Evaluation of Feed Forward Network for Chest X-ray Image Classification

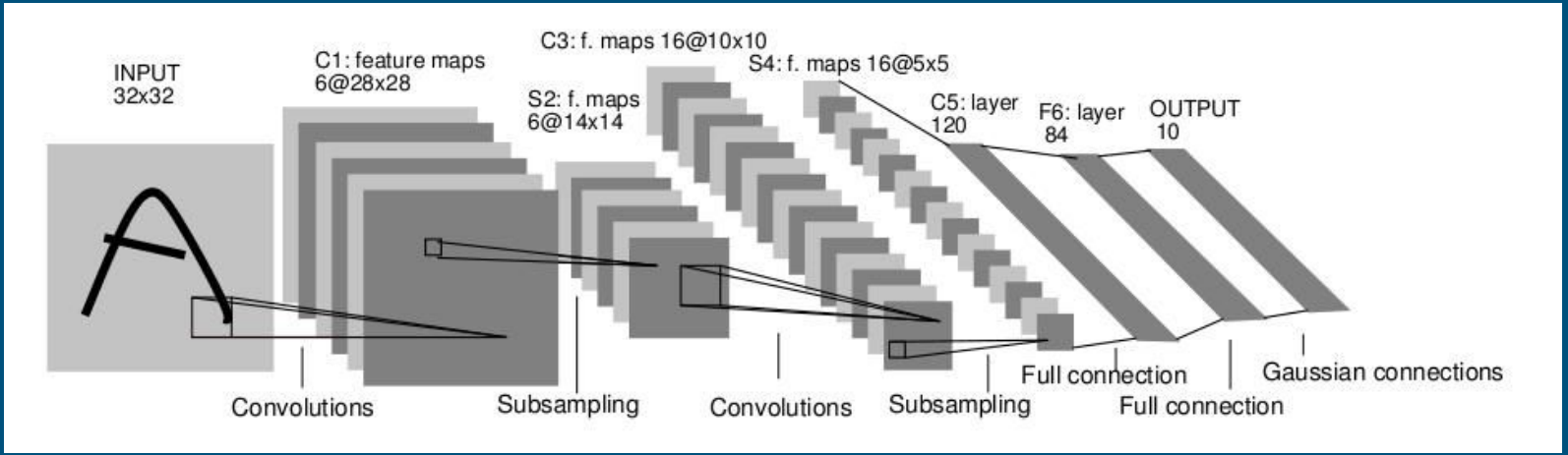
David Robison, Sadaf Asrar & Nathan Zencey

Data

- National Institute of Health (NIH) X-ray database
- 112,120 images of size 1024 x 1024 x 3 with one of 14 disease labels or healthy
- Processed to size 224 x 224 x 3 via random cropping; assigned binary labels.
- Train/Validation/Test split of 19,999/4,000/1,000

Network Architecture

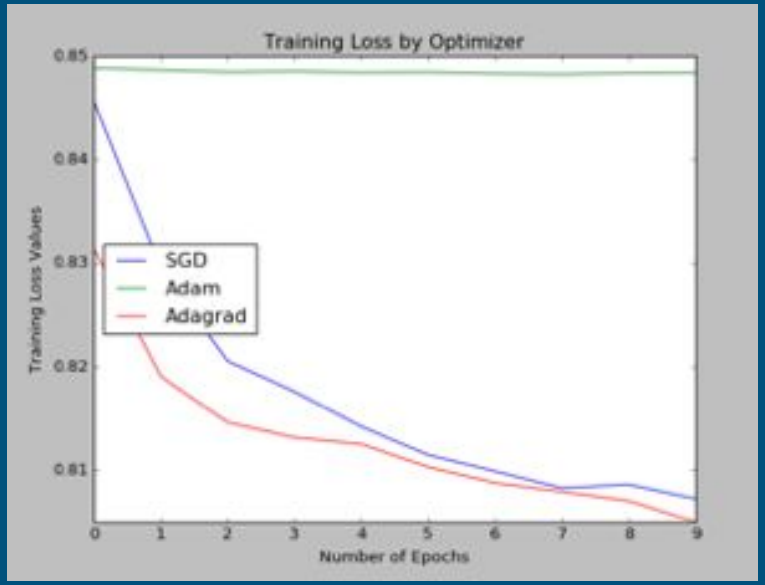
- Stochastic gradient descent optimization
- Two convolution and pooling layers, two fully connected layers, and an output layer.

