Multi-Channel ConvNet Approach to Predict the Risk of In-Hospital Mortality for ICU Patients

Fabien Viton, Mahmoud Elbattah, Jean-Luc Guérin, Gilles Dequen
Université de Picardie Jules Verne (UPJV), France
mahmoud.elbattah@u-picardie.fr

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Problem and Data Description

- Predicting the risk of in-hospital mortality based on multi-variate time series from ICU recordings (i.e. binary classification).
- The MIMIC database: A rich repository of ICU admissions to the Beth Israel Deaconess Medical Center in Boston between 2001 and 2012. [1]
- Dataset extracted from the MIMIC-III database.
- ≈13K ICU-related records.
- ≈ 11% mortality cases.

[1] Johnson, A. E., Pollard, T. J., Shen, L., Li-wei, H. L., Feng, M., Ghassemi, M., ... & Mark, R. G. (2016). MIMIC-III, a freely accessible critical care database. *Scientific Data*, 3, 160035.

Problem and Data Description (cont'd)

- 17 TS variables: The patient status over the 48-hour timespan after admission (e.g. heart rate, blood pressure, temperature, etc.).

Variables
Heart Rate
Respiratory Rate
Capillary Refill Rate
Systolic Blood Pressure
Diastolic Blood Pressure
Mean Blood Pressure
Fraction Inspired Oxygen (FiO_2)
Oxygen Saturation (SaO_2)
Temperature
Glucose
pH
Glascow Coma Scale Eye Opening
Glascow Coma Scale Motor Response
Glascow Coma Scale Verbal Response
Glascow Coma Scale Total
Height
Weight

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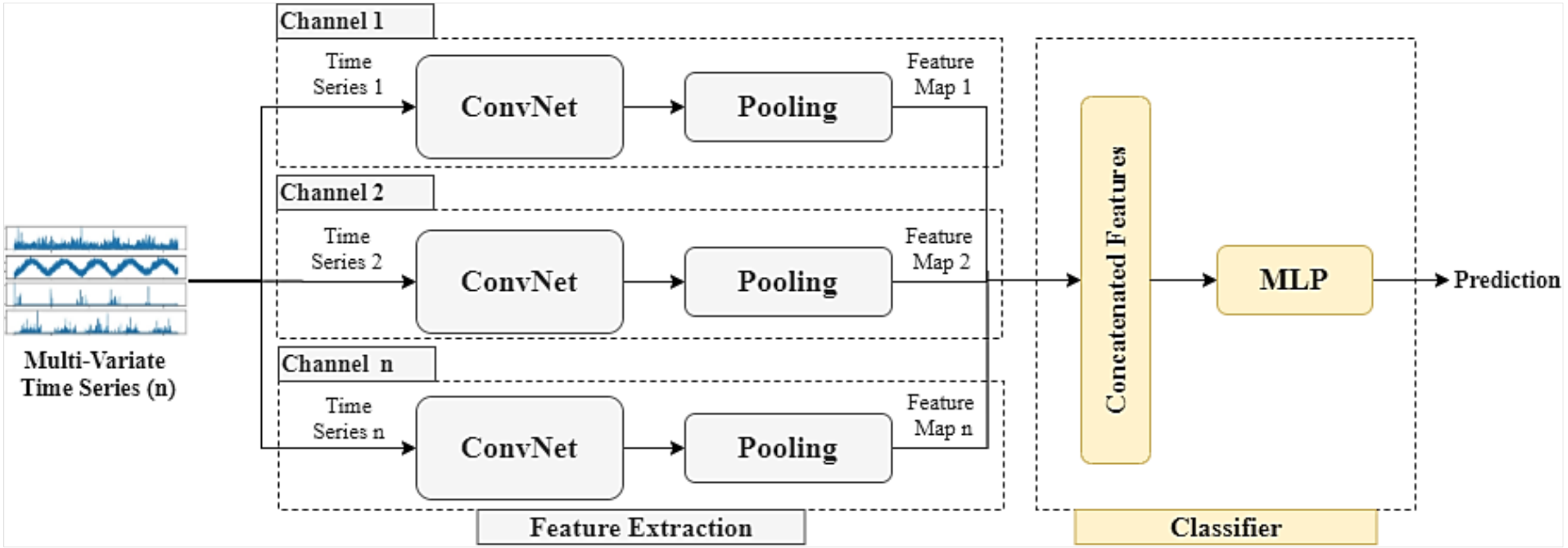
A Glimpse of Literature (Time Series Classification)

