一、项目实现目标

我的研究方向是智慧教育。这个项目的实现目标是利用深度学习方法，Gaze-LLE模型，解决了凝视目标估计的问题，它旨在预测一个人在场景中的视线位置。预先指定一个人的凝视目标需要对人的外表和场景内容进行推理。我需要将课堂上的场景用该模型进行测试，观察是否能识别学生上课注视情况。

二、测试数据集介绍

项目中的测试数据集是数据集我们在 GazeFollow 数据集和 VideoAttentionTarget 数据集

三、实验环境介绍

操作系统为 ubuntu2020
Python 为 3.10 版本
第三方库：numpy、torch、scikit-learn
GPU：5060ti 16G

四、训练数据

一共进行了 15 轮训练，大约 24 小时

```
TRAIN EPOCH 0, iter 1780/1891, loss=0.0495
TRAIN EPOCH 0, iter 1790/1891, loss=0.0477
TRAIN EPOCH 0, iter 1800/1891, loss=0.0455
TRAIN EPOCH 0, iter 1810/1891, loss=0.049
TRAIN EPOCH 0, iter 1820/1891, loss=0.0486
TRAIN EPOCH 0, iter 1830/1891, loss=0.0502
TRAIN EPOCH 0, iter 1840/1891, loss=0.0483
TRAIN EPOCH 0, iter 1850/1891, loss=0.0503
TRAIN EPOCH 0, iter 1860/1891, loss=0.0487
TRAIN EPOCH 0, iter 1870/1891, loss=0.0458
TRAIN EPOCH 0, iter 1880/1891, loss=0.0511
TRAIN EPOCH 0, iter 1890/1891, loss=0.0511
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_0.pt
Running evaluation
EVAL EPOCH 0: AUC=0.9404, Min L2=0.0709, Avg L2=0.1339
TRAIN EPOCH 1, iter 0/1891, loss=0.0487
TRAIN EPOCH 1, iter 10/1891, loss=0.049
TRAIN EPOCH 1, iter 20/1891, loss=0.0491
TRAIN EPOCH 1, iter 30/1891, loss=0.0475
TRAIN EPOCH 1, iter 40/1891, loss=0.0468
TRAIN EPOCH 1, iter 50/1891, loss=0.0499
```

```
TRAIN EPOCH 1, iter 1810/1891, loss=0.0475
TRAIN EPOCH 1, iter 1820/1891, loss=0.0412
TRAIN EPOCH 1, iter 1830/1891, loss=0.0454
TRAIN EPOCH 1, iter 1840/1891, loss=0.0444
TRAIN EPOCH 1, iter 1850/1891, loss=0.0456
TRAIN EPOCH 1, iter 1860/1891, loss=0.0472
TRAIN EPOCH 1, iter 1870/1891, loss=0.045
TRAIN EPOCH 1, iter 1880/1891, loss=0.0472
TRAIN EPOCH 1, iter 1890/1891, loss=0.0448
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_1.pt
Running evaluation
EVAL EPOCH 1: AUC=0.9453, Min L2=0.0641, Avg L2=0.128
TRAIN EPOCH 2, iter 0/1891, loss=0.0485
TRAIN EPOCH 2, iter 10/1891, loss=0.0437
TRAIN EPOCH 2, iter 20/1891, loss=0.048
TRAIN EPOCH 2, iter 30/1891, loss=0.0475
TRAIN EPOCH 2, iter 40/1891, loss=0.0446
TRAIN EPOCH 2, iter 50/1891, loss=0.0435
TRAIN EPOCH 2, iter 60/1891, loss=0.0465
TRAIN EPOCH 2, iter 70/1891, loss=0.0453
TRAIN EPOCH 2, iter 80/1891, loss=0.0422
TRAIN EPOCH 2, iter 1850/1891, loss=0.0478
TRAIN EPOCH 2, iter 1860/1891, loss=0.0444
TRAIN EPOCH 2, iter 1870/1891, loss=0.046
TRAIN EPOCH 2, iter 1880/1891, loss=0.0453
TRAIN EPOCH 2, iter 1890/1891, loss=0.0486
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_2.pt
Running evaluation
EVAL EPOCH 2: AUC=0.9499, Min L2=0.0593, Avg L2=0.1234
TRAIN EPOCH 3, iter 0/1891, loss=0.0446
TRAIN EPOCH 3, iter 10/1891, loss=0.0429
TRAIN EPOCH 3, iter 20/1891, loss=0.0419
TRAIN EPOCH 3, iter 30/1891, loss=0.0454
TRAIN EPOCH 3, iter 40/1891, loss=0.0454
TRAIN EPOCH 3, iter 50/1891, loss=0.044
TRAIN EPOCH 3, iter 60/1891, loss=0.0456
