

# X-RAY PNEUMONIA IMAGE CLASSIFICATION WITH DEEP LEARNING

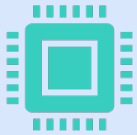


# The Problem



- Globally, a child dies of pneumonia every 39 seconds.
- Pneumonia is a leading cause of morbidity and mortality in children younger than the age of 5 years, killing more children than HIV/AIDS, malaria, and measles combined.
- Chest X-rays are primarily used for the diagnosis of this disease. However, even for a trained radiologist, it is a challenging task to examine chest X-rays.

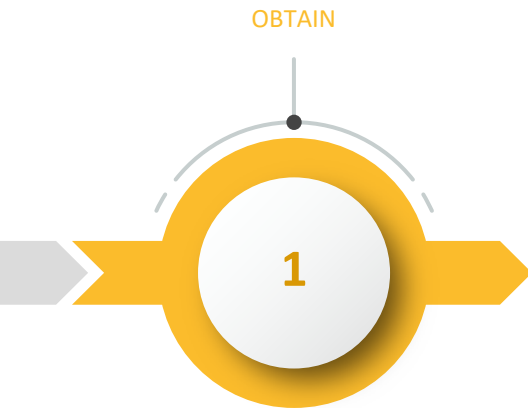
# The Solution



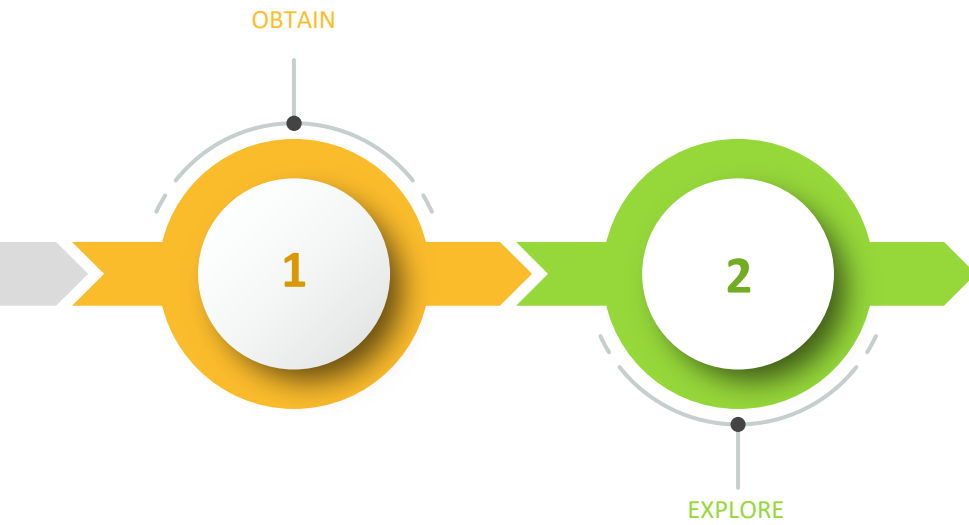
To solve this, deep learning (DL), a branch of machine learning (ML), inspired by the make-up of the human brain, are developed to detect hidden features in images which are not apparent or cannot be detected even by medical experts.

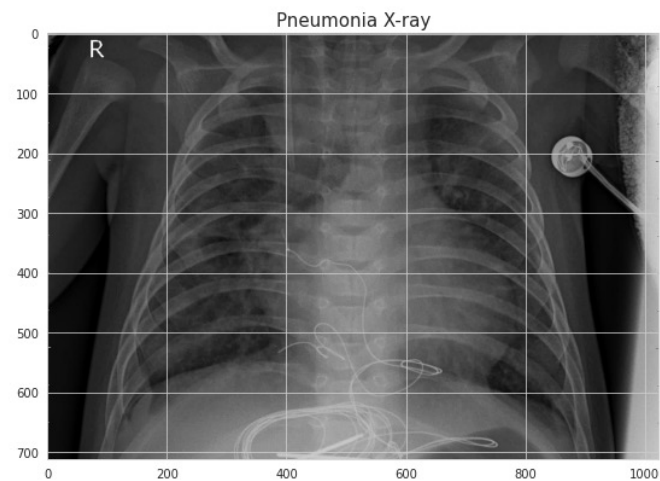
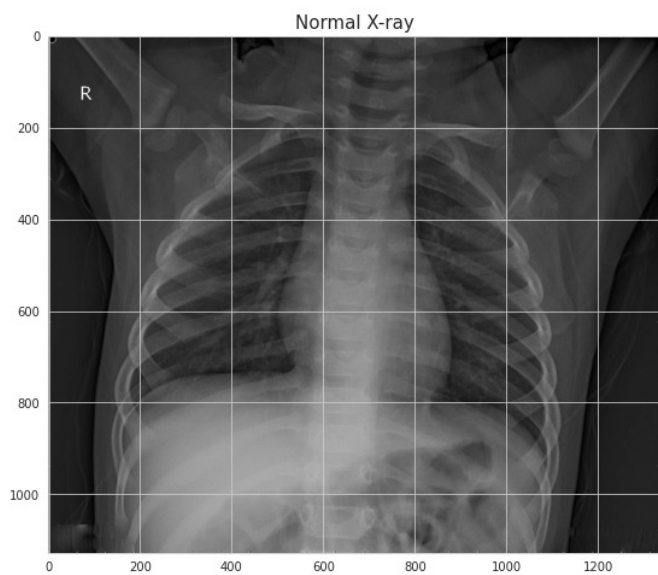


With AI system aiding medical experts in expediting the diagnosis, earlier treatment can be prescribed, resulting in improved clinical outcomes.