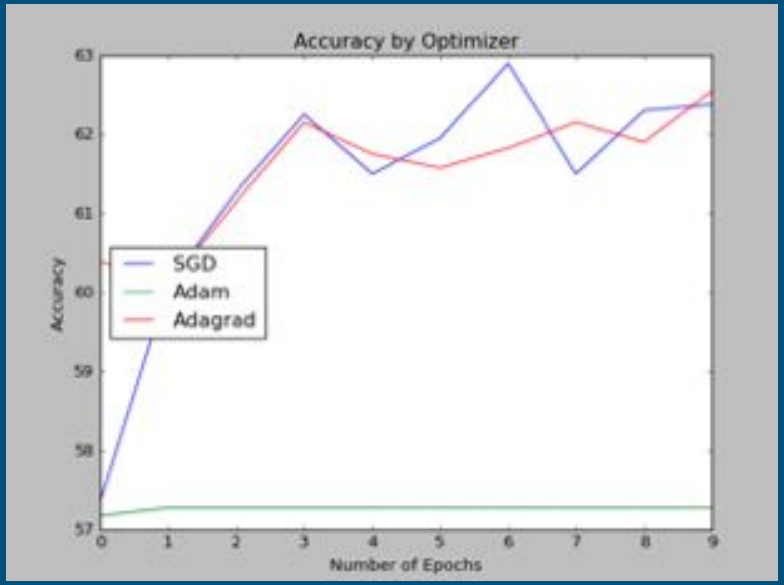


Evaluation of Optimizers

Optimization algorithm	F1 score	Accuracy (%)	Recall (%)	Precision (%)	Run time (sec.)
SGD	0.617	62	94	64	613
Adam	0.374	57	97	56	610
Adagrad	0.5	63	96	60	622

Training Loss & Test Accuracy by Optimization Algorithm

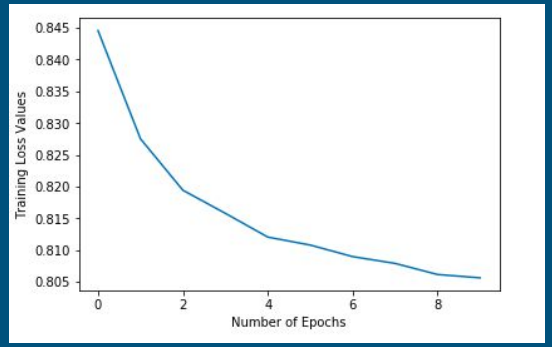




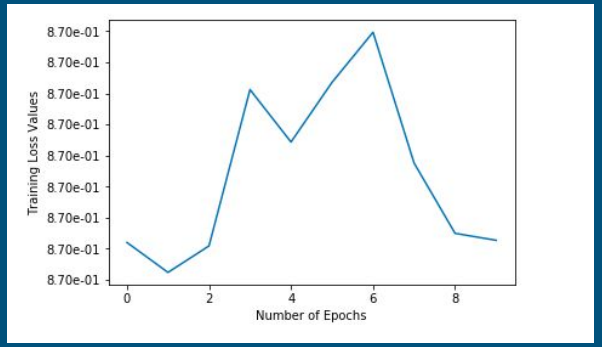
Evaluation of Transfer Functions

Transfer Function	F1 score	Accuracy (%)	Run time (sec.)
ReLu	0.425	61	545
Tanh	0.588	42	511
Sigmoid	0	57	532

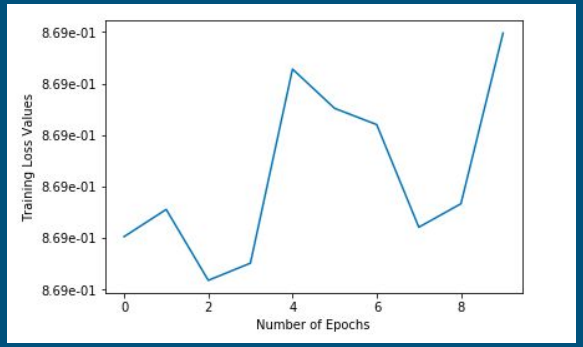
Transfer Function Training Loss by Epoch



