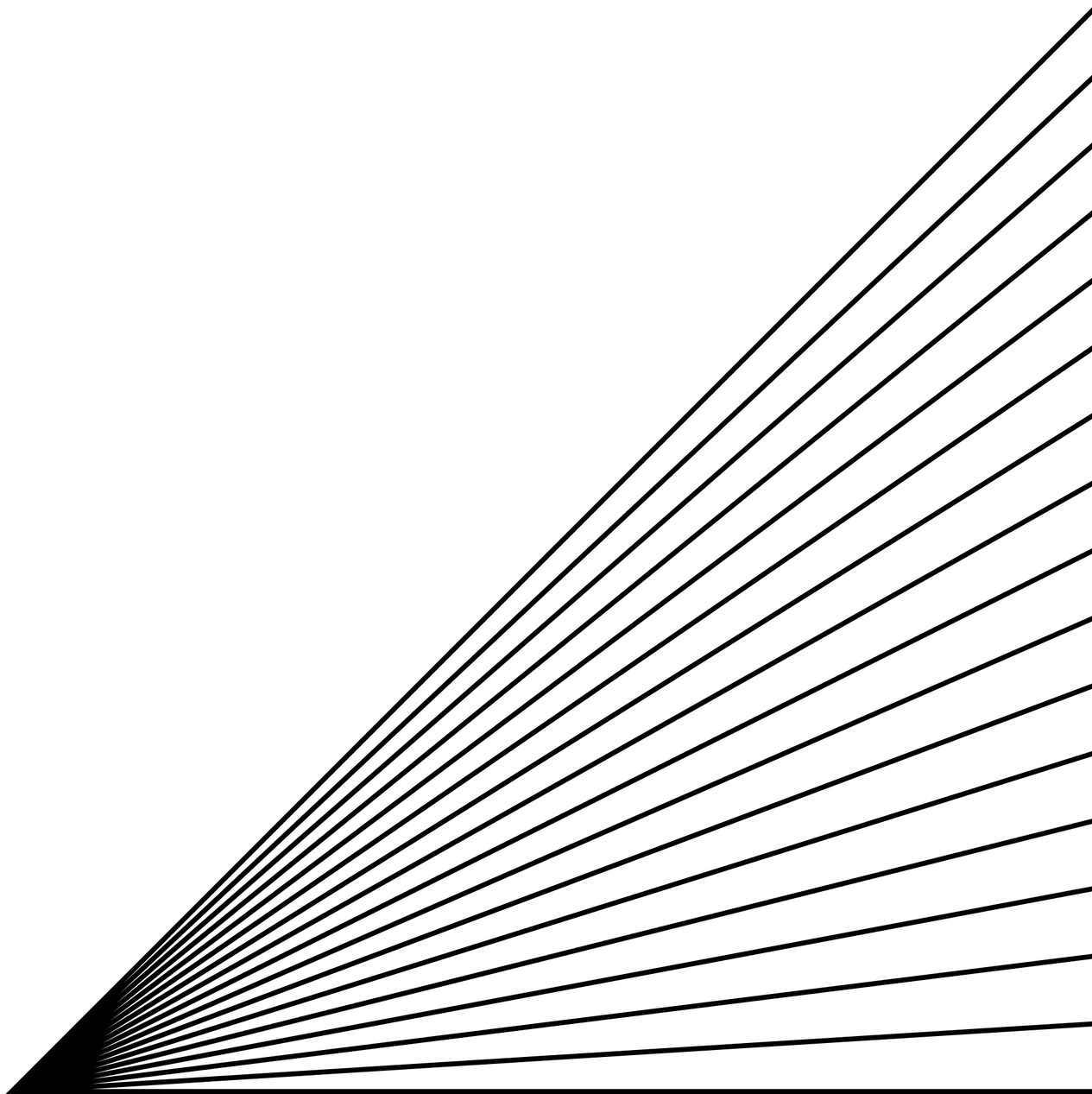