TRAIN EPOCH 3, iter 70/1891, loss=0.0508
TRAIN EPOCH 3, iter 80/1891, loss=0.0425
TRAIN EPOCH 3, iter 1860/1891, loss=0.047
TRAIN EPOCH 3, iter 1870/1891, loss=0.0446
TRAIN EPOCH 3, iter 1880/1891, loss=0.0423
TRAIN EPOCH 3, iter 1890/1891, loss=0.0399
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_3.pt
Running evaluation
EVAL EPOCH 3: AUC=0.9502, Min L2=0.0577, Avg L2=0.1208
TRAIN EPOCH 4, iter 0/1891, loss=0.0414
TRAIN EPOCH 4, iter 10/1891, loss=0.0451
TRAIN EPOCH 4, iter 20/1891, loss=0.0471
TRAIN EPOCH 4, iter 30/1891, loss=0.044
TRAIN EPOCH 4, iter 40/1891, loss=0.046
TRAIN EPOCH 4, iter 50/1891, loss=0.0429
TRAIN EPOCH 4, iter 60/1891, loss=0.0431
```

```
TRAIN EPOCH 4, iter 1820/1891, loss=0.0441
TRAIN EPOCH 4, iter 1830/1891, loss=0.0414
TRAIN EPOCH 4, iter 1840/1891, loss=0.046
TRAIN EPOCH 4, iter 1850/1891, loss=0.0448
TRAIN EPOCH 4, iter 1860/1891, loss=0.044
TRAIN EPOCH 4, iter 1870/1891, loss=0.0421
TRAIN EPOCH 4, iter 1880/1891, loss=0.0427
TRAIN EPOCH 4, iter 1890/1891, loss=0.042
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_4.pt
Running evaluation
EVAL EPOCH 4: AUC=0.9511, Min L2=0.056, Avg L2=0.1182
TRAIN EPOCH 5, iter 0/1891, loss=0.0424
TRAIN EPOCH 5, iter 10/1891, loss=0.0402
TRAIN EPOCH 5, iter 20/1891, loss=0.0432
TRAIN EPOCH 5, iter 30/1891, loss=0.0423
TRAIN EPOCH 5, iter 40/1891, loss=0.0441
TRAIN EPOCH 5, iter 50/1891, loss=0.0414
```

```
TRAIN EPOCH 5, iter 1840/1891, loss=0.0482
TRAIN EPOCH 5, iter 1850/1891, loss=0.0418
TRAIN EPOCH 5, iter 1860/1891, loss=0.0456
TRAIN EPOCH 5, iter 1870/1891, loss=0.0436
TRAIN EPOCH 5, iter 1880/1891, loss=0.0446
TRAIN EPOCH 5, iter 1890/1891, loss=0.0412
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_5.pt
Running evaluation
EVAL EPOCH 5: AUC=0.9527, Min L2=0.0525, Avg L2=0.113
TRAIN EPOCH 6, iter 0/1891, loss=0.0432
TRAIN EPOCH 6, iter 10/1891, loss=0.042
TRAIN EPOCH 6, iter 20/1891, loss=0.0456
TRAIN EPOCH 6, iter 30/1891, loss=0.0411
TRAIN EPOCH 6, iter 40/1891, loss=0.0407
TRAIN EPOCH 6, iter 50/1891, loss=0.0469
TRAIN EPOCH 6, iter 60/1891, loss=0.0474
TRAIN EPOCH 6, iter 70/1891, loss=0.0439
```

```
TRAIN EPOCH 6, iter 1840/1891, loss=0.0423
TRAIN EPOCH 6, iter 1850/1891, loss=0.0402
TRAIN EPOCH 6, iter 1860/1891, loss=0.0431
TRAIN EPOCH 6, iter 1870/1891, loss=0.0453
TRAIN EPOCH 6, iter 1880/1891, loss=0.0422
TRAIN EPOCH 6, iter 1890/1891, loss=0.0416
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_6.pt
Running evaluation
EVAL EPOCH 6: AUC=0.9533, Min L2=0.0517, Avg L2=0.1124
TRAIN EPOCH 7, iter 0/1891, loss=0.0434
TRAIN EPOCH 7, iter 10/1891, loss=0.0411
TRAIN EPOCH 7, iter 20/1891, loss=0.0392
TRAIN EPOCH 7, iter 30/1891, loss=0.0448
TRAIN EPOCH 7, iter 40/1891, loss=0.0469
TRAIN EPOCH 7, iter 50/1891, loss=0.0414
