Experimental Results

```python
In [1]: import sys
        sys.path.append('/home/kelvin.wong/Developer/chexpert-fusion/fusion_experiments/')

        import os
        import torch
        import tempfile
        import numpy as np
        import pandas as pd
        import seaborn as sns
        import sklearn.metrics
        import matplotlib.pyplot as plt

        from config.chexpert import PAPER_TRAINING_CLASSES

        %matplotlib inline
```

```
/home/kelvin.wong/.cache/bazel/_bazel_kelvin.wong/47fc07a62b8a2107c2e1b
04eb7772dd1/execroot/__main__/bazel-out/release_links/lib/python_env/IP
ython/html.py:14: ShimWarning: The `IPython.html` package has been depr
ecated since IPython 4.0. You should import from `notebook` instead. `I
Python.html.widgets` has moved to `ipywidgets`.
  "`IPython.html.widgets` has moved to `ipywidgets`.", ShimWarning)
```

```python
In [2]: NUM_GPUS = '1'
        BATCH_SIZE = '100'
        LABEL_CLASS = 'paper'
        OUTDIR = tempfile.mkdtemp()

        MIMIC_DATASET_PATH = '/home/kelvin.wong/Datasets/MIMIC-CXR'
        CHEXPERT_DATASET_PATH = '/home/kelvin.wong/Datasets/CheXpert-v1.0'

        EVALUATION_ARGUMENTS = [
            '--evaluate-once',
            '--use-test-set',
            '--cuda-benchmark',
            '--map-unobserved-to-negative',
            '--label-class',    LABEL_CLASS,
            '--num-gpus',       NUM_GPUS,
            '--val-batch-size', BATCH_SIZE,
            '--outdir',         OUTDIR,
        ]

        CHEXPERT_EVALUATION_ARGUMENTS = EVALUATION_ARGUMENTS + [
            '--dataset-class', 'PairedOnlyCustomSplit',
            '--train-data',    CHEXPERT_DATASET_PATH,
            '--val-data',      CHEXPERT_DATASET_PATH,
        ]

        MIMIC_EVALUATION_ARGUMENTS = EVALUATION_ARGUMENTS + [
            '--dataset-class', 'PairedOnlyMIMICDataset',
            '--train-data',    MIMIC_DATASET_PATH,
            '--val-data',      MIMIC_DATASET_PATH,
        ]
```

1. Single View Baselines

1.1 CheXpert Test Metrics

In [3]:
```python
from experiments.fusion_baselines.train_baselines import train_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/baseline_fron
tal/models/model_best.pth.tar'
frontal_baseline_chexpert_metrics = train_baselines(CHEXPERT_EVALUATION_
ARGUMENTS + ['--view', 'frontal', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/baseline_frontal/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=-1, label_class='paper', learning_
rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, norma
lization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdi
r='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tr
ain_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.
0', use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/
Datasets/CheXpert-v1.0', val_frequency=4800, view='frontal')
Val Epoch 28 [1/8]: Loss - 0.3170 Val Time - 6.2826 Forward Time - 6.22
97 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8094 AP - 0.4
740
Val Epoch 28 [2/8]: Loss - 0.3547 Val Time - 0.4884 Forward Time - 0.02
61 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8001 AP - 0.4
716
Val Epoch 28 [3/8]: Loss - 0.3746 Val Time - 0.4983 Forward Time - 0.02
25 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.7749 AP - 0.4
179
Val Epoch 28 [4/8]: Loss - 0.3102 Val Time - 0.4903 Forward Time - 0.01
93 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.7850 AP - 0.4
256
Val Epoch 28 [5/8]: Loss - 0.2761 Val Time - 0.4898 Forward Time - 0.01
89 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.7841 AP - 0.4
112
Val Epoch 28 [6/8]: Loss - 0.3204 Val Time - 0.4911 Forward Time - 0.01
90 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.7868 AP - 0.4
047
Val Epoch 28 [7/8]: Loss - 0.3524 Val Time - 0.5343 Forward Time - 0.01
97 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.7786 AP - 0.3
936
Val Epoch 28 [8/8]: Loss - 0.2968 Val Time - 2.6264 Forward Time - 2.62
16 Learning Rate - 0.0000 Memory - 0.098940928 GB AUC - 0.7794 AP - 0.3
952
Saving checkpoint /tmp/tmpmlz1uY/models/model_22500.pth.tar.
```

```python
In [4]: from experiments.fusion_baselines.train_baselines import train_baselines

        checkpoint = '/home/kelvin.wong/experiments/chexpert_train/baseline_late
        ral/models/model_best.pth.tar'
        lateral_baseline_chexpert_metrics = train_baselines(CHEXPERT_EVALUATION_
        ARGUMENTS + ['--view', 'lateral', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/baseline_lateral/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=-1, label_class='paper', learning_
rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, norma
lization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdi
r='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tr
ain_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.
0', use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/
Datasets/CheXpert-v1.0', val_frequency=4800, view='lateral')
Val Epoch 29 [1/8]: Loss - 0.3282 Val Time - 0.4973 Forward Time - 0.04
01 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7500 AP - 0.4
078
Val Epoch 29 [2/8]: Loss - 0.3604 Val Time - 0.4870 Forward Time - 0.03
56 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7632 AP - 0.4
065
Val Epoch 29 [3/8]: Loss - 0.3614 Val Time - 0.4902 Forward Time - 0.01
99 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7581 AP - 0.3
620
Val Epoch 29 [4/8]: Loss - 0.2804 Val Time - 0.4912 Forward Time - 0.01
92 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7781 AP - 0.3
882
Val Epoch 29 [5/8]: Loss - 0.2819 Val Time - 0.4867 Forward Time - 0.01
87 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7771 AP - 0.3
811
Val Epoch 29 [6/8]: Loss - 0.3121 Val Time - 0.4922 Forward Time - 0.01
85 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7819 AP - 0.3
859
Val Epoch 29 [7/8]: Loss - 0.3612 Val Time - 0.4892 Forward Time - 0.01
82 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7735 AP - 0.3
727
Val Epoch 29 [8/8]: Loss - 0.3349 Val Time - 0.0373 Forward Time - 0.01
90 Learning Rate - 0.0000 Memory - 0.127219712 GB AUC - 0.7739 AP - 0.3
725
Saving checkpoint /tmp/tmpmlz1uY/models/model_23000.pth.tar.
```

1.2 MIMIC CXR Valid Metrics

In [5]:
```python
from experiments.fusion_baselines.train_baselines import train_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/baseline_fron
tal/models/model_best.pth.tar'
frontal_baseline_mimic_metrics = train_baselines(MIMIC_EVALUATION_ARGUME
NTS + ['--view', 'frontal', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/baseline_frontal/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=-1, label_class='paper', learning_
rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, norma
lization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdi
r='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tr
ain_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', us
e_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Datase
ts/MIMIC-CXR', val_frequency=4800, view='frontal')
Val Epoch 28 [1/9]: Loss - 0.2695 Val Time - 0.5225 Forward Time - 0.03
85 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.8139 AP - 0.3
831
Val Epoch 28 [2/9]: Loss - 0.1948 Val Time - 0.4930 Forward Time - 0.03
52 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.8463 AP - 0.3
616
Val Epoch 28 [3/9]: Loss - 0.2856 Val Time - 0.4987 Forward Time - 0.02
01 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.8085 AP - 0.3
462
Val Epoch 28 [4/9]: Loss - 0.1953 Val Time - 0.4903 Forward Time - 0.01
97 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.8088 AP - 0.3
402
Val Epoch 28 [5/9]: Loss - 0.2264 Val Time - 0.4913 Forward Time - 0.01
95 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.7975 AP - 0.3
277
Val Epoch 28 [6/9]: Loss - 0.2500 Val Time - 0.4883 Forward Time - 0.01
95 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.8041 AP - 0.3
336
Val Epoch 28 [7/9]: Loss - 0.2261 Val Time - 0.4876 Forward Time - 0.02
00 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.8076 AP - 0.3
435
Val Epoch 28 [8/9]: Loss - 0.2322 Val Time - 0.4867 Forward Time - 0.01
98 Learning Rate - 0.0000 Memory - 0.358170112 GB AUC - 0.8109 AP - 0.3
425
Val Epoch 28 [9/9]: Loss - 0.2184 Val Time - 4.9454 Forward Time - 4.92
19 Learning Rate - 0.0000 Memory - 0.30888704 GB AUC - 0.8143 AP - 0.33
39
Saving checkpoint /tmp/tmpmlz1uY/models/model_22500.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_22500.pth.tar.
```

In [6]:
```python
from experiments.fusion_baselines.train_baselines import train_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/baseline_lateral/models/model_best.pth.tar'
lateral_baseline_mimic_metrics = train_baselines(MIMIC_EVALUATION_ARGUMENTS + ['--view', 'lateral', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/baseline_lateral/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=-1, label_class='paper', learning_
rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, norma
lization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdi
r='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tr
ain_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', us
e_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Datase
ts/MIMIC-CXR', val_frequency=4800, view='lateral')
Val Epoch 29 [1/9]: Loss - 0.3160 Val Time - 0.5109 Forward Time - 0.04
03 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.7629 AP - 0.3
926
Val Epoch 29 [2/9]: Loss - 0.2128 Val Time - 0.4824 Forward Time - 0.02
94 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8006 AP - 0.3
825
Val Epoch 29 [3/9]: Loss - 0.2949 Val Time - 0.4867 Forward Time - 0.02
09 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8001 AP - 0.3
790
Val Epoch 29 [4/9]: Loss - 0.2182 Val Time - 0.4850 Forward Time - 0.01
99 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8073 AP - 0.3
670
Val Epoch 29 [5/9]: Loss - 0.2471 Val Time - 0.4856 Forward Time - 0.01
96 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8057 AP - 0.3
688
Val Epoch 29 [6/9]: Loss - 0.2839 Val Time - 0.4864 Forward Time - 0.01
99 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8014 AP - 0.3
634
Val Epoch 29 [7/9]: Loss - 0.2721 Val Time - 0.4844 Forward Time - 0.01
95 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.7990 AP - 0.3
556
Val Epoch 29 [8/9]: Loss - 0.2609 Val Time - 0.4894 Forward Time - 0.01
94 Learning Rate - 0.0000 Memory - 0.329891328 GB AUC - 0.8085 AP - 0.3
548
Val Epoch 29 [9/9]: Loss - 0.2242 Val Time - 0.3915 Forward Time - 0.03
86 Learning Rate - 0.0000 Memory - 0.280608256 GB AUC - 0.8187 AP - 0.3
544
Saving checkpoint /tmp/tmpmlz1uY/models/model_23000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_23000.pth.tar.
```

2. Multi-view Fusion Baselines

2.1 CheXpert Test Metrics

In [7]:
```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_0/models/model_best.pth.tar'
fusion_baseline_0_chexpert_metrics = train_fusion_baselines(CHEXPERT_EVA
LUATION_ARGUMENTS + ['--fusion-index', '0', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_0/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=0, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.0',
use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Data
sets/CheXpert-v1.0', val_frequency=4800)
Val Epoch 31 [1/8]: Loss - 0.3239 Val Time - 2.7306 Forward Time - 2.68
45 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.7949 AP - 0.4
703
Val Epoch 31 [2/8]: Loss - 0.3521 Val Time - 0.6835 Forward Time - 0.34
51 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.7921 AP - 0.4
439
Val Epoch 31 [3/8]: Loss - 0.3573 Val Time - 0.5793 Forward Time - 0.02
44 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.7840 AP - 0.4
071
Val Epoch 31 [4/8]: Loss - 0.2746 Val Time - 0.5753 Forward Time - 0.02
19 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8012 AP - 0.4
303
Val Epoch 31 [5/8]: Loss - 0.2714 Val Time - 0.5802 Forward Time - 0.02
15 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8034 AP - 0.4
231
Val Epoch 31 [6/8]: Loss - 0.3074 Val Time - 0.5826 Forward Time - 0.02
14 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8063 AP - 0.4
219
Val Epoch 31 [7/8]: Loss - 0.3493 Val Time - 0.5788 Forward Time - 0.02
14 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.7972 AP - 0.4
077
Val Epoch 31 [8/8]: Loss - 0.3859 Val Time - 1.2319 Forward Time - 1.22
56 Learning Rate - 0.0001 Memory - 0.108600832 GB AUC - 0.7973 AP - 0.4
064
Saving checkpoint /tmp/tmpmlz1uY/models/model_24000.pth.tar.
```

In [8]:
```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_1/models/model_best.pth.tar'
fusion_baseline_1_chexpert_metrics = train_fusion_baselines(CHEXPERT_EVA
LUATION_ARGUMENTS + ['--fusion-index', '1', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_1/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=1, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.0',
use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Data
sets/CheXpert-v1.0', val_frequency=4800)
Val Epoch 36 [1/8]: Loss - 0.3076 Val Time - 1.6320 Forward Time - 1.58
96 Learning Rate - 0.0001 Memory - 0.349226496 GB AUC - 0.8031 AP - 0.4
737
Val Epoch 36 [2/8]: Loss - 0.3371 Val Time - 0.7745 Forward Time - 0.05
26 Learning Rate - 0.0001 Memory - 0.349226496 GB AUC - 0.8093 AP - 0.4
689
Val Epoch 36 [3/8]: Loss - 0.3451 Val Time - 0.7468 Forward Time - 0.02
66 Learning Rate - 0.0001 Memory - 0.349226496 GB AUC - 0.7989 AP - 0.4
367
Val Epoch 36 [4/8]: Loss - 0.2650 Val Time - 0.7793 Forward Time - 0.02
30 Learning Rate - 0.0001 Memory - 0.349226496 GB AUC - 0.8147 AP - 0.4
745
Val Epoch 36 [5/8]: Loss - 0.2723 Val Time - 0.7900 Forward Time - 0.02
33 Learning Rate - 0.0001 Memory - 0.349226496 GB AUC - 0.8146 AP - 0.4
606
Val Epoch 36 [6/8]: Loss - 0.2943 Val Time - 0.8244 Forward Time - 0.04
29 Learning Rate - 0.0001 Memory - 0.349226496 GB AUC - 0.8155 AP - 0.4
555
Val Epoch 36 [7/8]: Loss - 0.3347 Val Time - 0.7826 Forward Time - 0.02
75 Learning Rate - 0.0001 Memory - 0.349226496 GB AUC - 0.8104 AP - 0.4
415
Val Epoch 36 [8/8]: Loss - 0.3297 Val Time - 0.7340 Forward Time - 0.72
73 Learning Rate - 0.0001 Memory - 0.118276096 GB AUC - 0.8101 AP - 0.4
431
Saving checkpoint /tmp/tmpmlz1uY/models/model_28000.pth.tar.
```

```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_2/models/model_best.pth.tar'
fusion_baseline_2_chexpert_metrics = train_fusion_baselines(CHEXPERT_EVA
LUATION_ARGUMENTS + ['--fusion-index', '2', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_2/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=2, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.0',
use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Data
sets/CheXpert-v1.0', val_frequency=4800)
Val Epoch 11 [1/8]: Loss – 0.2977 Val Time – 1.7841 Forward Time – 1.73
31 Learning Rate – 0.0001 Memory – 0.414166528 GB AUC – 0.8145 AP – 0.5
123
Val Epoch 11 [2/8]: Loss – 0.3374 Val Time – 0.8760 Forward Time – 0.05
73 Learning Rate – 0.0001 Memory – 0.414166528 GB AUC – 0.8138 AP – 0.4
771
Val Epoch 11 [3/8]: Loss – 0.3330 Val Time – 0.8556 Forward Time – 0.03
10 Learning Rate – 0.0001 Memory – 0.414166528 GB AUC – 0.8065 AP – 0.4
381
Val Epoch 11 [4/8]: Loss – 0.2682 Val Time – 0.8584 Forward Time – 0.02
68 Learning Rate – 0.0001 Memory – 0.414166528 GB AUC – 0.8208 AP – 0.4
701
Val Epoch 11 [5/8]: Loss – 0.2595 Val Time – 0.8536 Forward Time – 0.02
64 Learning Rate – 0.0001 Memory – 0.414166528 GB AUC – 0.8199 AP – 0.4
686
Val Epoch 11 [6/8]: Loss – 0.2869 Val Time – 0.8556 Forward Time – 0.02
64 Learning Rate – 0.0001 Memory – 0.414166528 GB AUC – 0.8233 AP – 0.4
623
Val Epoch 11 [7/8]: Loss – 0.3293 Val Time – 0.8561 Forward Time – 0.02
64 Learning Rate – 0.0001 Memory – 0.414166528 GB AUC – 0.8160 AP – 0.4
472
Val Epoch 11 [8/8]: Loss – 0.3388 Val Time – 0.4924 Forward Time – 0.48
57 Learning Rate – 0.0001 Memory – 0.183216128 GB AUC – 0.8159 AP – 0.4
464
Saving checkpoint /tmp/tmpmlz1uY/models/model_22500.pth.tar.
```

In [10]:
```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_3/models/model_best.pth.tar'
fusion_baseline_3_chexpert_metrics = train_fusion_baselines(CHEXPERT_EVA
LUATION_ARGUMENTS + ['--fusion-index', '3', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_3/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=3, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.0',
use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Data
sets/CheXpert-v1.0', val_frequency=4800)
Val Epoch 48 [1/8]: Loss - 0.3031 Val Time - 1.5605 Forward Time - 1.50
25 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8112 AP - 0.5
111
Val Epoch 48 [2/8]: Loss - 0.3129 Val Time - 1.0120 Forward Time - 0.08
55 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8249 AP - 0.5
116
Val Epoch 48 [3/8]: Loss - 0.3321 Val Time - 0.9431 Forward Time - 0.03
64 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8134 AP - 0.4
622
Val Epoch 48 [4/8]: Loss - 0.2517 Val Time - 0.9733 Forward Time - 0.03
65 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8259 AP - 0.4
944
Val Epoch 48 [5/8]: Loss - 0.2679 Val Time - 0.9596 Forward Time - 0.03
75 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8242 AP - 0.4
897
Val Epoch 48 [6/8]: Loss - 0.2966 Val Time - 0.9492 Forward Time - 0.03
63 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8240 AP - 0.4
880
Val Epoch 48 [7/8]: Loss - 0.3368 Val Time - 0.9447 Forward Time - 0.03
61 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8196 AP - 0.4
703
Val Epoch 48 [8/8]: Loss - 0.3247 Val Time - 0.3567 Forward Time - 0.34
77 Learning Rate - 0.0001 Memory - 0.241542144 GB AUC - 0.8195 AP - 0.4
715
Saving checkpoint /tmp/tmpmlz1uY/models/model_37500.pth.tar.
```

```
In [11]: from experiments.fusion_baselines.train_fusion_baselines import train_fu
         sion_baselines

         checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
         nes_4/models/model_best.pth.tar'
         fusion_baseline_4_chexpert_metrics = train_fusion_baselines(CHEXPERT_EVA
         LUATION_ARGUMENTS + ['--fusion-index', '4', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_4/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=4, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.0',
use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Data
sets/CheXpert-v1.0', val_frequency=4800)
Val Epoch 50 [1/8]: Loss - 0.3084 Val Time - 1.1636 Forward Time - 1.11
04 Learning Rate - 0.0001 Memory - 0.42644224 GB AUC - 0.8070 AP - 0.48
60
Val Epoch 50 [2/8]: Loss - 0.3486 Val Time - 0.9921 Forward Time - 0.28
01 Learning Rate - 0.0001 Memory - 0.42644224 GB AUC - 0.8068 AP - 0.47
58
Val Epoch 50 [3/8]: Loss - 0.3323 Val Time - 0.9736 Forward Time - 0.28
12 Learning Rate - 0.0001 Memory - 0.42644224 GB AUC - 0.8002 AP - 0.45
49
Val Epoch 50 [4/8]: Loss - 0.2571 Val Time - 0.9814 Forward Time - 0.29
39 Learning Rate - 0.0001 Memory - 0.42644224 GB AUC - 0.8149 AP - 0.48
39
Val Epoch 50 [5/8]: Loss - 0.2634 Val Time - 0.9622 Forward Time - 0.28
48 Learning Rate - 0.0001 Memory - 0.42644224 GB AUC - 0.8145 AP - 0.47
72
Val Epoch 50 [6/8]: Loss - 0.2914 Val Time - 0.9570 Forward Time - 0.28
32 Learning Rate - 0.0001 Memory - 0.42644224 GB AUC - 0.8183 AP - 0.47
75
Val Epoch 50 [7/8]: Loss - 0.3228 Val Time - 0.9555 Forward Time - 0.28
16 Learning Rate - 0.0001 Memory - 0.42644224 GB AUC - 0.8138 AP - 0.46
40
Val Epoch 50 [8/8]: Loss - 0.2733 Val Time - 0.1324 Forward Time - 0.12
35 Learning Rate - 0.0001 Memory - 0.19549184 GB AUC - 0.8145 AP - 0.46
61
Saving checkpoint /tmp/tmpmlz1uY/models/model_39750.pth.tar.
```

