Title: Deep Learning for COVID-19 Pneumonia Diagnosis

BACKGROUND

The spread of the coronavirus has led to a vast increase of viral pneumonia cases around the globe. Around 75% of hospitalized COVID-19 patients develop some form of pneumonia. Chest radiographs are often taken to initially diagnose COVID-19 by identifying the presence of pneumonia in the lung. Using deep learning for rapid and early detection of pneumonia and its cause in COVID-19 patients can allow for faster isolation and treatment, and augment physician diagnosis and/or reduce physician error.

METHODS

1. Baseline Model
   - Modification of VGG16, a successful image classification model
   - Multiple data transformations
   - Small learning rate
2. Model 1
   - Reduced data transformations
   - Maintain baseline layering
3. Model 2
   - Baseline data transforms
   - Additional convolution, skip connection, and dropout
4. Model 3
   - Baseline data transforms
   - Additional convolution, skip connection, leaky RELU activation

Models trained on set of 200 x-ray images using 10-fold cross-validation and tested on set of 27 images.

RESULTS

	Avg Final Val Acc	Avg Test Acc
Baseline	92.0%	77.8%
Model 1	92.0%	79.3%
Model 2	89.5%	78.5%
Model 3	86.5%	80.4%

Pneumonia Classification Accuracy:

Models 1-3 ≈ Baseline

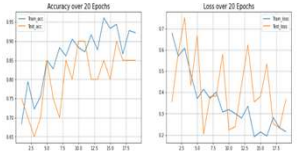
Model	Description	Test Accuracy
Baseline	From literature: VGG16, multiple data transformations	77.8%
Model 1	Baseline w/ data augmentation variation	79.3%
Model 2	Baseline w/ added convolution and dropout layers, single skip connection	78.5%
Model 3	Model 2 w/ two additional convolution layers, uses leaky RELU activation	80.4%

Limitations

- Lack of generalization, possibly due to overfitting
- Lack of training data

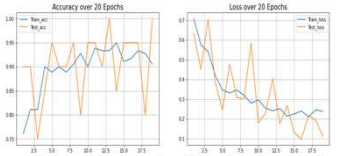
Conclusion: Testing of more complex models with more data is required

Figure 1: Baseline Training



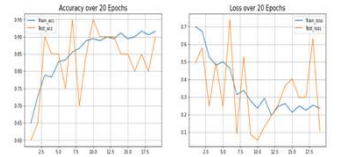
Fold training and validation loss and accuracy during Baseline training

Figure 2: Model 1 Training



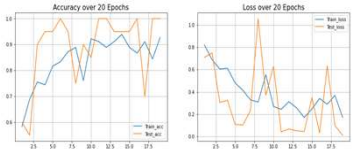
Fold training and validation loss and accuracy during Model 1 training

Figure 3: Model 2 Training



Fold training and validation loss and accuracy during Model 2 training

Figure 4: Model 3 Training



Fold training and validation loss and accuracy during Model 3 training

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