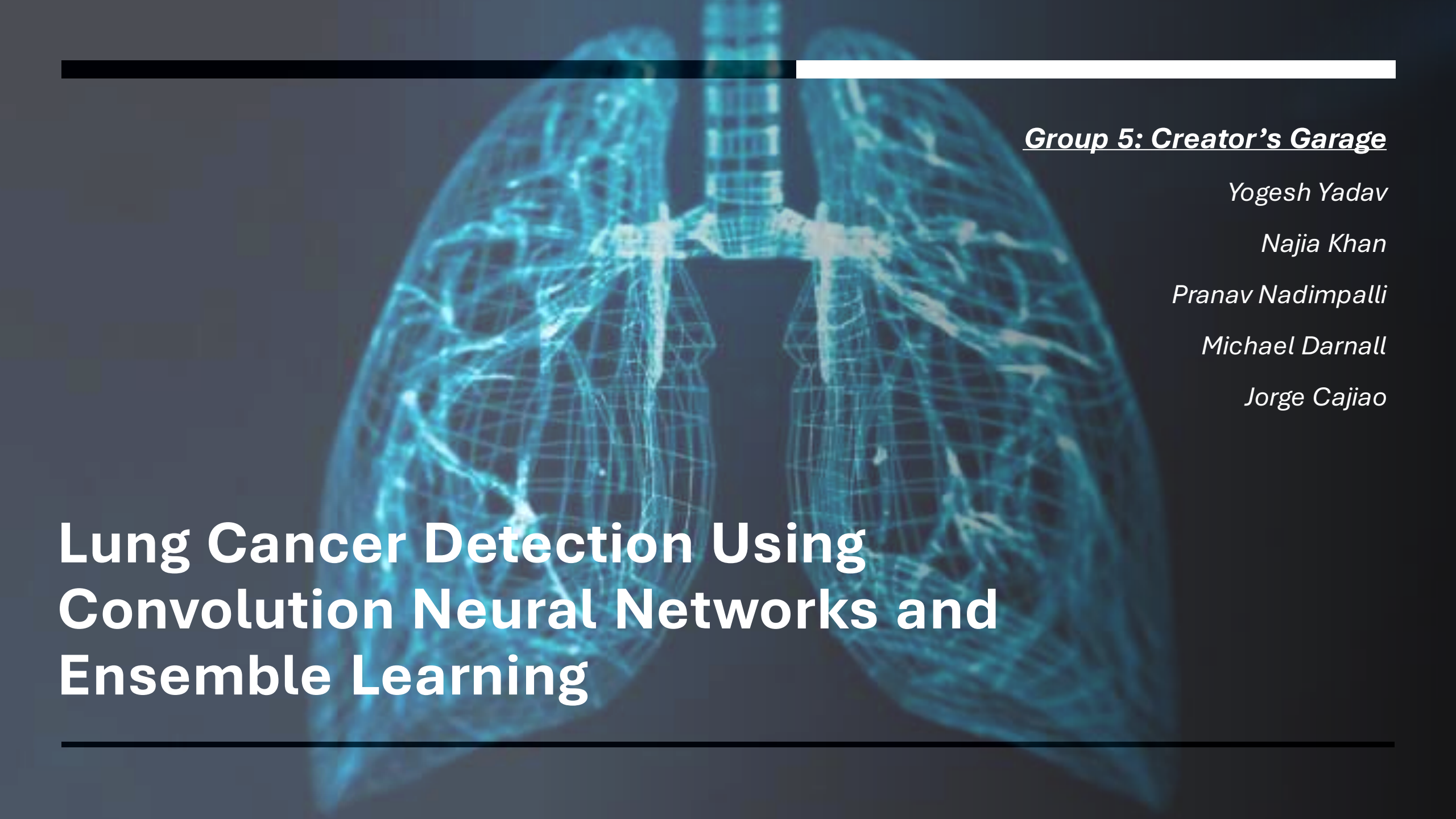


Lung Cancer Detection Using Convolution Neural Networks and Ensemble Learning

Group 5: Creator's Garage

Yogesh Yadav

Najia Khan

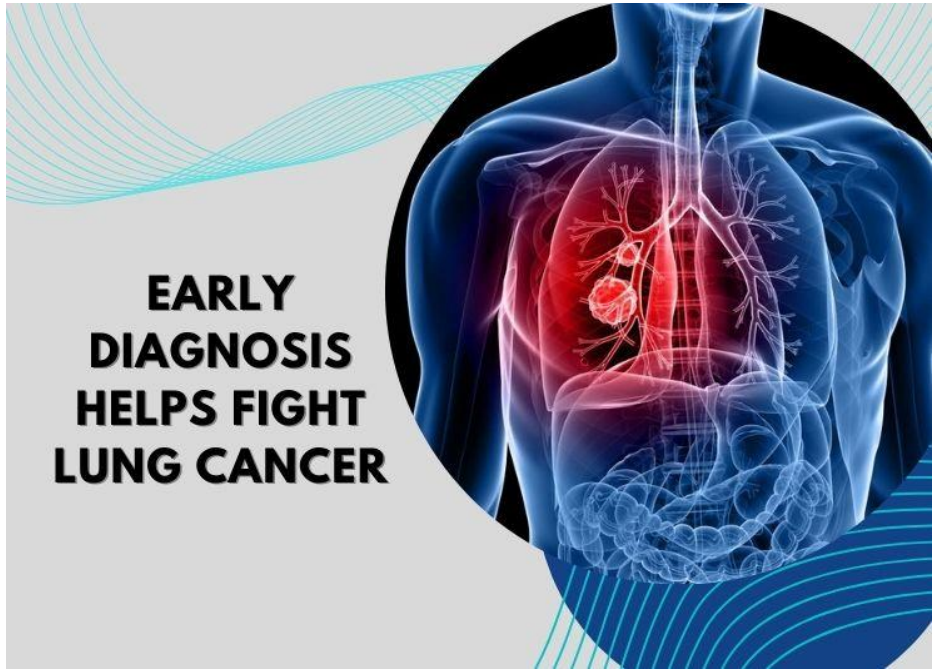
Pranav Nadimpalli

Michael Darnall

Jorge Cajiao

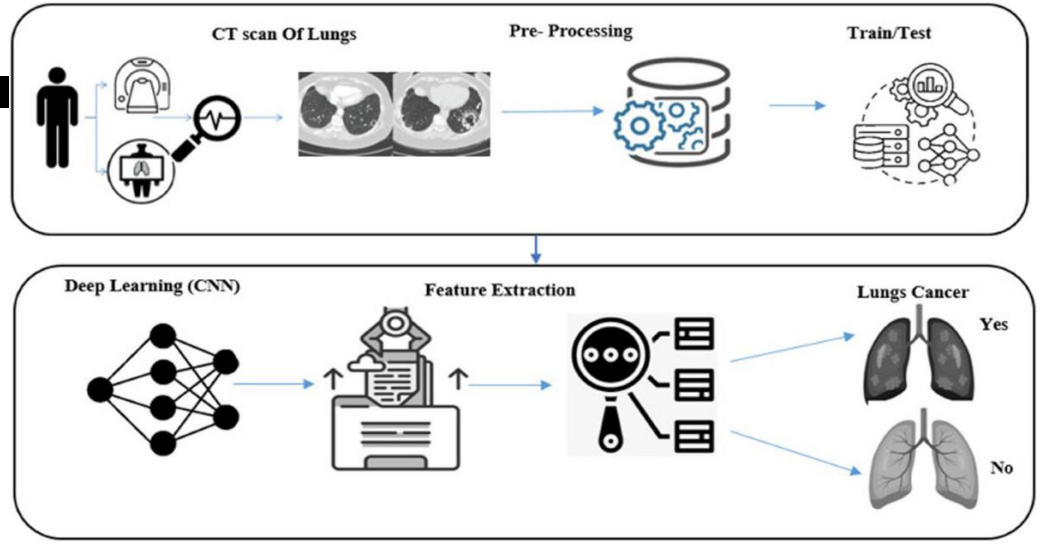
Introduction

- **Thousands** of lives are lost each year due to late detection of cancer
- Early diagnosis leads to the best patient outcomes
  - Early detection: 64%
