ESD - Elettronica dei Sistemi Digitali

Exercises on Data Representation

Prof. Riccardo Berta

2025.10.08

1 Data Representation Exercises

1.1 Exercise 1

What is the largest 32-bit binary number that can be represented with:

1.1.1 (a) Unsigned numbers

1.1.2 (b) Two's complement numbers

1.1.3 (c) Sign/magnitude numbers

1.2 Exercise 2

What is the smallest (most negative) 16-bit binary number that can be represented with:

1.2.1 (a) Unsigned numbers

1.2.2 (b) Two's complement numbers

1.2.3 (c) Sign/magnitude numbers

1.3 Exercise 3

What is the smallest (most negative) 32-bit binary number that can be represented with:

1.3.1 (a) Unsigned numbers

1.3.2 (b) Two's complement numbers

1.3.3 (c) Sign/magnitude numbers

1.4 Exercise 4

Convert the following unsigned binary numbers to decimal and to hexadecimal:

1.4.1 (a) 1110_2

1.4.2 (b) 100100_2

1.4.3 (c) 11010111_2

1.4.4 (d) 011101010100100_2

1.4.5 (e) 0110_2

1.4.6 (f) 101101_2

1.4.7 (g) 10010101_2

1.4.8 (h) 110101001001_2

1.5 Exercise 5

Convert the following hexadecimal numbers to decimal and to unsigned binary:

1.5.1 (a) $4E_{16}$

1.5.2 (b) $7C_{16}$

1.5.3 (c) $ED3A_{16}$

1.5.4 (d) $403FB001_{16}$

1.5.5 (e) $2B_{16}$

1.5.6 (f) $9F_{16}$

1.5.7 (g) $42CE_{16}$

1.5.8 (h) $E34F_{16}$

1.6 Exercise 6

Convert the following two's complement binary numbers to decimal:

1.6.1 (a) 1110_2 (4-bit)

1.6.2 (b) 100011_2 (6-bit)

1.6.3 (c) 01001110_2 (8-bit)

1.6.4 (d) 10110101_2 (8-bit)

1.6.5 (e) 1001_2 (4-bit)

1.6.6 (f) 110101_2 (6-bit)

1.6.7 (g) 01100010_2 (8-bit)

1.6.8 (h) 10111000_2 (8-bit)

1.7 Exercise 7

Convert the following decimal numbers to unsigned binary and to hexadecimal

1.7.1 (a) 42_{10}

1.7.2 (b) 63_{10}

1.7.3 (c) 229_{10}

1.7.4 (d) 845_{10}

1.7.5 (e) 56_{10}

1.7.6 (f) 75_{10}

1.7.7 (g) 183_{10}

1.7.8 (h) 754_{10}

1.8 Exercise 8

Convert the following decimal numbers to 8-bit two's complement numbers or indicate overflow. Range of 8-bit two's complement: $-128 \leq N \leq +127$.

1.8.1 (a) 24

1.8.2 (b) -59

1.8.3 (c) 128

1.8.4 (d) -150

1.8.5 (e) 127

1.8.6 (f) 48

1.8.7 (g) -34

1.8.8 (h) 133

1.8.9 (i) -129

1.9 Exercise 9

How many bytes are in a 32-bit word? How many nibbles are in the 32-bit word? How many bytes are in a 64-bit word? How many nibbles are in the 64-bit word? How many bits are in 2 bytes? How many bits are in 6 bytes?

1.10 Exercise 10

Convert the following decimal numbers to IEEE 754 single-precision format:

1.10.1 (a) 45.375_{10}

1.10.2 (b) -13.25_{10}

1.10.3 (c) 0.1_{10}

1.10.4 (d) -0.125_{10}

1.11 Exercise 11

Convert the following IEEE 754 single-precision numbers into decimal values:

1.11.1 (a) 0 10000010 01100000000000000000000

1.11.2 (b) 1 10000001 01000000000000000000000

1.11.3 (c) 0 01111101 10000000000000000000000

1.11.4 (d) 1 01111100 00000000000000000000000

1.12 Exercise 12

A particular modem operates at 768 Kb/sec. How many bytes can it receive in 1 minute?

1.13 Exercise 13

USB 3.0 can send data at 5 Gb/sec. How many bytes can it send in 1 minute?