High Training Sample Regime for LSTM (80-20 split): Code

DL hyperparameter description:

LSTM units - Positive integer, dimensionality of the output space.
Source : Keras
(https://keras.io/api/layers/recurrent_layers/lstm/)

Dense layer units - Positive integer, dimensionality of the output space.
Source : Keras
(https://keras.io/api/layers/core_layers/dense/)

Dropout rate - Float between 0 and 1. Fraction of the input units to drop. The dropout layer randomly sets input units to 0 with a frequency of rate at each step during training time, which prevents overfitting.
Source : Keras
(https://keras.io/api/layers/regularization_layers/dropout/)

Learning rate - The learning rate is a hyperparameter that controls how much to change the model in response to the estimated error each time the model weights are updated.

Here the learning rate is being set for the Adam optimizer.

Adam optimization is a stochastic gradient descent method that is based on adaptive estimation of first-order and second-order moments.
Source : Keras
(https://keras.io/api/optimizers/adam/)

The above-mentioned hyperparameters are tuned using KerasTuner. It is a general-purpose hyperparameter tuning library.
Source : Keras
(https://keras.io/guides/keras_tuner/)

Specifications for the Keras Tuner:

- Type of tuning : Random Search
- Objective to tune : Val accuracy
- Number of trials overall : 50
- Number of epochs per trial : 50
- Range for LSTM hyperparameters:
    a. LSTM units : 16 - 128 with step size of 16
    b. Dense layer units : 16 - 128 with step size of 16
    c. Dropout rate : 0 - 0.5 with step size of 0.1
    d. Learning rate : 1e-2, 1e-3, 1e-4

CFX + LSTM Hyperparameters : The hyperparameters: q, b, epsilon; as obtained while tuning ChaosNet were retained. Source: Link

File orientation for each dataset:

a. CFX-TUNING : /TRIALS -> Trials for LSTM hyperparameter tuning for corresponding values of q , b , epsilon
/RESULTS -> Saved hyperparameters

b. CFX-logs : /checkpoints -> Logs of trained CFX + LSTM model

c. ChaosFEX : CFX feature extractor for CFX + LSTM

d. SA-TUNING : /TRIALS -> Trials for stand-alone LSTM hyperparameter tuning
/RESULTS -> Saved hyperparameters

e. SA-logs : /checkpoints -> Logs of trained stand-alone LSTM model

f. TESTING-RESULTS : /CFX-RESULT -> Training and testing F1 scores for CFX + LSTM
/SA-RESULT -> Training and testing F1 scores for stand-alone LSTM

g. CFX_LSTM_TESTING.py : Python code to test the efficacy of CFX+LSTM on the particular dataset.

h. CFX_LSTM_TRAINING.py : Python code to tune the hyperparameters of CFX+LSTM on the particular dataset.

i. Codes.py : ChaosNet decision function for CFX+LSTM

j. SA_LSTM_TESTING.py : Python code to test the efficacy of stand-alone LSTM on the particular dataset.

k. SA_LSTM_TRAINING.py : Python code to tune the hyperparameters of stand-alone LSTM on the particular dataset.

Compiled training and testing F1 scores for stand-alone LSTM and CFX + LSTM models.

Dataset	Implementation	Tuned Hyperparameters	Training F1 Score	Testing F1 Score
Iris	Stand Alone LSTM	LSTM Units: 112 Dense Layer Units: 32 Dropout Rate: 0.1 Learning Rate: 0.01 Best number of epochs: 96	0.967	0.966
	ChaosFEX + LSTM	q = 0.141 b = 0.499 e = 0.147 LSTM Units: 96 Dense Layer Units: 16 Dropout Rate: 0.2 Learning Rate: 0.01 Best number of epochs: 8	0.949	0.964
Ionosphere	Stand Alone LSTM	LSTM Units: 16 Dense Layer Units: 32 Dropout Rate: 0.0 Learning Rate: 0.01 Best number of epochs: 36	0.946	0.874
	ChaosFEX + LSTM	q = 0.68 b = 0.969 e = 0.164 LSTM Units: 96 Dense Layer Units: 96 Dropout Rate: 0.2 Learning Rate: 0.001 Best number of epochs: 7	0.972	0.923
Wine	Stand Alone LSTM	LSTM Units: 48 Dense Layer Units: 96 Dropout Rate: 0.0 Learning Rate: 0.001 Best number of epochs: 100	1.0	1.0
	ChaosFEX + LSTM	q = 0.79 b = 0.499 e = 0.262 LSTM Units: 48 Dense Layer Units: 96 Dropout Rate: 0.0 Learning Rate: 0.001 Best number of epochs: 28	1.0	0.976

Bank Note Authentication	Stand Alone LSTM	LSTM Units: 32 Dense Layer Units: 128 Dropout Rate: 0.4 Learning Rate: 0.001 Best number of epochs: 100	1.0	0.971
	ChaosFEX + LSTM	q = 0.08 b = 0.25 e = 0.233 LSTM Units: 16 Dense Layer Units: 80 Dropout Rate: 0.1 Learning Rate: 0.001 Best number of epochs: 16	0.960	0.941
Haberman's Survival	Stand Alone LSTM	LSTM Units: 96 Dense Layer Units: 96 Dropout Rate: 0.1 Learning Rate: 0.0001 Best number of epochs: 92	0.442	0.409
	ChaosFEX + LSTM	q = 0.81 b = 0.14 e = 0.003 LSTM Units: 128 Dense Layer Units: 32 Dropout Rate: 0.4 Learning Rate: 0.001 Best number of epochs: 2	0.663	0.586
Breast Cancer Wisconsin	Stand Alone LSTM	LSTM Units: 96 Dense Layer Units: 16 Dropout Rate: 0.1 Learning Rate: 0.001 Best number of epochs: 71	0.983	0.858
	ChaosFEX + LSTM	q = 0.93 b = 0.49 e = 0.159 LSTM Units: 112 Dense Layer Units: 64 Dropout Rate: 0.2 Learning Rate: 0.001 Best number of epochs: 10	0.972	0.909
Statlog (Heart)	Stand Alone LSTM	LSTM Units: 128 Dense Layer Units: 16 Dropout Rate: 0.0 Learning Rate: 0.01 Best number of epochs: 3	0.958	0.837

	ChaosFEX + LSTM	q = 0.08 b = 0.06 e = 0.17 LSTM Units: 128 Dense Layer Units: 64 Dropout Rate: 0.0 Learning Rate: 0.01 Best number of epochs: 7	0.912	0.812
Seeds	Stand Alone LSTM	LSTM Units: 48 Dense Layer Units: 80 Dropout Rate: 0.0 Learning Rate: 0.01 Best number of epochs: 21	0.988	0.923
	ChaosFEX + LSTM	q = 0.02 b = 0.07 e = 0.238 LSTM Units: 112 Dense Layer Units: 96 Dropout Rate: 0.2 Learning Rate: 0.01 Best number of epochs: 49	0.976	0.902