IDEAS OF LOTFI ZADE IN EXPLAINABLE ARTIFICIAL INTELLIGENCE

ALEXEY AVERKIN

Federal Research Center “Computer Science and Control” of Russian Academy of Sciences.

Russian Federation, Moscow, 117333, Vavilova str. 40

e-mail:averkin2003@inbox.ru

+79104227182

This year marks the 100th anniversary of the birth of the great scientist of our time, the founder of several major scientific trends in applied mathematics, automatic control theory, computer science and artificial intelligence, Professor Lotfi Zadeh. He belonged to the cohort of very few pioneering scientists who generate new, original scientific ideas and form the basic scientific paradigms that change our world. Professor L. Zadeh was the founder of the theory of fuzzy sets and linguistic variables, the "father" of fuzzy logic and approximate reasoning, the author of the theory of possibility and general theory of uncertainty, the creator of Z-numbers theory and generalized restrictions, the ancestor of granular and soft computing. His ideas and theories not only opened a new epoch in the development of scientific thought, free from the limitations of narrow scientific directions and contributing to their synergy. They made a significant contribution to the development of new information and cognitive technologies, led to the creation of effective industrial technologies, such as fuzzy computers and processors, fuzzy regulators, fuzzy clustering and recognition systems, and many others. Professor L. Zadeh has been deservedly included in the IEEE Computer Society's gallery of fame scientists who have made pioneering contributions to the field of artificial intelligence and intelligent systems.

Soviet scientists were among the first to support the new direction. Speaking at the ICSCCW-2001 conference in June 2001, L. Zadeh stressed that his first paper on fuzzy sets took place in 1965 at a conference on cybernetics held in the USSR aboard the liner «Admiral Nakhimov».

The role of L. Zadeh in AI is also hard to overestimate, and I would especially like to focus on the concept of soft computing, originally combining hybrid models based on fuzzy sets, neural networks, and soft computing. The emergent properties of these models were one of the foundations of the current hype in artificial intelligence and machine learning.

The study of fuzzy logic culminated in the late 20th century and has since begun to slow down a bit. This slowdown may be due in part to the temporary absence of fuzzy math results in machine learning. Current research will pave the way for fuzzy logic researchers to develop AI applications and solve complex problems that are also of interest to the machine learning community. Experience and expertise in fuzzy logic is well suited to model ambiguities in big data, model uncertainty in knowledge representation, and provide transfer learning with noninductive inference.

This talk will examine fuzzy models to improve the effectiveness of XAI systems in explaining their decisions and actions to the user, through fuzzy models. and to establish a concrete and fundamental connection between two important fields in artificial intelligence i.e., symbolic systems and connectionist systems, more specifically, between deep learning and fuzzy logic. Several authors show how deep learning could benefit from the comparative research by re-examining many heuristics in the lens of fuzzy logic.

Very effective is also, the use of fuzzy layers in deep learning networks. The most interesting from the point of view of this research is the extraction of rules using neuro-fuzzy models. Systems based on fuzzy rules, developed using fuzzy logic, have become a field of active research in the last few years. These algorithms have proven their strengths in tasks such as managing complex systems, creating fuzzy controls. The relationship between production rules and neural networks of both worlds has been thoroughly studied and shown to be equivalent. This means that we can translate the knowledge embedded in the neural network into a more cognitively acceptable language - fuzzy rules. In other words, we get a semantic interpretation of neural networks.

As part of this ideology, the Russian Association of Artificial Intelligence is currently actively developing fuzzy situational management of complex systems based on their composite hybrid modelling, which uses the capabilities of analytical, neural network and fuzzy approaches to construct composite hybrid models.