Graph Neural Network for Detecting Market Manipulation in the Stock Exchange of Thailand

AUTOMATION ENGINEERING PROGRAM

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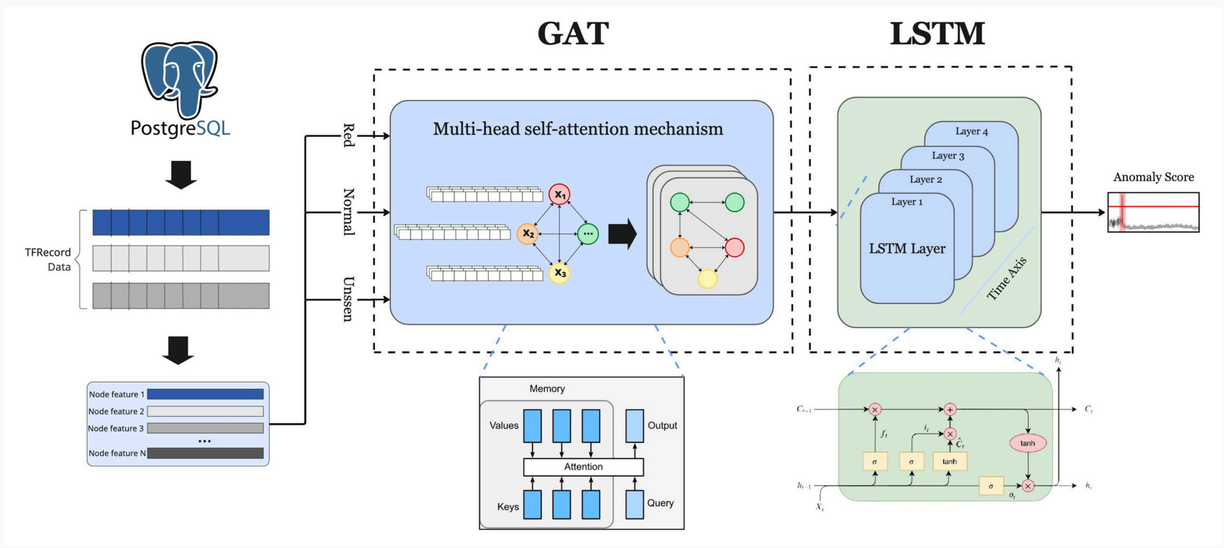
INTRODUCTION

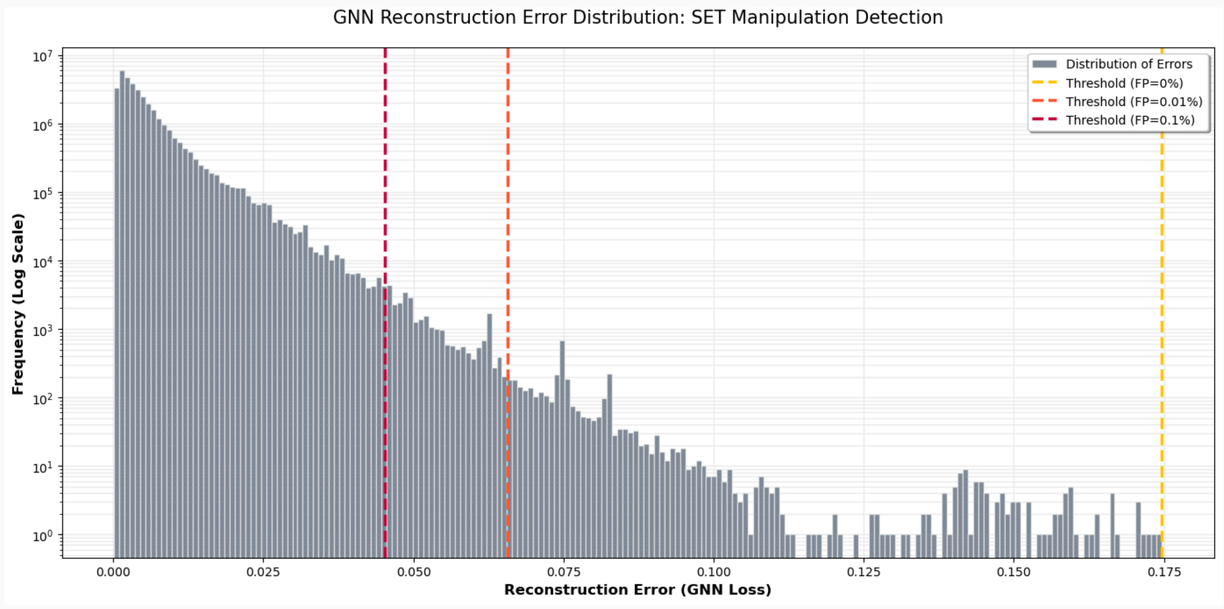
Detecting abnormal trading behavior in modern financial markets is challenging due to large volumes of high-frequency data and evolving manipulation strategies. This study proposes an unsupervised Graph Attention Network (GAT) + LSTM Autoencoder to learn normal trading behavior from Stock Exchange of Thailand (SET) data. GAT captures feature relationships, while LSTM learns temporal patterns. Anomalies are identified using reconstruction error.