2.2 MIMIC CXR Valid Metrics

In [12]:
```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_0/models/model_best.pth.tar'
fusion_baseline_0_mimic_metrics = train_fusion_baselines(MIMIC_EVALUATIO
N_ARGUMENTS + ['--fusion-index', '0', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_0/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=0, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', use
_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Dataset
s/MIMIC-CXR', val_frequency=4800)
Val Epoch 31 [1/9]: Loss - 0.2719 Val Time - 0.5924 Forward Time - 0.06
87 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8166 AP - 0.4
147
Val Epoch 31 [2/9]: Loss - 0.1901 Val Time - 0.5798 Forward Time - 0.02
52 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8495 AP - 0.3
998
Val Epoch 31 [3/9]: Loss - 0.2760 Val Time - 0.5805 Forward Time - 0.02
20 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8545 AP - 0.4
109
Val Epoch 31 [4/9]: Loss - 0.1873 Val Time - 0.5876 Forward Time - 0.02
14 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8557 AP - 0.4
102
Val Epoch 31 [5/9]: Loss - 0.2113 Val Time - 0.5924 Forward Time - 0.02
18 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8571 AP - 0.4
178
Val Epoch 31 [6/9]: Loss - 0.2604 Val Time - 0.5924 Forward Time - 0.02
16 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8526 AP - 0.3
973
Val Epoch 31 [7/9]: Loss - 0.2458 Val Time - 0.5802 Forward Time - 0.02
19 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8506 AP - 0.3
922
Val Epoch 31 [8/9]: Loss - 0.2479 Val Time - 0.5899 Forward Time - 0.02
26 Learning Rate - 0.0001 Memory - 0.339551232 GB AUC - 0.8508 AP - 0.3
913
Val Epoch 31 [9/9]: Loss - 0.2085 Val Time - 2.2534 Forward Time - 2.22
97 Learning Rate - 0.0001 Memory - 0.29026816 GB AUC - 0.8543 AP - 0.39
15
Saving checkpoint /tmp/tmpmlz1uY/models/model_24000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_24000.pth.tar.
```

In [13]:
```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_1/models/model_best.pth.tar'
fusion_baseline_1_mimic_metrics = train_fusion_baselines(MIMIC_EVALUATIO
N_ARGUMENTS + ['--fusion-index', '1', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_1/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=1, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', use
_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Dataset
s/MIMIC-CXR', val_frequency=4800)
Val Epoch 36 [1/9]: Loss - 0.2823 Val Time - 0.7873 Forward Time - 0.03
47 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.7956 AP - 0.42
83
Val Epoch 36 [2/9]: Loss - 0.1970 Val Time - 0.8017 Forward Time - 0.03
54 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.8351 AP - 0.44
05
Val Epoch 36 [3/9]: Loss - 0.2709 Val Time - 0.7763 Forward Time - 0.02
44 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.8457 AP - 0.41
59
Val Epoch 36 [4/9]: Loss - 0.1807 Val Time - 0.7642 Forward Time - 0.02
34 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.8574 AP - 0.41
72
Val Epoch 36 [5/9]: Loss - 0.2079 Val Time - 0.7682 Forward Time - 0.02
29 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.8554 AP - 0.41
86
Val Epoch 36 [6/9]: Loss - 0.2539 Val Time - 0.7441 Forward Time - 0.02
33 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.8525 AP - 0.41
64
Val Epoch 36 [7/9]: Loss - 0.2312 Val Time - 0.7632 Forward Time - 0.02
27 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.8490 AP - 0.41
44
Val Epoch 36 [8/9]: Loss - 0.2478 Val Time - 0.7737 Forward Time - 0.04
05 Learning Rate - 0.0001 Memory - 0.38399232 GB AUC - 0.8494 AP - 0.40
75
Val Epoch 36 [9/9]: Loss - 0.2062 Val Time - 1.5213 Forward Time - 1.49
63 Learning Rate - 0.0001 Memory - 0.334709248 GB AUC - 0.8569 AP - 0.4
090
Saving checkpoint /tmp/tmpmlz1uY/models/model_28000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_28000.pth.tar.
```

```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_2/models/model_best.pth.tar'
fusion_baseline_2_mimic_metrics = train_fusion_baselines(MIMIC_EVALUATIO
N_ARGUMENTS + ['--fusion-index', '2', '--checkpoint', checkpoint])
```

In [14]:

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_2/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=2, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', use
_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Dataset
s/MIMIC-CXR', val_frequency=4800)
Val Epoch 11 [1/9]: Loss - 0.2926 Val Time - 0.8790 Forward Time - 0.05
94 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8296 AP - 0.4
276
Val Epoch 11 [2/9]: Loss - 0.2035 Val Time - 0.8534 Forward Time - 0.05
06 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8556 AP - 0.4
347
Val Epoch 11 [3/9]: Loss - 0.2762 Val Time - 0.8556 Forward Time - 0.02
82 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8611 AP - 0.4
426
Val Epoch 11 [4/9]: Loss - 0.1901 Val Time - 0.8545 Forward Time - 0.02
84 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8681 AP - 0.4
519
Val Epoch 11 [5/9]: Loss - 0.2355 Val Time - 0.8602 Forward Time - 0.02
84 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8659 AP - 0.4
443
Val Epoch 11 [6/9]: Loss - 0.2686 Val Time - 0.8688 Forward Time - 0.02
82 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8632 AP - 0.4
380
Val Epoch 11 [7/9]: Loss - 0.2408 Val Time - 0.8536 Forward Time - 0.02
79 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8605 AP - 0.4
364
Val Epoch 11 [8/9]: Loss - 0.2665 Val Time - 0.8542 Forward Time - 0.02
81 Learning Rate - 0.0001 Memory - 0.414166528 GB AUC - 0.8586 AP - 0.4
307
Val Epoch 11 [9/9]: Loss - 0.2353 Val Time - 1.5660 Forward Time - 1.54
08 Learning Rate - 0.0001 Memory - 0.364883456 GB AUC - 0.8628 AP - 0.4
243
Saving checkpoint /tmp/tmpmlz1uY/models/model_22500.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_22500.pth.tar.
```

In [15]:
```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_3/models/model_best.pth.tar'
fusion_baseline_3_mimic_metrics = train_fusion_baselines(MIMIC_EVALUATIO
N_ARGUMENTS + ['--fusion-index', '3', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_3/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=3, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', use
_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Dataset
s/MIMIC-CXR', val_frequency=4800)
Val Epoch 48 [1/9]: Loss - 0.2737 Val Time - 0.9654 Forward Time - 0.05
17 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8238 AP - 0.4
320
Val Epoch 48 [2/9]: Loss - 0.1950 Val Time - 0.9431 Forward Time - 0.05
52 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8486 AP - 0.4
312
Val Epoch 48 [3/9]: Loss - 0.2753 Val Time - 0.9455 Forward Time - 0.03
68 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8515 AP - 0.4
221
Val Epoch 48 [4/9]: Loss - 0.1786 Val Time - 0.9504 Forward Time - 0.03
63 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8638 AP - 0.4
488
Val Epoch 48 [5/9]: Loss - 0.2031 Val Time - 0.9441 Forward Time - 0.03
59 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8633 AP - 0.4
523
Val Epoch 48 [6/9]: Loss - 0.2616 Val Time - 0.9598 Forward Time - 0.03
66 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8575 AP - 0.4
410
Val Epoch 48 [7/9]: Loss - 0.2277 Val Time - 0.9440 Forward Time - 0.03
70 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8550 AP - 0.4
328
Val Epoch 48 [8/9]: Loss - 0.2443 Val Time - 0.9481 Forward Time - 0.03
67 Learning Rate - 0.0001 Memory - 0.472492544 GB AUC - 0.8540 AP - 0.4
233
Val Epoch 48 [9/9]: Loss - 0.2172 Val Time - 1.2811 Forward Time - 1.25
30 Learning Rate - 0.0001 Memory - 0.423209472 GB AUC - 0.8605 AP - 0.4
209
Saving checkpoint /tmp/tmpmlz1uY/models/model_37500.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_37500.pth.tar.
```

In [16]:
```python
from experiments.fusion_baselines.train_fusion_baselines import train_fu
sion_baselines

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/fusion_baseli
nes_4/models/model_best.pth.tar'
fusion_baseline_4_mimic_metrics = train_fusion_baselines(MIMIC_EVALUATIO
N_ARGUMENTS + ['--fusion-index', '4', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/fusion_baselines_4/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=4, label_class='paper', learning_r
ate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normal
ization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', use
_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/Dataset
s/MIMIC-CXR', val_frequency=4800)
Val Epoch 50 [1/9]: Loss - 0.2762 Val Time - 1.0990 Forward Time - 0.30
49 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8040 AP - 0.4
127
Val Epoch 50 [2/9]: Loss - 0.1854 Val Time - 0.9738 Forward Time - 0.30
43 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8402 AP - 0.4
167
Val Epoch 50 [3/9]: Loss - 0.2681 Val Time - 1.0388 Forward Time - 0.30
47 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8414 AP - 0.4
323
Val Epoch 50 [4/9]: Loss - 0.1808 Val Time - 1.0405 Forward Time - 0.30
28 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8511 AP - 0.4
367
Val Epoch 50 [5/9]: Loss - 0.2026 Val Time - 0.9797 Forward Time - 0.27
88 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8498 AP - 0.4
331
Val Epoch 50 [6/9]: Loss - 0.2494 Val Time - 0.9558 Forward Time - 0.28
11 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8441 AP - 0.4
268
Val Epoch 50 [7/9]: Loss - 0.2220 Val Time - 0.9485 Forward Time - 0.28
14 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8427 AP - 0.4
371
Val Epoch 50 [8/9]: Loss - 0.2267 Val Time - 0.9598 Forward Time - 0.28
77 Learning Rate - 0.0001 Memory - 0.487583232 GB AUC - 0.8450 AP - 0.4
375
Val Epoch 50 [9/9]: Loss - 0.2030 Val Time - 0.9222 Forward Time - 0.89
34 Learning Rate - 0.0001 Memory - 0.43830016 GB AUC - 0.8521 AP - 0.43
56
Saving checkpoint /tmp/tmpmlz1uY/models/model_39750.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_39750.pth.tar.
```

3. Volumetric Fusion

3.1 CheXpert Test Metrics

```python
In [17]: from experiments.fusion_baselines.train_volumetric_fusion import train_v
         olumetric_fusion

         checkpoint = '/home/kelvin.wong/experiments/chexpert_train/volumetric_fu
         sion/models/model_best.pth.tar'
         volumetric_fusion_chexpert_metrics = train_volumetric_fusion(CHEXPERT_EV
         ALUATION_ARGUMENTS + ['--val-batch-size', '8', '--checkpoint', checkpoin
         t])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/volumetric_fusion/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustomSpli
t', evaluate_once=True, fusion_index=-1, is_big=False, label_class='pap
er', learning_rate=0.0001, log_frequency=1000, map_unobserved_to_negati
ve=True, normalization='batchnorm2d', num_epochs=10, num_gpus=1, num_wo
rkers=8, outdir='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shu
ffle=False, train_batch_size=1, train_data='/home/kelvin.wong/Datasets/
CheXpert-v1.0', use_2d_conv=False, use_test_set=True, val_batch_size=8,
val_data='/home/kelvin.wong/Datasets/CheXpert-v1.0', val_frequency=480
0)
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 40 [1/89]: Loss – 0.1969 Val Time – 5.1514 Forward Time – 5.1
406 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.7619 AP – 0.
4583


/home/kelvin.wong/.cache/bazel/_bazel_kelvin.wong/47fc07a62b8a2107c2e1b
04eb7772dd1/execroot/__main__/bazel-out/release_links/lib/python_env/sk
learn/metrics/ranking.py:444: RuntimeWarning: invalid value encountered
in true_divide
  recall = tps / tps[-1]
```

Encountered exception: Only one class present in y_true. ROC AUC score is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score is not defined in that case..
Val Epoch 40 [2/89]: Loss – 0.2535 Val Time – 0.4321 Forward Time – 0.0478 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.9021 AP – 0.5710
Encountered exception: Only one class present in y_true. ROC AUC score is not defined in that case..
Val Epoch 40 [3/89]: Loss – 0.4966 Val Time – 0.4218 Forward Time – 0.0234 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8155 AP – 0.4528
Val Epoch 40 [4/89]: Loss – 0.2193 Val Time – 0.4299 Forward Time – 0.0239 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8114 AP – 0.3603
Val Epoch 40 [5/89]: Loss – 0.3683 Val Time – 0.4170 Forward Time – 0.0211 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8094 AP – 0.3634
Val Epoch 40 [6/89]: Loss – 0.1619 Val Time – 0.4213 Forward Time – 0.0209 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8079 AP – 0.3476
Val Epoch 40 [7/89]: Loss – 0.2931 Val Time – 0.4186 Forward Time – 0.0211 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8043 AP – 0.4372
Val Epoch 40 [8/89]: Loss – 0.4112 Val Time – 0.4236 Forward Time – 0.0205 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8247 AP – 0.4430
Val Epoch 40 [9/89]: Loss – 0.4420 Val Time – 0.4263 Forward Time – 0.0208 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8298 AP – 0.4830
Val Epoch 40 [10/89]: Loss – 0.3596 Val Time – 0.4205 Forward Time – 0.0208 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8371 AP – 0.5107
Val Epoch 40 [11/89]: Loss – 0.0551 Val Time – 0.4218 Forward Time – 0.0206 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8423 AP – 0.5054
Val Epoch 40 [12/89]: Loss – 0.2511 Val Time – 0.4231 Forward Time – 0.0208 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8425 AP – 0.5098
Val Epoch 40 [13/89]: Loss – 0.3420 Val Time – 0.4205 Forward Time – 0.0208 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8569 AP – 0.5436
Val Epoch 40 [14/89]: Loss – 0.2845 Val Time – 0.4272 Forward Time – 0.0211 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8560 AP – 0.5359
Val Epoch 40 [15/89]: Loss – 0.3162 Val Time – 0.4250 Forward Time – 0.0213 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8504 AP – 0.5293
Val Epoch 40 [16/89]: Loss – 0.3215 Val Time – 0.4248 Forward Time – 0.0207 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8465 AP – 0.5332
Val Epoch 40 [17/89]: Loss – 0.1175 Val Time – 0.4293 Forward Time – 0.0208 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8444 AP – 0.5334
Val Epoch 40 [18/89]: Loss – 0.2388 Val Time – 0.4253 Forward Time – 0.0208 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8448 AP – 0.5277

```
Val Epoch 40 [19/89]: Loss - 0.3081 Val Time - 0.4192 Forward Time - 0.
0206 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8429 AP -
0.5237
Val Epoch 40 [20/89]: Loss - 0.5802 Val Time - 0.4215 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8424 AP -
0.5198
Val Epoch 40 [21/89]: Loss - 0.4864 Val Time - 0.4258 Forward Time - 0.
0379 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8382 AP -
0.5242
Val Epoch 40 [22/89]: Loss - 0.1760 Val Time - 0.4280 Forward Time - 0.
0390 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8384 AP -
0.5275
Val Epoch 40 [23/89]: Loss - 0.5038 Val Time - 0.4232 Forward Time - 0.
0215 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8400 AP -
0.5329
Val Epoch 40 [24/89]: Loss - 0.4219 Val Time - 0.4220 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8343 AP -
0.5361
Val Epoch 40 [25/89]: Loss - 0.3187 Val Time - 0.4208 Forward Time - 0.
0235 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8305 AP -
0.5254
Val Epoch 40 [26/89]: Loss - 0.5607 Val Time - 0.4225 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8232 AP -
0.5170
Val Epoch 40 [27/89]: Loss - 0.2333 Val Time - 0.4191 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8258 AP -
0.5127
Val Epoch 40 [28/89]: Loss - 0.3574 Val Time - 0.4241 Forward Time - 0.
0209 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8214 AP -
0.5056
Val Epoch 40 [29/89]: Loss - 0.4236 Val Time - 0.4195 Forward Time - 0.
0202 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8248 AP -
0.5070
Val Epoch 40 [30/89]: Loss - 0.6392 Val Time - 0.4270 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8216 AP -
0.4961
Val Epoch 40 [31/89]: Loss - 0.1093 Val Time - 0.4237 Forward Time - 0.
0216 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8229 AP -
0.4929
Val Epoch 40 [32/89]: Loss - 0.3862 Val Time - 0.4220 Forward Time - 0.
0289 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8233 AP -
0.4914
Val Epoch 40 [33/89]: Loss - 0.2226 Val Time - 0.4265 Forward Time - 0.
0216 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8217 AP -
0.4851
Val Epoch 40 [34/89]: Loss - 0.4047 Val Time - 0.4229 Forward Time - 0.
0217 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8212 AP -
0.4822
Val Epoch 40 [35/89]: Loss - 0.1845 Val Time - 0.4223 Forward Time - 0.
0241 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8192 AP -
0.4775
Val Epoch 40 [36/89]: Loss - 0.5315 Val Time - 0.4225 Forward Time - 0.
0209 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8184 AP -
0.4760
Val Epoch 40 [37/89]: Loss - 0.2907 Val Time - 0.4307 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8156 AP -
0.4710
```

```
Val Epoch 40 [38/89]: Loss - 0.2094 Val Time - 0.4250 Forward Time - 0.
0209 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8152 AP -
0.4693
Val Epoch 40 [39/89]: Loss - 0.0708 Val Time - 0.4233 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8191 AP -
0.4695
Val Epoch 40 [40/89]: Loss - 0.3171 Val Time - 0.4232 Forward Time - 0.
0204 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8201 AP -
0.4797
Val Epoch 40 [41/89]: Loss - 0.1318 Val Time - 0.4208 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8227 AP -
0.4837
Val Epoch 40 [42/89]: Loss - 0.4144 Val Time - 0.4272 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8181 AP -
0.4784
Val Epoch 40 [43/89]: Loss - 0.4257 Val Time - 0.4303 Forward Time - 0.
0247 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8192 AP -
0.4886
Val Epoch 40 [44/89]: Loss - 0.1518 Val Time - 0.4347 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8212 AP -
0.4890
Val Epoch 40 [45/89]: Loss - 0.3575 Val Time - 0.4227 Forward Time - 0.
0206 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8201 AP -
0.4921
Val Epoch 40 [46/89]: Loss - 0.1785 Val Time - 0.4256 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8226 AP -
0.4893
Val Epoch 40 [47/89]: Loss - 0.2428 Val Time - 0.4251 Forward Time - 0.
0203 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8245 AP -
0.4889
Val Epoch 40 [48/89]: Loss - 0.2477 Val Time - 0.4262 Forward Time - 0.
0204 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8246 AP -
0.4881
Val Epoch 40 [49/89]: Loss - 0.3117 Val Time - 0.4228 Forward Time - 0.
0202 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8247 AP -
0.4959
Val Epoch 40 [50/89]: Loss - 0.2940 Val Time - 0.4204 Forward Time - 0.
0204 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8282 AP -
0.5021
Val Epoch 40 [51/89]: Loss - 0.2376 Val Time - 0.4225 Forward Time - 0.
0395 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8276 AP -
0.5007
Val Epoch 40 [52/89]: Loss - 0.2255 Val Time - 0.4195 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8281 AP -
0.5002
Val Epoch 40 [53/89]: Loss - 0.3051 Val Time - 0.4252 Forward Time - 0.
0292 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8237 AP -
0.4994
Val Epoch 40 [54/89]: Loss - 0.3960 Val Time - 0.4212 Forward Time - 0.
0281 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8219 AP -
0.4970
Val Epoch 40 [55/89]: Loss - 0.3066 Val Time - 0.4229 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8219 AP -
0.4957
Val Epoch 40 [56/89]: Loss - 0.2061 Val Time - 0.4248 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8237 AP -
0.4960
```

