

Report on comparison between SwinT and pre-trained SwinT On ChestXray14

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Introduction

This report presents an analysis of the performance of the Swin Transformer architecture on the NIH Chest X-rays 14 dataset.

The study encompasses two experiments: training the Swin Transformer from scratch on the dataset and fine-tuning a pre-trained Swin Transformer on ImageNet for the same dataset. These experiments were run ten times each, and their performances were evaluated and compared using the AUC metric. Additionally, a p-value was computed to determine the statistical significance of any differences observed between the two approaches.

Methodology

1. Training Swin Transformer from scratch:

As we can observe, the AUC performance tends to improve from runs 2 to 6, reaching a peak around run 6 with an AUC value of 0.641.

2. Fine-tuning pre-trained Swin Transformer on ImageNet:

These AUC values demonstrate the discriminative power of the fine-tuned Swin Transformer model on the challenging ImageNet dataset. A higher AUC indicates better classification performance, reflecting the model's ability to distinguish between different object categories in the images.

As we can observe, the fine-tuning process has been effective in enhancing the model's capability to accurately classify images.

Results:

Run	AUC (mean) - Swin T model from scratch	AUC (mean)- Fine-tuned Swin T model
1	0.641	0.791
2	0.640	0.792
3	0.640	0.792
4	0.640	0.792
5	0.640	0.792
6	0.641	0.792
7	0.641	0.792
8	0.641	0.792
9	0.641	0.792
10	0.641	0.792

pathology	AUC (mean) - Swin T model from scratch	AUC (mean)- Fine-tuned Swin T model
Atelectasis	0.6041	0.75949
Cardiomegaly	0.6672	0.88147
Effusion	0.6823	0.8031
Infiltration	0.633	0.6899
Mass	0.5297	0.7924
Nodule	0.5688	0.7501
Pneumonia	0.5768	0.6716
Pneumothorax	0.6197	0.8513
Consolidation	0.6649	0.7244
Edema	0.7487	0.8321
Emphysema	0.5685	0.8821
Fibrosis	0.687	0.8066
Pleural_Thickening	0.6131	0.7524
Hernia	0.7699	0.8776
Mean	0.63812	0.79104

Figure 1 Comparison of two methods based on the AUCs

Comparison and p-value computation:

To compare the performances of training the Swin Transformer from scratch and fine-tuning a pre-trained model, a p-value was computed. The p-value determined the statistical significance of any observed differences between the two approaches. A p-value below the significant threshold (e.g., 0.05) indicated a statistically meaningful distinction between the methods. In other words, the difference observed between the methods is unlikely to have occurred by chance alone, and there is likely a true difference between them.

```

✓ [128] import scipy.stats as stats
0s      # Perform t-test
      t_statistic, p_value = stats.ttest_ind(pretrained_scores, scratch_scores)

      print("Test statistic:", t_statistic)
      print("p-value: {:.15f}".format(float(p_value)))

```

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Test statistic: 790.1384803829117
p-value: 0.000000000000000

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✓ # Perform Mann-Whitney U test
0s u_statistic, p_value = stats.mannwhitneyu(pretrained_scores, scratch_scores)

      print("Test statistic (U):", u_statistic)
      print("p-value: {:.15f}".format(float(p_value)))

```

