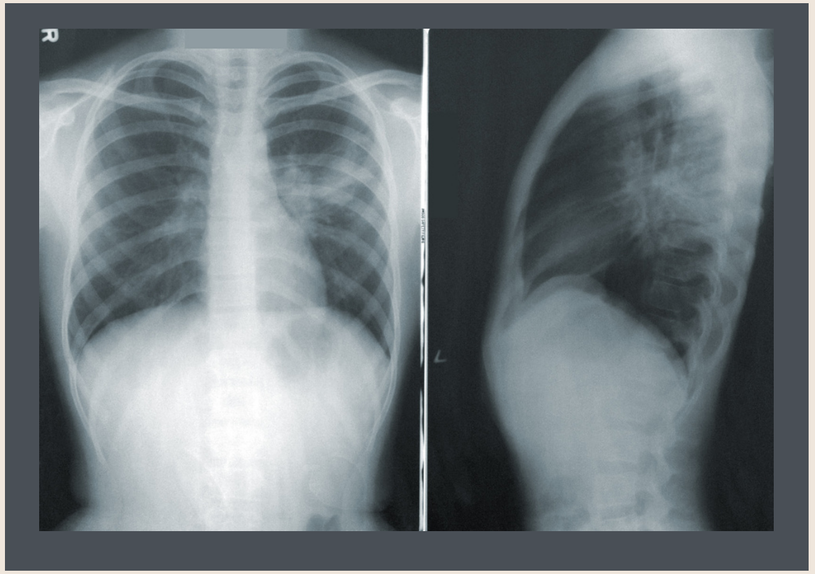
IDENTIFYING PNEUMONIA IN X-RAY IMAGES

IMAGE CLASSIFICATION UTILIZING CONVOLUTIONAL NEURAL NETWORKS



TRAVIS ROYCE

7.20.22

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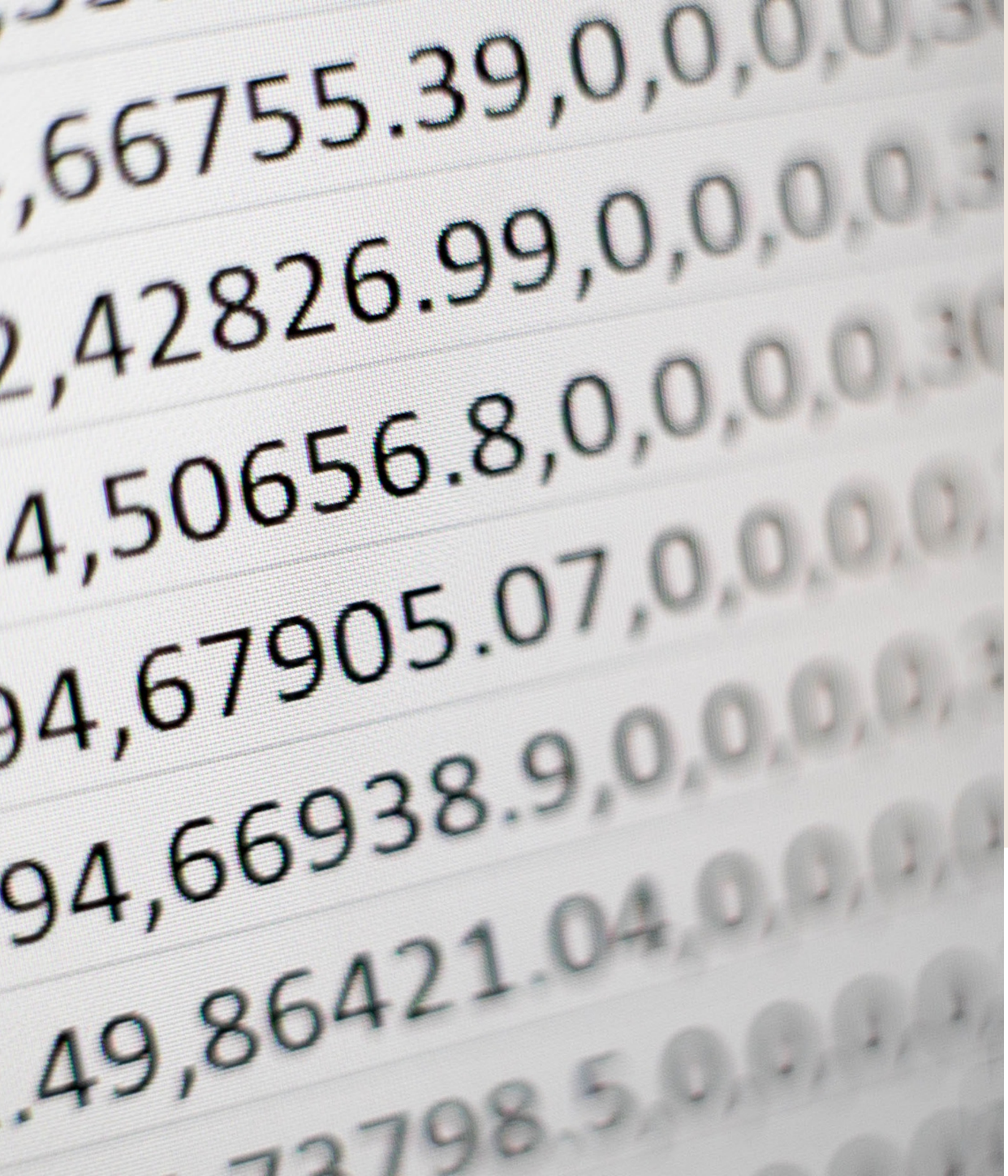
PROJECT OVERVIEW

