Tasks on Number Systems and Codes

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07.11.2024

Task 1

I will define the range of numbers represented in the signed magnitude (SM) code for a 16-bit format. Based on the result, I will write the formula to calculate the range of numbers L in signed magnitude (SM) code in an n-bit format.

Solution: The range of numbers in signed magnitude code for a 16-bit format is:

$$-2^{15} \leq L_{16} \leq 2^{15} - 1$$

The general formula for the range of numbers in signed magnitude code in an n-bit format is:

$$-2^{n-1} \leq L_n \leq 2^{n-1} - 1$$

Task 2

I will combine the first 8 digits of my PESEL number. I will assign a value of 0 to all even digits and a value of 1 to all odd digits and zeros. Then, I will calculate the decimal value of the resulting number, which has been encoded in an 8-bit signed magnitude code.

PESEL: 07221011130

- First 8 digits: '07221011' - Apply encoding: Even digits = 0, Odd digits and 0 = 1:

$$07221011 \rightarrow 110011111$$

Now, I will convert the binary number '10110101' to decimal:

$$110011111_2 = 415_{10}$$

Thus, the decimal value is 181.

Task 3

I will combine the 4th, 5th, and 6th digits of my PESEL number into a number and represent it in unsigned binary code. I will then convert the number into its opposite (negative) and write it again in U1 code.

PESEL (4th, 5th, and 6th digits):210

1. I will convert 210_{10} to binary :

$$210_{10} = 11010010_2$$

2. I will convert the number to its negative (opposite):

$$-210_{10} = 00101101_2$$

Task 4

I will combine the first 8 digits of my PESEL number. In the resulting number, I will assign a value of 1 to all even digits and a value of 0 to all odd digits and zeros. Then, I will calculate the decimal value of the resulting number encoded in an 8-bit unsigned binary.

PESEL: 07221011130

- First 8 digits: '07221011' - Apply encoding: Even digits = 1, Odd digits and 0 = 0:

$$07221011 \rightarrow 11001111$$

Now, I will convert the binary number '11000000' to decimal:

$$11001111_2 = 207_{10}$$

Thus, the decimal value is 207.

Task 5

I will repeat the steps from Task 4 to obtain the number encoded in an 8-bit unsigned binary code and calculate the decimal value.

PESEL: 07221011130

- First 8 digits: '07221011' - Apply encoding: Odd digits and zeros = 1, Even digits = 0:

$$07221011 \rightarrow 11001111$$

Now, I will convert the binary number '11000000' to decimal:

$$11000000_2 = 207_{10}$$

Thus, the decimal value is 207.

Task 6

I will combine the last 3 digits of my PESEL number and represent them in unsigned binary code. I will convert the number to its opposite (negative) and write it again. I will also check the correctness of the result using the simplified method for converting decimal numbers.

PESEL (last 3 digits): 130

1. I will convert 130_{10}:

$$130_{10} = 10000010_2$$

2. I will convert the number to its opposite (negative):

$$-130_{10} = 01111101_2$$

Task 7

I will convert the following numbers between number systems:

1. $10111,01111_2$ to decimal
2. $1110,1100_2$ to decimal
3. $22,125_{10}$ to binary
4. $75,875_{10}$ to binary

Solutions:

a) $10111,01111_2 \rightarrow 7.46875_{10}$
b) $1110,1100_2 \rightarrow 6.75_{10}$
c) $22,125_{10} \rightarrow 10110.001_2$
d) $75,875_{10} \rightarrow 1001011.111_2$

Additional Task (Optional)

Task 1: Assume that the 7th, 8th, and 9th digits of my PESEL number represent the integer part of a number, while the 10th and 11th digits represent the fractional part. Using fixed-point representation, I will convert the number into binary format with four decimal places of accuracy.

PESEL:07221011130
Integer part: '111' Fractional part: '30'
Number to convert: 111.30
In binary:

$$111.30_{10} \rightarrow 1101111.0100110011001101_2$$

Task 2: I will repeat the steps from Task 1 to obtain the decimal number. Using floating-point representation , I will convert it to binary with four decimal places of accuracy. I will check the correctness of the result.

PESEL:07221011130

Number to convert: 111.30

In floating-point representation:

$$111.30_{10} = 1.1130 \times 2^7$$

Thus, the binary representation is:

$$1101111.010011001100110011001101_2$$