Classifying Skin Lesions with Simulated Lens Blur

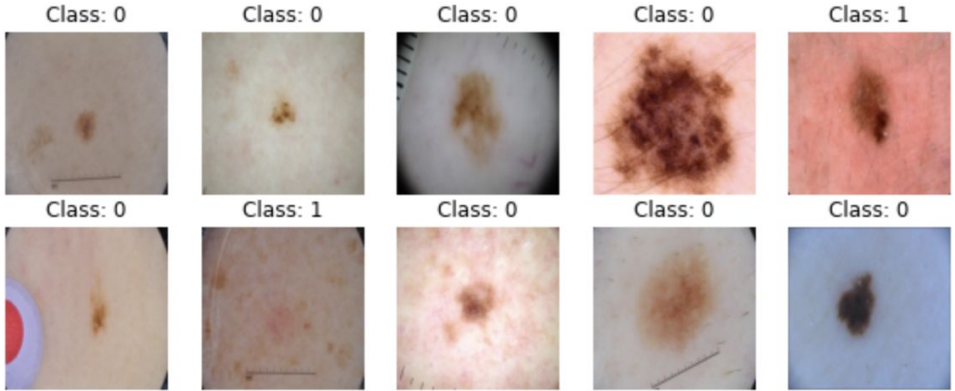
Christina Le and Allison Li

Introducing the Problem

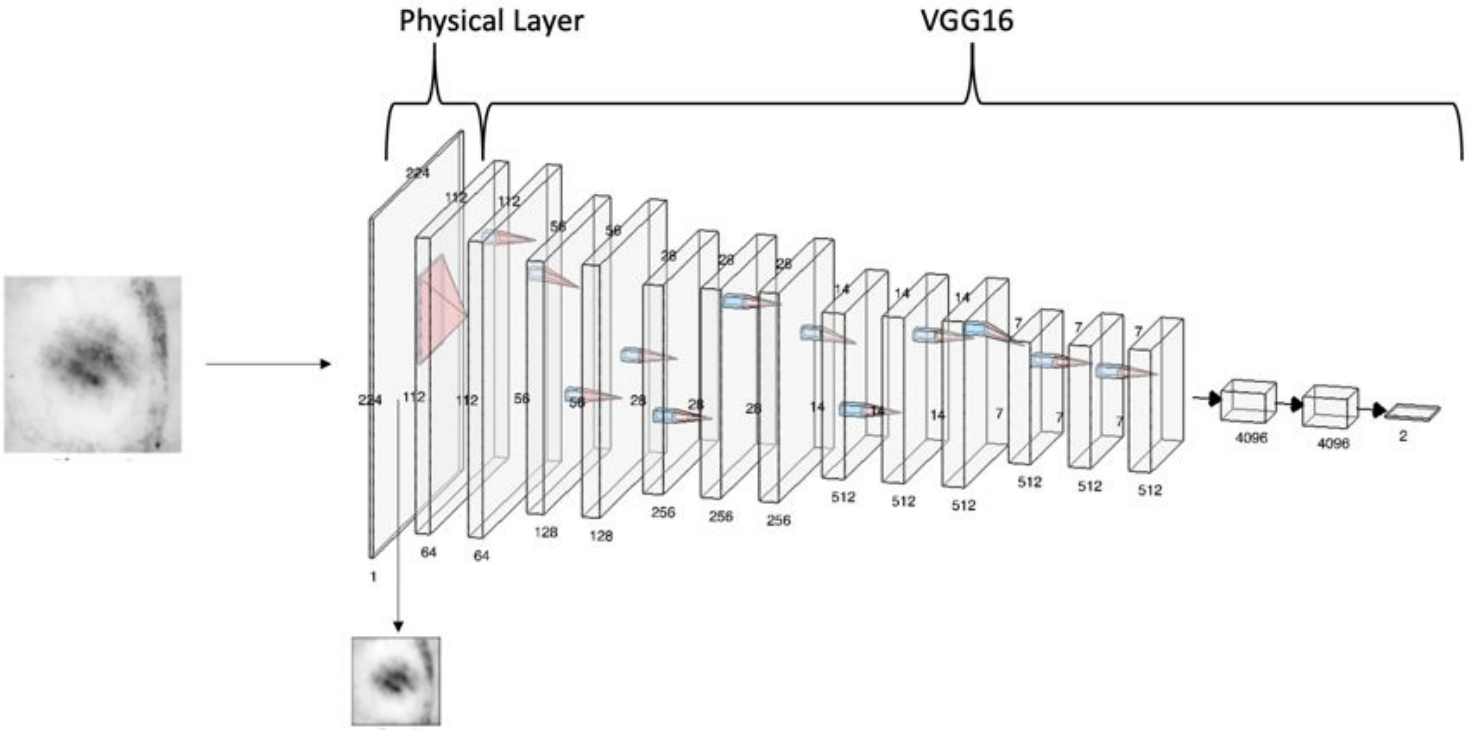
- Binary image classification task
  - a melanoma binary classifier with images of skin lesions from the ISIC 2017 challenge
- Features of a skin lesion not immediately visible may be captured and differentiated by a convolutional neural network
- Study effect of blurring on the network's ability to classify skin lesions
- Understand image resolution and quality requirements for accurate diagnosis of melanoma.