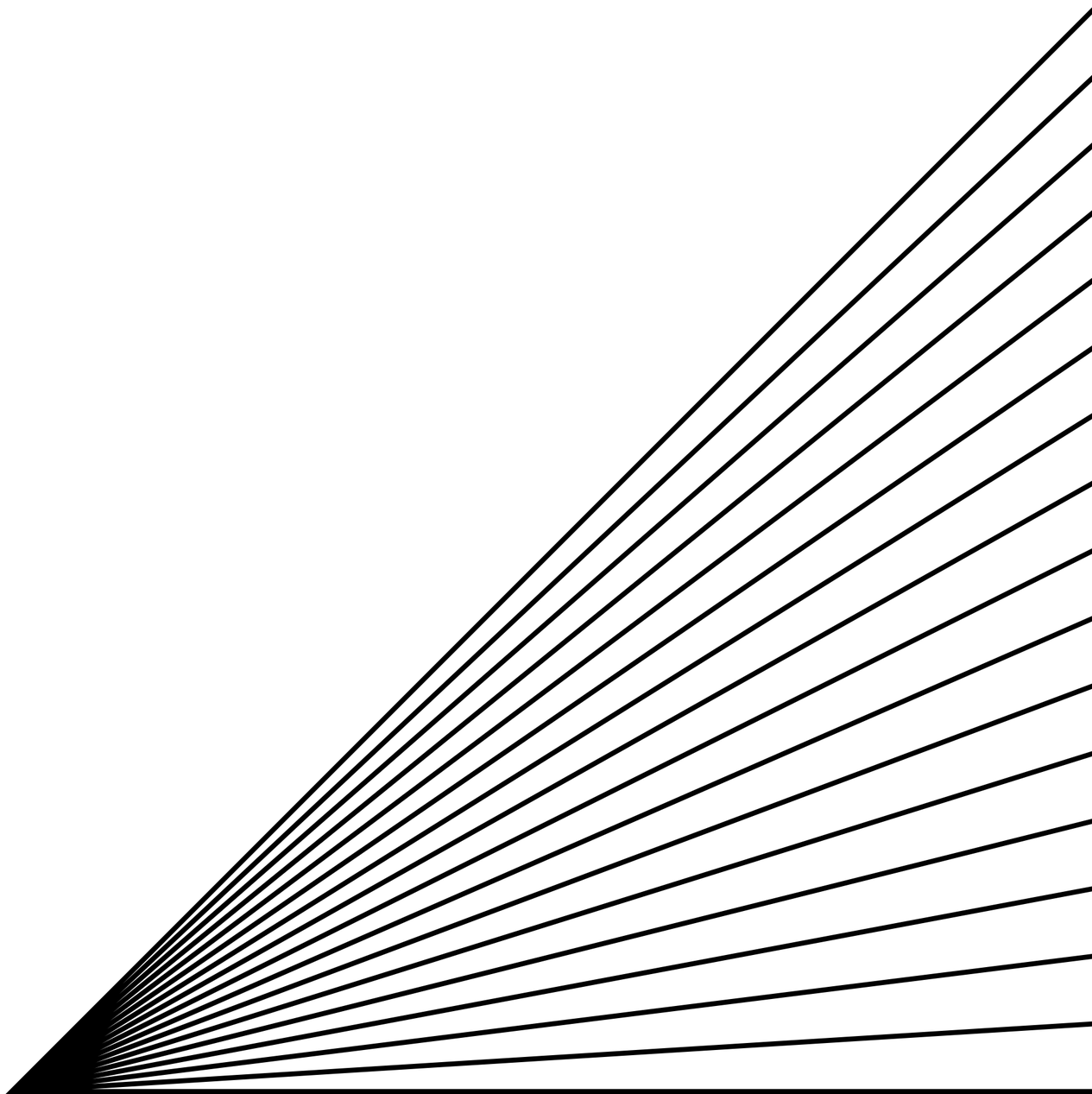
CATARACT EYE DISEASE DETECTION