TRAIN EPOCH 7, iter 60/1891, loss=0.0436
```

```
TRAIN EPOCH 7, iter 1840/1891, loss=0.0441
TRAIN EPOCH 7, iter 1850/1891, loss=0.0402
TRAIN EPOCH 7, iter 1860/1891, loss=0.0472
TRAIN EPOCH 7, iter 1870/1891, loss=0.0442
TRAIN EPOCH 7, iter 1880/1891, loss=0.0402
TRAIN EPOCH 7, iter 1890/1891, loss=0.0386
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_7.pt
Running evaluation
EVAL EPOCH 7: AUC=0.9536, Min L2=0.0515, Avg L2=0.1114
TRAIN EPOCH 8, iter 0/1891, loss=0.0433
TRAIN EPOCH 8, iter 10/1891, loss=0.0413
TRAIN EPOCH 8, iter 20/1891, loss=0.0414
TRAIN EPOCH 8, iter 30/1891, loss=0.0423
TRAIN EPOCH 8, iter 40/1891, loss=0.0444
TRAIN EPOCH 8, iter 50/1891, loss=0.0413
TRAIN EPOCH 8, iter 60/1891, loss=0.0416
TRAIN EPOCH 8, iter 70/1891, loss=0.0438
TRAIN EPOCH 8, iter 80/1891, loss=0.0376
```

```
TRAIN EPOCH 8, iter 1810/1891, loss=0.0387
TRAIN EPOCH 8, iter 1820/1891, loss=0.0448
TRAIN EPOCH 8, iter 1830/1891, loss=0.0396
TRAIN EPOCH 8, iter 1840/1891, loss=0.0414
TRAIN EPOCH 8, iter 1850/1891, loss=0.0383
TRAIN EPOCH 8, iter 1860/1891, loss=0.0412
TRAIN EPOCH 8, iter 1870/1891, loss=0.045
TRAIN EPOCH 8, iter 1880/1891, loss=0.0421
TRAIN EPOCH 8, iter 1890/1891, loss=0.0447
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_8.pt
Running evaluation
EVAL EPOCH 8: AUC=0.9543, Min L2=0.0492, Avg L2=0.1102
TRAIN EPOCH 9, iter 0/1891, loss=0.0399
TRAIN EPOCH 9, iter 10/1891, loss=0.0399
TRAIN EPOCH 9, iter 20/1891, loss=0.0396
TRAIN EPOCH 9, iter 30/1891, loss=0.0417
TRAIN EPOCH 9, iter 40/1891, loss=0.04
TRAIN EPOCH 9, iter 50/1891, loss=0.0435
TRAIN EPOCH 9, iter 60/1891, loss=0.0421
```

```
TRAIN EPOCH 9, iter 1850/1891, loss=0.0407
TRAIN EPOCH 9, iter 1860/1891, loss=0.0413
TRAIN EPOCH 9, iter 1870/1891, loss=0.0417
TRAIN EPOCH 9, iter 1880/1891, loss=0.0399
TRAIN EPOCH 9, iter 1890/1891, loss=0.0416
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_9.pt
Running evaluation
EVAL EPOCH 9: AUC=0.955, Min L2=0.0486, Avg L2=0.1089
TRAIN EPOCH 10, iter 0/1891, loss=0.0418
TRAIN EPOCH 10, iter 10/1891, loss=0.0395
TRAIN EPOCH 10, iter 20/1891, loss=0.0403
TRAIN EPOCH 10, iter 30/1891, loss=0.0407
TRAIN EPOCH 10, iter 40/1891, loss=0.0402
TRAIN EPOCH 10, iter 50/1891, loss=0.0408
TRAIN EPOCH 10, iter 60/1891, loss=0.0388
```

```
TRAIN EPOCH 10, iter 1840/1891, loss=0.0402
TRAIN EPOCH 10, iter 1850/1891, loss=0.0398
TRAIN EPOCH 10, iter 1860/1891, loss=0.0398
TRAIN EPOCH 10, iter 1870/1891, loss=0.0446
TRAIN EPOCH 10, iter 1880/1891, loss=0.0391
TRAIN EPOCH 10, iter 1890/1891, loss=0.0435
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_10.pt
Running evaluation
EVAL EPOCH 10: AUC=0.9553, Min L2=0.0489, Avg L2=0.1086
TRAIN EPOCH 11, iter 0/1891, loss=0.0429
TRAIN EPOCH 11, iter 10/1891, loss=0.041
