

作业2: 复现AlexNet

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1 训练过程截图

运行

```
python train.py
```

采用10个epoch, 可以发现每一个epoch中平均损失逐渐减小, 在测试集合的正确率更加高.

一次运行的过程:

```
Train Epoch: 1 [0/60000] Loss: 2.300812
Train Epoch: 1 [6400/60000] Loss: 1.647611
Train Epoch: 1 [12800/60000] Loss: 0.143852
Train Epoch: 1 [19200/60000] Loss: 0.268812
Train Epoch: 1 [25600/60000] Loss: 0.256480
Train Epoch: 1 [32000/60000] Loss: 0.163040
Train Epoch: 1 [38400/60000] Loss: 0.157375
Train Epoch: 1 [44800/60000] Loss: 0.032016
Train Epoch: 1 [51200/60000] Loss: 0.313532
Train Epoch: 1 [57600/60000] Loss: 0.066230
```

```
Test set: Average loss: 0.0001, Accuracy: 9799/10000 (97.99%)
```

```
Train Epoch: 2 [0/60000] Loss: 0.028989
Train Epoch: 2 [6400/60000] Loss: 0.064333
Train Epoch: 2 [12800/60000] Loss: 0.105209
Train Epoch: 2 [19200/60000] Loss: 0.010947
Train Epoch: 2 [25600/60000] Loss: 0.086354
Train Epoch: 2 [32000/60000] Loss: 0.008573
Train Epoch: 2 [38400/60000] Loss: 0.002687
Train Epoch: 2 [44800/60000] Loss: 0.029918
Train Epoch: 2 [51200/60000] Loss: 0.039090
Train Epoch: 2 [57600/60000] Loss: 0.107383
```

```
Test set: Average loss: 0.0000, Accuracy: 9910/10000 (99.10%)
```

```
Train Epoch: 3 [0/60000] Loss: 0.010170
Train Epoch: 3 [6400/60000] Loss: 0.057094
Train Epoch: 3 [12800/60000] Loss: 0.039308
Train Epoch: 3 [19200/60000] Loss: 0.016330
Train Epoch: 3 [25600/60000] Loss: 0.024696
Train Epoch: 3 [32000/60000] Loss: 0.013844
Train Epoch: 3 [38400/60000] Loss: 0.017124
Train Epoch: 3 [44800/60000] Loss: 0.005656
Train Epoch: 3 [51200/60000] Loss: 0.014341
Train Epoch: 3 [57600/60000] Loss: 0.000749
```

```
Test set: Average loss: 0.0000, Accuracy: 9922/10000 (99.22%)
```

```
Train Epoch: 4 [0/60000] Loss: 0.013354
Train Epoch: 4 [6400/60000] Loss: 0.002395
Train Epoch: 4 [12800/60000] Loss: 0.002297
```

Train Epoch: 4 [19200/60000] Loss: 0.002719
Train Epoch: 4 [25600/60000] Loss: 0.047895
Train Epoch: 4 [32000/60000] Loss: 0.026449
Train Epoch: 4 [38400/60000] Loss: 0.007887
Train Epoch: 4 [44800/60000] Loss: 0.018707
Train Epoch: 4 [51200/60000] Loss: 0.003069
Train Epoch: 4 [57600/60000] Loss: 0.011861

Test set: Average loss: 0.0000, Accuracy: 9938/10000 (99.38%)

Train Epoch: 5 [0/60000] Loss: 0.050627
Train Epoch: 5 [6400/60000] Loss: 0.127905
Train Epoch: 5 [12800/60000] Loss: 0.003870
Train Epoch: 5 [19200/60000] Loss: 0.000574
Train Epoch: 5 [25600/60000] Loss: 0.010829
Train Epoch: 5 [32000/60000] Loss: 0.012679
Train Epoch: 5 [38400/60000] Loss: 0.017785
Train Epoch: 5 [44800/60000] Loss: 0.007716
Train Epoch: 5 [51200/60000] Loss: 0.012575
Train Epoch: 5 [57600/60000] Loss: 0.000207

