# AI Lab1 Report

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## 1 实验环境

机器设备情况：RTX3090 x 1

所用语言：Python

库：anaconda python == 3.9

torch, numpy, sklearn

## 2 数据预处理及读取

### 2.1 MLP

读取.csv文件并存入.npy文件

```
train_path = r"..\data\Lab1_train.csv"
valid_path = r"..\data\Lab1_validation.csv"
test_path = r"..\data\Lab1_test.csv"

def load_data(mode):
    path = "data\Lab1_" + mode + ".csv"
    print(path)
    with open(path,encoding = 'utf-8') as f:
        content = np.loadtxt(f,str,delimiter = ",", skiprows = 1)
        feat = content[:,1:-1]
        label = content[:,-1]
    feat_path =  mode + "_feat" + ".npy"
    label_path =  mode + "_label" + ".npy"
    print("save...")
    # np.save(feat_path, feat)
    print("save...")
    # np.save(label_path, label)

# load_data("test")
# load_data("validation")
# load_data("train")
```

定义Dataset

```
class MyDataset(Dataset):
    def __init__(self, mode):
        super(MyDataset, self).__init__()
        feat_path = mode + "_feat.npy"
        label_path = mode + "_label.npy"
        feat = np.load(feat_path).astype(np.float)
        label = np.load(label_path).astype(np.float)
        self.feat = torch.from_numpy(feat)
        self.label = torch.from_numpy(label).long()

    def __getitem__(self, index):
        feat_ = self.feat[index]
        label_ = self.label[index]

        return feat_, label_

    def __len__(self):
        return len(self.label)
```

## 2.2 SVM

尝试了在整个数据集上进行训练，速度极慢。于是将数据集随机选出1/100作为新的数据集。也就是trainset 7k样本，validset 7k样本，testset 1k样本。记为"small_{}"feat/label,{}=train, validation, test

取1/100的代码：

```python
def get_small_data(rate, seed):
    setup_seed(seed)
    train_feat = np.load("train_feat.npy")
    train_label = np.load("train_label.npy")
    valid_feat = np.load("validation_feat.npy")
    valid_label = np.load("validation_label.npy")
    test_feat = np.load("test_feat.npy")
    test_label = np.load("test_label.npy")

    train_len = int(len(train_feat) * rate)
    valid_len = int(len(valid_feat) * rate)
    test_len = int(len(test_feat) * rate)

    select_train = random.sample(range(len(train_feat)), train_len)
    select_valid = random.sample(range(len(valid_feat)), valid_len)
    select_test = random.sample(range(len(test_feat)), test_len)

    new_train_feat = train_feat[select_train]
    new_train_label = train_label[select_train]
    new_valid_feat = valid_feat[select_valid]
    new_valid_label = valid_label[select_valid]
    new_test_feat = test_feat[select_test]
    new_test_label = test_label[select_test]

    new_train_feat_path = "small_train_feat" + ".npy"
    new_train_label_path = "small_train_label" + ".npy"
    new_valid_feat_path = "small_validation_feat" + ".npy"
    new_valid_label_path = "small_validation_label" + ".npy"
    new_test_feat_path = "small_test_feat" + ".npy"
    new_test_label_path = "small_test_label" + ".npy"

    np.save(new_train_feat_path, new_train_feat)
    np.save(new_train_label_path, new_train_label)
    np.save(new_valid_feat_path, new_valid_feat)
    np.save(new_valid_label_path, new_valid_label)
    np.save(new_test_feat_path, new_test_feat)
    np.save(new_test_label_path, new_test_label)

    return new_train_feat, new_train_label, new_valid_feat, new_valid_label, new_test_feat, new_test_label
```

# 3 训练过程

## 3.1 主要函数

### 3.1.1 MLP

1. init dataset和model

```python
def init_config(model, train_ds:str, valid_ds:str, bsz:int, learning_rate:float, device, idx):
    log(idx)
    setup_seed(42)
    logging.info("loading data...")
    print("loading data...")
    train_set = MyDataset(train_ds)
    valid_set = MyDataset(valid_ds)
    logging.info("loaded!")
    print("loaded!")
    train_loader = DataLoader(dataset = train_set, batch_size = bsz, shuffle=True)
    valid_loader = DataLoader(dataset = valid_set, batch_size = bsz, shuffle=True)
    Optim_SGD = torch.optim.SGD(model.parameters(), lr = learning_rate)
    CE_Loss = nn.CrossEntropyLoss().to(device)
    logging.info("initialize!")
    print("initialize!")
    # train_loop(MLPmodel, test_loader, valid_loader, Optim_SGD, CE_Loss, 10, device)
    return train_loader, valid_loader, Optim_SGD, CE_Loss
```

2. train

```python
def train_loop(model, train_loader, valid_loader, optimizer, criterion, epochs, device, idx):
    log(idx)
    logging.info("start training!")
    print("start training!")
    for epoch in range(epochs):
        for idx, (data, target) in enumerate(train_loader):
            data = data.to(device)
            target = target.to(device)
            optimizer.zero_grad()
            logits = model(data)
            loss = criterion(logits, target)
            loss.backward()
            optimizer.step()
            if(idx % 100 == 0):
                t_accs, t_f1, t_fpr, t_tpr, t_auc = eval(model, train_loader, device, idx)
                acuracy, F1, FPR, TPR, AUC = eval(model, valid_loader, device, idx)
                logging.info("train: epoch{}, idx{}: F1:{:.5f} accs{:.5f}".format(str(epoch), str(idx), t_f1, t_accs))
                logging.info("eval: epoch{}, idx{}: F1:{:.5f} accs{:.5f}".format(str(epoch), str(idx), F1, acuracy))
                print("epoch{}, idx{}: F1:{:.5f} accs{:.5f}".format(str(epoch), str(idx), F1, acuracy))
    return model
```

3. eval

```python
def eval(model, data_loader, device, idx):
    log(idx)
    model.eval()
    for i, (x, y) in enumerate(data_loader):
        x = Variable(x.to(device))
        logits = F.softmax(model(x),dim = -1)
        _, y_hat = logits.topk(1, dim = -1)
        y_hat = y_hat.cpu().numpy()
        y = y.numpy()
        accs = accuracy_score(y, y_hat)
        f1 = f1_score(y, y_hat, average="binary")
        fpr, tpr, threshold = roc_curve(y, y_hat)
        scale = auc(fpr, tpr)
    return accs, f1, fpr, tpr, scale
```

### 3.1.2 SVM

```python
# load train and validation data
print("Loading data...")
logging.info("Loading data...")
train_feat = np.load('train_feat.npy')
train_label = np.load('train_label.npy')
valid_feat = np.load('validation_feat.npy')
valid_label = np.load('validation_label.npy')
print("Data loaded.")
logging.info("Data loaded.")

print("Training SVM...")
logging.info("Training SVM...")
model.fit(train_feat, train_label)

print("SVM inference...")
logging.info("SVM inference...")
t_label = model.predict(train_feat)
pre_label = model.predict(valid_feat)

t_accs = accuracy_score(train_label, t_label)
accs = accuracy_score(valid_label, pre_label)
t_f1 = f1_score(train_label, t_label, average='binary')
f1 = f1_score(valid_label, pre_label, average="binary")
# fpr, tpr, threshold = roc_curve(y, y_hat)
# scale = auc(fpr, tpr)


logging.info("train: F1:{:.5f} accs{:.5f}".format(t_f1, t_accs))
logging.info("eval: F1:{:.5f} accs{:.5f}".format(f1, accs))

print("train: F1:{:.5f} accs{:.5f}".format(t_f1, t_accs))
print("eval: F1:{:.5f} accs{:.5f}".format(f1, accs))
```

## 3.2 训练及调参过程

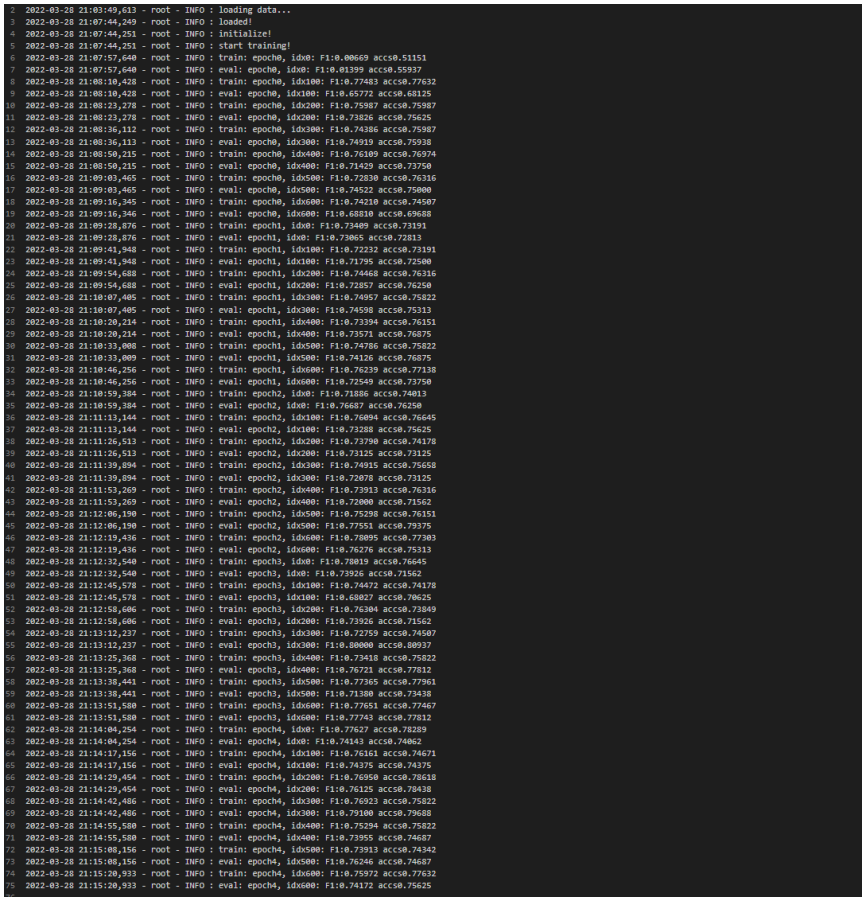
60分内容均有完成

### 3.2.1 MLP2

1. 第一次实验超参数：

   batch_size: 1024, learning_rate: 0.50, max_epoch: 5, activator: sigmoid, layer_list: [285, 16, 2]