TRAIN EPOCH 11, iter 20/1891, loss=0.0405
TRAIN EPOCH 11, iter 30/1891, loss=0.0448
TRAIN EPOCH 11, iter 40/1891, loss=0.0432
TRAIN EPOCH 11, iter 50/1891, loss=0.0436
TRAIN EPOCH 11, iter 60/1891, loss=0.0395
TRAIN EPOCH 11, iter 70/1891, loss=0.0389
```

```
TRAIN EPOCH 11, iter 1840/1891, loss=0.0393
TRAIN EPOCH 11, iter 1850/1891, loss=0.0414
TRAIN EPOCH 11, iter 1860/1891, loss=0.0433
TRAIN EPOCH 11, iter 1870/1891, loss=0.041
TRAIN EPOCH 11, iter 1880/1891, loss=0.0389
TRAIN EPOCH 11, iter 1890/1891, loss=0.0395
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_11.pt
Running evaluation
EVAL EPOCH 11: AUC=0.9553, Min L2=0.0473, Avg L2=0.1063
TRAIN EPOCH 12, iter 0/1891, loss=0.0361
TRAIN EPOCH 12, iter 10/1891, loss=0.042
TRAIN EPOCH 12, iter 20/1891, loss=0.0395
TRAIN EPOCH 12, iter 30/1891, loss=0.0404
TRAIN EPOCH 12, iter 40/1891, loss=0.0396
TRAIN EPOCH 12, iter 50/1891, loss=0.0409
TRAIN EPOCH 12, iter 60/1891, loss=0.0402
TRAIN EPOCH 12, iter 70/1891, loss=0.0426
TRAIN EPOCH 12, iter 80/1891, loss=0.0412
TRAIN EPOCH 12, iter 90/1891, loss=0.0393
```

```
TRAIN EPOCH 12, iter 1830/1891, loss=0.0407
TRAIN EPOCH 12, iter 1840/1891, loss=0.0373
TRAIN EPOCH 12, iter 1850/1891, loss=0.0429
TRAIN EPOCH 12, iter 1860/1891, loss=0.0404
TRAIN EPOCH 12, iter 1870/1891, loss=0.0362
TRAIN EPOCH 12, iter 1880/1891, loss=0.0409
TRAIN EPOCH 12, iter 1890/1891, loss=0.0402
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_12.pt
Running evaluation
EVAL EPOCH 12: AUC=0.9552, Min L2=0.0476, Avg L2=0.106
TRAIN EPOCH 13, iter 0/1891, loss=0.037
TRAIN EPOCH 13, iter 10/1891, loss=0.0451
TRAIN EPOCH 13, iter 20/1891, loss=0.0384
TRAIN EPOCH 13, iter 30/1891, loss=0.0377
TRAIN EPOCH 13, iter 40/1891, loss=0.0436
TRAIN EPOCH 13, iter 50/1891, loss=0.0411
TRAIN EPOCH 13, iter 60/1891, loss=0.0426
TRAIN EPOCH 13, iter 70/1891, loss=0.0401
TRAIN EPOCH 13, iter 80/1891, loss=0.0419
```

```
TRAIN EPOCH 13, iter 1840/1891, loss=0.0385
TRAIN EPOCH 13, iter 1850/1891, loss=0.0449
TRAIN EPOCH 13, iter 1860/1891, loss=0.0367
TRAIN EPOCH 13, iter 1870/1891, loss=0.0384
TRAIN EPOCH 13, iter 1880/1891, loss=0.0417
TRAIN EPOCH 13, iter 1890/1891, loss=0.0394
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_13.pt
Running evaluation
EVAL EPOCH 13: AUC=0.9556, Min L2=0.0471, Avg L2=0.1058
TRAIN EPOCH 14, iter 0/1891, loss=0.0383
TRAIN EPOCH 14, iter 10/1891, loss=0.0398
TRAIN EPOCH 14, iter 20/1891, loss=0.0381
TRAIN EPOCH 14, iter 30/1891, loss=0.0381
TRAIN EPOCH 14, iter 40/1891, loss=0.0376
TRAIN EPOCH 14, iter 50/1891, loss=0.0417
TRAIN EPOCH 14, iter 60/1891, loss=0.0421
TRAIN EPOCH 14, iter 70/1891, loss=0.0414
TRAIN EPOCH 14, iter 80/1891, loss=0.0381
TRAIN EPOCH 14, iter 90/1891, loss=0.0382
```

