

National Chiao Tung University

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Deep Learning

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Deep Learning HW1 Report

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Writing with \LaTeX on Overleaf

Deep Learning HW1 Report

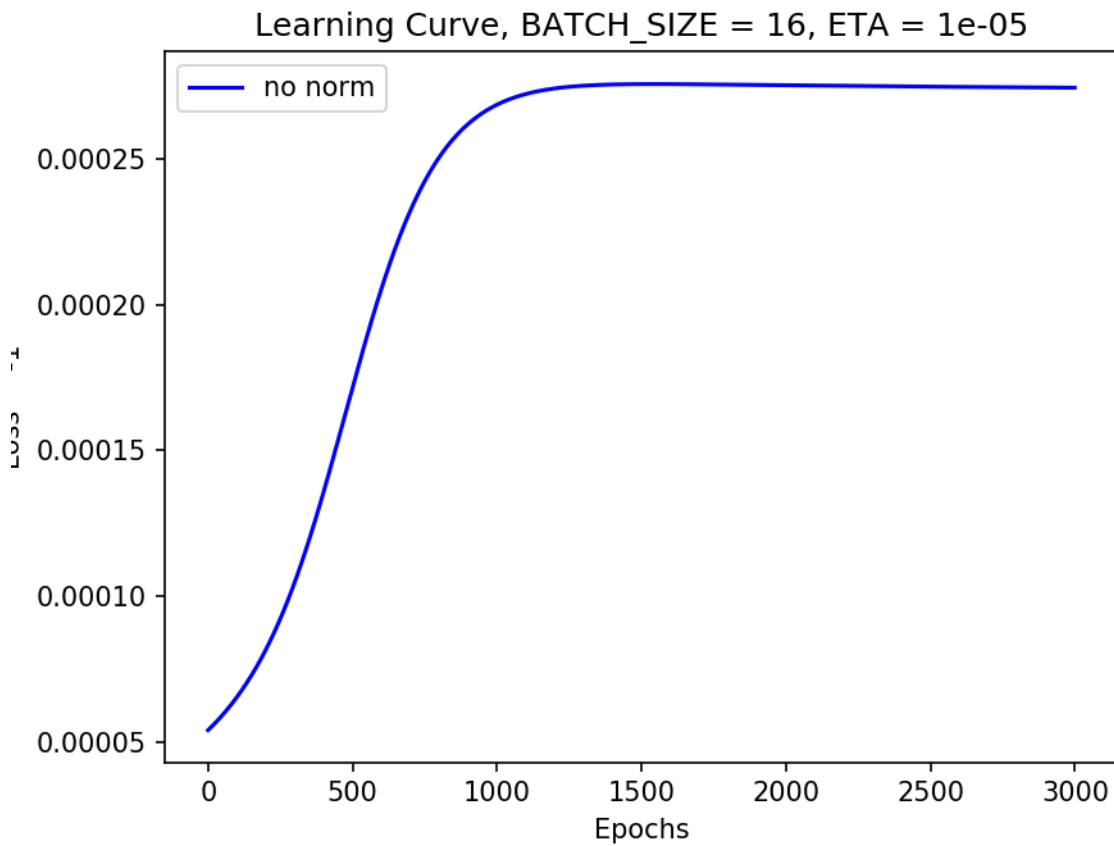
April 6, 2019

1 Self-designed DNN for binary classification

Loss is defined by

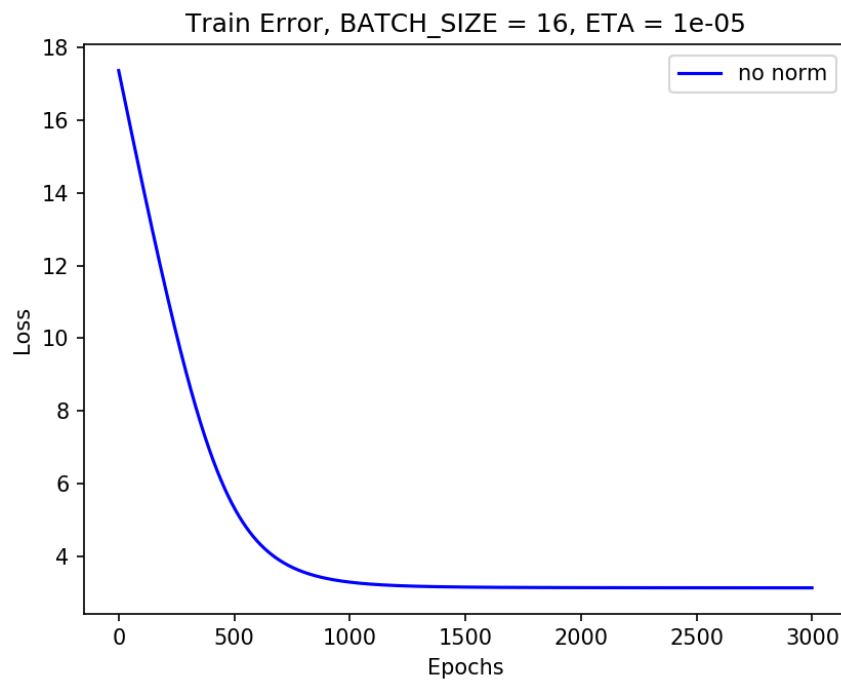
$$E(w) = \sum_{n=1}^N \sum_{k=1}^K t_{nk} \ln y_k(X_n, w)$$

1.1 Learning Curve



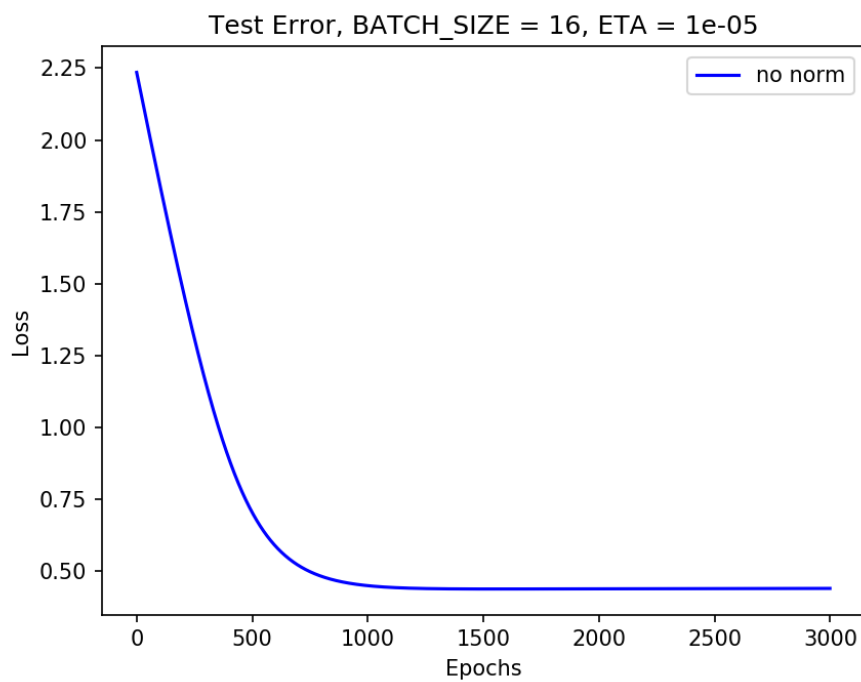
The Y-axis represents 1/Loss, telling the learning curve(loss is dropping and finally converged)

1.2 Training Loss



The Y-axis represents loss, telling the learning curve(loss is dropping and finally converged)

1.3 Testing Loss



The Y-axis represents loss, telling the learning curve(loss is dropping and finally converged)

1.4 Explanation of my neural network architecture

- Layer: Input 6unit (input including 6 features, which is 6 dimensions).

Hidden 4unit, since in my opinion, what influences the result most lies in the learning rate, the neuron set 4 will be optimal for computation (too many neurons merely increases the matrix computation time)

[Click for ref](#)

Output: 1unit for alive or death.

For the following two items, I select them based on the combination with shell script, and comparing the optimal results using the **same random seed** for benchmarking the learning curve vs batch size and learning rate. (Choose the normal learning rate first (such as 0.5) and slightly decrease by empirical method (automated training with shell script and comparing with pyplot figure).

According to this article the **high learning rate will cause the non-convergent of learning curve**.

