Pneumonia Patient Diagnosis Image Classification

Using image classification models to pneumonia diagnosis.

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Business Overview

Problem: Develop a model to predict which patients are healthy and which have pneumonia based on x-ray images.

Business Value: Having an accurate classification model will improve the medical business in several aspects, from technological advantages, economics and patient health.

Method

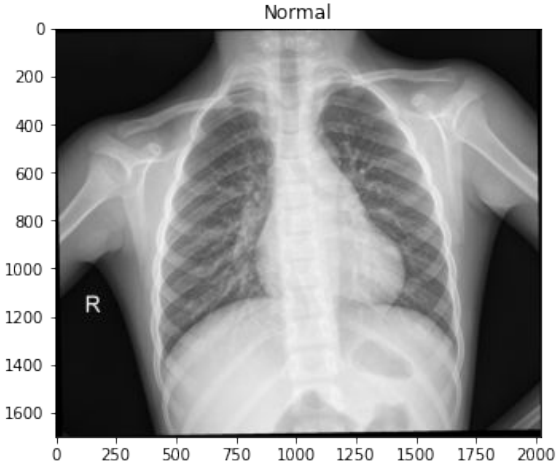
Used a convolutional neural network (CNN) model:

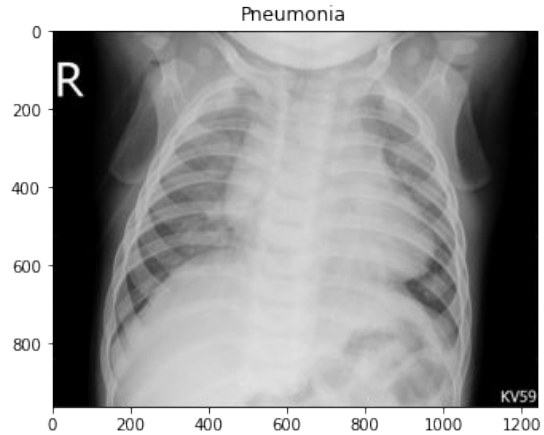
Model generates the images at smaller resolution.

Creates feature maps from pixels. Compressing images.

The model looks for generic pixel patterns. Learns more complex patterns from those.

Ran several models with different optimizers to find best performance for classification.





Best CNN Model.

CNN Model Recall: 94%

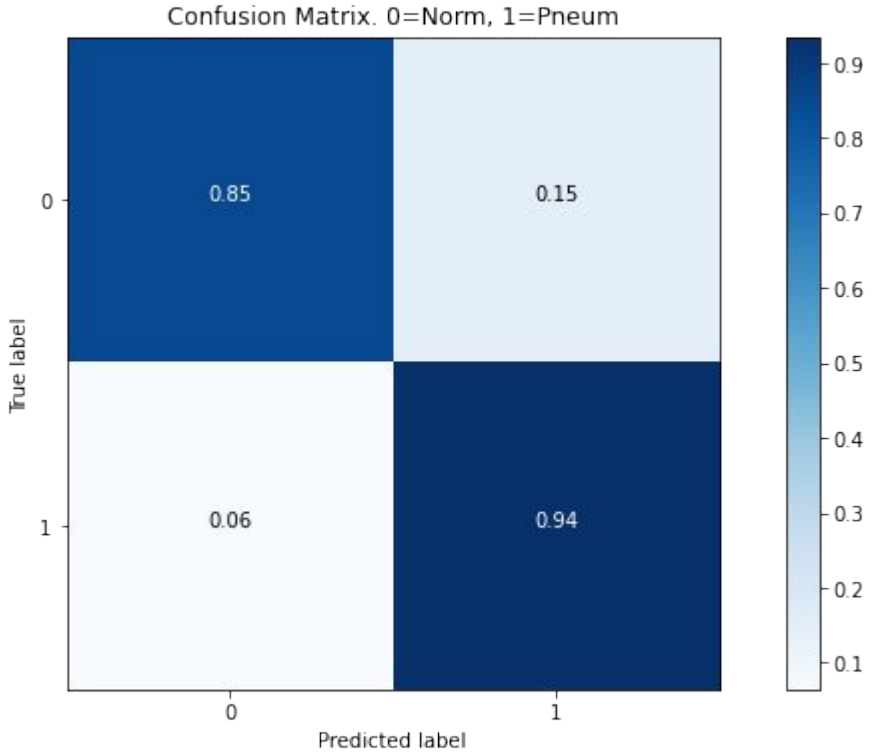
Precision: 91%

Overall accuracy 90%

- Recall is priority to capture all pneumonia cases.