2. 第一次实验结果：



```
2022-03-28 21:03:49,613 - root - INFO : loading data...
2022-03-28 21:07:44,249 - root - INFO : loaded!
2022-03-28 21:07:44,251 - root - INFO : initialize!
2022-03-28 21:07:44,251 - root - INFO : start training!
2022-03-28 21:07:57,640 - root - INFO : train: epoch0, idx0: F1:0.00669 accs0.51151
2022-03-28 21:07:57,640 - root - INFO : eval: epoch0, idx0: F1:0.01399 accs0.55937
2022-03-28 21:08:10,428 - root - INFO : train: epoch0, idx100: F1:0.77483 accs0.77632
2022-03-28 21:08:10,428 - root - INFO : eval: epoch0, idx100: F1:0.65772 accs0.68125
2022-03-28 21:08:23,278 - root - INFO : train: epoch0, idx200: F1:0.75987 accs0.75987
2022-03-28 21:08:23,278 - root - INFO : eval: epoch0, idx200: F1:0.73826 accs0.75625
2022-03-28 21:08:36,112 - root - INFO : train: epoch0, idx300: F1:0.74386 accs0.75987
2022-03-28 21:08:36,113 - root - INFO : eval: epoch0, idx300: F1:0.74919 accs0.75938
2022-03-28 21:08:50,215 - root - INFO : train: epoch0, idx400: F1:0.76109 accs0.76974
2022-03-28 21:08:50,215 - root - INFO : eval: epoch0, idx400: F1:0.71429 accs0.73750
2022-03-28 21:09:03,465 - root - INFO : train: epoch0, idx500: F1:0.72830 accs0.76316
2022-03-28 21:09:03,465 - root - INFO : eval: epoch0, idx500: F1:0.74522 accs0.75000
2022-03-28 21:09:16,345 - root - INFO : train: epoch0, idx600: F1:0.74210 accs0.74507
2022-03-28 21:09:16,346 - root - INFO : eval: epoch0, idx600: F1:0.68810 accs0.69688
2022-03-28 21:09:28,876 - root - INFO : train: epoch1, idx0: F1:0.73409 accs0.73191
2022-03-28 21:09:28,876 - root - INFO : eval: epoch1, idx0: F1:0.73065 accs0.72813
2022-03-28 21:09:41,948 - root - INFO : train: epoch1, idx100: F1:0.72232 accs0.73191
2022-03-28 21:09:41,948 - root - INFO : eval: epoch1, idx100: F1:0.71795 accs0.72500
2022-03-28 21:09:54,688 - root - INFO : train: epoch1, idx200: F1:0.74468 accs0.76316
2022-03-28 21:09:54,688 - root - INFO : eval: epoch1, idx200: F1:0.72857 accs0.76250
2022-03-28 21:10:07,405 - root - INFO : train: epoch1, idx300: F1:0.74957 accs0.75822
2022-03-28 21:10:07,405 - root - INFO : eval: epoch1, idx300: F1:0.74598 accs0.75313
2022-03-28 21:10:20,214 - root - INFO : train: epoch1, idx400: F1:0.73394 accs0.76151
2022-03-28 21:10:20,214 - root - INFO : eval: epoch1, idx400: F1:0.73571 accs0.76875
2022-03-28 21:10:33,008 - root - INFO : train: epoch1, idx500: F1:0.74786 accs0.75822
2022-03-28 21:10:33,009 - root - INFO : eval: epoch1, idx500: F1:0.74126 accs0.76875
2022-03-28 21:10:46,256 - root - INFO : train: epoch1, idx600: F1:0.76239 accs0.77138
2022-03-28 21:10:46,256 - root - INFO : eval: epoch1, idx600: F1:0.72549 accs0.73750
2022-03-28 21:10:59,384 - root - INFO : train: epoch2, idx0: F1:0.71886 accs0.74013
2022-03-28 21:10:59,384 - root - INFO : eval: epoch2, idx0: F1:0.76687 accs0.76250
2022-03-28 21:11:13,144 - root - INFO : train: epoch2, idx100: F1:0.76094 accs0.76645
2022-03-28 21:11:13,144 - root - INFO : eval: epoch2, idx100: F1:0.73288 accs0.75625
2022-03-28 21:11:26,513 - root - INFO : train: epoch2, idx200: F1:0.73790 accs0.74178
2022-03-28 21:11:26,513 - root - INFO : eval: epoch2, idx200: F1:0.73125 accs0.73125
2022-03-28 21:11:39,894 - root - INFO : train: epoch2, idx300: F1:0.74915 accs0.75658
2022-03-28 21:11:39,894 - root - INFO : eval: epoch2, idx300: F1:0.72078 accs0.73125
2022-03-28 21:11:53,269 - root - INFO : train: epoch2, idx400: F1:0.73913 accs0.76316
2022-03-28 21:11:53,269 - root - INFO : eval: epoch2, idx400: F1:0.72000 accs0.71562
2022-03-28 21:12:06,190 - root - INFO : train: epoch2, idx500: F1:0.75298 accs0.76151
2022-03-28 21:12:06,190 - root - INFO : eval: epoch2, idx500: F1:0.77551 accs0.79375
2022-03-28 21:12:19,436 - root - INFO : train: epoch2, idx600: F1:0.73095 accs0.77303
2022-03-28 21:12:19,436 - root - INFO : eval: epoch2, idx600: F1:0.76276 accs0.75313
2022-03-28 21:12:32,540 - root - INFO : train: epoch3, idx0: F1:0.78019 accs0.76645
2022-03-28 21:12:32,540 - root - INFO : eval: epoch3, idx0: F1:0.73926 accs0.71562
2022-03-28 21:12:45,578 - root - INFO : train: epoch3, idx100: F1:0.74472 accs0.74178
2022-03-28 21:12:45,578 - root - INFO : eval: epoch3, idx100: F1:0.68027 accs0.70625
2022-03-28 21:12:58,606 - root - INFO : train: epoch3, idx200: F1:0.76304 accs0.73849
2022-03-28 21:12:58,606 - root - INFO : eval: epoch3, idx200: F1:0.73926 accs0.71562
2022-03-28 21:13:12,237 - root - INFO : train: epoch3, idx300: F1:0.72759 accs0.74507
2022-03-28 21:13:12,237 - root - INFO : eval: epoch3, idx300: F1:0.80000 accs0.80937
2022-03-28 21:13:25,368 - root - INFO : train: epoch3, idx400: F1:0.73418 accs0.75822
2022-03-28 21:13:25,368 - root - INFO : eval: epoch3, idx400: F1:0.76721 accs0.77812
2022-03-28 21:13:38,441 - root - INFO : train: epoch3, idx500: F1:0.77365 accs0.77961
2022-03-28 21:13:38,441 - root - INFO : eval: epoch3, idx500: F1:0.71308 accs0.73438
2022-03-28 21:13:51,580 - root - INFO : train: epoch3, idx600: F1:0.77651 accs0.77467
2022-03-28 21:13:51,580 - root - INFO : eval: epoch3, idx600: F1:0.77743 accs0.77812
2022-03-28 21:14:04,254 - root - INFO : train: epoch4, idx0: F1:0.77627 accs0.78289
2022-03-28 21:14:04,254 - root - INFO : eval: epoch4, idx0: F1:0.74143 accs0.74062
2022-03-28 21:14:17,156 - root - INFO : train: epoch4, idx100: F1:0.76161 accs0.74671
2022-03-28 21:14:17,156 - root - INFO : eval: epoch4, idx100: F1:0.74375 accs0.74375
2022-03-28 21:14:29,454 - root - INFO : train: epoch4, idx200: F1:0.76950 accs0.78618
2022-03-28 21:14:29,454 - root - INFO : eval: epoch4, idx200: F1:0.76125 accs0.78438
2022-03-28 21:14:42,486 - root - INFO : train: epoch4, idx300: F1:0.76923 accs0.75822
2022-03-28 21:14:42,486 - root - INFO : eval: epoch4, idx300: F1:0.79100 accs0.79688
2022-03-28 21:14:55,580 - root - INFO : train: epoch4, idx400: F1:0.75294 accs0.75822
2022-03-28 21:14:55,580 - root - INFO : eval: epoch4, idx400: F1:0.73955 accs0.74687
2022-03-28 21:15:08,156 - root - INFO : train: epoch4, idx500: F1:0.73913 accs0.74342
2022-03-28 21:15:08,156 - root - INFO : eval: epoch4, idx500: F1:0.76246 accs0.74687
2022-03-28 21:15:20,933 - root - INFO : train: epoch4, idx600: F1:0.75972 accs0.77632
2022-03-28 21:15:20,933 - root - INFO : eval: epoch4, idx600: F1:0.74172 accs0.75625
```

3. 结果分析及超参数选择：

   train和eval都逐渐收敛

   但F1 score和accuracy都存在一定抖动，同时F1 score和accuracy无法到达很高的数值

   因此存在问题：无法收敛到最优的点

   针对这种情况，采取以下超参数调整办法：

   (a) 适当降低lr，如0.5->0.4

   (b) 增大某些层神经元数量，让网络学到更多、更细致的特征，利于提高F1 score

4. 第二次实验超参数：

   batch_size: 1024, learning_rate: 0.40, max_epoch: 5, activator: sigmoid, layer_list: [285, 32, 2]

