C:\Users\Young\anaconda3\python.exe "E:\人工智能基础A\hw2\可运行成果及训练数据\DenseNet121\DenseNet121 模型.py"

开始将JPG图像转换为PT文件...

完成转换，共处理 0 张图像

使用设备: cpu

C:\Users\Young\anaconda3\Lib\site-packages\torchvision\models\\_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated since 0.13 and may be removed in the future, please use 'weights' instead.

warnings.warn(

C:\Users\Young\anaconda3\Lib\site-packages\torchvision\models\\_utils.py:223: UserWarning: Arguments other than a weight enum or `None` for 'weights' are deprecated since 0.13 and may be removed in the future. The current behavior is equivalent to passing `weights=DenseNet121\_Weights.IMAGENET1K\_V1`. You can also use `weights=DenseNet121\_Weights.DEFAULT` to get the most up-to-date weights.

warnings.warn(msg)

训练集大小: 2450, 测试集大小: 614

第 1 次尝试

选择优化器: SGD, 学习率: 0.0002

Epoch 0/9

----------

train Loss: 1.0510 Acc: 0.4502

val Loss: 1.0315 Acc: 0.4593

Epoch 1/9

----------

train Loss: 0.9994 Acc: 0.5090

val Loss: 0.9763 Acc: 0.5342

Epoch 2/9

----------

train Loss: 0.9541 Acc: 0.5682

val Loss: 0.9340 Acc: 0.5961

Epoch 3/9

----------

train Loss: 0.9146 Acc: 0.6176

val Loss: 0.8953 Acc: 0.6319

Epoch 4/9

----------

train Loss: 0.8814 Acc: 0.6392

val Loss: 0.8642 Acc: 0.6661

Epoch 5/9

----------

train Loss: 0.8496 Acc: 0.6722

val Loss: 0.8304 Acc: 0.6857

Epoch 6/9

----------

train Loss: 0.8214 Acc: 0.6886

val Loss: 0.8036 Acc: 0.7101

Epoch 7/9

----------

train Loss: 0.8094 Acc: 0.7065

val Loss: 0.7994 Acc: 0.7150

Epoch 8/9

----------

train Loss: 0.8035 Acc: 0.7155

val Loss: 0.8012 Acc: 0.7117

Epoch 9/9

----------

train Loss: 0.8036 Acc: 0.7106

val Loss: 0.7969 Acc: 0.7150

训练完成，耗时 32m 57s

最佳验证准确率: 0.714984

第 2 次尝试

选择优化器: SGD, 学习率: 0.002

Epoch 0/9

----------

train Loss: 0.9161 Acc: 0.5910

val Loss: 0.7687 Acc: 0.7248

Epoch 1/9

----------

train Loss: 0.6905 Acc: 0.7669

val Loss: 0.6126 Acc: 0.8143

Epoch 2/9

----------

train Loss: 0.5831 Acc: 0.8159

val Loss: 0.5345 Acc: 0.8404

Epoch 3/9

----------

train Loss: 0.5247 Acc: 0.8257

val Loss: 0.4821 Acc: 0.8567

Epoch 4/9

----------

train Loss: 0.4746 Acc: 0.8535

val Loss: 0.4444 Acc: 0.8648

Epoch 5/9

----------

train Loss: 0.4534 Acc: 0.8531

val Loss: 0.4179 Acc: 0.8795

Epoch 6/9

----------

train Loss: 0.4312 Acc: 0.8604

val Loss: 0.3940 Acc: 0.8860

Epoch 7/9

----------

train Loss: 0.4088 Acc: 0.8645

val Loss: 0.3915 Acc: 0.8876

Epoch 8/9

----------

train Loss: 0.4094 Acc: 0.8714

val Loss: 0.3897 Acc: 0.8860

Epoch 9/9

----------

train Loss: 0.4110 Acc: 0.8682

val Loss: 0.3904 Acc: 0.8893

训练完成，耗时 35m 13s

最佳验证准确率: 0.889251

第 3 次尝试

选择优化器: SGD, 学习率: 0.02

Epoch 0/9

----------

train Loss: 0.7287 Acc: 0.7065

val Loss: 0.4846 Acc: 0.7948

Epoch 1/9

----------

train Loss: 0.4315 Acc: 0.8261

val Loss: 0.2790 Acc: 0.9023

Epoch 2/9

----------

train Loss: 0.3557 Acc: 0.8588

val Loss: 0.6188 Acc: 0.7769

Epoch 3/9

----------

train Loss: 0.3199 Acc: 0.8759

val Loss: 0.2534 Acc: 0.9007

Epoch 4/9

----------

train Loss: 0.2817 Acc: 0.8882

