

$$\begin{array}{r} \underline{1111110} \\ \cancel{111111} \\ \cancel{000000} \end{array} = -2$$

$$\begin{array}{l} 0101 \rightarrow 5 \\ 1010 \rightarrow \text{invert} \\ 1011 \rightarrow \text{plus} \\ \rightarrow -5 \end{array}$$

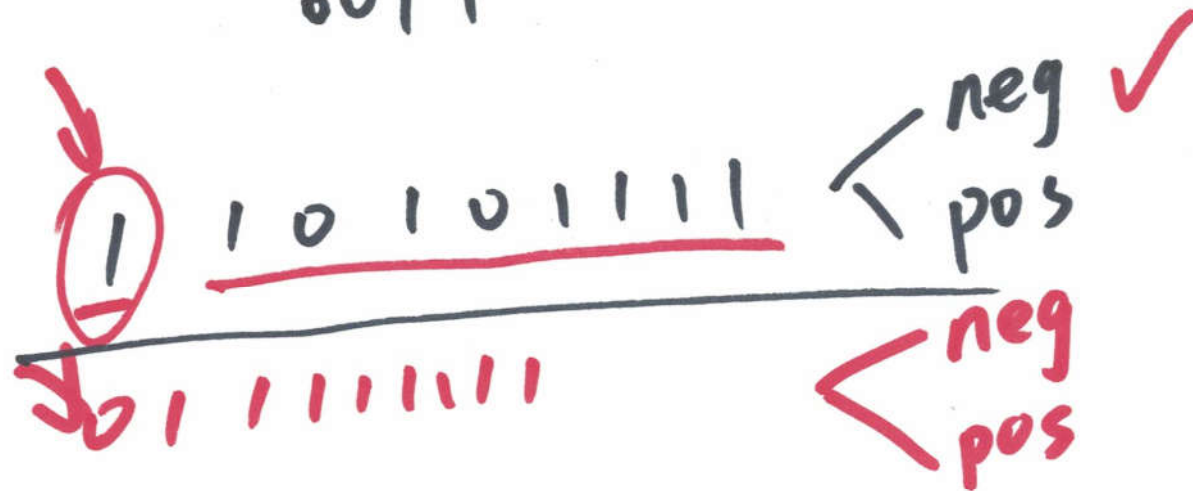
By definition

$$1111111 = -1$$

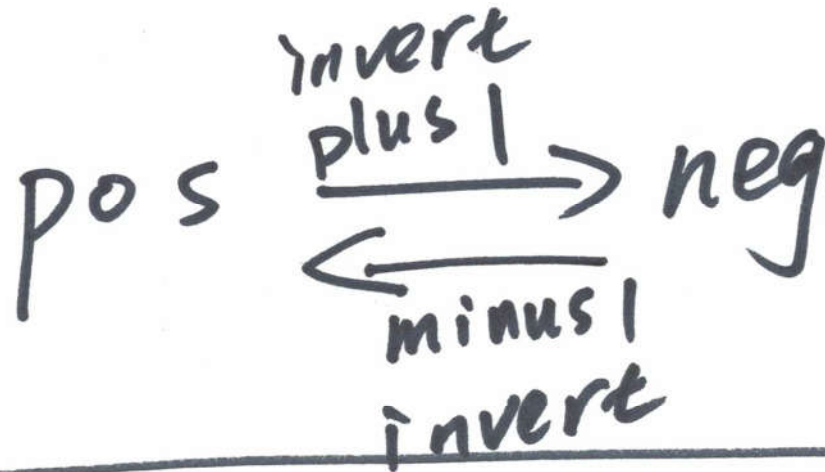
∴ invert  
plus 1

$$\begin{array}{r} 0101 \\ \hline -8 \leftarrow \quad \rightarrow 5 \end{array} = -3$$

$$\begin{array}{r} 1100 \\ 0011 \end{array}$$



# in 2's complement



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

carry  
 but no out  
 overflow

$$-2^{n-1} \leq \text{Range} \leq 2^{n-1} - 1$$

n: the number of bits

② 10-bit

# Overflow

Definition:

$$P + P = N \quad \checkmark$$

$$N + N = P \quad \checkmark$$

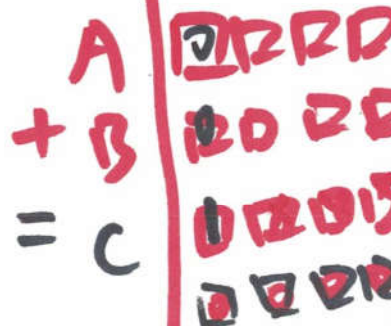
$$P + N = \underline{\underline{P \vee RN}} \quad \times$$

$$0 \dots + 0 \dots = 1 \dots$$

100111 001111

$$-25 + 7 = -18$$

$N + P$                        $N$



$$\begin{array}{r} 0001 \\ + 0001 \\ \hline 0010 \end{array} \quad \begin{array}{l} P \\ P \\ P \end{array}$$

Overflow: adopt ~~the~~ 1 more bit in the front

No overflow: Do not do that

$$\textcircled{1} 5 + 6 = 11$$

$$\begin{array}{r} 0101 \quad P \\ + 0110 \quad P \\ \hline 01011 \quad N \end{array}$$

↑

overflow

$$\textcircled{2} -5 + (-6) = -11$$

$$\begin{array}{r} 1011 \quad N \\ + 1010 \quad N \\ \hline 10101 \quad P \end{array}$$

overflow

$$\textcircled{3} -1 + 2 = 1$$

111    010

$$\begin{array}{r} 111 \quad N \\ + 010 \quad P \\ \hline \times 001 \quad P \end{array}$$

No overflow

④

$$21 + 11$$

~~010101~~

$$\begin{array}{r} D \quad 010101 + 001011 \\ P \quad + 001011 \\ \hline N \quad 100000 \end{array} \quad \times$$

000000

000000 | 000000

(5)