnitudes are weird among negatives

hard to negate

-8 but not 8

Algorithm for negating a 2's comp int.



What integer does 0xFFFFFFE5 represent in 32-bit two's comp.

1111 1111 1111 1111 1111 1111 1110 0101

0000 ——— 0 0001 1010 ⟶ complement

00 ——— 0 0001 1011 ⟶ +1

16+8+2+1

= 27 ⟶ −27

Why 2's complement? Addition works as we expect

$$\begin{array}{rr} 5 & 0101 \\ +\ -3 & +\ 1101 \\ \hline & \boxed{10010} \end{array}$$

What about characters?

a-z 0-9 A-Z <space> , . ! ? etc.

} ~75 symbols

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7 bits is enough