5. 第二次实验结果：

```
2022-03-28 22:37:04,660 - root - INFO : train: epoch1, idx0: F1:0.72277 accs0.72368
2022-03-28 22:37:04,660 - root - INFO : eval: epoch1, idx0: F1:0.72727 accs0.72813
2022-03-28 22:37:17,897 - root - INFO : train: epoch1, idx100: F1:0.71795 accs0.72862
2022-03-28 22:37:17,897 - root - INFO : eval: epoch1, idx100: F1:0.70968 accs0.71875
2022-03-28 22:37:31,341 - root - INFO : train: epoch1, idx200: F1:0.74427 accs0.76151
2022-03-28 22:37:31,341 - root - INFO : eval: epoch1, idx200: F1:0.74126 accs0.76875
2022-03-28 22:37:44,315 - root - INFO : train: epoch1, idx300: F1:0.74788 accs0.75493
2022-03-28 22:37:44,315 - root - INFO : eval: epoch1, idx300: F1:0.74522 accs0.75000
2022-03-28 22:37:57,213 - root - INFO : train: epoch1, idx400: F1:0.73394 accs0.76151
2022-03-28 22:37:57,214 - root - INFO : eval: epoch1, idx400: F1:0.74021 accs0.77187
2022-03-28 22:38:10,510 - root - INFO : train: epoch1, idx500: F1:0.74957 accs0.75822
2022-03-28 22:38:10,510 - root - INFO : eval: epoch1, idx500: F1:0.74740 accs0.77187
2022-03-28 22:38:23,568 - root - INFO : train: epoch1, idx600: F1:0.76239 accs0.77138
2022-03-28 22:38:23,569 - root - INFO : eval: epoch1, idx600: F1:0.72131 accs0.73438
2022-03-28 22:38:36,405 - root - INFO : train: epoch2, idx0: F1:0.71813 accs0.74178
2022-03-28 22:38:36,405 - root - INFO : eval: epoch2, idx0: F1:0.76543 accs0.76250
2022-03-28 22:38:49,467 - root - INFO : train: epoch2, idx100: F1:0.75885 accs0.76480
2022-03-28 22:38:49,467 - root - INFO : eval: epoch2, idx100: F1:0.73720 accs0.75938
2022-03-28 22:39:02,579 - root - INFO : train: epoch2, idx200: F1:0.73579 accs0.74013
2022-03-28 22:39:02,579 - root - INFO : eval: epoch2, idx200: F1:0.73125 accs0.73125
2022-03-28 22:39:15,971 - root - INFO : train: epoch2, idx300: F1:0.75127 accs0.75822
2022-03-28 22:39:15,971 - root - INFO : eval: epoch2, idx300: F1:0.72492 accs0.73438
2022-03-28 22:39:29,395 - root - INFO : train: epoch2, idx400: F1:0.73588 accs0.76151
2022-03-28 22:39:29,395 - root - INFO : eval: epoch2, idx400: F1:0.71827 accs0.71562
2022-03-28 22:39:42,607 - root - INFO : train: epoch2, idx500: F1:0.75556 accs0.76480
2022-03-28 22:39:42,608 - root - INFO : eval: epoch2, idx500: F1:0.77133 accs0.79063
2022-03-28 22:39:55,598 - root - INFO : train: epoch2, idx600: F1:0.77636 accs0.76974
2022-03-28 22:39:55,598 - root - INFO : eval: epoch2, idx600: F1:0.75758 accs0.75000
2022-03-28 22:40:08,335 - root - INFO : train: epoch3, idx0: F1:0.77743 accs0.76645
2022-03-28 22:40:08,335 - root - INFO : eval: epoch3, idx0: F1:0.74487 accs0.72813
2022-03-28 22:40:21,000 - root - INFO : train: epoch3, idx100: F1:0.74593 accs0.74342
2022-03-28 22:40:21,000 - root - INFO : eval: epoch3, idx100: F1:0.67808 accs0.70625
2022-03-28 22:40:33,771 - root - INFO : train: epoch3, idx200: F1:0.75749 accs0.73355
2022-03-28 22:40:33,771 - root - INFO : eval: epoch3, idx200: F1:0.75000 accs0.73125
2022-03-28 22:40:46,301 - root - INFO : train: epoch3, idx300: F1:0.73205 accs0.74836
2022-03-28 22:40:46,301 - root - INFO : eval: epoch3, idx300: F1:0.79739 accs0.80625
2022-03-28 22:40:58,880 - root - INFO : train: epoch3, idx400: F1:0.73609 accs0.75822
2022-03-28 22:40:58,880 - root - INFO : eval: epoch3, idx400: F1:0.76471 accs0.77500
2022-03-28 22:41:11,252 - root - INFO : train: epoch3, idx500: F1:0.77496 accs0.78125
2022-03-28 22:41:11,252 - root - INFO : eval: epoch3, idx500: F1:0.71864 accs0.74062
2022-03-28 22:41:23,609 - root - INFO : train: epoch3, idx600: F1:0.78289 accs0.78289
2022-03-28 22:41:23,609 - root - INFO : eval: epoch3, idx600: F1:0.77743 accs0.77812
2022-03-28 22:41:35,843 - root - INFO : train: epoch4, idx0: F1:0.77342 accs0.78125
2022-03-28 22:41:35,843 - root - INFO : eval: epoch4, idx0: F1:0.73750 accs0.73750
2022-03-28 22:41:48,403 - root - INFO : train: epoch4, idx100: F1:0.75767 accs0.74013
2022-03-28 22:41:48,403 - root - INFO : eval: epoch4, idx100: F1:0.75155 accs0.75000
2022-03-28 22:42:00,702 - root - INFO : train: epoch4, idx200: F1:0.77622 accs0.78947
2022-03-28 22:42:00,702 - root - INFO : eval: epoch4, idx200: F1:0.76552 accs0.78750
2022-03-28 22:42:13,329 - root - INFO : train: epoch4, idx300: F1:0.77044 accs0.75987
2022-03-28 22:42:13,329 - root - INFO : eval: epoch4, idx300: F1:0.79487 accs0.80000
2022-03-28 22:42:25,588 - root - INFO : train: epoch4, idx400: F1:0.75465 accs0.76151
2022-03-28 22:42:25,588 - root - INFO : eval: epoch4, idx400: F1:0.73955 accs0.74687
2022-03-28 22:42:37,909 - root - INFO : train: epoch4, idx500: F1:0.74124 accs0.74507
2022-03-28 22:42:37,910 - root - INFO : eval: epoch4, idx500: F1:0.76023 accs0.74375
2022-03-28 22:42:50,255 - root - INFO : train: epoch4, idx600: F1:0.76106 accs0.77796
2022-03-28 22:42:50,255 - root - INFO : eval: epoch4, idx600: F1:0.74667 accs0.76250
```

稳定性和F1 score都有一定提升

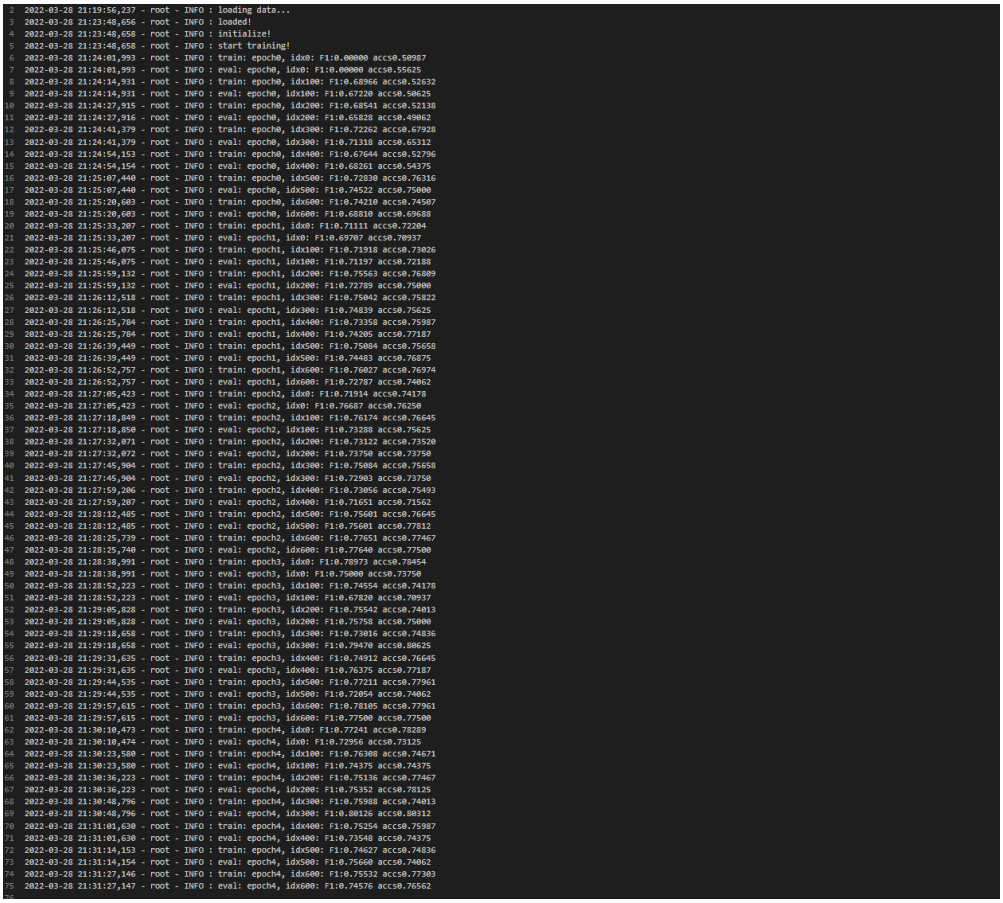
选择第二次实验的模型在test集上进行测试

### 3.2.2 MLP3

1. 第一次实验超参数：

   batch_size: 1024, learning_rate: 0.50, max_epoch: 5, activator: sigmoid, layer_list: [285, 64, 8, 2]

