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Introduction to Computer Science, Winter Semester 2016
Practice Assignment 8

Discussion: 17.12.2016 - 22.12.2016

Exercise 8-1

Convert the following numbers from binary to decimal:

a) $(1001001.011)_2$

b) $(101111.0111)_2$

c) $(0.1110100)_2$

Exercise 8-2

- Convert the following number from decimal to binary: 50.75
- Show the binary representation of the decimal number 42.74 with approximation of 5-bits after the decimal point.

Exercise 8-3

Show how the decimal number -22.246 is stored in a computer that uses 16 bits to represent real numbers (10 for the mantissa and 6 for the exponent, both including the sign bit). Show your work as indicated below.

a) Show the binary representation of the decimal number -22.246.

b) Show the binary number in normalized scientific notation.

c) Show how the binary number will be stored in the 16 bits below.

Sign of mantissa 1 bit	Mantissa 9 bits	Sign of exponent 1 bit	Exponent 5 bits

Exercise 8-4

Assume that our computer stores decimal numbers using 16 bits — 10 bits for a sign/magnitude mantissa and 6 bits for a sign/magnitude base-2 exponent.

Sign of mantissa 1 bit	Mantissa 9 bits	Sign of exponent 1 bit	Exponent 5 bits

Show the internal representation of the following decimal floating points:

a) 7.5

b) -20.25

c) 0.015625

Exercise 8-5

Recall the 16-Bit encoding schema for a normalized scientific binary floating point:

Sign of mantissa 1 bit	Mantissa 9 bits	Sign of exponent 1 bit	Exponent 5 bits

Translate the following numbers into this schema (show your workout):

a) 54272_{10}

b) $.00011011_2$

c) 10001.011_2

Exercise 8-6

We would like to store the floating-point number -33.66 in a computer that uses 16 bits to represent real numbers.

a) The aim now is to find out the number of bits that will be used for the exponent and the mantissa. Assuming that the number of bits to represent the exponent will be the least number of bits needed to represent the exponent for the number -33.66. Find

   - the total number of bits needed to represent the exponent and
   - the total number of bits to represent the mantissa (assuming that we have in total 16 bits to represent real numbers)

b) Give the largest number in binary that can be represented using the number of bits of the mantissa and the exponent from part a).

c) Show the binary representation of the decimal number -33.66.

d) Show the binary number in normalized scientific notation.

e) Show how the binary number will be stored in the 16 bits below.

Exercise 8-7

What would be the ranges of numbers that can be represented by sign/magnitude, 1's complement, and 2's complement using the following number of bits:

- 3 bits
- 8 bits
- 10 bits

Justify your answer.

Exercise 8-8

Write the 8-bit sign magnitude, 1's complement and 2's complement representations for each of these decimal numbers:

a) +18

b) +115

c) -49

d) -100

Exercise 8-9

Perform the addition of the following binary numbers.

a) $0.011 + 0.0101$

b) $101 + 1.01$

c) $1011 + 1.11$

d) $101.01 + 1011.01$

Exercise 8-10

Subtract the following 4-bit binary numbers which are represented using the two's complement notation and give the results in the decimal system (base 10).

a) $1011 - 1001$

b) $1100 - 0110$

c) $1010 - 0011$

d) $1011 - 1101$

e) $0111 - 1001$

f) $1100 - 1100$

Exercise 8-11

Assume that our computer stores decimal numbers using 8 bits. Perform the following subtractions using 2's complement notation:

a) $26 - 13$

b) $29 - 36$

c) $18 - 19$

Exercise 8-12

Assume that our computer stores decimal numbers using 5 bits. Perform the following operation using 2's complement notation:

$-13 - 12$