```

📄 Test statistic (U): 100.0
p-value: 0.000063864447504

```

Logs of SwinT from scratch

Epoch 1:

The average AUC is 0.641
The AUC of Atelectasis is 0.6319948250178722
The AUC of Cardiomegaly is 0.6700802836490207
The AUC of Effusion is 0.6842223105726798
The AUC of Infiltration is 0.633659896702811
The AUC of Mass is 0.5258502209694436
The AUC of Nodule is 0.568532385682514
The AUC of Pneumonia is 0.5825681790822096
The AUC of Pneumothorax is 0.6190567433519726
The AUC of Consolidation is 0.6662998949403542
The AUC of Edema is 0.7499142354158376
The AUC of Emphysema is 0.5644961826565373
The AUC of Fibrosis is 0.6876960772538374
The AUC of Pleural Thickening is 0.615578783475369
The AUC of Hernia is **0.7703722478887518**

Epoch 2:

The average AUC is 0.640
The AUC of Atelectasis is 0.6322081088959048
The AUC of Cardiomegaly is 0.6671103616718295
The AUC of Effusion is 0.6834311316976118
The AUC of Infiltration is 0.6334460100534978
The AUC of Mass is 0.5293317559909556
The AUC of Nodule is 0.5680686265455819
The AUC of Pneumonia is 0.5767704655655919
The AUC of Pneumothorax is 0.619778953832449
The AUC of Consolidation is 0.6661044814819788
The AUC of Edema is 0.7504146722648023
The AUC of Emphysema is 0.565438687796455
The AUC of Fibrosis is 0.6866399662795167
The AUC of Pleural Thickening is 0.6144792940592799
The AUC of Hernia is **0.7679619303278532**

Epoch 3:

The average AUC is 0.640
The AUC of Atelectasis is 0.6318481584262037
The AUC of Cardiomegaly is 0.6672519269621406
The AUC of Effusion is 0.6829787415387086
The AUC of Infiltration is 0.6336373855358846
The AUC of Mass is 0.5286754230589731
The AUC of Nodule is 0.5683114934750619
The AUC of Pneumonia is 0.575315390817535
The AUC of Pneumothorax is 0.6197620561044654
The AUC of Consolidation is 0.6653351862356573
The AUC of Edema is 0.749262847116615

The AUC of Emphysema is 0.5662775115874867
The AUC of Fibrosis is 0.6880813922452563
The AUC of Pleural_Thickening is 0.614677674114604
The AUC of Hernia is **0.7698102298295854**

Epoch 4:

The average AUC is 0.640
The AUC of Atelectasis is 0.6318486821643908
The AUC of Cardiomegaly is 0.6672575957461087
The AUC of Effusion is 0.6823532908470333
The AUC of Infiltration is 0.6337237559106524
The AUC of Mass is 0.5290595615659406
The AUC of Nodule is 0.5686395594318353
The AUC of Pneumonia is 0.5749298548302109
The AUC of Pneumothorax is 0.6205147517919111
The AUC of Consolidation is 0.6646081262628976
The AUC of Edema is 0.7491986140243049
The AUC of Emphysema is 0.5701403873540344
The AUC of Fibrosis is 0.6873130622582815
The AUC of Pleural_Thickening is 0.612779976790155
The AUC of Hernia is **0.7705613865302565**

Epoch 5:

The average AUC is 0.640
The AUC of Atelectasis is 0.6315428055426785
The AUC of Cardiomegaly is 0.6674932780495959
The AUC of Effusion is 0.682582341078911
The AUC of Infiltration is 0.6337010336205655
The AUC of Mass is 0.5308110842427834
The AUC of Nodule is 0.5681987098494297
The AUC of Pneumonia is 0.5761938860021143
The AUC of Pneumothorax is 0.6200410634743876
The AUC of Consolidation is 0.6647248335157052
The AUC of Edema is 0.7490061051574276
The AUC of Emphysema is 0.5704748759867068
The AUC of Fibrosis is 0.6873038837108746
