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Machine Learning Framework for Pattern Recognition and Anomaly Detection in Payments Systems

High-value payment systems (HVPS) are a central piece of the financial infrastructure in a country. We propose a novel machine learning (ML) framework for real-time transaction monitoring in such systems. Our framework uses a layered approach. First, we train an ML model based on supervised learning to serve as a payments-classifier to predict the submission time of individual interbank payments. The correctly classified payments are then used in the second layer to study participants' usual payment patterns, while the misclassified payments are analyzed using an unsupervised learning model for the purpose of detecting anomalies. We test our set of models on the payments data from the Canadian HVPS and artificially manipulated transactions. Our results suggest that the layered approach lets us systematically decompose large datasets into usual and unusual payments. This, in turn, allows for transaction-level anomaly detection, which, so far, has been difficult, due to the large size of payments datasets and the scarcity of anomalies. Our gradient boosting-based payments classifier outperforms traditional models by up to 35%, with a detection rate of 93% for artificially manipulated transactions. Moreover, we show that our framework can be applied to different types of payment systems and that it can be extended with additional algorithms to further improve its robustness.