Test set: Average loss: 0.0000, Accuracy: 9926/10000 (99.26%)

Train Epoch: 6 [0/60000] Loss: 0.024285
Train Epoch: 6 [6400/60000] Loss: 0.001571
Train Epoch: 6 [12800/60000] Loss: 0.000375
Train Epoch: 6 [19200/60000] Loss: 0.003859
Train Epoch: 6 [25600/60000] Loss: 0.001061
Train Epoch: 6 [32000/60000] Loss: 0.009940
Train Epoch: 6 [38400/60000] Loss: 0.000598
Train Epoch: 6 [44800/60000] Loss: 0.113665
Train Epoch: 6 [51200/60000] Loss: 0.002404
Train Epoch: 6 [57600/60000] Loss: 0.094093

Test set: Average loss: 0.0000, Accuracy: 9926/10000 (99.26%)

Train Epoch: 7 [0/60000] Loss: 0.009963
Train Epoch: 7 [6400/60000] Loss: 0.001771
Train Epoch: 7 [12800/60000] Loss: 0.001573
Train Epoch: 7 [19200/60000] Loss: 0.082411
Train Epoch: 7 [25600/60000] Loss: 0.047977
Train Epoch: 7 [32000/60000] Loss: 0.033230
Train Epoch: 7 [38400/60000] Loss: 0.002412
Train Epoch: 7 [44800/60000] Loss: 0.005507
Train Epoch: 7 [51200/60000] Loss: 0.011557
Train Epoch: 7 [57600/60000] Loss: 0.017860

Test set: Average loss: 0.0000, Accuracy: 9945/10000 (99.45%)

Train Epoch: 8 [0/60000] Loss: 0.003513
Train Epoch: 8 [6400/60000] Loss: 0.179183
Train Epoch: 8 [12800/60000] Loss: 0.000082
Train Epoch: 8 [19200/60000] Loss: 0.006674
Train Epoch: 8 [25600/60000] Loss: 0.000841
Train Epoch: 8 [32000/60000] Loss: 0.090951
Train Epoch: 8 [38400/60000] Loss: 0.001363

```

Train Epoch: 8 [44800/60000] Loss: 0.001896
Train Epoch: 8 [51200/60000] Loss: 0.001033
Train Epoch: 8 [57600/60000] Loss: 0.002773

Test set: Average loss: 0.0000, Accuracy: 9939/10000 (99.39%)

Train Epoch: 9 [0/60000] Loss: 0.007813
Train Epoch: 9 [6400/60000] Loss: 0.001135
Train Epoch: 9 [12800/60000] Loss: 0.000714
Train Epoch: 9 [19200/60000] Loss: 0.003064
Train Epoch: 9 [25600/60000] Loss: 0.004517
Train Epoch: 9 [32000/60000] Loss: 0.001455
Train Epoch: 9 [38400/60000] Loss: 0.024123
Train Epoch: 9 [44800/60000] Loss: 0.049417
Train Epoch: 9 [51200/60000] Loss: 0.023383
Train Epoch: 9 [57600/60000] Loss: 0.000900

Test set: Average loss: 0.0000, Accuracy: 9941/10000 (99.41%)

Train Epoch: 10 [0/60000] Loss: 0.000326
Train Epoch: 10 [6400/60000] Loss: 0.000279
Train Epoch: 10 [12800/60000] Loss: 0.000785
Train Epoch: 10 [19200/60000] Loss: 0.003784
Train Epoch: 10 [25600/60000] Loss: 0.000310
Train Epoch: 10 [32000/60000] Loss: 0.000165
Train Epoch: 10 [38400/60000] Loss: 0.001848
Train Epoch: 10 [44800/60000] Loss: 0.017060
Train Epoch: 10 [51200/60000] Loss: 0.000434
Train Epoch: 10 [57600/60000] Loss: 0.051113

Test set: Average loss: 0.0000, Accuracy: 9952/10000 (99.52%)

