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# Problem Sheet #05

## Problem 5.1:

a-) We can represent $b^n = 3^6 = 729$ different numbers. With 0 in the mid range, we can cover it by $[-364, 364]$

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -364 | -363 | ..... -2 | -1 | 0 | 1 | 2 ..... | 363 | 364 | (Decimal) |
| -222222 | ....... | | | 000000 | | ....... | | 222222 | (3 complement, 6 digits) |

because the number system has a fixed size of $n=6$ digits and a base of $b=3$.

b-) * The absolute value of -1 in base 3 is $(000001)_3$

We calculate for each digit $a_i' = (b-1) - a_i$, which gives us 222221. Adding 1 give us the 6 digit b-complement base 3 as follows: $(222222)_{3b6}$.

* The absolute value of -99 in base 3 is $(010200)_3$.

We calculate for each digit $a_i' = (b-1) - a_i$, which give us 212022. Adding 1 give us the 6 digit b-complement base 3 as follows:

$(212022)_{3b6}$.

c-) We add the numbers in 6-digit b complement base 3.

$$\begin{array}{r} 222222 \\ +\ 212022 \\ \hline 1212021 \end{array}$$

* We calculate for each digit $a_i' = (b-1) - a_i$, which gives us 1010202. Adding 1 leads to the base 3 representation $(1010210)_3$ of the absolute value, which is $1 + 99 = 100$ in the decimal number system.

which results in $-100$.

Problem T-2:

a-) the number 321.123 is positive, we set the sign bit to 0.

Now we convert $(321.123)_{10}$ into binary representation.
We can use the dec2bin algorithm:

$\Rightarrow$ $(321 \bmod 2) = 1$

$(160 \bmod 2) = 0$

$(80 \bmod (2)) = 0$

$(40 \bmod (2)) = 0$

$(20 \bmod (2)) = 0$

$(10 \bmod (2)) = 0$

$(5 \bmod (2)) = 1$

$(2 \bmod (2)) = 0$

$(1 \bmod (2)) = 1$

$$(101000001)_2$$

Now, we convert the fractional part of $(321.123)_{10}$ into a binary fraction using the dec-to-bin-f algorithm.

$\Rightarrow 0.123 \cdot 2 = 0.246 \quad \Rightarrow 0$

$0.246 \cdot 2 = 0.492 \quad \Rightarrow 00$

$0.492 \cdot 2 = 0.984 \quad \Rightarrow 000$

$0.984 \cdot 2 = 1.968 \quad \Rightarrow 0001$

$0{,}968 \cdot 2 = 1.936 \quad \Rightarrow 00011$

$0{,}936 = 1.872 \quad \Rightarrow 000111$

$\vdots \quad \vdots \qquad\qquad \vdots \quad \vdots$

which gives us: 00011111 011111001110110

Combining the last two results we get:

$(101000001.00011111011111001110110)_2$

for the decimal value $(321.123)_{10}$. We normalize ~~and get~~ the binary fraction and get:

$(1.0100000100011111011111001110110)_2 * 2^8$

* Adding the bias $127_{10}$ to the exponent $8_{10}$, [redacted] we get the biased exponent $135_{10} = (10000111)_2$.

Therefore, we get the ~~[illegible]~~ format with a sign bit of 0.

$$\left[\overset{S}{0}\ \underbrace{1000011}_{\text{exponent}}\ \underbrace{0100000100011111011111001110110}_{\text{Mantissa}}\right]$$