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REPORT HOMEWORK DEEP LEARNING

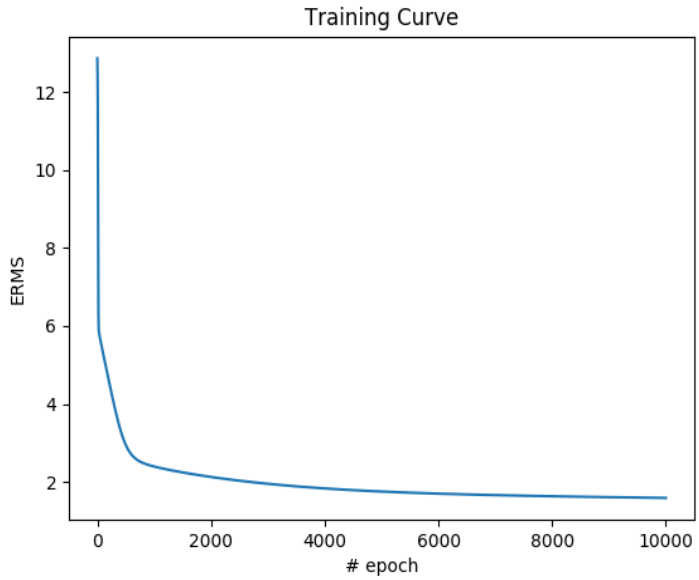
1. Regression

a. Network Architecture

Network Architecture	16 – 10 – 10 - 1
Selected features	in range (8)
Training ERMS	**1.82859705531**
Testing ERMS	**1.82903640282**
Epoches	10000
Learning rate	0.05
BatchSize	32
Training / Testing Size	75% - 25%

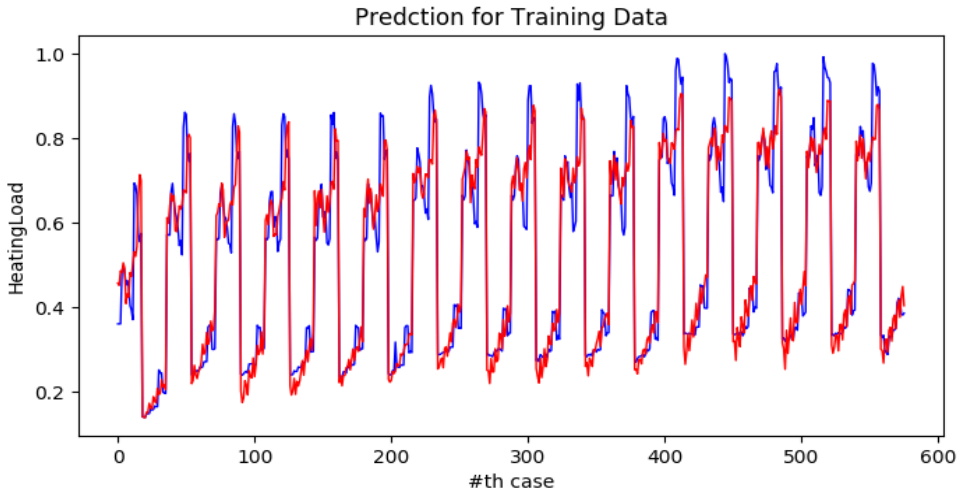
**Note that the error ERMS is calculated per batchSize, and the data are normalized to be from 0 to 1. Since later I will use the ERMS per each data*

