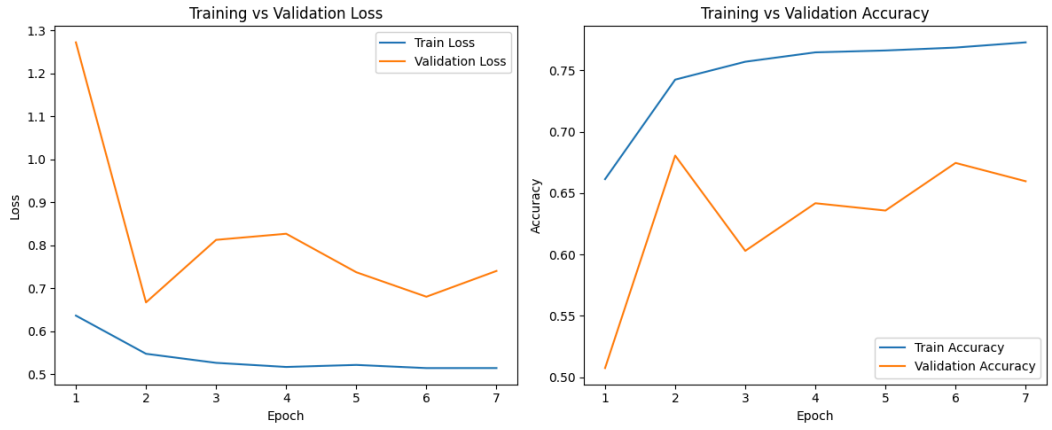
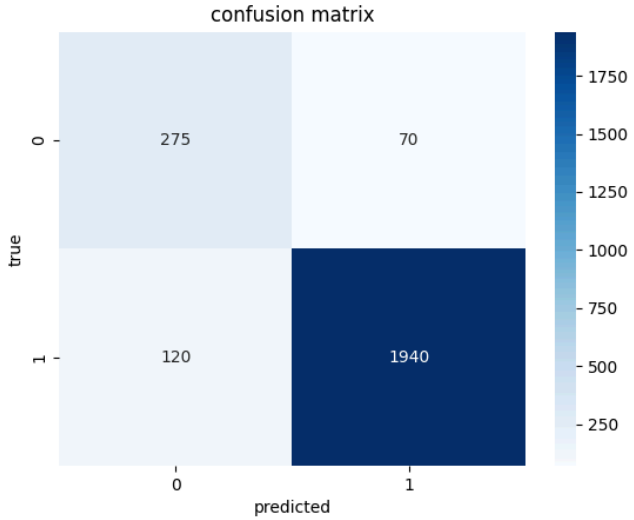
**Model #1 (2, .001)**

C:\Users\becks\CS487\MastitisClassification\.venv\Scripts\python.exe
C:\Users\becks\csc470\Breast-Histopathology-Image-Classification\CNN2.py
cuda
loaded image paths and labels
split data
train class distribution: {0: 1955, 1: 3940}
validation class distribution: {0: 825, 1: 850}
test class distribution: {0: 345, 1: 2060}
epoch 1, val loss: 0.7332, val acc: 0.6985
epoch 2, val loss: 0.7118, val acc: 0.6925
epoch 3, val loss: 0.8338, val acc: 0.6896
epoch 4, val loss: 0.9018, val acc: 0.6836
early stopping triggered.
classification report:

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.73 | 0.93 | 0.82 | 345 |
| 1 | 0.99 | 0.94 | 0.96 | 2060 |
| accuracy | | | 0.94 | 2405 |
| macro avg | 0.86 | 0.93 | 0.89 | 2405 |
| weighted avg | 0.95 | 0.94 | 0.94 | 2405 |

