

1. In a vain attempt to prevent Microsoft<sup>©</sup> from taking over the world, Machines de Buckmire International (MBI) is coming out with the Elppa, which uses brand-new 8-bit technology to represent floating-point numbers. It uses a 1-bit sign indicator, a 2-bit characteristic and a 5-bit mantissa. Here is the definition:

$$fl(x) = (-1)^s \times 16^{c-2} \times q$$

where the normalization is the the mantissa must be **non-zero**.

a. What is the largest normalized positive number MBI's Elppa can hold in memory?



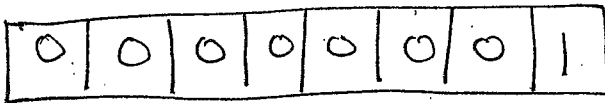
$$Z = 16^{3-2} \cdot 0.96875 = \boxed{15.5}$$

$$s = 0$$

$$c = 11_2 = 3$$

$$q = .11111_2 = 0.96875$$

b. What is the smallest normalized positive number MBI's Elppa can hold in memory?



This is smallest normalized number

$$s = 0$$

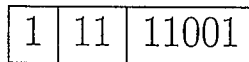
$$c = 0$$

$$q = 2^{-5} = \frac{1}{32}$$

$$A = 16^{-2} \cdot \frac{1}{32} = (2^4)^{-2} \cdot 2^{-5}$$

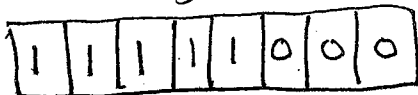
$$= 2^{-13} = \boxed{1.22 \times 10^{-4}}$$

c. The following bit of memory in the Elppa represents the number -12.5.



Find the next largest and next smallest numbers that the Elppa can represent in memory. (Show the memory representation and then compute the values.)

Next largest



$$s = -1$$

$$c = 3$$

$$q = .111_2 = .75$$

$$-1 \cdot 16 \cdot .75 = \boxed{-12}$$

Next smallest



$$s = -1$$

$$c = 3$$

$$q = .1101_2 = 2^{-1} + 2^{-2} + 2^{-4} = 0.8125$$

$$-1 \cdot 16^{3-2} \cdot 0.8125$$

$$= \boxed{-13}$$

d. What would the output be if you tried to multiply -2 by 8 on a MBI Elppa computer?

$$\boxed{11100100} = -2$$

$$\boxed{01110010} = 8$$

$$-2 \times 8 = -16 \text{ would cause}$$

OVERFLOW