PNEUMONIA DETECTION CHALLENGE

Leveraging AI for Improved Pneumonia Detection

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Capstone Project

Agenda

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- Data Information
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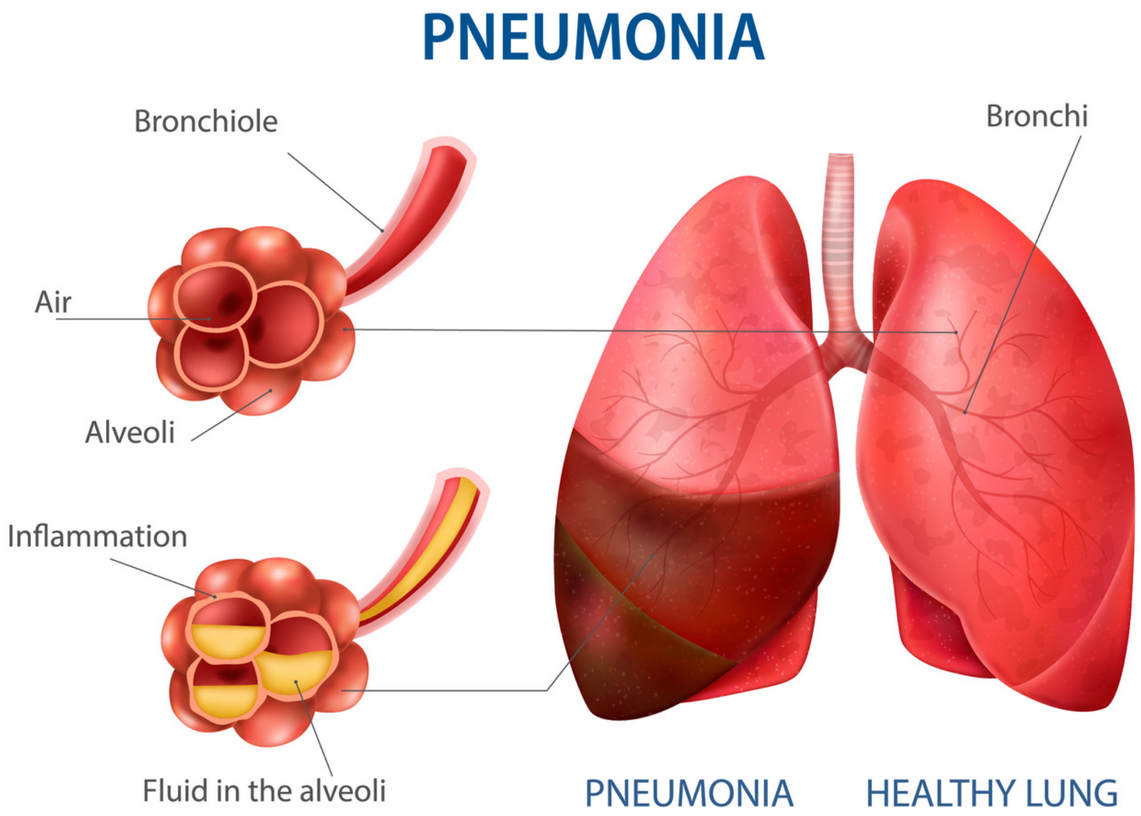
Goal

Build a machine learning model capable of identifying areas of the chest X-ray images that indicate the presence of pneumonia.