final test accuracy: 0.9397



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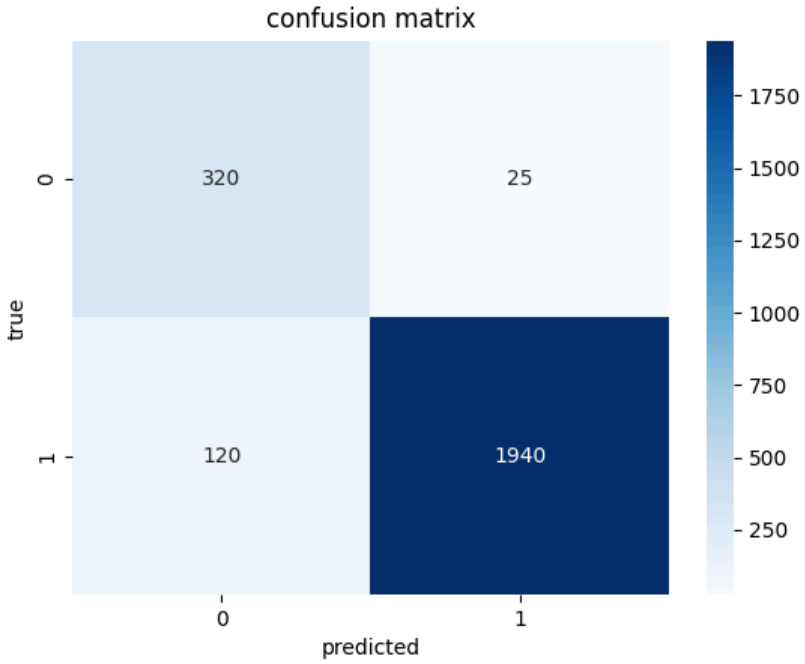
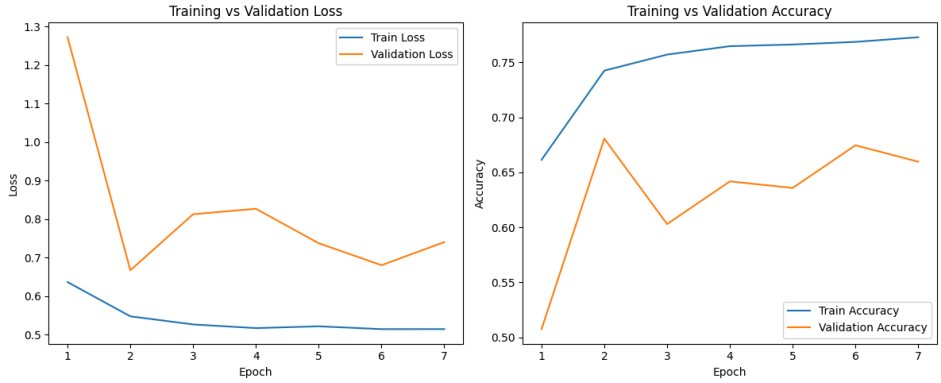
**Model #2 (8, .0001)**

C:\Users\becks\CS487\MastitisClassification\.venv\Scripts\python.exe
C:\Users\becks\csc470\Breast-Histopathology-Image-Classification\CNN2.py
cuda
loaded image paths and labels
split data
train class distribution: {0: 1955, 1: 3940}
validation class distribution: {0: 825, 1: 850}
test class distribution: {0: 345, 1: 2060}
epoch 1, val loss: 0.8103, val acc: 0.6448
epoch 2, val loss: 0.7774, val acc: 0.5582
epoch 3, val loss: 0.7780, val acc: 0.6597
epoch 4, val loss: 0.9597, val acc: 0.6567
early stopping triggered.
classification report:

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.70 | 0.86 | 0.77 | 345 |
| 1 | 0.97 | 0.94 | 0.96 | 2060 |
| accuracy | | | 0.93 | 2405 |
| macro avg | 0.84 | 0.90 | 0.86 | 2405 |
| weighted avg | 0.94 | 0.93 | 0.93 | 2405 |

final test accuracy: 0.9272

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**Model #3 (64, .001)**

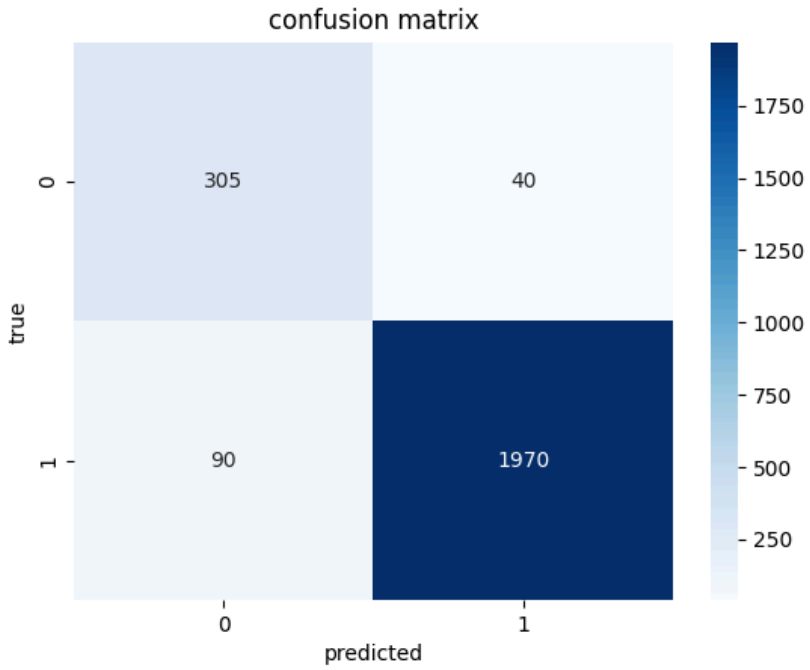
C:\Users\becks\CS487\MastitisClassification\.venv\Scripts\python.exe
C:\Users\becks\csc470\Breast-Histopathology-Image-Classification\CNN2.py
cuda
loaded image paths and labels
split data
train class distribution: {0: 1955, 1: 3940}
validation class distribution: {0: 825, 1: 850}
test class distribution: {0: 345, 1: 2060}
epoch 1, val loss: 0.7542, val acc: 0.6239
epoch 2, val loss: 0.8583, val acc: 0.5075
epoch 3, val loss: 0.7715, val acc: 0.6239