b. Learning Curve

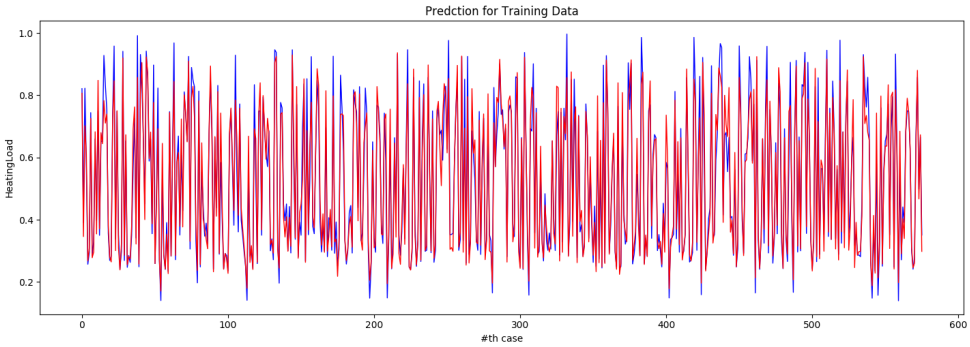



```
giang@CGILab:~/NCTU PhD 2018/Deep Learning Fall 2018/HW1DLSP2018$
Total Used Feature(s): 16
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17]
(768, 18)
12.8592386092
2.39804439292
2.13084854552
1.95560964808
1.83659382493
1.75712078793
1.70345938655
1.66535572137
1.63642220348
1.61311353913
Error Traning: 1.82859705531
Error Testing: 1.82903640282
```

