

Pattern classification with belief functions and deep neural network

Zhunga Liu

Northwestern Polytechnical University, China

Abstract. Evidence theory provides a principled framework for representing and reasoning with uncertain and imprecise information by assigning belief to subsets of the frame of discernment. This capability complements deep neural networks, which are effective at learning discriminative representations but are typically designed for single-class predictions. In this presentation, we discuss a series of studies that integrate evidence theory with deep learning for uncertain image classification. Rather than simply suppressing data uncertainty, these studies aim to identify, represent, and exploit the imprecision it induces. Network predictions are used to detect ambiguous samples, which can be represented by meta-classes, while likely labeling errors are identified and corrected.

The resulting precise and imprecise information is then incorporated into network training through label reconstruction, generalized representation learning, or imprecision-aware loss functions. This integration makes evidential reasoning part of the learning process and enables more reliable classification and cautious set-valued decisions when a single-class prediction is not sufficiently supported.