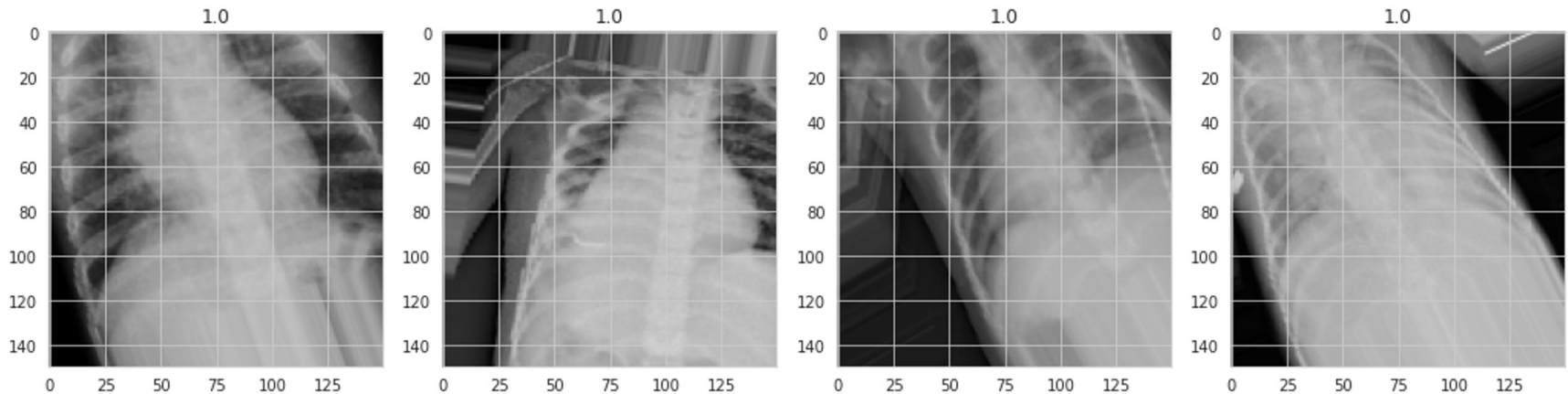
- Chest X-ray images (anterior-posterior) were selected from pediatric patients of one to five years old from Guangzhou Women and Children's Medical Center.
- There are 5,863 X-Ray images (JPEG)
- 2 categories: Normal & Pneumonia

