# APPLICATION

As an application, 5 symbols of cryptocurrencies are taken into consideration: BCHUSD, BTCUSD, ETHUSD, LTCUSD and RPLUSD. Each symbol is trained with 4 prediction models: Multi-layer perceptron (MLP), Long-short term memory (LSTM), Convolutional encoder-decoder model (Conv-EncDec) and Luong’s Attention (Luong-Att).

In each prediction model, hyperparameters that are considered in DOE are given in Table 1.1 with the levels of them. For each cryptocurrency symbol & predictive model types a full factorial design (Table 2.1) of the above-mentioned hyperparameters is created. Full factorial design consists of 16 runs with 4 repetitions to minimize the impact of random weight initializations of the predictive models.



Levels of Factors

|  |  |  |
| --- | --- | --- |
| Hyperparameter | Lower Level | Upper Level |
| Batch size | 60 | 70 |
| Number of hidden neurons | 10 | 14 |



Full Factorial Design

| Run ID | Batch Size | Number of Hidden Neurons |
| --- | --- | --- |
| 0 | 70 | 10 |
| 1 | 60 | 10 |
| 2 | 60 | 10 |
| 3 | 70 | 14 |
| 4 | 70 | 10 |
| 5 | 60 | 14 |
| 6 | 60 | 14 |
| 7 | 60 | 10 |
| 8 | 70 | 14 |
| 9 | 60 | 14 |
| 10 | 70 | 14 |
| 11 | 70 | 14 |
| 12 | 70 | 10 |
| 13 | 70 | 10 |
| 14 | 60 | 10 |
| 15 | 60 | 14 |

Full factorial design is executed for each symbol and predictive models and response values of experiments are calculated based on custom metric function. To ensure independence of runs, GPU kernel of Anaconda environment is restarted before each run. After completing all runs of full factorial design, a 1st order mathematical model is created. Based on the first order model, steepest descent process is executed until the upward direction curvature occurs. On the point, where curvature starts to occur on steepest descent process, central composite inscribed (CCI) design is created. After execution of CCI design, a 2nd order mathematical model is created. 2nd order mathematical model consists of interaction and square affects of the factors as well as linear affects. Based on the 2nd order mathematical model, a grid search algorithm is applied to find the optimum hyperparameter configuration within the defined interval of CCI design.

appendixes

[Appendix 1](#_Toc99960234)

[Experiments of Full Factorial Design for MLP](#_Toc99960235)

[Appendix 2](#_Toc99960236)

[Experiments of Full Factorial Design for LSTM](#_Toc99960237)

[Appendix 3](#_Toc99960238)

[Experiments of Full Factorial Design for Conv-EncDec](#_Toc99960239)

[Appendix 4](#_Toc99960240)

[Experiments of Full Factorial Design for Luong-Att](#_Toc99960241)



Experiments of Full Factorial Design for MLP

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Run ID | BCHUSD | BTCUSD | ETHUSD | LTCUSD | RPLUSD |
| 0 |  |  |  |  |  |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |
| 11 |  |  |  |  |  |
| 12 |  |  |  |  |  |
| 13 |  |  |  |  |  |
| 14 |  |  |  |  |  |
| 15 |  |  |  |  |  |



Experiments of Full Factorial Design for LSTM

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Run ID | BCHUSD | BTCUSD | ETHUSD | LTCUSD | RPLUSD |
| 0 |  |  |  |  |  |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |
| 11 |  |  |  |  |  |
| 12 |  |  |  |  |  |
| 13 |  |  |  |  |  |
| 14 |  |  |  |  |  |
| 15 |  |  |  |  |  |



Experiments of Full Factorial Design for Conv-EncDec

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Run ID | BCHUSD | BTCUSD | ETHUSD | LTCUSD | RPLUSD |
| 0 |  |  |  |  |  |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |
| 11 |  |  |  |  |  |
| 12 |  |  |  |  |  |
| 13 |  |  |  |  |  |
| 14 |  |  |  |  |  |
| 15 |  |  |  |  |  |



Experiments of Full Factorial Design for Luong-Att

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Run ID | BCHUSD | BTCUSD | ETHUSD | LTCUSD | RPLUSD |
| 0 |  |  |  |  |  |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |
| 11 |  |  |  |  |  |
| 12 |  |  |  |  |  |
| 13 |  |  |  |  |  |
| 14 |  |  |  |  |  |
| 15 |  |  |  |  |  |