MEMBER:

F2020376076 (Danish Jameel)



CATARACT:

CATARACT IS A COMMON EYE DISEASE THAT AFFECTS THE CLARITY OF THE LENS IN THE EYE, LEADING TO BLURRED VISION AND OTHER VISUAL IMPAIRMENTS. THE LENS OF THE EYE IS NORMALLY CLEAR AND HELPS TO FOCUS LIGHT ONTO THE RETINA AT THE BACK OF THE EYE, ALLOWING US TO SEE SHARP AND CLEAR IMAGES. HOWEVER, WITH A CATARACT, THE LENS BECOMES CLOUDED OR OPAQUE, OBSTRUCTING THE PASSAGE OF LIGHT AND CAUSING VISION PROBLEMS..

FACTOR BEHIND CATARACT:

CATARACTS CAN DEVELOP DUE TO A VARIETY OF FACTORS.

- AGE
- GENETICS
- TRAUMA
- DIABETES

THE SYMPTOMS OF CATARACTS CAN VARY, BUT COMMON SIGNS INCLUDE:

- **BLURRED OR HAZY VISION**
- **DIFFICULTY SEEING IN DIM OR LOW-LIGHT CONDITIONS**
- **INCREASED SENSITIVITY TO GLARE**
- **REDUCED COLOR PERCEPTION**
- **DOUBLE VISION IN ONE EYE**
- **FREQUENT CHANGES IN EYEGLASS OR CONTACT LENS PRESCRIPTION**

About Datasets.

Ocular Disease Intelligent Recognition (ODIR) is a structured ophthalmic database of 5,000 patients with age, color fundus photographs from left and right eyes and doctors' diagnostic keywords from doctors.

This dataset is meant to represent "real-life" set of patient information collected by Shanggong Medical Technology Co., Ltd. from different hospitals/medical centers in China. In these institutions, fundus images are captured by various cameras in the market, such as Canon, Zeiss and Kowa, resulting into varied image resolutions.

Annotations were labeled by trained human readers with quality control management. They classify patient into eight labels including:

- Normal (N),
- Diabetes (D),
- Glaucoma (G),
- Cataract (C),
- Age related Macular Degeneration (A),
- Hypertension (H),
- Pathological Myopia (M),
- Other diseases/abnormalities (O)

DATA PREPROCESSING:

- MOUNT GOOGLE DRIVE
- READ A CSV
- DEFINE A FUNCTION CALLED "HAS_CATARACT"
- OBTAIN A SAMPLE OF NORMAL FUNDUS IMAGES FOR BOTH EYES TO BALANCE THE DATASET.
- DEFINE THE DATASET DIRECTORY AND IMAGE SIZE (224)
- SPLIT THE DATASET INTO FEATURES (X) AND LABELS (Y)

MODEL EXPLANATION:

1: RESNET-50:

- RESNET-50: RESNET-50 IS A DEEP CONVOLUTIONAL NEURAL NETWORK (CNN) ARCHITECTURE THAT CONSISTS OF 50 LAYERS.
- THIS ALLOWS FOR EASIER TRAINING OF VERY DEEP NETWORKS AND HELPS TO ALLEVIATE THE DEGRADATION PROBLEM.

MODEL EXPLANATION:

1: RESNET 101 -152:

- RESNET101 AND RESNET152: RESNET101 AND RESNET152 ARE VARIANTS OF THE RESNET ARCHITECTURE WITH 101 AND 152 LAYERS, RESPECTIVELY. THEY FOLLOW THE SAME RESIDUAL CONNECTION APPROACH AS RESNET-50 BUT HAVE A DEEPER ARCHITECTURE.
- THESE MODELS ARE EVEN MORE POWERFUL IN CAPTURING COMPLEX FEATURES

MODEL EXPLANATION:

3: VGG16 AND VGG19:

VGG16 AND VGG19 ARE CNN ARCHITECTURES DEVELOPED BY THE VISUAL GEOMETRY GROUP (VGG) AT THE UNIVERSITY OF OXFORD. THESE MODELS ARE CHARACTERIZED BY THEIR SIMPLICITY AND UNIFORMITY IN ARCHITECTURE. BOTH VGG16 AND VGG19 CONSIST OF MULTIPLE CONVOLUTIONAL LAYERS WITH SMALL 3X3 FILTERS FOLLOWED BY MAX POOLING LAYERS. THE MAIN DIFFERENCE BETWEEN VGG16 AND VGG19 IS THE NUMBER OF LAYERS, WITH VGG16 HAVING 16 LAYERS AND VGG19 HAVING 19 LAYERS.

MODEL EXPLANATION:

4: DENSENET 169:

DENSENET-169 IS A CONVOLUTIONAL NEURAL NETWORK (CNN) ARCHITECTURE THAT BELONGS TO THE FAMILY OF DENSENET MODELS. IT WAS INTRODUCED BY HUANG ET AL. IN 2017 AS AN EXTENSION TO THE ORIGINAL DENSENET ARCHITECTURE.

