

ASSIGNMENT #2

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CS 3010.02 - 1

Exercise 1-3: # 1a, 1b, 4c, 4f, 4g, 5c, 5f, 5h, 7b, 7d, 8e, 9b, 9d

1. Determine the machine representation in single precision on a 32-bit word-length computer for the following decimal numbers.

a) $2^{-30} = (9.31322575 \times 10^{-10}) = [30800000]_{16}$

$$C = 127 - 30 = 97 \Rightarrow \text{Answer}$$

s	exp	mantissa
0	01100001	00000000000000000000 000000?

0011 0000 1000
3 0 8 0 0 0 0 0

b) $(64.015625)_{10} = [42800800]_{16}$

S	exp	mantissa
0	1000 0101	0000000000010...

0100 0010 1000 0000 0000 1000
Y: 2 8 0 0 8 00

$64/2 = 32$ $R=0$
 $32/2 = 16$ $R=0$
 $16/2 = 8$ $R=0$
 $8/2 = 4$ $R=0$
 $4/2 = 2$ $R=0$
 $2/2 = 1$ $R=0$

$$C = 127 + 6 = 133$$

1000000,000001 $\Rightarrow 1.0000000000001 \times 2^6$

4. Determine the single-precision and double-precision machine representation of the following decimal numbers.

c) -9876.54321

c) $-9876.54321_{10} = \boxed{C61A522C_{16}}$

$$9876 < 2^{14}$$

14 places + 10 places = 24

$0010\ 0110\ 1001\ 0100 \Rightarrow \overbrace{10011010010100}^{10011010010100} . 100010110$

$$.54321 \times 2 = 1.08642$$

$$1.00110100101001000101100 \times 2^{13}$$

$$0.08642 \times 2 = 0.17284$$

$$C = 140$$

$$\bullet 17284 \times 2 = 0,34568$$

S	exp	mantissa
1	1000 1100	00110100101001000101100

$$34568 \times 2 = 0.69136$$

$$\cdot 69136 \times 2 = 138272$$

$$38272 \times 2 = 0,76544$$

1

1

0.1000101100...

1100 0110 0001 1010 0101 0010 0010 1100

C C. 1 A 5 2 2 C

*FP32

4 c) $-9876.54321_{10} = \boxed{C0C34A4587D7C06D_{16}}$ * FP 64

$1.00110100101001000101100001111100111100000001101110 \times 2^{13} = 9876.54321$
 $C = 13 + 1023 = 1036$

S	exp	mantissa
1	10000001100	00110100101001000101100001111100111100000001101110

1100 0000 1100 0011 0100 1010 0100 0101 1000 0111 1110 0111 1100 0000 0110 1110
 C 0 C 3 4 A 4 5 8 7 D 7 C 0 6 D

f) $64.37109375 = \boxed{4280BD00_{16}}$ * FP 32

64.37109375
 $100\ 0000.0101111000000000$

$1.00000001011111 \times 2^6$
 $C = 127 + 6 = 133$

S	exp	mantissa
0	1000 0101	000,0000,1011,1110,0000,0000
	0100 0010 1000 0000	1011 1110 0000 0000
	4 2 8 0	B D 0 0

$64.37109375 = \boxed{405017C000000000_{16}}$ * FP 64

$1.000000010111110...0 \times 2^6$
 $C = 1023 + 6 = 1029$

S	exp	mantissa
0	100, 0000, 0101	0000,0001,0111,1100,....0
		37 zeros

0100 0000 0101 0000 0001 0111 1100 0000 0000 0000 0000
 4 0 5 0 1 7 C 0 0 0 0 11-15 zero in the

g) $-285.75 = \boxed{C38DD000_{16}}$

285.75
 $100011101.1100000000000000$
 $C = 127 + 8 = 135$

S	exp	mantissa
1	1000 0111	000,1110,1110,0000,0000,0000
	1100 0011 1000 1110 1110	
	C 3 8 D D 0 0 0	

$-285.75 = \boxed{C071DC0000000000_{16}}$ * FP 64

$1.00011101110...0 \times 2^8$
 43 zeros
 $C = 1023 + 8 = 1031$

S	exp	mantissa
1	100, 0000 0111	0001,1101,1100,0000....0
	1100 0000 0111 0001 1101 1100	10 to 53 zeros
	C 0 7 1 D C	

5. Identify the floating-point numbers corresponding to the following bit strings.

c) $0 \ 11111111 \ 000000000000000000000000 = \boxed{\infty}$ * reserved value for + infinity

d) $0 \ 10000001 \ 011000000000000000000000 = \boxed{5.5_{10}}$
 $+ \quad \quad \quad 129 \quad \quad \quad \downarrow$
 $129 - 127 = 2 \quad 1.011 \times 2^2 \Rightarrow 101.1 = 5.5$

e) $0 \ 01111011 \ 10011001100110011001100 = \boxed{0.09999999404_{10}}$
 $+ \quad \quad \quad 123 \quad \quad \quad \downarrow$
 $123 - 127 = -4 \quad 1.10011001100110011001100 \times 2^{-4}$
 \downarrow
 $0.000110011001100110011001100$
 $\frac{1}{2^4} + \frac{1}{2^5} + \frac{1}{2^8} + \frac{1}{2^9} + \frac{1}{2^{13}} + \frac{1}{2^{14}} + \frac{1}{2^{16}} + \frac{1}{2^{17}} + \frac{1}{2^{20}} + \frac{1}{2^{21}} + \frac{1}{2^{24}} + \frac{1}{2^{25}} = 0.09999999404$

7. Determine the decimal numbers that have the following machine representations:

b) $[3BCDCA00]_{16} = \boxed{0.006280183792_{10}}$

0011 1011 1100 1101 1100 1010 0000 0000
 3 B C D C A 0 0

s	exp	mantissa
0	0111 0111	100110111001010000000000

 $119 - 127 = -8$

$1.10011011100101 \times 2^{-8}$
 0.0000000110011011100101
 $\frac{1}{2^3} + \frac{1}{2^4} + \frac{1}{2^{12}} + \frac{1}{2^{13}} + \frac{1}{2^{15}} + \frac{1}{2^{16}} + \frac{1}{2^{17}} + \frac{1}{2^{20}} + \frac{1}{2^{22}} = 0.006280183792$

d) $[CB187ABC]_{16} = \boxed{-9992892_{10}}$

1 1001 0110 0011000011110101011100
 $150 - 127 = C = 23$
 \downarrow

$2^{-3} + 2^{-4} + 2^{-9} + 2^{-10} + 2^{-11} + 2^{-12} + 2^{-14} + 2^{-16} + 2^{-18} + 2^{-19} + 2^{-20} + 2^{-21} = 0.1912455559$

$-1.1912455559 \times 2^{23} = -9992892$

8. Determine the decimal numbers that have the following machine representations:

e) $[45223000]_{16} = [2595]_{10}$

S	exp	mantissa
0	1000 1010	010001000110000000000000
	138-127 = C = 11	₂ ₆ _{10 11}

$$2^{-2} + 2^{-6} + 2^{-10} + 2^{-11} = 0.2670898438$$

$$1.2670898438 \times 2^{11} = 2595$$

9. Are these machine representations? why or why not?

b) $[1A1AIA1A]_{16}$

This is NOT a valid machine representation since Hexadecimal does NOT have an I as a valid character that would represent a 4-bit binary string.

d) $[CABEGG94]_{16}$

This is NOT a valid machine representation. The character G is not a valid hexadecimal digit that represents a 4-bit binary string.