```
Val Epoch 40 [57/89]: Loss - 0.2314 Val Time - 0.4222 Forward Time - 0.
0201 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8264 AP -
0.5023
Val Epoch 40 [58/89]: Loss - 0.2531 Val Time - 0.4249 Forward Time - 0.
0368 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8263 AP -
0.4999
Val Epoch 40 [59/89]: Loss - 0.3540 Val Time - 0.4228 Forward Time - 0.
0218 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8273 AP -
0.5045
Val Epoch 40 [60/89]: Loss - 0.4435 Val Time - 0.4242 Forward Time - 0.
0216 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8234 AP -
0.4976
Val Epoch 40 [61/89]: Loss - 0.1943 Val Time - 0.4283 Forward Time - 0.
0205 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8247 AP -
0.4970
Val Epoch 40 [62/89]: Loss - 0.2181 Val Time - 0.4206 Forward Time - 0.
0206 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8231 AP -
0.4935
Val Epoch 40 [63/89]: Loss - 0.2866 Val Time - 0.4172 Forward Time - 0.
0206 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8246 AP -
0.4955
Val Epoch 40 [64/89]: Loss - 0.0662 Val Time - 0.4227 Forward Time - 0.
0206 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8260 AP -
0.4998
Val Epoch 40 [65/89]: Loss - 0.5542 Val Time - 0.4211 Forward Time - 0.
0201 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8275 AP -
0.5086
Val Epoch 40 [66/89]: Loss - 0.1070 Val Time - 0.4228 Forward Time - 0.
0210 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8289 AP -
0.5077
Val Epoch 40 [67/89]: Loss - 0.4488 Val Time - 0.4253 Forward Time - 0.
0204 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8296 AP -
0.5064
Val Epoch 40 [68/89]: Loss - 0.3152 Val Time - 0.4190 Forward Time - 0.
0208 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8272 AP -
0.5053
Val Epoch 40 [69/89]: Loss - 0.2350 Val Time - 0.4190 Forward Time - 0.
0205 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8263 AP -
0.5030
Val Epoch 40 [70/89]: Loss - 0.2243 Val Time - 0.4217 Forward Time - 0.
0210 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8261 AP -
0.4976
Val Epoch 40 [71/89]: Loss - 0.2174 Val Time - 0.4186 Forward Time - 0.
0213 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8257 AP -
0.4950
Val Epoch 40 [72/89]: Loss - 0.5426 Val Time - 0.4268 Forward Time - 0.
0209 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8237 AP -
0.4921
Val Epoch 40 [73/89]: Loss - 0.1351 Val Time - 0.4248 Forward Time - 0.
0207 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8248 AP -
0.4924
Val Epoch 40 [74/89]: Loss - 0.1698 Val Time - 0.4244 Forward Time - 0.
0206 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8257 AP -
0.4906
Val Epoch 40 [75/89]: Loss - 0.4947 Val Time - 0.4238 Forward Time - 0.
0204 Learning Rate - 0.0001 Memory - 0.106436608 GB AUC - 0.8227 AP -
0.4900
```

```
Val Epoch 40 [76/89]: Loss – 0.2717 Val Time – 0.4249 Forward Time – 0.
0205 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8238 AP –
0.4891
Val Epoch 40 [77/89]: Loss – 0.4361 Val Time – 0.4303 Forward Time – 0.
0196 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8226 AP –
0.4881
Val Epoch 40 [78/89]: Loss – 0.4237 Val Time – 0.4207 Forward Time – 0.
0195 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8213 AP –
0.4858
Val Epoch 40 [79/89]: Loss – 0.4713 Val Time – 0.4207 Forward Time – 0.
0193 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8192 AP –
0.4872
Val Epoch 40 [80/89]: Loss – 0.4225 Val Time – 0.4275 Forward Time – 0.
0196 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8183 AP –
0.4851
Val Epoch 40 [81/89]: Loss – 0.3203 Val Time – 0.4210 Forward Time – 0.
0193 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8183 AP –
0.4835
Val Epoch 40 [82/89]: Loss – 0.0959 Val Time – 0.4192 Forward Time – 0.
0195 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8195 AP –
0.4824
Val Epoch 40 [83/89]: Loss – 0.1417 Val Time – 0.4181 Forward Time – 0.
0198 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8198 AP –
0.4805
Val Epoch 40 [84/89]: Loss – 0.3982 Val Time – 0.4248 Forward Time – 0.
0196 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8199 AP –
0.4785
Val Epoch 40 [85/89]: Loss – 0.1823 Val Time – 0.4318 Forward Time – 0.
0196 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8214 AP –
0.4800
Val Epoch 40 [86/89]: Loss – 0.3605 Val Time – 0.4209 Forward Time – 0.
0196 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8215 AP –
0.4811
Val Epoch 40 [87/89]: Loss – 0.4950 Val Time – 0.4209 Forward Time – 0.
0196 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8177 AP –
0.4739
Val Epoch 40 [88/89]: Loss – 0.2302 Val Time – 0.4262 Forward Time – 0.
0194 Learning Rate – 0.0001 Memory – 0.106436608 GB AUC – 0.8179 AP –
0.4736
Val Epoch 40 [89/89]: Loss – 0.5921 Val Time – 3.5480 Forward Time – 3.
5441 Learning Rate – 0.0001 Memory – 0.091756544 GB AUC – 0.8166 AP –
0.4734
Saving checkpoint /tmp/tmpmlz1uY/models/model_34000.pth.tar.
```

3.2 MIMIC CXR Valid Metrics

In [18]:
```python
from experiments.fusion_baselines.train_volumetric_fusion import train_v
olumetric_fusion

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/volumetric_fu
sion/models/model_best.pth.tar'
volumetric_fusion_mimic_metrics = train_volumetric_fusion(MIMIC_EVALUATI
ON_ARGUMENTS + ['--val-batch-size', '8', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/volumetric_fusion/models/model_best.pth.tar', criterion
='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICDatase
t', evaluate_once=True, fusion_index=-1, is_big=False, label_class='pap
er', learning_rate=0.0001, log_frequency=1000, map_unobserved_to_negati
ve=True, normalization='batchnorm2d', num_epochs=10, num_gpus=1, num_wo
rkers=8, outdir='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shu
ffle=False, train_batch_size=1, train_data='/home/kelvin.wong/Datasets/
MIMIC-CXR', use_2d_conv=False, use_test_set=True, val_batch_size=8, val
_data='/home/kelvin.wong/Datasets/MIMIC-CXR', val_frequency=4800)
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 40 [1/110]: Loss – 0.1407 Val Time – 0.4422 Forward Time – 0.
0601 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.0000 AP –
0.0000
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 40 [2/110]: Loss – 0.1587 Val Time – 0.4258 Forward Time – 0.
0388 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8821 AP –
0.5417
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 40 [3/110]: Loss – 0.3222 Val Time – 0.4231 Forward Time – 0.
0225 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8158 AP –
0.3981
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 40 [4/110]: Loss – 0.3772 Val Time – 0.4236 Forward Time – 0.
0204 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8109 AP –
0.4188
Val Epoch 40 [5/110]: Loss – 0.2258 Val Time – 0.4240 Forward Time – 0.
0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8740 AP –
0.4558
Val Epoch 40 [6/110]: Loss – 0.4368 Val Time – 0.4237 Forward Time – 0.
0234 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8740 AP –
0.4552
Val Epoch 40 [7/110]: Loss – 0.3033 Val Time – 0.4219 Forward Time – 0.
0210 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8623 AP –
0.4507
Val Epoch 40 [8/110]: Loss – 0.1720 Val Time – 0.4208 Forward Time – 0.
0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8647 AP –
0.4889
Val Epoch 40 [9/110]: Loss – 0.3939 Val Time – 0.4279 Forward Time – 0.
```

0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8328 AP –
0.4257
Val Epoch 40 [10/110]: Loss – 0.2341 Val Time – 0.4288 Forward Time –
0.0210 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8060 AP –
0.3939
Val Epoch 40 [11/110]: Loss – 0.2919 Val Time – 0.4239 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8048 AP –
0.3975
Val Epoch 40 [12/110]: Loss – 0.2204 Val Time – 0.4263 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8206 AP –
0.4414
Val Epoch 40 [13/110]: Loss – 0.1765 Val Time – 0.4250 Forward Time –
0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8190 AP –
0.4204
Val Epoch 40 [14/110]: Loss – 0.0472 Val Time – 0.4261 Forward Time –
0.0397 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8254 AP –
0.4161
Val Epoch 40 [15/110]: Loss – 0.1659 Val Time – 0.4294 Forward Time –
0.0291 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8279 AP –
0.4082
Val Epoch 40 [16/110]: Loss – 0.1976 Val Time – 0.4226 Forward Time –
0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8297 AP –
0.4190
Val Epoch 40 [17/110]: Loss – 0.2958 Val Time – 0.4288 Forward Time –
0.0210 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8285 AP –
0.4098
Val Epoch 40 [18/110]: Loss – 0.1935 Val Time – 0.4225 Forward Time –
0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8245 AP –
0.4016
Val Epoch 40 [19/110]: Loss – 0.0324 Val Time – 0.4214 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8309 AP –
0.3998
Val Epoch 40 [20/110]: Loss – 0.4067 Val Time – 0.4298 Forward Time –
0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8297 AP –
0.3990
Val Epoch 40 [21/110]: Loss – 0.1438 Val Time – 0.4241 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8321 AP –
0.3988
Val Epoch 40 [22/110]: Loss – 0.1706 Val Time – 0.4283 Forward Time –
0.0213 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8402 AP –
0.4111
Val Epoch 40 [23/110]: Loss – 0.1888 Val Time – 0.4281 Forward Time –
0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8442 AP –
0.4269
Val Epoch 40 [24/110]: Loss – 0.1331 Val Time – 0.4255 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8469 AP –
0.4317
Val Epoch 40 [25/110]: Loss – 0.0721 Val Time – 0.4220 Forward Time –
0.0202 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8482 AP –
0.4302
Val Epoch 40 [26/110]: Loss – 0.2525 Val Time – 0.4235 Forward Time –
0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8460 AP –
0.4210
Val Epoch 40 [27/110]: Loss – 0.1057 Val Time – 0.4370 Forward Time –
0.0203 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8462 AP –
0.4142
Val Epoch 40 [28/110]: Loss – 0.5276 Val Time – 0.4281 Forward Time –

0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8486 AP –
0.4109
Val Epoch 40 [29/110]: Loss – 0.5060 Val Time – 0.4374 Forward Time –
0.0203 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8435 AP –
0.4121
Val Epoch 40 [30/110]: Loss – 0.3819 Val Time – 0.4250 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8466 AP –
0.4102
Val Epoch 40 [31/110]: Loss – 0.2119 Val Time – 0.4291 Forward Time –
0.0210 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8438 AP –
0.4048
Val Epoch 40 [32/110]: Loss – 0.3984 Val Time – 0.4211 Forward Time –
0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8228 AP –
0.3998
Val Epoch 40 [33/110]: Loss – 0.0490 Val Time – 0.4245 Forward Time –
0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8256 AP –
0.4038
Val Epoch 40 [34/110]: Loss – 0.0978 Val Time – 0.4307 Forward Time –
0.0203 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8271 AP –
0.4053
Val Epoch 40 [35/110]: Loss – 0.3974 Val Time – 0.4236 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8298 AP –
0.4067
Val Epoch 40 [36/110]: Loss – 0.1749 Val Time – 0.4227 Forward Time –
0.0205 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8352 AP –
0.4121
Val Epoch 40 [37/110]: Loss – 0.1692 Val Time – 0.4236 Forward Time –
0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8372 AP –
0.4173
Val Epoch 40 [38/110]: Loss – 0.1703 Val Time – 0.4301 Forward Time –
0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8355 AP –
0.4139
Val Epoch 40 [39/110]: Loss – 0.2624 Val Time – 0.4216 Forward Time –
0.0201 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8365 AP –
0.4121
Val Epoch 40 [40/110]: Loss – 0.0963 Val Time – 0.4269 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8411 AP –
0.4262
Val Epoch 40 [41/110]: Loss – 0.1596 Val Time – 0.4300 Forward Time –
0.0374 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8444 AP –
0.4302
Val Epoch 40 [42/110]: Loss – 0.1335 Val Time – 0.4233 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8449 AP –
0.4280
Val Epoch 40 [43/110]: Loss – 0.0648 Val Time – 0.4321 Forward Time –
0.0390 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8488 AP –
0.4320
Val Epoch 40 [44/110]: Loss – 0.1849 Val Time – 0.4239 Forward Time –
0.0233 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8481 AP –
0.4272
Val Epoch 40 [45/110]: Loss – 0.0706 Val Time – 0.4319 Forward Time –
0.0402 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8488 AP –
0.4249
Val Epoch 40 [46/110]: Loss – 0.0800 Val Time – 0.4224 Forward Time –
0.0220 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8506 AP –
0.4242
Val Epoch 40 [47/110]: Loss – 0.1280 Val Time – 0.4352 Forward Time –

0.0347 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8519 AP –
0.4225
Val Epoch 40 [48/110]: Loss – 0.3448 Val Time – 0.4234 Forward Time –
0.0216 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8469 AP –
0.4207
Val Epoch 40 [49/110]: Loss – 0.1769 Val Time – 0.4244 Forward Time –
0.0213 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8465 AP –
0.4157
Val Epoch 40 [50/110]: Loss – 0.2657 Val Time – 0.4294 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8467 AP –
0.4157
Val Epoch 40 [51/110]: Loss – 0.1414 Val Time – 0.4225 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8491 AP –
0.4134
Val Epoch 40 [52/110]: Loss – 0.0782 Val Time – 0.4314 Forward Time –
0.0390 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8510 AP –
0.4134
Val Epoch 40 [53/110]: Loss – 0.1722 Val Time – 0.4233 Forward Time –
0.0214 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8515 AP –
0.4074
Val Epoch 40 [54/110]: Loss – 0.1656 Val Time – 0.4285 Forward Time –
0.0366 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8517 AP –
0.4084
Val Epoch 40 [55/110]: Loss – 0.1395 Val Time – 0.4326 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8532 AP –
0.4154
Val Epoch 40 [56/110]: Loss – 0.1626 Val Time – 0.4321 Forward Time –
0.0370 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8549 AP –
0.4205
Val Epoch 40 [57/110]: Loss – 0.2257 Val Time – 0.4329 Forward Time –
0.0216 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8482 AP –
0.4213
Val Epoch 40 [58/110]: Loss – 0.0634 Val Time – 0.4346 Forward Time –
0.0384 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8499 AP –
0.4240
Val Epoch 40 [59/110]: Loss – 0.3521 Val Time – 0.4338 Forward Time –
0.0398 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8504 AP –
0.4187
Val Epoch 40 [60/110]: Loss – 0.1975 Val Time – 0.4320 Forward Time –
0.0217 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8526 AP –
0.4218
Val Epoch 40 [61/110]: Loss – 0.1725 Val Time – 0.4292 Forward Time –
0.0218 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8516 AP –
0.4184
Val Epoch 40 [62/110]: Loss – 0.2951 Val Time – 0.4326 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8504 AP –
0.4160
Val Epoch 40 [63/110]: Loss – 0.4791 Val Time – 0.4363 Forward Time –
0.0204 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8437 AP –
0.4152
Val Epoch 40 [64/110]: Loss – 0.1651 Val Time – 0.4315 Forward Time –
0.0205 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8449 AP –
0.4205
Val Epoch 40 [65/110]: Loss – 0.3264 Val Time – 0.4424 Forward Time –
0.0205 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8446 AP –
0.4120
Val Epoch 40 [66/110]: Loss – 0.1109 Val Time – 0.4356 Forward Time –

0.0207 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8462 AP –
0.4152
Val Epoch 40 [67/110]: Loss – 0.1782 Val Time – 0.4306 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8472 AP –
0.4178
Val Epoch 40 [68/110]: Loss – 0.2755 Val Time – 0.4355 Forward Time –
0.0205 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8465 AP –
0.4186
Val Epoch 40 [69/110]: Loss – 0.1869 Val Time – 0.4358 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8469 AP –
0.4180
Val Epoch 40 [70/110]: Loss – 0.2921 Val Time – 0.4336 Forward Time –
0.0211 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8478 AP –
0.4202
Val Epoch 40 [71/110]: Loss – 0.2915 Val Time – 0.4379 Forward Time –
0.0205 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8419 AP –
0.4210
Val Epoch 40 [72/110]: Loss – 0.1792 Val Time – 0.4339 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8424 AP –
0.4222
Val Epoch 40 [73/110]: Loss – 0.2260 Val Time – 0.4303 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8424 AP –
0.4193
Val Epoch 40 [74/110]: Loss – 0.0990 Val Time – 0.4280 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8429 AP –
0.4192
Val Epoch 40 [75/110]: Loss – 0.1937 Val Time – 0.4298 Forward Time –
0.0216 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8428 AP –
0.4112
Val Epoch 40 [76/110]: Loss – 0.1685 Val Time – 0.4319 Forward Time –
0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8428 AP –
0.4098
Val Epoch 40 [77/110]: Loss – 0.1433 Val Time – 0.4383 Forward Time –
0.0204 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8427 AP –
0.4107
Val Epoch 40 [78/110]: Loss – 0.1432 Val Time – 0.4354 Forward Time –
0.0216 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8429 AP –
0.4099
Val Epoch 40 [79/110]: Loss – 0.2287 Val Time – 0.4315 Forward Time –
0.0204 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8449 AP –
0.4163
Val Epoch 40 [80/110]: Loss – 0.2667 Val Time – 0.4306 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8450 AP –
0.4186
Val Epoch 40 [81/110]: Loss – 0.2721 Val Time – 0.4330 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8468 AP –
0.4247
Val Epoch 40 [82/110]: Loss – 0.1476 Val Time – 0.4285 Forward Time –
0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8479 AP –
0.4293
Val Epoch 40 [83/110]: Loss – 0.3143 Val Time – 0.4325 Forward Time –
0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8468 AP –
0.4287
Val Epoch 40 [84/110]: Loss – 0.0569 Val Time – 0.4338 Forward Time –
0.0202 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8476 AP –
0.4279
Val Epoch 40 [85/110]: Loss – 0.2408 Val Time – 0.4319 Forward Time –

0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8475 AP –
0.4267
Val Epoch 40 [86/110]: Loss – 0.2543 Val Time – 0.4310 Forward Time –
0.0204 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8506 AP –
0.4277
Val Epoch 40 [87/110]: Loss – 0.1865 Val Time – 0.4303 Forward Time –
0.0210 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8464 AP –
0.4253
Val Epoch 40 [88/110]: Loss – 0.3856 Val Time – 0.4353 Forward Time –
0.0206 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8459 AP –
0.4276
Val Epoch 40 [89/110]: Loss – 0.2562 Val Time – 0.4335 Forward Time –
0.0210 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8458 AP –
0.4255
Val Epoch 40 [90/110]: Loss – 0.1857 Val Time – 0.4344 Forward Time –
0.0220 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8468 AP –
0.4295
Val Epoch 40 [91/110]: Loss – 0.1488 Val Time – 0.4344 Forward Time –
0.0205 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8479 AP –
0.4296
Val Epoch 40 [92/110]: Loss – 0.1809 Val Time – 0.4341 Forward Time –
0.0213 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8478 AP –
0.4253
Val Epoch 40 [93/110]: Loss – 0.2220 Val Time – 0.4338 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8471 AP –
0.4273
Val Epoch 40 [94/110]: Loss – 0.2289 Val Time – 0.4339 Forward Time –
0.0209 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8469 AP –
0.4194
Val Epoch 40 [95/110]: Loss – 0.0726 Val Time – 0.4280 Forward Time –
0.0211 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8478 AP –
0.4211
Val Epoch 40 [96/110]: Loss – 0.1426 Val Time – 0.4335 Forward Time –
0.0208 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8478 AP –
0.4204
Val Epoch 40 [97/110]: Loss – 0.3620 Val Time – 0.4350 Forward Time –
0.0201 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8464 AP –
0.4171
Val Epoch 40 [98/110]: Loss – 0.2813 Val Time – 0.4349 Forward Time –
0.0203 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8475 AP –
0.4152
Val Epoch 40 [99/110]: Loss – 0.1592 Val Time – 0.4360 Forward Time –
0.0231 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8481 AP –
0.4144
Val Epoch 40 [100/110]: Loss – 0.2989 Val Time – 0.4385 Forward Time –
0.0197 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8480 AP –
0.4152
Val Epoch 40 [101/110]: Loss – 0.2821 Val Time – 0.4281 Forward Time –
0.0196 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8476 AP –
0.4142
Val Epoch 40 [102/110]: Loss – 0.4617 Val Time – 0.4381 Forward Time –
0.0200 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8464 AP –
0.4135
Val Epoch 40 [103/110]: Loss – 0.1166 Val Time – 0.4323 Forward Time –
0.0197 Learning Rate – 0.0001 Memory – 0.106960896 GB AUC – 0.8468 AP –
0.4160
Val Epoch 40 [104/110]: Loss – 0.1349 Val Time – 0.4368 Forward Time –