Pneumonia

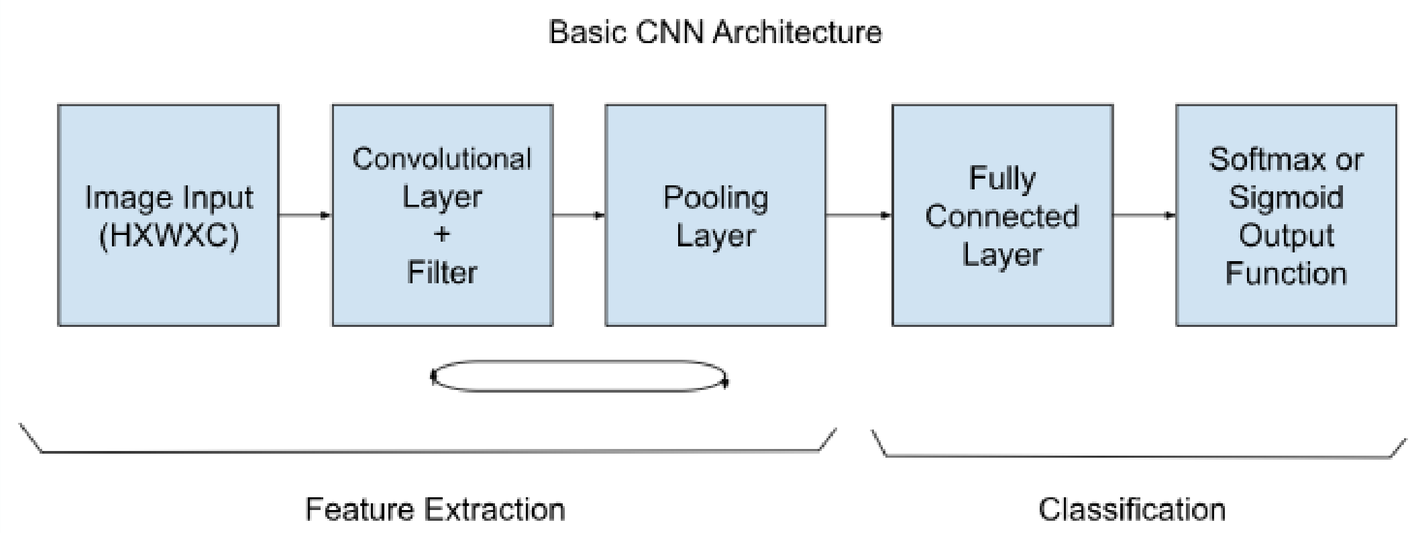
- Top 10 causes of death in the country.
- Lung infection
- **Causes**: Bacteria or viruses.
- **Symptoms**: Cough, fever, difficulty breathing, and chest pain.
- **Severity**: Ranges from mild to severe.
- **Diagnosis**: Through physical examination and tests like chest X-ray.
- **Treatment**: Antibiotics or antiviral medication, rest, and supportive care.
- **Prevention**: Vaccination, good hygiene, avoiding smoking.



Data Information

- 2018 Kaggle Competition
- Data set provided by the Radiological Society of North America (RSNA)
- 26684 X-ray images and labels.
  - 20672 Negative pneumonia diagnosis
  - 6012 Positive pneumonia diagnosis
- Original image size: 1024 x 1024
- Format: DICOM

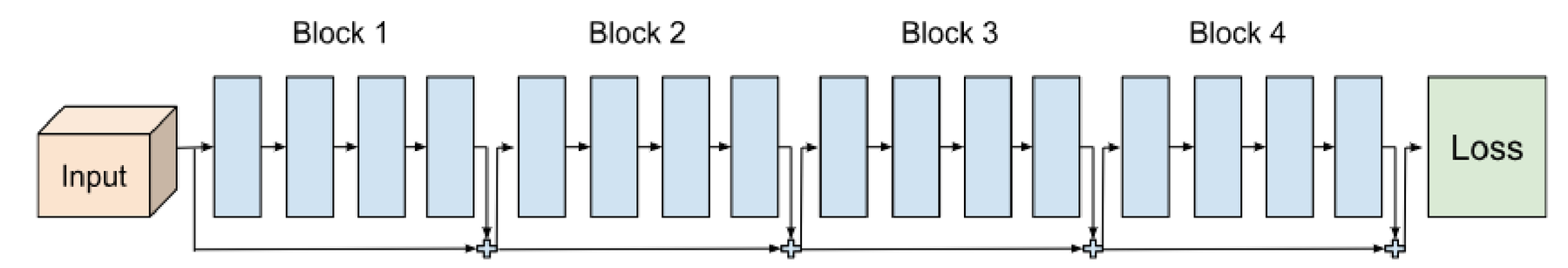
Convolutional Neural Network (CNN)



Primary uses of CNNs:

- **Image Classification**: Classify images into different categories, such as recognizing objects in photographs or classifying medical images.
- **Object Detection**: Detect and localize objects within images. Applications include autonomous vehicles, surveillance systems, and image search engines.
- **Instance Segmentation**: Differentiate between individual instances of objects within an image. This is useful for counting or tracking multiple objects in a video stream.
- **AI in Gaming**: Recognize characters, understand scenes, and generate realistic graphics, enhancing the gaming experience.

