Diagnosing Pediatric Pneumonia from Chest X-rays Using Convolutional Neural Networks

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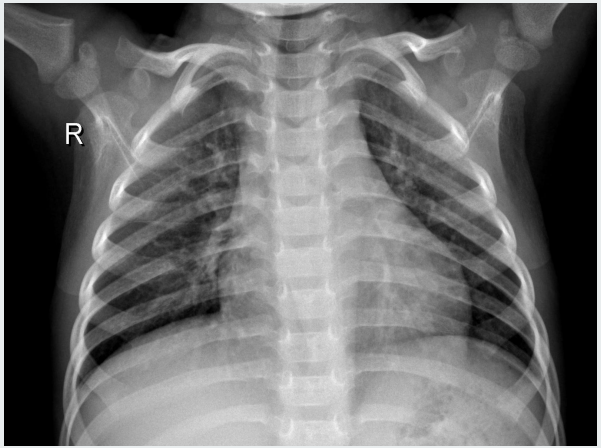
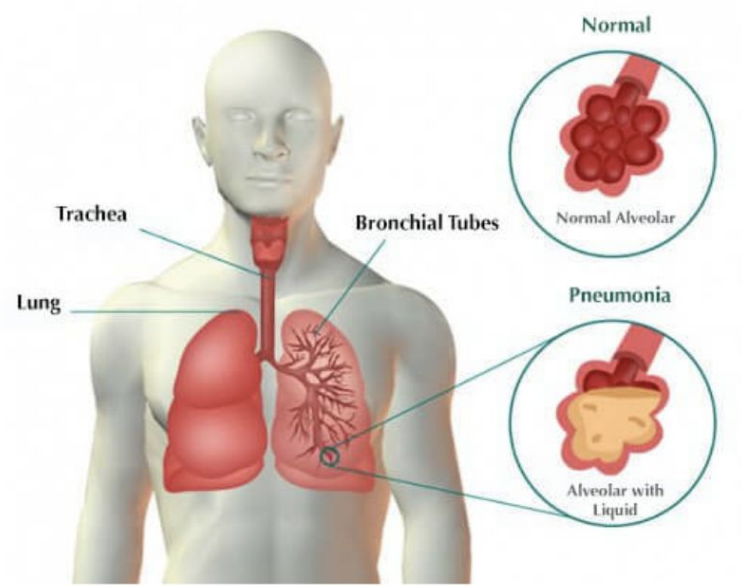


Introduction

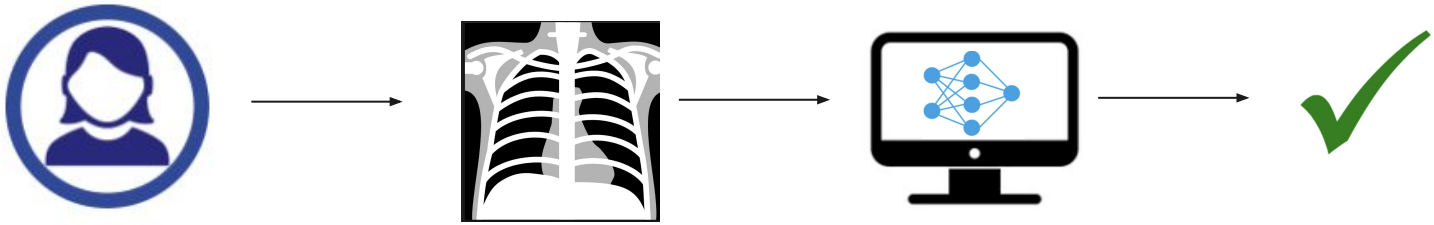
Pneumonia is responsible for 16% of child deaths under 5 years old



Early detection and treatment is critical to reducing pneumonia fatalities in children

Machine learning models can help expedite the disease screening process and serve as a 2nd opinion

