Neural Network Methods for the Detection of Anomalies in Time Series Data

Student

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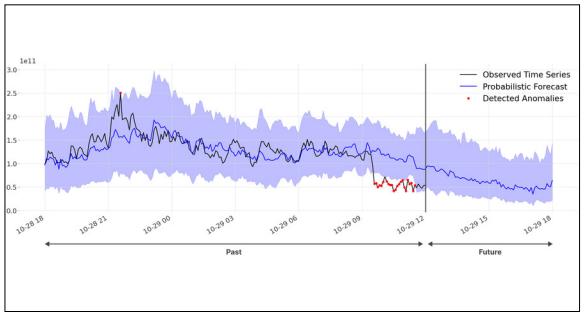
Introduction: Swisscom applies anomaly detection on thousands of time series to monitor different services. Because of the size and complexity of Swisscom operations, the number of time series has increased dramatically. This increase urged the need for methods that provide anomaly detection on multiple time series. Prior research has shown that neural networks are particularly well-suited for processing multiple time series.

Objective: This project's goal is to carry out research on how neural networks can be used to find anomalies in time series data for Swisscom. The focus lies on engineering and building working prototypes. As a first step, literature research was conducted to give an overview of neural network methods for detecting anomalies in time series. Then a TCN (Temporal Convolutional Network) architecture was chosen to build multivariate and global time series models for anomaly detection. This report discusses essential aspects concerning training, hyperparameter tuning, and model validation. Finally, the developed models were compared to the existing models in use.

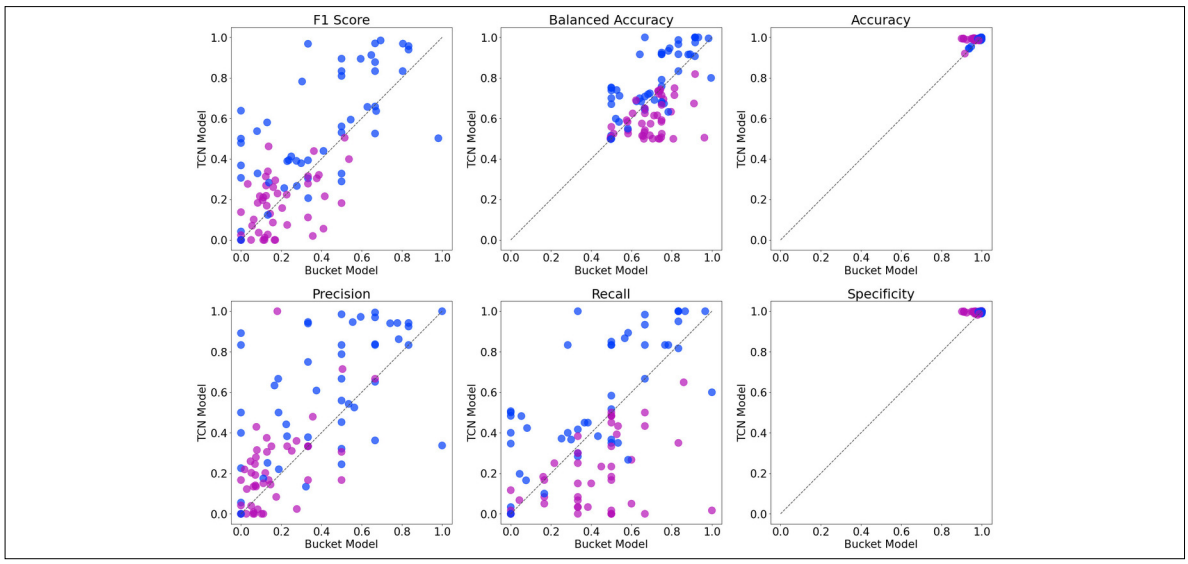
Result: The results of this project showed that the TCN architecture is suitable for building easy-to-use anomaly detection models for multiple time series and that the developed model can generally keep up with the existing models of Swisscom. On some time series, the TCN-based model even outperformed the existing models. For instance, the figure at the bottom compares the TCN model with the Bucket Model, an existing model used by Swisscom. Each dot in every plot stands for one time series. The color coding indicates which model has the smaller confidence interval (blue=TCN Model, magenta=Bucket Model).

Based on the F1 score, the TCN Model performed better on more series. The precision of the TCN Model was on most series better. Since anomalies are rare, a high recall is desirable. Considering the series with a recall higher than 0.8, the TCN Model reaches this goal better, even with smaller confidence intervals and thus probably a better precision. With this project, the first step regarding neural network-based anomaly detection has been successfully taken.

Validation plot of a test set with real anomalies on 29.10.20xx.
Own presentment



Classification metrics of the TCN Model and Bucket Model (existing model).
Own presentment



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Subject Area
Data Science

Project Partner
Swisscom AG