Abstract
Buildings account for a large part of the world's energy demand and the building sector lost billions due to the problem of interoperability. In addition, faults in the systems negatively affect energy efficiency and approaches to troubleshooting draw on, among other things, the topology of the technical operating units in the building management system. In this work, the energy consumption is considered by the algorithms used to solve those problems with the specially built Python package *MLEval*.
Thus, both a solution to the problem of interoperability and bug fixing are important steps towards the goals of the Paris Climate Agreement.
To this end, the approaches rely on AI-based algorithms, and the evaluation procedure in this work provides a systematic way to examine the algorithms not only in terms of performance, but also in terms of their energy consumption. For this purpose, the data basis is first evaluated and usable metrics are elaborated. Then, the algorithms are computed on the NVIDIA Jetson Nano single-board computer and monitored in parallel with respect to their power consumption. For this purpose, the integrated sensor technology of the Jetson Nano is used and methodologies from the Python package *MLEval* are applied. In addition, the package includes metrics and methods commonly used in the literature to summarize the documented power consumption into predefined metrics.
In reconstructing a procedure for identifying connections between technical operating units in building management systems, based on temperature measurement data, the procedure could be improved by up to 73.6% on the F1 metric, by using a tsfresh RF. An examination of the ResNet used in the literature revealed that for this deep learning algorithm, there is a quadratic relationship between the absolute energy consumption and the total number of data points in the timeseries used for training. Furthermore, the observations of the data and evaluation of the F1 metrics revealed that for the classification of interdependencies of the technical operating units, the noise in the measurements contains indirect information relevant to the classification. Investigations of models on the Mortar database for identification of technical operating units, based on temperature measurement data, were able to achieve peak values of 66.5% on the F1 metric and 63.7% on the MCC metric. For the tsfresh RF and tsfresh RidgeCV models used in this work, a linear relationship was found between absolute energy consumption and the total number of data points. Thus, it was possible to establish a formula for the energy consumption of ResNet as well as for the energy consumption of the models tsfresh RF and tsfresh RidgeCV, depending on the total number of data points used in the timeseries.