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Automated machine learning for dynamic energy management using time-series data

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Summary

Time-series forecasting through modelling sequences of temporally dependent observations has many industrial and scientific applications. While machine learning models have been widely used to create time-series forecasting models, creating efficient and performant time-series forecasting models is a complex task for domain users. Automated Machine Learning (AutoML) is a growing field that aims to make the process of creating machine-learning models accessible for non-machine learning experts. This is achieved by optimising machine learning pipelines automatically. Time-series machine-learning pipelines include various specialised pre-processing steps that are not currently supported by existing AutoML systems.

This dissertation investigates how AutoML can be extended to time-series data analysis problems such as time-series forecasting. Several challenges arise when developing specialised AutoML systems for time-series forecasting. For instance, advanced machine-learning pipelines that can extract time-series features and select well-suited machine-learning models need to be developed. Also, extra hyperparameters such as the window size, which shows how many historical data points are helpful, need to be optimised by the AutoML system. This dissertation addresses these issues. We provide a comprehensive overview of the AutoML research field, including hyperparameter optimisation techniques, neural architecture search, and existing AutoML systems. Next, we investigate the use of AutoML for short-term forecasting, single-step ahead time-series forecasting, and multi-step time-series forecasting with time-series features.