AMRITA VISHWA VIDYAPEETHAM

ELECTRICAL AND ELECTRONICS ENGINEERING & USER INTERFACE

Short term load forecasting using ANN

Group - 13

Team Members

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Introduction

- Develop a model for accurate short-term load forecasting using an **Artificial Neural Network (ANN)**.
- Accurate forecasting improves power system stability, resource management, and cost efficiency.
- Uses historical load data, weather conditions, and time-based features for better prediction accuracy.
- A **web interface** will display forecast results and error metrics.

Methodology

1. **Data Acquisition:**
    - The dataset was collected containing hourly electricity demand data alongside weather variables and calendar-based information.
    - Key features such as DEMAND, hourOfDay, and datetime were extracted for model development.
2. **Data Preprocessing**:
    - Missing values were identified and replaced using linear interpolation to maintain data continuity.

- Additional features like Previous Day Same Hour Load and Previous Week Same Hour Load were created to capture temporal patterns.
- The dataset was normalized to ensure consistent scaling across features.
- Highly correlated features (correlation > 0.98) were identified and removed to reduce multicollinearity.

3. Seasonal Analysis:

Seasonal data subsets were extracted to analyze demand patterns during:

- Winter (January)
- Spring (May)
- Summer (June)
- Fall (November)

4. **Data Splitting**:

The dataset was divided into:

- Training Set (80%) — For model training.
- Testing Set (20%) — For performance evaluation.

The split ensured time-sequential integrity to maintain temporal dependencies.

5. **Model Developments**:

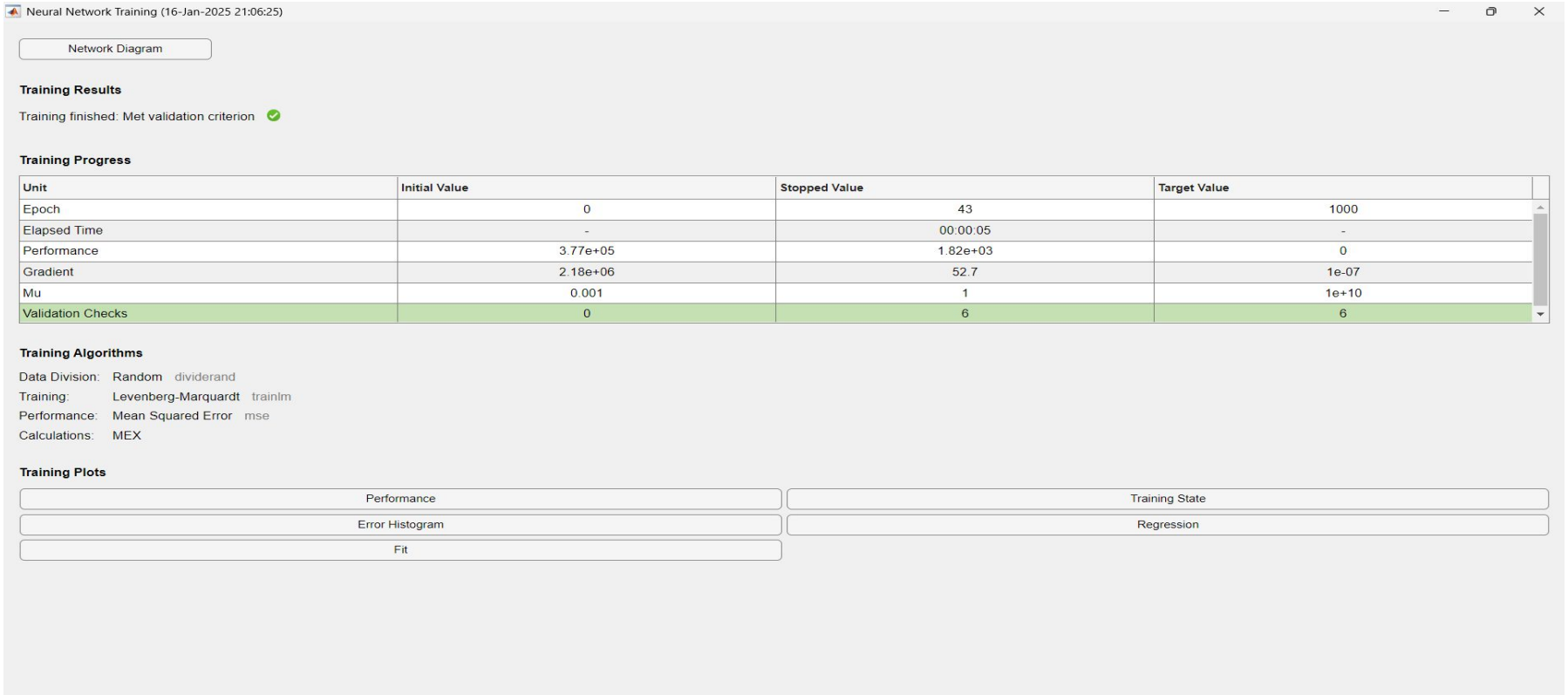
A Feedforward Neural Network (ANN) was designed with:

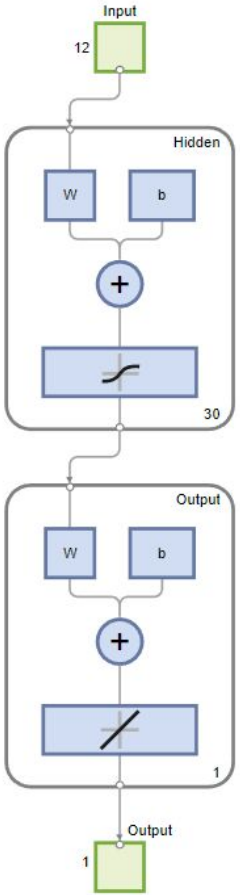
- 30 Hidden Neurons to balance complexity and performance.
- The model was trained using supervised learning techniques to minimize forecasting error.