THE MAIN BUILDING BLOCK OF DENSENET-169 IS THE "DENSE BLOCK," WHERE MULTIPLE CONVOLUTIONAL LAYERS ARE DENSELY CONNECTED TO FORM A BLOCK. WITHIN EACH DENSE BLOCK, THE OUTPUT FEATURE MAPS OF EACH LAYER ARE CONCATENATED TOGETHER AND SERVE AS INPUT TO SUBSEQUENT LAYERS WITHIN THE SAME BLOCK.

MODEL EXPLANATION:

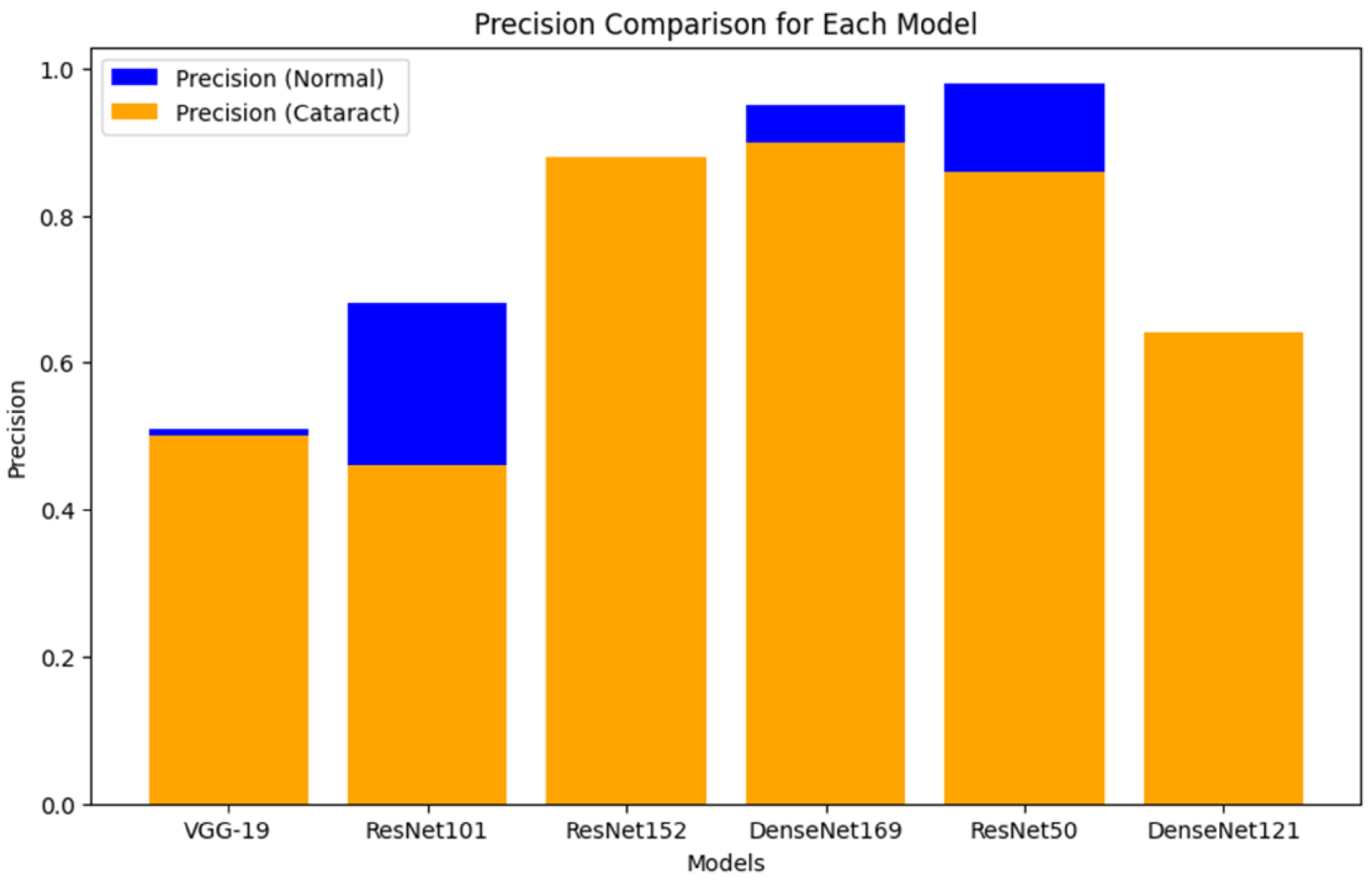
5: DENSENET 121:

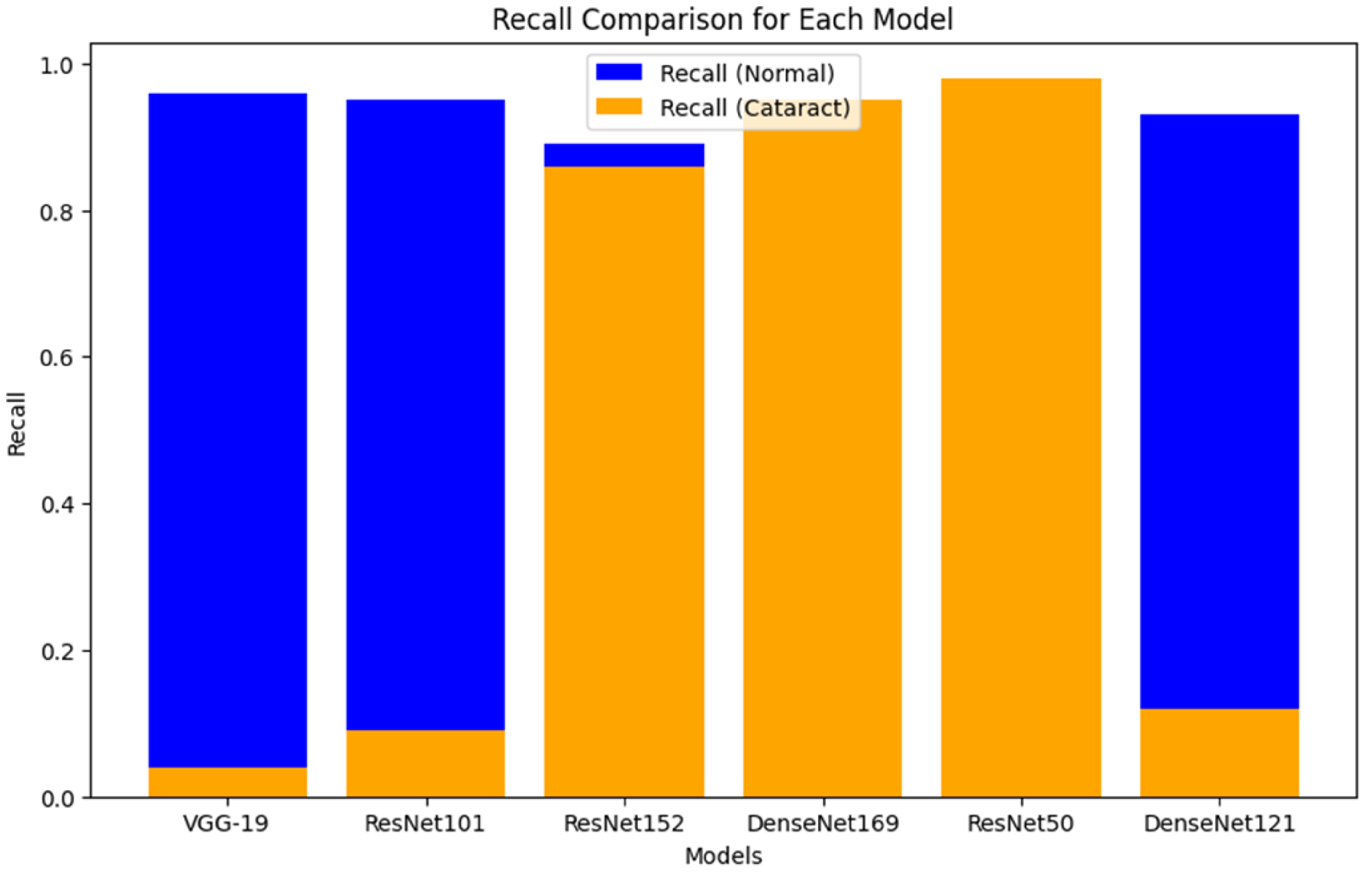
DENSENET-121 IS ANOTHER CNN ARCHITECTURE THAT IS KNOWN FOR ITS DENSE CONNECTIVITY PATTERN. IN DENSENET, EACH LAYER IS DIRECTLY CONNECTED TO EVERY OTHER LAYER IN A FEED-FORWARD FASHION. THIS DENSE CONNECTIVITY HELPS IN IMPROVING FEATURE REUSE, REDUCING THE NUMBER OF PARAMETERS, AND ENHANCING GRADIENT FLOW. DENSENET-121 HAS 121 LAYERS AND HAS BEEN SHOWN TO ACHIEVE HIGH ACCURACY ON IMAGE CLASSIFICATION TASKS WHILE REQUIRING FEWER PARAMETERS COMPARED TO OTHER MODELS.