The AUC of Pleural_Thickening is 0.6126907479433433
The AUC of Hernia is **0.7711371283953746**

Epoch 6:

The average AUC is 0.641
The AUC of Atelectasis is 0.6316578036862371
The AUC of Cardiomegaly is 0.6669914195297095
The AUC of Effusion is 0.6825592632734838
The AUC of Infiltration is 0.6335124628832378
The AUC of Mass is 0.5311502365375931
The AUC of Nodule is 0.5685841096768821
The AUC of Pneumonia is 0.5767261333468408
The AUC of Pneumothorax is 0.6208279003617608
The AUC of Consolidation is 0.6647825310554374
The AUC of Edema is 0.7491201452119282

The AUC of Emphysema is 0.5709937337399166
The AUC of Fibrosis is 0.6878055449626463
The AUC of Pleural_Thickening is 0.612549166721286
The AUC of Hernia is **0.7722323352189593**

Epoch 7:

The average AUC is 0.641
The AUC of Atelectasis is 0.6314896005230687
The AUC of Cardiomegaly is 0.6676134791169045
The AUC of Effusion is 0.6825427326861987
The AUC of Infiltration is 0.6335260674536609
The AUC of Mass is 0.5312724922832851
The AUC of Nodule is 0.5687346128212352
The AUC of Pneumonia is 0.5770854033982311
The AUC of Pneumothorax is 0.6208301621425696
The AUC of Consolidation is 0.6652730241566629
The AUC of Edema is 0.748793173252002
The AUC of Emphysema is 0.5711765915024352
The AUC of Fibrosis is 0.6879205745871819
The AUC of Pleural_Thickening is 0.6132529213684506
The AUC of Hernia is **0.771917537825181**

Epoch 8:

The average AUC is 0.641
The AUC of Atelectasis is 0.6316618291001712
The AUC of Cardiomegaly is 0.6677814034718871
The AUC of Effusion is 0.6827028565260143
The AUC of Infiltration is 0.6335422485508858
The AUC of Mass is 0.5317338363055535
The AUC of Nodule is 0.5683101464581063
The AUC of Pneumonia is 0.5775536155618751
The AUC of Pneumothorax is 0.6202932987205472
The AUC of Consolidation is 0.6652358647916135
The AUC of Edema is 0.7487799237337684
The AUC of Emphysema is 0.5701860363401767
The AUC of Fibrosis is 0.6871518727930048
The AUC of Pleural_Thickening is 0.6132457293935107
The AUC of Hernia is **0.7709135972441444**

Epoch 9:

The average AUC is 0.641
The AUC of Atelectasis is 0.6315266684883212
The AUC of Cardiomegaly is 0.6673717107795603
The AUC of Effusion is 0.682613128993669
The AUC of Infiltration is 0.633585472270533
The AUC of Mass is 0.5319221351956964
The AUC of Nodule is 0.5686582756788265
The AUC of Pneumonia is 0.5780671317487945
The AUC of Pneumothorax is 0.6204454869306815
The AUC of Consolidation is 0.6653230602234228
The AUC of Edema is 0.7487340864695614

The AUC of Emphysema is 0.5703047065082574
The AUC of Fibrosis is 0.6875522324032778
The AUC of Pleural_Thickening is 0.6132192185629408
The AUC of Hernia is **0.770828721915869**

Epoch 10:

The average AUC is 0.641
The AUC of Atelectasis is 0.6313800929174669
The AUC of Cardiomegaly is 0.6677523964090071
The AUC of Effusion is 0.6825807534085268
The AUC of Infiltration is 0.6335322775181841
The AUC of Mass is 0.5320252775235115
The AUC of Nodule is 0.5684666698866154
The AUC of Pneumonia is 0.5778105155343121
The AUC of Pneumothorax is 0.6203328657209701
The AUC of Consolidation is 0.6653256637134726
The AUC of Edema is 0.7487139019166994
The AUC of Emphysema is 0.5693443867822721
The AUC of Fibrosis is 0.6876952477539696
The AUC of Pleural_Thickening is 0.6130653912677052
