

**The Experiment Report of**

***Deep Learning***

**College Software College**

**Subject Software Engineering**

**Members**   **黄海南**

**Student ID 201720145150**

**E-mail 1969561063@qq.com**

**Tutor**   **Mingkui Tan**

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**1. Topic: Linear Regression, Linear Classification and Gradient Descent**

**2. Time: 2017-12-07**

**3. Reporter: 黄海南**

**4. Purposes:**

**（1）** **Further understand of linear regression and gradient descent.**

**（2）Conduct some experiments under small scale dataset.**

**（3）Realize the process of optimization and adjusting parameters.**

**5. Data sets and data analysis:**

**（1）Linear Regression uses Housing in LIBSVM Data, including 506 samples and each sample has 13 features.**

**（2）Linear classification uses australian in LIBSVM Data, including 690 samples and each sample has 14 features.**

**6. Experimental steps:**

**Linear Regression and Gradient Descent**

1. **Load the experiment data.**
2. **Devide dataset.**
3. **Initialize linear model parameters. You can choose to set all parameter into zero, initialize it randomly or with normal distribution.**
4. **Choose loss function and derivation.**
5. **Calculate gradient G toward loss function from all samples.**
6. **Denote the opposite direction of gradient G as D.**
7. **Update model:ηis learning rate, a hyper-parameter that we can adjust.**
8. **Get the loss under the training set and by validating under validation set.**
9. **Repeate step 5 to 8 for several times, and drawing graph of as well as with the number of iterations.**

**Linear Classification and Gradient Descent**

1. **Load the experiment data.**
2. **Divide dataset into training set and validation set.**
3. **Initialize SVM model parameters. You can choose to set all parameter into zero, initialize it randomly or with normal distribution.**
4. **Choose loss function and derivation.**
5. **Calculate gradient G toward loss function from all samples.**
6. **Denote the opposite direction of gradient G as D.**
7. **Update model:ηis learning rate, a hyper-parameter that we can adjust.**
8. **Select the appropriate threshold, mark the sample whose predict scores greater than the threshold as positive, on the contrary as negative. Get the loss under the trainin set and by validating under validation set.**
9. **Repeate step 5 to 8 for several times, and drawing graph of as well as with the number of iterations.**

**7. Code:**

**Show in the ClassificationExperiment.ipynb and the RegressionExperiment.ipynb.**

(Fill in the contents of 8-12 respectively for linear regression and linear classification)

**8. Selection of validation (hold-out, cross-validation, k-folds cross-validation, etc.):**

**（1）Linear Regression and Gradient Descent: hold-out**

**（2）Linear Classification and Gradient Descent：hold-out**

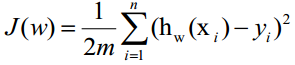
**9. The initialization method of model parameters:**

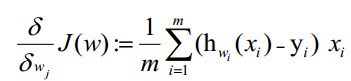
**（1）Linear Regression and Gradient Descent: normal distribution**

**（2）Linear Classification and Gradient Descent：normal distribution**

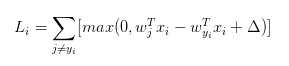
**10. The selected loss function and its derivatives:**

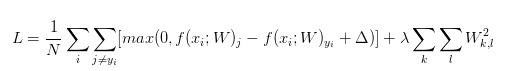
**（1）Linear Regression and Gradient Descent:**

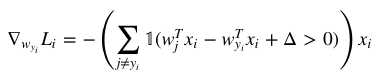




**（2）Linear Classification and Gradient Descent：**







**The function of 1(x) is the indicator function. If x is true, it is equal to 1, and if x is false, the function is 0.**

**11. Experimental results and curve:**

## Hyper-parameter selection (η, epoch, etc.):

1. **Linear Regression and Gradient Descent:**

η=0.01

epoch=30

1. **Linear Classification and Gradient Descent：**

η=0.01

epoch=30

regularization\_strengths = 1

## Assessment Results (based on selected validation):

**（1）Linear Regression and Gradient Descent:**

**（2）Linear Classification and Gradient Descent：**

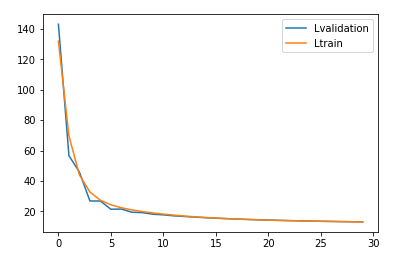
## Predicted Results (Best Results):

**（1）Linear Regression and Gradient Descent: Gradient Descent**

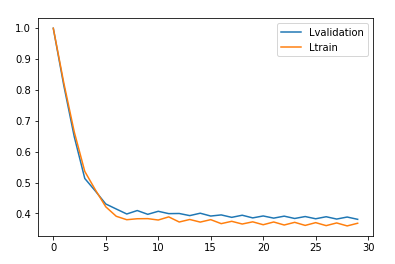
**（2）Linear Classification and Gradient Descent：Gradient Descent**

## Loss curve:

1. **Linear Regression and Gradient Descent:**

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1. **Linear Classification and Gradient Descent：**



**12. Results analysis:**

**（1）The convergence is about the same.**

**（2）Linear Regression just started out with a big loss error while Linear Classification started out with a small loss.**

**13. Similarities and differences between linear regression and linear classification:**

**Linear Regression is on the basis of regression while Linear Classification is based on the classification.** **Their loss function is different.** **But the solution to the problem is similar.** **And then we can get a better solution in the end.**

**14. Summary:**

**Linear Regression is on the basis of regression while Linear Classification is based on the classification.** **Their loss function is different.** **But the solution to the problem is similar.** **Results are affected by parameters.And then we can get a better solution in the end.**