2. 第一次实验结果：



```
2022-03-28 21:19:56,237 - root - INFO : loading data...
2022-03-28 21:23:48,656 - root - INFO : loaded!
2022-03-28 21:23:48,658 - root - INFO : initialize!
2022-03-28 21:23:48,658 - root - INFO : start training!
2022-03-28 21:24:01,993 - root - INFO : train: epoch0, idx0: F1:0.00000 accs0.50987
2022-03-28 21:24:01,993 - root - INFO : eval: epoch0, idx0: F1:0.00000 accs0.55625
2022-03-28 21:24:14,931 - root - INFO : train: epoch0, idx100: F1:0.68966 accs0.52632
2022-03-28 21:24:14,931 - root - INFO : eval: epoch0, idx100: F1:0.67220 accs0.50625
2022-03-28 21:24:27,915 - root - INFO : train: epoch0, idx200: F1:0.68541 accs0.52138
2022-03-28 21:24:27,916 - root - INFO : eval: epoch0, idx200: F1:0.65828 accs0.49062
2022-03-28 21:24:41,379 - root - INFO : train: epoch0, idx300: F1:0.72262 accs0.67928
2022-03-28 21:24:41,379 - root - INFO : eval: epoch0, idx300: F1:0.71318 accs0.65312
2022-03-28 21:24:54,153 - root - INFO : train: epoch0, idx400: F1:0.67644 accs0.52796
2022-03-28 21:24:54,154 - root - INFO : eval: epoch0, idx400: F1:0.68261 accs0.54375
2022-03-28 21:25:07,440 - root - INFO : train: epoch0, idx500: F1:0.72830 accs0.76316
2022-03-28 21:25:07,440 - root - INFO : eval: epoch0, idx500: F1:0.74522 accs0.75000
2022-03-28 21:25:20,603 - root - INFO : train: epoch0, idx600: F1:0.74210 accs0.74507
2022-03-28 21:25:20,603 - root - INFO : eval: epoch0, idx600: F1:0.68810 accs0.69688
2022-03-28 21:25:33,207 - root - INFO : train: epoch1, idx0: F1:0.71111 accs0.72204
2022-03-28 21:25:33,207 - root - INFO : eval: epoch1, idx0: F1:0.69707 accs0.70937
2022-03-28 21:25:46,075 - root - INFO : train: epoch1, idx100: F1:0.71918 accs0.73026
2022-03-28 21:25:46,075 - root - INFO : eval: epoch1, idx100: F1:0.71197 accs0.72188
2022-03-28 21:25:59,132 - root - INFO : train: epoch1, idx200: F1:0.75563 accs0.76809
2022-03-28 21:25:59,132 - root - INFO : eval: epoch1, idx200: F1:0.72789 accs0.75000
2022-03-28 21:26:12,518 - root - INFO : train: epoch1, idx300: F1:0.75042 accs0.75822
2022-03-28 21:26:12,518 - root - INFO : eval: epoch1, idx300: F1:0.74839 accs0.75625
2022-03-28 21:26:25,784 - root - INFO : train: epoch1, idx400: F1:0.73358 accs0.75987
2022-03-28 21:26:25,784 - root - INFO : eval: epoch1, idx400: F1:0.74205 accs0.77187
2022-03-28 21:26:39,449 - root - INFO : train: epoch1, idx500: F1:0.75084 accs0.75658
2022-03-28 21:26:39,449 - root - INFO : eval: epoch1, idx500: F1:0.74483 accs0.76875
2022-03-28 21:26:52,757 - root - INFO : train: epoch1, idx600: F1:0.76027 accs0.76974
2022-03-28 21:26:52,757 - root - INFO : eval: epoch1, idx600: F1:0.72787 accs0.74062
2022-03-28 21:27:05,423 - root - INFO : train: epoch2, idx0: F1:0.71914 accs0.74178
2022-03-28 21:27:05,423 - root - INFO : eval: epoch2, idx0: F1:0.76687 accs0.76250
2022-03-28 21:27:18,849 - root - INFO : train: epoch2, idx100: F1:0.76174 accs0.76645
2022-03-28 21:27:18,850 - root - INFO : eval: epoch2, idx100: F1:0.73288 accs0.75625
2022-03-28 21:27:32,071 - root - INFO : train: epoch2, idx200: F1:0.73122 accs0.73520
2022-03-28 21:27:32,072 - root - INFO : eval: epoch2, idx200: F1:0.73750 accs0.73750
2022-03-28 21:27:45,904 - root - INFO : train: epoch2, idx300: F1:0.75084 accs0.75658
2022-03-28 21:27:45,904 - root - INFO : eval: epoch2, idx300: F1:0.72903 accs0.73750
2022-03-28 21:27:59,206 - root - INFO : train: epoch2, idx400: F1:0.73056 accs0.75493
2022-03-28 21:27:59,207 - root - INFO : eval: epoch2, idx400: F1:0.71651 accs0.71562
2022-03-28 21:28:12,485 - root - INFO : train: epoch2, idx500: F1:0.75601 accs0.76645
2022-03-28 21:28:12,485 - root - INFO : eval: epoch2, idx500: F1:0.75601 accs0.77812
2022-03-28 21:28:25,739 - root - INFO : train: epoch2, idx600: F1:0.77651 accs0.77467
2022-03-28 21:28:25,740 - root - INFO : eval: epoch2, idx600: F1:0.77640 accs0.77500
2022-03-28 21:28:38,991 - root - INFO : train: epoch3, idx0: F1:0.78973 accs0.78454
2022-03-28 21:28:38,991 - root - INFO : eval: epoch3, idx0: F1:0.75000 accs0.73750
2022-03-28 21:28:52,223 - root - INFO : train: epoch3, idx100: F1:0.74554 accs0.74178
2022-03-28 21:28:52,223 - root - INFO : eval: epoch3, idx100: F1:0.67820 accs0.70937
2022-03-28 21:29:05,828 - root - INFO : train: epoch3, idx200: F1:0.76542 accs0.74013
2022-03-28 21:29:05,828 - root - INFO : eval: epoch3, idx200: F1:0.75758 accs0.75000
2022-03-28 21:29:18,658 - root - INFO : train: epoch3, idx300: F1:0.73016 accs0.74836
2022-03-28 21:29:18,658 - root - INFO : eval: epoch3, idx300: F1:0.79470 accs0.80625
2022-03-28 21:29:31,635 - root - INFO : train: epoch3, idx400: F1:0.74912 accs0.76645
2022-03-28 21:29:31,635 - root - INFO : eval: epoch3, idx400: F1:0.76375 accs0.77187
2022-03-28 21:29:44,535 - root - INFO : train: epoch3, idx500: F1:0.77211 accs0.77961
2022-03-28 21:29:44,535 - root - INFO : eval: epoch3, idx500: F1:0.72054 accs0.74062
2022-03-28 21:29:57,615 - root - INFO : train: epoch3, idx600: F1:0.78105 accs0.77961
2022-03-28 21:29:57,615 - root - INFO : eval: epoch3, idx600: F1:0.77500 accs0.77500
2022-03-28 21:30:10,473 - root - INFO : train: epoch4, idx0: F1:0.77241 accs0.78289
2022-03-28 21:30:10,474 - root - INFO : eval: epoch4, idx0: F1:0.72956 accs0.73125
2022-03-28 21:30:23,580 - root - INFO : train: epoch4, idx100: F1:0.76308 accs0.74671
2022-03-28 21:30:23,580 - root - INFO : eval: epoch4, idx100: F1:0.74375 accs0.74375
2022-03-28 21:30:36,223 - root - INFO : train: epoch4, idx200: F1:0.76136 accs0.77467
2022-03-28 21:30:36,223 - root - INFO : eval: epoch4, idx200: F1:0.75352 accs0.78125
2022-03-28 21:30:48,796 - root - INFO : train: epoch4, idx300: F1:0.75988 accs0.74013
2022-03-28 21:30:48,796 - root - INFO : eval: epoch4, idx300: F1:0.80126 accs0.80312
2022-03-28 21:31:01,630 - root - INFO : train: epoch4, idx400: F1:0.75254 accs0.75987
2022-03-28 21:31:01,630 - root - INFO : eval: epoch4, idx400: F1:0.73548 accs0.74375
2022-03-28 21:31:14,153 - root - INFO : train: epoch4, idx500: F1:0.74627 accs0.74836
2022-03-28 21:31:14,154 - root - INFO : eval: epoch4, idx500: F1:0.75660 accs0.74062
2022-03-28 21:31:27,146 - root - INFO : train: epoch4, idx600: F1:0.75532 accs0.77303
2022-03-28 21:31:27,147 - root - INFO : eval: epoch4, idx600: F1:0.74576 accs0.76562
```

