2.6 Binary subtraction

These questions relate to Section 14.3 of Block 1. Question 8 relates to Activity 42 and Question 9 to Activity 43.

Question 8

Find the 2's complement of each of these signed integers:

* (a) 0111 1011

* (b) 1011 1000

(c) 0101 1111

(d) 1100 0111

(e) 0111 0101

Question 9

Carry out the following subtractions by first finding the additive inverse of the number to be subtracted. All numbers are in 2's complement representation.

† (a) 0101 0000 – 0100 1101

(b) 1011 0111 – 0000 1111

(c) 0101 1100 – 1111 0001

(d) 0111 1000 – 1101 1100

(e) 1001 1110 – 0111 1011

2.7 Logic operations

Strictly speaking, logic operations are not ‘numeracy’, but this question is included here for convenience. It relates to Section 15 of Block 1 and to Activity 46.

Don’t feel you need to try all the parts of the question; just do as many as you need to gain confidence, both as you study Block 1 and when you come to revise for the exam.

Question 10

For each of (a)–(e) below, find:

(i) NOT A

(ii) NOT B

(iii) A AND B

(iv) A OR B

(v) A XOR B

(a) A = 0111 1010 B = 0110 0001

(b) A = 1111 0000 B = 0001 0110

(c) A = 0010 0111 B = 1001 1001

(d) A = 0001 1101 B = 1001 1100

(e) A = 1001 1111 B = 1001 1111

Question 8

In each case, the 2's complement is formed by first finding the complement (1's complement) and then adding 1. The complement is formed by changing each 1 to 0 and each 0 to 1.

(a) The complement of 0111 1011 is 1000 0100. Adding 1 to this gives 1000 0101. So this is the 2's complement.

(b) The complement of 1011 1000 is 0100 0111. Adding 1 to this gives 0100 1000. So this is the 2's complement.

(c) The 2's complement of 0101 1111 is 1010 0001.

(d) The 2's complement of 1100 0111 is 0011 1001.

(e) The 2's complement of 0111 0101 is 1000 1011.

Question 9

In each case, the 2's complement of the number to be subtracted must be found, as in Question 8. Then this can be added to the other number, as in Question 7.

(a) The 2's complement of the number to be subtracted, 0100 1101, is 1011 0011. Hence the sum is:

$$\begin{array}{cccccccccc} & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & \\ + & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 1 & \\ \hline & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & \\ 1 & 1 & 1 & 1 & & & & & & \text{(carry)} \end{array}$$

A carry to a ninth bit can be ignored in 8-bit 2's complement arithmetic, and so the answer is 0000 0011.

(b) The answer is 1010 1000.

(c) The answer is 0110 1011.

(d) The answer is 1001 1100.

(e) The answer is 0010 0011.

Notice that in parts (d) and (e) 2's complement overflow has occurred. In (d) adding two positive numbers has produced an apparently negative result, and in (e) adding two negative numbers has produced an apparently positive result.

Question 10

(a) (i) NOT A is 1000 0101
(ii) NOT B is 1001 1110
(iii) A AND B is 0110 0000
(iv) A OR B is 0111 1011
(v) A XOR B is 0001 1011

(b) (i) NOT A is 0000 1111
(ii) NOT B is 1110 1001
(iii) A AND B is 0001 0000
(iv) A OR B is 1111 0110
(v) A XOR B is 1110 0110

(c) (i) NOT A is 1101 1000
(ii) NOT B is 0110 0110
(iii) A AND B is 0000 0001

(iv) A OR B is 1011 1111

(v) A XOR B is 1011 1110

(d) (i) NOT A is 1110 0010

(ii) NOT B is 0110 0011

(iii) A AND B is 0001 1100

(iv) A OR B is 1001 1101

(v) A XOR B is 1000 0001

(e) (i) NOT A is 0110 0000

(ii) NOT B is 0110 0000

(iii) A AND B is 1001 1111

(iv) A OR B is 1001 1111

(v) A XOR B is 0000 0000