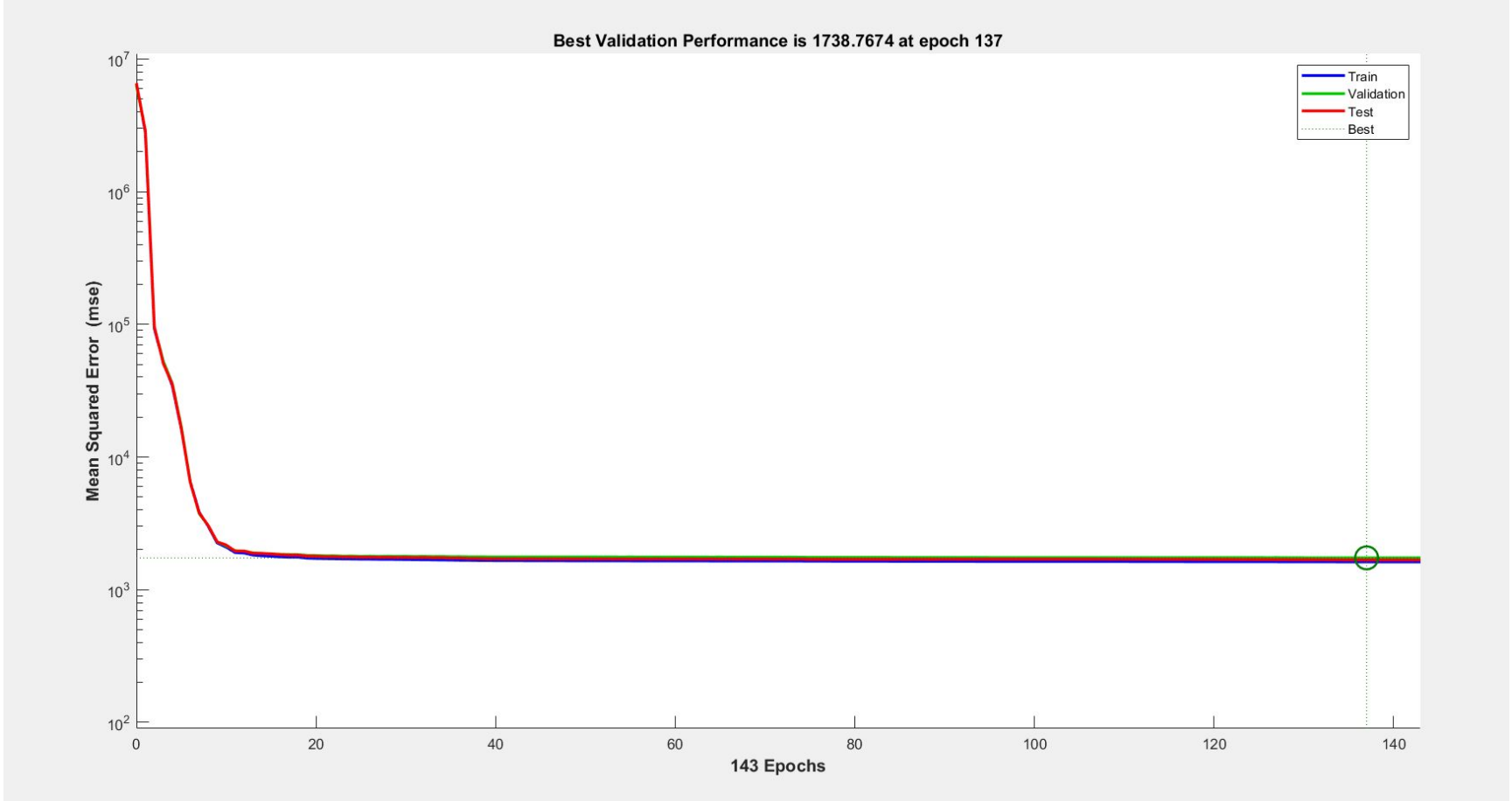
6. Model Evaluation:

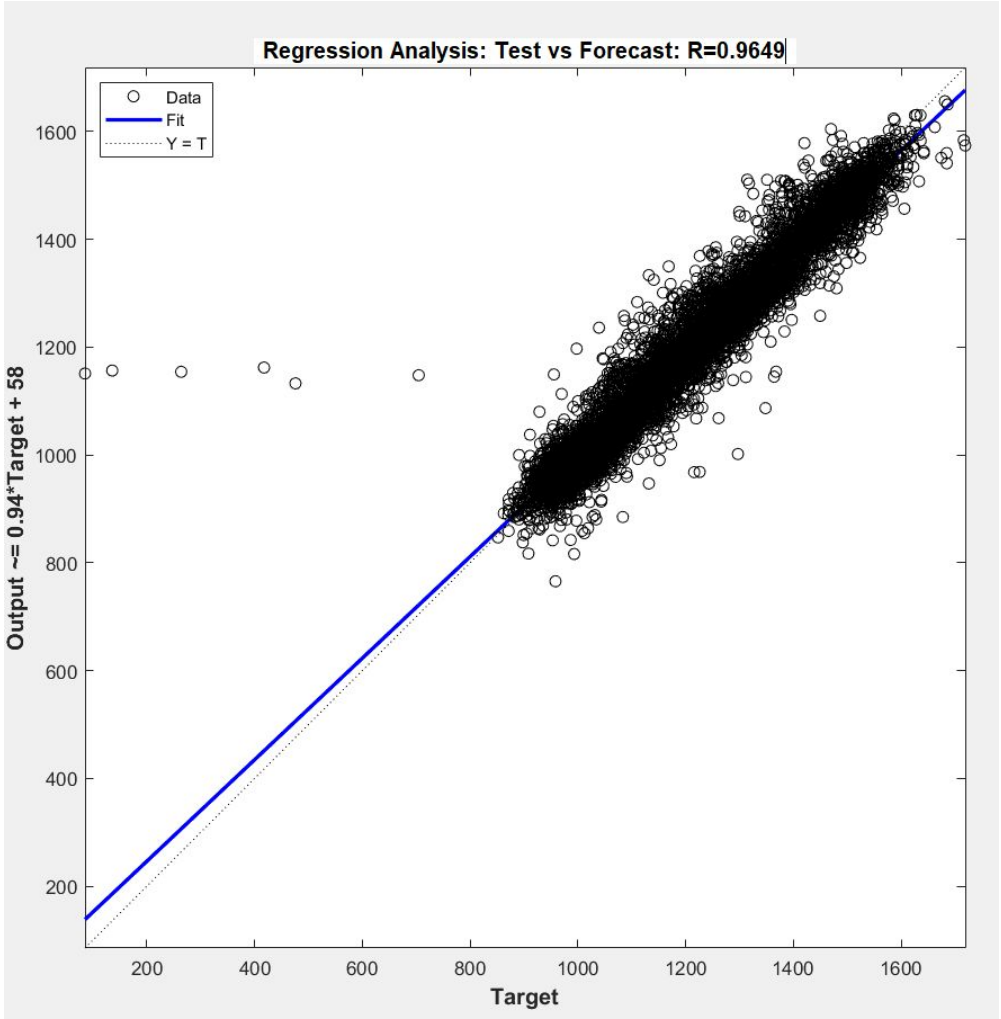
- Forecasted load values were compared with actual values using key performance metrics:
  - Mean Absolute Error (MAE)
  - Mean Absolute Percentage Error (MAPE)
- Regression analysis and error visualization techniques were employed to assess prediction accuracy.

Outputs


Neural Network Training (16-Jan-2025 21:06:25)
Network Diagram
Training Results
Training finished: Met validation criterion
Training Progress
Unit | Initial Value | Stopped Value | Target Value
Epoch | 0 | 43 | 1000
Elapsed Time | - | 00:00:05 | -
Performance | 3.77e+05 | 1.82e+03 | 0
Gradient | 2.18e+06 | 52.7 | 1e-07
Mu | 0.001 | 1 | 1e+10
Validation Checks | 0 | 6 | 6
Training Algorithms
Data Division: Random dividerand
Training: Levenberg-Marquardt trainlm
Performance: Mean Squared Error mse
Calculations: MEX
Training Plots
Performance
Training State
Error Histogram
Regression
Fit

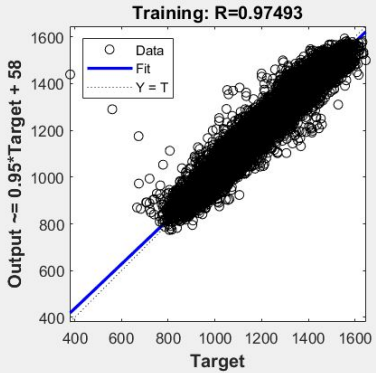

Input
12
Hidden
W
b
30
Output
W
b
1
Output
1

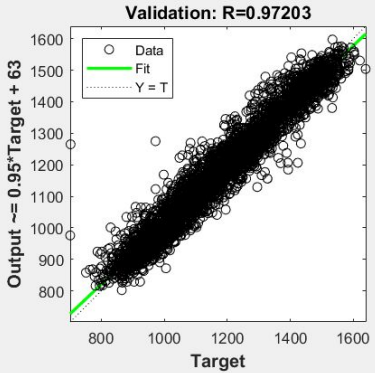

Best Validation Performance is 1738.7674 at epoch 137
Mean Squared Error (mse)
143 Epochs
Train
Validation
Test
Best
10^7
10^6
10^5
10^4
10^3
10^2
0
20
40
60
80
100
120
140

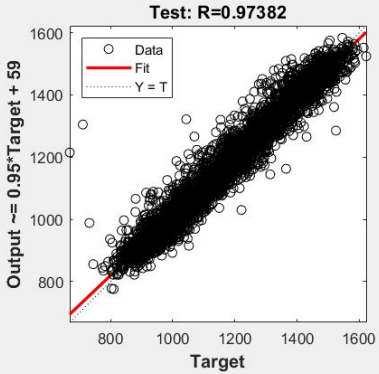

Regression Analysis: Test vs Forecast: R=0.9649
Data
Fit
Y = T
Output ~= 0.94*Target + 58
Target
200
400
600
800
1000
1200
1400
1600