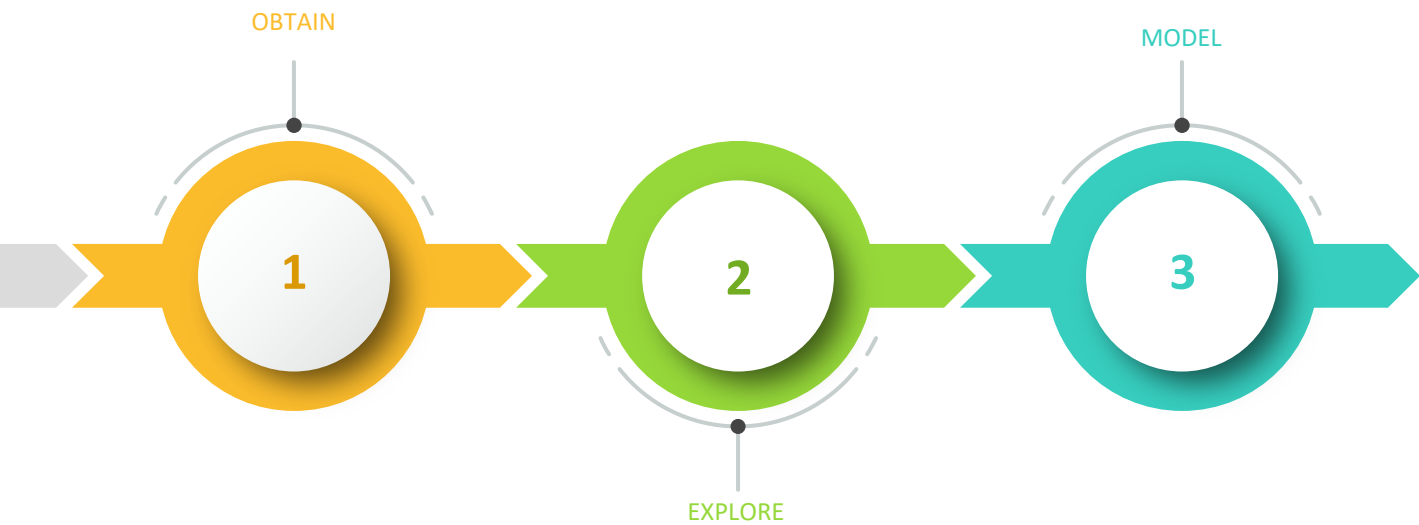




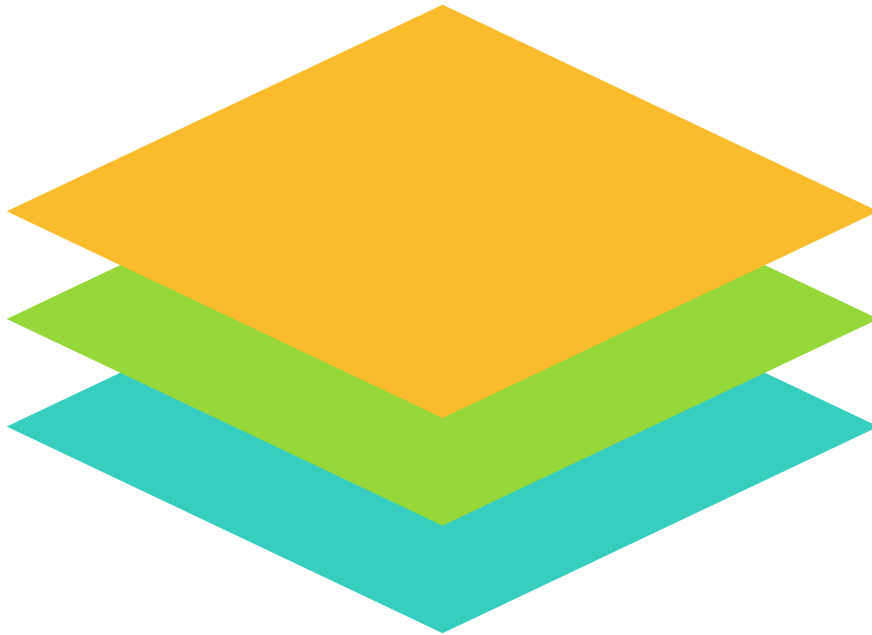
# Data Augmentation




- Small training dataset will overfit model.
- Augment data to artificially create training images through different ways of processing images such as random rotation, shifts, shear and flips, etc. of each training instances.