The goal of this project was to utilize convolutional neural networks to build an image classification algorithm that predicts the presence of pneumonia in lung X-rays.

PRODUCT OVERVIEW

The end product is a web application which can be used by individuals and/or health care professionals to upload X-ray results and determine the presence of pneumonia within said X-rays.



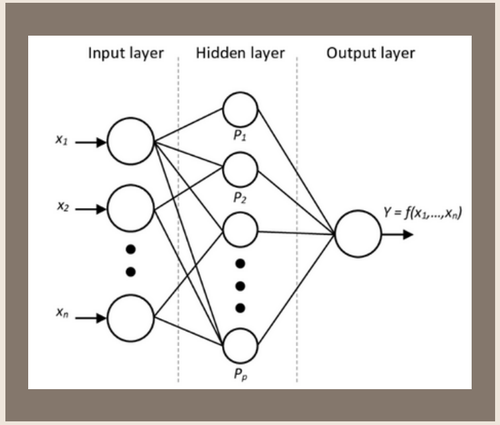
THE DATA

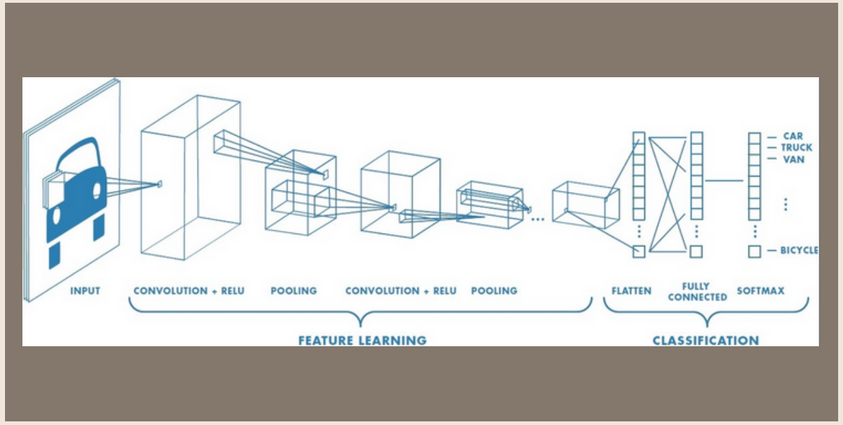
The data consists of approximately **5,900 images** in two categories - 1) **normal**, and 2) **pneumonia** (see bottom images).