3. 结果分析及超参数选择：

   train和eval都逐渐收敛

   但F1 score和accuracy都存在一定抖动

   因此存在问题：无法收敛到最优的点

   针对这种情况，采取以下超参数调整办法：

   (a) 适当降低lr，如0.5->0.3

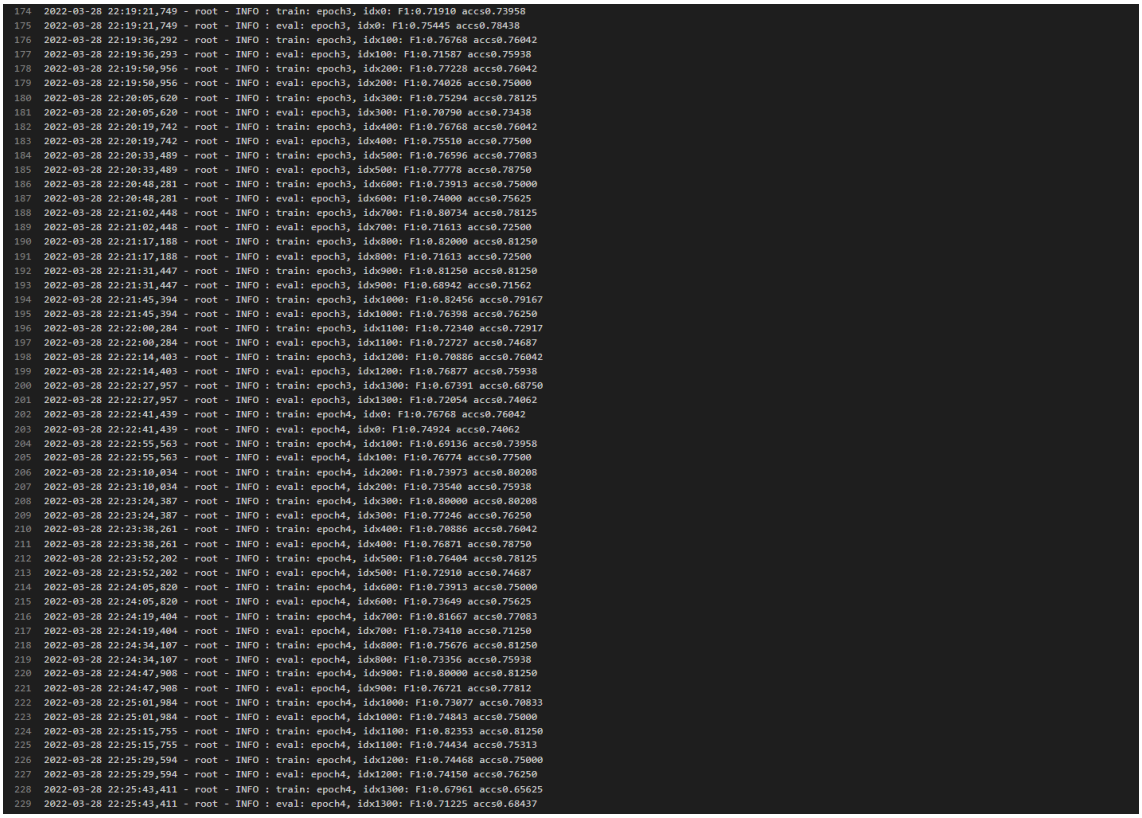
   (b) 适当减小batchszie，防止bsz大、lr小从而导致收敛到局部最优

   (c) 增大某些层神经元数量，让网络学到更多、更细致的特征，利于提高F1 score

4. 第二次实验超参数：

   batch_size: 512, learning_rate: 0.30, max_epoch: 5, activator: sigmoid, layer_list: [285, 128, 16, 2]

5. 第二次实验结果：




F1 score最大值超过了第一次试验，但稳定性没有提升。

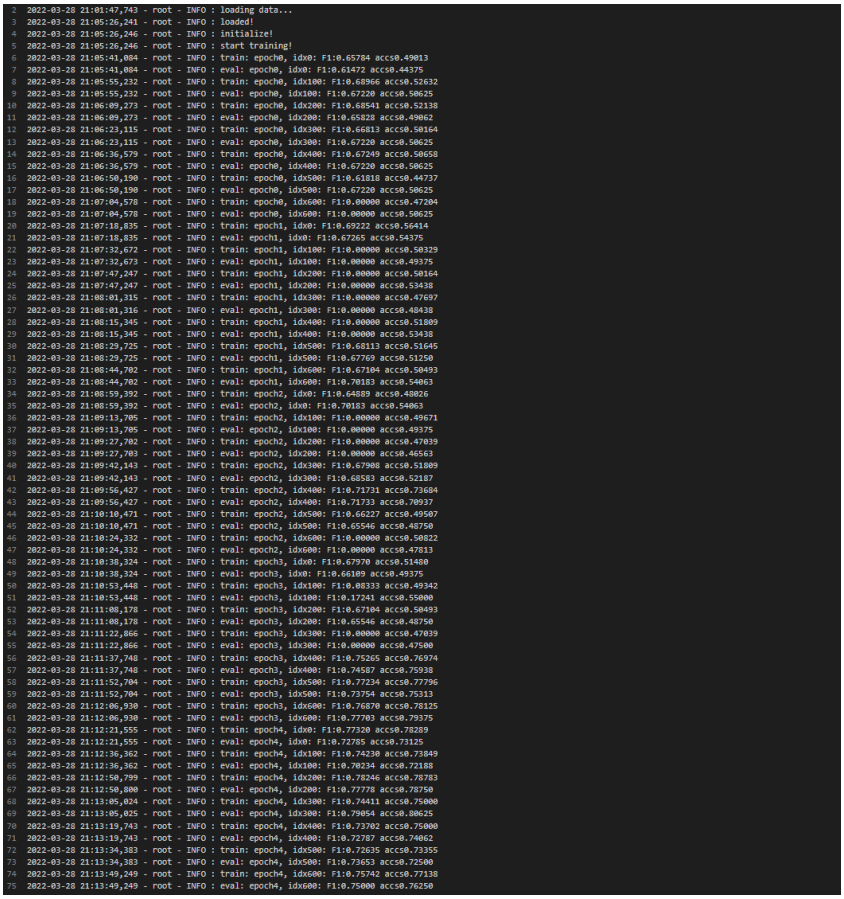
选择第二次实验的模型在test集上进行测试。

### 3.2.3 MLP4

1. 第一次实验超参数：

   batch_size: 1024, learning_rate: 0.50, max_epoch: 5, activator: sigmoid, layer_list: [285, 128, 64, 8, 2]