The AUC of Hernia is **0.7693316090033834**

Logs of pre-trained SwinT

Epoch 1:

The average AUC is 0.791
The AUC of Atelectasis is 0.7578068751347845
The AUC of Cardiomegaly is 0.882068630725704
The AUC of Effusion is 0.8042148232934574
The AUC of Infiltration is 0.6909734554257134
The AUC of Mass is 0.7939481430838302
The AUC of Nodule is 0.748285495332202
The AUC of Pneumonia is 0.6740131736912978
The AUC of Pneumothorax is 0.8512565583503039
The AUC of Consolidation is 0.7252907181649134
The AUC of Edema is 0.824985086769741
The AUC of Emphysema is 0.8935504564940666
The AUC of Fibrosis is 0.8048442792284225
The AUC of Pleural_Thickening is 0.7491682659412202
The AUC of Hernia is 0.8751062824752006

Epoch 2:

The average AUC is 0.792
The AUC of Atelectasis is 0.7592250873923634
The AUC of Cardiomegaly is 0.8817842817428914
The AUC of Effusion is 0.8039379622571909
The AUC of Infiltration is 0.6898545195537731
The AUC of Mass is 0.7948516754131523
The AUC of Nodule is 0.7501196074578416

The AUC of Pneumonia is 0.6688815782116382
The AUC of Pneumothorax is 0.8517364135231424
The AUC of Consolidation is 0.7267891659757794
The AUC of Edema is 0.8252686402968891
The AUC of Emphysema is 0.89183308554224
The AUC of Fibrosis is 0.8120672150123713
The AUC of Pleural_Thickening is 0.7521019159612242
The AUC of Hernia is 0.8782467519998771

Epoch 3:

The average AUC is 0.792
The AUC of Atelectasis is 0.7599925804254313
The AUC of Cardiomegaly is 0.882011667351316
The AUC of Effusion is 0.8030262528882721
The AUC of Infiltration is 0.6903309511037365
The AUC of Mass is 0.7945115222032202
The AUC of Nodule is 0.749644921414053
The AUC of Pneumonia is 0.6720271575360314
The AUC of Pneumothorax is 0.8520669831790405
The AUC of Consolidation is 0.7254951499887743
The AUC of Edema is 0.8263235346745513
The AUC of Emphysema is 0.8915024056473559
The AUC of Fibrosis is 0.8129886333912524
The AUC of Pleural_Thickening is 0.7535181080312092
The AUC of Hernia is 0.881179798414265

Epoch 4:

The average AUC is 0.792
The AUC of Atelectasis is 0.7602560205492777
The AUC of Cardiomegaly is 0.8820908469521397
The AUC of Effusion is 0.8031141953580558
The AUC of Infiltration is 0.690121822953732
The AUC of Mass is 0.7928594249312771
The AUC of Nodule is 0.7494353355907586
The AUC of Pneumonia is 0.67316540018064
The AUC of Pneumothorax is 0.8518016626879531
The AUC of Consolidation is 0.7248305341552936
The AUC of Edema is 0.8261389456716486
The AUC of Emphysema is 0.8910390204996387
The AUC of Fibrosis is 0.8146255136518412
The AUC of Pleural_Thickening is 0.752288920266621
The AUC of Hernia is 0.8781998993820831

Epoch 5:

The average AUC is 0.792
The AUC of Atelectasis is 0.7603907641623493
The AUC of Cardiomegaly is 0.8817648968411665
The AUC of Effusion is 0.8031306399386835
The AUC of Infiltration is 0.690537786668749
The AUC of Mass is 0.7924172516761488
The AUC of Nodule is 0.7509176397440676

The AUC of Pneumonia is 0.6730023583183512
The AUC of Pneumothorax is 0.8514000630577861
The AUC of Consolidation is 0.7248299988923425
The AUC of Edema is 0.8260351687234555
The AUC of Emphysema is 0.8899729317480385
The AUC of Fibrosis is 0.8134579920247903
The AUC of Pleural_Thickening is 0.752845102327051