6 CNN layers and 2 dense layers.

Rec. image size - 64x64 px

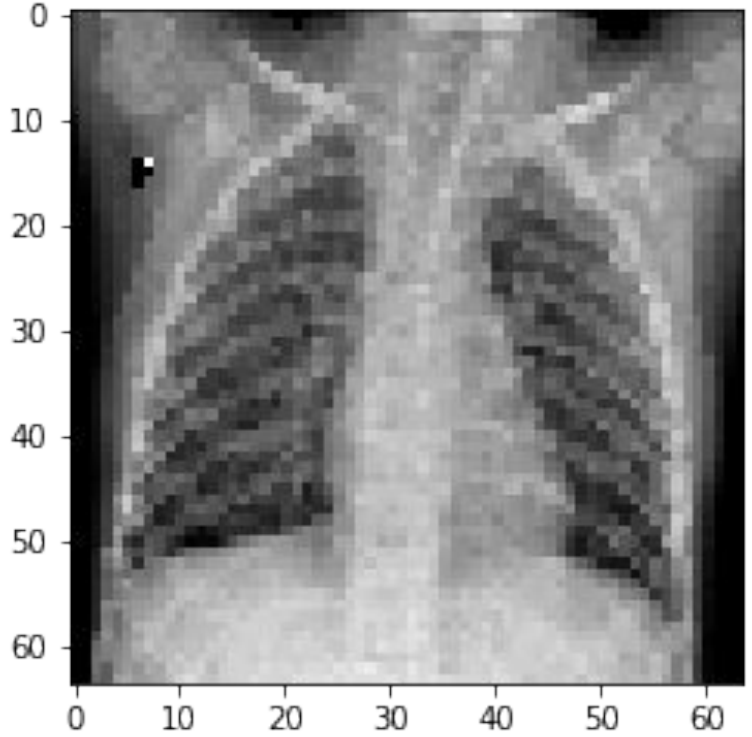


*Additional model reports in the appendix.

Business factors.

Advantages:

- Technological.
- Economical.
- Health.



Technical.

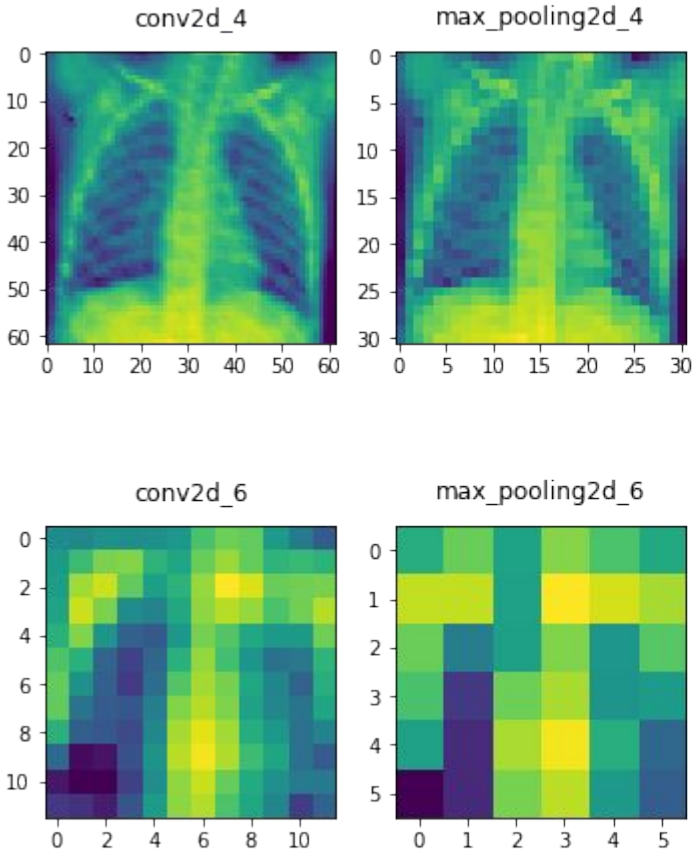
Model is cloud based. Powerful GPU.

CNN - type of deep learning neural network. Faster than dense layer neural network.

Image size of 64x64 pixels.

Maps pixels into more simple patterns. Based on pixel numbers. Color added for example.

Trains 4,700+ images in approximately 5 minutes. That could be 4,700 different patients for your business.



Economic.

Quick modeling times. Quicker diagnosis.

Less time needed to manually scan each image. Less labor hours needed for this repetitive task.

Computer can help ease workload.

Redirect time/hours to patient face-to-face.

Confidence in diagnosis and in doctor. Business reputation goes up.

Saves them time in receiving diagnosis.

Less need for second opinion.

Allocate labor hours, for more efficient practice.

Health.

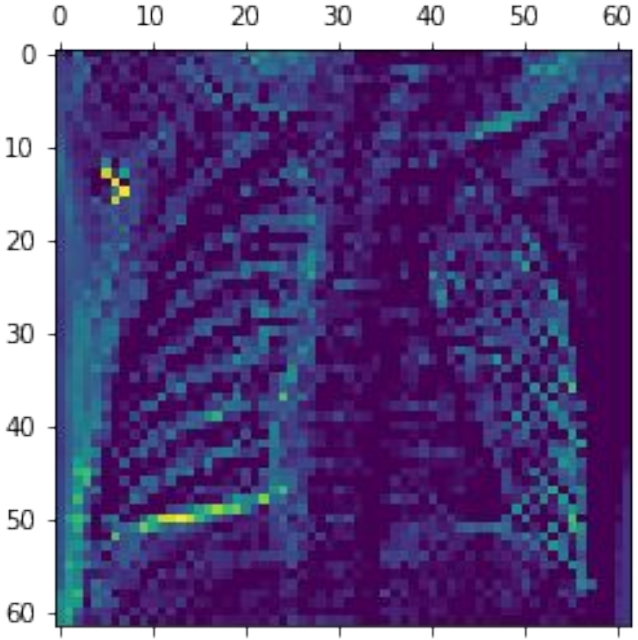
More accurate analysis and diagnosis.

