Attention-Bridging TS Fuzzy Rules for Universal Multi-Domain Adaptation without Source Data

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Abstract: Universal source-free domain adaptation is an urgent, unsolved problem in transfer learning. Existing source-free and universal domain adaptation methods ignore soft information and data uncertainty during transfer resulting from limited precise target labels and the data shift between the source and target domains, which can lead to negative transfer. To solve this problem, we propose a deep attention-bridging model based on Takagi-Sugeno fuzzy rules for universal domain adaptation. The model is designed to cope with some of the most challenging situations in transfer learning where there are multiple source domains but access to the source data is not available. Hence, to build fuzzy rules in source domain(s), similar source classes are grouped into clusters which share a rule. Then, through an extension of fuzzy c-means clustering to deep structures, the model learns the fuzzy cluster prototypes and their memberships. To predict target task, thresholds for dividing the shared class from the unknown classes are defined through entropy assumption and fuzzy outputs. Here, the soft class centers generated from the model parameters, which are based on a set of selected shared classes, are designed to match the target data to the source feature space. Last, a combination strategy involving an attention layer provides the final predictions. Experiments with real-world datasets confirm the strength of the proposed fuzzy model.

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