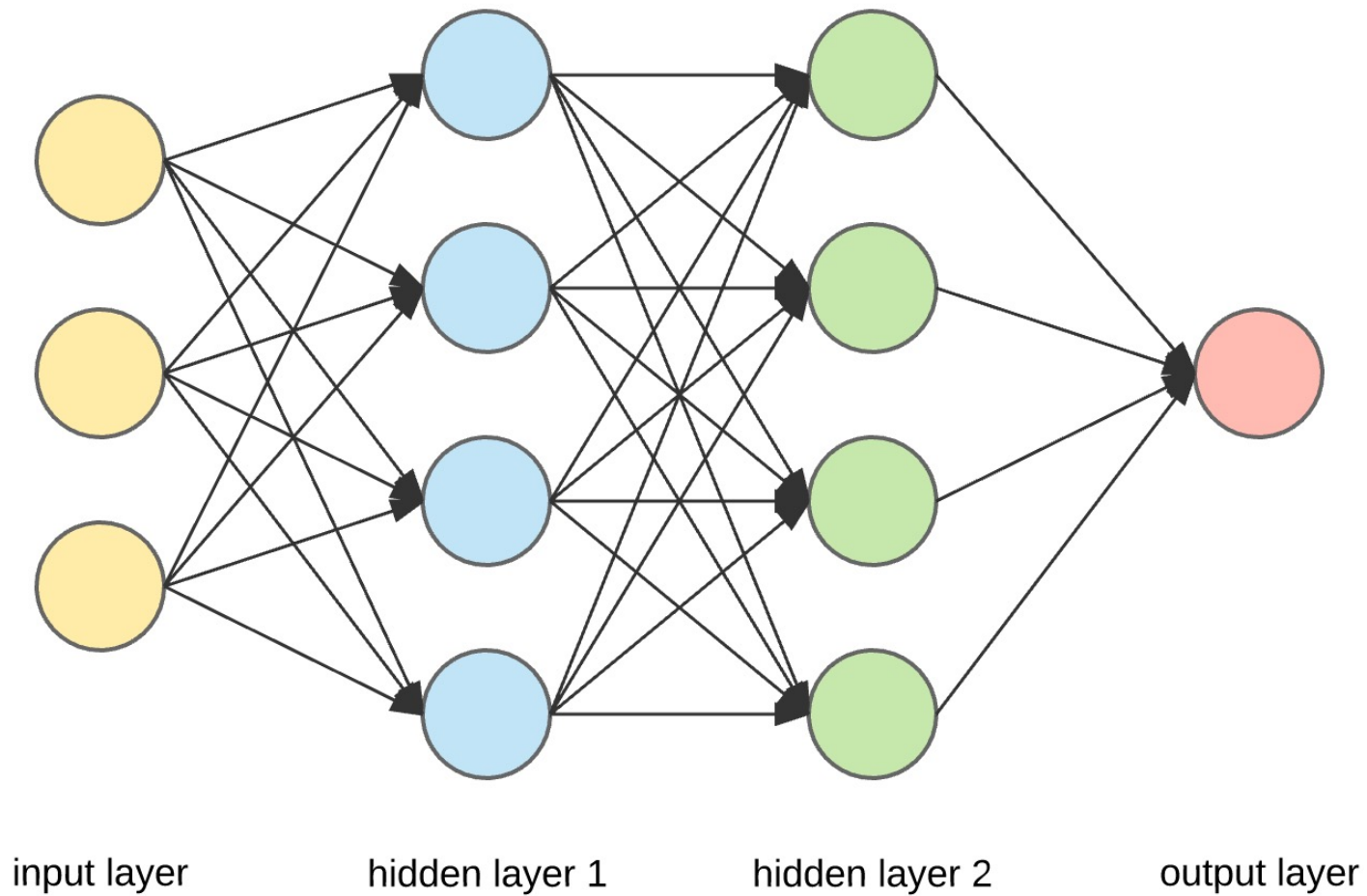




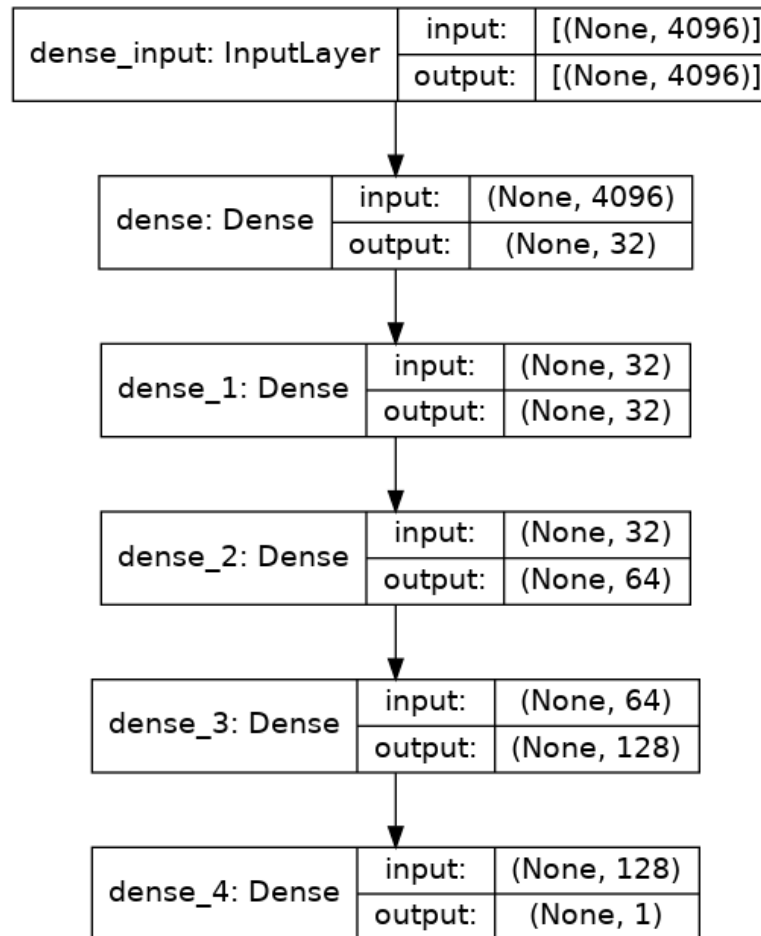


-  MULTILAYER PERCEPTRON MODEL
-  CONVOLUTIONAL NEURAL NETWORK  
MODEL
-  TRANSFER LEARNING VGG16 CNN  
MODEL

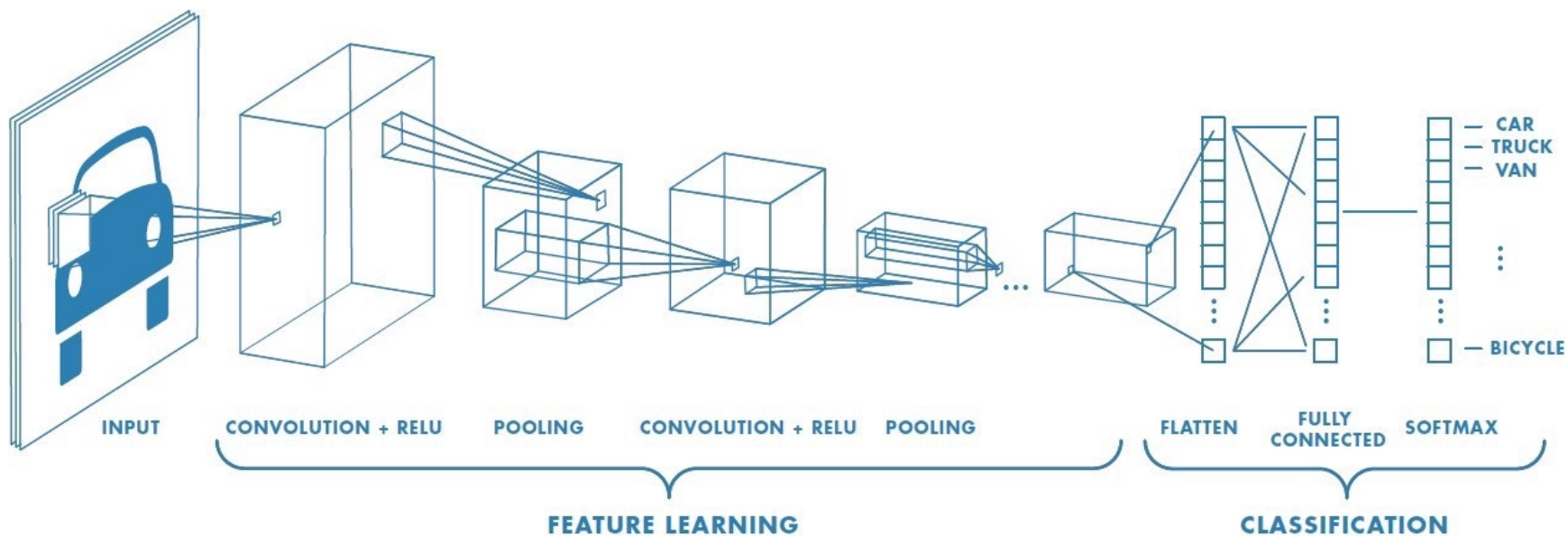
