MIE-MPI, Mathematics for Informatics - Homework no. 3

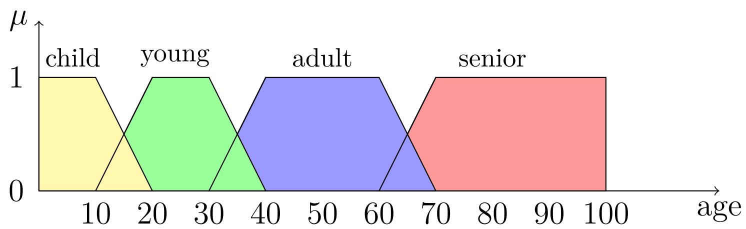
Instructions:

- You should try to solve all the exercises. Even if you do not do all the exercises, you can get all the points.
- Presentation is taken into account; correct results themselves are not enough. The reasoning on how the result was found should be clearly visible.
- Comment your calculations in a reasonable way: the reader should understand what you do and *why*. The solution should be "possible to read", not "needed to decrypt".
- Do not answer unasked questions. It is important to know what is needed to solve the problem and what is not needed.
- If you use a result from another source than the lectures and tutorials, cite your source properly (do not forget to cite used software if applicable).
- The homework is to be send either by email at `francesco.dolce@fjfi.cvut.cz` or via Microsoft-Teams, before Wednesday December 16th, 2020

Exercice 1. Prove that the following binary operation is a t-norm:

$$a \star b = \begin{cases} b & \text{if } a = 1, \\ a & \text{if } b = 1, \\ 0 & \text{otherwise.} \end{cases}$$

Exercice 2. Let us consider the 4 fuzzy sets in the following picture: *child*, *young*, *adult*, *senior*.



Write the definition and draw the graph of the membership function of the fuzzy sets "**young-adult**" defined us "*young*" ∩ "*adult*" using the following t-norms:

a) product,

b) Gödel,

c) Łukasiewicz.

Exercice 3. Using the picture and the fuzzy sets of the previous exercice (and De Morgan's law) write the definition and draw the graph of the membership function of the fuzzy set "**grown-up**" defined as "*adult*" $\cup$ "*senior*" using the following t-norms:

a) product,

b) Gödel,

c) Łukasiewicz.

Exercice 4. Say which of the following numbers are normalized machine numbers in single precision (`binary32`) or in double precision (`binary64`). When is the case, represent them (using the standard `IEEE-754`).

- 10^{2679};
- 10^{-2679};
- $10 + \frac{7}{8}$;
- 4^{10};
- 4^{-10};
- $\frac{3}{5}$;
- $7 + \frac{1}{7}$;
- $7 + \frac{1}{8}$;
- 2^{-1280};
- 2^{-128}.

Exercice 5. What are the normalized machine numbers, in single precision (`binary32`) and in double precision (`binary64`), which are the closed neighbours of 0?

Exercice 6. Is it true that $\mathrm{fl}(x + y) = \mathrm{fl}(x) + \mathrm{fl}(y)$? Justify your answer (i.e., give an argument or find a counterexample).