Integrating Predictive Analytics with Customer Behavior Data in E-commerce Based on Machine Learning Model

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Abstract: *In modern competitive e-commerce, consumer behavior is vital to understand and predict to raise engagement, reduce churn, and streamline company strategy. Conventional machine learning models do not tend to capture complex and evolving consumer behavior, leading to mediocre prediction performance. The proposed paper presents a hybrid Model, which integrates the Bidirectional Long Short-Term Memory (BiLSTM) networks to learn long-term sequential connections between consumer behavior data and Convolutional Neural Networks (CNN) to extract local features. The mitigation of data quality and imbalance is done through the extensive preparation steps of the methodology, which involve handling missing values, one-hot encoding, min-max normalization, and SMOTE-based class balancing. Several additional models such as the Random Forest, Logistic Regression, Stochastic Gradient Boosting, SVM, and two novel models namely K-Nearest Neighbors (KNN) and CNN-BiLSTM were also tested and reviewed. The CNN-BiLSTM model scored significantly higher to its competitors with 97% accuracy (Acc), 99.8% recall (Rec) and 99.8% F1score, indicating a high ability to learn complex and non-linear patterns; KNN achieved 96% accuracy. The findings confirm the proposed methodology in terms of reliable and effective e-commerce customer turnover prediction.*

Keywords: Customer Behavior Prediction, E-commerce, Churn Prediction, Deep Learning, CNN-BiLSTM, Deep Learning Predictive Analytics