```
0.0197 Learning Rate - 0.0001 Memory - 0.106960896 GB AUC - 0.8469 AP -
0.4140
Val Epoch 40 [105/110]: Loss - 0.1659 Val Time - 0.4349 Forward Time -
0.0194 Learning Rate - 0.0001 Memory - 0.106960896 GB AUC - 0.8484 AP -
0.4137
Val Epoch 40 [106/110]: Loss - 0.1290 Val Time - 0.4354 Forward Time -
0.0197 Learning Rate - 0.0001 Memory - 0.106960896 GB AUC - 0.8491 AP -
0.4116
Val Epoch 40 [107/110]: Loss - 0.3303 Val Time - 0.4331 Forward Time -
0.0196 Learning Rate - 0.0001 Memory - 0.106960896 GB AUC - 0.8492 AP -
0.4089
Val Epoch 40 [108/110]: Loss - 0.0973 Val Time - 0.4306 Forward Time -
0.0196 Learning Rate - 0.0001 Memory - 0.106960896 GB AUC - 0.8492 AP -
0.4055
Val Epoch 40 [109/110]: Loss - 0.0545 Val Time - 0.4313 Forward Time -
0.0194 Learning Rate - 0.0001 Memory - 0.106960896 GB AUC - 0.8495 AP -
0.4050
Val Epoch 40 [110/110]: Loss - 0.1899 Val Time - 0.4324 Forward Time -
0.0196 Learning Rate - 0.0001 Memory - 0.106960896 GB AUC - 0.8511 AP -
0.4059
Saving checkpoint /tmp/tmpmlz1uY/models/model_34000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_34000.pth.tar.
```

4. Cross Sectional Fusion

4.1 CheXpert Test Metrics

In [19]:
```python
from experiments.fusion_baselines.train_cross_sectional_fusion import train_cross_sectional_fusion

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_sectional_fusion_0/models/model_best.pth.tar'
cross_sectional_fusion_0_chexpert_metrics = train_cross_sectional_fusion(CHEXPERT_EVALUATION_ARGUMENTS + ['--fusion-index', '0', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_fusion_0/models/model_best.pth.tar', cri
terion='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustom
Split', evaluate_once=True, fusion_index=0, label_class='paper', learni
ng_rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, no
rmalization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, ou
tdir='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False,
train_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.
0', use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/
Datasets/CheXpert-v1.0', val_frequency=4800)
Val Epoch 38 [1/8]: Loss - 0.3035 Val Time - 0.6446 Forward Time - 0.20
26 Learning Rate - 0.0001 Memory - 0.359062016 GB AUC - 0.8154 AP - 0.5
121
Val Epoch 38 [2/8]: Loss - 0.3301 Val Time - 0.5353 Forward Time - 0.03
66 Learning Rate - 0.0001 Memory - 0.359062016 GB AUC - 0.8109 AP - 0.4
754
Val Epoch 38 [3/8]: Loss - 0.3494 Val Time - 0.5388 Forward Time - 0.02
09 Learning Rate - 0.0001 Memory - 0.359062016 GB AUC - 0.7971 AP - 0.4
430
Val Epoch 38 [4/8]: Loss - 0.2695 Val Time - 0.5470 Forward Time - 0.02
06 Learning Rate - 0.0001 Memory - 0.359062016 GB AUC - 0.8099 AP - 0.4
695
Val Epoch 38 [5/8]: Loss - 0.2631 Val Time - 0.5409 Forward Time - 0.02
03 Learning Rate - 0.0001 Memory - 0.359062016 GB AUC - 0.8110 AP - 0.4
654
Val Epoch 38 [6/8]: Loss - 0.3102 Val Time - 0.5390 Forward Time - 0.02
04 Learning Rate - 0.0001 Memory - 0.359062016 GB AUC - 0.8121 AP - 0.4
632
Val Epoch 38 [7/8]: Loss - 0.3314 Val Time - 0.5412 Forward Time - 0.02
01 Learning Rate - 0.0001 Memory - 0.359062016 GB AUC - 0.8049 AP - 0.4
468
Val Epoch 38 [8/8]: Loss - 0.3263 Val Time - 0.0921 Forward Time - 0.05
17 Learning Rate - 0.0001 Memory - 0.128111616 GB AUC - 0.8050 AP - 0.4
466
Saving checkpoint /tmp/tmpmlz1uY/models/model_30000.pth.tar.
```

In [20]:
```python
from experiments.fusion_baselines.train_cross_sectional_fusion import train_cross_sectional_fusion

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_sectional_fusion_4/models/model_best.pth.tar'
cross_sectional_fusion_4_chexpert_metrics = train_cross_sectional_fusion(CHEXPERT_EVALUATION_ARGUMENTS + ['--fusion-index', '4', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_fusion_4/models/model_best.pth.tar', cri
terion='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyCustom
Split', evaluate_once=True, fusion_index=4, label_class='paper', learni
ng_rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, no
rmalization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, ou
tdir='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False,
train_batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.
0', use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/
Datasets/CheXpert-v1.0', val_frequency=4800)
Val Epoch 46 [1/8]: Loss - 0.2933 Val Time - 1.2493 Forward Time - 1.19
26 Learning Rate - 0.0001 Memory - 0.543284736 GB AUC - 0.8126 AP - 0.5
086
Val Epoch 46 [2/8]: Loss - 0.3427 Val Time - 1.0334 Forward Time - 0.43
44 Learning Rate - 0.0001 Memory - 0.543284736 GB AUC - 0.8181 AP - 0.4
870
Val Epoch 46 [3/8]: Loss - 0.3546 Val Time - 1.0323 Forward Time - 0.43
65 Learning Rate - 0.0001 Memory - 0.543284736 GB AUC - 0.8020 AP - 0.4
377
Val Epoch 46 [4/8]: Loss - 0.2706 Val Time - 1.0297 Forward Time - 0.43
61 Learning Rate - 0.0001 Memory - 0.543284736 GB AUC - 0.8129 AP - 0.4
480
Val Epoch 46 [5/8]: Loss - 0.2772 Val Time - 1.0281 Forward Time - 0.43
30 Learning Rate - 0.0001 Memory - 0.543284736 GB AUC - 0.8103 AP - 0.4
485
Val Epoch 46 [6/8]: Loss - 0.3089 Val Time - 1.0312 Forward Time - 0.43
45 Learning Rate - 0.0001 Memory - 0.543284736 GB AUC - 0.8103 AP - 0.4
444
Val Epoch 46 [7/8]: Loss - 0.3584 Val Time - 1.0330 Forward Time - 0.43
46 Learning Rate - 0.0001 Memory - 0.543284736 GB AUC - 0.8021 AP - 0.4
270
Val Epoch 46 [8/8]: Loss - 0.3484 Val Time - 0.1710 Forward Time - 0.16
25 Learning Rate - 0.0001 Memory - 0.312334336 GB AUC - 0.8024 AP - 0.4
266
Saving checkpoint /tmp/tmpmlz1uY/models/model_37000.pth.tar.
```

4.2 MIMIC CXR Valid Metrics

```python
In [21]: from experiments.fusion_baselines.train_cross_sectional_fusion import tr
         ain_cross_sectional_fusion

         checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_section
         al_fusion_0/models/model_best.pth.tar'
         cross_sectional_fusion_0_mimic_metrics = train_cross_sectional_fusion(MI
         MIC_EVALUATION_ARGUMENTS + ['--fusion-index', '0', '--checkpoint', check
         point])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_fusion_0/models/model_best.pth.tar', cri
terion='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICD
ataset', evaluate_once=True, fusion_index=0, label_class='paper', learn
ing_rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, n
ormalization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, o
utdir='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=Fals
e, train_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CX
R', use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/
Datasets/MIMIC-CXR', val_frequency=4800)
Val Epoch 38 [1/9]: Loss - 0.2682 Val Time - 0.5721 Forward Time - 0.05
76 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8233 AP - 0.4
699
Val Epoch 38 [2/9]: Loss - 0.1906 Val Time - 0.5389 Forward Time - 0.03
56 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8404 AP - 0.4
329
Val Epoch 38 [3/9]: Loss - 0.2770 Val Time - 0.5412 Forward Time - 0.02
08 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8404 AP - 0.4
153
Val Epoch 38 [4/9]: Loss - 0.1798 Val Time - 0.5492 Forward Time - 0.02
00 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8501 AP - 0.4
161
Val Epoch 38 [5/9]: Loss - 0.2019 Val Time - 0.5397 Forward Time - 0.02
00 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8435 AP - 0.4
257
Val Epoch 38 [6/9]: Loss - 0.2468 Val Time - 0.5401 Forward Time - 0.01
98 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8375 AP - 0.4
217
Val Epoch 38 [7/9]: Loss - 0.2213 Val Time - 0.5423 Forward Time - 0.02
02 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8369 AP - 0.4
225
Val Epoch 38 [8/9]: Loss - 0.2229 Val Time - 0.5436 Forward Time - 0.01
96 Learning Rate - 0.0001 Memory - 0.330672128 GB AUC - 0.8411 AP - 0.4
251
Val Epoch 38 [9/9]: Loss - 0.2263 Val Time - 0.5234 Forward Time - 0.17
80 Learning Rate - 0.0001 Memory - 0.281389056 GB AUC - 0.8426 AP - 0.4
121
Saving checkpoint /tmp/tmpmlz1uY/models/model_30000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_30000.pth.tar.
```

```
In [22]: from experiments.fusion_baselines.train_cross_sectional_fusion import tr
         ain_cross_sectional_fusion

         checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_section
         al_fusion_4/models/model_best.pth.tar'
         cross_sectional_fusion_4_mimic_metrics = train_cross_sectional_fusion(MI
         MIC_EVALUATION_ARGUMENTS + ['--fusion-index', '4', '--checkpoint', check
         point])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_fusion_4/models/model_best.pth.tar', cri
terion='bce_loss', cuda_benchmark=True, dataset_class='PairedOnlyMIMICD
ataset', evaluate_once=True, fusion_index=4, label_class='paper', learn
ing_rate=0.0001, log_frequency=1000, map_unobserved_to_negative=True, n
ormalization='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, o
utdir='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=Fals
e, train_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CX
R', use_test_set=True, val_batch_size=100, val_data='/home/kelvin.wong/
Datasets/MIMIC-CXR', val_frequency=4800)
Val Epoch 46 [1/9]: Loss - 0.3077 Val Time - 1.0232 Forward Time - 0.42
02 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.7586 AP - 0.3
980
Val Epoch 46 [2/9]: Loss - 0.1960 Val Time - 0.9987 Forward Time - 0.41
96 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.8040 AP - 0.3
845
Val Epoch 46 [3/9]: Loss - 0.2770 Val Time - 0.9964 Forward Time - 0.42
04 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.8317 AP - 0.3
921
Val Epoch 46 [4/9]: Loss - 0.1820 Val Time - 0.9949 Forward Time - 0.41
99 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.8474 AP - 0.4
011
Val Epoch 46 [5/9]: Loss - 0.2096 Val Time - 0.9946 Forward Time - 0.42
00 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.8473 AP - 0.4
134
Val Epoch 46 [6/9]: Loss - 0.2642 Val Time - 0.9910 Forward Time - 0.41
78 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.8412 AP - 0.4
094
Val Epoch 46 [7/9]: Loss - 0.2312 Val Time - 1.0070 Forward Time - 0.41
85 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.8391 AP - 0.4
130
Val Epoch 46 [8/9]: Loss - 0.2687 Val Time - 0.9927 Forward Time - 0.41
82 Learning Rate - 0.0001 Memory - 0.464285184 GB AUC - 0.8334 AP - 0.3
963
Val Epoch 46 [9/9]: Loss - 0.2064 Val Time - 1.0262 Forward Time - 0.98
81 Learning Rate - 0.0001 Memory - 0.415002112 GB AUC - 0.8431 AP - 0.3
981
Saving checkpoint /tmp/tmpmlz1uY/models/model_37000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_37000.pth.tar.
```

5. Cross Sectional Attention

5.1 CheXpert Test Metrics

In [23]:
```python
from experiments.fusion_baselines.train_cross_sectional_attention_fusion
import train_cross_sectional_attention_fusion

