Bayesian

1- Bayesian Multi-modeling of Deep Neural Nets for Probabilistic Crop Yield Prediction

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Abstract

An imperative aspect of agricultural planning is accurate yield prediction. Artificial Intelligence (AI) techniques, such as Deep Learning (DL), have been recognized as effective means for achieving practical solutions to this problem. However, these approaches most often provide deterministic estimates and do not account for the uncertainties involved in model predictions. This study presents a framework that employs the Bayesian Model Averaging (BMA) and a set of Copula functions to integrate the outputs of multiple deep neural networks, including the 3DCNN (3D Convolutional Neural Network) and ConvLSTM (Convolutional Long Short-Term Memory), and provides a probabilistic estimate of soybean crop yield over a hundred counties across three states in the United States. The results of this study show that the proposed approach produces more accurate and reliable soybean crop yield predictions than the 3DCNN and ConvLSTM networks alone while accounting for the models' uncertainties.

Keywords
Author Keywords
Artificial IntelligenceDeep LearningModel UncertaintyProbabilistic Estimates
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Bayesian

2- A Variational Bayesian Deep Network with Data Self-Screening Layer for Massive Time-Series Data Forecasting

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Abstract

Compared with mechanism-based modeling methods, data-driven modeling based on big data has become a popular research field in recent years because of its applicability. However, it is not always better to have more data when building a forecasting model in practical areas. Due to the noise and conflict, redundancy, and inconsistency of big time-series data, the forecasting accuracy may reduce on the contrary. This paper proposes a deep network by selecting and understanding data to improve performance. Firstly, a data self-screening layer (DSSL) with a maximal information distance coefficient (MIDC) is designed to filter input data with high correlation and low redundancy; then, a variational Bayesian gated recurrent unit (VBGRU) is used to improve the anti-noise ability and robustness of the model. Beijing's air quality and meteorological data are conducted in a verification experiment of 24 h PM2.5 concentration forecasting, proving that the proposed model is superior to other models in accuracy.

Keywords
Author Keywords
time-series data forecastdata self-screening layervariational inferencegated recurrent unitmaximal information distance coefficient
Keywords Plus

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PARAMETER-ESTIMATION ALGORITHMSHORT-TERM-MEMORYIDENTIFICATION METHODSOUTPUT ESTIMATIONNEURAL-NETWORKSSYSTEMSPREDICTIONMODELSTATE

Bayesian

3- Prediction of undrained shear strength using extreme gradient boosting and random forest based on Bayesian optimization

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Abstract

Accurate assessment of undrained shear strength (USS) for soft sensitive clays is a great concern in geotechnical engineering practice. This study applies novel data-driven extreme gradient boosting (XGBoost) and random forest (RF) ensemble learning methods for capturing the relationships between the USS and various basic soil parameters. Based on the soil data sets from TC304 database, a general approach is developed to predict the USS of soft clays using the two machine learning methods above, where five feature variables including the preconsolidation stress (PS), vertical effective stress (VES), liquid limit (LL), plastic limit (PL) and natural water content (W) are adopted. To reduce the dependence on the rule of thumb and inefficient brute-force search, the Bayesian optimization method is applied to determine the appropriate model hyper-parameters of both XGBoost and RF. The developed models are comprehensively compared with three comparison machine learning methods and two transformation models with respect to predictive accuracy and robustness under 5-fold cross-validation (CV). It is shown that XGBoost-based and RF-based methods outperform these approaches. Besides, the XGBoost-based model provides feature importance ranks, which makes it a promising tool in the prediction of geotechnical parameters and enhances the interpretability of model.

Keywords
Author Keywords
Undrained shear strengthExtreme gradient boostingRandom forestBayesian optimizationk-fold CV

Bayesian

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ADAPTIVE REGRESSION SPLINESCLASSIFICATION ALGORITHMSNEURAL-NETWORKSYOUNGS MODULUSMULTIVARIATEPARAMETERSMODELSCLAYS

Bayesian

4- Exploring the Relationships between Achievement Goals, Community Identification and Online Collaborative Reflection: A Deep Learning and Bayesian Approach

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Abstract

Collaborative reflection (co-reflection) plays a vital role in collaborative knowledge construction and behavior shared regulation. Although the mixed effect of online co-reflection was reported in the literature, few studies have comprehensively examined both individual and group factors and their relationships that affect the co-reflection level. Therefore, this study explored the structural relationships between achievement goals (task-based, self-based, and other-based goals), online community identification, and co-reflection, which can consequently assist instructors in improving the related pedagogical strategies. To this end, 26813 posts on MOOC and college online learning platforms were gathered. Specifically, deep learning techniques were first used to train a classifier that classifies the large-scale co-reflection text automatically. The Bayesian method was then applied to disclose the structural relationships among achievement goals, community identification, and co - reflection. The results showed that the proposed classification algorithm achieved the best performance. Two best-fit models for characterizing the respective relationships between co-reflection and community identification as well as achievement goals were obtained using the Bayesian method. The results of the experiments on these two models demonstrated that both task-avoidance and other-avoidance goals were related directly to co-reflection, all task-approach, self-approach and other-approach goals were related indirectly to co-reflection, but self-avoidance goals had both a direct and an indirect relationship with co-reflection. The relationship between community identification and co-reflection was mediated by other-based goals. Some theoretical and practical implications were discussed for instructors and practitioners to build an online community.

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