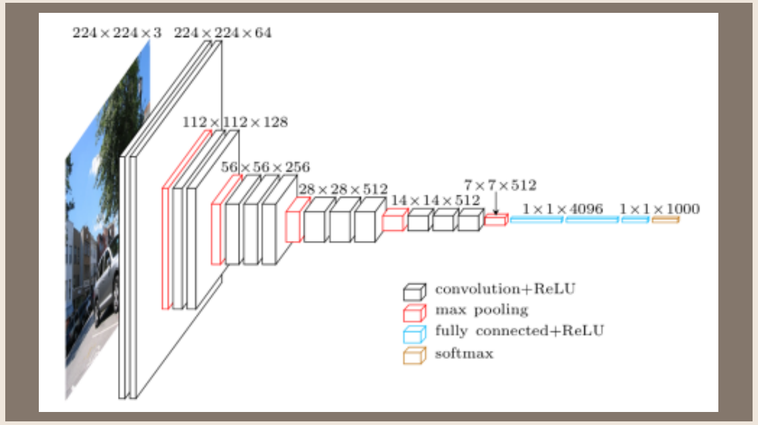
The given data included pre-split testing and training data. However, I found the number of both test images and training images to be lacking, as test images accounted for **less than 15%** of total data and there were only **18 total** provided training images.

I re-split the data so the final data split was approximately **3,200 images** in the training set, **1,750 images** in the test set, and **800 images** in the validation set.

MODELING OVERVIEW







INITIAL MODEL: FULLY-CONNECTED NEURAL NETWORK

This is a 'simple' neural network model that is connected deeply, which means each neuron in the dense layer receives input from all neurons of its previous layer.

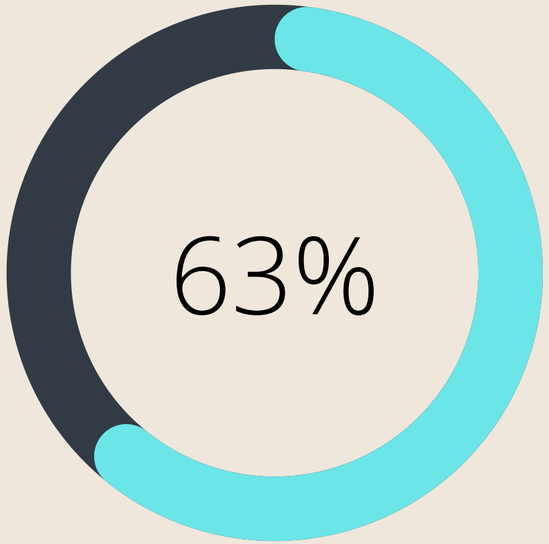
MODELS 2-10: CONVOLUTIONAL NEURAL NETWORKS

Convolutional Neural Networks add the concepts of convolution and pooling, as well as utilizing a 3D structure.

VISUAL GEOMETRY GROUP (VGG) MODEL

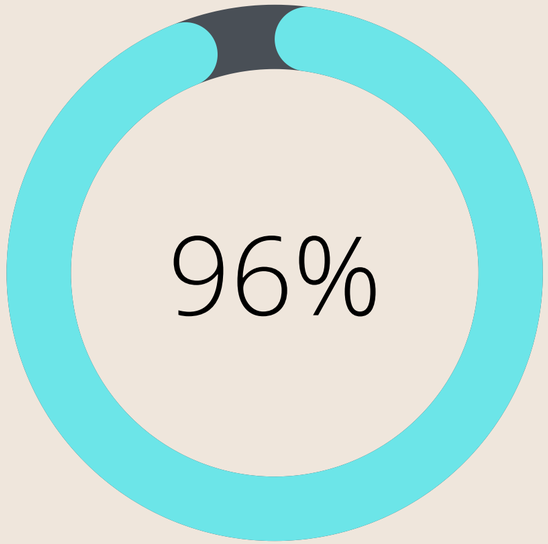
The VGG Model won the 2014 ImageNet visual recognition challenge.

MODEL TESTING RESULTS



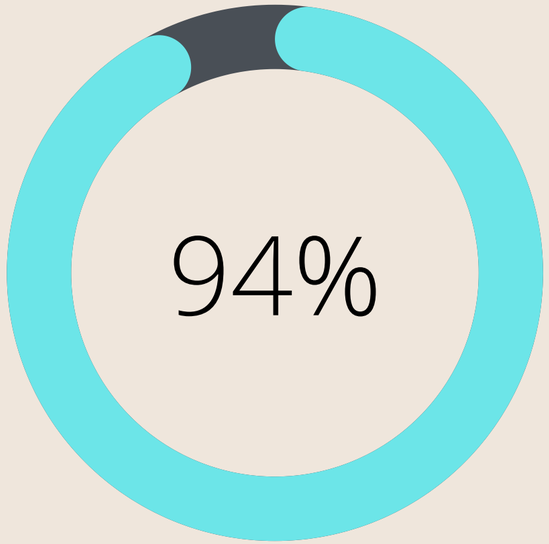
INITIAL MODEL: DENSELY TRAINED

80 Percent Accuracy



MODELS 2-10: CONVOLUTIONAL NEURAL NETWORK ITERATIONS

The accuracy ranged from 84 percent to 95.5 percent.