The AUC of Hernia is 0.8769252854361327

Epoch 6:

The average AUC is 0.792
The AUC of Atelectasis is 0.7601543561037547
The AUC of Cardiomegaly is 0.8817421669953499
The AUC of Effusion is 0.8032925572406857
The AUC of Infiltration is 0.6904552745746989
The AUC of Mass is 0.7923335765899778
The AUC of Nodule is 0.7511135255190516
The AUC of Pneumonia is 0.6723534756306007
The AUC of Pneumothorax is 0.8512932045003293
The AUC of Consolidation is 0.725337165427731
The AUC of Edema is 0.825874430925909
The AUC of Emphysema is 0.8904216770527439
The AUC of Fibrosis is 0.8139412278699945
The AUC of Pleural_Thickening is 0.7530121071761158
The AUC of Hernia is 0.876926579216981

Epoch 7:

The average AUC is 0.792
The AUC of Atelectasis is 0.7601693453284136
The AUC of Cardiomegaly is 0.8819633617487139
The AUC of Effusion is 0.8033728189851754
The AUC of Infiltration is 0.6905795812045425
The AUC of Mass is 0.7925874890447508
The AUC of Nodule is 0.7512084051752137
The AUC of Pneumonia is 0.671596610589128
The AUC of Pneumothorax is 0.8515128775683257
The AUC of Consolidation is 0.7255122770864755
The AUC of Edema is 0.8257287545364181
The AUC of Emphysema is 0.8902357928141637
The AUC of Fibrosis is 0.8139416353812418
The AUC of Pleural_Thickening is 0.7535675225637146
The AUC of Hernia is 0.8779367589979872

Epoch 8:

The average AUC is 0.792
The AUC of Atelectasis is 0.7605931648465318
The AUC of Cardiomegaly is 0.8819235021524942
The AUC of Effusion is 0.8031944313980679
The AUC of Infiltration is 0.6907238810579698
The AUC of Mass is 0.7919582298416123
The AUC of Nodule is 0.7512340254951235

The AUC of Pneumonia is 0.6713972072100074
The AUC of Pneumothorax is 0.8515576029869938
The AUC of Consolidation is 0.7253351834458264
The AUC of Edema is 0.8255061328883102
The AUC of Emphysema is 0.8905896684393318
The AUC of Fibrosis is 0.8135588145902646
The AUC of Pleural_Thickening is 0.7535955301593369
The AUC of Hernia is 0.8787542160155304

Epoch 9:

The average AUC is 0.792
The AUC of Atelectasis is 0.7602432239870542
The AUC of Cardiomegaly is 0.8821728329424918
The AUC of Effusion is 0.8031316175566093
The AUC of Infiltration is 0.6908770387472961
The AUC of Mass is 0.7924017026310715
The AUC of Nodule is 0.7513221003740274
The AUC of Pneumonia is 0.6716609187402768
The AUC of Pneumothorax is 0.8520950817358287
The AUC of Consolidation is 0.7252437463135057
The AUC of Edema is 0.8256193372252103
The AUC of Emphysema is 0.8908014751222535
The AUC of Fibrosis is 0.8135083930688156
The AUC of Pleural_Thickening is 0.7538044436704417
The AUC of Hernia is 0.8784899309305556

Epoch 10:

The average AUC is 0.792
The AUC of Atelectasis is 0.7599849769667075
The AUC of Cardiomegaly is 0.8817878540338372
The AUC of Effusion is 0.8032519466292893
The AUC of Infiltration is 0.6908397472231521
The AUC of Mass is 0.7920507171048714
The AUC of Nodule is 0.7511374130397538
The AUC of Pneumonia is 0.671224966467147
The AUC of Pneumothorax is 0.8521391740253003
The AUC of Consolidation is 0.7249803153719381
The AUC of Edema is 0.8253929018708248
The AUC of Emphysema is 0.8906004214803516
The AUC of Fibrosis is 0.8140412580472747
The AUC of Pleural_Thickening is 0.7541904979649386
The AUC of Hernia is 0.8790629975690404