Computer Architecture Floating Point Multiply Notes (Section 3.5)

Floating-Point Multiply:

$$(a \times b^c) \times (d \times b^e) = a \times d \times b^{(c+e)}$$

1) Add the exponents together. Since IEEE 754 floating point notation has a bias (an exponent of 0 is represented by 127 for single precision) the bias will double if we added biased values together, so we need to subtract one of these biased back out.

2) Multiply the signifcands. Remember that the leading 1 of the significand is implied and only the fraction portion of the significand is represented in IEEE 754. This is done exactly like integer multiplication where we ignore the binary point. The binary point is then placed such that the number of fraction bits of the result is the sum of the fraction bits of the values being multiplied.

1.00 X 0.1010 = 0.101000 (2 fraction bit plus 4 fraction bits = 6 fraction bits)

same as: 100 x 01010 = 0101000, then binary point such that have 6 fraction bits

3) Normalize the product and check for overflow/underflow.

4) Set the sign bit to 0 if the signs of the multiplicand and multiplier are the same, otherwise set to 1.

Floating-Point Multiply Example:

0x40E0 0000 X 0x3F40 0000 (IEEE 754 S. P.)

0100 0000 1110 0000 0000 0000 0000 0000
X 0011 1111 0100 0000 0000 0000 0000 0000

	sign	exponent	fraction
	0	1000 0001	1100 0000 0000 0000 0000 000
X	0	0111 1110	1000 0000 0000 0000 0000 000
	positive	129 = 127 + 2	1100 0000 0000 0000 0000 000
X	positive	126 = 127 - 1	1000 0000 0000 0000 0000 000

1.11×2^{2} X 1.1×2^{-1}

Exponent is 129 + 126 - 127 = 128 (sum of bias exponents minus bias)

Significand is 111 X 11 with three fraction bits after the binary point

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   111
    11
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   111
  111
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 10101      = 10.101
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Since 10.101 in not normalized, shift binary point 1 place left and compensate by adding 1 to the exponent:

Significand = 1.0101 Exponent = 129

We have 23 fraction bit in IEEE 754 S. P., so we do not need to round

Since the signs of the multiplier/multiplicand are both positive the product is positive.

sign	exponent	fraction
0	1000 0001	0101 0000 0000 0000 0000 000

0100 0000 1010 1000 0000 0000 0000 0000

0x40A8 0000 (IEEE 754 S. P.)