  - Late-stage detection: 9%
- Up to **30–40%** of signs are missed in radiology screenings
  - Early-stage tumors are small and ambiguous.



Jorge Alejandro Cajiao

Our Solution



Ensemble of 5 pre-trained CNNs

Trained on **~600 chest CT scans** from Kaggle dataset

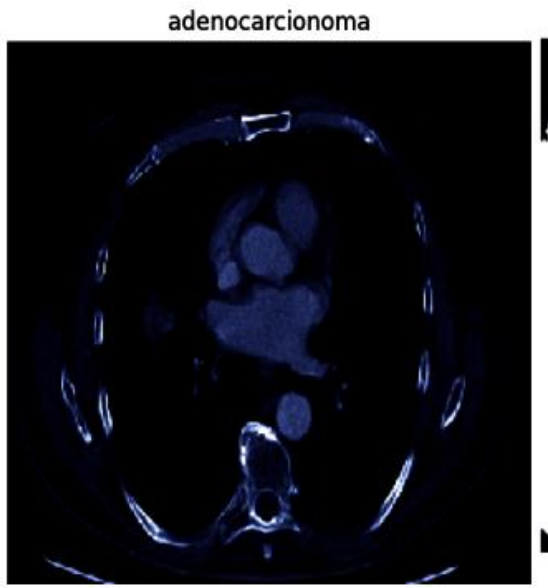
Uses **weighted averaging** to boost prediction accuracy

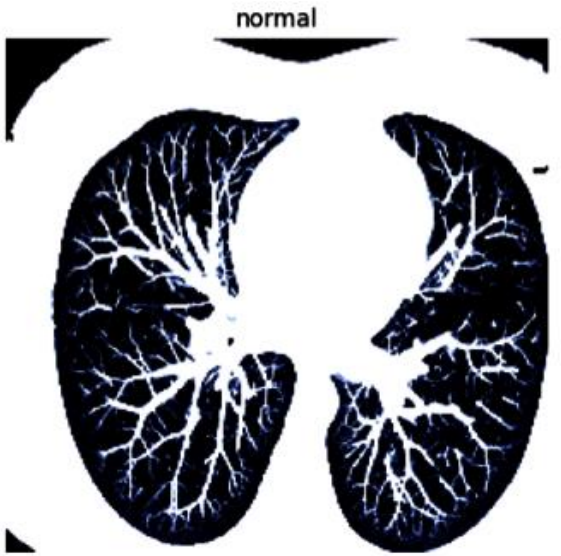
Designed to **support doctors** in identifying cancer from radiology images