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_section
al_attention_fusion_mlp_0/models/model_best.pth.tar'
cross_sectional_attention_fusion_0_chexpert_metrics = train_cross_sectio
nal_attention_fusion(CHEXPERT_EVALUATION_ARGUMENTS + ['--val-batch-size'
, '8', '--fusion-index', '0', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_attention_fusion_mlp_0/models/model_bes
t.pth.tar', criterion='bce_loss', cuda_benchmark=True, dataset_class='P
airedOnlyCustomSplit', evaluate_once=True, fusion_index=0, fusion_opera
tor='cross_sectional_attention_mlp', label_class='paper', learning_rate
=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normaliza
tion='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir='/
tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, train_
batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.0', us
e_test_set=True, val_batch_size=8, val_data='/home/kelvin.wong/Dataset
s/CheXpert-v1.0', val_frequency=4800)
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 44 [1/89]: Loss – 0.2191 Val Time – 0.1637 Forward Time – 0.1
373 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7024 AP – 0.
5000
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 44 [2/89]: Loss – 0.3197 Val Time – 0.0840 Forward Time – 0.0
337 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8155 AP – 0.
4786
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 44 [3/89]: Loss – 0.6274 Val Time – 0.0835 Forward Time – 0.0
322 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7020 AP – 0.
4162
Val Epoch 44 [4/89]: Loss – 0.2747 Val Time – 0.0819 Forward Time – 0.0
311 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7092 AP – 0.
3303
Val Epoch 44 [5/89]: Loss – 0.3460 Val Time – 0.0823 Forward Time – 0.0
312 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7407 AP – 0.
3997
Val Epoch 44 [6/89]: Loss – 0.2111 Val Time – 0.0819 Forward Time – 0.0
309 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7455 AP – 0.
3564
Val Epoch 44 [7/89]: Loss – 0.2901 Val Time – 0.0867 Forward Time – 0.0
326 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7495 AP – 0.
3885
Val Epoch 44 [8/89]: Loss – 0.4134 Val Time – 0.0827 Forward Time – 0.0
308 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7689 AP – 0.
3916
Val Epoch 44 [9/89]: Loss – 0.4207 Val Time – 0.1020 Forward Time – 0.0
314 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7717 AP – 0.
4278
Val Epoch 44 [10/89]: Loss – 0.2526 Val Time – 0.0829 Forward Time – 0.
0260 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7871 AP –
0.4654
Val Epoch 44 [11/89]: Loss – 0.0447 Val Time – 0.0809 Forward Time – 0.
0241 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8005 AP –
0.4634
Val Epoch 44 [12/89]: Loss – 0.1913 Val Time – 0.0993 Forward Time – 0.
```

0475 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8098 AP — 0.4713
Val Epoch 44 [13/89]: Loss — 0.4276 Val Time — 0.0947 Forward Time — 0.0234 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8046 AP — 0.4716
Val Epoch 44 [14/89]: Loss — 0.3365 Val Time — 0.0892 Forward Time — 0.0234 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8036 AP — 0.4625
Val Epoch 44 [15/89]: Loss — 0.3351 Val Time — 0.0839 Forward Time — 0.0236 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.7980 AP — 0.4631
Val Epoch 44 [16/89]: Loss — 0.4047 Val Time — 0.0823 Forward Time — 0.0356 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.7902 AP — 0.4614
Val Epoch 44 [17/89]: Loss — 0.2044 Val Time — 0.0828 Forward Time — 0.0409 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.7902 AP — 0.4591
Val Epoch 44 [18/89]: Loss — 0.2355 Val Time — 0.0813 Forward Time — 0.0301 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.7959 AP — 0.4553
Val Epoch 44 [19/89]: Loss — 0.3119 Val Time — 0.0805 Forward Time — 0.0236 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.7973 AP — 0.4577
Val Epoch 44 [20/89]: Loss — 0.3990 Val Time — 0.0848 Forward Time — 0.0232 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8057 AP — 0.4751
Val Epoch 44 [21/89]: Loss — 0.3539 Val Time — 0.0808 Forward Time — 0.0229 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8089 AP — 0.4851
Val Epoch 44 [22/89]: Loss — 0.1304 Val Time — 0.0802 Forward Time — 0.0226 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8099 AP — 0.4863
Val Epoch 44 [23/89]: Loss — 0.5448 Val Time — 0.0836 Forward Time — 0.0236 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8120 AP — 0.4843
Val Epoch 44 [24/89]: Loss — 0.4084 Val Time — 0.0803 Forward Time — 0.0225 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8043 AP — 0.4834
Val Epoch 44 [25/89]: Loss — 0.3316 Val Time — 0.0811 Forward Time — 0.0249 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8025 AP — 0.4784
Val Epoch 44 [26/89]: Loss — 0.5553 Val Time — 0.0800 Forward Time — 0.0232 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.7965 AP — 0.4781
Val Epoch 44 [27/89]: Loss — 0.2100 Val Time — 0.0801 Forward Time — 0.0227 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8009 AP — 0.4752
Val Epoch 44 [28/89]: Loss — 0.3927 Val Time — 0.0837 Forward Time — 0.0231 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.7977 AP — 0.4676
Val Epoch 44 [29/89]: Loss — 0.3649 Val Time — 0.0801 Forward Time — 0.0222 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8017 AP — 0.4698
Val Epoch 44 [30/89]: Loss — 0.5588 Val Time — 0.0926 Forward Time — 0.0236 Learning Rate — 0.0001 Memory — 0.231416832 GB AUC — 0.8006 AP — 0.4665
Val Epoch 44 [31/89]: Loss — 0.1346 Val Time — 0.0983 Forward Time — 0.

0282 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8001 AP –
0.4659
Val Epoch 44 [32/89]: Loss – 0.3613 Val Time – 0.0853 Forward Time – 0.
0283 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7999 AP –
0.4663
Val Epoch 44 [33/89]: Loss – 0.2390 Val Time – 0.0955 Forward Time – 0.
0359 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8006 AP –
0.4617
Val Epoch 44 [34/89]: Loss – 0.4797 Val Time – 0.0953 Forward Time – 0.
0290 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7988 AP –
0.4571
Val Epoch 44 [35/89]: Loss – 0.2170 Val Time – 0.0800 Forward Time – 0.
0237 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7977 AP –
0.4506
Val Epoch 44 [36/89]: Loss – 0.4843 Val Time – 0.0837 Forward Time – 0.
0239 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7974 AP –
0.4592
Val Epoch 44 [37/89]: Loss – 0.3134 Val Time – 0.0861 Forward Time – 0.
0235 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7929 AP –
0.4539
Val Epoch 44 [38/89]: Loss – 0.1561 Val Time – 0.0976 Forward Time – 0.
0323 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7957 AP –
0.4566
Val Epoch 44 [39/89]: Loss – 0.0601 Val Time – 0.0884 Forward Time – 0.
0325 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7987 AP –
0.4599
Val Epoch 44 [40/89]: Loss – 0.2902 Val Time – 0.0813 Forward Time – 0.
0321 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7977 AP –
0.4700
Val Epoch 44 [41/89]: Loss – 0.1826 Val Time – 0.0958 Forward Time – 0.
0314 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7992 AP –
0.4708
Val Epoch 44 [42/89]: Loss – 0.4165 Val Time – 0.1002 Forward Time – 0.
0318 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7944 AP –
0.4649
Val Epoch 44 [43/89]: Loss – 0.4047 Val Time – 0.0864 Forward Time – 0.
0322 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7971 AP –
0.4769
Val Epoch 44 [44/89]: Loss – 0.1659 Val Time – 0.0863 Forward Time – 0.
0314 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7991 AP –
0.4766
Val Epoch 44 [45/89]: Loss – 0.3920 Val Time – 0.0814 Forward Time – 0.
0313 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7961 AP –
0.4782
Val Epoch 44 [46/89]: Loss – 0.1814 Val Time – 0.0934 Forward Time – 0.
0314 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.7984 AP –
0.4753
Val Epoch 44 [47/89]: Loss – 0.2216 Val Time – 0.0949 Forward Time – 0.
0315 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8007 AP –
0.4805
Val Epoch 44 [48/89]: Loss – 0.2452 Val Time – 0.0894 Forward Time – 0.
0320 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8012 AP –
0.4810
Val Epoch 44 [49/89]: Loss – 0.4030 Val Time – 0.0815 Forward Time – 0.
0314 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8015 AP –
0.4879
Val Epoch 44 [50/89]: Loss – 0.2206 Val Time – 0.0829 Forward Time – 0.

0309 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8050 AP –
0.4965
Val Epoch 44 [51/89]: Loss – 0.2968 Val Time – 0.0876 Forward Time – 0.
0335 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8065 AP –
0.4957
Val Epoch 44 [52/89]: Loss – 0.2411 Val Time – 0.0822 Forward Time – 0.
0281 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8064 AP –
0.4928
Val Epoch 44 [53/89]: Loss – 0.2977 Val Time – 0.0801 Forward Time – 0.
0228 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8035 AP –
0.4932
Val Epoch 44 [54/89]: Loss – 0.2858 Val Time – 0.0813 Forward Time – 0.
0274 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8027 AP –
0.4962
Val Epoch 44 [55/89]: Loss – 0.2684 Val Time – 0.0800 Forward Time – 0.
0231 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8035 AP –
0.4970
Val Epoch 44 [56/89]: Loss – 0.1748 Val Time – 0.0801 Forward Time – 0.
0231 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8060 AP –
0.4967
Val Epoch 44 [57/89]: Loss – 0.2688 Val Time – 0.0846 Forward Time – 0.
0239 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8079 AP –
0.4968
Val Epoch 44 [58/89]: Loss – 0.2579 Val Time – 0.1040 Forward Time – 0.
0238 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8089 AP –
0.4941
Val Epoch 44 [59/89]: Loss – 0.3505 Val Time – 0.0948 Forward Time – 0.
0238 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8097 AP –
0.4967
Val Epoch 44 [60/89]: Loss – 0.4496 Val Time – 0.0817 Forward Time – 0.
0226 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8059 AP –
0.4889
Val Epoch 44 [61/89]: Loss – 0.1750 Val Time – 0.0945 Forward Time – 0.
0230 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8064 AP –
0.4877
Val Epoch 44 [62/89]: Loss – 0.2423 Val Time – 0.0814 Forward Time – 0.
0235 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8061 AP –
0.4864
Val Epoch 44 [63/89]: Loss – 0.3173 Val Time – 0.0803 Forward Time – 0.
0238 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8079 AP –
0.4929
Val Epoch 44 [64/89]: Loss – 0.1106 Val Time – 0.0805 Forward Time – 0.
0234 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8084 AP –
0.4936
Val Epoch 44 [65/89]: Loss – 0.5862 Val Time – 0.0811 Forward Time – 0.
0235 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8079 AP –
0.5027
Val Epoch 44 [66/89]: Loss – 0.0650 Val Time – 0.0807 Forward Time – 0.
0232 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8099 AP –
0.5023
Val Epoch 44 [67/89]: Loss – 0.4634 Val Time – 0.0802 Forward Time – 0.
0229 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8107 AP –
0.5018
Val Epoch 44 [68/89]: Loss – 0.3035 Val Time – 0.0814 Forward Time – 0.
0227 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8105 AP –
0.5007
Val Epoch 44 [69/89]: Loss – 0.2547 Val Time – 0.0803 Forward Time – 0.

0227 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8095 AP –
0.4989
Val Epoch 44 [70/89]: Loss – 0.1695 Val Time – 0.0832 Forward Time – 0.
0432 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8101 AP –
0.4956
Val Epoch 44 [71/89]: Loss – 0.1949 Val Time – 0.0818 Forward Time – 0.
0298 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8098 AP –
0.4941
Val Epoch 44 [72/89]: Loss – 0.6124 Val Time – 0.0817 Forward Time – 0.
0239 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8083 AP –
0.4881
Val Epoch 44 [73/89]: Loss – 0.1819 Val Time – 0.0824 Forward Time – 0.
0261 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8083 AP –
0.4881
Val Epoch 44 [74/89]: Loss – 0.2684 Val Time – 0.0804 Forward Time – 0.
0229 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8088 AP –
0.4858
Val Epoch 44 [75/89]: Loss – 0.4873 Val Time – 0.0800 Forward Time – 0.
0232 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8068 AP –
0.4826
Val Epoch 44 [76/89]: Loss – 0.2074 Val Time – 0.0873 Forward Time – 0.
0232 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8082 AP –
0.4861
Val Epoch 44 [77/89]: Loss – 0.3642 Val Time – 0.0976 Forward Time – 0.
0282 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8073 AP –
0.4869
Val Epoch 44 [78/89]: Loss – 0.3959 Val Time – 0.0931 Forward Time – 0.
0303 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8074 AP –
0.4857
Val Epoch 44 [79/89]: Loss – 0.3840 Val Time – 0.0985 Forward Time – 0.
0382 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8084 AP –
0.4892
Val Epoch 44 [80/89]: Loss – 0.5044 Val Time – 0.0809 Forward Time – 0.
0235 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8073 AP –
0.4870
Val Epoch 44 [81/89]: Loss – 0.2442 Val Time – 0.0899 Forward Time – 0.
0257 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8076 AP –
0.4870
Val Epoch 44 [82/89]: Loss – 0.0842 Val Time – 0.0985 Forward Time – 0.
0240 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8091 AP –
0.4885
Val Epoch 44 [83/89]: Loss – 0.1061 Val Time – 0.0843 Forward Time – 0.
0225 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8098 AP –
0.4881
Val Epoch 44 [84/89]: Loss – 0.5042 Val Time – 0.0941 Forward Time – 0.
0245 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8102 AP –
0.4871
Val Epoch 44 [85/89]: Loss – 0.1449 Val Time – 0.0939 Forward Time – 0.
0226 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8117 AP –
0.4887
Val Epoch 44 [86/89]: Loss – 0.3545 Val Time – 0.0818 Forward Time – 0.
0303 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8119 AP –
0.4888
Val Epoch 44 [87/89]: Loss – 0.4820 Val Time – 0.0899 Forward Time – 0.
0234 Learning Rate – 0.0001 Memory – 0.231416832 GB AUC – 0.8100 AP –
0.4847
Val Epoch 44 [88/89]: Loss – 0.2584 Val Time – 0.0993 Forward Time – 0.

```
0239 Learning Rate - 0.0001 Memory - 0.231416832 GB AUC - 0.8101 AP -
0.4848
Val Epoch 44 [89/89]: Loss - 0.5052 Val Time - 0.1030 Forward Time - 0.
0837 Learning Rate - 0.0001 Memory - 0.216736768 GB AUC - 0.8091 AP -
0.4847
Saving checkpoint /tmp/tmpmlz1uY/models/model_35000.pth.tar.
```

In [24]:
```python
from experiments.fusion_baselines.train_cross_sectional_attention_fusion import train_cross_sectional_attention_fusion

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_sectional_attention_fusion_mlp_4/models/model_best.pth.tar'
cross_sectional_attention_fusion_4_chexpert_metrics = train_cross_sectional_attention_fusion(CHEXPERT_EVALUATION_ARGUMENTS + ['--val-batch-size', '8', '--fusion-index', '4', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_attention_fusion_mlp_4/models/model_bes
t.pth.tar', criterion='bce_loss', cuda_benchmark=True, dataset_class='P
airedOnlyCustomSplit', evaluate_once=True, fusion_index=4, fusion_opera
tor='cross_sectional_attention_mlp', label_class='paper', learning_rate
=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normaliza
tion='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir='/
tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, train_
batch_size=1, train_data='/home/kelvin.wong/Datasets/CheXpert-v1.0', us
e_test_set=True, val_batch_size=8, val_data='/home/kelvin.wong/Dataset
s/CheXpert-v1.0', val_frequency=4800)
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 34 [1/89]: Loss - 0.2439 Val Time - 0.3762 Forward Time - 0.3
486 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8452 AP - 0.6
250
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 34 [2/89]: Loss - 0.3037 Val Time - 0.1699 Forward Time - 0.0
984 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8428 AP - 0.5
254
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 34 [3/89]: Loss - 0.5073 Val Time - 0.1477 Forward Time - 0.0
842 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.7908 AP - 0.4
858
Val Epoch 34 [4/89]: Loss - 0.2161 Val Time - 0.1433 Forward Time - 0.0
803 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8052 AP - 0.3
971
Val Epoch 34 [5/89]: Loss - 0.4043 Val Time - 0.1473 Forward Time - 0.0
833 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.7962 AP - 0.3
836
Val Epoch 34 [6/89]: Loss - 0.1787 Val Time - 0.1437 Forward Time - 0.0
802 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.7955 AP - 0.3
807
Val Epoch 34 [7/89]: Loss - 0.2852 Val Time - 0.1470 Forward Time - 0.0
832 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8008 AP - 0.4
489
Val Epoch 34 [8/89]: Loss - 0.3507 Val Time - 0.1441 Forward Time - 0.0
803 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8140 AP - 0.4
249
Val Epoch 34 [9/89]: Loss - 0.4460 Val Time - 0.1474 Forward Time - 0.0
805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8168 AP - 0.4
620
Val Epoch 34 [10/89]: Loss - 0.3942 Val Time - 0.1438 Forward Time - 0.
0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8061 AP - 0.
4713
Val Epoch 34 [11/89]: Loss - 0.0610 Val Time - 0.1470 Forward Time - 0.
0821 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8128 AP - 0.
4653
Val Epoch 34 [12/89]: Loss - 0.2210 Val Time - 0.1430 Forward Time - 0.
```

0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8094 AP - 0.
4679
Val Epoch 34 [13/89]: Loss - 0.3843 Val Time - 0.1471 Forward Time - 0.
0820 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8200 AP - 0.
4778
Val Epoch 34 [14/89]: Loss - 0.2207 Val Time - 0.1427 Forward Time - 0.
0803 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8279 AP - 0.
4845
Val Epoch 34 [15/89]: Loss - 0.3017 Val Time - 0.1477 Forward Time - 0.
0821 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8236 AP - 0.
4816
Val Epoch 34 [16/89]: Loss - 0.3228 Val Time - 0.1424 Forward Time - 0.
0803 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8184 AP - 0.
4804
Val Epoch 34 [17/89]: Loss - 0.2215 Val Time - 0.1491 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8140 AP - 0.
4763
Val Epoch 34 [18/89]: Loss - 0.2094 Val Time - 0.1444 Forward Time - 0.
0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8191 AP - 0.
4901
Val Epoch 34 [19/89]: Loss - 0.2768 Val Time - 0.1473 Forward Time - 0.
0817 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8244 AP - 0.
4932
Val Epoch 34 [20/89]: Loss - 0.4293 Val Time - 0.1428 Forward Time - 0.
0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8316 AP - 0.
5008
Val Epoch 34 [21/89]: Loss - 0.4417 Val Time - 0.1475 Forward Time - 0.
0817 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8316 AP - 0.
5107
Val Epoch 34 [22/89]: Loss - 0.1808 Val Time - 0.1431 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8319 AP - 0.
5135
Val Epoch 34 [23/89]: Loss - 0.4582 Val Time - 0.1467 Forward Time - 0.
0823 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8344 AP - 0.
5109
Val Epoch 34 [24/89]: Loss - 0.4109 Val Time - 0.1431 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8285 AP - 0.
5059
Val Epoch 34 [25/89]: Loss - 0.3345 Val Time - 0.1480 Forward Time - 0.
0803 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8231 AP - 0.
5001
Val Epoch 34 [26/89]: Loss - 0.5282 Val Time - 0.1450 Forward Time - 0.
0803 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8192 AP - 0.
5009
Val Epoch 34 [27/89]: Loss - 0.2186 Val Time - 0.1487 Forward Time - 0.
0835 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8222 AP - 0.
4981
Val Epoch 34 [28/89]: Loss - 0.4222 Val Time - 0.1431 Forward Time - 0.
0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8147 AP - 0.
4888
Val Epoch 34 [29/89]: Loss - 0.3399 Val Time - 0.1477 Forward Time - 0.
0824 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8192 AP - 0.
4912
Val Epoch 34 [30/89]: Loss - 0.6108 Val Time - 0.1453 Forward Time - 0.
0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8148 AP - 0.
4855
Val Epoch 34 [31/89]: Loss - 0.1645 Val Time - 0.1485 Forward Time - 0.

0824 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8138 AP – 0.
4807
Val Epoch 34 [32/89]: Loss – 0.2900 Val Time – 0.1442 Forward Time – 0.
0805 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8155 AP – 0.
4855
Val Epoch 34 [33/89]: Loss – 0.2471 Val Time – 0.1484 Forward Time – 0.
0805 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8151 AP – 0.
4773
Val Epoch 34 [34/89]: Loss – 0.4596 Val Time – 0.1434 Forward Time – 0.
0806 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8122 AP – 0.
4718
Val Epoch 34 [35/89]: Loss – 0.1984 Val Time – 0.1475 Forward Time – 0.
0833 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8101 AP – 0.
4656
Val Epoch 34 [36/89]: Loss – 0.4518 Val Time – 0.1433 Forward Time – 0.
0804 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8127 AP – 0.
4777
Val Epoch 34 [37/89]: Loss – 0.3321 Val Time – 0.1468 Forward Time – 0.
0811 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8086 AP – 0.
4724
Val Epoch 34 [38/89]: Loss – 0.2035 Val Time – 0.1444 Forward Time – 0.
0805 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8086 AP – 0.
4728
Val Epoch 34 [39/89]: Loss – 0.0931 Val Time – 0.1467 Forward Time – 0.
0819 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8110 AP – 0.
4696
Val Epoch 34 [40/89]: Loss – 0.3449 Val Time – 0.1438 Forward Time – 0.
0806 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8091 AP – 0.
4684
Val Epoch 34 [41/89]: Loss – 0.1718 Val Time – 0.1490 Forward Time – 0.
0806 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8108 AP – 0.
4695
Val Epoch 34 [42/89]: Loss – 0.4202 Val Time – 0.1429 Forward Time – 0.
0804 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8053 AP – 0.
4645
Val Epoch 34 [43/89]: Loss – 0.4225 Val Time – 0.1473 Forward Time – 0.
0815 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8079 AP – 0.
4742
Val Epoch 34 [44/89]: Loss – 0.1427 Val Time – 0.1429 Forward Time – 0.
0805 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8100 AP – 0.
4755
Val Epoch 34 [45/89]: Loss – 0.3579 Val Time – 0.1469 Forward Time – 0.
0834 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8091 AP – 0.
4770
Val Epoch 34 [46/89]: Loss – 0.2020 Val Time – 0.1430 Forward Time – 0.
0805 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8103 AP – 0.
4717
Val Epoch 34 [47/89]: Loss – 0.2674 Val Time – 0.1470 Forward Time – 0.
0827 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8103 AP – 0.
4735
Val Epoch 34 [48/89]: Loss – 0.2283 Val Time – 0.1434 Forward Time – 0.
0804 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8117 AP – 0.
4748
Val Epoch 34 [49/89]: Loss – 0.3359 Val Time – 0.1502 Forward Time – 0.
0870 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8122 AP – 0.
4793
Val Epoch 34 [50/89]: Loss – 0.2958 Val Time – 0.1460 Forward Time – 0.

