Data representation
Proposed exercises

Exercise 1. A computer has a word width that allows you to represent numbers in complement to two in the range [-222, 222-1]. Respond:

a) What is the number of bits that store the registers of this computer?
b) How much KB of memory can address at most this computer?

Exercise 2. The following numbers are represented in two's complement using 6 bits. Indicate their corresponding decimal value:

a) 010011
b) 110111
c) 100000

Exercise 3. You want to represent integers within the range -8191...8191.

a) What is the number of bits needed if you want to use a representation in one's complement?
b) What is the number of bits needed if you want to use a sign-magnitude representation?

Exercise 4. Indicate the representation of the following numbers, reasoning your answer:

a) -16 in two's complement with 5 bits
b) -16 in one's complement with 5 bits
c) +13 in sign-magnitude with 5 bits
d) -14 in two's complement with 5 bits

Exercise 5. Represent in the single precision IEEE 754 standard the numbers 14 and 3,5.

Exercise 6. Respond in a justified way

a) Where is a float variable more accurate, on a 32-bit or 64-bit computer?
b) Indicate in a reasoned and justified way if any 32-bit integer in two's complement can be stored exactly in a float?

Exercise 7. Make the sum of the previous numbers represented in the IEEE 754 standard.

Exercise 8. Make the product of the previous numbers represented in the IEEE 754 standard.

Exercise 9. Consider a 16-bit floating point representation (similar to the IEEE 754 standard) that uses 5 bits for the exponent and 10 for the mantissa. It is requested:

a) What is the smallest and largest non-standardized number that can be represented.
b) Which is the smallest and the largest standardized one that can be represented.

Exercise. Represent the numbers 14 and 3,5 using the 16-bit floating point representation.

Exercise 11. Indicate the decimal value of the following hexadecimal numbers that follow the IEEE 754 floating point format

a) 0xFF800000
b) 0x7F804000
c) 0xC7B00000
d) 0x00180000

Exercise 12. Add 8,76 x 10 to 1,47 x 10^2 assuming that only 3 digits are available for the mantissa, first with guard and rounding digits and then without them.

Exercise 13. What is the error made in the representation of the number 0,1 when using the 16-bit standard as opposed to using 32 bits?

Exercise 14. Indicate, in a reasoned way, the decimal value of the following hexadecimal numbers that represent floating point numbers in the 32-bit IEEE 754 standard:

a) 0x7F800000

b) 0x40E00000

Exercise 15. How many non-standardized numbers can be represented in the IEEE 754 32-bit standard?

Exercise 16. Calculate the number of values that can be represented in 32-bit floating point that are between 1 and 2, and between 3 and 4.

Exercise 17. The following numbers are represented in two's complement using 6 bits. Indicate their corresponding decimal value:

a) 010011
b) 100111

Exercise 18. Indicate the decimal value of the following number represented in the 32-bit IEEE 754 floating point standard: 0x00200000.

Exercise 19. Indicate the decimal value of the following number represented in the single precision IEEE 754 standard: 0xBE800000.

Exercise 20. In the single precision IEEE 754 standard:

a) Indicate the decimal value corresponding to the largest negative number that can be represented.
b) Indicate the value of 0xFFF00000, which corresponds to the bits stored in a float type variable.