```

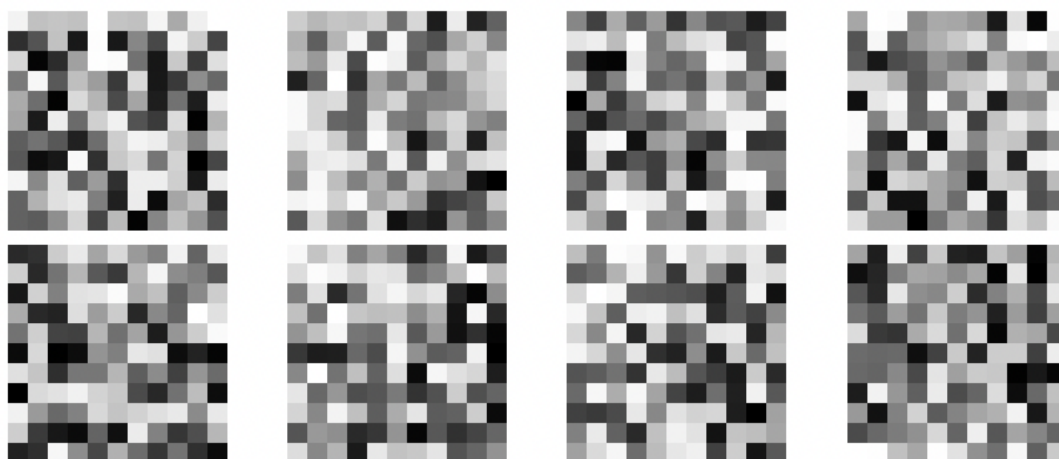
2 可视化卷积层的图像

运行

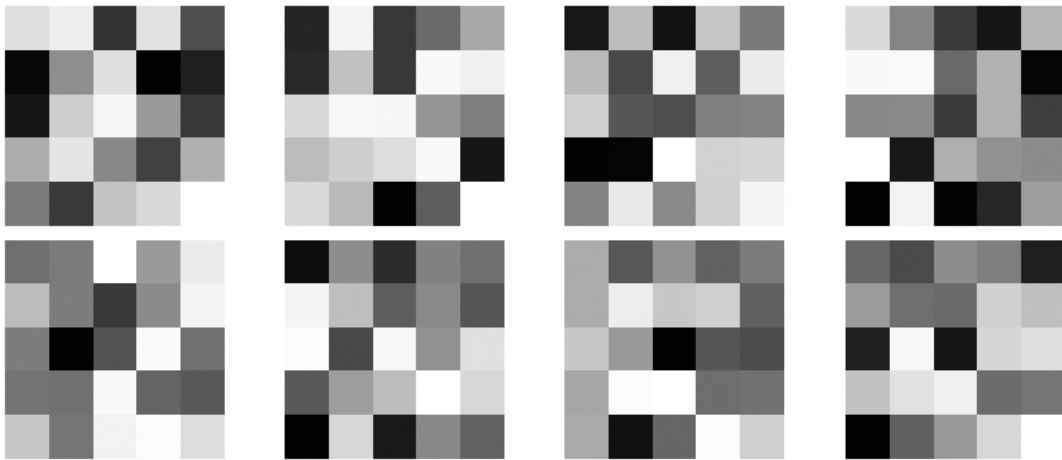
```
python show.py
```

就会使用matplotlib弹出窗口。

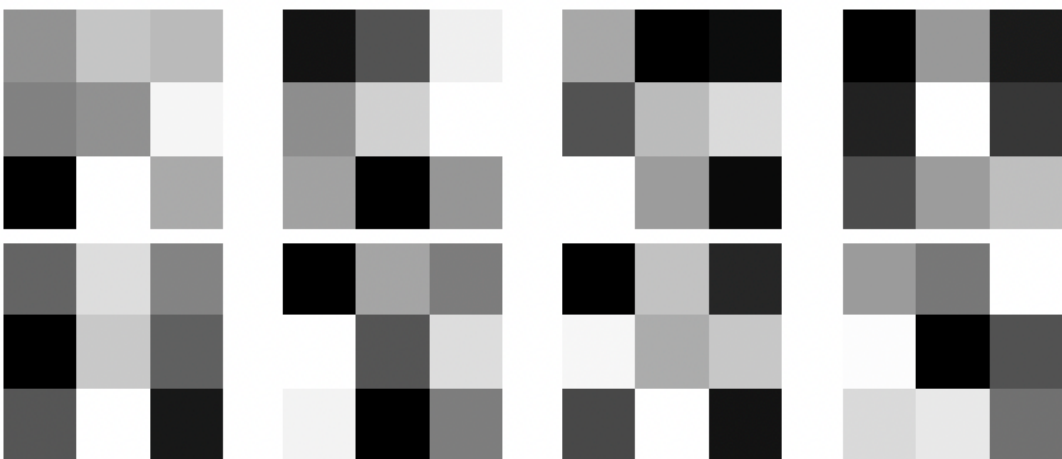
