CS680, Spring 2020, Assignment 7

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June 29, 2020

Exercise 1

1.

$$t \quad \sqrt{\exp(s^2)} + \cos(\ln(1+s^2)) + 1 \tag{1}$$

2.

$$\frac{\partial t}{\partial s} \quad \frac{\partial t}{\partial d}\frac{\partial d}{\partial c}\frac{\partial c}{\partial a}\frac{\partial a}{\partial s} + \frac{\partial t}{\partial d}\frac{\partial d}{\partial b}\frac{\partial b}{\partial a}\frac{\partial a}{\partial s}$$

$$\begin{aligned} \frac{\partial t}{\partial d}\frac{\partial d}{\partial c}\frac{\partial c}{\partial a}\frac{\partial a}{\partial s} \quad & 2s\exp(s^2)\frac{1}{2}[\exp(s^2)]^{\frac{1}{2}} \\ \frac{\partial t}{\partial d}\frac{\partial d}{\partial b}\frac{\partial b}{\partial a}\frac{\partial a}{\partial s} \quad & 2s\frac{1}{1+s^2}\cdot -\sin(\ln(1+s^2)) \\ \frac{\partial t}{\partial s} \quad & s[\exp(s^2)]^{\frac{1}{2}} - \frac{2s\sin(\ln(1+s^2))}{1+s^2} \end{aligned} \tag{2}$$

Exercise 2

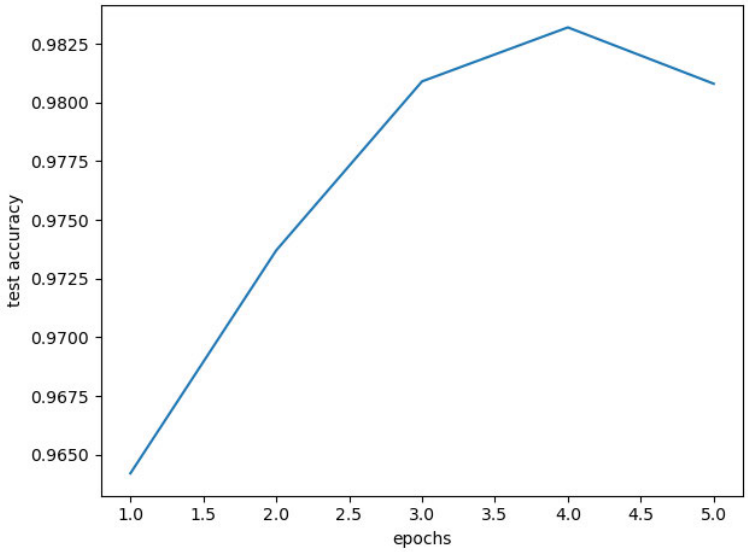

Figure 1: test accuracy vs the number of epochs

(a)

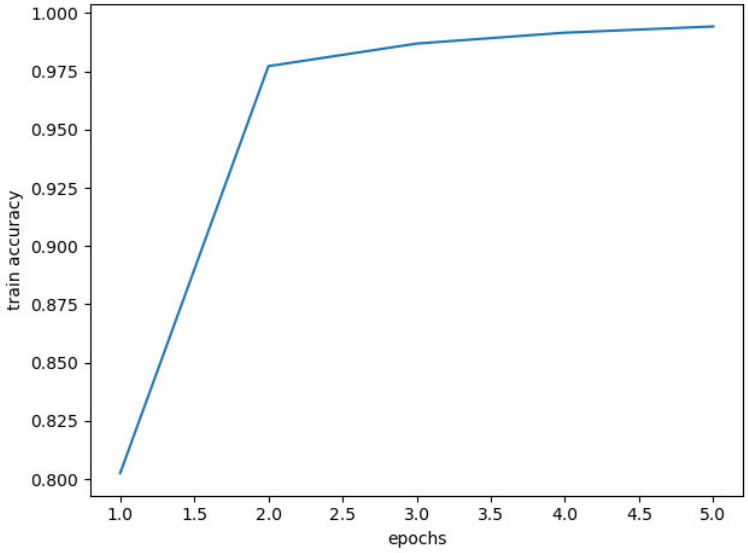

Figure 2: training accuracy vs the number of epochs

(b)