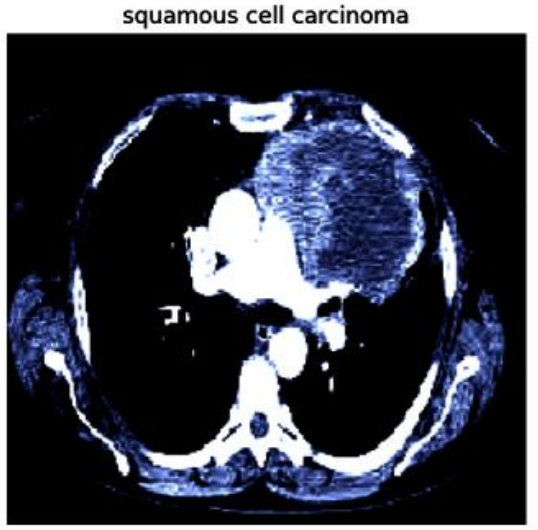
Yogesh Yadav

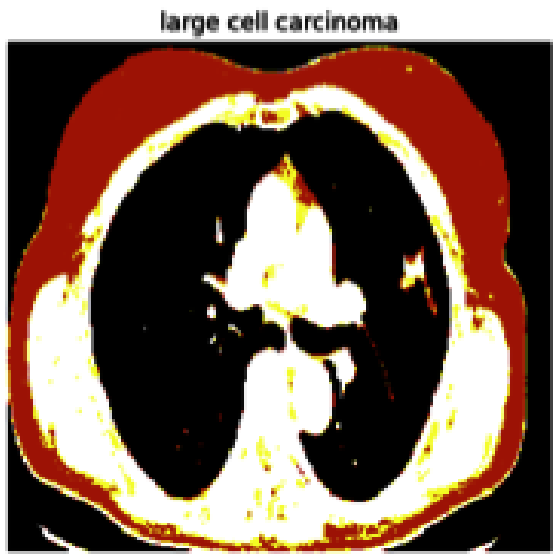
Project Flow

1. Data Preparation	Kaggle CT scans resized (224x224) using OpenCV library Resizing: All images standardized to 224x224 pixels. Normalization: Pixel values scaled to [0, 1] by dividing by 255. Conversion: Images converted to NumPy arrays for training.
2. Model Selection	5 pre-trained CNN models CNNs excel at recognizing patterns in medical images Pre-trained models leverage learned features from large datasets Ensemble learning combines strengths of multiple models for better performance.
3. Ensemble Learning	Better-performing models get higher influence. Formula: Weight (w_i) = (Accuracy of Model i) / (Sum of all accuracies) Example: If Xception has 99.8% accuracy, it gets the highest weight.
4. Results and Evaluation	Classification accuracy, sensitivity, F1 score. Ensemble Model Performance: Accuracy: 99% Sensitivity (Recall): 100% (No False Negatives) False Positives: 1 case (Normal scan misclassified as cancer)



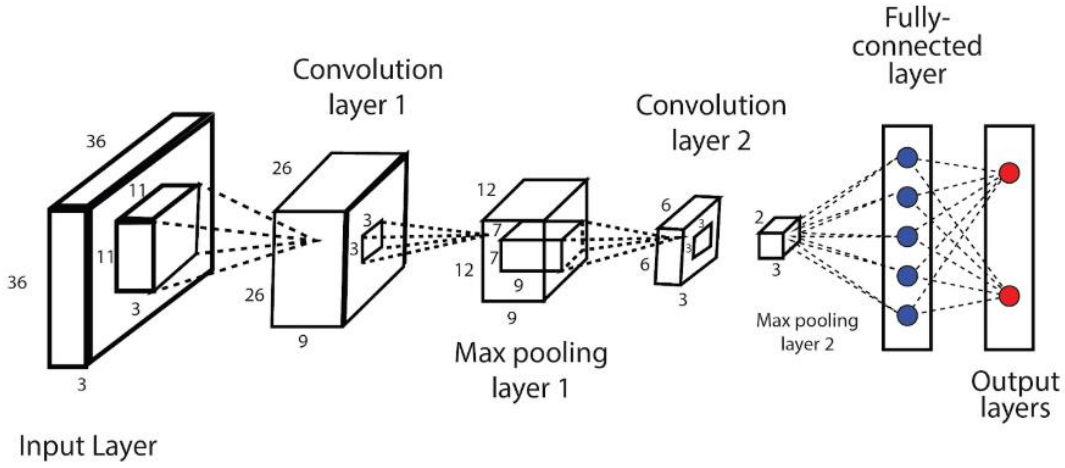






Yogesh Yadav

Theory: What is a CNN? Why Ensemble?



The Convolution Neural Network (CNN) is a deep learning network architecture that learns from data by finding similar patterns in images, which recognizes objects, classes, and categories.

ResNet50_V2

- Deep CNN with skip connections to prevent vanishing gradients

Inception_V3

- Factorized convolutions for efficient feature extraction

Xception_V3

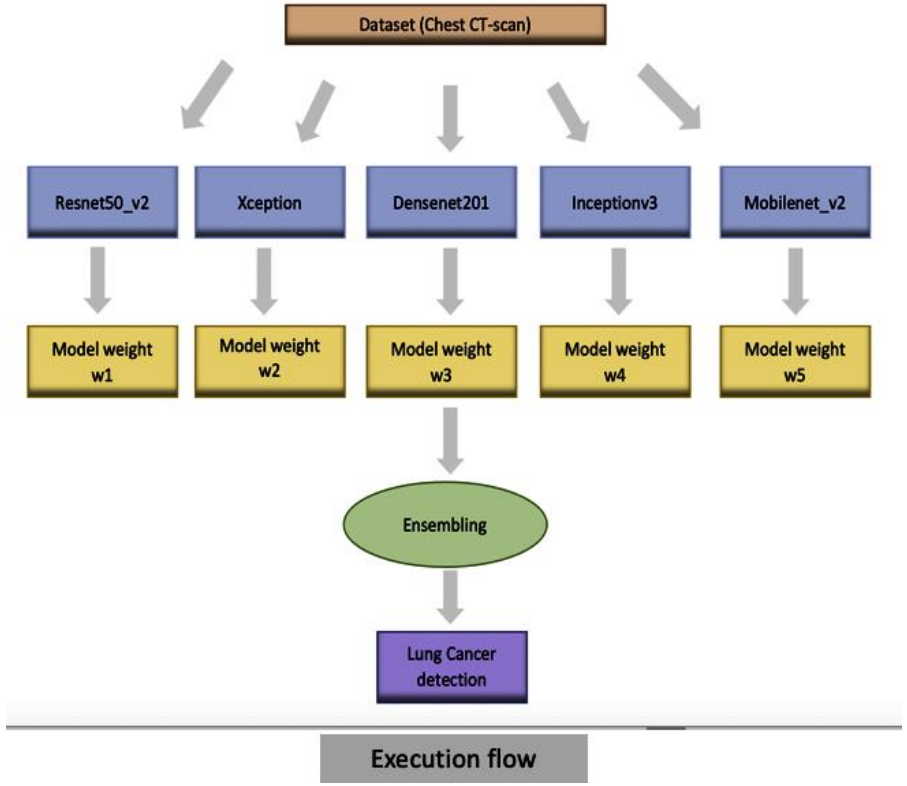
- Depth-wise separable convolutions to improve performance