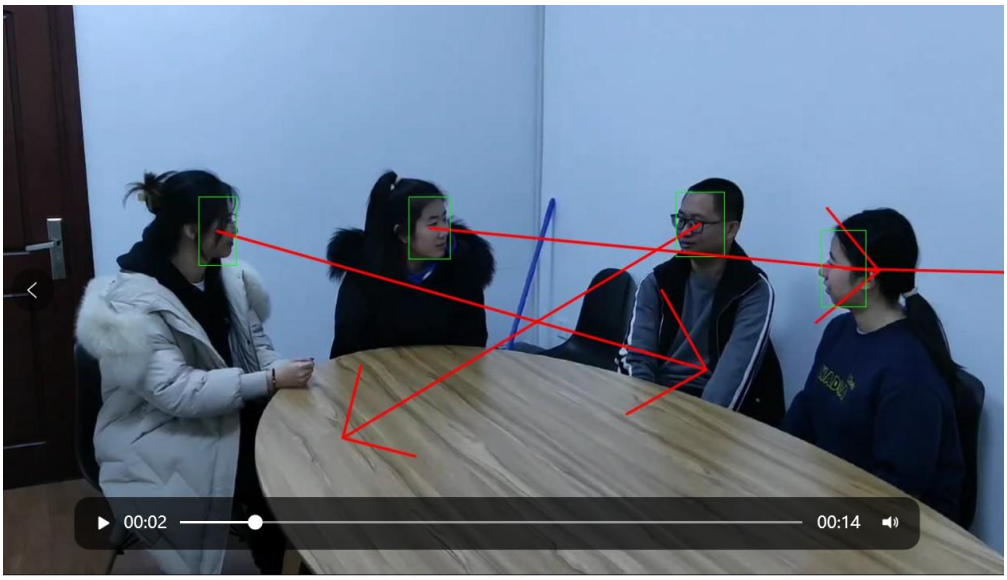
```
TRAIN EPOCH 14, iter 1760/1891, loss=0.0395
TRAIN EPOCH 14, iter 1770/1891, loss=0.0404
TRAIN EPOCH 14, iter 1780/1891, loss=0.0381
TRAIN EPOCH 14, iter 1790/1891, loss=0.0405
TRAIN EPOCH 14, iter 1800/1891, loss=0.0397
TRAIN EPOCH 14, iter 1810/1891, loss=0.042
TRAIN EPOCH 14, iter 1820/1891, loss=0.0381
TRAIN EPOCH 14, iter 1830/1891, loss=0.0376
TRAIN EPOCH 14, iter 1840/1891, loss=0.0397
TRAIN EPOCH 14, iter 1850/1891, loss=0.0413
TRAIN EPOCH 14, iter 1860/1891, loss=0.0405
TRAIN EPOCH 14, iter 1870/1891, loss=0.0374
TRAIN EPOCH 14, iter 1880/1891, loss=0.0418
TRAIN EPOCH 14, iter 1890/1891, loss=0.0413
Saved checkpoint to ./experiments/train_full_gazefollow/2025-06-22_19-59-23/epoch_14.pt
Running evaluation
EVAL EPOCH 14: AUC=0.9556, Min L2=0.0477, Avg L2=0.1065
Completed training. Best Min L2 of 0.0471 obtained at epoch 13
wandb:
wandb: You can sync this run to the cloud by running:
wandb: wandb sync /home/zhounan/paperproject/gazelle-main/wandb/offline-run-20250622_195923-sfhpyfyi
wandb: Find logs at: wandb/offline-run-20250622_195923-sfhpyfyi/logs
```

根据训练数据可知，第十三轮的训练数据效果最好。

六、测试

图片测试：可以识别人脸的注视方向，但是仍需要提高精度，效果不太理想。

视频测试：显然视频测试的精度更加准确，可以准确识别注视方向。



七、改进方向

接下来需要继续提高精度，并尝试是否能准确识别注视的物体，例如书本，黑板，老师等。