c. Regression result with train label

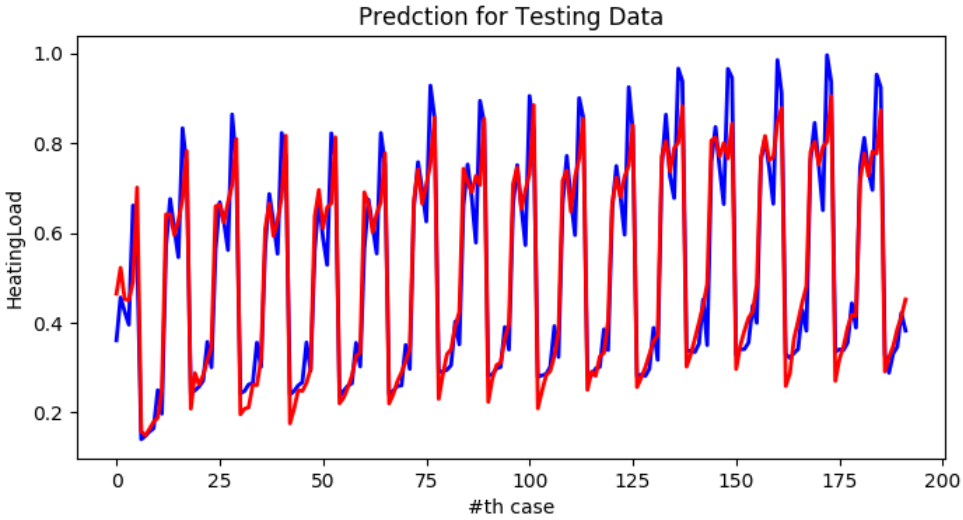


No shuffle data

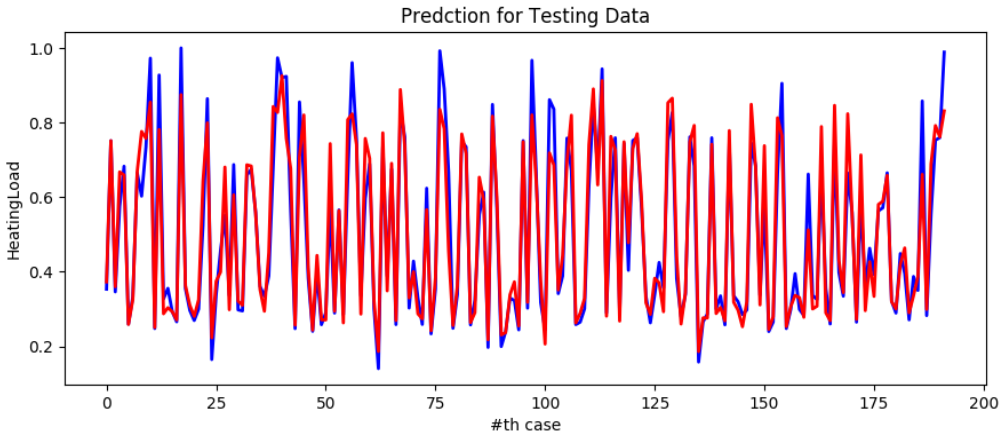


Shuffle data

d. Regression result with test label



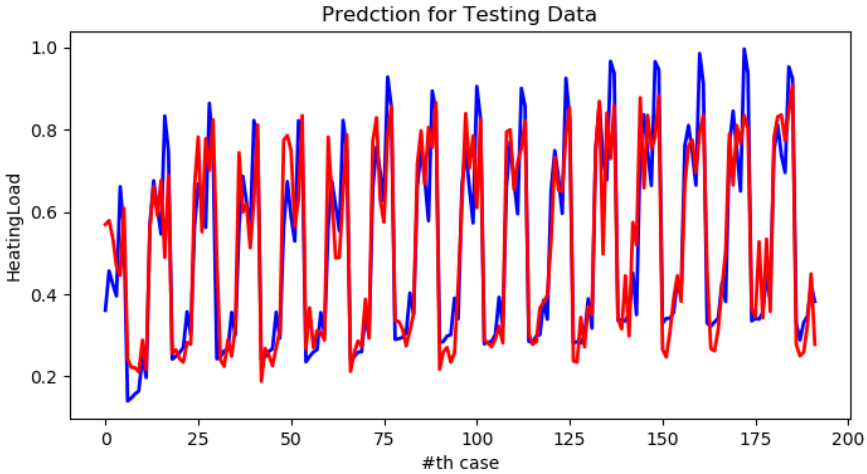
No shuffle data



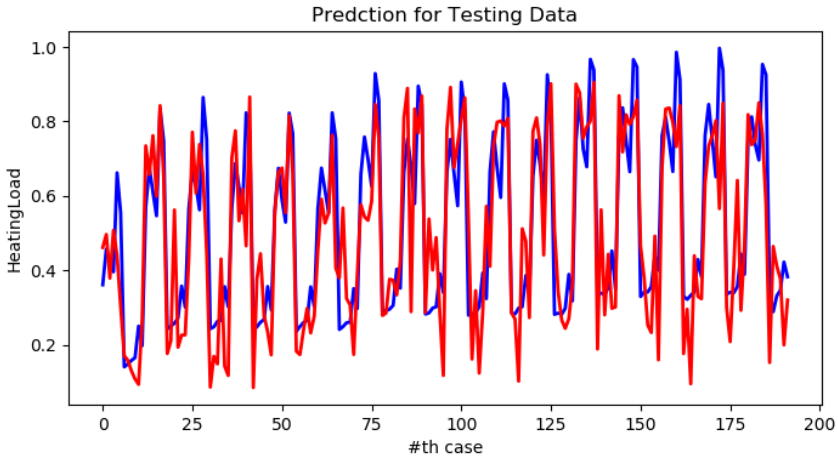
Shuffle data

e. Design a feature selection procedure

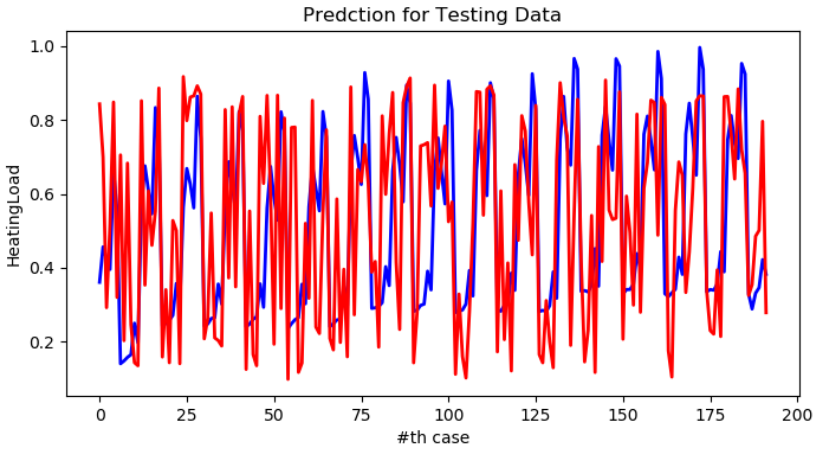
- A method to identify which feature that has the most influent to the result is th*at* **<u>adding noise to the feature</u>**. Assuming that in practice, the collected data comes from the sensors might be noise, and which feature that we need to reduce the noise as small as possible
- The error is generated by Gaussian (μ,σ), zero mean and be normalize from 0 to 1, saying as how many percent that data was be noise.
- Here is the result comparing when adding noise to different selected feature (1^{st}, 2^{nd},3^{rd} feature, respectively)