DenseNet201

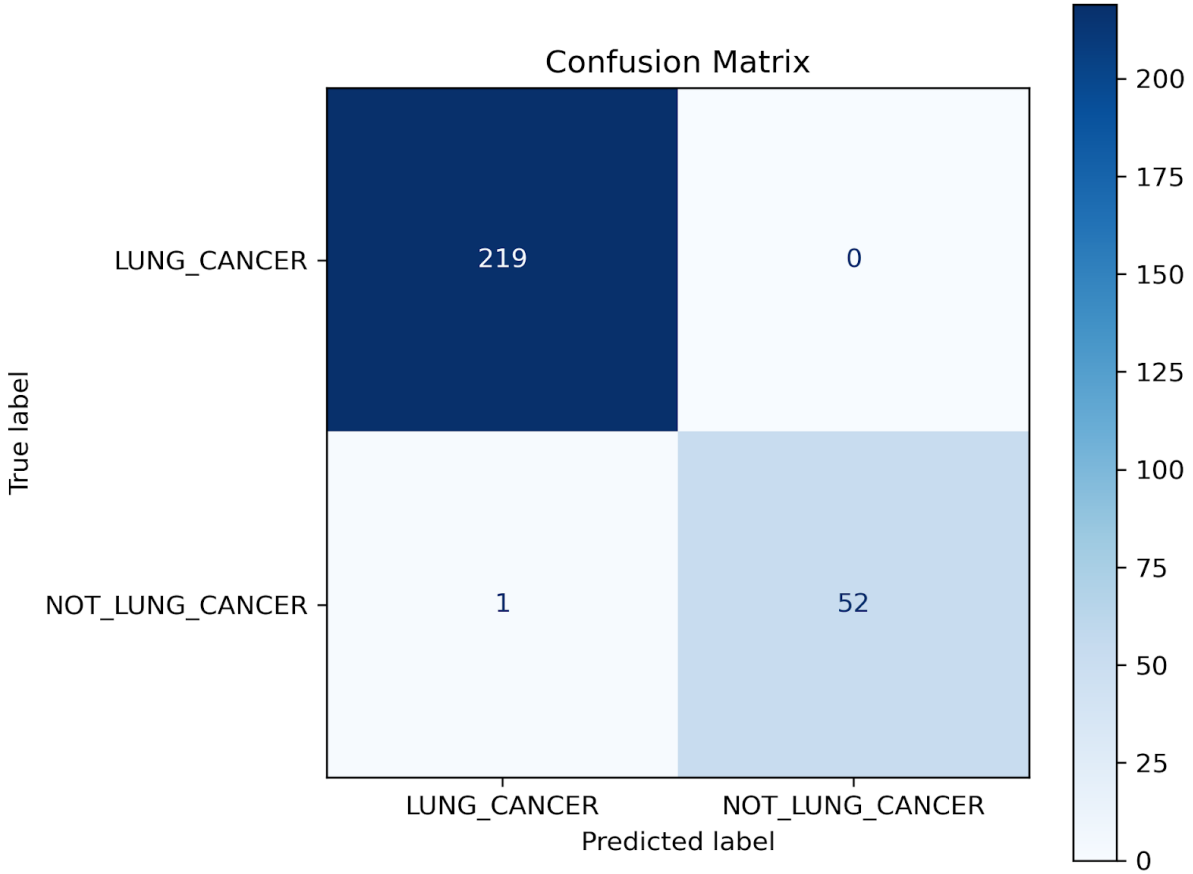
- Densely connected layers for feature reuse and gradient flow for faster training

MobileNet_V2

- Lightweight model with inverted residuals for mobile and edge devices



Confusion Matrix & Classification Report



Classification Report:

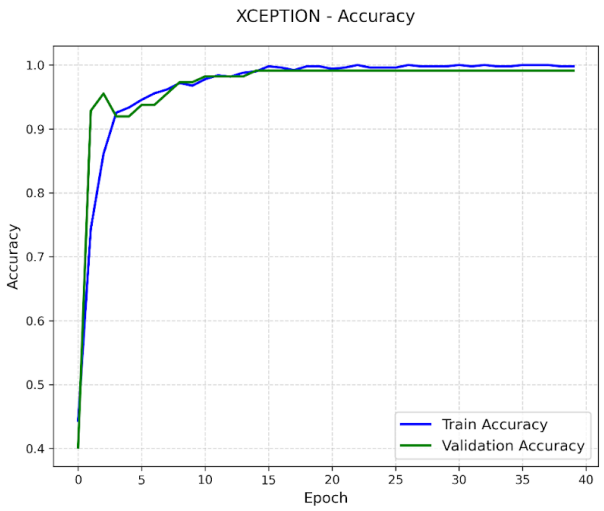
	precision	recall	f1-score	support
LUNG_CANCER	0.9954	1.0000	0.9977	218
NOT_LUNG_CANCER	1.0000	0.9815	0.9907	54
accuracy			0.9963	272
macro avg	0.9977	0.9907	0.9942	272
weighted avg	0.9963	0.9963	0.9963	272