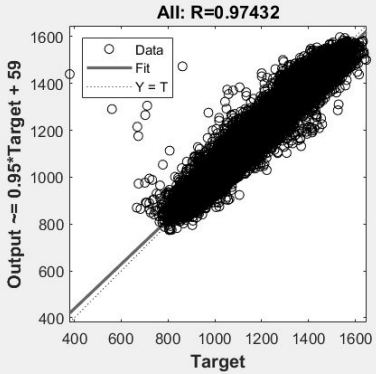
Neural Network Training Regression (plotregression), Epoch 43 , Training finished: Met validation criterion

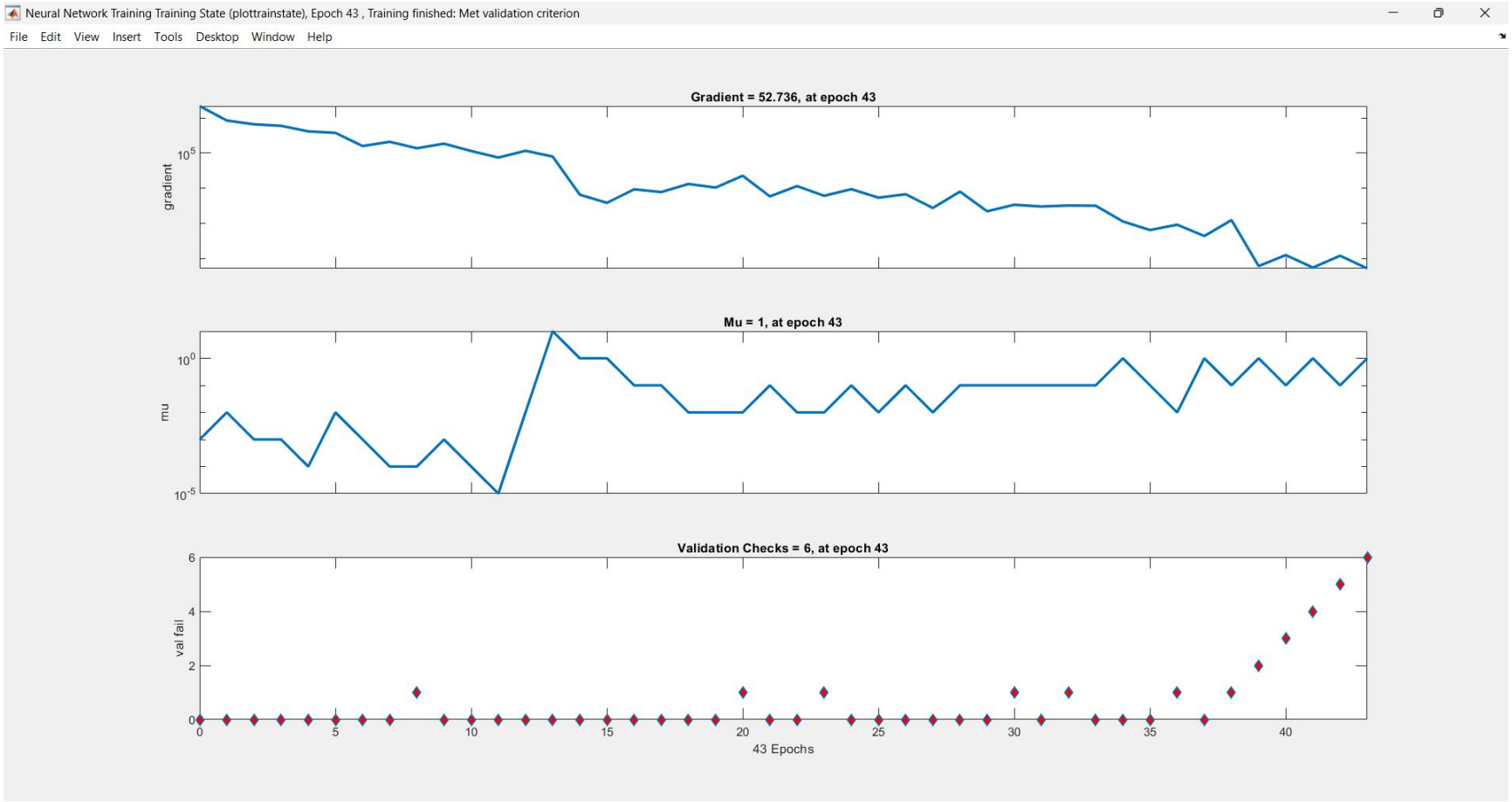
File Edit View Insert Tools Desktop Window Help