- TS classification was identified as one of the key challenges in Data Mining research (Yang and Wu, 2006).
- **Distance-based methods** (e.g. Dynamic Time Warping (DTW)) have been long recognized as the most performing technique (Berndt and Clifford, 1994).
- **Deep Learning:** an attractive approach for complex TS problems that involve large-scale datasets and multiple variables.
- For example, ConvNets were applied as a feature extractor for multivariate TS classification (Zheng et al. 2016).
- RNN architectures were also explored (e.g. Siami-Namini, Tavakoli, and Namin, 2018; Siami-Namini, Tavakoli, and Namin, 2019)

Approach Overview



Experimental Results

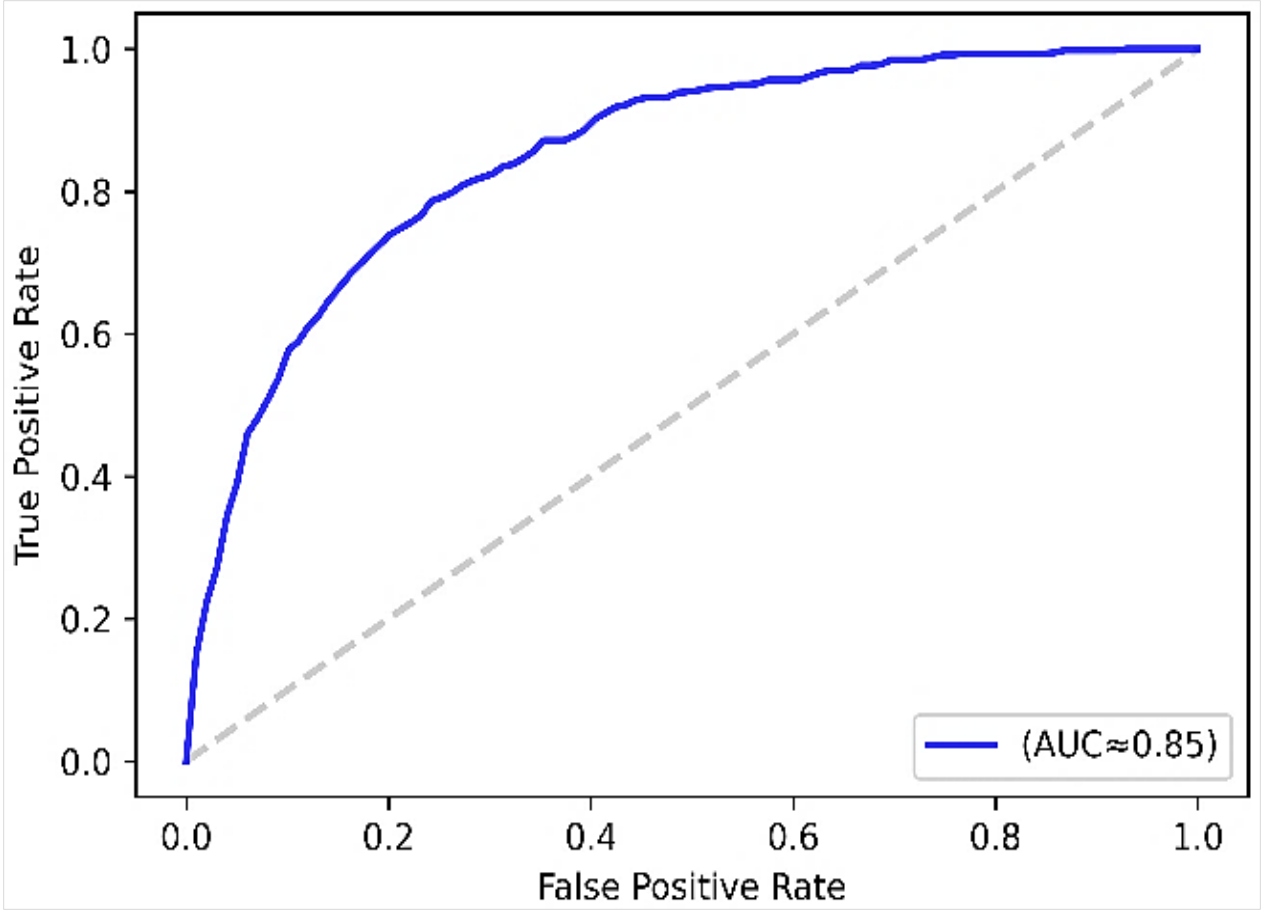


Figure: ROC curve.

Experimental Results (cont'd)

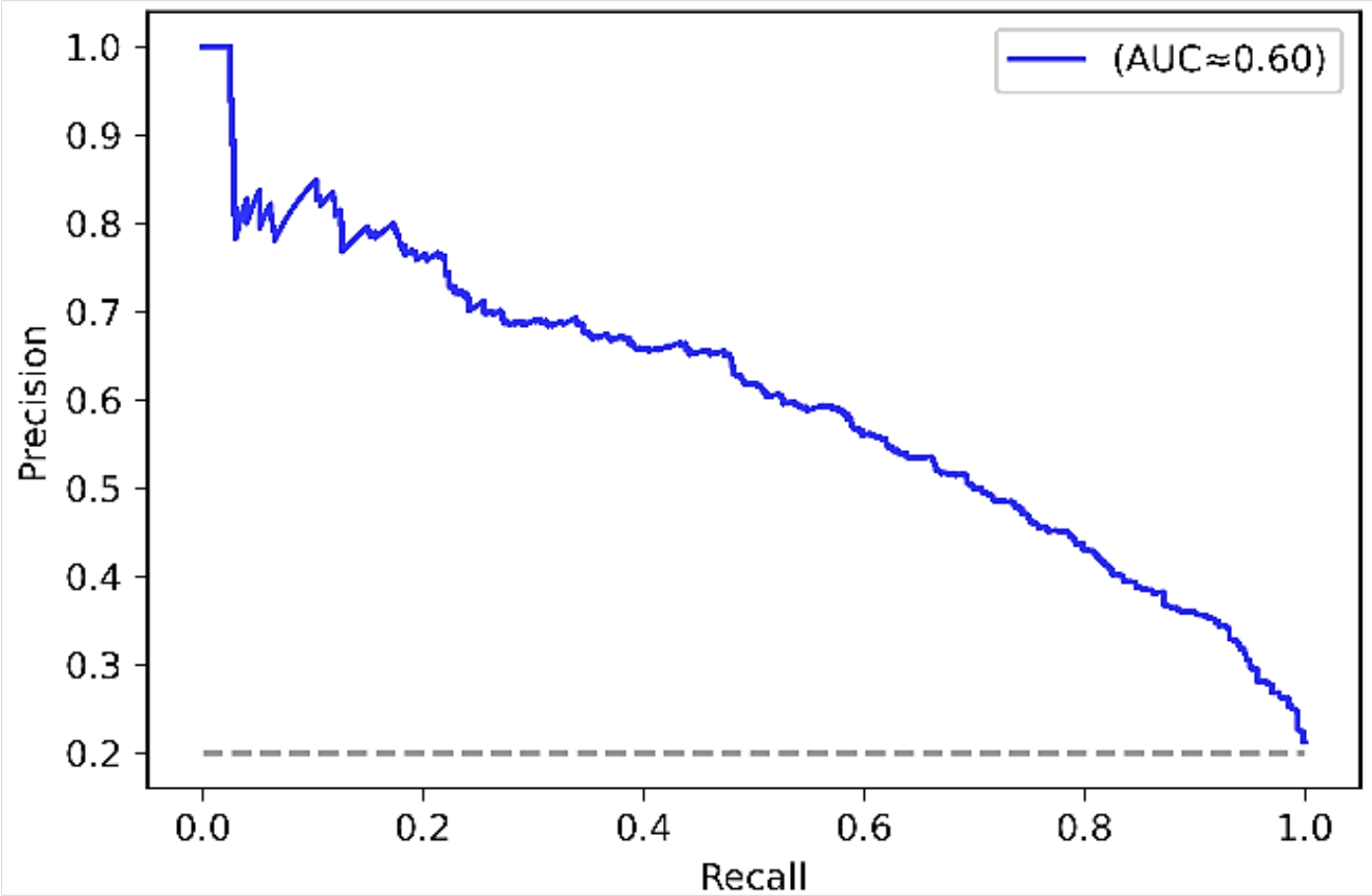


Figure: Precision-Recall curve.