Table 1: Distribution of Datasets

Set	Melanoma	Seborrheic Keratosis or Benign Nevi
Training	337	1468
Validation	37	163
Testing	117	483
		*reports the number of images found per class



Model


Physical Layer
VGG16
224
112
112
56
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112
56
56
28
28
28
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7
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128
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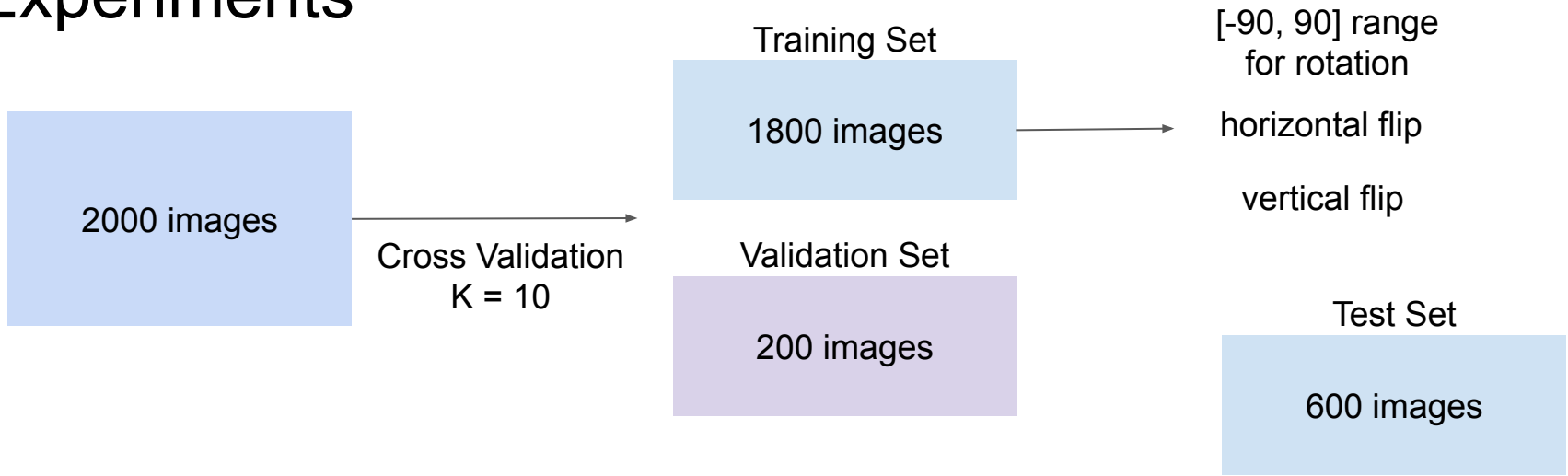
4096
4096
2