With the aforementioned site, I start up with learning rate 0.5 and empirically dropped down to about **0.00001 +- 0.000005**

```
if [ $sel -eq 1 ];
then
    batch_size=$2
    for learning_rate in 0.000001 0.000003 0.000005 0.000008 0.00001 0.000015 0.00002;
    do
        echo $learning_rate
        python3 dnn_1.py $1\_ $batch_size\_ $learning_rate $batch_size $learning_rate
    done
else
    python3 dnn_1.py $1_8_0.000005 8 0.000005
fi

mkdir -p $1_1
mv $1*\*.png $1_1/
```

- Batch size: 16 for optimal, (too large will consume too much memory resource, and too small will cause the unstable learning curve. Although more randomness, less chance to converge)

[Ref link](#)

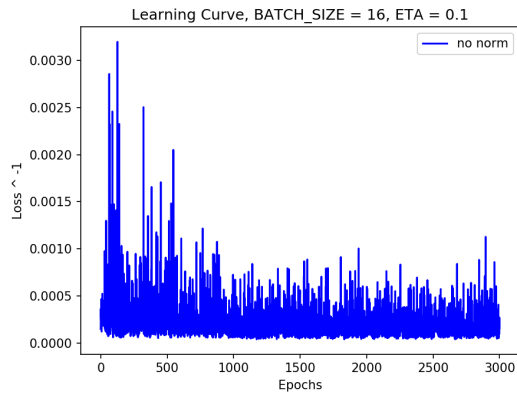


Figure 1: Learning rate = 0.1

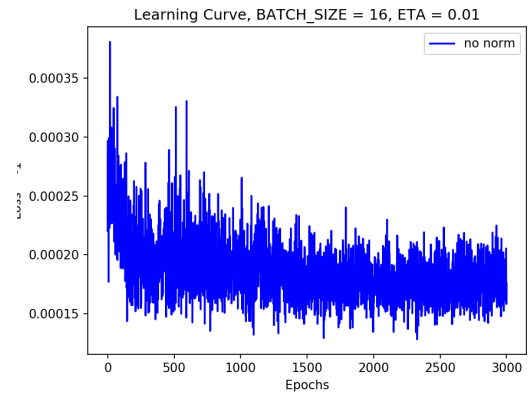
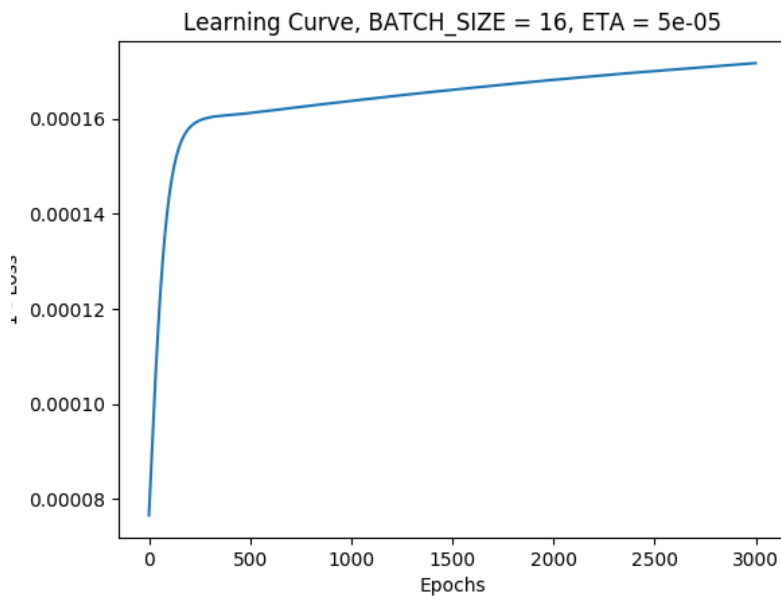


