ZIB Challenge

David Nolte

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Docker containers

Two `docker` containers are created and connected via a `docker` network: one container holding the database (`MongoDB`, populated by the script `docker_db/populate_db.py`) and the other containing the `JupyterLab` environment for deep neural networks (with `tensorflow/keras`) and the notebooks for solving the given task (see folder `docker_jl`).

The repository's `README.rst` explains the procedure.

ECG Dataset

The dataset is a subset of the large ECG signal PTB-XL data set [1], considering only those ECG timeseries were the cardiac rhythm diagnosis was marked *sinus rhythm* (SR) or *atrial fibrillation* (AFIB). The dataset is partitioned into 10 folds, where the first 8 are recommended by the authors of [1] to be used for the training of a neural network, and 9 and 10—the data with the highest confidence in the diagnosis—for testing and validation.

Deep Neural Network

A deep neural network is trained to classify the ECG time series into 'SR' and 'AFIB'. A residual neural network (ResNet) is used, following [2, 3]. The implementation uses the `keras` library. See the code in the `jupyter` notebook `ecg_resnet.ipynb` and the references [2, 3] for details on the setup.

Results

The accuracy of the ResNet w.r.t. the training and the validation data over the training iterations is illustrated in Fig. 1.

Figure 1: ResNet accuracy with training data

The test dataset is classified with an accuracy of XXX. A useful metric for the quality of the trained network is the confusion matrix, showing the number of correctly and erroneously classified sets, see Fig. 2.

Figure 2: Confusion matrix for testing dataset

Only 20 ECG signals labelled SR are wrongly classified as AFIB, and vice-versa.

References

[1] P. Wagner et al. "PTB-XL, a Large Publicly Available Electrocardiography Dataset." In: *Scientific Data* 7 (May 25, 2020), p. 154. ISSN: 2052-4463. DOI: 10.1038/s41597-020-0495-6. pmid: 32451379. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7248071/ (visited on 11/30/2021).

[2] M. Kachuee, S. Fazeli, and M. Sarrafzadeh. "ECG Heartbeat Classification: A Deep Transferable Representation." In: *2018 IEEE International Conference on Healthcare Informatics (ICHI)*. 2018 IEEE International Conference on Healthcare Informatics (ICHI). June 2018, pp. 443–444. DOI: 10.1109/ICHI.2018.00092.

[3] spdrnl. *Ecg*. Aug. 31, 2021. URL: https://github.com/spdrnl/ecg (visited on 11/30/2021).