# Multilayer Perceptron



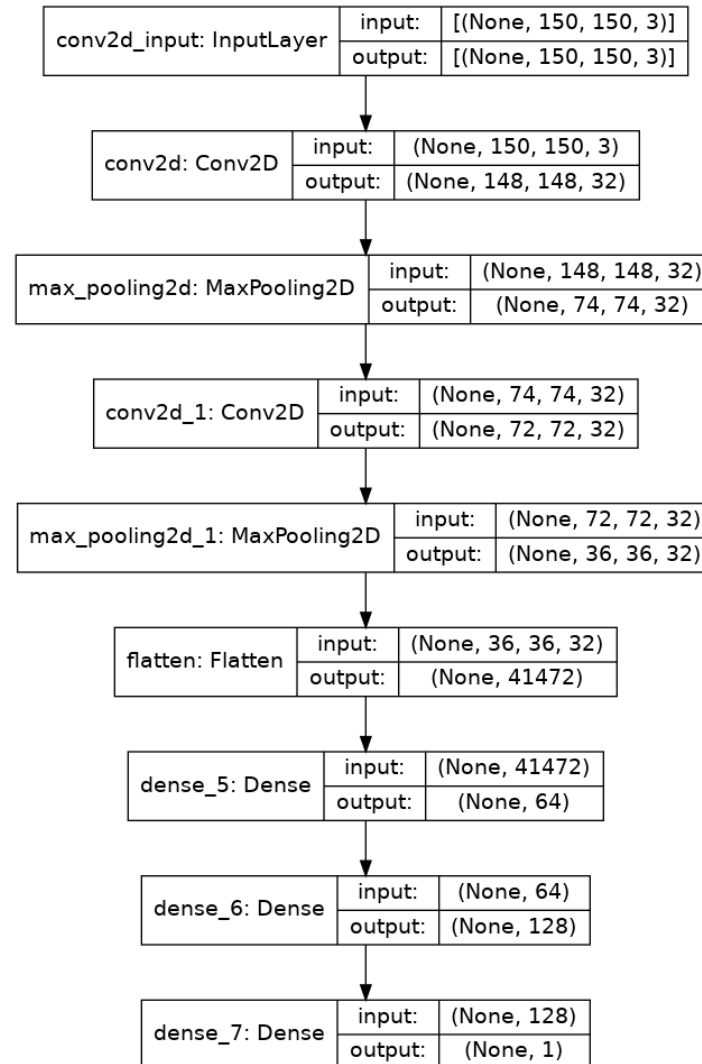
# Multilayer Perceptron



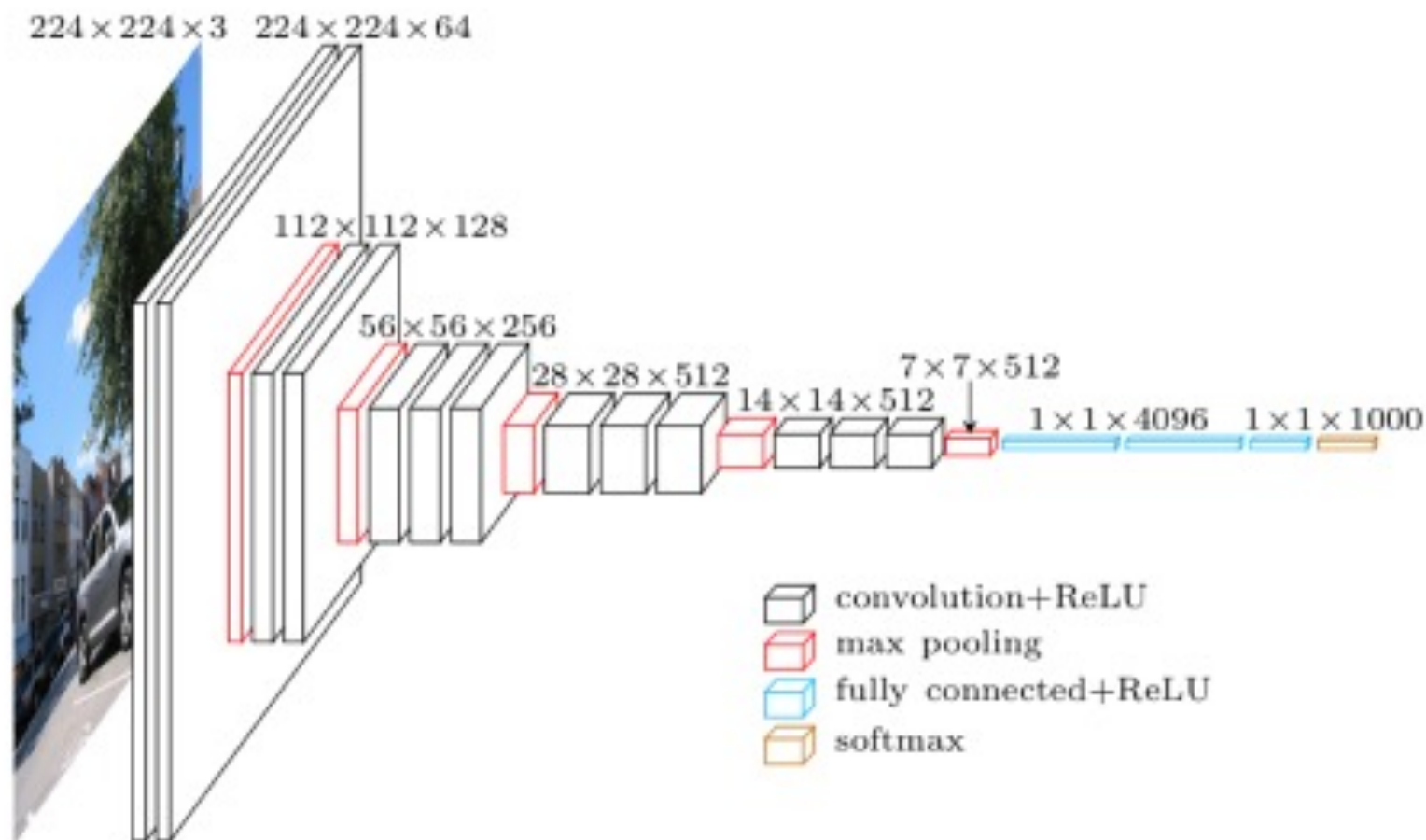
# Convolutional Neural Network



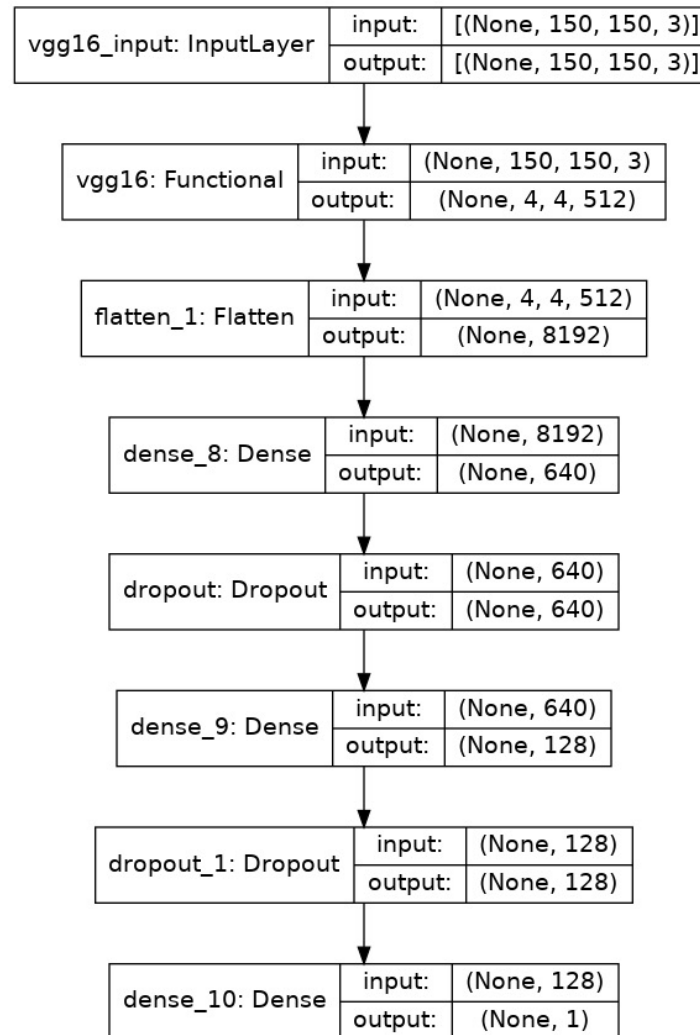
