Anomaly Detection in Multivariate Time Series Data

Student

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Introduction: Swisscom actively monitors its Voice over IP systems to operate the telephone services reliably. Periodically collected metrics undergo real-time anomaly detection to ensure system integrity. Presently, the anomaly detection system employs univariate models, despite the multivariate nature of the data. However, previous research has demonstrated that neural networks are suitable for extending Swisscom's anomaly detection system with multivariate models.

Approach: This project explores whether a multivariate model can effectively improve anomaly detection in the VoIP platform metrics, aiming to reduce false positive alerts without compromising the recall score. The research started with an exploratory data analysis, followed by literature research providing an overview of different neural network architectures for anomaly detection in multivariate time series.

Building upon these findings, a forecast-based anomaly detection system was developed using temporal convolutional networks. A ground truth dataset containing real anomalies was utilized to assess the quality of the newly developed model and compare it with the existing univariate system. The key deliverable of this project is the TCN forecast model, complemented by a model-agnostic unsupervised algorithm to fine-tune forecast bounds.

Result: Evaluation results demonstrate that the improved multivariate anomaly detection system outperforms the existing univariate one. The developed model exhibits a remarkable 28% improvement in the F1 score, increasing it from 0.5 to 0.78. Moreover, the multivariate model reduces false positive alerts while maintaining a notably higher true positive rate, achieving the research goal of enhancing precision without sacrificing recall.
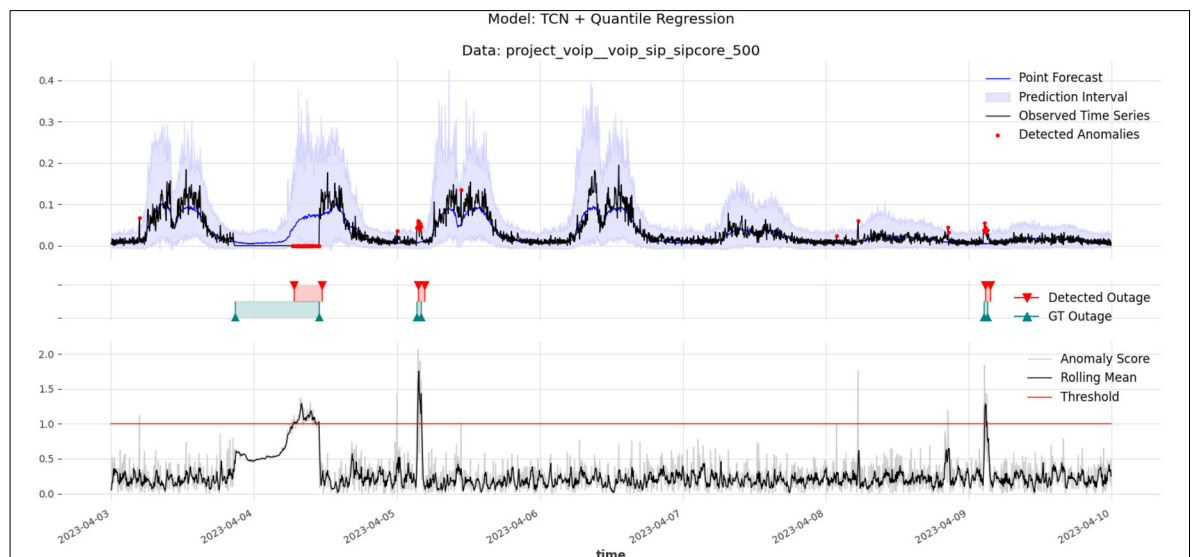
Number of SIP response messages for the codes 200 OK, 300 Multiple Choices, and 404 Not Found over 1 week in April 2023
Own presentment
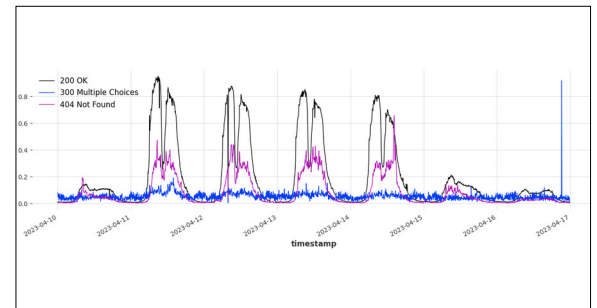
Confusion matrix of the existing univariate models and the developed multivariate TCN model
Own presentment
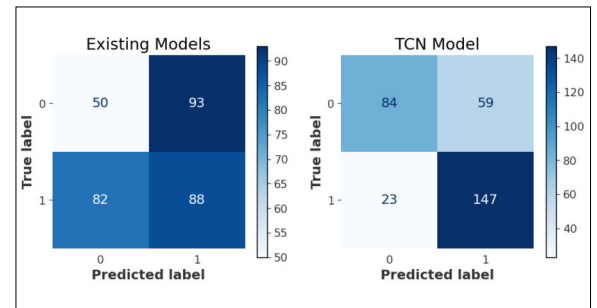
Validation plot of one week and one time series dimension
Own presentment

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Subject Area
Data Science

Project Partner
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