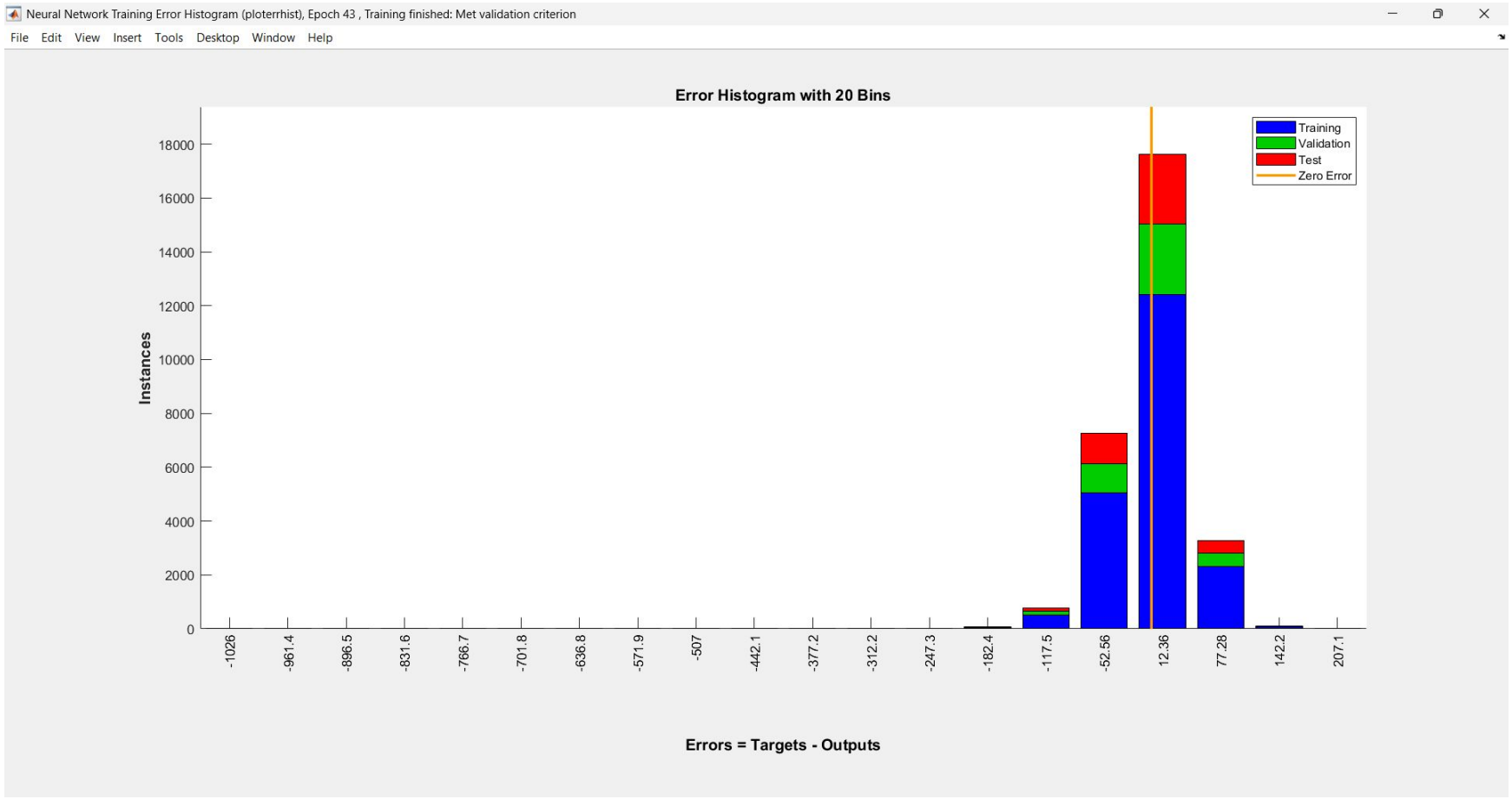


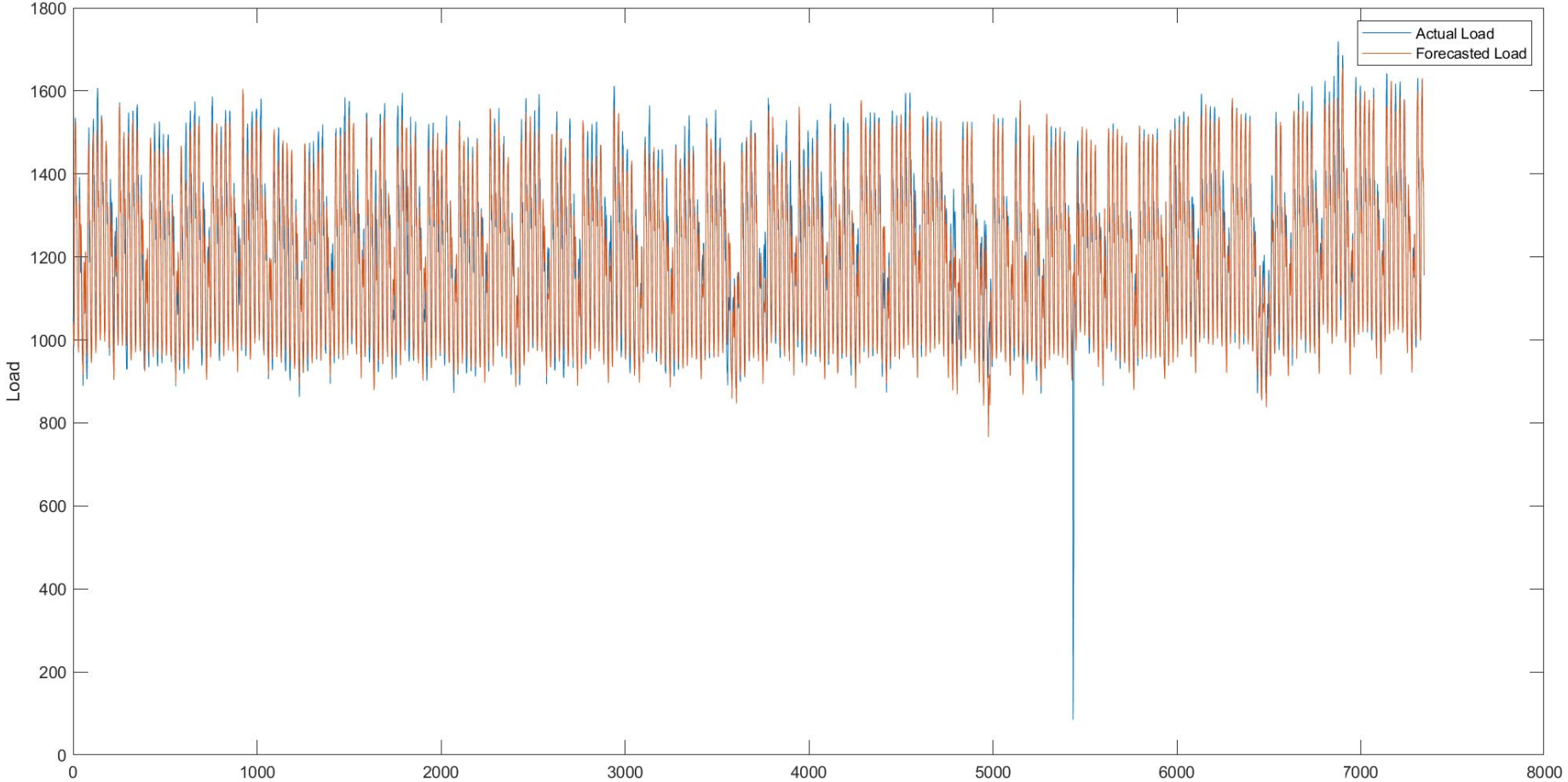


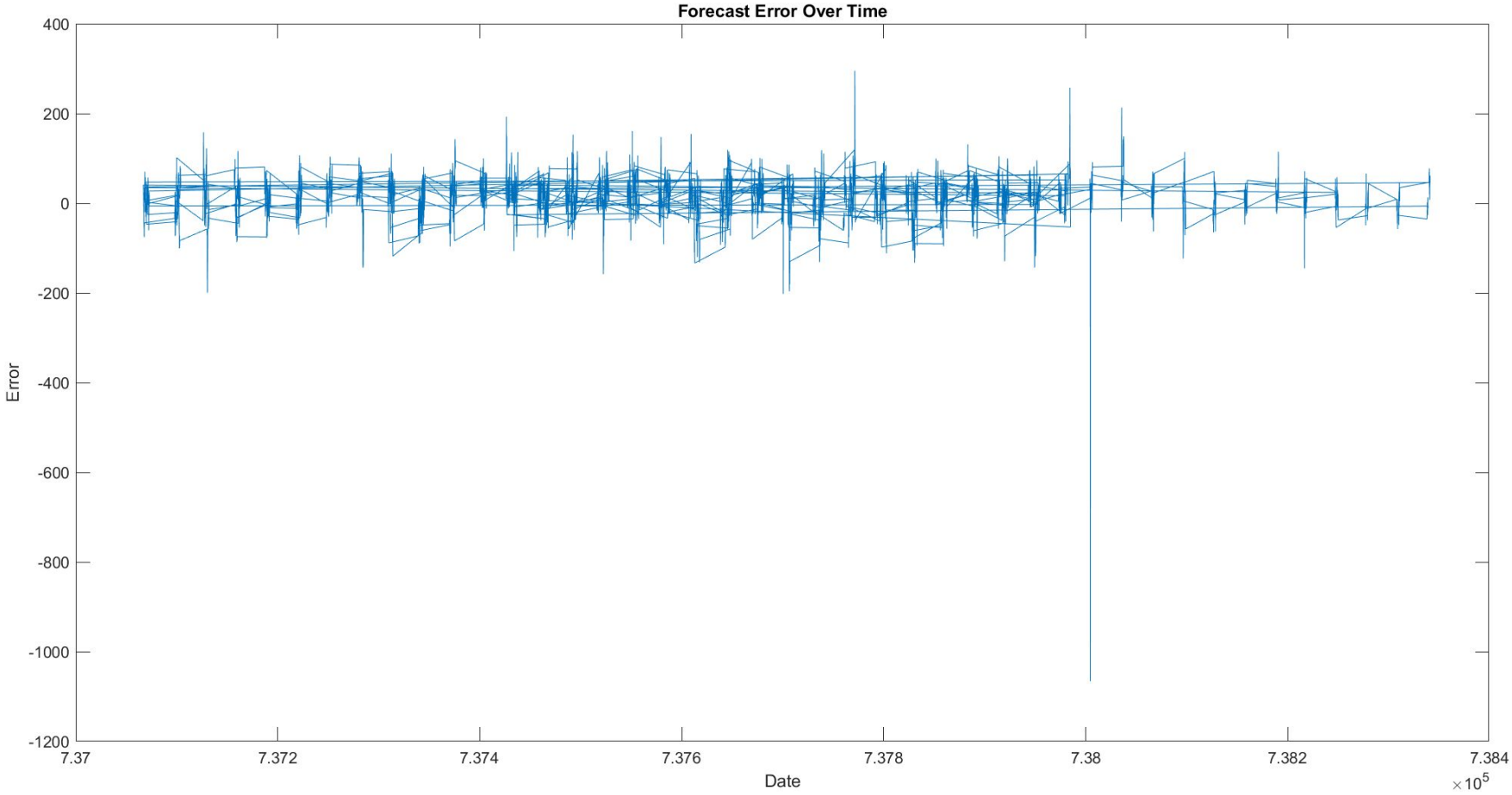




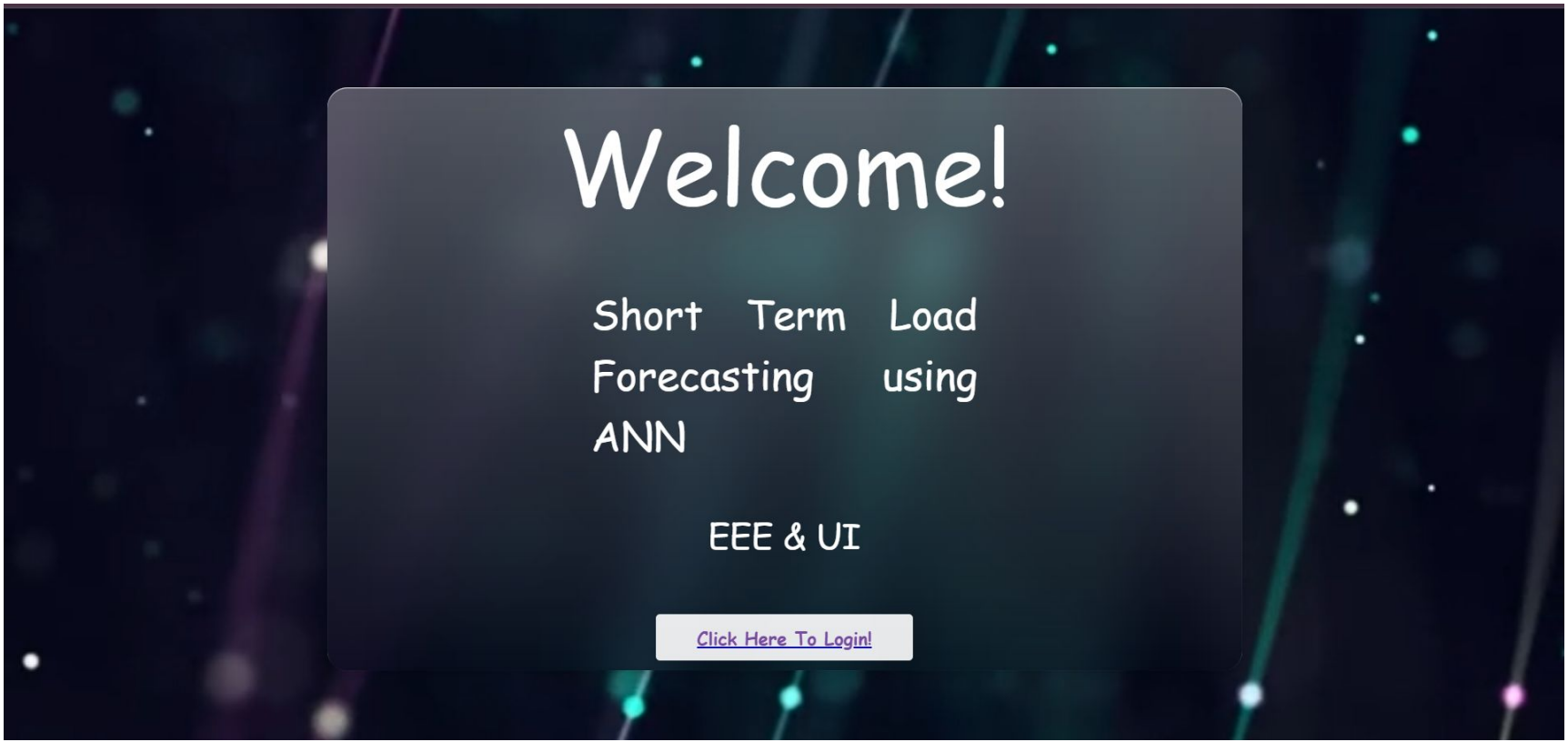

Neural Network Training Training State (plottrainstate), Epoch 43 , Training finished: Met validation criterion
File Edit View Insert Tools Desktop Window Help
Gradient = 52.736, at epoch 43
gradient
10^5
Mu = 1, at epoch 43
mu
10^0
10^{-5}
Validation Checks = 6, at epoch 43
val fail
0
2
4
6
0
5
10
15
20
25
30
35
40
43 Epochs