Adding noise to the 1^{st} feature



Adding noise to the 2nd feature



Adding noise to the 3rd feature

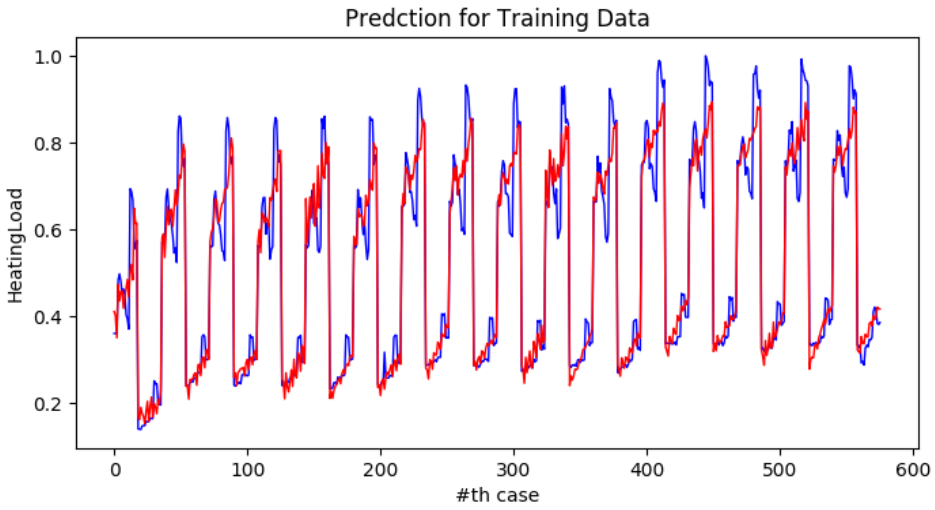
- The error per data comparing between training data and testing data are

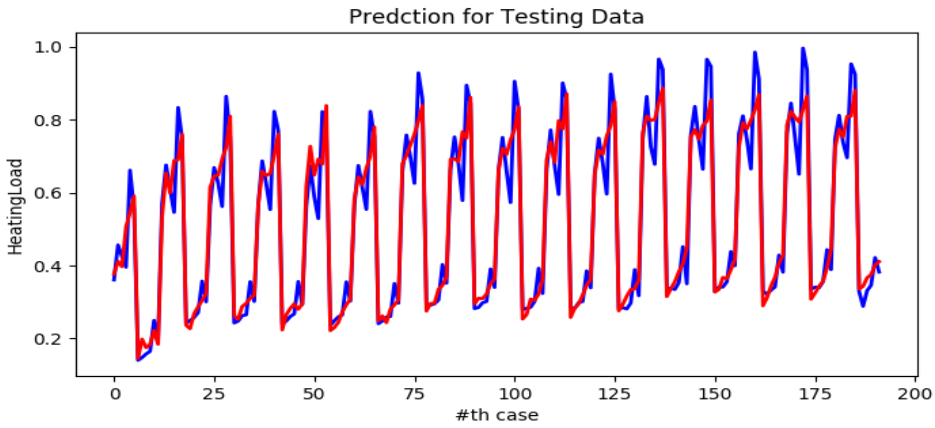
	Error Training (No noise):	Error Testing (added noise:
Nosie on the 1st	0.0675503322733	0.0985013862361
Nosie on the 2nd	0.0704411594573	0.141085554944
Nosie on the 3rd	0.0767251142719	0.242303226266
No adding	0.0673750234233	0.076345786349