Clinical Decision Support System



Physician examines patient with outward symptoms

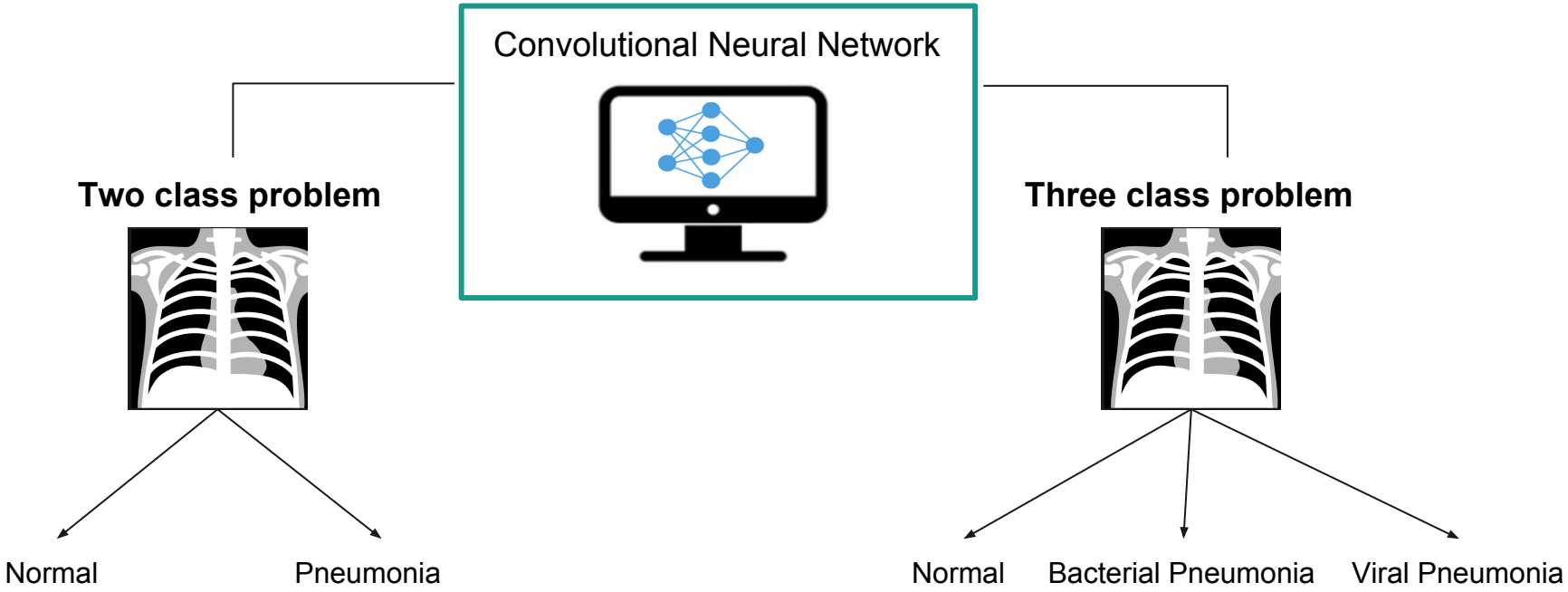
Physician orders X-ray

Machine learning model classifies X-ray

Physician confirms diagnosis

Armed with AI systems, physicians make more accurate diagnoses than either the system or physician alone

Goal to classify pediatric pneumonia from chest X-rays using machine learning to reduce time to diagnosis

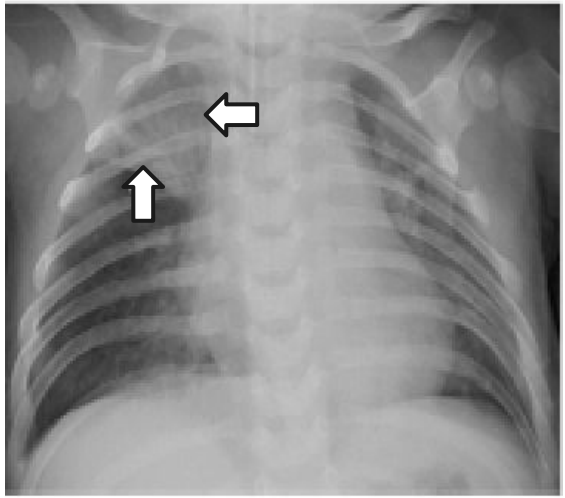


Data Gathering & Analysis

Obtained 5,000+ physician labeled pediatric chest X-rays from a 2018 study by Kermany et al.