Conv Layer 1's first 8 filters (in_ch=0)



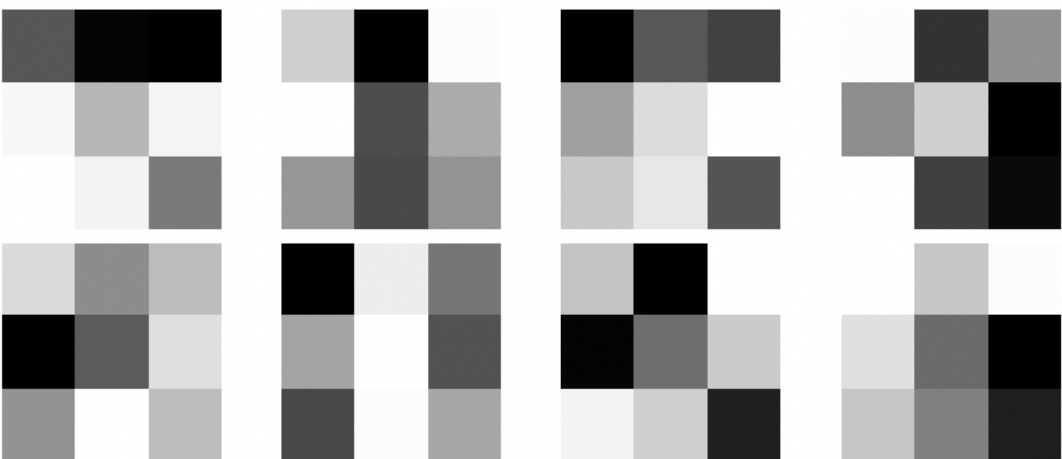
Conv Layer 2's first 8 filters (in_ch=0)



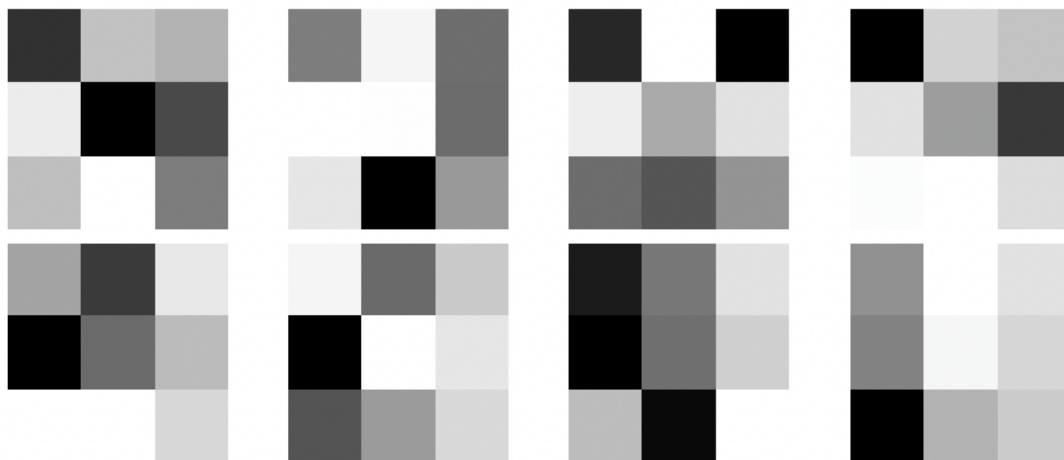
Conv Layer 3's first 8 filters (in_ch=0)



