

HW #1
CSc 137, Harvey

Total (12 pts)

Problems 1.3, 1.4, 1.5, 1.14 (3 pts each)

Reading assignment: Section 1.1 to 1.4 (all sub-sections).

Advance reading assignment: Section 2.1 through 2.4 (all subsections)

1.3. What is the 16-bit FP number representation of -5.375 in hex with 1-bit sign, 4-bit biased exponent, and 11-bit fraction, where bias offset = 7?

$$\begin{aligned}
 5_{10} &= 101_2 \\
 0.375_{10} &= 011_2 \\
 -5.375_{10} &= -101.011_2 \\
 -101.011_2 &= -1.01011 \times 2^2 \\
 2 + 7 &= 9_{10} = 1001_2
 \end{aligned}$$

$$-1.01011 \times 2^{2+7} = -1.01011 \times 2^9$$

$$-1.01011 \times 2^{9_{10} = 1001_2}$$

1100101011000000

↑
sign
bit

↑
biased
exponent

↑
11-bit
fraction

1.4. What is the real number equivalent to FP number 0x3400 with 1-bit sign, 4-bit biased exponent, 11-bit fraction, and bias offset = 7?

$$\begin{aligned}
 0x3400 &= 00110100 \text{ 0000 0000} \\
 0110_2 &= 6_{10} = E \\
 e &= E - 7 = 6 - 7 = -1 \\
 1. \text{ mantissa} \times 2^e &= 1.100000000000 \times 2^{-1} = 0.11_2
 \end{aligned}$$

$$\begin{aligned}
 0.11_2 &= 0 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2} \\
 &= 0 + 0.5 + 0.25 \\
 &= \boxed{0.75}
 \end{aligned}$$

sign bit = 0, so, positive

1.5. What is the real number equivalent to FP number 0x3400 with 1-bit sign, 4-bit biased exponent, 11-bit fraction, and bias offset = 8?

$$\begin{aligned}
 0x3400 &= 0 \ 0110 \ 100 \ 0000 \ 0000 \\
 0110_2 &= 6_{10} - 8_{10} = -2_{10}
 \end{aligned}$$

$$1.1 \times 2^{-2} = 0.011_2$$

$$0.011_2 = 0 \times 2^0 + 0 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-3}$$
$$0 + 0 + 0.25 + 0.125$$

$$= \boxed{0.375}$$

1.14 What is a Von Neumann architecture bottleneck?

A Von Neumann architecture bottleneck is a bottleneck between a faster processor and slower memory.