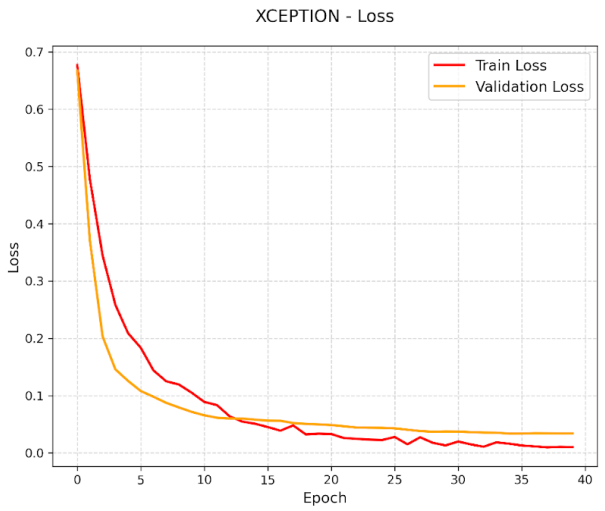
CNN Model Comparison

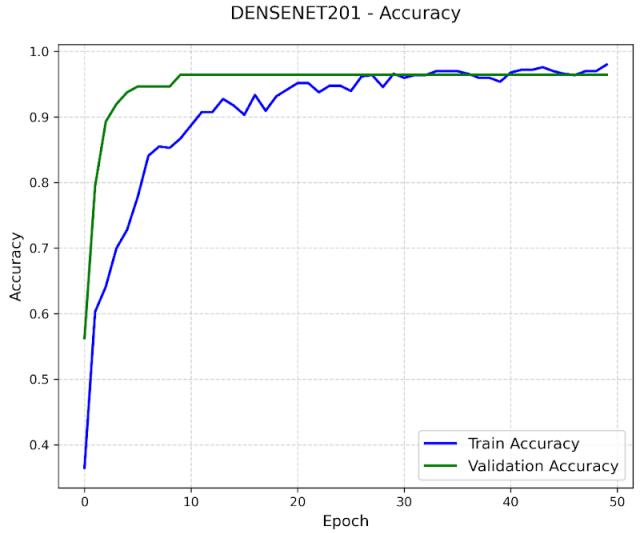
Table 1. Accuracy stats and assigned ensembling weights for each model

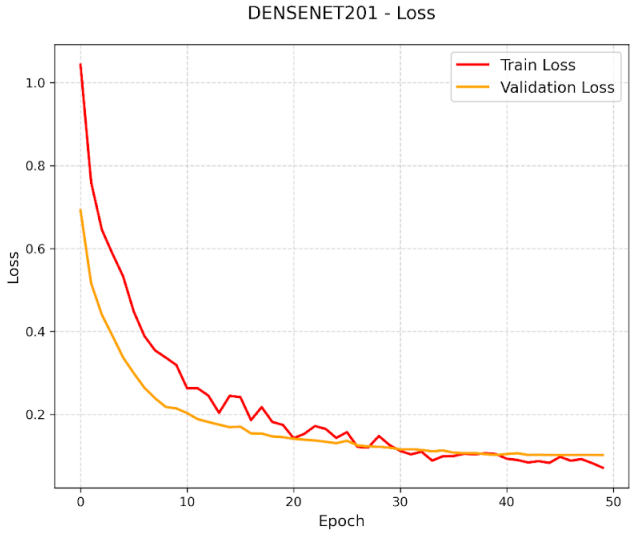
Model	Train Acc	Train Loss	Val Acc	Val Loss	Test Acc	Test Loss
mobilenet_v2	95.16%	0.1260	95.54%	0.1234	99.26%	0.0478
xception	99.80%	0.0101	99.11%	0.0341	99.26%	0.0443
resnet50_v2	97.58%	0.0637	98.21%	0.0349	99.63%	0.0219
densenet201	97.98%	0.0716	96.43%	0.1022	99.26%	0.0637
inception_v3	92.14%	0.2054	96.43%	0.1340	97.79%	0.1204

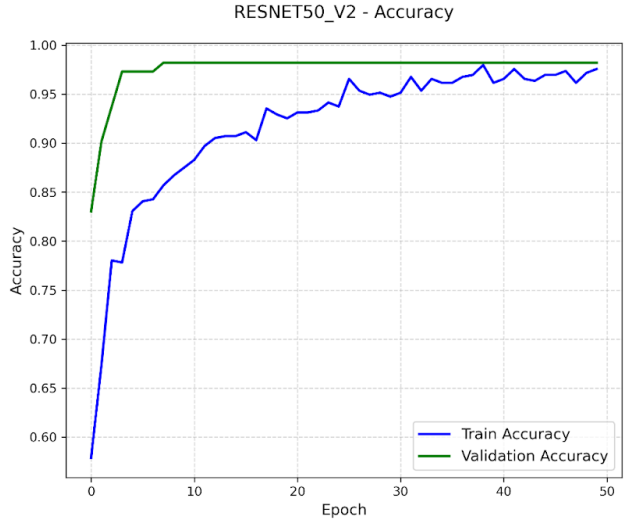
Training and Validation: Accuracy & Loss