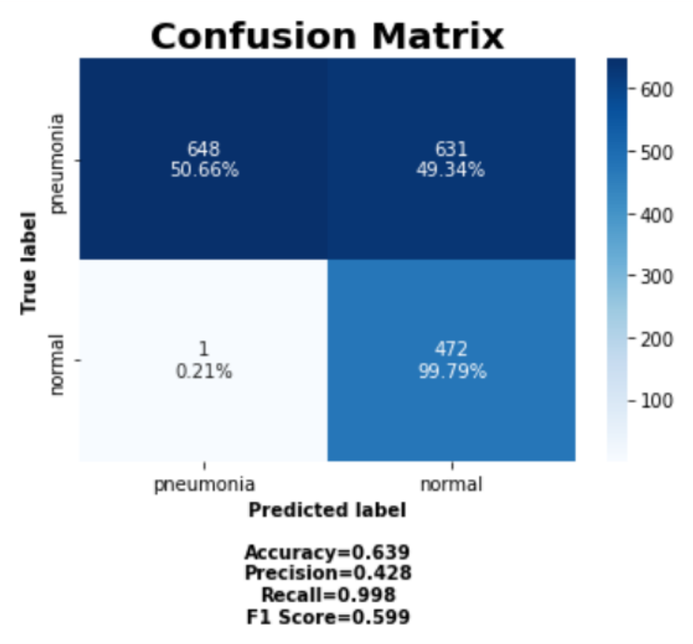


VGG16 MODEL

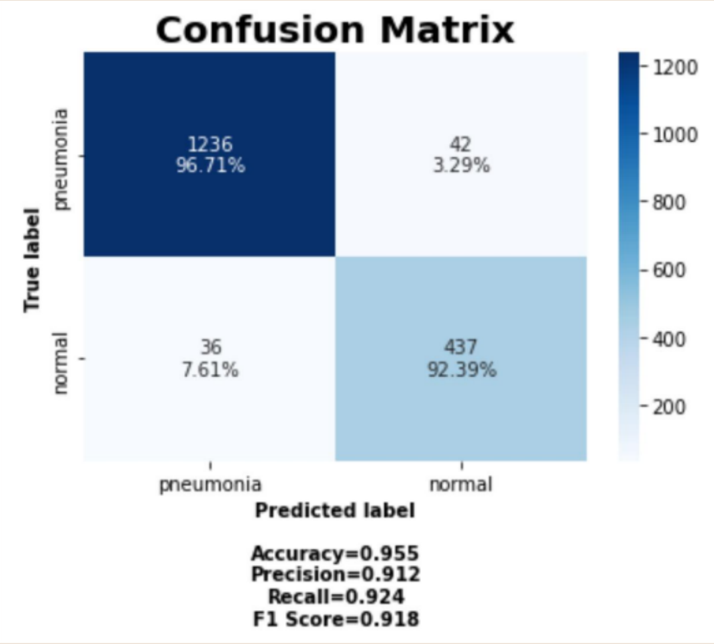
The VGG16 Model predicted with 94 percent accuracy

