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A dynamic and on-line ensemble regression for changing environments

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Abstract-

On-line learning in environments and applications with time-varying behavior pose serious challenges. Changes may lead the learning model designed with old data, to become inconsistent with the new data, so that adaptation strategies are necessary. Unfortunately, most adaptation strategies are performed only on a batch basis, i.e. after accumulating certain number of samples. This process usually requires a long time, and thus such data may not reflect the current state of the system. However, even the learning system is adapted on a sample basis, most existing on-line learning algorithms adapt slowly to the abrupt changes. To overcome these drawbacks, a new dynamic and on-line ensemble regression (DOER) with fast adaptation capability for on-line prediction of variables given on a sample basis is proposed in this paper. DOER brings together desired properties which are not given by the previous works on on-line ensemble for regression: (1) on-line inclusion and removal of models to keep only the most accurate models with respect to the current state of the system; (2) dynamic adaptation of the models’ weights based on their on-line predictions on the recent samples; and (3) on-line adaptation of the models’ parameters. The accuracy of each model is obtained using a sliding window that is filled with the predictive errors of the most recent samples. Based on the model’s accuracies, weights are dynamically assigned, where accurate models are heavily weighted. When a new sample is available, all the models are retrained, and a new model may be included if the ensemble’s performance is not satisfactory. Inaccurate models can be removed for reducing the computational costs. Experiments on synthetic and real-world data sets are reported to evaluate the effectiveness of the DOER. Results show that DOER offers faster adaptation capability when compared to the state-of-the-art approaches.

Index Terms- Ensemble learning; Learning in changing environments; Regression; Concept drift

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