Conv Layer 4's first 8 filters (in_ch=0)



Conv Layer 5's first 8 filters (in_ch=0)



可见第一层某种程度上保留了一部分轮廓,但是与原图像的内容并不呈现一一对应;因此不具有可解释性.

3 不使用卷积网络的效果

采用MLP. 使用

```
python test-woutc.py
```

运行代码. 结果

```
Epoch 1 [0/938] Loss: 2.2919
Epoch 1 [200/938] Loss: 0.6793
Epoch 1 [400/938] Loss: 0.8996
Epoch 1 [600/938] Loss: 0.6023
Epoch 1 [800/938] Loss: 0.4253
Test Accuracy: 93.45%
Epoch 2 [0/938] Loss: 0.5495
Epoch 2 [200/938] Loss: 0.5307
Epoch 2 [400/938] Loss: 0.6009
Epoch 2 [600/938] Loss: 0.2643
Epoch 2 [800/938] Loss: 0.4459
Test Accuracy: 94.21%
Epoch 3 [0/938] Loss: 0.4852
Epoch 3 [200/938] Loss: 0.3926
Epoch 3 [400/938] Loss: 0.6544
Epoch 3 [600/938] Loss: 0.5307
Epoch 3 [800/938] Loss: 0.6120
Test Accuracy: 94.43%
```

Epoch 4 [0/938] Loss: 0.5218
Epoch 4 [200/938] Loss: 0.2916
Epoch 4 [400/938] Loss: 0.2371
Epoch 4 [600/938] Loss: 0.3928
Epoch 4 [800/938] Loss: 1.0279
Test Accuracy: 94.65%
Epoch 5 [0/938] Loss: 0.1669
Epoch 5 [200/938] Loss: 0.6917
Epoch 5 [400/938] Loss: 0.4362
Epoch 5 [600/938] Loss: 0.3818
Epoch 5 [800/938] Loss: 0.6231
Test Accuracy: 94.71%
Epoch 6 [0/938] Loss: 0.3754
Epoch 6 [200/938] Loss: 0.2932
Epoch 6 [400/938] Loss: 0.2496
Epoch 6 [600/938] Loss: 0.2493
Epoch 6 [800/938] Loss: 0.5280
Test Accuracy: 95.13%
Epoch 7 [0/938] Loss: 0.1927
Epoch 7 [200/938] Loss: 0.2722
Epoch 7 [400/938] Loss: 0.4495
Epoch 7 [600/938] Loss: 0.1859
Epoch 7 [800/938] Loss: 0.3549
Test Accuracy: 94.18%
Epoch 8 [0/938] Loss: 0.3406
Epoch 8 [200/938] Loss: 0.3077
Epoch 8 [400/938] Loss: 0.3514
Epoch 8 [600/938] Loss: 0.3857
Epoch 8 [800/938] Loss: 0.2748
Test Accuracy: 94.31%
Epoch 9 [0/938] Loss: 0.4019
Epoch 9 [200/938] Loss: 0.2828
Epoch 9 [400/938] Loss: 0.4446
Epoch 9 [600/938] Loss: 0.1556
Epoch 9 [800/938] Loss: 0.3359
Test Accuracy: 95.13%
Epoch 10 [0/938] Loss: 0.4766
Epoch 10 [200/938] Loss: 0.3913
Epoch 10 [400/938] Loss: 0.3861
Epoch 10 [600/938] Loss: 0.2253
Epoch 10 [800/938] Loss: 0.2099
Test Accuracy: 95.18%