Topics

- Positional Number Systems
- Base conversion
- Special bases: 2,8,16
- Signed quantities
- Elementary arithmetic operations
- Binary Codes

Problems

1 Build a table with all the possible 3 binary digits (bits). For each combination determine the respective decimal, octal, and hexadecimal representation. Repeat the exercise with 4 bits.

2 Compute the decimal value of the following unsigned integer quantities:

a) 00001111_2 b) 1347_8 c) $DF5_{16}$

d) 10100011_2 e) 7751_8 f) $A7A2_{16}$

g) 11111111_2 h) 2013_8 i) $40FF_{16}$

3 Determine the octal, hexadecimal, decimal, and binary representations of the following non-negative integer quantities:

a) 1036_{10} b) 7354_8 c) $16B5_{16}$ d) 111100111_2

e) 7564_{10} f) 6102_8 g) $D3F9_{16}$ h) 110101011_2

4 Compute the decimal value of the following rational quantities. Do not exceed the precision of the original representation:

a) 110110.1101001_2 b) 127.444_8 c) $2D.8_{16}$

5 Determine the octal, hexadecimal and binary representations of the following rational non-negative quantities. Do not exceed the precision of the original representation:

a) 13.25_{10} b) 33.47_{10} c) 123.3_{10}

6 Compute the following additions and check the results with decimal representation:

a) $10101110_2 + 00011111_2$ b) $125_8 + 17_8$

c) $125_{16} + 1A7_{16}$ d) $00111011_2 + AD_{16}$

7 Compute the following subtractions and check the results with decimal representation:

a) 10101110_2 - 00011111_2 b) 125_8 - 17_8

c) 107_{16} - DC_{16} d) AD_{16} - 00111011_2

8 Compute the signed decimal value of the following quantities assuming a two's complement 8 bit encoding:

a) 11111110 b) 00000000 c) 11111111 d) 00110011

9 Assume a two's complement 8 bit encoding. Determine, whenever possible, the corresponding two's complement 4 bit encoding:

a) 11111110 b) 00000110 c) 11111111 d) 00110011

10 Assume a two's complement 4 bit encoding. Determine, the corresponding two's complement 8 bit encoding:

a) 1110 b) 0110 c) 1000 d) 0001

11 Consider a 12 bit quantity represented as 7650_8. Compute the corresponding signed decimal value assuming a two's complement 12 bit binary representation.

12 Show, whenever possible, the 8 bit binary representation of the following quantities assuming a two's complement encoding:

a) 45_{10} b) -13_8 c) $-F1_{16}$ d) 130_{10}

13 Compute the result of the following operations assuming an 8 bit two's complement representation. Verify the possible overflow cases.

a) $-1_{10} + 63_{10}$ b) $11111_2 + 10101_2$ c) $-11_{10} - 123_{10}$ d) $54_{16} + 2E_{16}$

14 Show in binary, octal, hexadecimal, and decimal the positive and negative limits of the representation of a 12 bit signed quantity

15 Determine *m*, the minimum number of bits necessary to code 6 different objects? Suggest an example. Compute the total number of different codes that can be produced in this case.

16 Represent the following numbers in BCD_{8421} code.

a) 111_{10} b) 125_8 c) ABC_{16}

17 Build the Gray tables with 3 and 4 bits. Build another table with the first 4 and last 4 Gray code words with 5 bits.

18 Determine the Gray code words corresponding to the following natural binary code words:

a) 00001111 b) 10011001 c) 11111111

19 Determine the natural binary code words corresponding to the following Gray code words:

a) 00001111 b) 10011001 c) 11111111

20 Compute the Hamming distance for the following code word pairs

a) 10101010 e 01010101 b) 11110000 e 11000011 c) 10101111 e 10101111

21 Verify that, for every Gray code, the Hamming distance for any pair of consecutive code words is always 1. Verify that the same happens for the first and the last code word pair.