COMP2611: Computer Organization

Arithmetic Logic Unit II (Solution)

- Question 1: According to the multiplication hardware – refined version, do multiplication of two unsigned number 5 x 7 (0101 and 0111), fill in the table below.

Iteration	Multiplicand (M)	Product (P)	Remark
0	0101	0000 0111	Initial state
1		0101 0111	Left(P) = Left(P) + M
		0010 1011	P = P >> 1
2		0111 1011	Left(P) = Left(P) + M
		0011 1101	P = P >> 1
3		1000 1101	Left(P) = Left(P) + M
		0100 0110	P = P >> 1
4		0100 0110	No operation
		0010 0011	P = P >> 1

- Question 2: According to Booth's algorithm, do multiplication of two signed number +2 and -3 (0010 and 1101), fill in the table below.

Iteration	Multiplicand (M)	Product (P)	Remark
0	0010	0000 1101 0	Initial state
1		1110 1101 0	Left(P) = Left(P) - M
		1111 0110 1	P = P >> 1
2		0001 0110 1	Left(P) = Left(P) + M
		0000 1011 0	P = P >> 1
3		1110 1011 0	Left(P) = Left(P) - M
		1111 0101 1	P = P >> 1
4		1111 0101 1	No operation
		1111 1010 1	P = P >> 1

- Question 3: According to the division hardware – improved version. Divide 8 (1000) by 3 (0011), fill in the table below.

Iteration	Divisor (D)	Remainder (R)	Remark
0	0011	0000 1000 0001 0000	Initial state R = R << 1
1		1110 0000 0001 0000 0010 0000	Left(R) = Left(R) – D Undo R = R << 1, R_0 = 0
2		1111 0000 0010 0000 0100 0000	Left(R) = Left(R) – D Undo R = R << 1, R_0 = 0
3		0001 0000 0010 0001	Left(R) = Left(R) – D R = R << 1, R_0 = 1
4		1111 0001 0010 0001 0100 0010	Left(R) = Left(R) – D Undo R = R << 1, R_0 = 0
extra		0010 0010	Left(R) = Left(R) >> 1

Thus, the quotient is 0010 (2) and the remainder is 0010 (2)