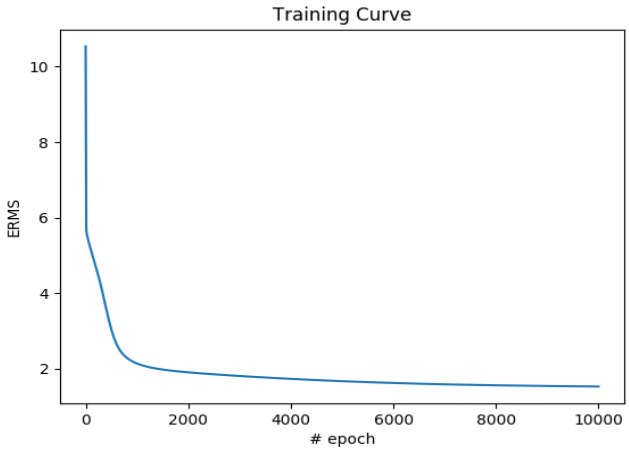
**ERMS/each data*

- By this test, we could say that the 3rd feature influent to the result more than the others two feature. Try this method to find out which feature is more important than the others feature.
- By the way, this is the state-of-the-art questions on Machine Learning, as well as how we configure the parameter and the structure of the network.

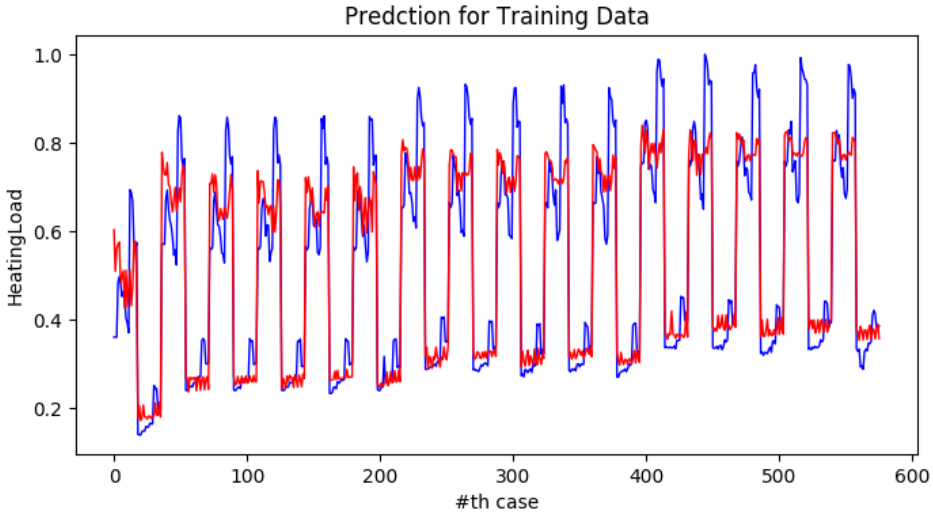
- Another medthod to select features is by the <u>variance of the feature</u>. Remove the features have the value variance that **<u>smaller</u>** than a threshold (or the others). We expect that the feature that have small variance will not effect to the result.
    - Remove 1 feature (2nd feature). **<u>The result quite similar to use all of the features</u>**

