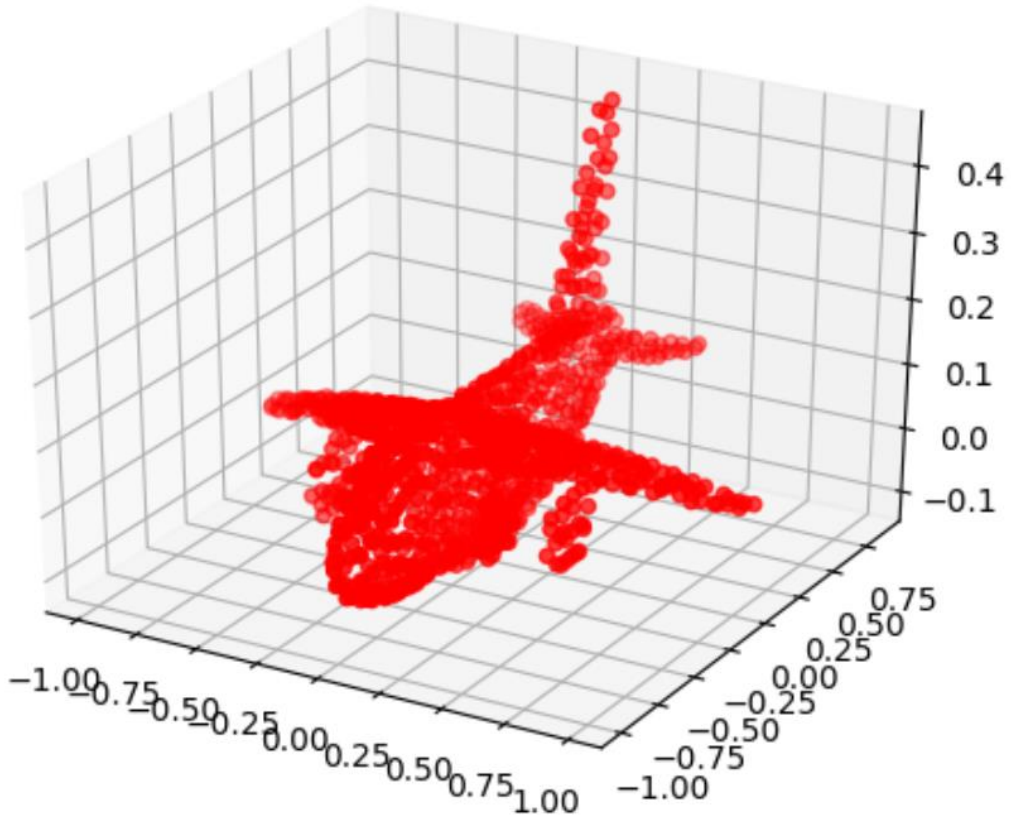
三维点云作业 第五章

学习了第五章的内容，了解了神经网络的思想

此前并不了解神经网络，从飞桨上寻找了开源的 PointNet 点云分类项目，进行了测试




```
物体标签: airplane , 预测标签: airplane
```

测试发现训练的模型能够正常对点云进行分类

网络构建代码为：

```python
class PointNet(nn.Layer):
    def __init__(self, num_classes=40, max_points=1024):
        super(PointNet, self).__init__()
        self.t_net1 = TNet(3, [3, 64, 128, 1024])
        self.fc1 = FC([1024, 512, 256, 9])
        self.mlp1 = MLP(2, [3, 64, 64])
        self.t_net2 = TNet(3, [64, 64, 128, 1024])
        self.fc2 = FC([1024, 512, 256, (64 * 64)])
        self.mlp2 = MLP(3, [64, 64, 128, 1024])
        self.fc3 = FC([1024, 512, 256, num_classes], True, True)
    def forward(self, x):
        batchsize = x.shape[0]
        t_net = self.t_net1(x)
        t_net = paddle.squeeze(t_net, axis=[-2, -1])
        t_net = self.fc1(t_net)
        t_net = paddle.reshape(t_net, [batchsize, 3, 3])
        x = paddle.squeeze(x, axis=-1)
        x = paddle.transpose(x, (0, 2, 1))
        x = paddle.matmul(x, t_net)
        x = paddle.transpose(x, (0, 2, 1))
        x = paddle.unsqueeze(x, axis=-1)
        x = self.mlp1(x)
        t_net = self.t_net2(x)
        t_net = paddle.squeeze(t_net, axis=[-2, -1])
        t_net = self.fc2(t_net)
        t_net = paddle.reshape(t_net, [batchsize, 64, 64])
        x = paddle.squeeze(x, axis=-1)
        x = paddle.transpose(x, (0, 2, 1))
        x = paddle.matmul(x, t_net)
        x = paddle.transpose(x, (0, 2, 1))
        x = paddle.unsqueeze(x, axis=-1)
        x = self.mlp2(x)
        x = paddle.max(x, axis=2)
        x = paddle.squeeze(x, axis=-1)
        x = self.fc3(x)
        return x
```

