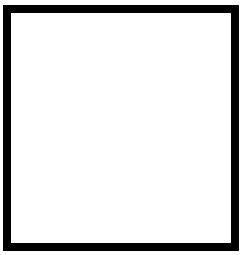
Emerging Technologies in CpE 2

Assignment 10.1

Time-based Application Research



Score

Submitted by:
de Leon, Bryan Paul A
CPE32S3

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Submitted to:

Engr. Roman Richard

Title of the Study**: Forecasting Time Series in Healthcare With Gaussian Processes and Dynamic Time Warping Based Subset Selection**
Author: **Puri, Chetanya; Koojiman, Gerben; Vanrumste, Bart; Luca, Stijn**
Date of Publication: **October 13, 2022**
Title of Publication: **IEEE Journal of Biomedical and Health Informatics**

Problem Discussed in the Study

- The modeling of real-world time series can be especially difficult in the case where there is an insufficiency in available models, this could be detrimental to the development of personalized prediction models, as the accuracy of predictive models are highly reliant on data.

  Furthermore, the study aims to introduce a novel approach in training if there is a deficiency in available data. By implementing a technique wherein data is selected based on test time series, separated into subsets, a Gaussian–process-based model is then learned using existing data and the selected subsets.

Motivations of the Authors

- Modeling real-world healthcare related time series for forecasting is often riddled with multiple problems, most especially the limited availability of data, this is due to practical constraints. A study might be conducted only in a small group of people, hence, the data gathered within the study does not completely represent the demographic. As such, the authors proposed a way to effectively develop methods for forecasting, despite lacking data.

Proposed Solution of the Author

- The study addressed the challenge of forecasting time series in healthcare, especially when data availability is limited. The proposed solution introduces a new technique that selects the data that exhibits data with temporal similarities to the test time series. This allows the Gaussian Process based model to enhance its training by only selecting relevant data.

Methodology

- The initial step of the solution involves employing a novel approach in selecting relevant data that could be used to speed up the process of learning for the Gaussian based model.

  Following the selection of a suitable subset, the methodology utilizes Gaussian Processes (GP) to develop the forecasting model. Gaussian Processes are chosen for their flexibility and capability to handle uncertainties and non-linearities in time series data, which are common in healthcare applications. The GP model is trained using both the selected subset and the test data, allowing it to learn from a broader yet highly relevant dataset. The performance of this approach is then validated through experiments with real-world healthcare data.

Results

- The results demonstrate that the novel approach of using dynamic time warping-based subset selection combined with Gaussian Processes modeling significantly enhances the accuracy of time series forecasting in healthcare. Specifically, the study shows that this methodology outperforms existing state-of-the-art methods by approximately 20%. This improvement is notable in the context of healthcare applications where early and accurate predictions can be crucial for patient outcomes.

Recommendations

- The Authors could further improve the accuracy of their model by integrating a wider variety of data sources, this could include more diverse healthcare settings and patients.