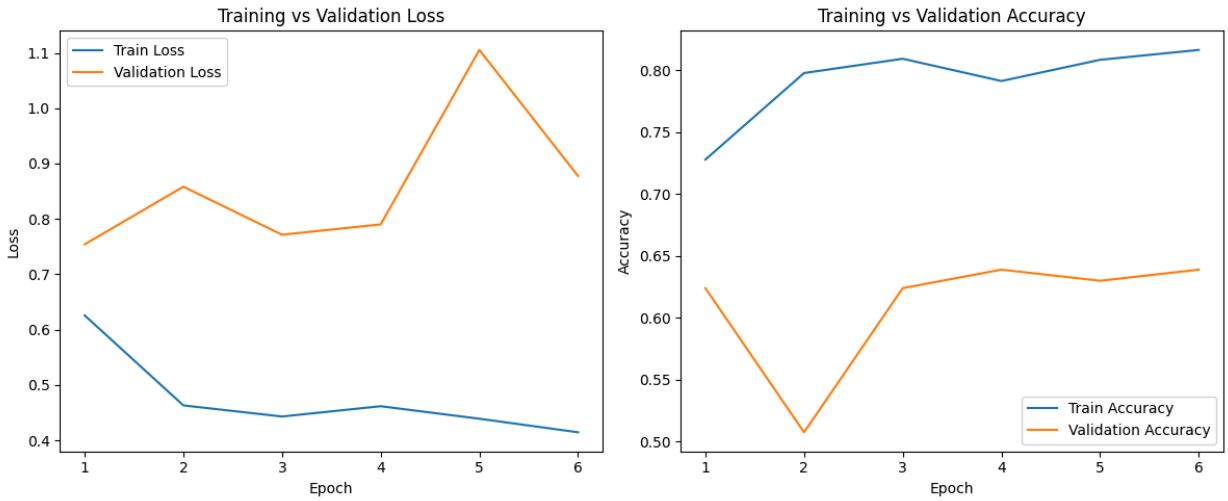
epoch 4, val loss: 0.7902, val acc: 0.6388
epoch 5, val loss: 1.1053, val acc: 0.6299
epoch 6, val loss: 0.8776, val acc: 0.6388
early stopping triggered.
classification report:

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.77 | 0.88 | 0.82 | 345 |
| 1 | 0.98 | 0.96 | 0.97 | 2060 |
| accuracy | | | 0.95 | 2405 |
| macro avg | 0.88 | 0.92 | 0.90 | 2405 |
| weighted avg | 0.95 | 0.95 | 0.95 | 2405 |

final test accuracy: 0.9459

Process finished with exit code 0



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Logs included in this pdf

| Model # | Batch Size | Learning Rate | Accuracy | F1-Score (Benign) | F1-Score (Malignant) |
|---|---|---|---|---|---|
| 1 | 2 | .001 | 93.97% | 0.82 | 0.96 |
| 2 | 8 | .0001 | 92.72% | 0.77 | 0.96 |
| 3 | 64 | .001 | 94.59% | 0.82 | 0.97 |
| 4 | 128 | .0005 | 90.64% | 0.75 | 0.94 |
| 5* | 64 | .001 | 95.01% | 0.84 | 0.97 |

**5***

- Added a learning rate scheduler that reduces the learning rate by half if validation loss does not improve for 2 consecutive epochs
- Reduced dropout from 0.5 to 0.4 after the dense layer with 1024 neurons to slightly lower regularization and allow the model to retain more information
- Logs are seen below

cuda
loaded image paths and labels
split data
train class distribution: {0: 1955, 1: 3940}
validation class distribution: {0: 825, 1: 850}

test class distribution: {0: 345, 1: 2060}
epoch 1, val loss: 0.7601, val acc: 0.5075
epoch 2, val loss: 1.1325, val acc: 0.5343
epoch 3, val loss: 0.8823, val acc: 0.6000
epoch 4, val loss: 0.8083, val acc: 0.6209
early stopping triggered.
classification report:

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.77 | 0.93 | 0.84 | 345 |
| 1 | 0.99 | 0.95 | 0.97 | 2060 |
| accuracy | | | 0.95 | 2405 |
| macro avg | 0.88 | 0.94 | 0.91 | 2405 |
| weighted avg | 0.96 | 0.95 | 0.95 | 2405 |

final test accuracy: 0.9501

Process finished with exit code 0