```
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8160 AP - 0.
4880
Val Epoch 34 [51/89]: Loss - 0.2871 Val Time - 0.1449 Forward Time - 0.
0811 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8172 AP - 0.
4867
Val Epoch 34 [52/89]: Loss - 0.2584 Val Time - 0.1466 Forward Time - 0.
0825 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8175 AP - 0.
4862
Val Epoch 34 [53/89]: Loss - 0.3143 Val Time - 0.1431 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8141 AP - 0.
4881
Val Epoch 34 [54/89]: Loss - 0.3512 Val Time - 0.1453 Forward Time - 0.
0824 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8120 AP - 0.
4873
Val Epoch 34 [55/89]: Loss - 0.1940 Val Time - 0.1431 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8145 AP - 0.
4879
Val Epoch 34 [56/89]: Loss - 0.1550 Val Time - 0.1463 Forward Time - 0.
0831 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8172 AP - 0.
4900
Val Epoch 34 [57/89]: Loss - 0.2228 Val Time - 0.1440 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8195 AP - 0.
4947
Val Epoch 34 [58/89]: Loss - 0.2400 Val Time - 0.1446 Forward Time - 0.
0806 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8204 AP - 0.
4926
Val Epoch 34 [59/89]: Loss - 0.4365 Val Time - 0.1438 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8192 AP - 0.
4913
Val Epoch 34 [60/89]: Loss - 0.5064 Val Time - 0.1458 Forward Time - 0.
0826 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8159 AP - 0.
4821
Val Epoch 34 [61/89]: Loss - 0.2056 Val Time - 0.1436 Forward Time - 0.
0806 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8168 AP - 0.
4803
Val Epoch 34 [62/89]: Loss - 0.1902 Val Time - 0.1462 Forward Time - 0.
0827 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8168 AP - 0.
4793
Val Epoch 34 [63/89]: Loss - 0.3598 Val Time - 0.1448 Forward Time - 0.
0807 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8171 AP - 0.
4786
Val Epoch 34 [64/89]: Loss - 0.0873 Val Time - 0.1434 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8185 AP - 0.
4797
Val Epoch 34 [65/89]: Loss - 0.5464 Val Time - 0.1460 Forward Time - 0.
0828 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8186 AP - 0.
4865
Val Epoch 34 [66/89]: Loss - 0.0819 Val Time - 0.1463 Forward Time - 0.
0831 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8203 AP - 0.
4860
Val Epoch 34 [67/89]: Loss - 0.4020 Val Time - 0.1462 Forward Time - 0.
0828 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8214 AP - 0.
4870
Val Epoch 34 [68/89]: Loss - 0.3460 Val Time - 0.1434 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8187 AP - 0.
4858
Val Epoch 34 [69/89]: Loss - 0.3322 Val Time - 0.1485 Forward Time - 0.
```

0838 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8175 AP - 0.4830
Val Epoch 34 [70/89]: Loss - 0.2025 Val Time - 0.1432 Forward Time - 0.0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8171 AP - 0.4804
Val Epoch 34 [71/89]: Loss - 0.1947 Val Time - 0.1741 Forward Time - 0.0991 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8173 AP - 0.4797
Val Epoch 34 [72/89]: Loss - 0.5683 Val Time - 0.1737 Forward Time - 0.1005 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8148 AP - 0.4755
Val Epoch 34 [73/89]: Loss - 0.1579 Val Time - 0.1669 Forward Time - 0.0884 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8160 AP - 0.4758
Val Epoch 34 [74/89]: Loss - 0.1683 Val Time - 0.1641 Forward Time - 0.0990 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8168 AP - 0.4749
Val Epoch 34 [75/89]: Loss - 0.4957 Val Time - 0.1455 Forward Time - 0.0826 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8143 AP - 0.4743
Val Epoch 34 [76/89]: Loss - 0.2357 Val Time - 0.1427 Forward Time - 0.0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8157 AP - 0.4770
Val Epoch 34 [77/89]: Loss - 0.3616 Val Time - 0.1455 Forward Time - 0.0814 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8150 AP - 0.4778
Val Epoch 34 [78/89]: Loss - 0.3908 Val Time - 0.1429 Forward Time - 0.0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8145 AP - 0.4761
Val Epoch 34 [79/89]: Loss - 0.4404 Val Time - 0.1439 Forward Time - 0.0807 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8146 AP - 0.4774
Val Epoch 34 [80/89]: Loss - 0.3953 Val Time - 0.1431 Forward Time - 0.0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8138 AP - 0.4759
Val Epoch 34 [81/89]: Loss - 0.3382 Val Time - 0.1442 Forward Time - 0.0812 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8130 AP - 0.4737
Val Epoch 34 [82/89]: Loss - 0.1547 Val Time - 0.1454 Forward Time - 0.0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8135 AP - 0.4718
Val Epoch 34 [83/89]: Loss - 0.1197 Val Time - 0.1454 Forward Time - 0.0820 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8140 AP - 0.4698
Val Epoch 34 [84/89]: Loss - 0.4352 Val Time - 0.1427 Forward Time - 0.0804 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8140 AP - 0.4691
Val Epoch 34 [85/89]: Loss - 0.1579 Val Time - 0.1462 Forward Time - 0.0812 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8155 AP - 0.4704
Val Epoch 34 [86/89]: Loss - 0.3738 Val Time - 0.1428 Forward Time - 0.0805 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8151 AP - 0.4699
Val Epoch 34 [87/89]: Loss - 0.5515 Val Time - 0.1428 Forward Time - 0.0820 Learning Rate - 0.0001 Memory - 0.47228928 GB AUC - 0.8119 AP - 0.4647
Val Epoch 34 [88/89]: Loss - 0.2237 Val Time - 0.1399 Forward Time - 0.

```
0806 Learning Rate – 0.0001 Memory – 0.47228928 GB AUC – 0.8122 AP – 0.
4632
Val Epoch 34 [89/89]: Loss – 0.5410 Val Time – 0.2464 Forward Time – 0.
2412 Learning Rate – 0.0001 Memory – 0.457609216 GB AUC – 0.8110 AP –
0.4633
Saving checkpoint /tmp/tmpmlz1uY/models/model_27000.pth.tar.
```

5.2 MIMIC CXR Valid Metrics

In [25]:
```python
from experiments.fusion_baselines.train_cross_sectional_attention_fusion
import train_cross_sectional_attention_fusion

checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_section
al_attention_fusion_mlp_0/models/model_best.pth.tar'
cross_sectional_attention_fusion_0_mimic_metrics = train_cross_sectional
_attention_fusion(MIMIC_EVALUATION_ARGUMENTS + ['--val-batch-size', '8',
'--fusion-index', '0', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_attention_fusion_mlp_0/models/model_bes
t.pth.tar', criterion='bce_loss', cuda_benchmark=True, dataset_class='P
airedOnlyMIMICDataset', evaluate_once=True, fusion_index=0, fusion_oper
ator='cross_sectional_attention_mlp', label_class='paper', learning_rat
e=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normaliz
ation='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', use
_test_set=True, val_batch_size=8, val_data='/home/kelvin.wong/Datasets/
MIMIC-CXR', val_frequency=4800)
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 44 [1/110]: Loss - 0.2153 Val Time - 0.1090 Forward Time - 0.
0511 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.0000 AP - 0.0
000
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 44 [2/110]: Loss - 0.2359 Val Time - 0.0801 Forward Time - 0.
0244 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8000 AP - 0.5
714
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 44 [3/110]: Loss - 0.3691 Val Time - 0.0870 Forward Time - 0.
0235 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8222 AP - 0.4
731
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 44 [4/110]: Loss - 0.4478 Val Time - 0.1039 Forward Time - 0.
0352 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7830 AP - 0.4
565
Val Epoch 44 [5/110]: Loss - 0.2381 Val Time - 0.0863 Forward Time - 0.
0283 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8289 AP - 0.4
175
Val Epoch 44 [6/110]: Loss - 0.4678 Val Time - 0.0800 Forward Time - 0.
0238 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8245 AP - 0.4
079
Val Epoch 44 [7/110]: Loss - 0.3483 Val Time - 0.0836 Forward Time - 0.
0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8032 AP - 0.3
889
Val Epoch 44 [8/110]: Loss - 0.2409 Val Time - 0.0803 Forward Time - 0.
0230 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8144 AP - 0.4
467
```

```
Val Epoch 44 [9/110]: Loss - 0.3926 Val Time - 0.0847 Forward Time - 0.
0436 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7915 AP - 0.4
012
Val Epoch 44 [10/110]: Loss - 0.2386 Val Time - 0.0806 Forward Time -
0.0240 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7661 AP -
0.3775
Val Epoch 44 [11/110]: Loss - 0.3265 Val Time - 0.0806 Forward Time -
0.0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7700 AP -
0.3836
Val Epoch 44 [12/110]: Loss - 0.2085 Val Time - 0.0808 Forward Time -
0.0243 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7855 AP -
0.4090
Val Epoch 44 [13/110]: Loss - 0.2783 Val Time - 0.0854 Forward Time -
0.0246 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7813 AP -
0.3932
Val Epoch 44 [14/110]: Loss - 0.0807 Val Time - 0.0810 Forward Time -
0.0238 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7838 AP -
0.3862
Val Epoch 44 [15/110]: Loss - 0.1628 Val Time - 0.0807 Forward Time -
0.0228 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7857 AP -
0.3713
Val Epoch 44 [16/110]: Loss - 0.2853 Val Time - 0.0838 Forward Time -
0.0227 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7806 AP -
0.3796
Val Epoch 44 [17/110]: Loss - 0.3044 Val Time - 0.0995 Forward Time -
0.0339 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7825 AP -
0.3726
Val Epoch 44 [18/110]: Loss - 0.2891 Val Time - 0.0815 Forward Time -
0.0238 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7775 AP -
0.3662
Val Epoch 44 [19/110]: Loss - 0.0544 Val Time - 0.0803 Forward Time -
0.0236 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7837 AP -
0.3635
Val Epoch 44 [20/110]: Loss - 0.4048 Val Time - 0.0801 Forward Time -
0.0232 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7922 AP -
0.3648
Val Epoch 44 [21/110]: Loss - 0.2082 Val Time - 0.0860 Forward Time -
0.0395 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.7940 AP -
0.3586
Val Epoch 44 [22/110]: Loss - 0.1260 Val Time - 0.0812 Forward Time -
0.0259 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8034 AP -
0.3779
Val Epoch 44 [23/110]: Loss - 0.2004 Val Time - 0.0811 Forward Time -
0.0236 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8038 AP -
0.3832
Val Epoch 44 [24/110]: Loss - 0.2298 Val Time - 0.0839 Forward Time -
0.0238 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8032 AP -
0.3801
Val Epoch 44 [25/110]: Loss - 0.0720 Val Time - 0.0873 Forward Time -
0.0236 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8068 AP -
0.3800
Val Epoch 44 [26/110]: Loss - 0.3800 Val Time - 0.0838 Forward Time -
0.0396 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8015 AP -
0.3701
Val Epoch 44 [27/110]: Loss - 0.1261 Val Time - 0.0889 Forward Time -
0.0293 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8024 AP -
0.3679
```

```
Val Epoch 44 [28/110]: Loss - 0.5361 Val Time - 0.0886 Forward Time -
0.0239 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8051 AP -
0.3766
Val Epoch 44 [29/110]: Loss - 0.4583 Val Time - 0.0863 Forward Time -
0.0314 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8157 AP -
0.3904
Val Epoch 44 [30/110]: Loss - 0.3487 Val Time - 0.0805 Forward Time -
0.0236 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8260 AP -
0.3952
Val Epoch 44 [31/110]: Loss - 0.2397 Val Time - 0.0807 Forward Time -
0.0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8249 AP -
0.3900
Val Epoch 44 [32/110]: Loss - 0.4153 Val Time - 0.0843 Forward Time -
0.0239 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8127 AP -
0.3841
Val Epoch 44 [33/110]: Loss - 0.0874 Val Time - 0.0880 Forward Time -
0.0284 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8157 AP -
0.3867
Val Epoch 44 [34/110]: Loss - 0.1314 Val Time - 0.0809 Forward Time -
0.0280 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8166 AP -
0.3849
Val Epoch 44 [35/110]: Loss - 0.4570 Val Time - 0.0844 Forward Time -
0.0253 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8183 AP -
0.3845
Val Epoch 44 [36/110]: Loss - 0.2441 Val Time - 0.0806 Forward Time -
0.0234 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8179 AP -
0.3862
Val Epoch 44 [37/110]: Loss - 0.2385 Val Time - 0.0809 Forward Time -
0.0235 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8199 AP -
0.3874
Val Epoch 44 [38/110]: Loss - 0.2204 Val Time - 0.0836 Forward Time -
0.0243 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8176 AP -
0.3829
Val Epoch 44 [39/110]: Loss - 0.2731 Val Time - 0.0858 Forward Time -
0.0435 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8177 AP -
0.3833
Val Epoch 44 [40/110]: Loss - 0.1111 Val Time - 0.0816 Forward Time -
0.0306 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8222 AP -
0.4080
Val Epoch 44 [41/110]: Loss - 0.2134 Val Time - 0.0894 Forward Time -
0.0409 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8265 AP -
0.4134
Val Epoch 44 [42/110]: Loss - 0.1406 Val Time - 0.0867 Forward Time -
0.0442 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8277 AP -
0.4121
Val Epoch 44 [43/110]: Loss - 0.1343 Val Time - 0.0817 Forward Time -
0.0299 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8310 AP -
0.4154
Val Epoch 44 [44/110]: Loss - 0.2568 Val Time - 0.0807 Forward Time -
0.0250 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8293 AP -
0.4108
Val Epoch 44 [45/110]: Loss - 0.1584 Val Time - 0.0838 Forward Time -
0.0247 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8293 AP -
0.4012
Val Epoch 44 [46/110]: Loss - 0.0918 Val Time - 0.0855 Forward Time -
0.0242 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8319 AP -
0.4021
```

```
Val Epoch 44 [47/110]: Loss - 0.1335 Val Time - 0.0803 Forward Time -
0.0233 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8333 AP -
0.3997
Val Epoch 44 [48/110]: Loss - 0.3626 Val Time - 0.0825 Forward Time -
0.0252 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8296 AP -
0.3972
Val Epoch 44 [49/110]: Loss - 0.2664 Val Time - 0.0831 Forward Time -
0.0417 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8296 AP -
0.3911
Val Epoch 44 [50/110]: Loss - 0.2718 Val Time - 0.0824 Forward Time -
0.0372 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8314 AP -
0.3913
Val Epoch 44 [51/110]: Loss - 0.1460 Val Time - 0.0808 Forward Time -
0.0241 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8341 AP -
0.3911
Val Epoch 44 [52/110]: Loss - 0.0953 Val Time - 0.0809 Forward Time -
0.0239 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8367 AP -
0.3936
Val Epoch 44 [53/110]: Loss - 0.1389 Val Time - 0.0820 Forward Time -
0.0246 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8384 AP -
0.3926
Val Epoch 44 [54/110]: Loss - 0.2168 Val Time - 0.0803 Forward Time -
0.0239 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8375 AP -
0.3913
Val Epoch 44 [55/110]: Loss - 0.2062 Val Time - 0.0802 Forward Time -
0.0232 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8387 AP -
0.3947
Val Epoch 44 [56/110]: Loss - 0.2742 Val Time - 0.0821 Forward Time -
0.0251 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8398 AP -
0.3974
Val Epoch 44 [57/110]: Loss - 0.2750 Val Time - 0.0827 Forward Time -
0.0417 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8311 AP -
0.3993
Val Epoch 44 [58/110]: Loss - 0.1432 Val Time - 0.0803 Forward Time -
0.0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8327 AP -
0.3993
Val Epoch 44 [59/110]: Loss - 0.4098 Val Time - 0.0807 Forward Time -
0.0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8335 AP -
0.3931
Val Epoch 44 [60/110]: Loss - 0.2820 Val Time - 0.0806 Forward Time -
0.0232 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8324 AP -
0.3928
Val Epoch 44 [61/110]: Loss - 0.2350 Val Time - 0.0821 Forward Time -
0.0244 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8308 AP -
0.3877
Val Epoch 44 [62/110]: Loss - 0.3208 Val Time - 0.0804 Forward Time -
0.0236 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8291 AP -
0.3858
Val Epoch 44 [63/110]: Loss - 0.4400 Val Time - 0.0811 Forward Time -
0.0231 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8249 AP -
0.3853
Val Epoch 44 [64/110]: Loss - 0.2838 Val Time - 0.0821 Forward Time -
0.0268 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8259 AP -
0.3864
Val Epoch 44 [65/110]: Loss - 0.2768 Val Time - 0.0817 Forward Time -
0.0332 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8264 AP -
0.3884
```

```
Val Epoch 44 [66/110]: Loss - 0.1811 Val Time - 0.0817 Forward Time -
0.0322 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8272 AP -
0.3897
Val Epoch 44 [67/110]: Loss - 0.2487 Val Time - 0.0805 Forward Time -
0.0255 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8281 AP -
0.3906
Val Epoch 44 [68/110]: Loss - 0.2797 Val Time - 0.0814 Forward Time -
0.0241 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8270 AP -
0.3918
Val Epoch 44 [69/110]: Loss - 0.2475 Val Time - 0.0822 Forward Time -
0.0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8273 AP -
0.3910
Val Epoch 44 [70/110]: Loss - 0.3742 Val Time - 0.0875 Forward Time -
0.0234 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8262 AP -
0.3923
Val Epoch 44 [71/110]: Loss - 0.3191 Val Time - 0.0882 Forward Time -
0.0245 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8201 AP -
0.3922
Val Epoch 44 [72/110]: Loss - 0.2598 Val Time - 0.0871 Forward Time -
0.0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8207 AP -
0.3920
Val Epoch 44 [73/110]: Loss - 0.3460 Val Time - 0.0832 Forward Time -
0.0416 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8202 AP -
0.3882
Val Epoch 44 [74/110]: Loss - 0.2062 Val Time - 0.0811 Forward Time -
0.0299 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8204 AP -
0.3844
Val Epoch 44 [75/110]: Loss - 0.2427 Val Time - 0.0803 Forward Time -
0.0251 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8208 AP -
0.3851
Val Epoch 44 [76/110]: Loss - 0.1904 Val Time - 0.0823 Forward Time -
0.0239 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8213 AP -
0.3839
Val Epoch 44 [77/110]: Loss - 0.2401 Val Time - 0.0808 Forward Time -
0.0270 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8209 AP -
0.3817
Val Epoch 44 [78/110]: Loss - 0.2250 Val Time - 0.0805 Forward Time -
0.0234 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8213 AP -
0.3824
Val Epoch 44 [79/110]: Loss - 0.2185 Val Time - 0.0820 Forward Time -
0.0233 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8232 AP -
0.3896
Val Epoch 44 [80/110]: Loss - 0.3243 Val Time - 0.0810 Forward Time -
0.0233 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8226 AP -
0.3893
Val Epoch 44 [81/110]: Loss - 0.2460 Val Time - 0.0832 Forward Time -
0.0418 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8247 AP -
0.3957
Val Epoch 44 [82/110]: Loss - 0.2421 Val Time - 0.0814 Forward Time -
0.0299 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8253 AP -
0.4009
Val Epoch 44 [83/110]: Loss - 0.4432 Val Time - 0.0810 Forward Time -
0.0250 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8235 AP -
0.3979
Val Epoch 44 [84/110]: Loss - 0.1492 Val Time - 0.0837 Forward Time -
0.0258 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8242 AP -
0.3961
```

```
Val Epoch 44 [85/110]: Loss - 0.2822 Val Time - 0.0806 Forward Time -
0.0233 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8236 AP -
0.3952
Val Epoch 44 [86/110]: Loss - 0.2553 Val Time - 0.0810 Forward Time -
0.0233 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8271 AP -
0.3951
Val Epoch 44 [87/110]: Loss - 0.2256 Val Time - 0.0821 Forward Time -
0.0282 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8222 AP -
0.3923
Val Epoch 44 [88/110]: Loss - 0.3475 Val Time - 0.0806 Forward Time -
0.0231 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8225 AP -
0.3949
Val Epoch 44 [89/110]: Loss - 0.3427 Val Time - 0.0834 Forward Time -
0.0411 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8225 AP -
0.3933
Val Epoch 44 [90/110]: Loss - 0.2678 Val Time - 0.0815 Forward Time -
0.0306 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8228 AP -
0.3990
Val Epoch 44 [91/110]: Loss - 0.1935 Val Time - 0.0806 Forward Time -
0.0244 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8237 AP -
0.3988
Val Epoch 44 [92/110]: Loss - 0.2500 Val Time - 0.0825 Forward Time -
0.0251 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8238 AP -
0.3948
Val Epoch 44 [93/110]: Loss - 0.2769 Val Time - 0.0799 Forward Time -
0.0237 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8233 AP -
0.3955
Val Epoch 44 [94/110]: Loss - 0.2599 Val Time - 0.0807 Forward Time -
0.0236 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8231 AP -
0.3894
Val Epoch 44 [95/110]: Loss - 0.0965 Val Time - 0.0818 Forward Time -
0.0242 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8243 AP -
0.3914
Val Epoch 44 [96/110]: Loss - 0.1797 Val Time - 0.0802 Forward Time -
0.0270 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8245 AP -
0.3904
Val Epoch 44 [97/110]: Loss - 0.3641 Val Time - 0.0971 Forward Time -
0.0334 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8198 AP -
0.3891
Val Epoch 44 [98/110]: Loss - 0.3272 Val Time - 0.1018 Forward Time -
0.0317 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8200 AP -
0.3874
Val Epoch 44 [99/110]: Loss - 0.1712 Val Time - 0.0867 Forward Time -
0.0318 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8209 AP -
0.3878
Val Epoch 44 [100/110]: Loss - 0.2933 Val Time - 0.0837 Forward Time -
0.0309 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8213 AP -
0.3898
Val Epoch 44 [101/110]: Loss - 0.3161 Val Time - 0.0815 Forward Time -
0.0306 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8210 AP -
0.3897
Val Epoch 44 [102/110]: Loss - 0.4973 Val Time - 0.0883 Forward Time -
0.0309 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8245 AP -
0.3899
Val Epoch 44 [103/110]: Loss - 0.2165 Val Time - 0.1006 Forward Time -
0.0334 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8246 AP -
0.3913
```