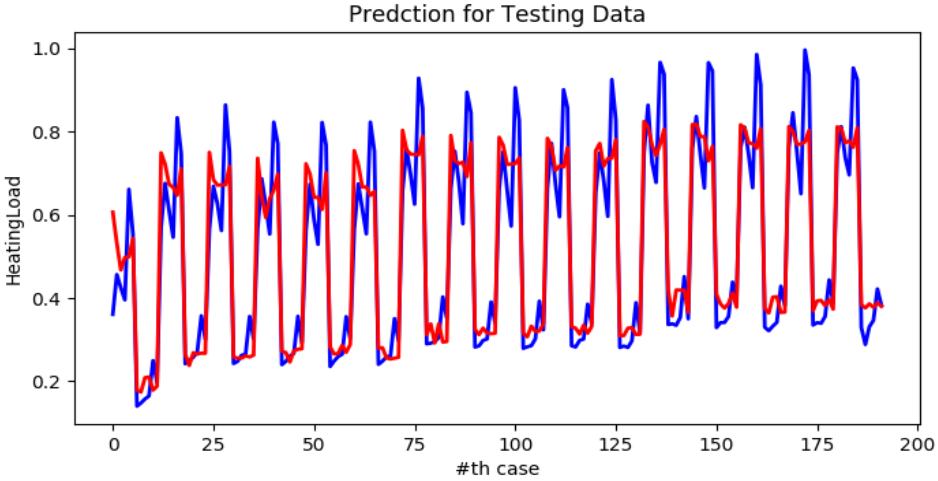






- Remove 2 features (0th and 2nd features). The result is shown below


Predction for Training Data
HeatingLoad
#th case
1.0
0.8
0.6
0.4
0.2
0
100
200
300
400
500
600

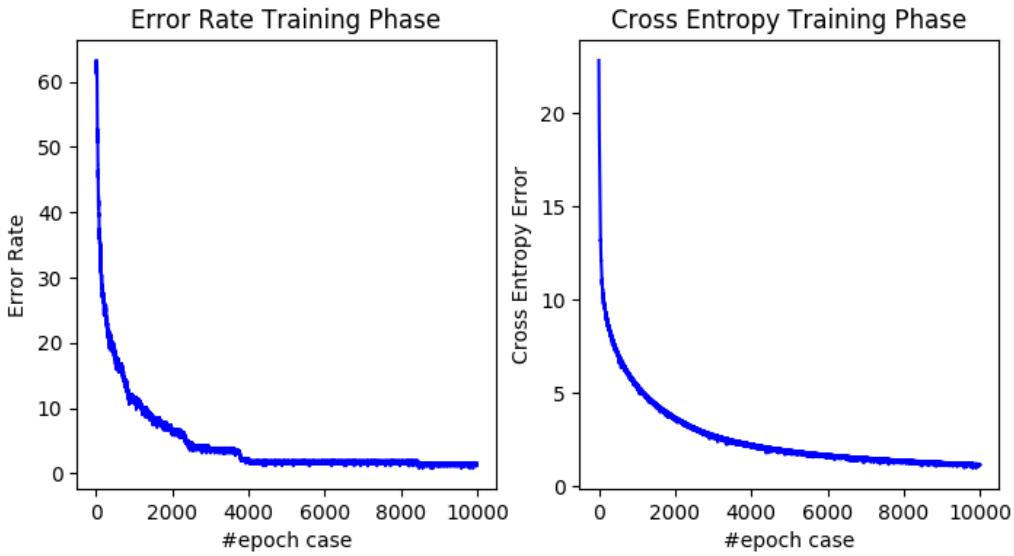

Predction for Testing Data
HeatingLoad
#th case
1.0
0.8
0.6
0.4
0.2
0
25
50
75
100
125
150
175
200

2. Classification

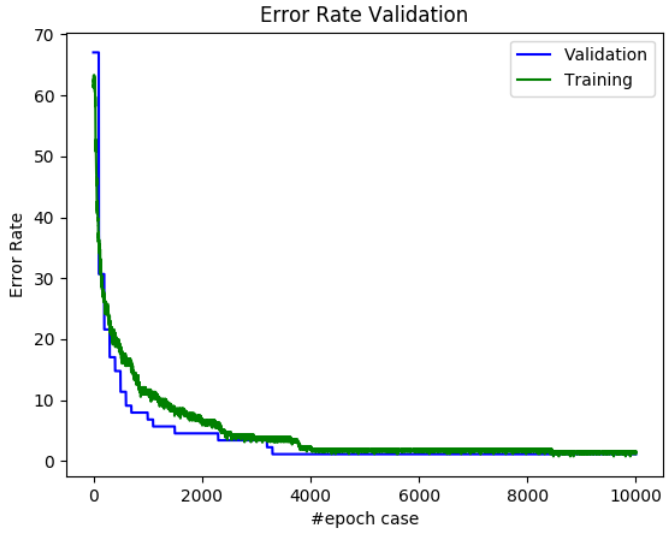
a. Network Architecture

Network Architecture	128-64-32-3-2
Selected features	all
Error Rate Training	**0.78%**
Error Rate Testing	**1.136%**
Epoches	10000
Learning rate	0.0001
BatchSize	16
Training / Testing Size	75% - 25%