Normal

Bacterial Pneumonia



Viral Pneumonia

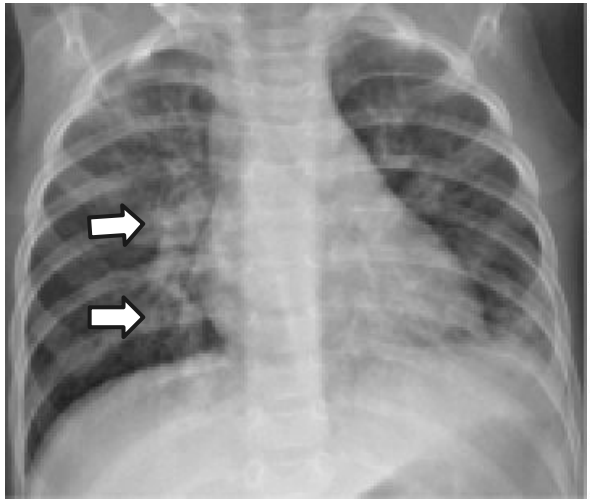
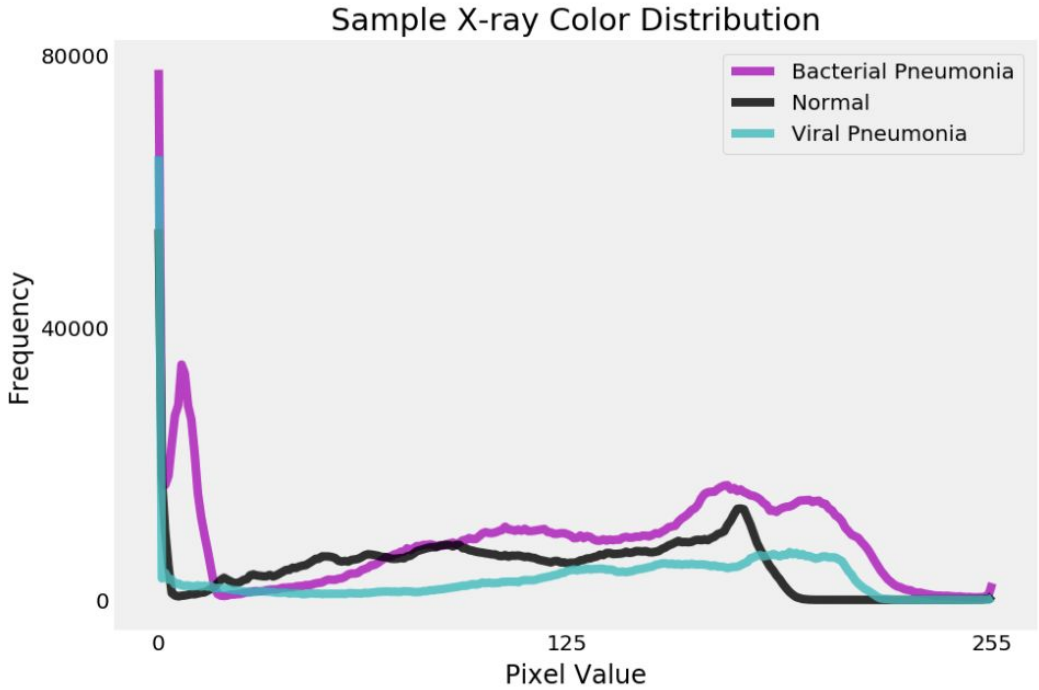
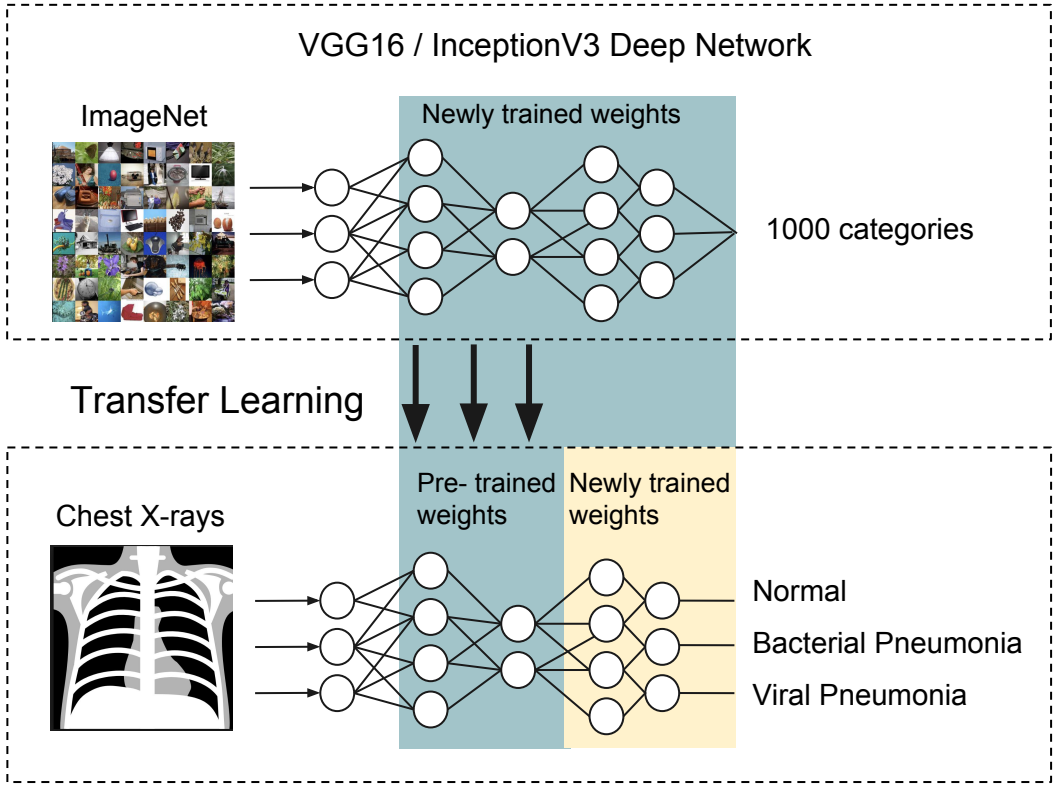