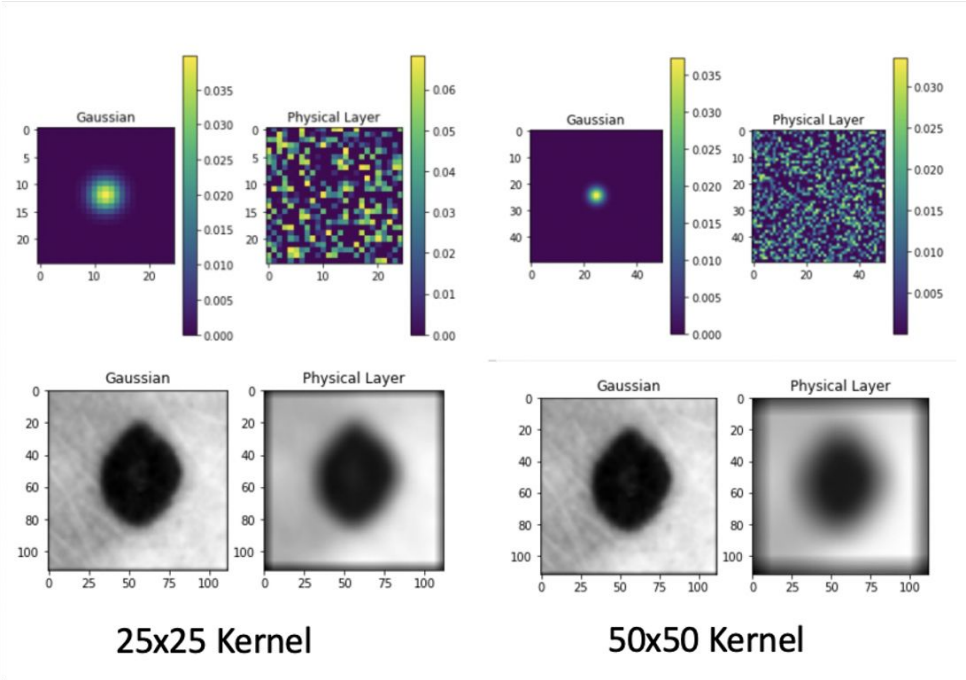
Experiments



- Models ran with 15-20 epochs depending on the specific experiment
- Measured focal loss and area under the curve (AUC)

Physical Layer

- Convolution and average pooling added prior to the VGG16 model
- Simulating lower resolution incoherent imaging system with lens blur
- Convolutional kernel is trainable
  - Initialized randomly
  - Non-negative constraint



Results

- Learned blur performed better than Gaussian blur
- Class imbalance limitation

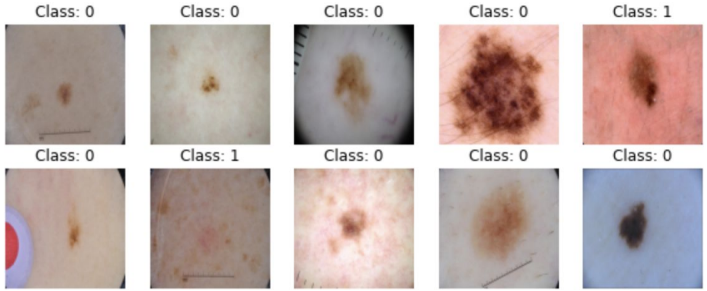
Table 2: Test Loss and Test AUC after training

Experiment	Kernel Size	Loss	AUC
No blur	–	0.0321 ± 0.000187	0.815 ± 0.00939
Physical Layer	10	0.0321 ± 0.000186	0.813 ± 0.00862
Physical Layer	25	0.0322 ± 0.000346	0.825 ± 0.00470
Physical Layer	50	0.0322 ± 0.000626	0.823 ± 0.00358
Physical Layer	100	0.0320 ± 0.000165	0.827 ± 0.00207
Physical Layer	200	0.0320 ± 0.000104	0.827 ± 0.00215
Gaussian Blur	10	0.0321 ± 0.000217	0.813 ± 0.01064
Gaussian Blur	25	0.0321 ± 0.000268	0.812 ± 0.00920
Gaussian Blur	50	0.0321 ± 0.000219	0.807 ± 0.00766
Gaussian Blur	100	0.0322 ± 0.000394	0.807 ± 0.00428
Gaussian Blur	200	0.0324 ± 0.001076	0.810 ± 0.00126

Wrap-up/Conclusion

- Blur does not significantly impact the model's accuracy or means of classification
- Main limitations were our training data and potentially the model's depth
- Future experiments could include looking into the relationship between our results and segmentation masks, find a dataset with more melanoma images
- Turn this problem into a multi-class classification problem that is able to differentiate between melanoma, benign nevi, and seborrhoeic keratosis

Classification Task



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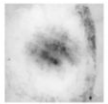

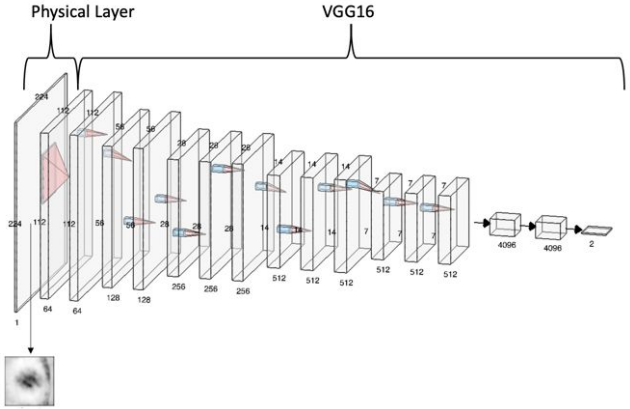

Class 1: Melanoma
Class 2: Seborrheic Keratosis or Benign Nevi

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Results

simulated blur

learned blur