2. 第一次实验结果：



```
2022-03-28 21:01:47,743 - root - INFO : loading data...
2022-03-28 21:05:26,241 - root - INFO : loaded!
2022-03-28 21:05:26,246 - root - INFO : initialize!
2022-03-28 21:05:26,246 - root - INFO : start training!
2022-03-28 21:05:41,084 - root - INFO : train: epoch0, idx0: F1:0.65784 accs0.49013
2022-03-28 21:05:41,084 - root - INFO : eval: epoch0, idx0: F1:0.61472 accs0.44375
2022-03-28 21:05:55,232 - root - INFO : train: epoch0, idx100: F1:0.68966 accs0.52632
2022-03-28 21:05:55,232 - root - INFO : eval: epoch0, idx100: F1:0.67220 accs0.50625
2022-03-28 21:06:09,273 - root - INFO : train: epoch0, idx200: F1:0.68541 accs0.52138
2022-03-28 21:06:09,273 - root - INFO : eval: epoch0, idx200: F1:0.65828 accs0.49062
2022-03-28 21:06:23,115 - root - INFO : train: epoch0, idx300: F1:0.66813 accs0.50164
2022-03-28 21:06:23,115 - root - INFO : eval: epoch0, idx300: F1:0.67220 accs0.50625
2022-03-28 21:06:36,579 - root - INFO : train: epoch0, idx400: F1:0.67249 accs0.50658
2022-03-28 21:06:36,579 - root - INFO : eval: epoch0, idx400: F1:0.67220 accs0.50625
2022-03-28 21:06:50,190 - root - INFO : train: epoch0, idx500: F1:0.61818 accs0.44737
2022-03-28 21:06:50,190 - root - INFO : eval: epoch0, idx500: F1:0.67220 accs0.50625
2022-03-28 21:07:04,578 - root - INFO : train: epoch0, idx600: F1:0.00000 accs0.47204
2022-03-28 21:07:04,578 - root - INFO : eval: epoch0, idx600: F1:0.00000 accs0.50625
2022-03-28 21:07:18,835 - root - INFO : train: epoch1, idx0: F1:0.69222 accs0.56414
2022-03-28 21:07:18,835 - root - INFO : eval: epoch1, idx0: F1:0.67265 accs0.54375
2022-03-28 21:07:32,672 - root - INFO : train: epoch1, idx100: F1:0.00000 accs0.50329
2022-03-28 21:07:32,673 - root - INFO : eval: epoch1, idx100: F1:0.00000 accs0.49375
2022-03-28 21:07:47,247 - root - INFO : train: epoch1, idx200: F1:0.00000 accs0.50164
2022-03-28 21:07:47,247 - root - INFO : eval: epoch1, idx200: F1:0.00000 accs0.53438
2022-03-28 21:08:01,315 - root - INFO : train: epoch1, idx300: F1:0.00000 accs0.47697
2022-03-28 21:08:01,316 - root - INFO : eval: epoch1, idx300: F1:0.00000 accs0.48438
2022-03-28 21:08:15,345 - root - INFO : train: epoch1, idx400: F1:0.00000 accs0.51809
2022-03-28 21:08:15,345 - root - INFO : eval: epoch1, idx400: F1:0.00000 accs0.53438
2022-03-28 21:08:29,725 - root - INFO : train: epoch1, idx500: F1:0.68113 accs0.51645
2022-03-28 21:08:29,725 - root - INFO : eval: epoch1, idx500: F1:0.67769 accs0.51250
2022-03-28 21:08:44,702 - root - INFO : train: epoch1, idx600: F1:0.67104 accs0.50493
2022-03-28 21:08:44,702 - root - INFO : eval: epoch1, idx600: F1:0.70183 accs0.54063
2022-03-28 21:08:59,392 - root - INFO : train: epoch2, idx0: F1:0.64889 accs0.48026
2022-03-28 21:08:59,392 - root - INFO : eval: epoch2, idx0: F1:0.70183 accs0.54063
2022-03-28 21:09:13,705 - root - INFO : train: epoch2, idx100: F1:0.00000 accs0.49671
2022-03-28 21:09:13,705 - root - INFO : eval: epoch2, idx100: F1:0.00000 accs0.49375
2022-03-28 21:09:27,703 - root - INFO : train: epoch2, idx200: F1:0.00000 accs0.47039
2022-03-28 21:09:27,703 - root - INFO : eval: epoch2, idx200: F1:0.00000 accs0.46563
2022-03-28 21:09:42,143 - root - INFO : train: epoch2, idx300: F1:0.67908 accs0.51809
2022-03-28 21:09:42,143 - root - INFO : eval: epoch2, idx300: F1:0.68583 accs0.52187
2022-03-28 21:09:56,427 - root - INFO : train: epoch2, idx400: F1:0.71731 accs0.73684
2022-03-28 21:09:56,427 - root - INFO : eval: epoch2, idx400: F1:0.71733 accs0.70937
2022-03-28 21:10:10,471 - root - INFO : train: epoch2, idx500: F1:0.66227 accs0.49507
2022-03-28 21:10:10,471 - root - INFO : eval: epoch2, idx500: F1:0.65546 accs0.48750
2022-03-28 21:10:24,332 - root - INFO : train: epoch2, idx600: F1:0.00000 accs0.50822
2022-03-28 21:10:24,332 - root - INFO : eval: epoch2, idx600: F1:0.00000 accs0.47813
2022-03-28 21:10:38,324 - root - INFO : train: epoch3, idx0: F1:0.67970 accs0.51480
2022-03-28 21:10:38,324 - root - INFO : eval: epoch3, idx0: F1:0.66109 accs0.49375
2022-03-28 21:10:53,448 - root - INFO : train: epoch3, idx100: F1:0.08333 accs0.49342
2022-03-28 21:10:53,448 - root - INFO : eval: epoch3, idx100: F1:0.17241 accs0.55000
2022-03-28 21:11:08,178 - root - INFO : train: epoch3, idx200: F1:0.67104 accs0.50493
2022-03-28 21:11:08,178 - root - INFO : eval: epoch3, idx200: F1:0.65546 accs0.48750
2022-03-28 21:11:22,866 - root - INFO : train: epoch3, idx300: F1:0.00000 accs0.47039
2022-03-28 21:11:22,866 - root - INFO : eval: epoch3, idx300: F1:0.00000 accs0.47500
2022-03-28 21:11:37,748 - root - INFO : train: epoch3, idx400: F1:0.75265 accs0.76974
2022-03-28 21:11:37,748 - root - INFO : eval: epoch3, idx400: F1:0.74587 accs0.75938
2022-03-28 21:11:52,704 - root - INFO : train: epoch3, idx500: F1:0.77234 accs0.77796
2022-03-28 21:11:52,704 - root - INFO : eval: epoch3, idx500: F1:0.73754 accs0.75313
2022-03-28 21:12:06,930 - root - INFO : train: epoch3, idx600: F1:0.76670 accs0.78125
2022-03-28 21:12:06,930 - root - INFO : eval: epoch3, idx600: F1:0.77703 accs0.79375
2022-03-28 21:12:21,555 - root - INFO : train: epoch4, idx0: F1:0.77320 accs0.78289
2022-03-28 21:12:21,555 - root - INFO : eval: epoch4, idx0: F1:0.72785 accs0.73125
2022-03-28 21:12:36,362 - root - INFO : train: epoch4, idx100: F1:0.74230 accs0.73849
2022-03-28 21:12:36,362 - root - INFO : eval: epoch4, idx100: F1:0.70234 accs0.72188
2022-03-28 21:12:50,799 - root - INFO : train: epoch4, idx200: F1:0.78246 accs0.78783
2022-03-28 21:12:50,800 - root - INFO : eval: epoch4, idx200: F1:0.77778 accs0.78750
2022-03-28 21:13:05,024 - root - INFO : train: epoch4, idx300: F1:0.74411 accs0.75000
2022-03-28 21:13:05,025 - root - INFO : eval: epoch4, idx300: F1:0.79054 accs0.80625
2022-03-28 21:13:19,743 - root - INFO : train: epoch4, idx400: F1:0.73702 accs0.75000
2022-03-28 21:13:19,743 - root - INFO : eval: epoch4, idx400: F1:0.72787 accs0.74062
2022-03-28 21:13:34,383 - root - INFO : train: epoch4, idx500: F1:0.72635 accs0.73355
2022-03-28 21:13:34,383 - root - INFO : eval: epoch4, idx500: F1:0.73653 accs0.72500
2022-03-28 21:13:49,249 - root - INFO : train: epoch4, idx600: F1:0.75742 accs0.77138
2022-03-28 21:13:49,249 - root - INFO : eval: epoch4, idx600: F1:0.75000 accs0.76250
```

3. 结果分析及超参数选择：

   F1 score始终有较大的抖动，甚至经常出现0

   同时accuary也存在抖动。直到epoch4之后，F1 score和accuracy才上到一个较高的数值
   因此存在问题有：

   (a) lr太大，导致前期一直没有学习到什么，后期也存在一定抖动
   (b) 2.存在几次F1 score为0的情况，说明存在较严重的过拟合现象

   针对这种情况，采取以下超参数调整办法：

   (a) 适当降低lr，如0.5->0.3
   (b) 适当增大batchszie，避免出现学到某个batch的局部特征，从而导致F1骤降的情况发生
   (c) 将激活函数换为relu,降低过拟合现象
   (d) 减小某些层神经元数量，目的是让网络学到更精炼、更高层的特征，提高泛化性，避免学到某些层特征时导致F1骤降的情况发生

4. 第二次实验超参数：

   batch_size: 512, learning_rate: 0.30, max_epoch: 5, activator: sigmoid, layer_list: [285, 128, 16, 2]

5. 第二次实验结果：

```
2022-03-28 22:44:29,443 - root - INFO : loading data...
2022-03-28 22:48:03,398 - root - INFO : loaded!
2022-03-28 22:48:03,410 - root - INFO : initialize!
2022-03-28 22:48:03,410 - root - INFO : start training!
2022-03-28 22:48:15,235 - root - INFO : train: epoch0, idx0: F1:0.53887 accs0.51654
2022-03-28 22:48:15,235 - root - INFO : eval: epoch0, idx0: F1:0.52647 accs0.50744
2022-03-28 22:48:27,543 - root - INFO : train: epoch0, idx100: F1:0.00000 accs0.49632
2022-03-28 22:48:27,543 - root - INFO : eval: epoch0, idx100: F1:0.00299 accs0.50372
2022-03-28 22:48:39,614 - root - INFO : train: epoch0, idx200: F1:0.75720 accs0.76225
2022-03-28 22:48:39,615 - root - INFO : eval: epoch0, idx200: F1:0.73875 accs0.75372
2022-03-28 22:48:52,090 - root - INFO : train: epoch0, idx300: F1:0.74362 accs0.75368
2022-03-28 22:48:52,090 - root - INFO : eval: epoch0, idx300: F1:0.74317 accs0.75521
2022-03-28 22:49:03,617 - root - INFO : train: epoch1, idx0: F1:0.73367 accs0.74510
2022-03-28 22:49:03,617 - root - INFO : eval: epoch1, idx0: F1:0.74602 accs0.75074
2022-03-28 22:49:15,690 - root - INFO : train: epoch1, idx100: F1:0.75488 accs0.76164
2022-03-28 22:49:15,690 - root - INFO : eval: epoch1, idx100: F1:0.74349 accs0.75818
2022-03-28 22:49:28,237 - root - INFO : train: epoch1, idx200: F1:0.76562 accs0.77941
2022-03-28 22:49:28,237 - root - INFO : eval: epoch1, idx200: F1:0.72843 accs0.74702
2022-03-28 22:49:40,575 - root - INFO : train: epoch1, idx300: F1:0.72681 accs0.73836
2022-03-28 22:49:40,575 - root - INFO : eval: epoch1, idx300: F1:0.73749 accs0.74628
2022-03-28 22:49:51,793 - root - INFO : train: epoch2, idx0: F1:0.74307 accs0.75000
2022-03-28 22:49:51,793 - root - INFO : eval: epoch2, idx0: F1:0.71287 accs0.74107
2022-03-28 22:50:04,114 - root - INFO : train: epoch2, idx100: F1:0.74903 accs0.76225
2022-03-28 22:50:04,114 - root - INFO : eval: epoch2, idx100: F1:0.74529 accs0.76860
2022-03-28 22:50:16,881 - root - INFO : train: epoch2, idx200: F1:0.74984 accs0.75919
2022-03-28 22:50:16,881 - root - INFO : eval: epoch2, idx200: F1:0.73086 accs0.74628
2022-03-28 22:50:29,158 - root - INFO : train: epoch2, idx300: F1:0.74323 accs0.75613
2022-03-28 22:50:29,158 - root - INFO : eval: epoch2, idx300: F1:0.74603 accs0.76190
2022-03-28 22:50:40,853 - root - INFO : train: epoch3, idx0: F1:0.74688 accs0.76409
2022-03-28 22:50:40,853 - root - INFO : eval: epoch3, idx0: F1:0.71843 accs0.73289
2022-03-28 22:50:53,322 - root - INFO : train: epoch3, idx100: F1:0.75506 accs0.77022
2022-03-28 22:50:53,322 - root - INFO : eval: epoch3, idx100: F1:0.73718 accs0.75595
2022-03-28 22:51:05,749 - root - INFO : train: epoch3, idx200: F1:0.73009 accs0.75490
2022-03-28 22:51:05,749 - root - INFO : eval: epoch3, idx200: F1:0.71240 accs0.74107
2022-03-28 22:51:18,241 - root - INFO : train: epoch3, idx300: F1:0.77077 accs0.77512
2022-03-28 22:51:18,241 - root - INFO : eval: epoch3, idx300: F1:0.73956 accs0.74479
2022-03-28 22:51:29,380 - root - INFO : train: epoch4, idx0: F1:0.76942 accs0.76900
2022-03-28 22:51:29,380 - root - INFO : eval: epoch4, idx0: F1:0.74444 accs0.75223
2022-03-28 22:51:41,941 - root - INFO : train: epoch4, idx100: F1:0.74148 accs0.76287
2022-03-28 22:51:41,941 - root - INFO : eval: epoch4, idx100: F1:0.73424 accs0.75223
2022-03-28 22:51:54,461 - root - INFO : train: epoch4, idx200: F1:0.77154 accs0.77574
2022-03-28 22:51:54,461 - root - INFO : eval: epoch4, idx200: F1:0.74923 accs0.75893
2022-03-28 22:52:06,849 - root - INFO : train: epoch4, idx300: F1:0.74550 accs0.75735
2022-03-28 22:52:06,849 - root - INFO : eval: epoch4, idx300: F1:0.73761 accs0.75967
```