Experimental Results (cont'd)

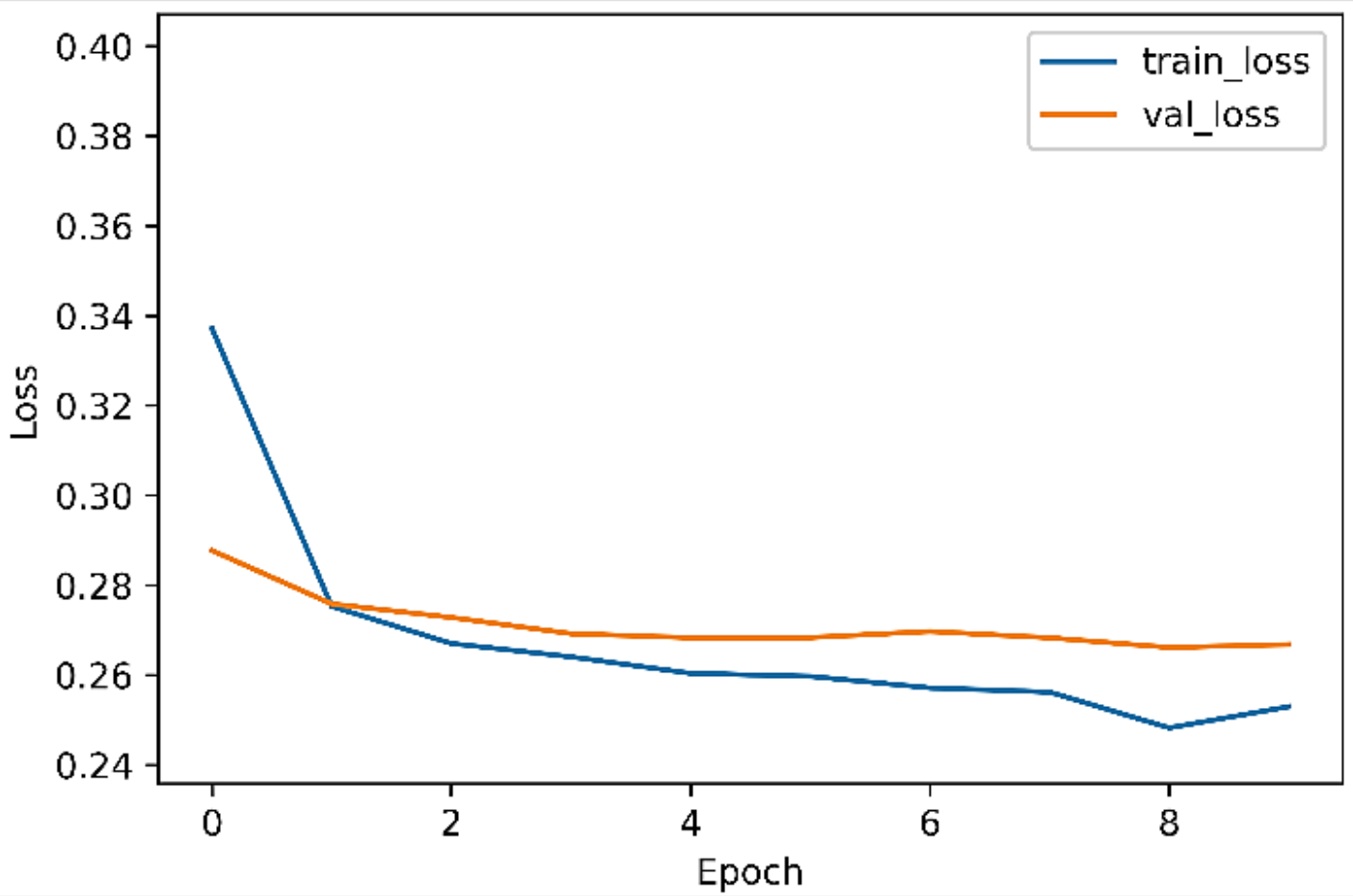


Figure: Model loss in training and validation sets.