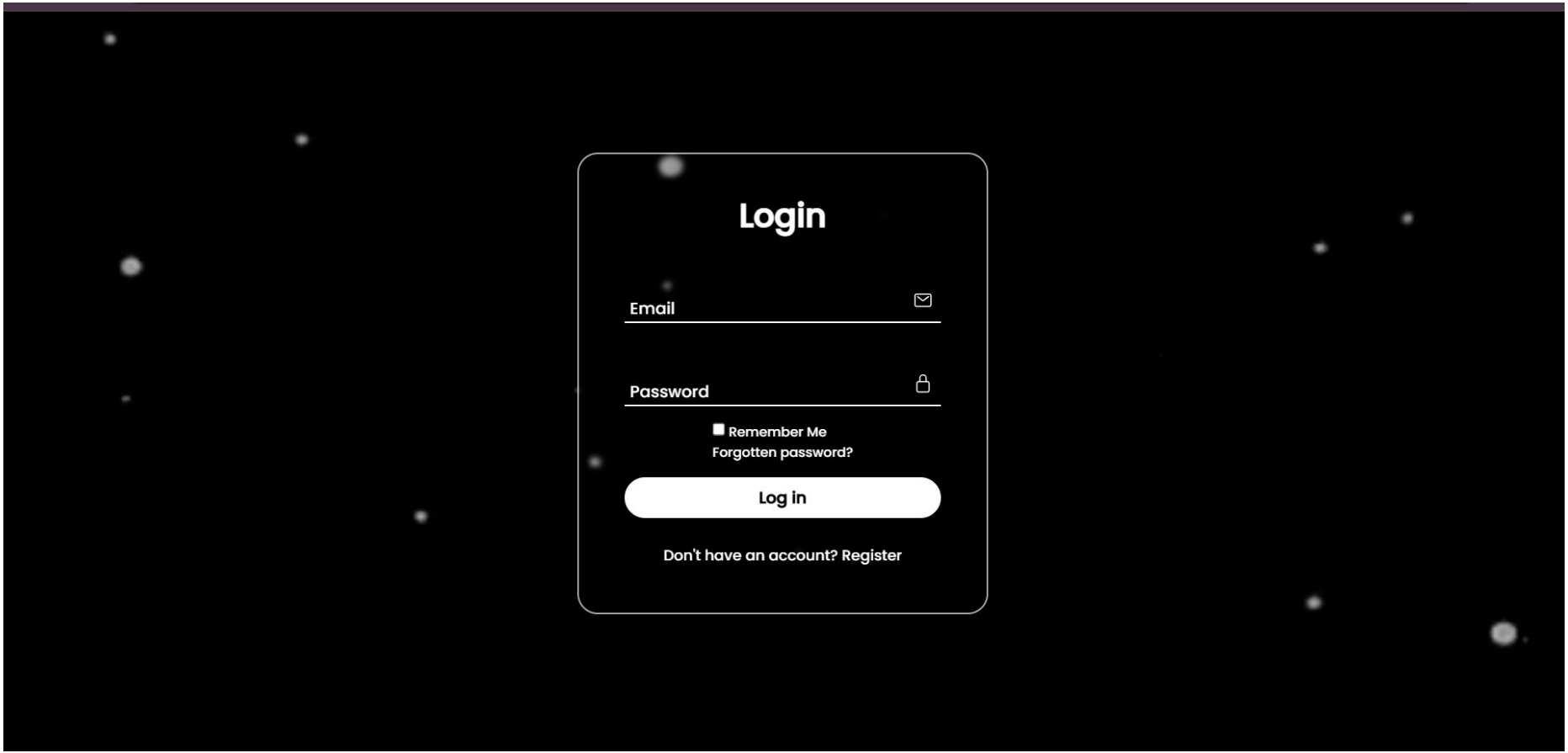

Neural Network Training Error Histogram (ploterrhist), Epoch 43 , Training finished: Met validation criterion
File Edit View Insert Tools Desktop Window Help
Error Histogram with 20 Bins
Training
Validation
Test
Zero Error
Instances
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-1026
-961.4
-896.5
-831.6
-766.7
-701.8
-636.8
-571.9
-507
-442.1
-377.2
-312.2
-247.3
-182.4
-117.5
-52.56
12.36
77.28
142.2
207.1
Errors = Targets - Outputs


Actual Load
Forecasted Load
Load
1800
1600
1400
1200
1000
800
600
400
200
0
0
1000
2000
3000
4000
5000
6000
7000
8000


Forecast Error Over Time
400
200
0
-200
-400
-600
-800
-1000
-1200
Error
7.37
7.372
7.374
7.376
7.378
7.38
7.382
7.384
Date
×10^5

UI Output


Welcome!
Short Term Load Forecasting using ANN
EEE & UI
Click Here To Login!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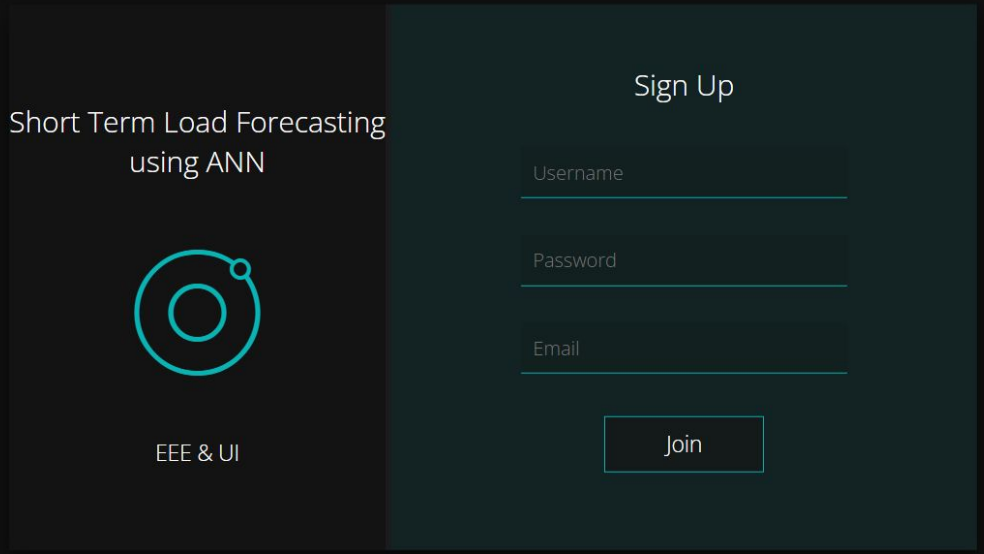
Forgotten password?
Log in
Don't have an account? Register


Short Term Load Forecasting using ANN
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Hello!

Welcome to Short term Load Forecasting Project..

Click below button if you wish to view "Forecast Results Analysis".

Results

Outputs

Thank You!