val Loss: 0.3381 Acc: 0.8616

Epoch 5/9

----------

train Loss: 0.2800 Acc: 0.8943

val Loss: 0.2601 Acc: 0.8958

Epoch 6/9

----------

train Loss: 0.2740 Acc: 0.8976

val Loss: 0.2632 Acc: 0.8860

Epoch 7/9

----------

train Loss: 0.2339 Acc: 0.9094

val Loss: 0.2169 Acc: 0.9251

Epoch 8/9

----------

train Loss: 0.2230 Acc: 0.9180

val Loss: 0.2190 Acc: 0.9267

Epoch 9/9

----------

train Loss: 0.2262 Acc: 0.9159

val Loss: 0.2269 Acc: 0.9137

训练完成，耗时 250m 40s

最佳验证准确率: 0.926710

第 4 次尝试

选择优化器: Adam, 学习率: 0.0002

Epoch 0/9

----------

train Loss: 0.9580 Acc: 0.5441

val Loss: 0.8025 Acc: 0.7036

Epoch 1/9

----------

train Loss: 0.7240 Acc: 0.7408

val Loss: 0.6352 Acc: 0.8046

Epoch 2/9

----------

train Loss: 0.6011 Acc: 0.8122

val Loss: 0.5438 Acc: 0.8534

Epoch 3/9

----------

train Loss: 0.5322 Acc: 0.8282

val Loss: 0.4844 Acc: 0.8632

Epoch 4/9

----------

train Loss: 0.4860 Acc: 0.8363

val Loss: 0.4352 Acc: 0.8730

Epoch 5/9

----------

train Loss: 0.4474 Acc: 0.8629

val Loss: 0.4119 Acc: 0.8893

Epoch 6/9

----------

train Loss: 0.4224 Acc: 0.8633

val Loss: 0.3818 Acc: 0.8779

Epoch 7/9

----------

train Loss: 0.4062 Acc: 0.8649

val Loss: 0.3822 Acc: 0.8974

Epoch 8/9

----------

train Loss: 0.4078 Acc: 0.8698

val Loss: 0.3799 Acc: 0.8958

Epoch 9/9

----------

train Loss: 0.3991 Acc: 0.8739

val Loss: 0.3811 Acc: 0.8893

训练完成，耗时 42m 9s

最佳验证准确率: 0.897394

第 5 次尝试

选择优化器: Adam, 学习率: 0.002

Epoch 0/9

----------

train Loss: 0.5721 Acc: 0.7702

val Loss: 0.3676 Acc: 0.8648

Epoch 1/9

----------

train Loss: 0.3611 Acc: 0.8657

val Loss: 0.2888 Acc: 0.8974

Epoch 2/9

----------

train Loss: 0.3294 Acc: 0.8759

val Loss: 0.2714 Acc: 0.8974

Epoch 3/9

----------

train Loss: 0.3059 Acc: 0.8784

val Loss: 0.2575 Acc: 0.9007

Epoch 4/9

----------

train Loss: 0.2678 Acc: 0.9037

val Loss: 0.2447 Acc: 0.9137

Epoch 5/9

----------

train Loss: 0.2550 Acc: 0.9053

val Loss: 0.2215 Acc: 0.9235

Epoch 6/9

----------

train Loss: 0.2455 Acc: 0.9082

val Loss: 0.2173 Acc: 0.9267

Epoch 7/9

----------

train Loss: 0.2143 Acc: 0.9220

val Loss: 0.2146 Acc: 0.9218

Epoch 8/9

----------

train Loss: 0.2066 Acc: 0.9335

val Loss: 0.2120 Acc: 0.9267

Epoch 9/9

----------

train Loss: 0.2107 Acc: 0.9265

val Loss: 0.2121 Acc: 0.9218

训练完成，耗时 20m 13s

最佳验证准确率: 0.926710

第 6 次尝试

选择优化器: Adam, 学习率: 0.02

Epoch 0/9

----------

train Loss: 1.4031 Acc: 0.7114

val Loss: 0.4437 Acc: 0.8290

Epoch 1/9

----------

train Loss: 0.4174 Acc: 0.8559

val Loss: 0.3821 Acc: 0.8534

Epoch 2/9

----------

train Loss: 0.3849 Acc: 0.8645

val Loss: 0.3041 Acc: 0.8925

Epoch 3/9

----------

train Loss: 0.4241 Acc: 0.8657

val Loss: 0.3428 Acc: 0.8941

Epoch 4/9

----------

train Loss: 0.3716 Acc: 0.8763

val Loss: 0.2775 Acc: 0.9137

Epoch 5/9

----------

train Loss: 0.3253 Acc: 0.8947

val Loss: 0.2534 Acc: 0.9202

Epoch 6/9

----------

train Loss: 0.3741 Acc: 0.8804

val Loss: 0.3085 Acc: 0.9088

Epoch 7/9

----------

train Loss: 0.1774 Acc: 0.9376

val Loss: 0.2591 Acc: 0.9251

Epoch 8/9

