

$$\begin{array}{r}
 53 \\
 + 22 \\
 \hline
 75
 \end{array}$$

$$\begin{array}{r}
 \overset{1}{0}0\overset{1}{1}0101 \\
 + 00010110 \\
 \hline
 01001011 \\
 64 + 8 + 2 + 1 = 75
 \end{array}$$

$$\begin{array}{r}
 48 \\
 + 40 \\
 \hline
 88
 \end{array}$$

$$\begin{array}{r}
 \overset{1}{0}0110000 \\
 + 00101000 \\
 \hline
 01011000 \\
 64 + 16 + 8 = 88
 \end{array}$$

$$\begin{array}{r}
 200 \\
 + 100 \\
 \hline
 300
 \end{array}$$

$$\begin{array}{r}
 \textcircled{X} \overset{1}{1}1001000 \\
 + 01100100 \\
 \hline
 00101100 \\
 32 + 8 + 4 = 44
 \end{array}$$

Sign and magnitude

	Sign bit	0	+
		1	-

+5	0:00000101	00000000
-5	1:00000101	10000000

↑
 sign magnitude

$$7 + 5 = 12 \qquad -7 + 5 = -2$$

$$\begin{array}{r}
 5 \quad \textcircled{X} 00000101 \leftarrow \\
 + 11111011 \leftarrow \\
 \hline
 00000000 \leftarrow
 \end{array}$$

↑

Sign bit	0	+
	1	-

-5 2's CB

$$\begin{array}{r}
 11111011 \\
 0000100 \\
 + 1 \\
 \hline
 00000101 \rightarrow +5
 \end{array}$$

Two's Complement

To "take the two's complement" of an integer:

- 1) reverse all bits
- 2) add 1

$$\begin{array}{r}
 -7 \\
 +5 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 11111001 \\
 +000000101 \\
 \hline
 111111110 \quad -2 \\
 \uparrow \\
 00000001 \\
 +1 \\
 \hline
 00000010 = 2
 \end{array}
 \quad
 \begin{array}{r}
 00000111 \quad +7 \\
 11111000 \\
 +1 \\
 \hline
 11111001 = -7
 \end{array}$$

$$\begin{array}{r}
 12 \\
 + -5 \\
 \hline
 7
 \end{array}
 \quad
 \begin{array}{r}
 \text{OC } 12 \\
 \text{FB } -5 \\
 00001100 \\
 +1111011 \\
 \hline
 00000111 = 7 \\
 1 \quad 4+2+1
 \end{array}
 \quad
 \begin{array}{r}
 00001100 \\
 11110011 \\
 +1 \\
 \hline
 11110100 = -12
 \end{array}$$

$$\begin{array}{r}
 -12 \\
 +5 \\
 \hline
 -7
 \end{array}
 \quad
 \begin{array}{r}
 11110100 \\
 00000101 \\
 \hline
 11111001 = -7 \\
 \uparrow
 \end{array}
 \quad
 \begin{array}{r}
 00000110 \\
 +1 \\
 \hline
 00000111 = 7
 \end{array}$$

$$\begin{array}{r}
 -12 \\
 + -5 \\
 \hline
 -17
 \end{array}
 \quad
 \begin{array}{r}
 *11110100 \\
 +11111011 \\
 \hline
 11101111 = -17 \\
 \uparrow
 \end{array}
 \quad
 \begin{array}{r}
 00010000 \\
 +1 \\
 \hline
 00010001 \\
 16 + 1 = 17
 \end{array}$$

$$\begin{array}{r}
 120 \\
 +100 \\
 \hline
 220
 \end{array}
 \quad
 \begin{array}{r}
 11 \\
 01111000 \\
 +01100100 \\
 \hline
 11011100 = -36 \\
 \uparrow \\
 00100011 \\
 +1 \\
 \hline
 00100010 \\
 4 \quad 32 = 36
 \end{array}$$

$$\textcircled{10000000} = -128$$

$$\begin{array}{c} \uparrow \\ 01111111 \\ \textcircled{10000000} \end{array} \left. \begin{array}{c} \\ +1 \end{array} \right\}$$

$$\begin{array}{r} 01111111 \\ +1 \\ \hline 10000000 = -128 \end{array} \quad +1270x7F$$

$$\begin{array}{r} -5 \\ \downarrow 11111011 \end{array} \quad 8 \text{ bits}$$

$$\begin{array}{r} +5 \\ 00000101 \end{array} \quad 8 \text{ bits}$$

$$\begin{array}{r} +5 \\ 0000000000000101 \end{array} \quad 16 \text{ bits}$$

$$\begin{array}{r} -5 \\ \underline{1111111111111011} = -5 \end{array}$$

$$\begin{array}{r} 0000000000000100 \\ +1 \end{array}$$

$$\begin{array}{r} 0000000000000101 = 5 \end{array}$$

8-bit

Negative? Positive?

01101001

Pos.

00010000

Pos

11011100

Neg.

10000010

Neg.

↑

8-bit

4C Pos

7D Pos

8Z Neg

C1 Neg

16-bit

C04A Neg

72A0 Pos

DB12 Neg

41AB Pos