# Convolutional Neural Network



# Transfer Learning with VGG16



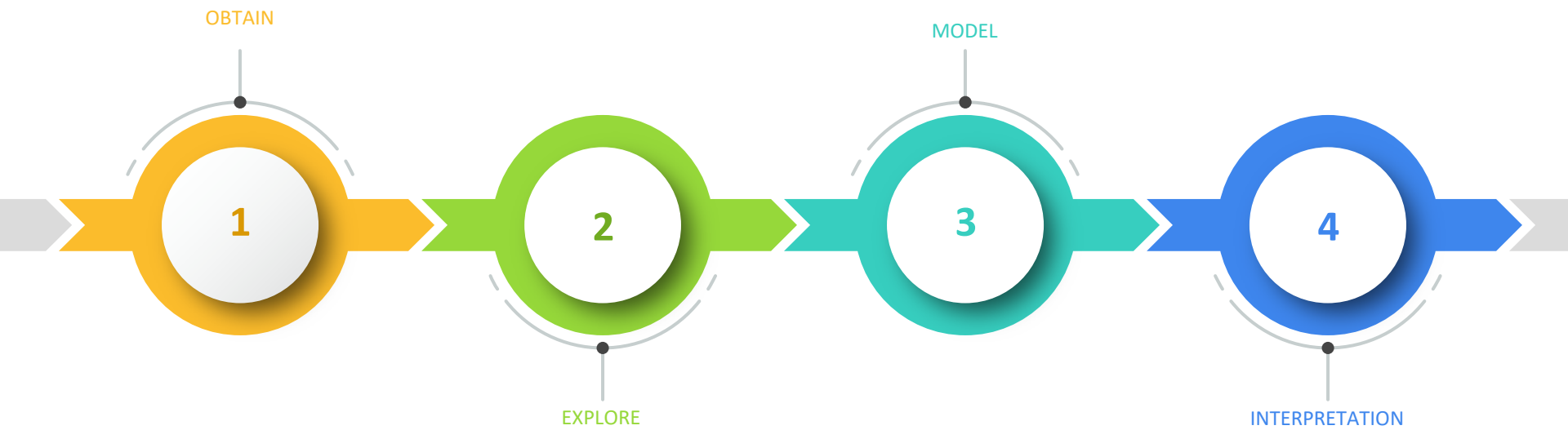
# Transfer Learning with VGG16



# Summary of Key Findings

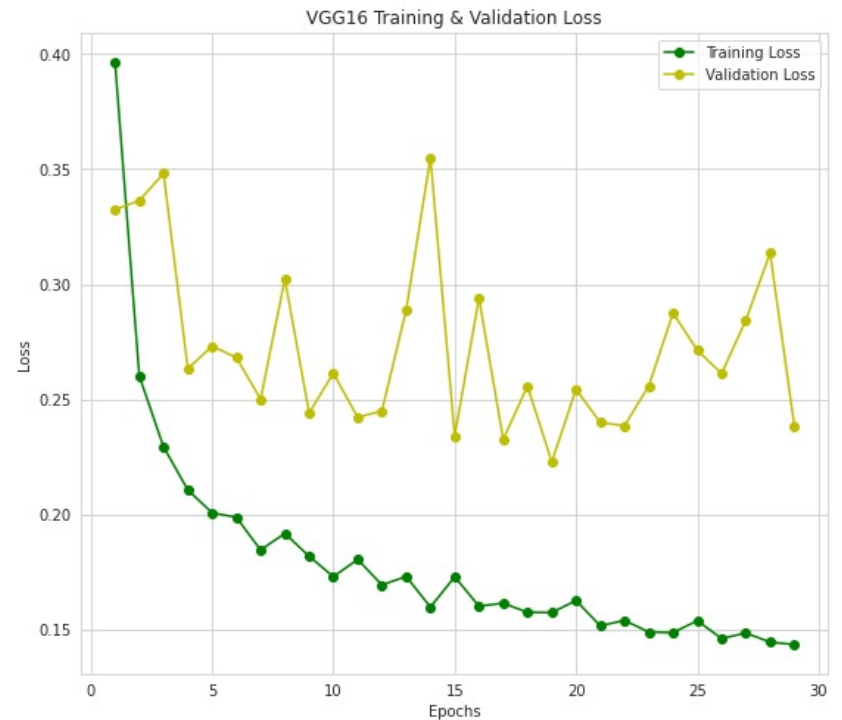
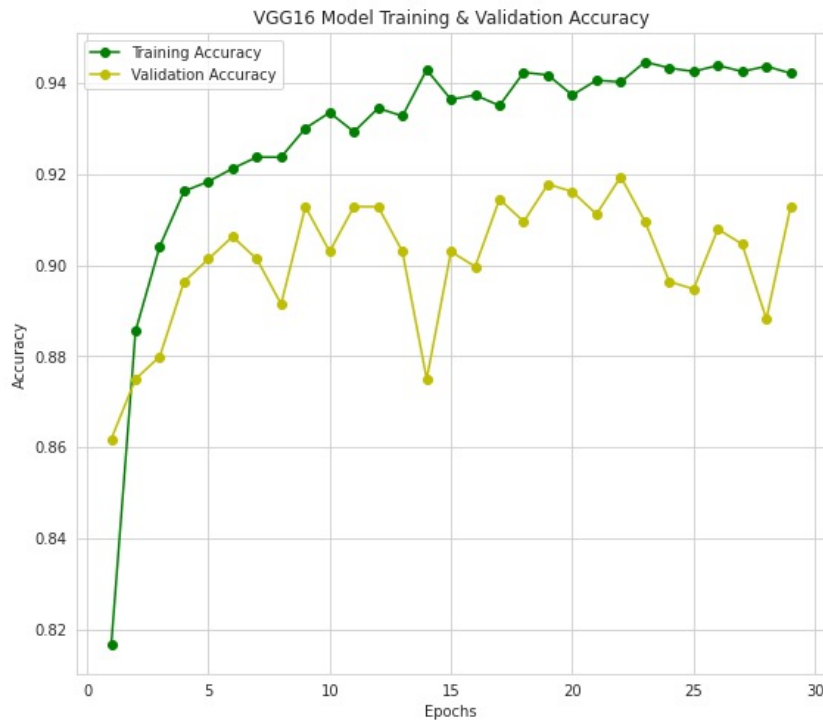
	Model	Accuracy	Precision	Recall	F1 Score	AUC
0	Multilayer Perceptron Model	0.79	0.84	0.74	0.75	0.74
1	Convolutional Neural Network Model	0.88	0.89	0.85	0.86	0.85
2	Transfer Learning: VGG16 CNN Model	0.92	0.91	0.90	0.91	0.90





