Assignment #4: Deep Neural Networks - Heart Sound Classification using LSTM with Attention

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1. Introduction

In this project, we aim to build a sequential model using LSTM with attention mechanism for heart sound classification. The phonocardiogram (PCG) dataset consists of heart sound recordings collected from different locations on the body, including both normal and abnormal recordings. The goal is to detect abnormal heart sounds, which can provide valuable information for the appraisal of heart disease and pulmonary hypertension.

2. Methodology

2.1 Data Preprocessing

- The '.wav' files of PCG records were read and labeled as normal or abnormal using the 'REFERENCE.csv' files.
- Signal values were normalized to ensure they fall within the range of -1 to 1.
- The minimum length of the signals was determined, and all signals were adjusted to this length.

2.2 LSTM Network with Attention Mechanism

- The LSTM network with attention mechanism was implemented as a custom Keras layer called `Attention`.
- The architecture of the model includes a Bidirectional LSTM layer, the `Attention` layer, a Dropout layer for regularization, and a Dense layer for binary classification (sigmoid activation).

3. Training

- Number of Epochs: 50
- Learning Rate: 1e-3
- Input Size: [mention the input size of your data]
- Batch Size: 20

4. Results

- During training, the loss values were monitored on both the train and test datasets. The plot of loss values is shown in below.

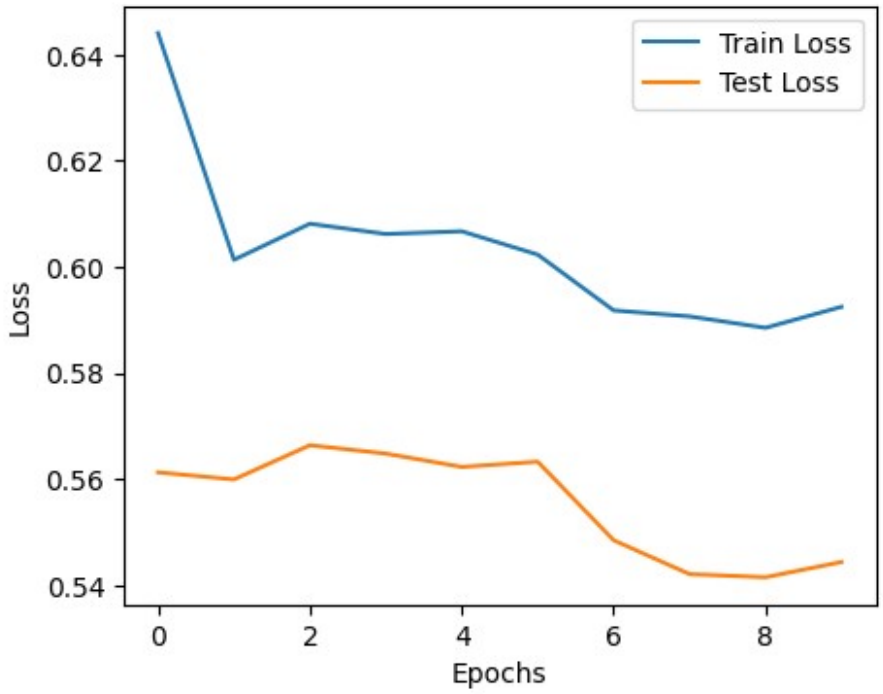
5. Evaluation

- The trained model was evaluated on the test dataset using the following metrics:
  - Accuracy
  - Precision
  - Recall
  - F1-score

Train the model and plot the loss values

```
Epoch 1/10
40/40 [==============================] - 156s 4s/step - loss: 0.6441 -
accuracy: 0.5888 - val_loss: 0.5613 - val_accuracy: 0.7563
Epoch 2/10
40/40 [==============================] - 151s 4s/step - loss: 0.6013 -
accuracy: 0.7030 - val_loss: 0.5599 - val_accuracy: 0.7766
Epoch 3/10
40/40 [==============================] - 150s 4s/step - loss: 0.6081 -
accuracy: 0.7005 - val_loss: 0.5664 - val_accuracy: 0.7310
Epoch 4/10
40/40 [==============================] - 151s 4s/step - loss: 0.6062 -
accuracy: 0.6878 - val_loss: 0.5648 - val_accuracy: 0.7563
Epoch 5/10
40/40 [==============================] - 149s 4s/step - loss: 0.6067 -
accuracy: 0.6929 - val_loss: 0.5623 - val_accuracy: 0.7614
Epoch 6/10
40/40 [==============================] - 148s 4s/step - loss: 0.6023 -
accuracy: 0.6916 - val_loss: 0.5633 - val_accuracy: 0.7563
Epoch 7/10
40/40 [==============================] - 149s 4s/step - loss: 0.5918 -
accuracy: 0.7183 - val_loss: 0.5485 - val_accuracy: 0.7665
Epoch 8/10
40/40 [==============================] - 155s 4s/step - loss: 0.5907 -
accuracy: 0.7157 - val_loss: 0.5421 - val_accuracy: 0.7817
Epoch 9/10
40/40 [==============================] - 154s 4s/step - loss: 0.5885 -
accuracy: 0.7195 - val_loss: 0.5415 - val_accuracy: 0.7766
Epoch 10/10
40/40 [==============================] - 151s 4s/step - loss: 0.5925 -
accuracy: 0.7132 - val_loss: 0.5444 - val_accuracy: 0.7766
```

Plot the loss values



Evaluate the classifier

```
+-----------+---------+
| Metric    |   Value |
+===========+=========+
| Accuracy  |   77.66 |
+-----------+---------+
| Precision |   74.31 |
+-----------+---------+
| Recall    |   83.51 |
+-----------+---------+
| F1-score  |   78.64 |
+-----------+---------+
```