MODEL TESTING RESULTS

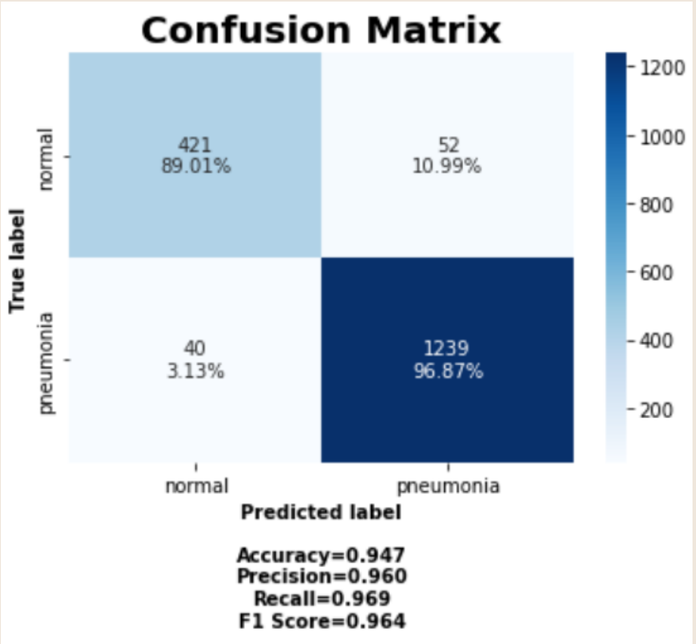
INITIAL MODEL: DENSELY TRAINED

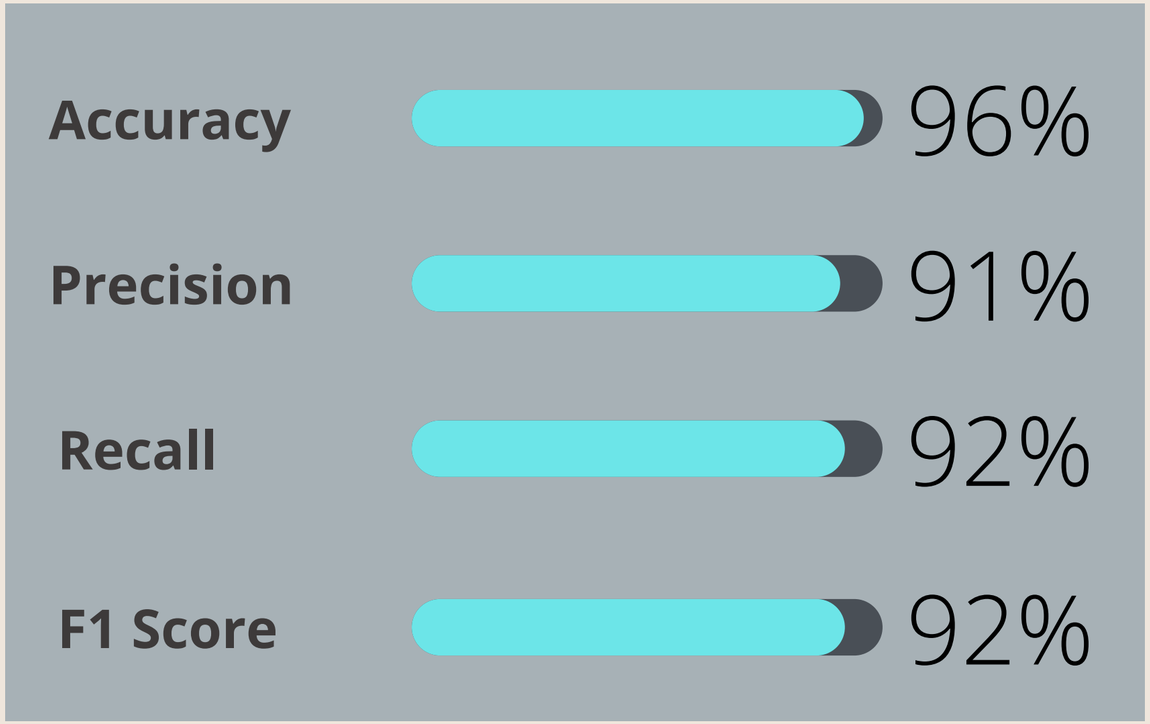


CONVOLUTIONAL NEURAL NETWORK ITERATIONS



VGG16 MODEL





FINAL MODEL

The final model is the **fourth** iteration of the convolutional neural network (CNN) models.

The final result included **1,236** true positives, **437** true negatives, **36** false negatives, and **42** false positives.

In **product terms**, this means that we could expect our web application to **correctly** pick if an individual has pneumonia based on their X-ray **95.5 percent** of the time.

While 95.5 percent is solid accuracy, this product could potentially be used by doctors as a tool to confirm their diagnosis. This would be **helpful** in the **following way:**

If a doctor has a **2 percent** misdiagnosis rate, and this model had a **4 percent** error rate, the chance that both the doctor AND the model would misdiagnose the same X-ray would be just **0.08 percent**.

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