Image analysis revealed varying color distributions and inconsistent sizing in the X-rays



Modeling

Compared performance of newly initialized neural networks to transfer learning approach



Optimized for sensitivity to reduce number of false negatives and ensure delivery of needed treatment

False negatives

Patient **diagnosed as healthy** who has **pneumonia**

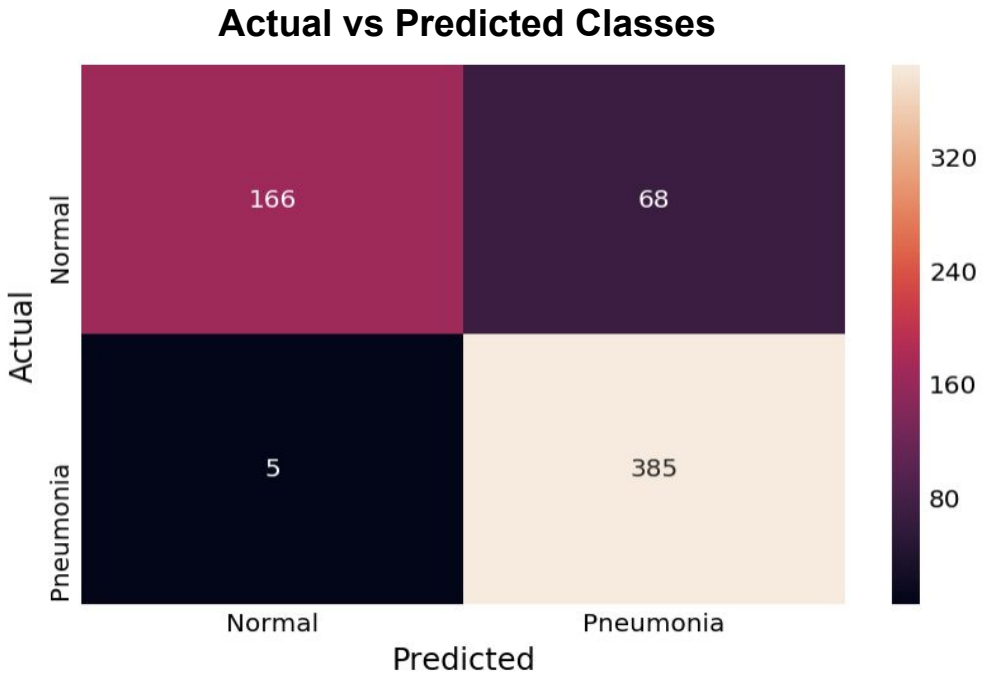
Sensitivity

False positives

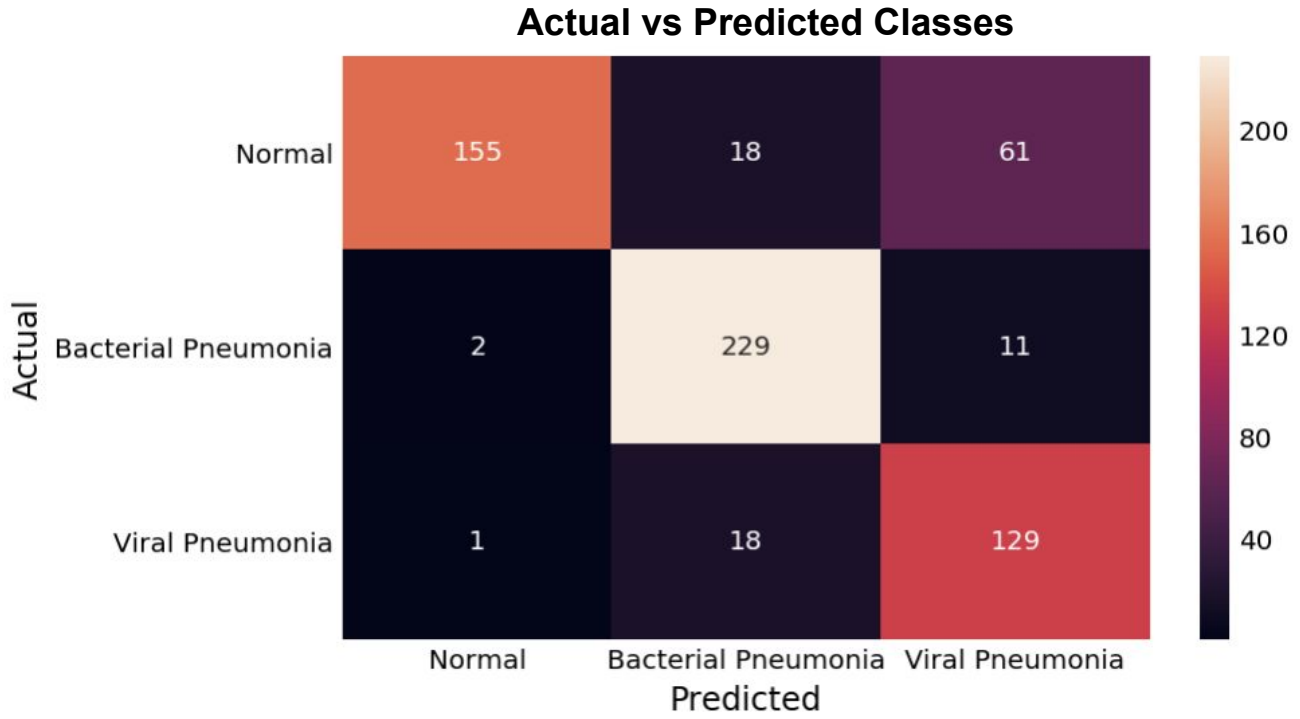
Patient **diagnosed with pneumonia** who is **healthy**

