ELEMENTS OF COMPUTER SYSTEMS

SYSC 5704 - DEPARTMENT OF SYSTEMS & COMPUTER ENGINEERING

ASSIGNMENT - 3

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3.10 Data 151 & 214 are signed 8 bit decimal integers and are stored in 2's complement format.

151 in binary → 10010111

Taking 2's complement → 01101000

$$\begin{array}{r} 01101000 \\ +1 \\ \hline 01101001 \end{array}$$

214 in binary → 11010110

Taking 2's complement → 00101001

$$\begin{array}{r} 00101001 \\ +1 \\ \hline 00101010 \end{array}$$

151 - 214 ⇒

$$\begin{array}{r} 01101001 \\ 00101010 \\ \hline 00111111 \end{array}$$

converting 00111111 to decimal → we get -63.

3.17. $0\times33 \times 0\times55 = 0\times10EF$

$0\times33 = 51 = 32+16+2+1$

We can shift 0x55 to 5 places (0xAA0) and add 0x55 shifted 4 places (0x550), then add 0x55 shifted left once (0xAA), then add 0x55.

0xAA0 + 0x550 + 0xAA + 0x55 = 0x10EF.

Therefore, 3 shifts and 3 adds are required.

3.20. The binary representation for the bit pattern 0x0C000000 is 1100000000000000000000000000.

The decimal number for both cases (2's complement integer and unsigned integer) is 201326592.

3.22. binary representation:

0x0C000000 ⇒ 0000 1100 0000 0000 0000 0000 0000 0000

representation in terms of sign bit, exponent & mantissa ⇒ 0 0001 1000 0000 0000 0000 0000 0000 0000

sign bit is 0 → hence positive

Exponent = 0x18 = 24 ⇒ 24 − 127 = −103

There is a hidden 1

mantissa = 0

Hence the answer is 1.0×2^{-103}. ⇒ 9.8607613E-32

3.23. $63.25 \times 10^0 = 111111.01 \times 2^0$

normalize and move binary point 5 to the left

1.1111101×2^5

sign is positive.

exponent $= 127+5 = 132$

final bit pattern : 0 1000 0100 1111 1010 0000000000000000

= 0100 0010 0111 1101 0000 0000 0000 0000

= 0X42700000

3.27. $-1.5625 \times 10^{-1} = -0.15625 \times 10^0$

$= -.00101 \times 2^0$

move the binary point 3 to the right

$= -1.01 \times 2^{-3}$

exponent $= -3 \Rightarrow -3+16 = 13$

mantissa = $-.0100000000$

answer : 1011010100000000

3.32. $(3.984375 \times 10^{-1} + 3.4375 \times 10^{-1}) + 1.771 \times 10^3$

$3.984375 \times 10^{-1} = 1.1001100000 \times 2^{-2}$

$3.4375 \times 10^{-1} = 1.0110000000 \times 2^{-2}$

$1.771 \times 10^3 = 1771 = 1.1011101011 \times 2^{10}$

shift binary point of smaller left 12 so exponents match

(A) → 1. 10011 00000

(B) → + 1. 0110000000

10. 1111100000 normalize.,

(A+B) → 1. 0111110000 × 2^{-1}

(C) → +1. 1011101011

(A+B) → . 0000000000 10 111110000

Guard = 1; round = 0

(A+B)+C → 1. 1011101011 101 sticky = 1

(A+B)+C → 1. 1011101100 × 2^{10}

= 0110101010111-01100

= 1772

3.33. $3.984375 \times 10^{-1} + (3.4375 \times 10^{-1} + 1.771 \times 10^{3})$

$3.984375 \times 10^{-1} = 1.1001100000 \times 2^{-2}$

$3.4375 \times 10^{-1} = 1.0110000000 \times 2^{-2}$

$1.771 \times 10^{3} = 1771 = 1.1011101011 \times 2^{10}$

shift binary point of smaller left 12 so exponents match

(B) .0000000000 01 0110000000 guard = 0, round = 1
sticky = 1

(C) +1. 1011101011

+1. 1011101011

(A) .0000000000 011001100000

A+(B+C) +1. 1011101011 no round

A+(B+C) +1. 1011101011 × 2^{10} = 0110101011101011

= 1771

3.34. $(A+B)+C = 1772$ (derived from 3.32)

$A+(B+C) = 1771$ (derived from 3.33)

Hence, they are not equal.

3.41 It is possible to represent $-1/4$ using the IEEE 754 FP format.

The format is as follows:

1011111 01 00000000000000000000000

sign: $-$ve

exponent: -2

3.42. If $-1/4$ is added 4 times, we get

$$(-1/4) + (-1/4) + (-1/4) + (-1/4) = -1$$

If $-1/4$ is multiplied by 4, we get,

$$(-1/4) * 4 = -1$$

Hence, they both are equal.