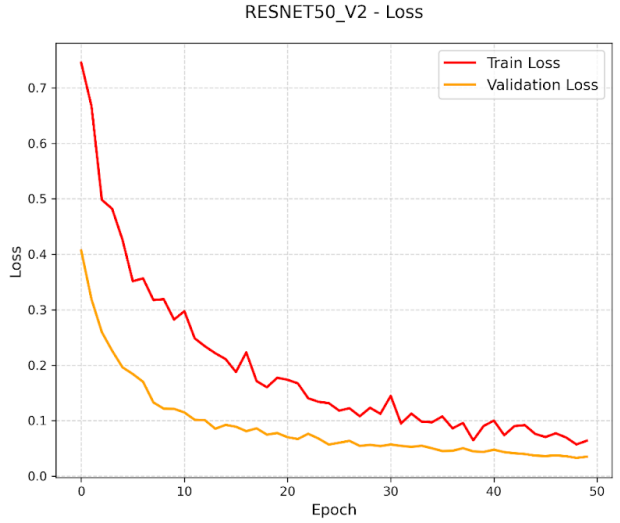




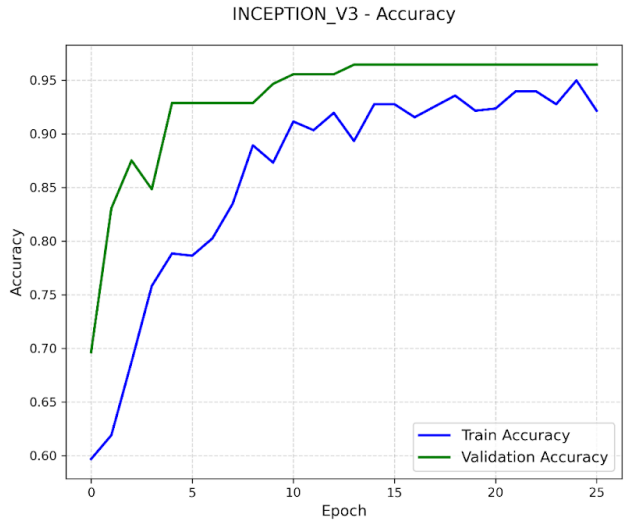


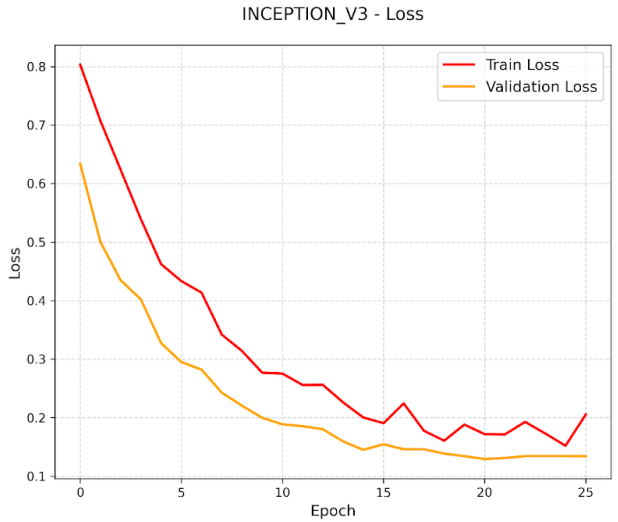


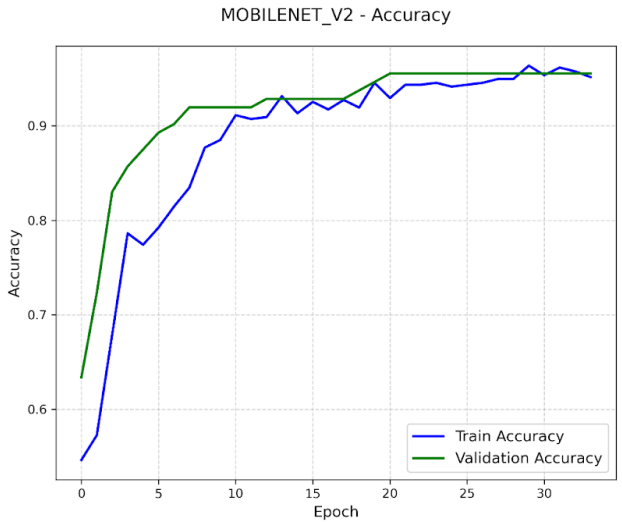


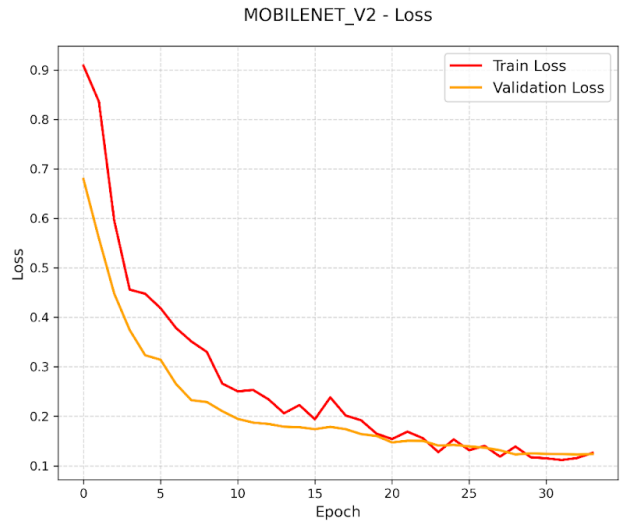


Training and Validation: Accuracy & Loss

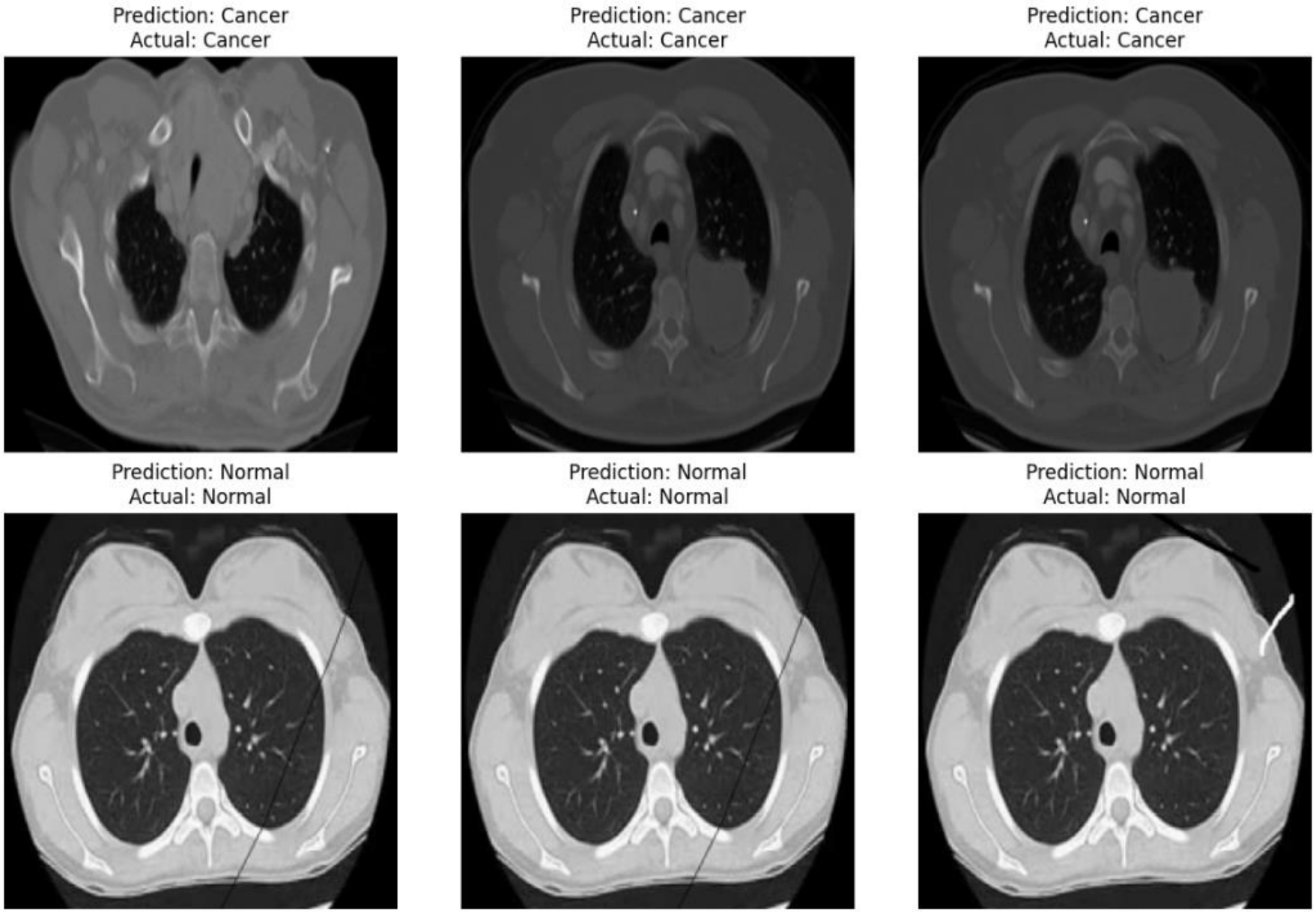








Najia Khan


Prediction: Cancer
Actual: Cancer
Prediction: Cancer
Actual: Cancer
Prediction: Cancer
Actual: Cancer