Work in Progress: Explainability of Predictions

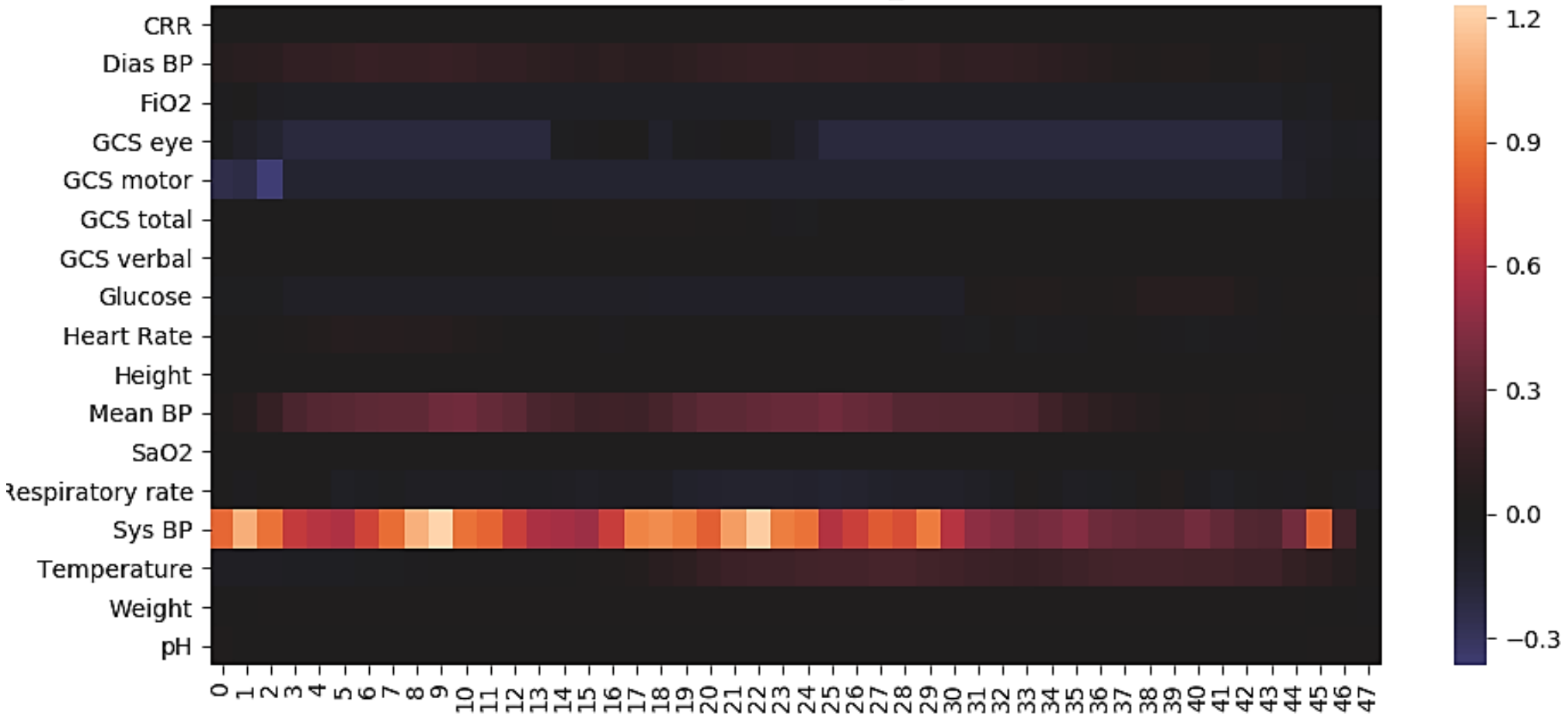


Figure: An example of heatmaps used for explainability.

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THANK YOU!