CS 221 Numbers Evaluation Assignment

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1.

2.

3.

4.

5.

a.

$$\begin{aligned}\text{min} &: 0\\ \text{max} &: 2^{43}-1\end{aligned}$$

b.

$$\begin{aligned}\text{min} &: -2^{42}\\ \text{max} &: 2^{42}-1\end{aligned}$$

c.

$$\begin{aligned}\text{min} &: 0\\ \text{max} &: 2^{11}-1\end{aligned}$$

d.

$$\begin{aligned}\text{min} &: -2^{10}\\ \text{max} &: 2^{10}-1\end{aligned}$$

6.

a.

The largest tiny floating point would have a sign of 0, an exponent of 7 (or $1110_2 - 7$) and a mantissa of 1.875 (or 1.111_2), and so would equal $(-1)^0 \cdot 1.875 \cdot 2^7 = 240$. The second-largest tiny floating point would have the same sign and exponent and a mantissa of 1.75 (or 1.111_2) which would equal $(-1)^0 \cdot 1.75 \cdot 2^7 = 224$. So, the difference between the largest non-infinite number representable with tiny floating points and the second largest would be $240 - 224 = 16$.

b.

The smallest positive tiny floating point would have a sign of 0, an exponent of -6 (or 0000_2) and a mantissa of 0.125 (or 0.001_2 due to denormalized encoding), and so would equal $(-1)^0 \cdot 0.125 \cdot 2^{-6} \approx 0.001953125 = 0.000000001_2$. The second smallest would have the same sign and exponent and a mantissa of 0.25 (or 0.010_2) which would equal $(-1)^0 \cdot 0.25 \cdot 2^{-6} \approx 0.00390625$ or exactly 0.00000001_2. So the difference between the two would approximately be $0.00390625 - 0.001953125 \approx 0.001953125 = 0.000000001_2$.