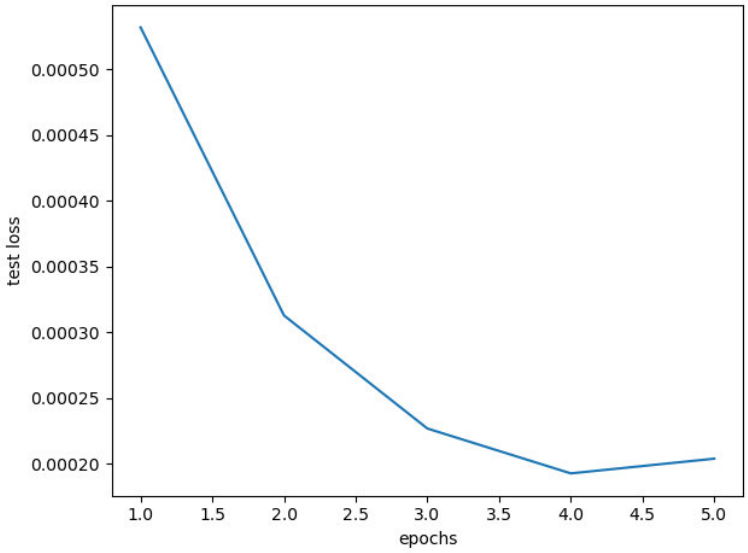

Figure 3: test loss vs the number of epochs

(c)

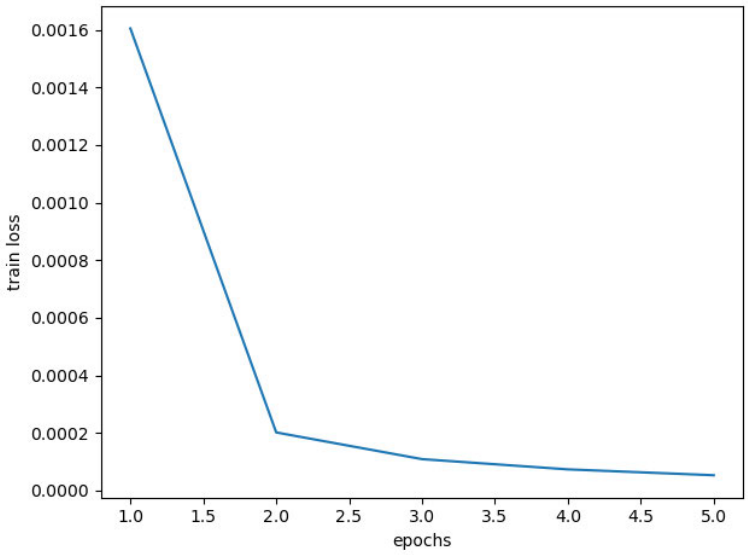

Figure 4: training loss vs the number of epochs

(d)

(e) After horizon flip, test accuracy: 0.325100

After vertical flip, test accuracy: 0.365400

As we can see from above results, the accuracy has decreased much.

(f) After adding 0.01 Gaussian noise, test accuracy: 0.948800

After adding 0.1 Gaussian noise, test accuracy: 0.307900

After adding 1.0 Gaussian noise, test accuracy: 0.119300

As we can see from above results, bigger the variance of Gaussian noise, lower the accuracy.

(g) After horizon flip, test accuracy: 0.947100

After vertical flip, test accuracy: 0.935700

After adding 0.01 Gaussian noise, test accuracy: 0.940300

After adding 0.1 Gaussian noise, test accuracy: 0.915400

After adding 1.0 Gaussian noise, test accuracy: 0.632200

In this case, the training data includes: original training data, horizontal flipped training data, vertical flipped training data, training data added 1.0 Gaussian noise. Therefore, we expand the datasets into 4 times bigger including flipping and noising, in this case, the model is more robust and accuracy has increased.