A LARGE MARGIN DEEP NEURAL NETWORK FOR SEPSIS CLASSIFICATION

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ABSTRACT

Data in clinical medical often exhibit highly imbalanced class distribution. To mitigate this issue, current approaches based on deep neural networks typically follow the strategies such as re-sampling and cost-sensitive learning. However, these methods neglect the underlying data structure. To exploit the spatial relationship, we propose a novel sampling method which explicitly enforces constraints on the intra-class and inter-class margins. To achieve this goal, we elaborate our method in 4 steps. In step 1, we first apply K-means for each class to obtain the initial clusters. In step 2, we propose to ensure the following relationship holds for each sample in the training set.

$$D(f(x_i), f(x_i^a)) < D(f(x_i), f(x_i^b)) < D(f(x_i), f(x_i^c)) < D(f(x_i), f(x_i^d))$$

, where D is Euclidean distance, f is Euclidean embedding learned by CNN, x_i^a is x_i's farthest intra-cluster sample, x_i^b is x_i's nearest intra-class sample from another cluster, x_i^c is x_i's farthest intra-class sample and x_i^d is x_i's nearest inter-class sample. We construct a table to record all tuples $(x_i, x_i^a, x_i^b, x_i^c, x_i^d)$ in the training set. In step 3, we propose a large margin CNNs (LM-CNN) associated with a novel hinge loss, which ensures the above relationship holds. We train the LM-CNN by randomly sampling the tuples obtained in step. We show that more separable representation can be learned by our LM-CNN. In step 4, We further augment the LM-CNN with LSTM to capture the temporal dependencies. We conduct the experiment using training data of Physionet Challenge 2019 and obtain 0.863, 0.106, 0.862, 0.124 and 0.482 for AUROC , AUPRC, Accuracy, F-measure and Utility in the offline experiment. The experiment results demonstrate the promise of our method.

***K*eywords** Imbalanced class distribution · Sampling · Large margin CNN