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Bayesian multi-instance multi-label learning using Gaussian process prior

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Abstract Multi-instance multi-label learning (MIML) is a newly proposed framework, in which the multi-label problems are investigated by representing each sample with multiple feature vectors named instances. In this framework, the multi-label learning task becomes to learn a many-to-many relationship, and it also offers a possibility for explaining why a concerned sample has the certain class labels. The connections between instances and labels as well as the correlations among labels are equally crucial information for MIML. However, the existing MIML algorithms can rarely exploit them simultaneously. In this paper, a new MIML algorithm is proposed based on Gaussian process. The basic idea is to suppose a latent function with Gaussian process prior in the instance space for each label and infer the predictive probability of labels by integrating over uncertainties in these functions using the Bayesian approach, so that the connection between instances and every label can be exploited by defining a likelihood function and the correlations among labels can be identified by the covariance matrix of the latent functions. Moreover, since different relationships between instances and labels can be captured by defining different likelihood functions, the algorithm may be used to deal with the problems with various multi-instance assumptions. Experimental results on several benchmark data sets show that the proposed algorithm is valid and can achieve superior performance to the existing ones.

Keywords Multi-label learning · Gaussian process · Multi-instance multi-label learning · Laplace approximation

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