Computer Architecture–Homework VI

107 Fall semester, Chapter 10

10.14 Given $x = 0101$ and $y = 1010$ in twos complement notation (i.e., $x = 5$, $y = -6$), compute the product $p = x \times y$ with Booth's algorithm.

Sol:

A	Q	Q_{-1}	M	Count		
0000	1010	0	0101	4	Initial values	
0000	0101	0	0101	3	Arithmetic shift right	$\Leftarrow Q_0Q_{-1} = 00$
1011	0101	0	0101	3	A=A-M	$\Leftarrow Q_0Q_{-1} = 10$
1101	1010	1	0101	2	Arithmetic shift right	
0010	1010	1	0101	2	A=A+M	$\Leftarrow Q_0Q_{-1} = 01$
0001	0101	0	0101	1	Arithmetic shift right	
1100	0101	0	0101	1	A=A-M	$\Leftarrow Q_0Q_{-1} = 10$
1110	0010	1	0101	0	Arithmetic shift right	
1110	0010					

The product p is in the A and Q registers; i.e., 1110 0010 in twos complement notation, -30 in decimal form.

10.20 Divide -14 by 13 in binary twos complement notation, using 5-bit words. Use the algorithm described in Section 10.3.

Sol:

A	Q	M	Count	
11111	10010	01101	5	Initial values
11111	00100	01101	5	Shift left
01100	00100	01101	5	A=A+M
11111	00100	01101	4	A=A-M (Restore)
11110	01000	01101	4	Shift left
01011	01000	01101	4	A=A+M
11110	01000	01101	3	A=A-M (Restore)
11100	10000	01101	3	Shift left
01001	10000	01101	3	A=A+M
11100	10000	01101	2	A=A-M (Restore)
11001	00000	01101	2	Shift left
00110	00000	01101	2	A=A+M
11001	00000	01101	1	A=A-M (Restore)
10010	00000	01101	1	Shift left
11111	00000	01101	1	A=A+M
11111	00001	01101	0	Set $Q_0 = 1$
11111	11111			

The remainder is in the A register; i.e., 11111 in twos complement notation, -1 in decimal form.
Since the dividend and the divisor have different signs, the quotient is the twos complement (negation) of the value in the Q register; i.e., 11111 in twos complement notation, -1 in decimal form.