Specificity

Binary classification CNN model performed best with 88% accuracy, 99% sensitivity, and 71% specificity



Multi-class VGG16 model performed best with 82% accuracy, 99% sensitivity, and 66% specificity



Conclusions

Results demonstrate success in diagnosing pneumonia from chest X-rays using machine learning

Key takeaways

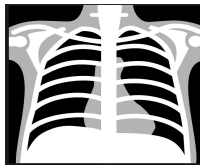
- Binary classification performance comparable to human experts
- Viral pneumonia proved more difficult to identify than bacterial
- Transfer learning did not always outperform newly initiated neural networks

Models can be further improved to increase accuracy and specificity metrics

Next Steps

Try additional transfer learning models

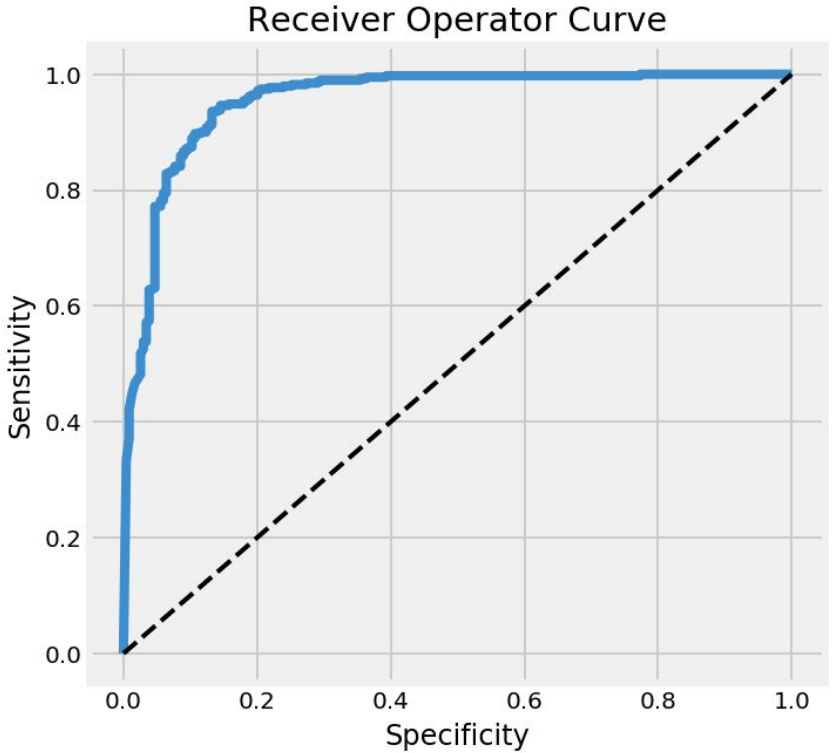
Replicate Kermany et al. study



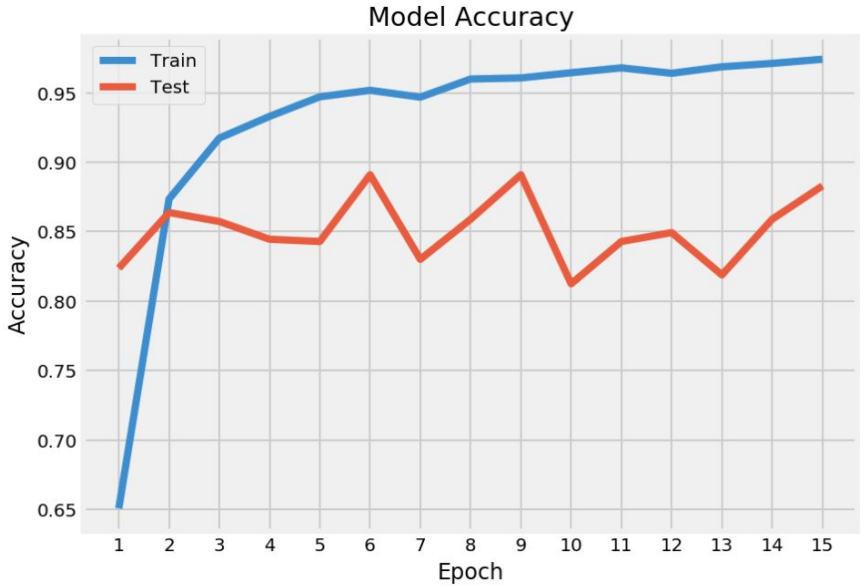
Bacterial and viral pneumonia classification

Appendix

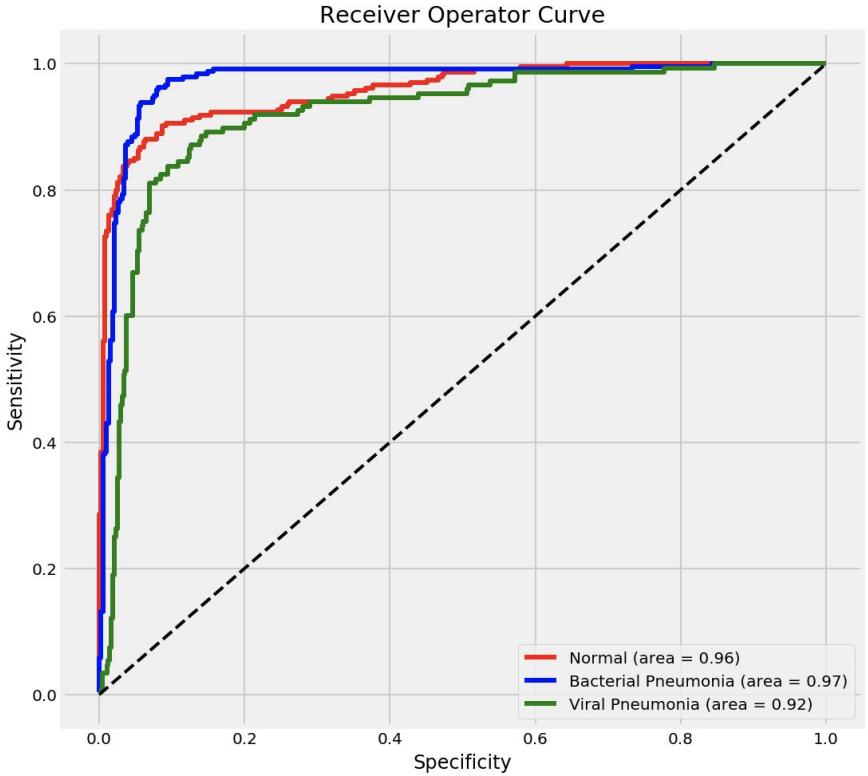
Binary classification CNN model had a 0.96 AUC-ROC score



Binary classification CNN model is overfit due to divergence of test and train loss and accuracy scores



VGG16 multi-class classification model had an average 0.95 AUC-ROC score



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