METHODOLOGY

Historical trading data from the SET were collected and transformed into normalized limit order book features, arranged into temporal windows of $10 \times 15 \times 1$. Each feature was treated as a graph node, and Pearson correlation was used to create an adjacency matrix. Specifically, Graph Attention Networks (GATs) were used to capture the node interactions by computing attention scores based on the adjacency matrix. The multi-head attention mechanism enables the model to focus on multiple aspects of the feature relationships, aggregating information from neighboring nodes. The attention scores are modulated by the adjacency matrix, which reflects the correlation between features over time.

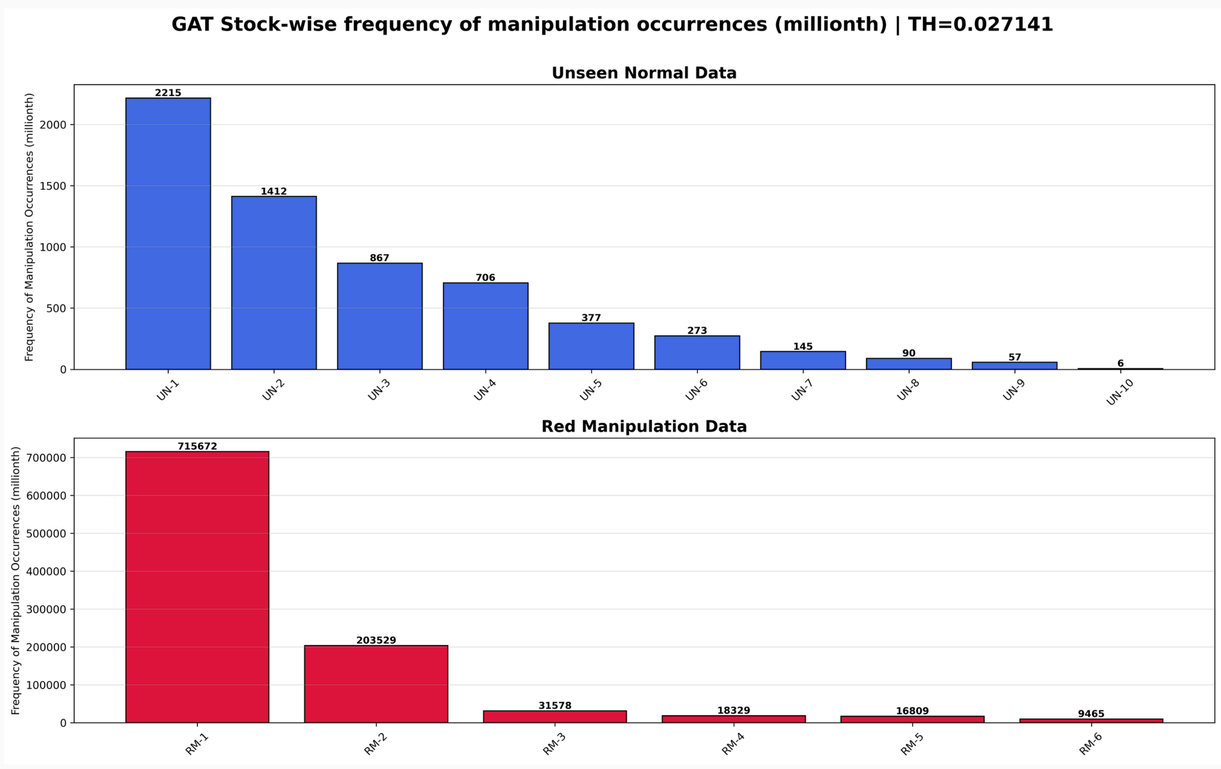


The anomaly thresholds are determined from the validation reconstruction error distribution using percentile-based cutoffs.