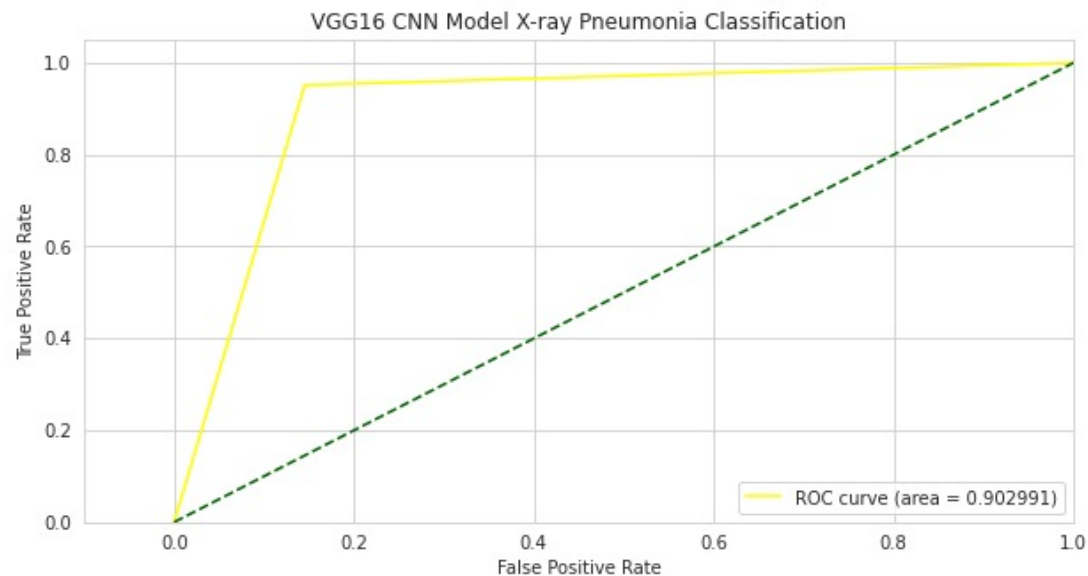
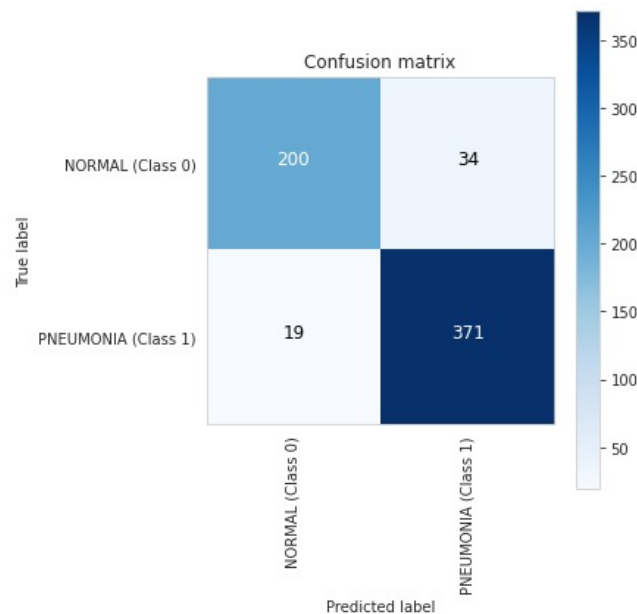
# Best Model

## Transfer Learning with VGG16



Train accuracy = 95%

Validation accuracy = 92%



Accuracy of 92%

Recall/sensitivity of 90%

Precision/specificity of 91%

The area under the ROC curve of 90%

# Future Work

1. Build a multi-class classification deep learning model to distinguish between Normal, Viral Pneumonia, and Bacterial Pneumonia
2. Combine CNN models with other classifiers such as Support Vector Machine (SVM)
3. Tune parameters such as learning rate, batch size, try another optimizer, number of layers, different types of layer, number of neurons per layer, and the type of activation functions for each layer. GridSearchCV or RandomizedSearchSV can be used to achieve this.

The background features abstract, organic shapes in light blue and purple. A large, light blue shape is on the left, and a large, purple shape is on the right. The text "THANK YOU" is centered in the middle of the image, overlapping both shapes. The text is in a bold, blue, sans-serif font.

**THANK YOU**

The background features abstract organic shapes. On the left, a light blue circle partially contains the text. On the right, a large, flowing shape transitions from purple at the top to blue at the bottom. At the bottom left, there is a light blue wavy shape.

# APPENDIX

