Information

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Assignment07 : Logistic regression for a binary classification with a regularization
Deadline : May 14, 2020

Library

Data

Logistic regression

$$\hat{h} = \sigma(z)$$
$$z = g(x, y, \theta), \text{ where } g \text{ is a high dimensional function and } \theta \in \mathbb{R}^{24}$$
$$\hat{h} = (\hat{h}_{0,0}, \hat{h}_{0,1}, \ldots, \hat{h}_{n,n})$$
$$g(x, y, \theta) = \sum_{i=0}^{5} \sum_{j=0}^{i} \theta_{i,j} x^{i-j} y^{j}$$

Initial Value
$$\theta_{i,j} = 1.0, \text{ for all } i, j$$

$$\eta = 0.001$$
$$\lambda_1 = 0.01$$
$$\lambda_2 = 0.1$$

Objective Function

$$J(\theta) = \frac{1}{n} \sum_{i=1}^{n} \left[-h^{(i)} \log(\sigma(z^{(i)})) - (1 - h^{(i)}) \log(1 - \sigma(z^{(i)})) \right] + \lambda \frac{1}{2n} \left(\| \theta \|_2^2 \right) + \sum_{i=0}^{5} \sum_{j=0}^{i} \theta_{i,j}^2$$

Training Process - Gradient Descent

$$\theta_{i,j}^{t+1} = \theta_{i,j}^{t} - \eta \left[\frac{1}{n} \sum_{k=1}^{n} (\sigma(z_k) \cdot x_k^{i-j} y_k^{j} - h^{(k)}) \frac{\partial \sigma(z^{(k)})}{\partial \theta_{i,j}} + \lambda \theta_{i,j}^{t} \right], \text{ for all } i, j$$

Check the Convergence

Grid

Result

1. Training Data

Training Data

2. Training Error with Varying Regularization Parameters

Training Error

3. Values of the Chosen Regularization Parameters

4. Training Accuracy with Varying Regularization Parameters

Training Accuracy

5. Final Training Accuracy with Varying Regularization Parameters

6. Optimal Classifier with Varying Regularization Parameters Superimposed on the Training Data

Optimal Classifier Superimposed