包含了两次 T-Net，三次 MLP，一次 maxpool，最后得到长度为总类别 num_classes 的一维向量，与课上讲的 PointNet 运行流程一致

训练的 epoch 为 40

训练完成后，查看模型输出的结果

```
物体标签: airplane , 预测标签: airplane
[[  0.       -31.734545 -30.30704  -41.272152 -45.163483 -42.511574
  -28.792522 -34.48369  -43.632324 -34.58648  -41.464516 -40.89577
  -56.51882  -50.501823 -58.665165 -33.119045 -47.339863 -31.436094
  -31.707914 -46.48326  -33.92519  -49.624138 -51.50315  -54.782272
  -47.07271  -40.78285  -24.370985 -36.116558 -39.082554 -37.267776
  -42.58355  -33.318504 -48.95818  -47.562717 -29.054142 -46.043846
  -41.154232 -38.603233 -59.965652 -47.20205 ]]
{0: 'airplane', 1: 'bathtub', 2: 'bed', 3: 'bench', 4: 'bookshelf', 5: 'bottle', 6: 'bowl', 7: 'car', 8: 'chair', 9: 'cone
', 10: 'cup', 11: 'curtain', 12: 'desk', 13: 'door', 14: 'dresser', 15: 'flower_pot', 16: 'glass_box', 17: 'guitar', 18: 'k
eyboard', 19: 'lamp', 20: 'laptop', 21: 'mantel', 22: 'monitor', 23: 'night_stand', 24: 'person', 25: 'piano', 26: 'plant',
27: 'radio', 28: 'range_hood', 29: 'sink', 30: 'sofa', 31: 'stairs', 32: 'stool', 33: 'table', 34: 'tent', 35: 'toilet', 3
6: 'tv_stand', 37: 'vase', 38: 'wardrobe', 39: 'xbox'}
```

查看训练 epoch 为 5 的模型输出的结果

```
[[-9.7287045e-04 -1.3861089e+01 -1.3002350e+01 -1.0891262e+01
  -1.8535578e+01 -1.8690281e+01 -1.7387182e+01 -1.5313787e+01
  -1.6300827e+01 -1.7001728e+01 -1.9681290e+01 -1.9202820e+01
  -2.0722713e+01 -2.0442043e+01 -2.2772810e+01 -1.5770840e+01
  -1.7827131e+01 -1.0199191e+01 -7.0122652e+00 -1.9722317e+01
  -1.6118011e+01 -2.0050219e+01 -1.6474895e+01 -2.3088608e+01
  -1.6172794e+01 -1.7007910e+01 -1.2454748e+01 -1.4540401e+01
  -1.7799904e+01 -1.5716690e+01 -1.2941409e+01 -1.2996185e+01
  -1.9273132e+01 -1.4600836e+01 -1.4950834e+01 -1.3719125e+01
  -1.4080736e+01 -1.6950298e+01 -2.1466949e+01 -1.9762653e+01]]
{0: 'airplane', 1: 'bathtub', 2: 'bed', 3: 'bench', 4: 'bookshelf', 5: 'bottle', 6: 'bowl', 7: 'car
', 8: 'chair', 9: 'cone', 10: 'cup', 11: 'curtain', 12: 'desk', 13: 'door', 14: 'dresser', 15: 'flo
wer_pot', 16: 'glass_box', 17: 'guitar', 18: 'keyboard', 19: 'lamp', 20: 'laptop', 21: 'mantel', 2
2: 'monitor', 23: 'night_stand', 24: 'person', 25: 'piano', 26: 'plant', 27: 'radio', 28: 'range_ho
od', 29: 'sink', 30: 'sofa', 31: 'stairs', 32: 'stool', 33: 'table', 34: 'tent', 35: 'toilet', 36:
'tv_stand', 37: 'vase', 38: 'wardrobe', 39: 'xbox'}
```

发现迭代 5 次后，评分较为集中，区分度不大

查看 epoch 为 20 的模型输出的结果

```
[[-4.7683704e-07 -2.2968834e+01 -1.9236492e+01 -2.2010851e+01
  -2.7416290e+01 -2.3973080e+01 -2.4903034e+01 -2.8132545e+01
  -2.2365894e+01 -2.4810123e+01 -2.6006168e+01 -2.5407467e+01
  -2.9488234e+01 -2.7470718e+01 -3.3447750e+01 -1.9614689e+01
  -2.9067385e+01 -1.4816441e+01 -1.7068449e+01 -2.8601952e+01
  -2.3524338e+01 -2.8409039e+01 -2.2950991e+01 -3.2656631e+01
  -2.2550821e+01 -2.5570150e+01 -1.6364422e+01 -2.0360176e+01
  -2.7325920e+01 -2.1860283e+01 -1.7779570e+01 -1.7838341e+01
  -3.0442612e+01 -2.4020004e+01 -2.4568430e+01 -2.3334255e+01
  -2.0212875e+01 -2.2231989e+01 -3.2664783e+01 -2.8738358e+01]]
{0: 'airplane', 1: 'bathtub', 2: 'bed', 3: 'bench', 4: 'bookshelf', 5: 'bottle', 6: 'bowl', 7: 'car
', 8: 'chair', 9: 'cone', 10: 'cup', 11: 'curtain', 12: 'desk', 13: 'door', 14: 'dresser', 15: 'flo
wer_pot', 16: 'glass_box', 17: 'guitar', 18: 'keyboard', 19: 'lamp', 20: 'laptop', 21: 'mantel', 2
2: 'monitor', 23: 'night_stand', 24: 'person', 25: 'piano', 26: 'plant', 27: 'radio', 28: 'range_ho
od', 29: 'sink', 30: 'sofa', 31: 'stairs', 32: 'stool', 33: 'table', 34: 'tent', 35: 'toilet', 36:
'tv_stand', 37: 'vase', 38: 'wardrobe', 39: 'xbox'}
```

发现迭代 20 次后评分区分度变高

综上，模型在训练时，会随着 epoch 变大逐渐收敛。根据实验结果认为模型搭建正确