Robust Fuzzy Neural Network with an Adaptive Inference Engine

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Abstract: Fuzzy neural networks (FNNs) have been very successful at handling uncertainty in data using fuzzy mappings and if-then rules. However, they suffer from generalization and dimensionality issues. Although deep neural networks (DNNs) represent a step toward processing high-dimensional data, their capacity to address data uncertainty is limited. Furthermore, deep learning algorithms designed to improve robustness are either time consuming or yield unsatisfactory performance. In this article, we propose a robust fuzzy neural network (RFNN) to overcome these problems. The network contains an adaptive inference engine that is capable of handling samples with high-level uncertainty and high dimensions. Unlike traditional FNNs that use a fuzzy AND operation to calculate the firing strength for each rule, our inference engine is able to learn the firing strength adaptively. It also further processes the uncertainty in membership function values. Taking advantage of the learning ability of neural networks, the acquired fuzzy sets can be learned from training inputs automatically to cover the input space well. Furthermore, the consequent layer uses neural network structures to enhance the reasoning ability of the fuzzy rules when dealing with complex inputs. Experiments on a range of datasets show that RFNN delivers state-of-the-art accuracy even at very high levels of uncertainty. Our code is available online. https://github.com/leijiezhang/RFNN

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