Faster diagnosis. Less chance of disease spreading or getting worse.

Better chance of recovery.

Less chance for human error.

More patients are able to be treated more efficiently. Better overall population health.



Summary & Recommendations

This model will provide business advantages to your company in several ways, benefitting your doctors, your staff and the patients.

1. Technology.
2. Economy.
3. Health.

Future work

- Acquire more data for a better working model.
- Include more model tuning to achieve better accuracy.
- Try larger image sizes.
- Train model to help diagnose other diseases/injuries.

Thank you.

Appendix.

CNN model layers.

Each layer develops more patterns and more channel dimensions of the images, going from 32 up to 128 feature mapped dimensions.

Dense layers at the end connect all of the parameters as final learning step for output.

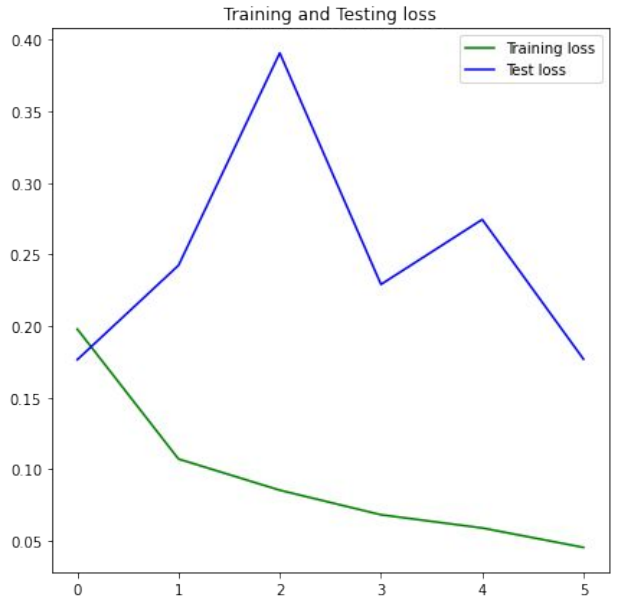
```
Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_10 (Conv2D)           (None, 62, 62, 32)        896
_________________________________________________________________
max_pooling2d_10 (MaxPooling (None, 31, 31, 32)        0
_________________________________________________________________
conv2d_11 (Conv2D)           (None, 29, 29, 64)        18496
_________________________________________________________________
max_pooling2d_11 (MaxPooling (None, 14, 14, 64)        0
_________________________________________________________________
conv2d_12 (Conv2D)           (None, 12, 12, 128)       73856
_________________________________________________________________
max_pooling2d_12 (MaxPooling (None, 6, 6, 128)         0
_________________________________________________________________
flatten_4 (Flatten)          (None, 4608)              0
_________________________________________________________________
dense_7 (Dense)              (None, 512)               2359808
_________________________________________________________________
dense_8 (Dense)              (None, 1)                 513
=================================================================
Total params: 2,453,569
Trainable params: 2,453,569
Non-trainable params: 0
```

Appendix.

Training and testing accuracy shown through model training process.

X-axis steps are known as epochs.

Loss shows how well the model is predicting during training.



Appendix.

Epoch steps of training a model show the time for each step, loss, accuracy and compared validation data which the model separates before training.

```
_________________________________________________________________
None
Epoch 1/6
500/500 [==============================] - 52s 104ms/step - loss: 0.1979 - acc: 0.9182 - val_loss: 0.1766 - val_acc: 0.93
Epoch 2/6
500/500 [==============================] - 52s 103ms/step - loss: 0.1075 - acc: 0.9604 - val_loss: 0.2425 - val_acc: 0.92
Epoch 3/6
500/500 [==============================] - 52s 103ms/step - loss: 0.0853 - acc: 0.9676 - val_loss: 0.3909 - val_acc: 0.88
Epoch 4/6
500/500 [==============================] - 52s 103ms/step - loss: 0.0683 - acc: 0.9745 - val_loss: 0.2292 - val_acc: 0.92
Epoch 5/6
500/500 [==============================] - 52s 103ms/step - loss: 0.0592 - acc: 0.9786 - val_loss: 0.2745 - val_acc: 0.91
Epoch 6/6
500/500 [==============================] - 51s 103ms/step - loss: 0.0455 - acc: 0.9834 - val_loss: 0.1770 - val_acc: 0.93
Training took a total of 0:05:10.536690
```