DOCTORAL THESIS

Shapelet Discovery for Time Series Analysis

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Date of Award:
2021

Abstract

Time series shapelets (or simply, shapelets) are discriminative subsequences that have been recently found effective for time series analysis, including classification and clustering. The quality of shapelets is crucial to both the accuracy and efficiency of time series analysis. However, the major of research has focused on building accurate models from some shapelet candidates rather than *discovering* high-quality shapelets. Discovery of high-quality shapelets is known to be computationally costly. Furthermore, shapelet discovery for time series analysis has a few challenges. Among the few existing work on shapelet discovery, they cannot be applied to multivariate time series classification (MTSC) since the shapelet candidates of MTSC may come from different variables of different lengths and thus cannot be directly compared. The current unsupervised shapelet discovery method cannot determine clustering quality on both univariate and multivariate time series. In this dissertation, first, we propose BSPCOVER to discover a set of high-quality shapelets for model building and then propose a matrix profile-based shapelet approach (MPS) to further improve the efficiency of shapelet discovery. Second, we propose ShapeNet for MTSC, a deep learning approach for discovering shapelets, and Autoencoder for Shapelets (AutoShape) for clustering, which takes the advantages of both shapelets and autoencoder for determining shapelets in an unsupervised manner. Experimental evaluation on well-known time series datasets (UCR and UEA archive) shows the superiority of our proposed approaches on both accuracy and efficiency. Last but not least, one of the strengths of shapelets is its interpretability. For all of our proposed

solutions, we illustrate the interpretability of shapelets with some case studies.

Keywords: Time Series Analysis, Shapelet Discovery, Classification, Clustering, Efficiency, Accuracy

Table of Contents

List of Figures

List of Tables

List of Algorithms