DD2424 Assignment 2 Report (For Basic Part)

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1 Analytic Gradient Computations

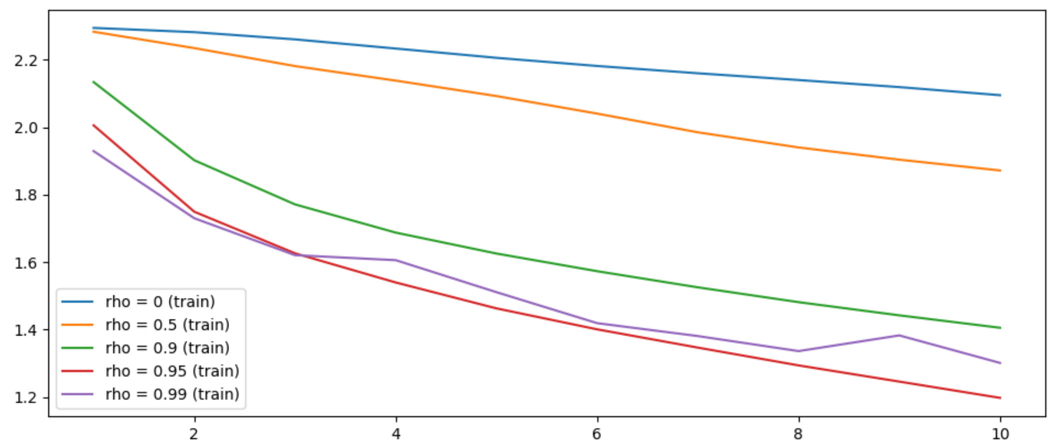
I wrote a function to compute the gradient numerically based on the centered difference formula. Then I use the first 10 data points and the first 400 dimensions as the data for gradient computing. The mean relative differents for b as W are shown below.

$$\text{When } \lambda = 0.1,\ \ e_W = 1.1353 \cdot 10^{-6},\ \ e_b = 3.2248 \cdot 10^{-6}$$
$$\text{When } \lambda = 0.0,\ \ e_W = 9.2920 \cdot 10^{-7},\ \ e_b = 3.2249 \cdot 10^{-6}$$

According to the result, the relative difference is acceptable (around 10^{-6}), which means the analytic gradient computations are correct.

2 Effect of Momentum

I train the network with `eta=0.01`, `n_epochs=10`, `lambda=1e-6`, `decay_rate=0.95`, `n_batch=100`, and the `momentem (rho)` is tested in $\{0, 0.5, 0.9, 0.95, 0.99\}$. The result of the experiments is shown below.



The results show that when `rho=0.95`, the training is boosted most because under same number of epochs, the train loss with momentum is less than the train loss without momentum. And whatever `rho` is applied, the training process is accelerated, which shows the positive effect of momentum.

3 Find `lambda` and `eta`

The range I searched for `lambda` and `eta` are $[10^{-6}, 10^{-2}]$ and $[10^{-3}, 0.04]$ respectively. I set the `n_epoch` as 10, and I calculate the accuracy on validation set for each hyper-parameter setting.

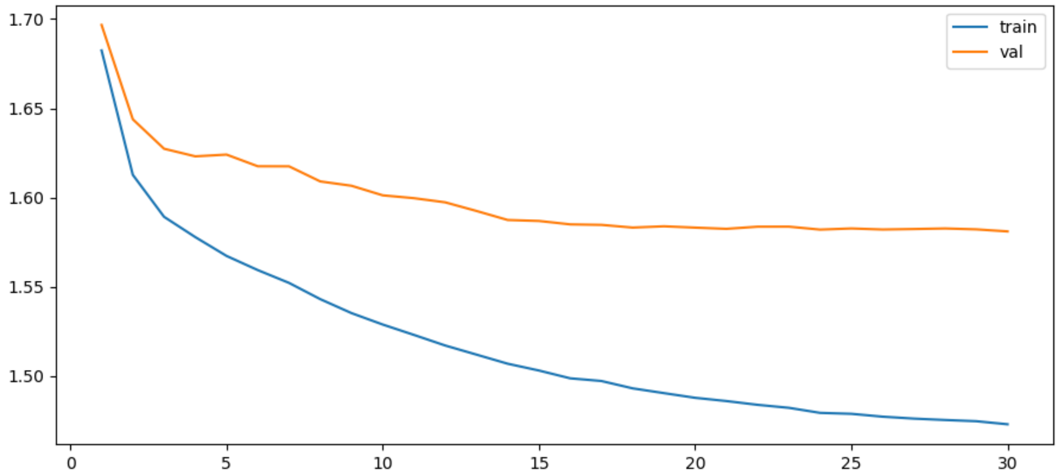
And the three best hyper-parameter settings are

```
Accuracy: 0.4472, lambda: 0.0023292248102687557, eta: 0.017453577972249945
Accuracy: 0.4437, lambda: 0.00590089433327251, eta: 0.013611753934771816
Accuracy: 0.4429, lambda: 0.0014195906437909028, eta: 0.018820783416993257
```

4 Train the Network

The hyperparameter setting is

```
lambda=0.0023292248102687557, eta=0.017453577972249945,
momemtum=0.95, weight_decay=0.95, n_batch=100, n_epoch=30
```



The accuracy on test set is 0.5127 after 30 epochs.