```
Val Epoch 44 [104/110]: Loss - 0.3011 Val Time - 0.0856 Forward Time -
0.0329 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8246 AP -
0.3868
Val Epoch 44 [105/110]: Loss - 0.1851 Val Time - 0.0791 Forward Time -
0.0341 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8259 AP -
0.3871
Val Epoch 44 [106/110]: Loss - 0.1982 Val Time - 0.0796 Forward Time -
0.0253 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8264 AP -
0.3877
Val Epoch 44 [107/110]: Loss - 0.3303 Val Time - 0.0785 Forward Time -
0.0210 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8258 AP -
0.3887
Val Epoch 44 [108/110]: Loss - 0.1773 Val Time - 0.0804 Forward Time -
0.0201 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8257 AP -
0.3858
Val Epoch 44 [109/110]: Loss - 0.1014 Val Time - 0.0792 Forward Time -
0.0205 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8260 AP -
0.3850
Val Epoch 44 [110/110]: Loss - 0.2368 Val Time - 0.0789 Forward Time -
0.0214 Learning Rate - 0.0001 Memory - 0.1696384 GB AUC - 0.8272 AP -
0.3846
Saving checkpoint /tmp/tmpmlz1uY/models/model_35000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_35000.pth.tar.
```

```python
In [26]: from experiments.fusion_baselines.train_cross_sectional_attention_fusion
         import train_cross_sectional_attention_fusion

         checkpoint = '/home/kelvin.wong/experiments/chexpert_train/cross_section
         al_attention_fusion_mlp_4/models/model_best.pth.tar'
         cross_sectional_attention_fusion_4_mimic_metrics = train_cross_sectional
         _attention_fusion(MIMIC_EVALUATION_ARGUMENTS + ['--val-batch-size', '8',
         '--fusion-index', '4', '--checkpoint', checkpoint])
```

```
Namespace(activation='relu', checkpoint='/home/kelvin.wong/experiments/
chexpert_train/cross_sectional_attention_fusion_mlp_4/models/model_bes
t.pth.tar', criterion='bce_loss', cuda_benchmark=True, dataset_class='P
airedOnlyMIMICDataset', evaluate_once=True, fusion_index=4, fusion_oper
ator='cross_sectional_attention_mlp', label_class='paper', learning_rat
e=0.0001, log_frequency=1000, map_unobserved_to_negative=True, normaliz
ation='batchnorm2d', num_epochs=10, num_gpus=1, num_workers=8, outdir
='/tmp/tmpmlz1uY', save_predictions=False, seed=123, shuffle=False, tra
in_batch_size=1, train_data='/home/kelvin.wong/Datasets/MIMIC-CXR', use
_test_set=True, val_batch_size=8, val_data='/home/kelvin.wong/Datasets/
MIMIC-CXR', val_frequency=4800)
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 34 [1/110]: Loss - 0.1293 Val Time - 0.1722 Forward Time - 0.
0885 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.0000 AP -
0.0000
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 34 [2/110]: Loss - 0.2037 Val Time - 0.1458 Forward Time - 0.
0814 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.9333 AP -
0.6667
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 34 [3/110]: Loss - 0.3711 Val Time - 0.1471 Forward Time - 0.
0838 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8524 AP -
0.5143
Encountered exception: Only one class present in y_true. ROC AUC score
is not defined in that case..
Val Epoch 34 [4/110]: Loss - 0.4316 Val Time - 0.1439 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8066 AP -
0.4461
Val Epoch 34 [5/110]: Loss - 0.2074 Val Time - 0.1476 Forward Time - 0.
0842 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8576 AP -
0.4322
Val Epoch 34 [6/110]: Loss - 0.4773 Val Time - 0.1440 Forward Time - 0.
0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8523 AP -
0.4131
Val Epoch 34 [7/110]: Loss - 0.2878 Val Time - 0.1470 Forward Time - 0.
0838 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8464 AP -
0.4102
Val Epoch 34 [8/110]: Loss - 0.2042 Val Time - 0.1436 Forward Time - 0.
0807 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8467 AP -
0.4595
```

```
Val Epoch 34 [9/110]: Loss - 0.4070 Val Time - 0.1453 Forward Time - 0.
0808 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8152 AP -
0.3864
Val Epoch 34 [10/110]: Loss - 0.2461 Val Time - 0.1505 Forward Time -
0.0807 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.7959 AP -
0.3595
Val Epoch 34 [11/110]: Loss - 0.3151 Val Time - 0.1447 Forward Time -
0.0807 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8008 AP -
0.3613
Val Epoch 34 [12/110]: Loss - 0.2357 Val Time - 0.1468 Forward Time -
0.0834 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8102 AP -
0.3888
Val Epoch 34 [13/110]: Loss - 0.3031 Val Time - 0.1442 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8046 AP -
0.3668
Val Epoch 34 [14/110]: Loss - 0.0684 Val Time - 0.1470 Forward Time -
0.0834 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8114 AP -
0.3624
Val Epoch 34 [15/110]: Loss - 0.1403 Val Time - 0.1445 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8160 AP -
0.3568
Val Epoch 34 [16/110]: Loss - 0.2356 Val Time - 0.1479 Forward Time -
0.0834 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8158 AP -
0.3690
Val Epoch 34 [17/110]: Loss - 0.3153 Val Time - 0.1477 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8130 AP -
0.3600
Val Epoch 34 [18/110]: Loss - 0.1995 Val Time - 0.1492 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8121 AP -
0.3548
Val Epoch 34 [19/110]: Loss - 0.0691 Val Time - 0.1441 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8174 AP -
0.3522
Val Epoch 34 [20/110]: Loss - 0.4176 Val Time - 0.1486 Forward Time -
0.0819 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8265 AP -
0.3676
Val Epoch 34 [21/110]: Loss - 0.1682 Val Time - 0.1438 Forward Time -
0.0804 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8296 AP -
0.3643
Val Epoch 34 [22/110]: Loss - 0.1685 Val Time - 0.1474 Forward Time -
0.0821 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8391 AP -
0.3789
Val Epoch 34 [23/110]: Loss - 0.1932 Val Time - 0.1426 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8396 AP -
0.3931
Val Epoch 34 [24/110]: Loss - 0.1924 Val Time - 0.1477 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8394 AP -
0.3939
Val Epoch 34 [25/110]: Loss - 0.0732 Val Time - 0.1423 Forward Time -
0.0804 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8411 AP -
0.3931
Val Epoch 34 [26/110]: Loss - 0.3468 Val Time - 0.1488 Forward Time -
0.0808 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8384 AP -
0.3934
Val Epoch 34 [27/110]: Loss - 0.1283 Val Time - 0.1454 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8403 AP -
0.3877
```

```
Val Epoch 34 [28/110]: Loss - 0.4722 Val Time - 0.1472 Forward Time -
0.0816 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8438 AP -
0.3927
Val Epoch 34 [29/110]: Loss - 0.4482 Val Time - 0.1443 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8430 AP -
0.3977
Val Epoch 34 [30/110]: Loss - 0.3619 Val Time - 0.1480 Forward Time -
0.0816 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8458 AP -
0.4025
Val Epoch 34 [31/110]: Loss - 0.2412 Val Time - 0.1441 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8430 AP -
0.3957
Val Epoch 34 [32/110]: Loss - 0.3398 Val Time - 0.1480 Forward Time -
0.0815 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8304 AP -
0.3886
Val Epoch 34 [33/110]: Loss - 0.0726 Val Time - 0.1487 Forward Time -
0.0847 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8338 AP -
0.3917
Val Epoch 34 [34/110]: Loss - 0.1401 Val Time - 0.1461 Forward Time -
0.0842 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8341 AP -
0.3904
Val Epoch 34 [35/110]: Loss - 0.4720 Val Time - 0.1429 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8353 AP -
0.3967
Val Epoch 34 [36/110]: Loss - 0.2190 Val Time - 0.1466 Forward Time -
0.0823 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8357 AP -
0.4002
Val Epoch 34 [37/110]: Loss - 0.1656 Val Time - 0.1437 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8381 AP -
0.4048
Val Epoch 34 [38/110]: Loss - 0.2145 Val Time - 0.1471 Forward Time -
0.0823 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8363 AP -
0.4009
Val Epoch 34 [39/110]: Loss - 0.1962 Val Time - 0.1441 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8381 AP -
0.4011
Val Epoch 34 [40/110]: Loss - 0.1158 Val Time - 0.1466 Forward Time -
0.0821 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8427 AP -
0.4154
Val Epoch 34 [41/110]: Loss - 0.2326 Val Time - 0.1538 Forward Time -
0.0808 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8460 AP -
0.4201
Val Epoch 34 [42/110]: Loss - 0.1660 Val Time - 0.1521 Forward Time -
0.0847 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8469 AP -
0.4143
Val Epoch 34 [43/110]: Loss - 0.0633 Val Time - 0.1441 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8512 AP -
0.4186
Val Epoch 34 [44/110]: Loss - 0.1807 Val Time - 0.1484 Forward Time -
0.0837 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8516 AP -
0.4158
Val Epoch 34 [45/110]: Loss - 0.1063 Val Time - 0.1451 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8526 AP -
0.4132
Val Epoch 34 [46/110]: Loss - 0.0849 Val Time - 0.1526 Forward Time -
0.0852 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8552 AP -
0.4144
```

```
Val Epoch 34 [47/110]: Loss - 0.1206 Val Time - 0.1439 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8566 AP -
0.4131
Val Epoch 34 [48/110]: Loss - 0.3758 Val Time - 0.1456 Forward Time -
0.0821 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8515 AP -
0.4078
Val Epoch 34 [49/110]: Loss - 0.1856 Val Time - 0.1494 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8514 AP -
0.4043
Val Epoch 34 [50/110]: Loss - 0.2925 Val Time - 0.1524 Forward Time -
0.0823 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8516 AP -
0.3971
Val Epoch 34 [51/110]: Loss - 0.0987 Val Time - 0.1604 Forward Time -
0.0858 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8547 AP -
0.3993
Val Epoch 34 [52/110]: Loss - 0.1069 Val Time - 0.1587 Forward Time -
0.0888 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8570 AP -
0.4007
Val Epoch 34 [53/110]: Loss - 0.1700 Val Time - 0.1537 Forward Time -
0.0866 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8584 AP -
0.3990
Val Epoch 34 [54/110]: Loss - 0.2073 Val Time - 0.1617 Forward Time -
0.0913 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8579 AP -
0.4015
Val Epoch 34 [55/110]: Loss - 0.2021 Val Time - 0.1542 Forward Time -
0.0839 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8595 AP -
0.4045
Val Epoch 34 [56/110]: Loss - 0.2183 Val Time - 0.1500 Forward Time -
0.0833 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8616 AP -
0.4086
Val Epoch 34 [57/110]: Loss - 0.2317 Val Time - 0.1507 Forward Time -
0.0849 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8562 AP -
0.4102
Val Epoch 34 [58/110]: Loss - 0.1314 Val Time - 0.1516 Forward Time -
0.0843 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8579 AP -
0.4127
Val Epoch 34 [59/110]: Loss - 0.3681 Val Time - 0.1526 Forward Time -
0.0850 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8595 AP -
0.4086
Val Epoch 34 [60/110]: Loss - 0.2536 Val Time - 0.1505 Forward Time -
0.0854 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8588 AP -
0.4103
Val Epoch 34 [61/110]: Loss - 0.2100 Val Time - 0.1493 Forward Time -
0.0853 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8576 AP -
0.4051
Val Epoch 34 [62/110]: Loss - 0.3128 Val Time - 0.1534 Forward Time -
0.0875 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8549 AP -
0.4024
Val Epoch 34 [63/110]: Loss - 0.4481 Val Time - 0.1459 Forward Time -
0.0830 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8471 AP -
0.4026
Val Epoch 34 [64/110]: Loss - 0.3079 Val Time - 0.1490 Forward Time -
0.0827 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8468 AP -
0.4022
Val Epoch 34 [65/110]: Loss - 0.2655 Val Time - 0.1533 Forward Time -
0.0835 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8473 AP -
0.4019
```

```
Val Epoch 34 [66/110]: Loss – 0.1521 Val Time – 0.1532 Forward Time –
0.0872 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8487 AP –
0.4027
Val Epoch 34 [67/110]: Loss – 0.2723 Val Time – 0.1523 Forward Time –
0.0862 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8484 AP –
0.4025
Val Epoch 34 [68/110]: Loss – 0.3430 Val Time – 0.1461 Forward Time –
0.0834 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8477 AP –
0.4005
Val Epoch 34 [69/110]: Loss – 0.1734 Val Time – 0.1539 Forward Time –
0.0886 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8492 AP –
0.4016
Val Epoch 34 [70/110]: Loss – 0.3732 Val Time – 0.1481 Forward Time –
0.0830 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8492 AP –
0.4036
Val Epoch 34 [71/110]: Loss – 0.2857 Val Time – 0.1482 Forward Time –
0.0845 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8432 AP –
0.4016
Val Epoch 34 [72/110]: Loss – 0.2398 Val Time – 0.1437 Forward Time –
0.0806 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8439 AP –
0.4025
Val Epoch 34 [73/110]: Loss – 0.2585 Val Time – 0.1459 Forward Time –
0.0805 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8437 AP –
0.4019
Val Epoch 34 [74/110]: Loss – 0.1848 Val Time – 0.1442 Forward Time –
0.0805 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8440 AP –
0.4009
Val Epoch 34 [75/110]: Loss – 0.2035 Val Time – 0.1455 Forward Time –
0.0821 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8446 AP –
0.4036
Val Epoch 34 [76/110]: Loss – 0.1805 Val Time – 0.1477 Forward Time –
0.0847 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8448 AP –
0.4023
Val Epoch 34 [77/110]: Loss – 0.2459 Val Time – 0.1446 Forward Time –
0.0821 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8436 AP –
0.4002
Val Epoch 34 [78/110]: Loss – 0.2543 Val Time – 0.1437 Forward Time –
0.0806 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8432 AP –
0.3975
Val Epoch 34 [79/110]: Loss – 0.2062 Val Time – 0.1486 Forward Time –
0.0844 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8439 AP –
0.4002
Val Epoch 34 [80/110]: Loss – 0.2754 Val Time – 0.1538 Forward Time –
0.0866 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8427 AP –
0.3998
Val Epoch 34 [81/110]: Loss – 0.2371 Val Time – 0.1579 Forward Time –
0.0921 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8440 AP –
0.4034
Val Epoch 34 [82/110]: Loss – 0.2053 Val Time – 0.1507 Forward Time –
0.0856 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8451 AP –
0.4081
Val Epoch 34 [83/110]: Loss – 0.3811 Val Time – 0.1535 Forward Time –
0.0865 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8440 AP –
0.4046
Val Epoch 34 [84/110]: Loss – 0.1107 Val Time – 0.1506 Forward Time –
0.0854 Learning Rate – 0.0001 Memory – 0.353869824 GB AUC – 0.8448 AP –
0.4034
```

```
Val Epoch 34 [85/110]: Loss - 0.3166 Val Time - 0.1612 Forward Time -
0.0877 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8443 AP -
0.4013
Val Epoch 34 [86/110]: Loss - 0.2125 Val Time - 0.1526 Forward Time -
0.0861 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8474 AP -
0.4050
Val Epoch 34 [87/110]: Loss - 0.1638 Val Time - 0.1529 Forward Time -
0.0849 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8440 AP -
0.4027
Val Epoch 34 [88/110]: Loss - 0.4185 Val Time - 0.1454 Forward Time -
0.0827 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8433 AP -
0.4023
Val Epoch 34 [89/110]: Loss - 0.3436 Val Time - 0.1514 Forward Time -
0.0843 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8436 AP -
0.4001
Val Epoch 34 [90/110]: Loss - 0.2131 Val Time - 0.1577 Forward Time -
0.0914 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8438 AP -
0.4022
Val Epoch 34 [91/110]: Loss - 0.1820 Val Time - 0.1569 Forward Time -
0.0875 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8450 AP -
0.4023
Val Epoch 34 [92/110]: Loss - 0.1618 Val Time - 0.1437 Forward Time -
0.0806 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8455 AP -
0.4012
Val Epoch 34 [93/110]: Loss - 0.2368 Val Time - 0.1487 Forward Time -
0.0835 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8452 AP -
0.4026
Val Epoch 34 [94/110]: Loss - 0.2015 Val Time - 0.1618 Forward Time -
0.0906 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8450 AP -
0.3939
Val Epoch 34 [95/110]: Loss - 0.0839 Val Time - 0.1568 Forward Time -
0.0872 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8462 AP -
0.3959
Val Epoch 34 [96/110]: Loss - 0.1099 Val Time - 0.1515 Forward Time -
0.0810 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8470 AP -
0.3957
Val Epoch 34 [97/110]: Loss - 0.3312 Val Time - 0.1579 Forward Time -
0.0887 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8419 AP -
0.3939
Val Epoch 34 [98/110]: Loss - 0.2737 Val Time - 0.1436 Forward Time -
0.0809 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8417 AP -
0.3904
Val Epoch 34 [99/110]: Loss - 0.1587 Val Time - 0.1480 Forward Time -
0.0823 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8427 AP -
0.3905
Val Epoch 34 [100/110]: Loss - 0.3442 Val Time - 0.1469 Forward Time -
0.0835 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8421 AP -
0.3903
Val Epoch 34 [101/110]: Loss - 0.3084 Val Time - 0.1447 Forward Time -
0.0823 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8418 AP -
0.3899
Val Epoch 34 [102/110]: Loss - 0.5178 Val Time - 0.1433 Forward Time -
0.0805 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8422 AP -
0.3869
Val Epoch 34 [103/110]: Loss - 0.2215 Val Time - 0.1449 Forward Time -
0.0819 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8422 AP -
0.3873
```

```
Val Epoch 34 [104/110]: Loss - 0.2093 Val Time - 0.1441 Forward Time -
0.0807 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8421 AP -
0.3835
Val Epoch 34 [105/110]: Loss - 0.1178 Val Time - 0.1813 Forward Time -
0.1062 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8441 AP -
0.3857
Val Epoch 34 [106/110]: Loss - 0.2136 Val Time - 0.1524 Forward Time -
0.0895 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8446 AP -
0.3836
Val Epoch 34 [107/110]: Loss - 0.3381 Val Time - 0.1439 Forward Time -
0.0825 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8443 AP -
0.3827
Val Epoch 34 [108/110]: Loss - 0.1742 Val Time - 0.1413 Forward Time -
0.0808 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8440 AP -
0.3801
Val Epoch 34 [109/110]: Loss - 0.0912 Val Time - 0.1434 Forward Time -
0.0823 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8445 AP -
0.3795
Val Epoch 34 [110/110]: Loss - 0.2989 Val Time - 0.1432 Forward Time -
0.0809 Learning Rate - 0.0001 Memory - 0.353869824 GB AUC - 0.8447 AP -
0.3785
Saving checkpoint /tmp/tmpmlz1uY/models/model_27000.pth.tar.
Saving best checkpoint /tmp/tmpmlz1uY/models/model_27000.pth.tar.
```

6. Precision-Recall Curves

In [237]:
```python
MODEL_NAMES = [
    ('frontal_baseline', 'Frontal Only'),
    ('lateral_baseline', 'Lateral Only'),
#     ('fusion_baseline_0', 'FC (Level 0)'),
#     ('fusion_baseline_1', 'FC (Level 1)'),
#     ('fusion_baseline_2', 'FC (Level 2)'),
#     ('fusion_baseline_3', 'FC (Level 3)'),
#     ('fusion_baseline_4', 'FC (Level 4)'),
    ('volumetric_fusion', 'VC (Level 0)'),
#     ('cross_sectional_fusion_0', 'CSF (Level 0)'),
#     ('cross_sectional_fusion_4', 'CSV (Level 4)'),
    ('cross_sectional_attention_fusion_0', 'CSAF (Level 0)'),
#     ('cross_sectional_attention_fusion_4', 'CSAF (Level 4)'),
]