ReLu

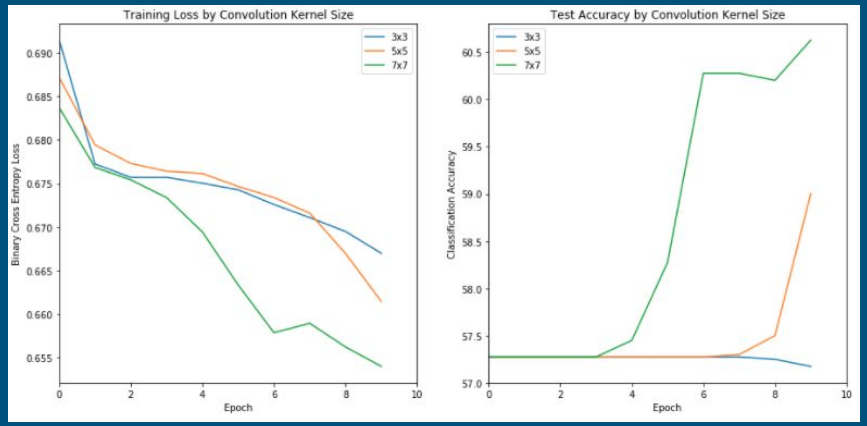


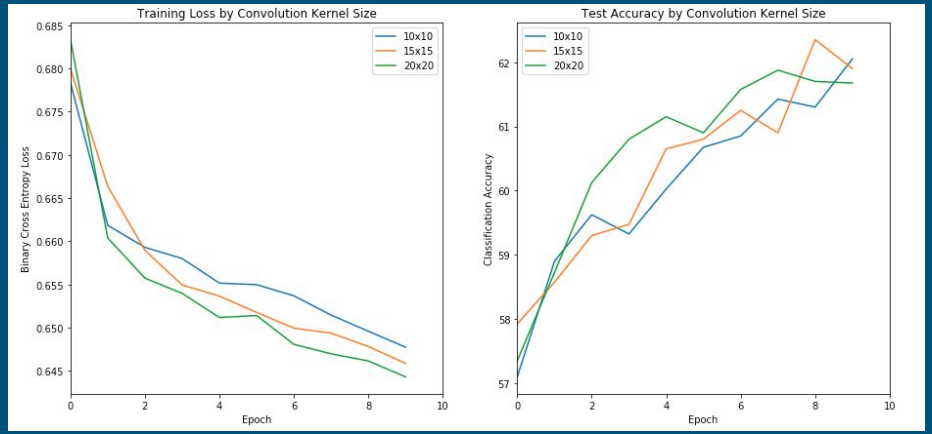
Tanh



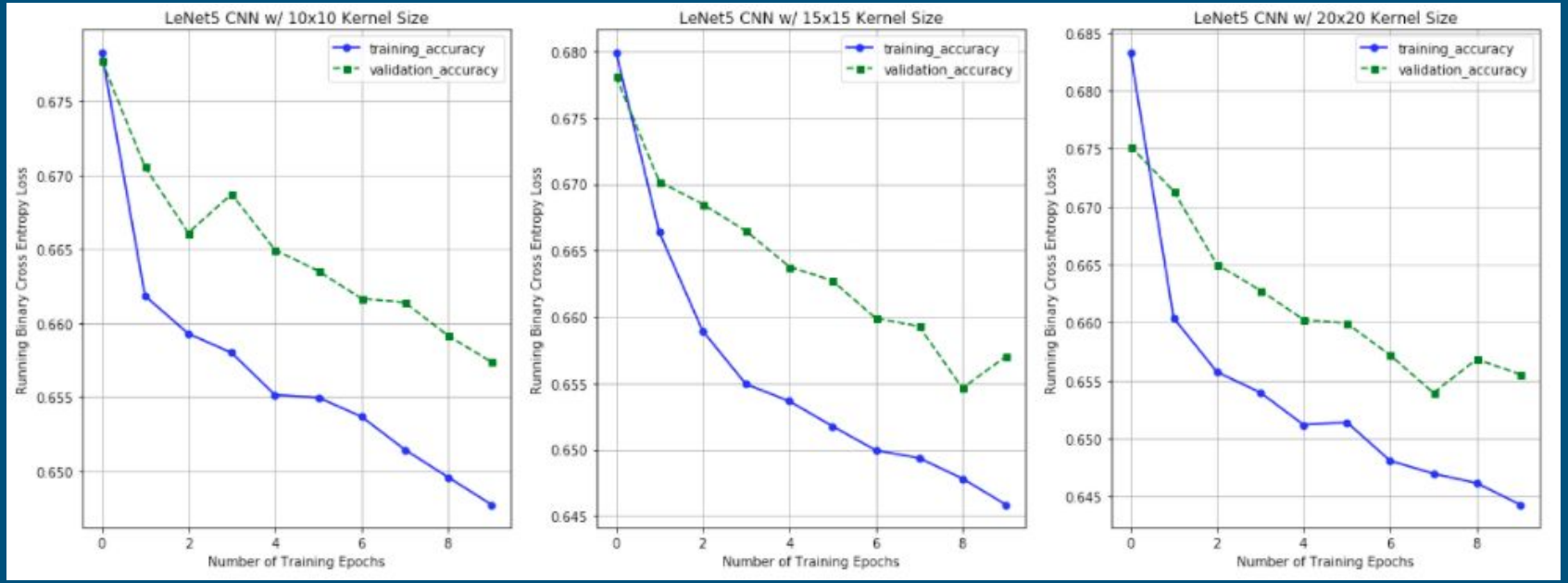
Sigmoid

Evaluation of Kernels





Training Loss and Validation Loss with Large Kernels



Conclusion

- For a LeNet 5 Architecture, larger kernel sizes, stochastic gradient descent, and ReLu transfer functions achieve highest performance.
- From a practical perspective, results are mediocre.
- Further gains could be made with dropout and data augmentation.