CMPUT 229 - Quiz #4 — Winter 2014

Name: Solution

The following is a format for the binary representation of a floating-point number:

The exponent is expressed using a bias of 15. Given the binary representation above, the decimal value of the number represented can be computed by the following expression:

$$N = \begin{cases} 0.0 & \text{if } exponent = 0 \text{ and } fraction = 0 \\ (-1)^S \times 0.fraction \times 2^{-15} & \text{if } exponent = 0 \text{ and } fraction \neq 0 \\ (-1)^S \times 1.fraction \times 2^{-15} & \text{if } 0 < exponent < 31 \\ (-1)^S \times \infty & \text{if } exponent = 31 \text{ and } fraction = 0 \\ NaN & \text{if } exponent = 31 \text{ and } fraction \neq 0 \end{cases}$$

Question 1 (3 points):

Let $X = 32_{10}$. Give the normalized binary representation for X and the bit pattern representation of X in this notation.

$32_{10} = 100000_2 \Rightarrow \boxed{1.0 \times 2^5}$

Sign = 0
Exponent = 5 + bias = 20 ⇒ 10100
Fraction = 00000

$\boxed{0\ \ 10100\ \ 00000}$

Question 2 (3 points):

Let $Y = 6.75_{10}$. Give the normalized binary representation for Y and the bit pattern representation of Y in this notation.

$6.75_{10} = 110.11_2 \Rightarrow \boxed{1.1011 \times 2^2}$

Sign = 0
Exponent = 2 + bias = 17 ⇒ 10001
Fraction = 10110

$\boxed{0\ \ 10001\ \ 10110}$

Question 3 (4 points): If this machine has an adder with a round bit, a guard bit and a sticky bit, what is the value of $X + Y$ computed by this machine? Give both the normalized binary notation and the decimal value.

$$\begin{array}{r} 1.00000 \\ +\ 0.0011011 \\ \hline 1.00110 \end{array} \times 2^5 \times 2^5$$

guard = 1
round = 1
sticky = 0
} round

$\boxed{1.00111 \times 2^5}$

$100111_2 = 32_{10} + 4_{10} + 2_{10} + 1_{10} = \boxed{39_{10}}$