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L1 Mathematics
Machine Framework
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Worksheet N°02: Data Representation Part II

Exercise 01:

1. The infinity symbol ∞ has the Unicode code point U+221E.
   a) How many bytes are needed to encode it in UTF-8?
   b) Give its UTF-8 code in binary, then in hexadecimal.
2. The UTF-8 code of the character Ω is given by $(\text{CEA9})_{16}$.
   a) Give the lenght (number of bytes) used for this character
   b) Find the Unicode code point of this character.

Exercise 02:

1. What are the intervals of representation of the signed integers on 8 bits in SM, C1 and C2 ?
2. Represent the following decimal numbers in SM, C1 and C2 on 8 bits when it is possible:

$$+45 \qquad -52 \qquad -128 \qquad +500.$$

3. Use the 16-bits representation for the numbers which cannot be represented on 8 bits.

Exercise 03:

Give the decimal value of the following signed numbers:

$(11001001)_{SM}$ $(10011100)_{C1}$ $(01101110)_{C2}$ $(0011010)_{SM}$
$(10010110)_{C2}$ $(1111111100001011)_{C2}$ $(00010110)_{C1}$ $(1000)_{C2}$

Exercise 04:

1. Give the IEEE-754 single-precision representation in binary and hexadecimal of the number:

$$(-54{,}125)_{10}$$

2. Decode the number $(11000010000011100000000000000000)_2$, written in IEEE-754 single-precision format.
3. **(Optional)** Encode the number $(+150.375)_{10}$ in IEEE-754 double-precision format.

Exercise 05 (Optional):

Consider a machine that codes signed integers on 8 bits.

1. Give the range of integers that can be represented in SM, C1 and C2.
2. How many distinct values can be represented in each of these three systems? Explain the difference.
3. Give the representations of zero in SM, C1 and C2.
4. What happens if we try to represent $(-128)_{10}$ or $(+128)_{10}$ in C1 on 8 bits?
5. Generalize: give the range of representable integers on n bits in SM, C1 and C2.

Exercise 06 (Optional):

1) What's the different between these Unicode representations: UTF-32, UTF-16 et UTF-8?
2) By using the Unicode UTF-8, give the hexadecimal code of this word: **"Élève"**.
   Knowing that: É = U+00C9, l = U+006C, è = U+00E8, v = U+0076 and e = U+0065.
3) Concider the the following UTF-8 code:

$$(\text{CF } 80 \text{ } 20 \text{ } E2 \text{ } 89 \text{ } 88 \text{ } 20 \text{ } 33 \text{ } 2C \text{ } 31 \text{ } 34)_{16}$$

   a) Give the number of characters and the lenght used for each character in this code.

   b) Convert this UTF-8 code into Unicode and give the corresponding text.

   (We give: 4 = U+0034 , ≈ = U+2248, space = U+0020, 3 = U+0033, comma = U+002C, 1 = U+0031 and π = U+03C0).