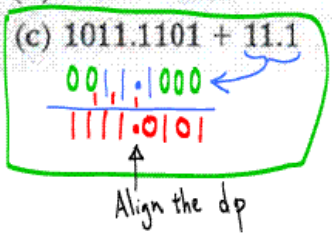
6-1. Add the following in binary. Check your results by doing the addition in decimal.

(a) 1010 + 1011

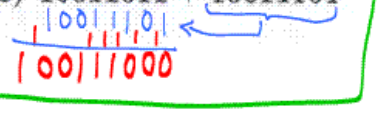
(b) 1111 + 0011

(c) 1011.1101 + 11.1



(d) 0.1011 + 0.1111

(e) 10011011 + 10011101



(Ans. on p. 562)

8-bit → $2^8 = 256$ nos. { 0 to +127 ; -1 to -128

6-2. Represent each of the following signed decimal numbers in the 2's-complement system. Use a total of eight bits, including the sign bit.

(a) +32 = 0010 0000 (e) +127 = 0111 1111$_2$ (i) −1 = 1111 1111$_2$ (m) +84

(b) −14 (f) −127 = 1000 0001$_2$ (j) −128 = 1000 0000$_2$ (n) +3 = 0000 0011$_2$ (8-bit)

(c) +63 = 0011 1111 (g) +89 (k) +169 (o) −3 = 1111 1100 + 1 = 1111 1101$_2$

(d) −104 (h) −55 (l) 0 = 0000 0000$_2$ (p) −190 (Cannot be rep. in 8-bit!)

Start with +14 = 0000 1110$_2$ (8-bit)

Negation { Invert: 1111 0001 ; Add 1: 1

to get −14: 1111 0010

Unsigned Number	8-bit Binary	Signed Number	
0	0000 0000	+0	The upper half is used for representing **positive** numbers.
1	0000 0001	+1	
2	0000 0010	+2	
3	0000 0011	+3	
:	:	:	(This half is same as unsigned numbers.)
125	0111 1101	+125	
126	0111 1110	+126	
127	0111 1111	+127	← $+(2^7-1)$
128	1000 0000	−128	← $-(2^7)$
129	1000 0001	−127	
130	1000 0010	−126	
:	:	:	The lower half is used for representing **negative** numbers.
252	1111 1100	−4	
253	1111 1101	−3	
254	1111 1110	−2	
255	1111 1111	−1	(-1 at the bottom)

$2^8 = 256$ nos.

(Signed numbers which are positive have same values as their unsigned number equivalent.)

6-3. Each of the following numbers represents a signed decimal number in the 2's-complement system. Determine the decimal value in each case. (*Hint:* Use negation to convert negative numbers to positive.)

(a) 01101 — 5-bit
(b) 11101
(c) 01111011
(d) 10011001
(e) 01111111 — 8-bit
(f) 10000000 → Pattern for: biggest -ve $(-2^7 = -128)$
(g) 11111111 → Pattern for: -1
(h) 10000001
(i) 01100011
(j) 11011001 — 8-bit

Which of them are negative?

Pattern for: biggest +ve $(+2^7 - 1 = +127)$

(d) Let 10011001 = $-x$

Negation steps:
Invert: 01100110
Add 1: 1
01100111 = $+x$

Weight: 64 32 16 8 4 2 1
1 1 0 0 1 1 1
103

Hence $x = 103 \rightarrow -x = -103$

ie min. to max.

6-7. What is the range of unsigned decimal values that can be represented in 10 bits? What is the range of signed decimal values using the same number of bits?

10-bit → 2^{10} = 1024 noes.

512 +ve

512 -ve

For unsigned noes.

For signed noes

Unsigned no. range : 0 to 1023

Signed no. range : +ve : 0 to +511

-ve : -1 to -512

(ie. -512 to +511)