COMP 273, Assignment 1 Detailed Answers

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Q.1.1

1.1.1 $(741)_{10} \rightarrow (?)_2$

Divide $(741)_{10}$ by the new base, which is 2 here, and get the remainders.

2| 741	
| 370	… 1
| 185	… 0
| 92	… 1
| 46	… 0 ↑
| 23	… 0 |
| 11	… 1 |
| 5	… 1 |
| 2	… 1 |
| 1	… 0
| 0	… 1

Therefore, $(741)_{10} = (1011100101)_2$.

1.1.2 $(741)_{10} \rightarrow (?)_{16}$

Divide $(741)_{10}$ by 16 and get the remainders

16| 741	
| 46	… 5
| 2	… 14 = $(E)_{16}$
| 0	… 2

Therefore, $(741)_{10} = (2E5)_{16}$.

1.1.3 $(1.3515625)_{10} \rightarrow (?)_2$

Multiply $(1.3515625)_{10}$ by the new base, which is 2 here, and get the left-hand side of the decimal each time.

1.3515625	$\rightarrow$	0.3515625	+ 1
			.
0.3515625 x 2 = 0.703125			+ 0
0.703125 x 2 = 0.40625			+ 1
0.40625 x 2 = 0.8125			+ 0
0.8125 x 2 = 0.625			+ 1
0.625 x 2 = 0.25			+ 1
0.25 x 2 = 0.5			+ 0
0.5 x 2 = 0.0			+ 1

Therefore, $(1.3515625)_{10} = (1.0101101)_2$.

1.1.4 $(1.3515625)_{10} \rightarrow (?)_{16}$

Multiply $(1.3515625)_{10}$ by 16 and get the LHS of the decimal each time.

1.3515625	$\rightarrow$	0.3515625	+ 1
			.
0.3515625 x 16 = 0.625			+ 5
0.625 x 16 = 0.0			+ 10 = $(A)_{16}$

Therefore, $(1.3515625)_{10} = (1.5A)_{16}$.

1.1.5 $(1001101)_2 \rightarrow (?)_{10}$

$(1001101)_2 = (1x2^6)_{10} + (1x2^3)_{10} + (1x2^2)_{10} + (1x2^0)_{10} = 64 + 8 + 4 + 1 = 77_{10}$

Therefore, $(1001101)_2 = (77)_{10}$.

1.1.6 $(1001101)_2 \rightarrow (?)_{16}$

Since $16 = 2^4$, we can just group four digits of the binary number.

$(0100\ 1101)_2 = (4\ D)_{16}$

Therefore, $(1001101)_2 = (4D)_{16}$.

1.1.7 $(0.101011)_2 \rightarrow (?)_{10}$

$(0.101011)_2 = (1x2^{-1})_{10} + (1x2^{-3})_{10} + (1x2^{-5})_{10} + (1x2^{-6})_{10} = \frac{1}{2} + \frac{1}{8} + \frac{1}{32} + \frac{1}{64}$

$= (\frac{43}{64})_{10} = (0.671875)_{10}$

Therefore, $(0.101011)_2 = (0.671875)_{10}$.

1.1.8 $(0.101011)_2 \rightarrow (?)_{16}$

Again, group the binary number by 4 digits.

$(0.1010\ 1100)_2 = (0.A\ C)_{16}$

Therefore, $(0.101011)_2 = (0.AC)_{16}$.

1.1.9 $(F00D)_{16} \rightarrow (?)_2$

This time, we can expand one hexadecimal digit into four binary digits.

$(F)_{16} = (1111)_2$

$(0)_{16} = (0000)_2$

$(0)_{16} = (0000)_2$

$(D)_{16} = (1101)_2$

$(F00D)_{16} = (1111\ 0000\ 0000\ 1101)_2$

Therefore, $(F00D)_{16} = (1111000000001101)_2$.

1.1.10 $(F00D)_{16} \rightarrow (?)_{10}$

$(F00D)_{16} = (15 \text{ x } 16^3)_{10} + (13 \text{ x } 16^0)_{10} = 61440 + 13 = (61453)_{10}$

Therefore, $(F00D)_{16} = (61453)_{10}$.

1.1.11 $(A.BED)_{16} \rightarrow (?)_2$

Again, we can expand one hexadecimal digit into four binary digits.

$(A)_{16} = (1010)_2$
$(B)_{16} = (1011)_2$
$(E)_{16} = (1110)_2$
$(D)_{16} = (1101)_2$
$(A.BED)_{16} = (1010\ .\ 1011\ 1110\ 1101)_2$

Therefore, $(A.BED)_{16} = (1010.101111101101)_2$.

1.1.12 $(A.BED)_{16} \rightarrow (?)_{10}$

$(A.BED)_{16} = (10 \text{ x } 16^0)_{10} + (11 \text{ x } 16^{-1})_{10} + (14 \text{ x } 16^{-2})_{10} + (13 \text{ x } 16^{-3})_{10}$
$= 10 + \frac{11}{16} + \frac{14}{16^2} + \frac{13}{16^3} = 10 + 0.6875 + 0.0546875 + 0.003173828 =$
10.74536133

Therefore, $(A.BED)_{16} = (10.74536133)_{10}$

<u>Q.1.2</u>

1.2.1 $(1.00001)_{10}$ in IEEE single precision floating point number

First of all, $(1.00001)_{10}$ in binary is $(1.00000000000000000101001111\ldots)_2$
We know that the number is a positive number, so the sign bit is **0**.

For the IEEE single precision floating point number format, we only need 23 digits after the decimal point, so round up to that many digits.) Therefore, $(1.00001)_{10} = (1.00000000000000001010100)_2$. We do not store the leading 1, and so **00000000000000001010100** will be the 23 mantissa bits.

So, $(1.00001)_{10} = (1.\ 00000000000000001010100)_2 \text{ x } 2^0$, so the decimal exponent is 0. Adding the fixed bias of 127 to 0, we get $(127)_{10}$. $(127)_{10}$ in binary is $(\mathbf{01111111})_2$, and that will be the 8 exponent bits.

Therefore, we can represent $(1.00001)_{10}$ in IEEE single precision floating point number format as:

0   01111111   00000000000000001010100

1.2.2 $(-0.32750702)_{10}$ in IEEE single precision floating point number

First of all, the number is negative, so the sign bit is **1**.

$(0.32750702)_{10}$ in binary is $(0.01010011110101111000000000\ldots)_2$.
In the scientific form, it is $(1.0100111101011100000000\ldots)_2 \times 2^{-2}$.
We only need up to 23 digits for the mantissa, and we do not store the leading 1, so the 23-digit mantissa bit will be **01001111010111100000000**.

Finally, since the number is $(1.0100111101011100000000\ldots)_2 \times 2^{-2}$, the exponent in decimal form is -2. We add the fixed bias of 127, and we get -2+127=125. $(125)_{10}$ in binary is $(\mathbf{01111101})_2$, which is the 8-digit exponent bit.

Therefore, $(-0.32750702)_{10}$ in IEEE single precision floating point number format is:

1 01111101 01001111010111100000000