Department of Information and Communication Technology

Machine Learning in Medicine

Report 1

ID - Student Name:
22BI13220 - Nguyen Minh Khoi - Data Science

Lecturer:
Prof. Tran Giang Son

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1 Introduction

This report presents Practical 1 of Machine Learning in Medicine, where a publicly available Kaggle dataset is analyzed to understand its structure and features before developing a classification model. The study involves a detailed description of the dataset, including its features, sources, and preprocessing steps. A deep learning approach is implemented to build the classification model, and its performance is thoroughly evaluated. The results are then compared to those reported in the original research paper to assess the effectiveness of the proposed model.

2 Dataset

The MIT-BIH Arrhythmia Dataset is a widely used benchmark for ECG classification tasks. It contains 187 features that describe heartbeat signals recorded at a 125 Hz sampling rate. The dataset categorizes heartbeats into five classes: Normal, Atrial Premature, Premature Ventricular Contraction, Fusion of Ventricular and Normal, and Paced beats. It consists of 87,554 training samples and 21,892 testing samples, but suffers from a class imbalance, with the Normal class being the most prevalent.

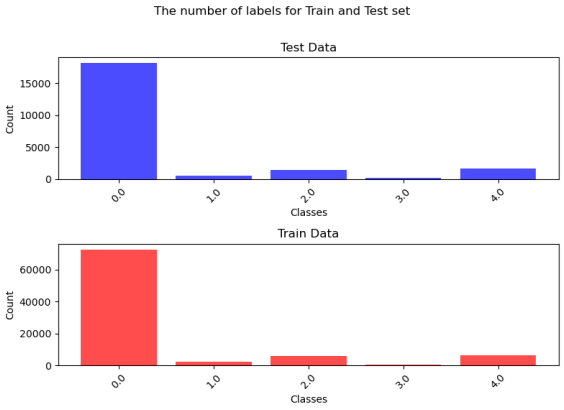

Figure 1: Samples in Train and Test set

3 Model Architecture

The deep learning model used for heartbeat classification consists of multiple fully connected layers with batch normalization, dropout, and LeakyReLU activation. The architecture is structured as follows:

- **Input Layer**: The input features are fed into a dense layer with 512 neurons.
- **Hidden Layers**:
  - **First Hidden Layer**: A fully connected (Dense) layer with 512 neurons, followed by batch normalization, LeakyReLU activation, and dropout.
  - **Second Hidden Layer**: A Dense layer with 256 neurons, batch normalization, LeakyReLU activation, and dropout.
  - **Third Hidden Layer**: A Dense layer with 128 neurons, batch normalization, LeakyReLU activation, and dropout.
  - **Fourth Hidden Layer**: A Dense layer with 64 neurons, batch normalization, and LeakyReLU activation.
- **Output Layer**: A final Dense layer with 5 neurons corresponding to the five heartbeat categories.

This architecture incorporates **batch normalization** to stabilize training, **LeakyReLU activation** to prevent dead neurons, and **dropout** to reduce overfitting. The model parameters are optimized using a deep learning approach to achieve high classification accuracy.

4 Result

Class	Precision	Recall	F1-score	Support
0	0.98	1.00	0.99	18117
1	0.94	0.60	0.74	556
2	0.96	0.92	0.94	1448
3	0.78	0.69	0.73	162
4	0.99	0.98	0.98	1608
Accuracy			0.98	21,891
Macro Avg	0.93	0.84	0.88	21,891
Weighted Avg	0.98	0.98	0.98	21,891

Table 1: Classification Report

The former model outperforms **This Paper** across all key metrics. It achieves **98% accuracy**, significantly higher than **95.9%**, demonstrating improved overall performance. Its **98% precision** surpasses **95.2%**, indicating better positive prediction reliability. Additionally, its **98% recall** exceeds **95.1%**, showing improved sensitivity in detecting all classes. These enhancements suggest better class balance handling and more effective deep learning techniques.