CHEXPERT_PR_METERS = {
    'frontal_baseline'                  : frontal_baseline_chexpert_metrics['pr_meter'],
    'lateral_baseline'                  : lateral_baseline_chexpert_metrics['pr_meter'],
    'fusion_baseline_0'                 : fusion_baseline_0_chexpert_metrics['pr_meter'],
    'fusion_baseline_1'                 : fusion_baseline_1_chexpert_metrics['pr_meter'],
    'fusion_baseline_2'                 : fusion_baseline_2_chexpert_metrics['pr_meter'],
    'fusion_baseline_3'                 : fusion_baseline_3_chexpert_metrics['pr_meter'],
    'fusion_baseline_4'                 : fusion_baseline_4_chexpert_metrics['pr_meter'],
    'volumetric_fusion'                 : volumetric_fusion_chexpert_metrics['pr_meter'],
    'cross_sectional_fusion_0'          : cross_sectional_fusion_0_chexpert_metrics['pr_meter'],
    'cross_sectional_fusion_4'          : cross_sectional_fusion_4_chexpert_metrics['pr_meter'],
    'cross_sectional_attention_fusion_0': cross_sectional_attention_fusion_0_chexpert_metrics['pr_meter'],
    'cross_sectional_attention_fusion_4': cross_sectional_attention_fusion_4_chexpert_metrics['pr_meter'],
}

MIMIC_PR_METERS = {
    'frontal_baseline'                  : frontal_baseline_mimic_metrics['pr_meter'],
    'lateral_baseline'                  : lateral_baseline_mimic_metrics['pr_meter'],
    'fusion_baseline_0'                 : fusion_baseline_0_mimic_metrics['pr_meter'],
    'fusion_baseline_1'                 : fusion_baseline_1_mimic_metrics['pr_meter'],
    'fusion_baseline_2'                 : fusion_baseline_2_mimic_metrics['pr_meter'],
    'fusion_baseline_3'                 : fusion_baseline_3_mimic_metrics['pr_meter'],
    'fusion_baseline_4'                 : fusion_baseline_4_mimic_metric
```

```
s['pr_meter'],
    'volumetric_fusion'                   : volumetric_fusion_mimic_metric
s['pr_meter'],
    'cross_sectional_fusion_0'            : cross_sectional_fusion_0_mimic
_metrics['pr_meter'],
    'cross_sectional_fusion_4'            : cross_sectional_fusion_4_mimic
_metrics['pr_meter'],
    'cross_sectional_attention_fusion_0': cross_sectional_attention_fusi
on_0_mimic_metrics['pr_meter'],
    'cross_sectional_attention_fusion_4': cross_sectional_attention_fusi
on_4_mimic_metrics['pr_meter'],
}
```

In [238]:
```python
figure, axes = plt.subplots(
    nrows=2, ncols=len(PAPER_TRAINING_CLASSES),
    figsize=(25, 8), dpi=80,
    sharex=True, sharey=True,
)
figure.tight_layout()
# title = figure.suptitle('Precision-Recall Curve', fontsize='xx-large')

figure.subplots_adjust(top=0.95)

# Chexpert PR Curves
for i in range(len(PAPER_TRAINING_CLASSES)):
    for (model, model_title) in MODEL_NAMES:
        meter = CHEXPERT_PR_METERS[model]
        precision, recall, _ = sklearn.metrics.precision_recall_curve(me
ter.get_targets(i), meter.get_scores(i))
        axes[0][i].plot(recall, precision, label='{}'.format(model_title
))
    axes[0][0].set_ylabel('CheXpert Test Set', fontsize='xx-large')

# MIMIC CXR PR Curves
for i in range(len(PAPER_TRAINING_CLASSES)):
    for (model, model_title) in MODEL_NAMES:
        meter = MIMIC_PR_METERS[model]
        precision, recall, _ = sklearn.metrics.precision_recall_curve(me
ter.get_targets(i), meter.get_scores(i))
        axes[1][i].plot(recall, precision, label='{}'.format(model_title
))
    axes[1][2].legend(bbox_to_anchor=(0.5, -0.10), loc='upper center', n
col=4, fontsize='xx-large')
    axes[1][0].set_ylabel('MIMIC CXR Validation Set', fontsize='xx-larg
e')


for i in range(len(PAPER_TRAINING_CLASSES)):
    axes[0][i].set_title(PAPER_TRAINING_CLASSES[i], fontsize='xx-large')
```
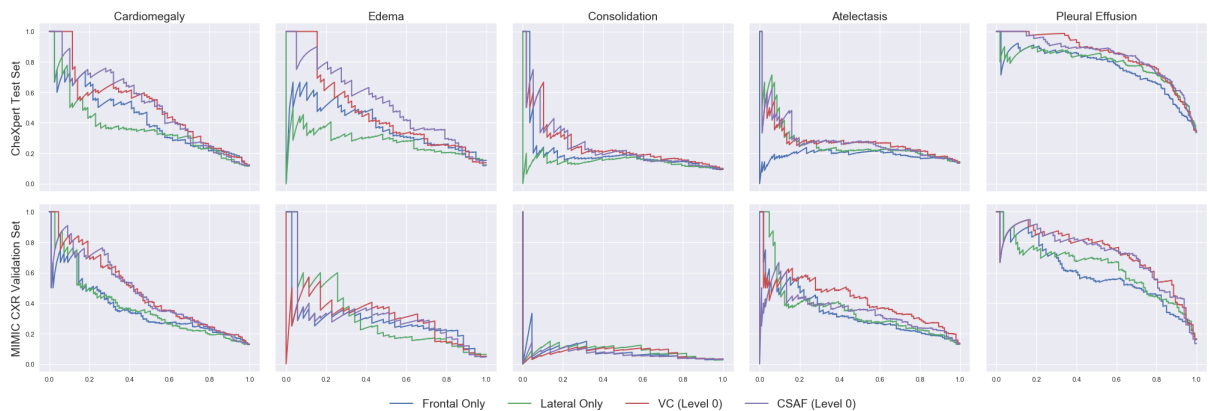

7. ROC Curves

```python
In [241]: MODEL_NAMES = [
              ('frontal_baseline', 'Frontal Only'),
              ('lateral_baseline', 'Lateral Only'),
          #     ('fusion_baseline_0', 'FC (Level 0)'),
          #     ('fusion_baseline_1', 'FC (Level 1)'),
          #     ('fusion_baseline_2', 'FC (Level 2)'),
          #     ('fusion_baseline_3', 'FC (Level 3)'),
          #     ('fusion_baseline_4', 'FC (Level 4)'),
              ('volumetric_fusion', 'VC (Level 0)'),
          #     ('cross_sectional_fusion_0', 'CSF (Level 0)'),
          #     ('cross_sectional_fusion_4', 'CSV (Level 4)'),
              ('cross_sectional_attention_fusion_0', 'CSAF (Level 0)'),
          #     ('cross_sectional_attention_fusion_4', 'CSAF (Level 4)'),
          ]


          CHEXPERT_ROC_METERS = {
              'frontal_baseline'                    : frontal_baseline_chexpert_metr
          ics['roc_meter'],
              'lateral_baseline'                    : lateral_baseline_chexpert_metr
          ics['roc_meter'],
              'fusion_baseline_0'                   : fusion_baseline_0_chexpert_met
          rics['roc_meter'],
              'fusion_baseline_1'                   : fusion_baseline_1_chexpert_met
          rics['roc_meter'],
              'fusion_baseline_2'                   : fusion_baseline_2_chexpert_met
          rics['roc_meter'],
              'fusion_baseline_3'                   : fusion_baseline_3_chexpert_met
          rics['roc_meter'],
              'fusion_baseline_4'                   : fusion_baseline_4_chexpert_met
          rics['roc_meter'],
              'volumetric_fusion'                   : volumetric_fusion_chexpert_met
          rics['roc_meter'],
              'cross_sectional_fusion_0'            : cross_sectional_fusion_0_chexp
          ert_metrics['roc_meter'],
              'cross_sectional_fusion_4'            : cross_sectional_fusion_4_chexp
          ert_metrics['roc_meter'],
              'cross_sectional_attention_fusion_0': cross_sectional_attention_fusi
          on_0_chexpert_metrics['roc_meter'],
              'cross_sectional_attention_fusion_4': cross_sectional_attention_fusi
          on_4_chexpert_metrics['roc_meter'],
          }

          MIMIC_ROC_METERS = {
              'frontal_baseline'                    : frontal_baseline_mimic_metrics
          ['roc_meter'],
              'lateral_baseline'                    : lateral_baseline_mimic_metrics
          ['roc_meter'],
              'fusion_baseline_0'                   : fusion_baseline_0_mimic_metric
          s['roc_meter'],
              'fusion_baseline_1'                   : fusion_baseline_1_mimic_metric
          s['roc_meter'],
              'fusion_baseline_2'                   : fusion_baseline_2_mimic_metric
          s['roc_meter'],
              'fusion_baseline_3'                   : fusion_baseline_3_mimic_metric
          s['roc_meter'],
```

```
    'fusion_baseline_4'                    : fusion_baseline_4_mimic_metric
s['roc_meter'],
    'volumetric_fusion'                    : volumetric_fusion_mimic_metric
s['roc_meter'],
    'cross_sectional_fusion_0'             : cross_sectional_fusion_0_mimic
_metrics['roc_meter'],
    'cross_sectional_fusion_4'             : cross_sectional_fusion_4_mimic
_metrics['roc_meter'],
    'cross_sectional_attention_fusion_0': cross_sectional_attention_fusi
on_0_mimic_metrics['roc_meter'],
    'cross_sectional_attention_fusion_4': cross_sectional_attention_fusi
on_4_mimic_metrics['roc_meter'],
}
```

In [242]:
```python
figure, axes = plt.subplots(
    nrows=2, ncols=len(PAPER_TRAINING_CLASSES),
    figsize=(25, 8), dpi=80,
    sharex=True, sharey=True,
)
figure.tight_layout()
# title = figure.suptitle('Receiver Operating Characteristic Curves', fo
ntsize='x-large')

figure.subplots_adjust(top=0.95)

# Chexpert PR Curves
for i in range(len(PAPER_TRAINING_CLASSES)):
    for (model, model_title) in MODEL_NAMES:
        meter = CHEXPERT_ROC_METERS[model]
        fpr, tpr, _ = sklearn.metrics.roc_curve(meter.get_targets(i), me
ter.get_scores(i))
        axes[0][i].plot(fpr, tpr, label='{}'.format(model_title))
    axes[0][i].plot([0, 1], [0, 1], color='navy', linestyle='--')
    axes[0][0].set_ylabel('CheXpert Test Set', fontsize='xx-large')


# MIMIC CXR PR Curves
for i in range(len(PAPER_TRAINING_CLASSES)):
    for (model, model_title) in MODEL_NAMES:
        meter = MIMIC_ROC_METERS[model]
        fpr, tpr, _ = sklearn.metrics.roc_curve(meter.get_targets(i), me
ter.get_scores(i))
        axes[1][i].plot(fpr, tpr, label='{}'.format(model_title))
    axes[1][i].plot([0, 1], [0, 1], color='navy', linestyle='--')
    axes[1][2].legend(bbox_to_anchor=(0.5, -0.10), loc='upper center', n
col=4, fontsize='xx-large')
    axes[1][0].set_ylabel('MIMIC CXR Validation Set', fontsize='xx-larg
e')

for i in range(len(PAPER_TRAINING_CLASSES)):
    axes[0][i].set_title(PAPER_TRAINING_CLASSES[i], fontsize='xx-large')
```
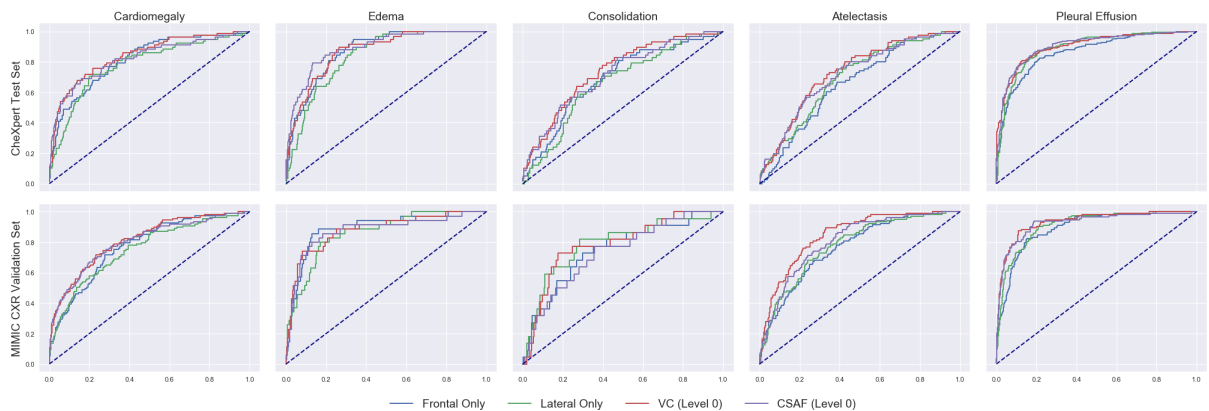

8. Latex Table

```python
In [244]:  MODEL_NAMES = [
               ('frontal_baseline', 'Frontal Only'),
               ('lateral_baseline', 'Lateral Only'),
           #     ('fusion_baseline_0', 'FC (Level 0)'),
           #     ('fusion_baseline_1', 'FC (Level 1)'),
           #     ('fusion_baseline_2', 'FC (Level 2)'),
           #     ('fusion_baseline_3', 'FC (Level 3)'),
           #     ('fusion_baseline_4', 'FC (Level 4)'),
               ('volumetric_fusion', 'VC (Level 0)'),
               ('cross_sectional_fusion_0', 'CSF (Level 0)'),
               ('cross_sectional_fusion_4', 'CSF (Level 4)'),
               ('cross_sectional_attention_fusion_0', 'CSAF (Level 0)'),
               ('cross_sectional_attention_fusion_4', 'CSAF (Level 4)'),
           ]


           lines = []

           line = '{}'.format(PAPER_TRAINING_CLASSES[0])
           for class_name in PAPER_TRAINING_CLASSES[1:]:
               line += ' & {}'.format(class_name)
           lines.append(line + '\\\\')

           for (model, model_title) in MODEL_NAMES:
               chexpert_meter = CHEXPERT_PR_METERS[model]
               chexpert_values = chexpert_meter.values()

               mimic_meter = MIMIC_PR_METERS[model]
               mimic_values = mimic_meter.values()

               line = model_title
               line += ' & {:.3f} / {:.3f}'.format(chexpert_values['mean'], mimic_v
           alues['mean'])
               for i in range(len(PAPER_TRAINING_CLASSES)):
                   line += ' & {:.3f} / {:.3f}'.format(chexpert_values[PAPER_TRAINI
           NG_CLASSES[i]], mimic_values[PAPER_TRAINING_CLASSES[i]])
               lines.append(line + '\\\\')
               lines.append('\\hline')

           lines = '\n'.join(lines)
           print(lines)
```

```
Cardiomegaly & Edema & Consolidation & Atelectasis & Pleural Effusion\\
Frontal Only & 0.395 / 0.334 & 0.431 / 0.365 & 0.390 / 0.286 & 0.200 /
0.087 & 0.192 / 0.338 & 0.762 / 0.593\\
\hline
Lateral Only & 0.373 / 0.354 & 0.372 / 0.376 & 0.285 / 0.314 & 0.148 /
0.095 & 0.272 / 0.360 & 0.785 / 0.627\\
\hline
VC (Level 0) & 0.473 / 0.406 & 0.509 / 0.480 & 0.474 / 0.314 & 0.255 /
0.080 & 0.282 / 0.428 & 0.847 / 0.728\\
\hline
CSF (Level 0) & 0.447 / 0.412 & 0.473 / 0.459 & 0.451 / 0.434 & 0.199 /
0.073 & 0.277 / 0.372 & 0.833 / 0.723\\
\hline
CSF (Level 4) & 0.427 / 0.398 & 0.441 / 0.459 & 0.388 / 0.359 & 0.205 /
0.087 & 0.266 / 0.395 & 0.832 / 0.690\\
\hline
CSAF (Level 0) & 0.485 / 0.385 & 0.515 / 0.469 & 0.532 / 0.313 & 0.250
/ 0.072 & 0.286 / 0.351 & 0.840 / 0.718\\
\hline
CSAF (Level 4) & 0.463 / 0.379 & 0.511 / 0.435 & 0.498 / 0.291 & 0.216
/ 0.083 & 0.268 / 0.364 & 0.824 / 0.720\\
\hline
```

```
In [246]:  MODEL_NAMES = [
               ('frontal_baseline', 'Frontal Only'),
               ('lateral_baseline', 'Lateral Only'),
           #       ('fusion_baseline_0', 'FC (Level 0)'),
           #       ('fusion_baseline_1', 'FC (Level 1)'),
           #       ('fusion_baseline_2', 'FC (Level 2)'),
           #       ('fusion_baseline_3', 'FC (Level 3)'),
           #       ('fusion_baseline_4', 'FC (Level 4)'),
               ('volumetric_fusion', 'VC (Level 0)'),
               ('cross_sectional_fusion_0', 'CSF (Level 0)'),
               ('cross_sectional_fusion_4', 'CSF (Level 4)'),
               ('cross_sectional_attention_fusion_0', 'CSAF (Level 0)'),
               ('cross_sectional_attention_fusion_4', 'CSAF (Level 4)'),
           ]


           lines = []

           line = '{}'.format(PAPER_TRAINING_CLASSES[0])
           for class_name in PAPER_TRAINING_CLASSES[1:]:
               line += ' & {}'.format(class_name)
           lines.append(line + '\\\\')

           for (model, model_title) in MODEL_NAMES:
               chexpert_meter = CHEXPERT_ROC_METERS[model]
               chexpert_values = chexpert_meter.values()

               mimic_meter = MIMIC_ROC_METERS[model]
               mimic_values = mimic_meter.values()

               line = model_title
               line += ' & {:.3f} / {:.3f}'.format(chexpert_values['mean'], mimic_v
           alues['mean'])
               for i in range(len(PAPER_TRAINING_CLASSES)):
                   line += ' & {:.3f} / {:.3f}'.format(chexpert_values[PAPER_TRAINI
           NG_CLASSES[i]], mimic_values[PAPER_TRAINING_CLASSES[i]])
               lines.append(line + '\\\\')
               lines.append('\\hline')

           lines = '\n'.join(lines)
           print(lines)
```

```
Cardiomegaly & Edema & Consolidation & Atelectasis & Pleural Effusion\\
Frontal Only & 0.779 / 0.814 & 0.813 / 0.772 & 0.873 / 0.890 & 0.690 /
0.747 & 0.657 / 0.767 & 0.865 / 0.895\\
\hline
Lateral Only & 0.774 / 0.819 & 0.782 / 0.752 & 0.837 / 0.861 & 0.662 /
0.789 & 0.696 / 0.779 & 0.893 / 0.912\\
\hline
VC (Level 0) & 0.817 / 0.851 & 0.839 / 0.812 & 0.872 / 0.880 & 0.739 /
0.783 & 0.732 / 0.846 & 0.902 / 0.935\\
\hline
CSF (Level 0) & 0.805 / 0.843 & 0.823 / 0.811 & 0.876 / 0.901 & 0.690 /
0.749 & 0.738 / 0.824 & 0.898 / 0.928\\
\hline
CSF (Level 4) & 0.802 / 0.843 & 0.805 / 0.779 & 0.874 / 0.882 & 0.712 /
0.809 & 0.720 / 0.800 & 0.902 / 0.945\\
\hline
CSAF (Level 0) & 0.809 / 0.827 & 0.820 / 0.799 & 0.892 / 0.874 & 0.714
/ 0.732 & 0.715 / 0.805 & 0.905 / 0.925\\
\hline
CSAF (Level 4) & 0.811 / 0.845 & 0.843 / 0.790 & 0.881 / 0.889 & 0.704
/ 0.781 & 0.734 / 0.823 & 0.894 / 0.942\\
\hline
```