稳定性提升明显。F1 score没有明显提升，与上一次实验持平。

选择第二次实验的模型在test集上进行测试

### 3.2.4 SVM

#### 3.2.4.1 kernal = rbf

```
2022-03-29 21:34:44,315 - root - INFO : c:1.0, kernal:rbf
2022-03-29 21:34:44,315 - root - INFO : Loading data...
2022-03-29 21:34:46,027 - root - INFO : Data loaded.
2022-03-29 21:34:46,027 - root - INFO : Training SVM...
2022-03-29 21:34:52,996 - root - INFO : SVM inference...
2022-03-29 21:35:03,890 - root - INFO : train: F1:0.74727 accs0.75871
2022-03-29 21:35:03,890 - root - INFO : eval: F1:0.74328 accs0.75650
2022-03-29 21:35:14,965 - root - INFO : c:1000.0, kernal:rbf
2022-03-29 21:35:14,965 - root - INFO : Loading data...
2022-03-29 21:35:16,767 - root - INFO : Data loaded.
2022-03-29 21:35:16,767 - root - INFO : Training SVM...
2022-03-29 21:35:39,001 - root - INFO : SVM inference...
2022-03-29 21:35:48,978 - root - INFO : train: F1:0.96253 accs0.96314
2022-03-29 21:35:48,979 - root - INFO : eval: F1:0.69513 accs0.69650
2022-03-29 21:36:05,153 - root - INFO : c:500.0, kernal:rbf
2022-03-29 21:36:05,154 - root - INFO : Loading data...
2022-03-29 21:36:06,849 - root - INFO : Data loaded.
2022-03-29 21:36:06,849 - root - INFO : Training SVM...
2022-03-29 21:36:20,910 - root - INFO : SVM inference...
2022-03-29 21:36:31,371 - root - INFO : train: F1:0.91598 accs0.91800
2022-03-29 21:36:31,371 - root - INFO : eval: F1:0.71939 accs0.72500
2022-03-29 21:36:58,497 - root - INFO : c:100.0, kernal:rbf
2022-03-29 21:36:58,497 - root - INFO : Loading data...
2022-03-29 21:37:00,423 - root - INFO : Data loaded.
2022-03-29 21:37:00,424 - root - INFO : Training SVM...
2022-03-29 21:37:08,473 - root - INFO : SVM inference...
2022-03-29 21:37:19,662 - root - INFO : train: F1:0.77539 accs0.78614
2022-03-29 21:37:19,662 - root - INFO : eval: F1:0.74367 accs0.75700
2022-03-29 21:37:49,778 - root - INFO : c:50.0, kernal:rbf
2022-03-29 21:37:49,779 - root - INFO : Loading data...
2022-03-29 21:37:51,417 - root - INFO : Data loaded.
2022-03-29 21:37:51,417 - root - INFO : Training SVM...
2022-03-29 21:37:58,288 - root - INFO : SVM inference...
2022-03-29 21:38:08,384 - root - INFO : train: F1:0.74757 accs0.75900
2022-03-29 21:38:08,384 - root - INFO : eval: F1:0.74328 accs0.75650
2022-03-29 21:39:49,465 - root - INFO : c:150.0, kernal:rbf
2022-03-29 21:39:49,466 - root - INFO : Loading data...
2022-03-29 21:39:51,149 - root - INFO : Data loaded.
2022-03-29 21:39:51,149 - root - INFO : Training SVM...
2022-03-29 21:39:59,319 - root - INFO : SVM inference...
2022-03-29 21:40:08,805 - root - INFO : train: F1:0.82188 accs0.82929
2022-03-29 21:40:08,805 - root - INFO : eval: F1:0.74209 accs0.75150
```

可以看到，软间隔c=1时，train和epoch的F1 score较为接近；调为1000，过拟合；调为500，仍过拟合；调为100，效果略有上升；调为50，持平；调为150，过拟合

选择c=100作为候选

3.2.4.2 kernal = linear

```
2022-03-29 21:42:30,915 - root - INFO : c:1, kernal:linear
2022-03-29 21:42:30,916 - root - INFO : Loading data...
2022-03-29 21:42:32,591 - root - INFO : Data loaded.
2022-03-29 21:42:32,591 - root - INFO : Training SVM...
2022-03-29 21:42:38,651 - root - INFO : SVM inference...
2022-03-29 21:42:42,939 - root - INFO : train: F1:0.74727 accs0.75871
2022-03-29 21:42:42,940 - root - INFO : eval: F1:0.74328 accs0.75650
2022-03-29 21:43:03,532 - root - INFO : c:100, kernal:linear
2022-03-29 21:43:03,532 - root - INFO : Loading data...
2022-03-29 21:43:05,150 - root - INFO : Data loaded.
2022-03-29 21:43:05,150 - root - INFO : Training SVM...
2022-03-29 21:43:55,854 - root - INFO : SVM inference...
2022-03-29 21:44:01,196 - root - INFO : train: F1:0.76563 accs0.77671
2022-03-29 21:44:01,196 - root - INFO : eval: F1:0.73945 accs0.75300
```

软间隔c=1时，train和epoch的F1 score较为接近；调为100，持平

F1 score低于“kernal = rbf， c = 100”的模型

3.2.4.3 kernal = poly

```
2022-03-29 21:45:28,448 - root - INFO : c:1, kernal:poly, degree:3
2022-03-29 21:45:28,448 - root - INFO : Loading data...
2022-03-29 21:45:30,056 - root - INFO : Data loaded.
2022-03-29 21:45:30,056 - root - INFO : Training SVM...
2022-03-29 21:45:36,600 - root - INFO : SVM inference...
2022-03-29 21:45:43,697 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:45:43,697 - root - INFO : eval: F1:0.00000 accs0.49800
2022-03-29 21:45:55,311 - root - INFO : c:1, kernal:poly, degree:10
2022-03-29 21:45:55,311 - root - INFO : Loading data...
2022-03-29 21:45:56,992 - root - INFO : Data loaded.
2022-03-29 21:45:56,993 - root - INFO : Training SVM...
2022-03-29 21:46:03,687 - root - INFO : SVM inference...
2022-03-29 21:46:10,746 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:46:10,746 - root - INFO : eval: F1:0.00000 accs0.49800
2022-03-29 21:46:19,709 - root - INFO : c:1, kernal:poly, degree:64
2022-03-29 21:46:19,709 - root - INFO : Loading data...
2022-03-29 21:46:21,336 - root - INFO : Data loaded.
2022-03-29 21:46:21,336 - root - INFO : Training SVM...
2022-03-29 21:46:27,752 - root - INFO : SVM inference...
2022-03-29 21:46:35,162 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:46:35,162 - root - INFO : eval: F1:0.00000 accs0.49800
2022-03-29 21:46:50,973 - root - INFO : c:1, kernal:poly, degree:128
2022-03-29 21:46:50,973 - root - INFO : Loading data...
2022-03-29 21:46:52,726 - root - INFO : Data loaded.
2022-03-29 21:46:52,726 - root - INFO : Training SVM...
2022-03-29 21:46:59,226 - root - INFO : SVM inference...
2022-03-29 21:47:06,739 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:47:06,739 - root - INFO : eval: F1:0.00000 accs0.49800
2022-03-29 21:47:42,753 - root - INFO : c:100, kernal:poly, degree:128
2022-03-29 21:47:42,753 - root - INFO : Loading data...
2022-03-29 21:47:44,394 - root - INFO : Data loaded.
2022-03-29 21:47:44,394 - root - INFO : Training SVM...
2022-03-29 21:47:50,887 - root - INFO : SVM inference...
2022-03-29 21:47:58,387 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:47:58,387 - root - INFO : eval: F1:0.00000 accs0.49800
2022-03-29 21:48:09,035 - root - INFO : c:100, kernal:poly, degree:256
2022-03-29 21:48:09,035 - root - INFO : Loading data...
2022-03-29 21:48:10,683 - root - INFO : Data loaded.
2022-03-29 21:48:10,684 - root - INFO : Training SVM...
2022-03-29 21:48:17,293 - root - INFO : SVM inference...
2022-03-29 21:48:24,919 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:48:24,919 - root - INFO : eval: F1:0.00000 accs0.49800
2022-03-29 21:48:35,059 - root - INFO : c:100, kernal:poly, degree:512
2022-03-29 21:48:35,059 - root - INFO : Loading data...
2022-03-29 21:48:36,743 - root - INFO : Data loaded.
2022-03-29 21:48:36,743 - root - INFO : Training SVM...
2022-03-29 21:48:43,330 - root - INFO : SVM inference...
2022-03-29 21:48:51,047 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:48:51,047 - root - INFO : eval: F1:0.00000 accs0.49800
2022-03-29 21:48:57,658 - root - INFO : c:10000, kernal:poly, degree:512
2022-03-29 21:48:57,659 - root - INFO : Loading data...
2022-03-29 21:48:59,300 - root - INFO : Data loaded.
2022-03-29 21:48:59,300 - root - INFO : Training SVM...
2022-03-29 21:49:05,718 - root - INFO : SVM inference...
2022-03-29 21:49:13,210 - root - INFO : train: F1:0.00000 accs0.50514
2022-03-29 21:49:13,211 - root - INFO : eval: F1:0.00000 accs0.49800
```

一阵狂调，皆失败...