Figure 2: Learning rate = 0.01

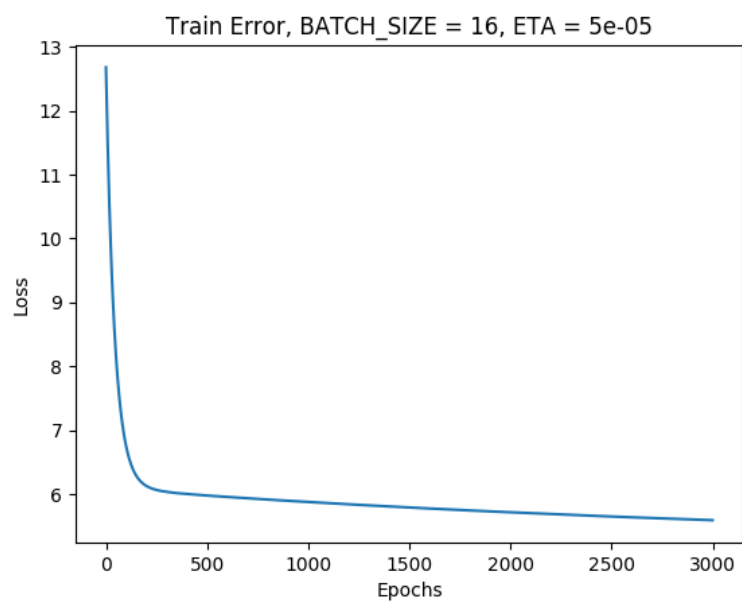
- Learning rate: 0.00001 (1e-5) will be optimal (The above figures shows some high learning rate causing non-convergent of learning curve)

2 TA-designed DNN

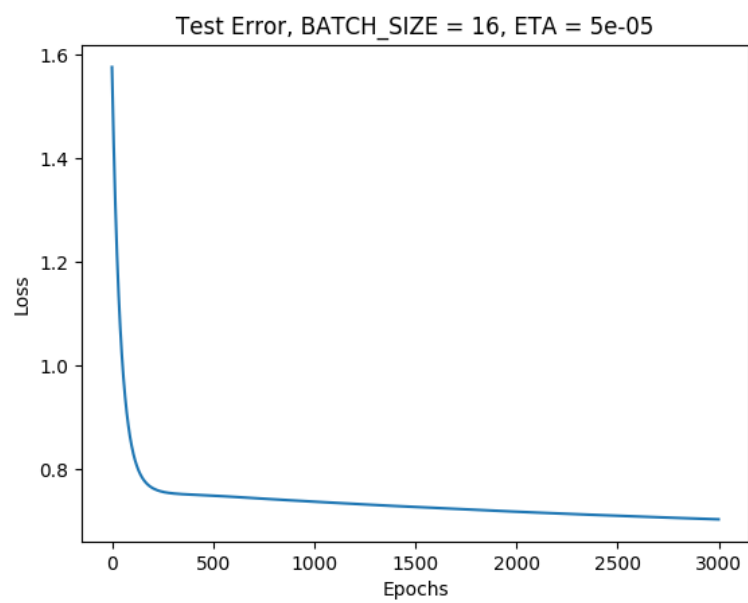
The selection of learning rate and training batch size is the same as above



Learning curve

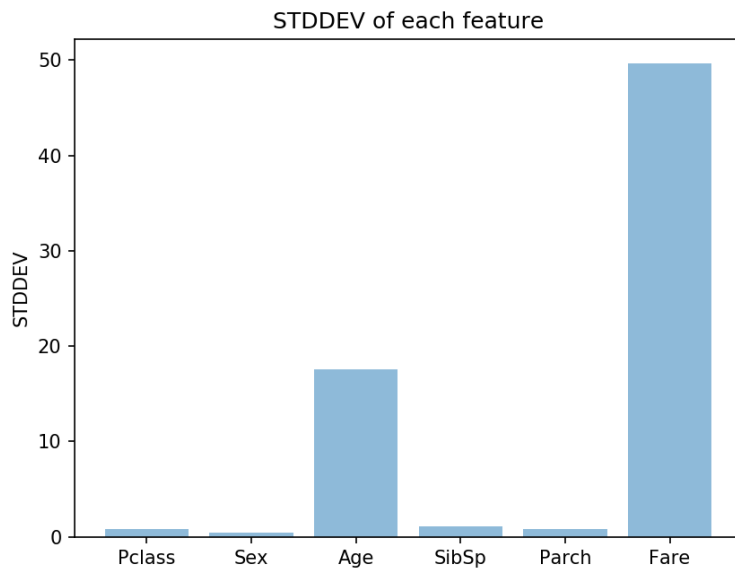


Training error



Testing error

3 The normalization of features



Why normalize the data?

Normalization is a technique often applied as part of data preparation for machine learning. The goal of normalization is to change the values of numeric columns in the dataset to a common scale, without distorting differences in the ranges of values. For machine learning, every dataset does not require normalization. It is required only when features have different ranges.

The following figure is the result of normalized fare and normalized all the features, which shows the better performance under normalization (use the same random seed, same batch size and same learning rate for fairness), the normalized results converged better and quicker. Note: Same cross entropy formula is used.

