Exercise Sheet 2
 # Number systems

Directive*: the use of the calculator is not permitted, except for complicated operations.*

Exercise 1

Perform the following conversions (for complicated calculations, leave the result as fraction)

- **decimal-----binary**

    9   64   13.75   29.625   8.6

- **binary ----- decimal**

    $(10)_2$ $(1011)_2$ $(101101)_2$ $(0001110)_2$ $(110001.11)_2$ $(1101.101)_2$

- **decimal -----octal**

    18   7   65.25   30.125

- **octal----- decimal**

    $(14)_8$ $(52)_8$ $(101)_8$ $(7.05)_8$ $(200.13)_8$

- **decimal -----hexa**

    9   12   29   160.25   31.75

- **hexa----- decimal**

    $(8)_{16}$ $(2E)_{16}$ $(AA)_{16}$ $(1F.E)_{16}$ $(A0.8)_{16}$

Exercise 2

Convert directly the following numbers as requested

- $(23)_8 = (\ldots\ldots\ldots)_2$ $(143.6)_8 = (\ldots\ldots\ldots)_2$ $(110100)_2 = (\ldots\ldots\ldots)_8$

    $(11001111001.1110110101)2 = (\ldots\ldots\ldots)8$

- $(1F)16 = (\ldots\ldots\ldots)2$ $(A2.AF)16 = (\ldots\ldots\ldots)2$ $(101001110)2 = (\ldots\ldots\ldots)16$

    $(111.11101001110111)_2 = (\ldots\ldots\ldots)_{16}$

- $(705)_8 = (\ldots\ldots\ldots)_{16}$ $(4D)_{16} = (\ldots\ldots\ldots)_8$ $(65.13)_8 =$

    $(\ldots\ldots\ldots)_{16}$ $(2D.FFC)_{16} = (\ldots\ldots\ldots)_8$

Exercise 3

1. Convert the following binary numbers into decimal and deduce the general rules.

    $(11)_2$ $(111)_2$ $(1111)_2$ $(\underbrace{1111\ldots\ldots\ldots1}_{n})_2$

    $(10)_2$ $(100)_2$ $(1000)_2$ $(1\underbrace{00\ldots\ldots\ldots0}_{n})_2$

2. Use the previous rules to calculate the decimal values of the following numbers

    $(111011)_2$ $(11110110111)_2$ $(1111110110110)_2$

    $(111111000000)_2$ $(111111000000111111)_2$

Exercise 4 (exam 2021)

Determine the pairs of integers (x,y) such that: $(xy)_7 = (yx)_{10}$

Exercise 5 (exam 2023)

The sum of the digits of a 2-digit number is equal to 11. If we add 45 to this number we obtain a number formed by exchanging digits. What is this number?

Exercise 6

Perform the following operations in binary

- $(1101010)_2 + (1110011)_2$
- $(1010)_2 + (111)_2$
- $(1010.011)_2 + (111.11)_2$
- $(111011)_2 - (11)_2$
- $(100001)_2 - (11110)_2$
- $(1001.1110)_2 - (11.1001)_2$

Extra exercises

Exercise #1

Perform the requested conversions

$(213)_8 = (\ldots\ldots\ldots)_7$ $(110)_7 = (\ldots\ldots\ldots)_4$ $(65)_7 = (\ldots\ldots\ldots)_9$

$(AD)_{16} = (\ldots\ldots\ldots)_6$ $(158)_9 = (\ldots\ldots\ldots)_{16}$ $(101011)_2 = (\ldots\ldots\ldots)_3$

Exercise #2

1. Write the following decimal as a sum of powers of 10.   N= 1928.765
2. What is the quick way to convert a large decimal number to binary?
3. Find the base "X" in the equation: $(4F)_{16} = (142)_X$
4. How to calculate the double/half of a number (integer/fractional) written in binary?
5. Which numbers have the same representation in all numbering systems?
6. Among the following numbers, find the number which has a meaning in Hexadecimal:

   CACFH, BAC, ROUE, ABCD, AFAK, DE1549C2?
7. How to check the parity (even/odd) of a number written in binary?
8. How many bits are required to write 614 in binary?
9. What is the advantage of using the octal/hexadecimal system?
10. What are the pros and cons of calculator?

Exercise #3

Suppose a number system of base **b.**

1. Complete the following conversions

$b = (\ldots\ldots)_b$ $b^2 = (\ldots\ldots)_b$ $b^n = (\ldots\ldots)_b$ (n : integer ≥ 1)

2. Let X a decimal number $X = 4b^5 + 2b^3 + b + 7$

   How to write X in the base **b?**