Tutorial 6 – Week of Oct. 25th

Question 1) (3.22)
What decimal number does the bit pattern
0×0C000000 4 * 8 = 32
represent if it is a floating-point number? Use the IEEE 754 standard.

Solution:

$0\times0C000000 = 0000\ 1100\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000$

$= 0\ 0001\ 1000\ 0000\ 0000\ 0000\ 0000\ 0000\ 000$

sign is positive

this is the biased exponent
we want to get the actual exponent
actual exp. = biased exp. - bias(127)

actual exp $= 0\times18 = 24 - 127 = -103$

there is a hidden 1

mantissa = 0

1.

answer $= 1.0\times 2^{-103}$

Question 2) (3.23)
Write down the binary representation of the decimal number 63.25 assuming the IEEE 754 single precision format.

Solution:

$63.25\times10^0 = 111111.01\times 2^0$

normalize, move binary point five to the left

1.1111101×2^5

sign = positive, exp $= 127 + 5 = 132$

1.

Final bit pattern: 0 1000 0100 1111 1010 0000 0000 0000 000

$= 0100\ 0010\ 0111\ 1101\ 0000\ 0000\ 0000\ 0000 = 0x427D0000$

Question 3) (3.24)
Write down the binary representation of the decimal number 63.25 assuming the IEEE 754 double precision format.

Solution:

$63.25 \times 10^0 = 111111.01 \times 2^0$

normalize, move binary point five to the left

fraction part

3 1.1111101×2^5 normalized (scientific notation) binary representation

a hidden 1 sign = positive, $exp = 1023 + 5 = 1028$ biased exponent = actual exponent + bias

1 2

Final bit pattern:

0 100 0000 0100 1111 1010 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000

= 0x404FA00000000000

Question 4) (3.27)
IEEE 754-2008 contains a half precision that is only 16 bits wide. The leftmost bit is still the sign bit, the exponent is 5 bits wide and has a bias of 15, and the mantissa is 10 bits long. A hidden 1 is assumed. Write down the bit pattern to represent -1.5625×10^{-1} assuming a version of this format, which uses an excess-16 format to store the exponent.

bias = 15

Solution:

$-1.5625 \times 10^{-1} = -0.15625 \times 10^0$

$= -0.00101 \times 2^0$

move the binary point three to the right, $= -1.01 \times 2^{-3}$

biased exponent $= -3 = -3 + 15 = 12$, fraction $= -0.0100000000$

answer: 1011000100000000 sign = negative = 1