Prediction: Normal
Actual: Normal
Prediction: Normal
Actual: Normal
Prediction: Normal
Actual: Normal

Misclassification

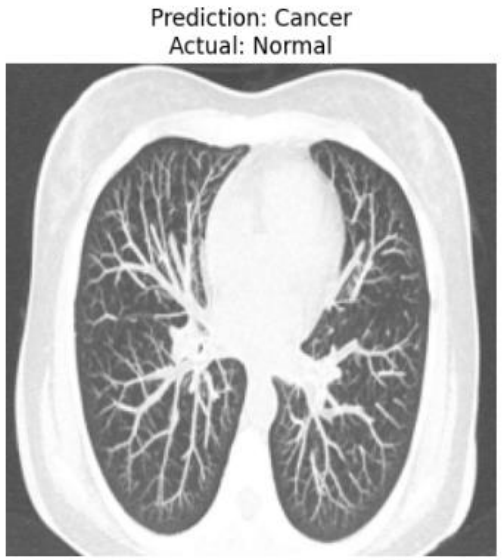
Misclassification may be due to:

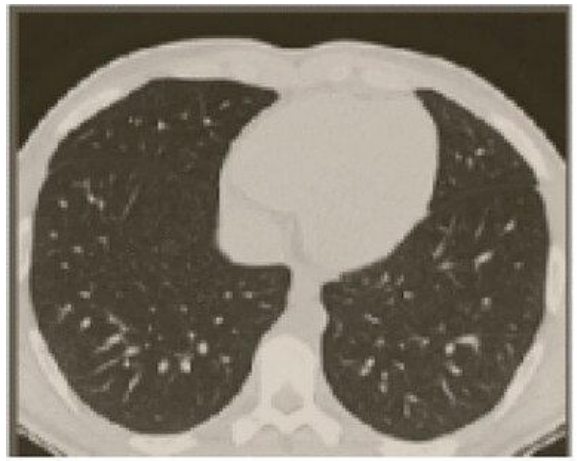
1. Feature Similarity: Brighter regions trigger false positive

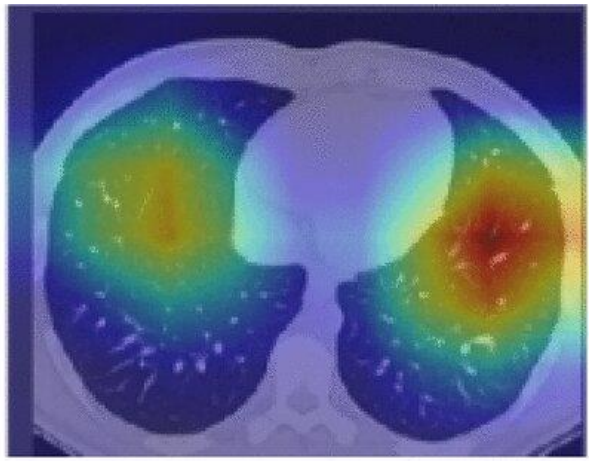
2. Class Imbalance: Training set may favor cancer, skewing decision boundary

Solution:

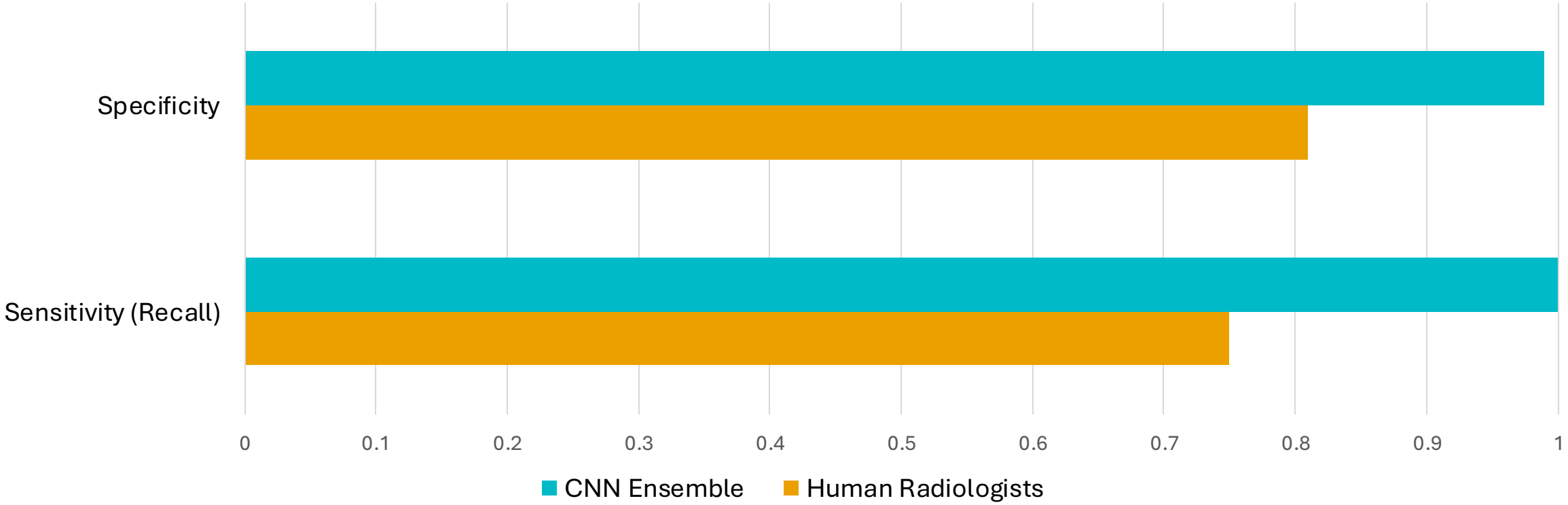
Use Grad-CAM for model interpretability







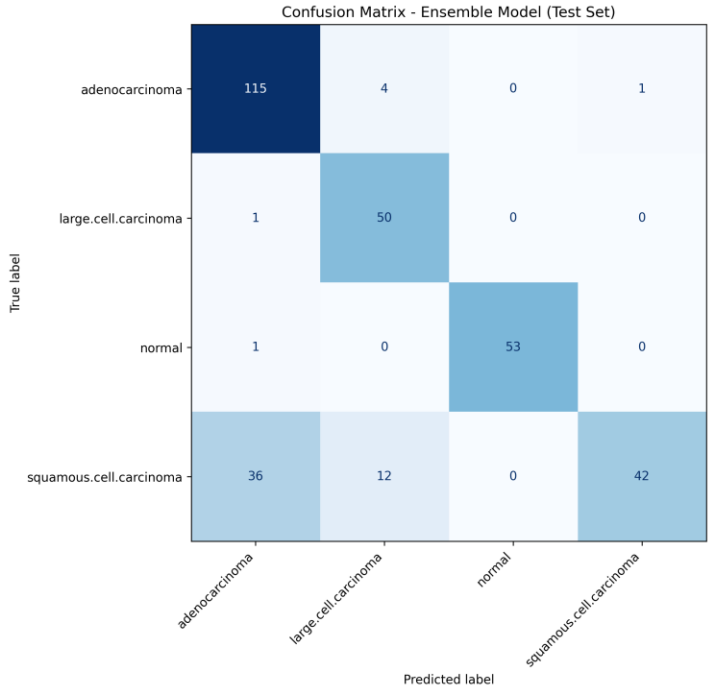
Performance Benchmark
CNN Ensemble vs Radiologists



https://www.sciencedirect.com/science/article/pii/S0009926018305749?via%3Dihub

Michael Darnall

Stretch Goal: Classifying Types of Cancer



Model	Train Accuracy	Valid Accuracy	Test Accuracy
resnet50_v2_best	98.86%	81.94%	71.11%
mobilenet_v2_best	98.86%	90.28%	76.19%
densenet201_best	97.39%	77.78%	69.21%
inception_v3_best	94.94%	75.00%	62.86%
xception_best	98.86%	80.56%	72.70%
Ensemble	99.18%	91.67%	82.54%

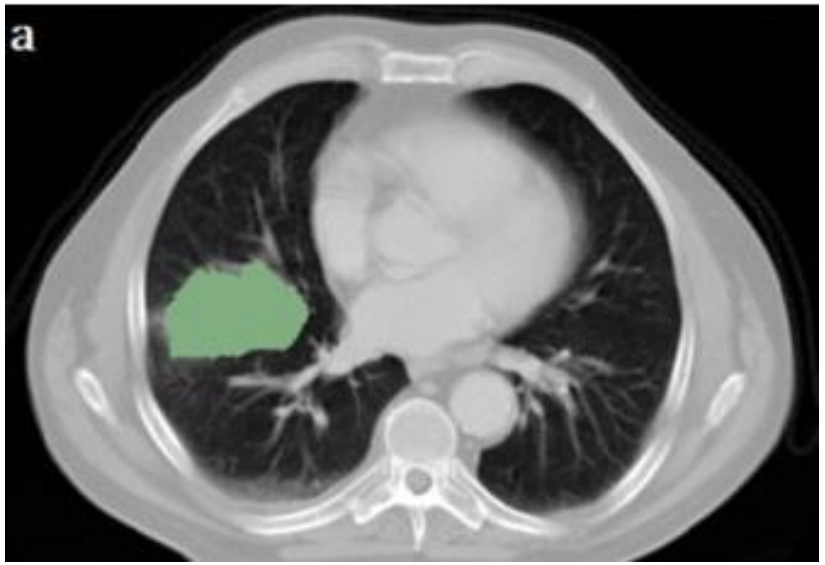
- Modified from classes from **Cancer** and **No Cancer** to four separate classifications
- Classify by not only whether a person has cancer, but what kind of cancer
- Around 82% ensemble test accuracy, with each individual model's test accuracy being 60-80%
- Should continue to refine this model, as it provides more long-term value.

Future Scope

Expand detection to **multiple** diseases

Integrate image **segmentation** techniques

Collaborate with medical professionals for real-time feedback and continuous data collection




Thank you!