CI Final Exam
Date: 10/1/2020
Duration: 11h to 12:30h

Answer the exam in three different page sets: questions from 1 to 2, 3 to 5 and 6 to 8. Do not forget to write your name in ALL the sheets.

1. Given the following two rules:

"**If** $\tilde{x}$ **is** A_1 **then** $\tilde{y}$ **is** B_1"
"**If** $\tilde{x}$ **is** A_2 **then** $\tilde{y}$ **is** B_2".

where $A_1 \cap A_2 \neq \emptyset$. Suppose a fuzzy input $\tilde{x} = A_1$. Is the output $\tilde{y} = B_1$? Explain your answer and give a graphical representation.

2. List the 3 main reasons why ANFIS has a remarkable ability to generalize.

3. Enumerate three elements that, when learning with Neural Networks, will help to reduce the variance in the bias-variance decomposition.

4. Which is the role of momentum in the gradient descent procedure? What is expected to happen when we use a very small momentum coefficient?

5. What is the main motivation for using the convolution operation?

6. In theory of natural selection, which are the conditions that a population of organisms must hold (or, put in other way, in which processes must they be involved) in order to evolve and adapt to the environment?

7. Let $\boldsymbol{x} = (x_1, \ldots, x_n)$ and $\boldsymbol{y} = (y_1, \ldots, y_n)$ be two selected individuals where the n variables (genes) are real-valued. Without any coding of these variables into integers or bit-strings, list some different types of (dual) recombination operators that you know and specify how an offspring individual $\boldsymbol{z} = (z_1, \ldots, z_n)$ is computed from $\boldsymbol{x}$ and $\boldsymbol{y}$ for each type of recombination operator.

8. Explain with your own words the meaning of the following replacement methods used in evolutionary algorithms (i.e. how the next generation is formed) and identify, for each of these replacement methods, a type of evolutionary algorithm that uses it:

a) (μ, λ) with $\lambda = \mu$
b) (μ, λ) with $\lambda < \mu$ and reverse tournament selection
c) (μ, λ) with q-elitism and $\lambda = \mu - q$
d) (μ, λ) with $\lambda >> \mu$ and deterministic replacement
e) $(\mu + \lambda)$ with deterministic replacement