CSE 691 Assign2 Report

Lichen Liang

C:\Users\owner\AppData\Local\Programs\Python\Python38\python.exe
C:/Users/owner/PycharmProjects/CSE691/Assign2/runSvmSoftmax.py

2021-03-19 03:30:06.149059: W
tensorflow/stream_executor/platform/default/dso_loader.cc:60] Could not load dynamic library
'cudart64_110.dll'; dlerror: cudart64_110.dll not found

2021-03-19 03:30:06.149580: I tensorflow/stream_executor/cuda/cudart_stub.cc:29] Ignore
above cudart dlerror if you do not have a GPU set up on your machine.

Train image shape: (49000, 32, 32, 3)

Train label shape: (49000,)

Validate image shape: (1000, 32, 32, 3)

Validate label shape: (1000,)

Test image shape: (10000, 32, 32, 3)

Test label shape: (10000,)

Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for
integers).

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integers).

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integers).

Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for
integers).

Train image shape after add bias column: (49000, 3073)

Val image shape after add bias column: (1000, 3073)

Test image shape after add bias column: (10000, 3073)

###
################

Start training Svm classifier

Loop 0 loss 155259.70113113307

Loop 100 loss 20793.18446503861

Loop 200 loss 2788.0163496543623

Loop 300 loss 375.9542079779761

Loop 400 loss 54.81932068764688

Loop 500 loss 12.168973508619858

Loop 600 loss 6.420633665615709

Loop 700 loss 5.5873194923343465

Loop 800 loss 5.256993044586253

Loop 900 loss 5.754961294520025

Loop 1000 loss 5.8405756841239524

Loop 1100 loss 5.686799915617631

Loop 1200 loss 5.75986813502512

Loop 1300 loss 6.318270354710775

Loop 1400 loss 5.773198820948456

Training time: 12.578767538070679

Training acc: 35.54489795918367%

Validating acc: 36.5%

Testing acc: 35.27%

Finding best model for Svm classifier

Best validation accuracy: 37.5

Best Model parameter, lr = 1e-06, reg = 1000.0

Training acc: 36.587755102040816%

Validating acc: 37.5%

Testing acc: 35.709999999999994%

##
################

Start training Softmax classifier

Loop 0 loss 153041.18113655926

Loop 100 loss 20505.561222252723

Loop 200 loss 2747.334946289545

Loop 300 loss 369.3915204393883

Loop 400 loss 51.11475548524972

Loop 500 loss 8.707868588525088

Loop 600 loss 3.016918293777515

Loop 700 loss 2.261915391304855

Loop 800 loss 2.1799524461265105

Loop 900 loss 2.122997623612829

Loop 1000 loss 2.1828548320363175

Loop 1100 loss 2.1451021498167813

Loop 1200 loss 2.1277501533941594

Loop 1300 loss 2.176009951691508

Loop 1400 loss 2.1845005662527717

Training time: 12.392898321151733

Training acc: 30.761224489795918%

Validating acc: 32.800000000000004%

Testing acc: 31.259999999999998%

Finding best model for Softmax classifier

Best validation accuracy: 38.7

Best Model parameter, lr = 1e-06, reg = 5000.0

Training acc: 37.073469387755104%

Validating acc: 38.7%

Testing acc: 36.67%

Process finished with exit code 0

```
C:\Users\owner\AppData\Local\Programs\Python\Python38\python.exe C:/Users/owner/PycharmProjects/CSE691/Assign2/runSvmSoftmax.py
2021-03-19 03:30:06.149059: W tensorflow/stream_executor/platform/default/dso_loader.cc:60] Could not load dynamic library 'cudart64_110.dll'; dlerror: cudart64_110.dll not found
2021-03-19 03:30:06.149580: I tensorflow/stream_executor/cuda/cudart_stub.cc:29] Ignore above cudart dlerror if you do not have a GPU set up on your machine.
Train image shape:      (49000, 32, 32, 3)
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Validate label shape: (1000,)
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Test label shape:       (10000,)
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Val image shape after add bias column:     (1000, 3073)
Test image shape after add bias column:    (10000, 3073)


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Loop 1200 loss 5.75986813502512
Loop 1300 loss 6.318270354710775
Loop 1400 loss 5.773198820948456
Training time: 12.578767538070679
Training acc:   35.54489795918367%
Validating acc: 36.5%
Testing acc:    35.27%
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```
Finding best model for Svm classifier
Best validation accuracy: 37.5
Best Model parameter, lr = 1e-06, reg = 1000.0
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Finding best model for Softmax classifier
Best validation accuracy: 38.7
Best Model parameter, lr = 1e-06, reg = 5000.0
Training acc:    37.073469387755104%
Validating acc: 38.7%
Testing acc:     36.67%


Process finished with exit code 0
```

$$h_1 = x \cdot W_1 = \begin{bmatrix} 1 & 2 & 10 \end{bmatrix} \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 3 & 2 & 2 \end{bmatrix}$$

$$h_2 = h_1 \cdot W_2 = \begin{bmatrix} 3 & 2 & 2 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 5 & 5 \end{bmatrix}$$

$$z = h_2 \cdot W_3 = \begin{bmatrix} 5 & 5 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \end{bmatrix}$$

$$L = (z-y)^2 = (5-10)^2 = 25$$

$$\frac{dL}{dz} = 2(z-y) = 2(5-10) = -10$$

$$\frac{dL}{dh_2} = dz \cdot W_3^T = -10 \begin{bmatrix} 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & -10 \end{bmatrix}$$

$$\frac{dL}{dh_1} = dh_2 \cdot W_2^T = \begin{bmatrix} 0 & -10 \end{bmatrix} \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -10 & 0 & -10 \end{bmatrix}$$

$$\frac{dL}{dw_3} = dw_3 = h_2^T \cdot dz = \begin{bmatrix} 5 \\ 5 \end{bmatrix} (-10) = \begin{bmatrix} -50 \\ -50 \end{bmatrix}$$

$$\frac{dL}{dw_2} = dw_2 = h_1^T \cdot dh_2 = \begin{bmatrix} 3 \\ 2 \\ 2 \end{bmatrix} \begin{bmatrix} 0 & -10 \end{bmatrix} = \begin{bmatrix} 0 & -30 \\ 0 & -20 \\ 0 & -20 \end{bmatrix}$$

$$\frac{dL}{dw_1} = dw_1 = x^T \cdot dh_1 = \begin{bmatrix} 1 \\ 2 \\ 1 \\ 0 \end{bmatrix} \cdot \begin{bmatrix} -10 & 0 & -10 \end{bmatrix} = \begin{bmatrix} -10 & 0 & -10 \\ -20 & 0 & -20 \\ -10 & 0 & -10 \\ 0 & 0 & 0 \end{bmatrix}$$