最终选择“kernal = rbf， c = 100”的模型在test集上进行测试

## 3.3 测试及分析

36分内容均有完成

### 3.3.1 拟合情况及F1 score， AUC， ROC曲线

#### 3.3.1.1 MLP2

F1 score及AUC：

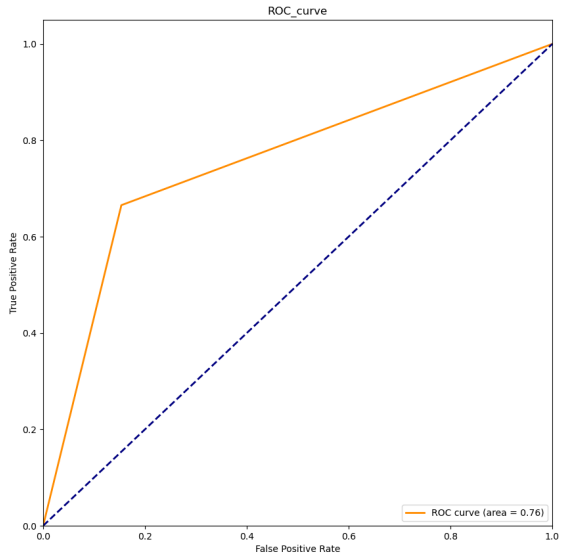
```
2022-03-30 02:20:56,931 - root - INFO : get data
2022-03-30 02:23:02,917 - root - INFO : load data done

2022-03-30 02:23:02,917 - root - INFO : get data
2022-03-30 02:23:20,995 - root - INFO : load data done

2022-03-30 02:23:20,995 - root - INFO : load MLP model
2022-03-30 02:23:24,780 - root - INFO : load MLP model done

2022-03-30 02:23:24,816 - root - INFO : predict MLP
2022-03-30 02:23:26,331 - root - INFO : predict SVM done

2022-03-30 02:23:26,331 - root - INFO : F1_score:0.7325383304940373, train_F1_score:0.7428674656003332, AUC0.7558238514083215
```

分析：由F1_score和train_F1_score较为接近，且与验证集结果持平，可以判断拟合良好

符合验证集预期。

ROC曲线：

注意到这里的ROC曲线并不是阶梯状上升的（如PPT上所示）。可能是该数据集的数据特征决定的。




#### 3.3.1.2 MLP3

F1 score及AUC：

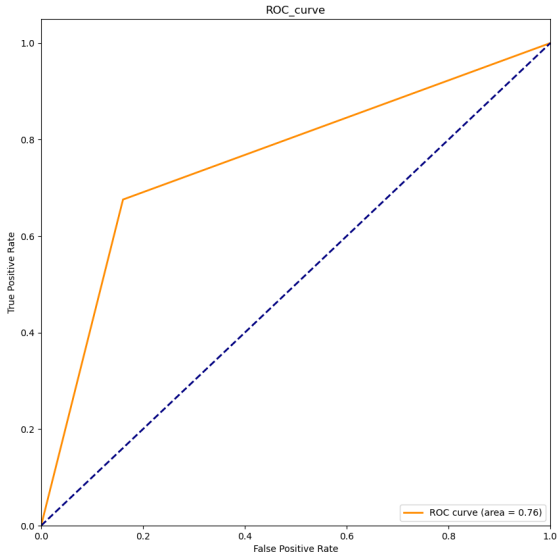
```
2022-03-30 02:23:26,334 - root - INFO : get data
2022-03-30 02:25:33,738 - root - INFO : load data done

2022-03-30 02:25:33,738 - root - INFO : get data
2022-03-30 02:25:52,003 - root - INFO : load data done

2022-03-30 02:25:52,003 - root - INFO : load MLP model
2022-03-30 02:25:52,033 - root - INFO : load MLP model done

2022-03-30 02:25:52,069 - root - INFO : predict MLP
2022-03-30 02:25:52,810 - root - INFO : predict SVM done

2022-03-30 02:25:52,810 - root - INFO : F1_score:0.7369662094924935, train_F1_score:0.7463361692761894, AUC0.7574916280973238
```

分析：由F1_score和train_F1_score较为接近，且与验证集结果持平，可以判断拟合良好

符合验证集预期。

ROC曲线：

注意到这里的ROC曲线并不是阶梯状上升的（如PPT上所示）。可能是该数据集的数据特征决定的。




3.3.1.3 MLP4

F1 score及AUC：

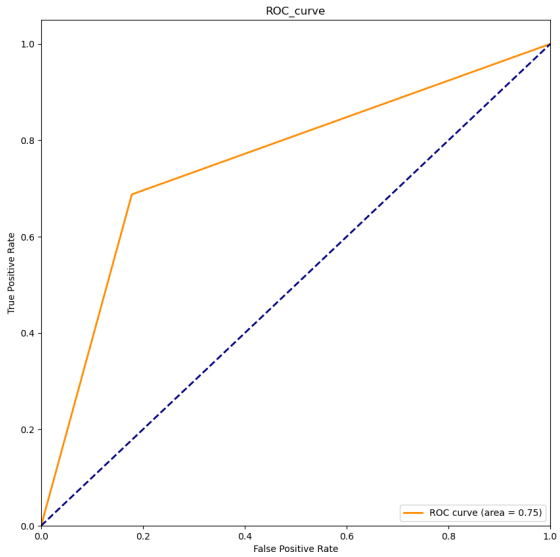
```
2022-03-30 02:25:52,812 - root - INFO : get data
2022-03-30 02:28:04,777 - root - INFO : load data done

2022-03-30 02:28:04,777 - root - INFO : get data
2022-03-30 02:28:22,846 - root - INFO : load data done

2022-03-30 02:28:22,846 - root - INFO : load MLP model
2022-03-30 02:28:22,870 - root - INFO : load MLP model done

2022-03-30 02:28:22,906 - root - INFO : predict MLP
2022-03-30 02:28:23,574 - root - INFO : predict SVM done

2022-03-30 02:28:23,575 - root - INFO : F1_score:0.7382980535797946, train_F1_score:0.7490497518280292, AUC0.7547711034758281
```

分析：由F1_score和train_F1_score较为接近，且与验证集结果持平，可以判断拟合良好

符合验证集预期。

ROC曲线：

注意到这里的ROC曲线并不是阶梯状上升的（如PPT上所示）。可能是该数据集的数据特征决定的。




3.3.1.4 SVM

F1 score及AUC：

```
2022-03-30 02:28:23,577 - root - INFO : get data
2022-03-30 02:28:24,856 - root - INFO : load data done

2022-03-30 02:28:24,856 - root - INFO : get data
2022-03-30 02:28:25,047 - root - INFO : load data done

2022-03-30 02:28:25,047 - root - INFO : load SVM model
2022-03-30 02:28:25,069 - root - INFO : load SVM model done

2022-03-30 02:28:25,069 - root - INFO : predict SVM
2022-03-30 02:28:34,632 - root - INFO : predict SVM done

2022-03-30 02:28:34,633 - root - INFO : F1_score:0.7205240174672487, train_F1_score:0.7753938484621155, AUC0.7433755760368663
```

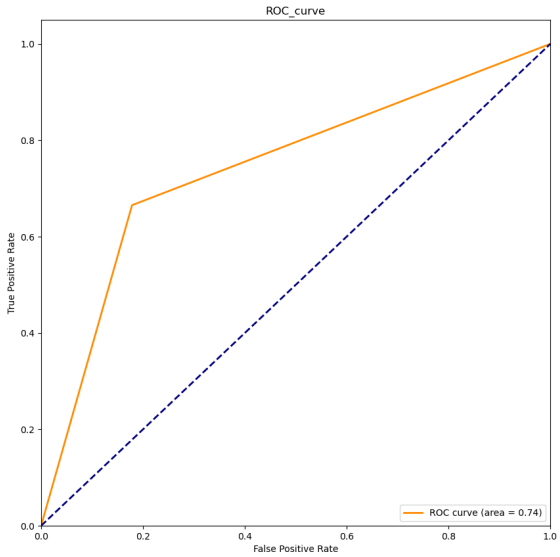
分析：有一定过拟合现象（train_F1_score比F1_score高了5个点）

大体上符合验证集预期

ROC曲线：

注意到这里的ROC曲线与上三张图相似。

F1_score，train_F1_score，AUC，ROC曲线都与另三个在全数据集上进行训练的结果差不多，因此可以认为1/100随机采样后的特征仍服从原始数据集的分布，即数据预处理在该实验要求下对实验结果产生的影响可以忽略




# 4 实验结论

熟悉了Pytorch和sklearn库

学会了分析各种评价指标（本实验主要是F1 score）来进行超参数的选择与调整