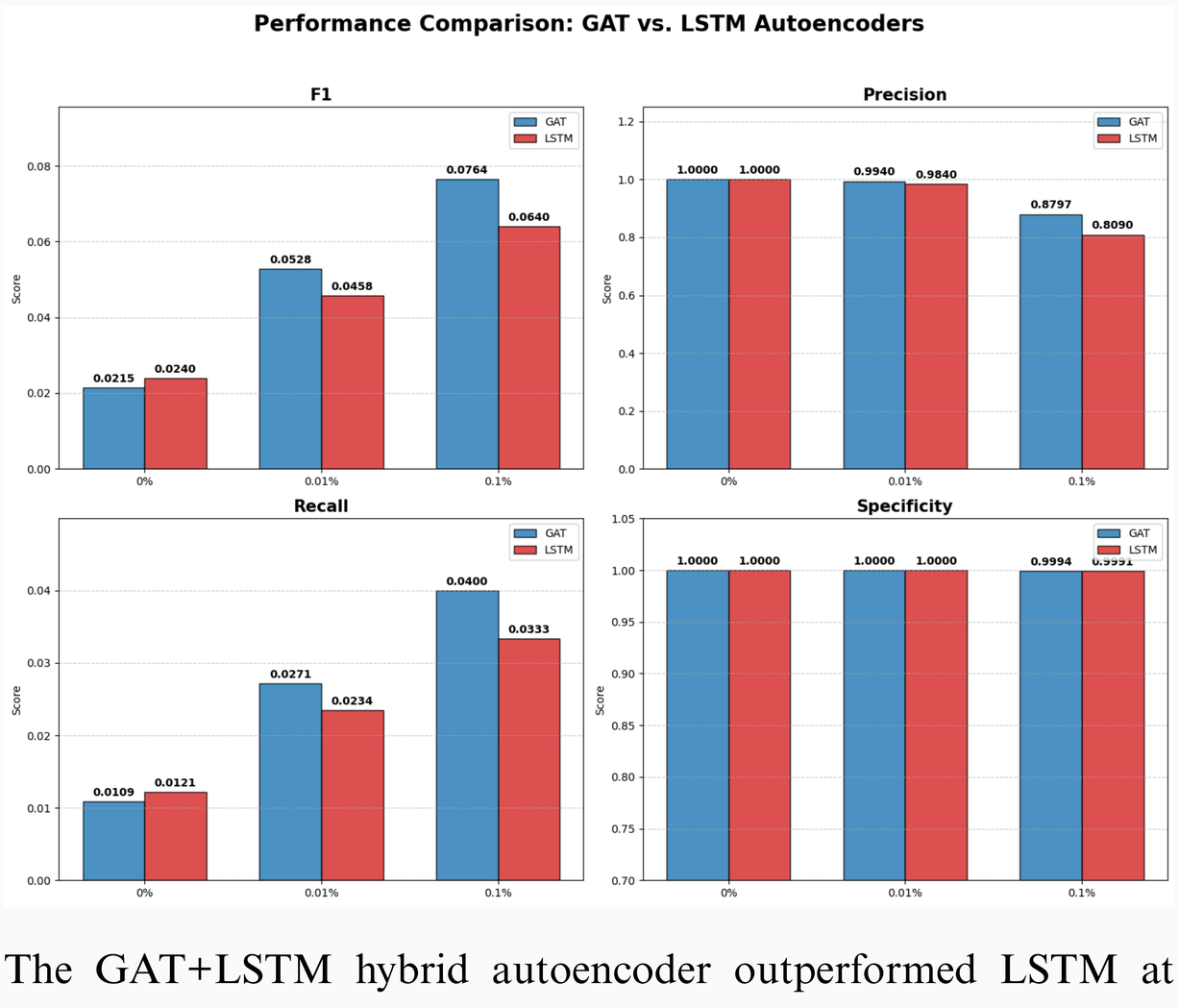


Thresholds (FP rates) = { 0%, 0.01%, 0.1% }

RESULTS



The model detected very low anomaly frequencies in normal stocks while red manipulation stocks showed significantly higher frequencies. The model provides the best sensitivity to detect more manipulation cases while maintaining a low false positive rate.



The GAT+LSTM hybrid autoencoder outperformed LSTM at 0.01% and 0.1% thresholds, with higher F1-score and recall, showing better anomaly detection performance.

CONCLUSION

The proposed model achieved better recall and specificity than the LSTM benchmark, reducing false alarms while maintaining stable detection performance. Results show that combining graph learning with temporal modeling is effective for financial anomaly detection.