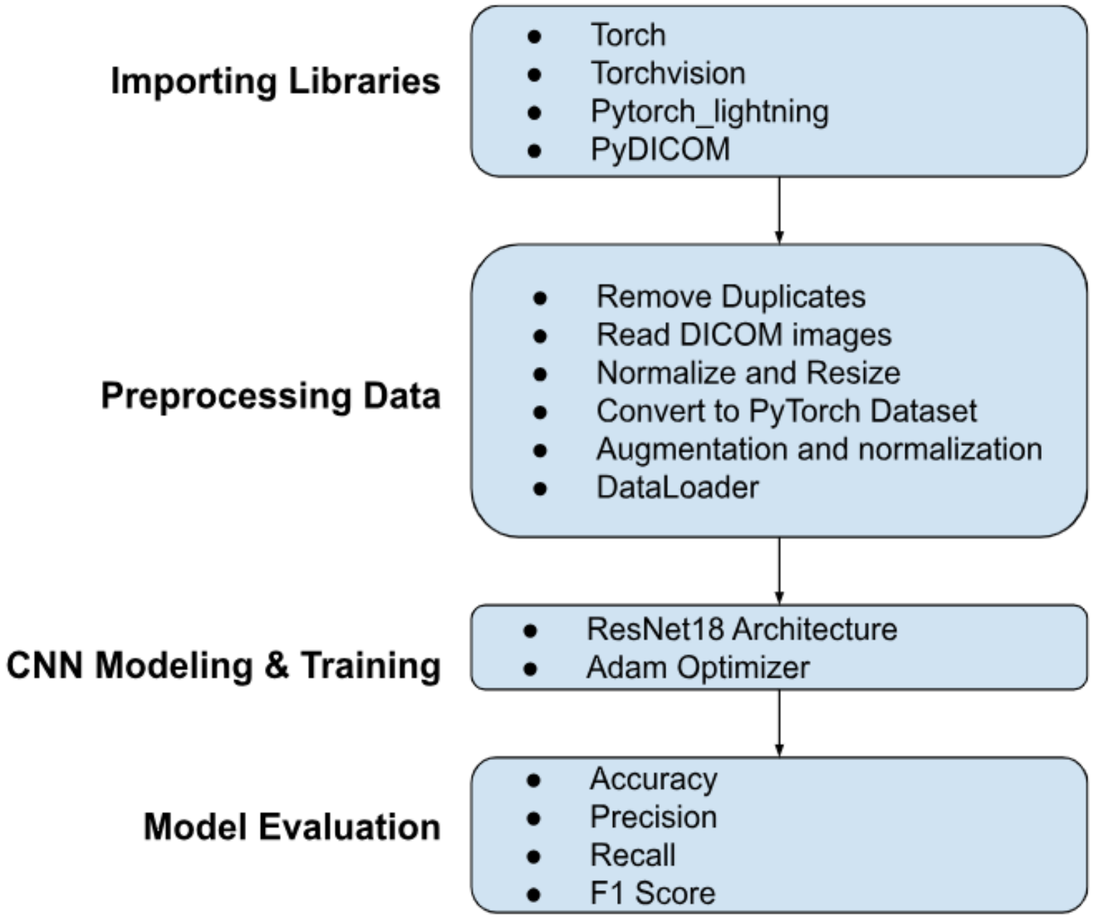
Resnet Architecture



ResNet (Residual Network) architectures have become a standard choice for many computer vision tasks. These are the main advantages:

1. **Vanishing Gradient:** Deeper networks are more prone to the vanishing gradient problem, which leads to overfitting. ResNet uses skip connections, which allow gradients to flow more directly through the network.
2. **Ease of Training:** With skip connections, ResNet learns residual functions (changes to the output) with respect to the input rather than learning the complete mapping from input to output. This makes it easier for the network to optimize the training objective.
3. **Improved Performance:** ResNet architectures excel at computer vision tasks, including image classification, object detection, and segmentation. They can capture more complex patterns and features from input data, leading to better performance.

Project Breakdown



Results

		Predicted Values	
		Negative (0)	Positive (1)
Actual Values	Negative (0)	TN	FP
	Positive (1)	FN	TP

- **Accuracy**: Measures the overall correctness of a model by calculating the ratio of correctly predicted instances to the total number of instances.

$$\text{Accuracy} = \frac{\text{Number of Correct Predictions}}{\text{Total Number of Predictions}}$$

- **Precision**: High precision ensures that the model's prediction of pneumonia is highly likely to be correct, minimizing unnecessary treatments or interventions.

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Positives}}$$

- **Recall**: High recall ensures that the model doesn't miss cases of pneumonia, minimizing false negatives.

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Negatives}}$$

- **F1 Score:** A high F1 score indicates both high precision and high recall, meaning the model has good positive predictive value and good sensitivity to detect positive pneumonia cases.

$$F1 = \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}}$$

- Accuracy: 81.22%
- Precision: 55.88%
- Recall: 79.34%
- F1Score: 65.57%

Confusion Matrix:

[1700 379]
[125 480]

Confusion Matrix (threshold 0.25):

[1259 820]
[45 560]

Future work

01

AI combines chest X-rays with patient data to improve diagnosis.

02

AI chest X-ray model analysis reveals race and sex bias.

03

Speed up runtimes using GPU and CUDA. Result: Using Google Colab Nvidia V100 GPU reduced the runtime to ~1hr from 26 hrs using an Intel i7 CPU.

Thank You