----------

train Loss: 0.1675 Acc: 0.9408

val Loss: 0.2564 Acc: 0.9218

Epoch 9/9

----------

train Loss: 0.1610 Acc: 0.9412

val Loss: 0.2521 Acc: 0.9251

训练完成，耗时 20m 16s

最佳验证准确率: 0.925081

第 7 次尝试

选择优化器: AdamW, 学习率: 0.0002

Epoch 0/9

----------

train Loss: 0.9749 Acc: 0.5306

val Loss: 0.8439 Acc: 0.7150

Epoch 1/9

----------

train Loss: 0.7418 Acc: 0.7408

val Loss: 0.6692 Acc: 0.8160

Epoch 2/9

----------

train Loss: 0.6201 Acc: 0.8078

val Loss: 0.5633 Acc: 0.8518

Epoch 3/9

----------

train Loss: 0.5464 Acc: 0.8318

val Loss: 0.5024 Acc: 0.8632

Epoch 4/9

----------

train Loss: 0.4931 Acc: 0.8437

val Loss: 0.4556 Acc: 0.8632

Epoch 5/9

----------

train Loss: 0.4517 Acc: 0.8592

val Loss: 0.4207 Acc: 0.8664

Epoch 6/9

----------

train Loss: 0.4308 Acc: 0.8641

val Loss: 0.3964 Acc: 0.8860

Epoch 7/9

----------

train Loss: 0.4130 Acc: 0.8673

val Loss: 0.3922 Acc: 0.8779

Epoch 8/9

----------

train Loss: 0.4063 Acc: 0.8784

val Loss: 0.3926 Acc: 0.8876

Epoch 9/9

----------

train Loss: 0.4054 Acc: 0.8776

val Loss: 0.3861 Acc: 0.8795

训练完成，耗时 20m 11s

最佳验证准确率: 0.887622

第 8 次尝试

选择优化器: AdamW, 学习率: 0.002

Epoch 0/9

----------

train Loss: 0.5355 Acc: 0.7988

val Loss: 0.3479 Acc: 0.8762

Epoch 1/9

----------

train Loss: 0.3694 Acc: 0.8608

val Loss: 0.2890 Acc: 0.8811

Epoch 2/9

----------

train Loss: 0.2966 Acc: 0.8890

val Loss: 0.2631 Acc: 0.9104

Epoch 3/9

----------

train Loss: 0.2680 Acc: 0.8955

val Loss: 0.2434 Acc: 0.9169

Epoch 4/9

----------

train Loss: 0.2539 Acc: 0.9045

val Loss: 0.2390 Acc: 0.9186

Epoch 5/9

----------

train Loss: 0.2495 Acc: 0.9098

val Loss: 0.2258 Acc: 0.9153

Epoch 6/9

----------

train Loss: 0.2585 Acc: 0.9012

val Loss: 0.2307 Acc: 0.9218

Epoch 7/9

----------

train Loss: 0.2089 Acc: 0.9249

val Loss: 0.2128 Acc: 0.9283

Epoch 8/9

----------

train Loss: 0.2109 Acc: 0.9216

val Loss: 0.2127 Acc: 0.9251

Epoch 9/9

----------

train Loss: 0.2108 Acc: 0.9212

val Loss: 0.2137 Acc: 0.9251

训练完成，耗时 20m 10s

最佳验证准确率: 0.928339

第 9 次尝试

选择优化器: AdamW, 学习率: 0.02

Epoch 0/9

----------

train Loss: 1.1329 Acc: 0.7420

val Loss: 0.5245 Acc: 0.8094

Epoch 1/9

----------

train Loss: 0.4030 Acc: 0.8510

val Loss: 0.3810 Acc: 0.8648

Epoch 2/9

----------

train Loss: 0.3202 Acc: 0.8780

val Loss: 0.9355 Acc: 0.7622

Epoch 3/9

----------

train Loss: 0.3788 Acc: 0.8776

val Loss: 0.3531 Acc: 0.8860

Epoch 4/9

----------

train Loss: 0.4286 Acc: 0.8739

val Loss: 0.3035 Acc: 0.8990

Epoch 5/9

----------

train Loss: 0.4161 Acc: 0.8735

val Loss: 0.3095 Acc: 0.9153

Epoch 6/9

----------

train Loss: 0.2552 Acc: 0.9176

val Loss: 0.7119 Acc: 0.8436

Epoch 7/9

----------

train Loss: 0.2214 Acc: 0.9290

val Loss: 0.2571 Acc: 0.9235

Epoch 8/9

----------

train Loss: 0.1441 Acc: 0.9490

val Loss: 0.2567 Acc: 0.9218

Epoch 9/9

----------

train Loss: 0.1498 Acc: 0.9445

val Loss: 0.2489 Acc: 0.9235

训练完成，耗时 20m 2s

最佳验证准确率: 0.923453

最佳验证准确率: 0.9283

最佳优化器: AdamW

最佳学习率: 0.002

评估结果:

准确率: 0.9283

精确率: 0.9282

召回率: 0.9283

F1分数: 0.9282