

COMP2120 Tutorial Exercise

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February 17, 2025

A machine uses 36-bit word to represent single-precision floating point numbers as follows:

S	11-bit exponent (E)	24-bit Significand (M)
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The value presented is given by $(-1)^S \times 1.M \times 2^{E-1023}$.

- (a) Write down the bit pattern corresponding to the value 7.375
- (b) Write down the value corresponding to the bit pattern C05D00000
- (c) What is the largest positive number that can be represented, assuming there is no pattern with special meaning in the representation?
- (d) What is the smallest positive number other than 0 that can be represented, assuming no pattern with special meaning?

(a)

$7.375_{10} = 111.011_2 = 1.11011_2 \times 2^2$ Thus, $S = 0$, $E = 1025 = 100\ 0000\ 0001_2$, $M = (1101\ 1000\ 0000\ \dots)_2$
Hence, the bit pattern is $0100\ 0000\ 0001\ 1101\ 1000\ 0000\ 0000\ 0000\ 0000_2 = 401D80000_{16}$

(b)

$C05D00000_{16} = 1100\ 0000\ 0101\ 1101\ 0000\ 0000\ 0000\ 0000\ 0000_2$
Thus, $S = 1$, $E = 100\ 0000\ 0101_2 = 1029$, $M = (1101\ 0000\ \dots)_2$, $1.M = 1.1101_2 = 1.8125$
Hence, the value is $-1 \times 2^{1029-1023} \times 1.8125 = -116.0$

(c)

The largest positive number is $2^{1024} - 2^{1000}$ when $S = 0$, $E = 111\ 1111\ 1111$, $M = 1111\ 1111\ \dots\ 1111$.

(d)

The smallest positive number is 2^{-1023} when $S = 0$, $E = 000\ 0000\ \dots\ 0000$, $M = 0000\ 0000\ \dots\ 0000$.