b. Learning Curve



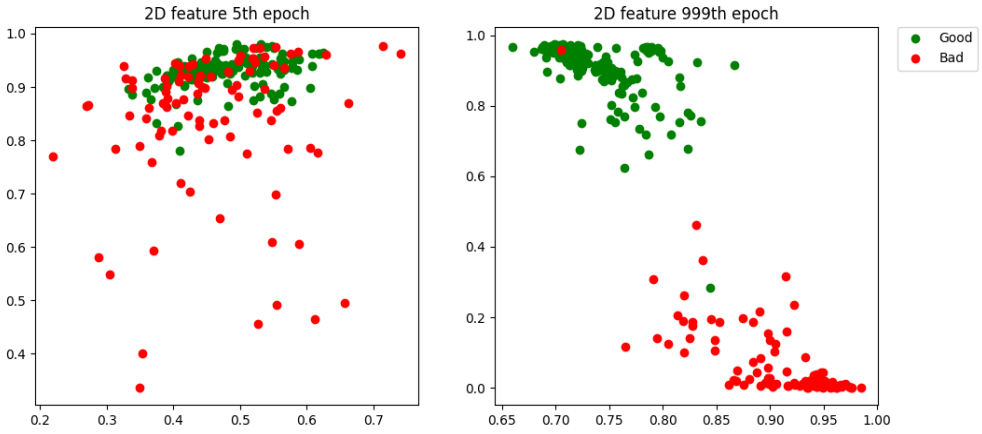
Error & Loss during Training Phase

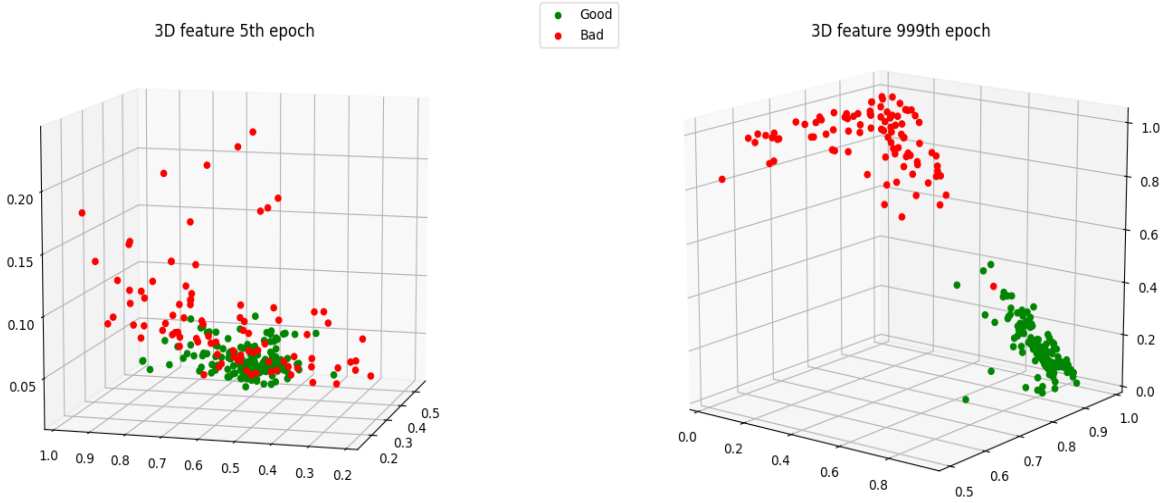


Error rate of training & validation during Training Phase

c. Plotting latent features at different training state

By changing the hidden layer before output layer, using 2 or 3 nodes, we then compare the result by visualize (2D or 3D) the distribution of this hidden layer at diffident training stage.





***Usage:**

To run regression program:

```
>> python mainRegression.py
```

To run Classification program:

```
>> python mainClassification.py
```

If there is anything that goes wrong from my code, please contact me for checking. Thank you very much

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