Chunyuan Shen

ID:801322013

Homework 5

<https://github.com/cryyin/ECGR5105/tree/main/homework5>

**Problem 1 (20 pts):**

In our temperature prediction example, let’s change our model to a non-linear system. Consider the following description for our model:

w2 \* t\_u \*\* 2 + w1 \* t\_u + b.

1.a Modify the training loop properly to accommodate this redefinition.



Graphical user interface, text, application

Description automatically generated

Modify the model and training.

1.b Use 5000 epochs for your training. Explore different learning rates from 0.1 to 0.0001 (you need four separate trainings). Report your loss for every 500 epochs per training.

Lr=0.1:

Graphical user interface, text, table

Description automatically generated

Lr=0.01:

Text

Description automatically generated

Lr=0.001:

Text

Description automatically generated

Lr=0.0001:

Text

Description automatically generated

1.c Pick the best non-linear model and compare your final best loss against the linear model that we did during the lecture. For this, visualize the non-linear model against the linear model over the input dataset, as we did during the lecture. Is the actual result better or worse than our baseline linear model?

The best one is learning\_rate = 0.001. The loss of it is only 2.8763

Chart, scatter chart

Description automatically generated

The non-linear model is better because it has a smaller loss.

**Problem 2 (30 pts):**

2.a. Develop preprocessing and a training loop to train a linear regression model that predicts housing price based on the following input variables:

area, bedrooms, bathrooms, stories, parking

For this, you need to use the housing dataset. For training and validation use 80% (training) and 20% (validation) split. Identify the best parameters for your linear regression model, based on the above input variables. In this case, you will have six parameters:

U=W5\*X5 + W4\*X4 + W3\*X3 + W2\*X2 + W1\*X1 + B

input variables:

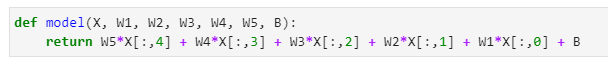
Graphical user interface, text, application, email

Description automatically generated

Split the dataset:



New model:



2.b Use 5000 epochs for your training. Explore different learning rates from 0.1 to 0.0001 (you need four separate trainings). Report your loss and validation accuracy for every 500 epochs per each training. Pick the best linear model.

Lr=0.1:

Text

Description automatically generated

Lr=0.01:

Text

Description automatically generated

Lr=0.001:

Text

Description automatically generated

Lr=0.0001:

Text, table

Description automatically generated

The best one is 0.1 and 0.01, they have the minimized loss.

**Problem 3 (50 pts):**

3.a Build a fully connected neural network for the housing dataset you did in previous problem. For training and validation use 80% (training) and 20% (validation) split. For this part, only use one hidden layer with 8 nodes. Train your network for 200 epochs. Report your training time, training loss, and evaluation accuracy after 200 epochs. Analyze your results in your report. Make sure to submit your code by providing the GitHub URL of your course repository for this course. (15pts)

8 nodes in 1 hidden layer:

Graphical user interface, text

Description automatically generated with medium confidence

Result:

Text, table

Description automatically generated

Because my learning rate is 0.1, it goes to the limit immediately. And because I used gpu to training it, time is 0.00s.

3.b Extend your network with two more additional hidden layers, like the example we did in lecture. Train your network for 200 epochs. Report your training time, training loss, and evaluation accuracy after 200 epochs. Analyze your results in your report. Make sure to submit your code by providing the GitHub URL of your course repository for this course. Analyze your results in your report and compare your model size and accuracy over the baseline implementation in Problem1. a. Do you see any over-fitting? Make sure to submit your code by providing the GitHub URL of your course repository for this course. (25pts)

2 more layers:

Graphical user interface

Description automatically generated with medium confidence

Result:

Text

Description automatically generated

Similar to the first one, is really quick for training. Compare with 1a the is a little over fitting. Valid loss is a little bit higher than training loss.