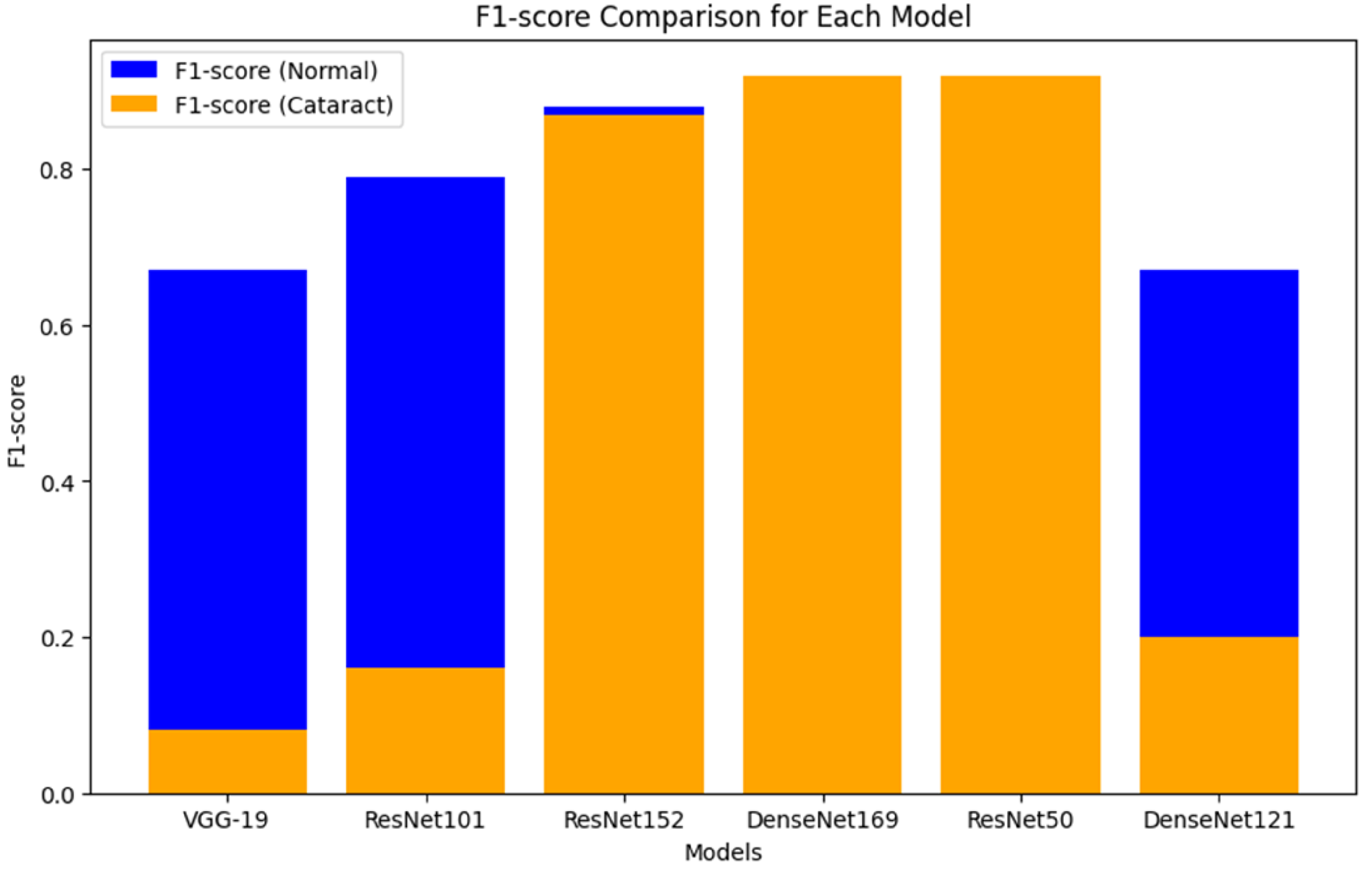
TECHNIQUES USED:

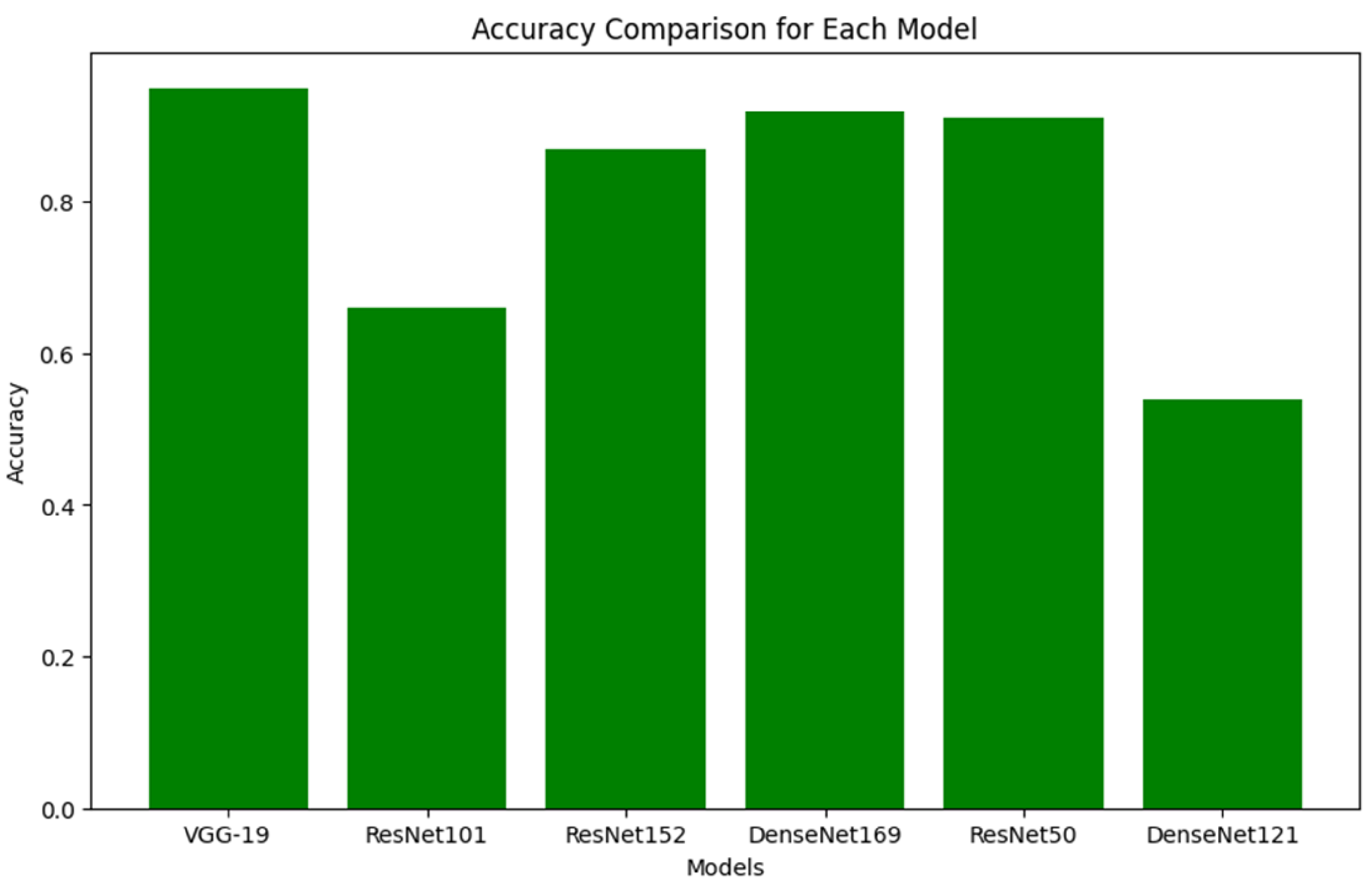
- EARLY STOPPING CALLBACK FUNCTION
- SIGMOID FUNCTION
- MODEL.COMPILE(OPTIMIZER="ADAM",LOSS="BINARY_CROSS ENTROPY",METRICS=["ACCURACY"])
- FLATTEN IMAGE
- DENSE LAYER
- CROSS VALIDATION TECHNIQUE

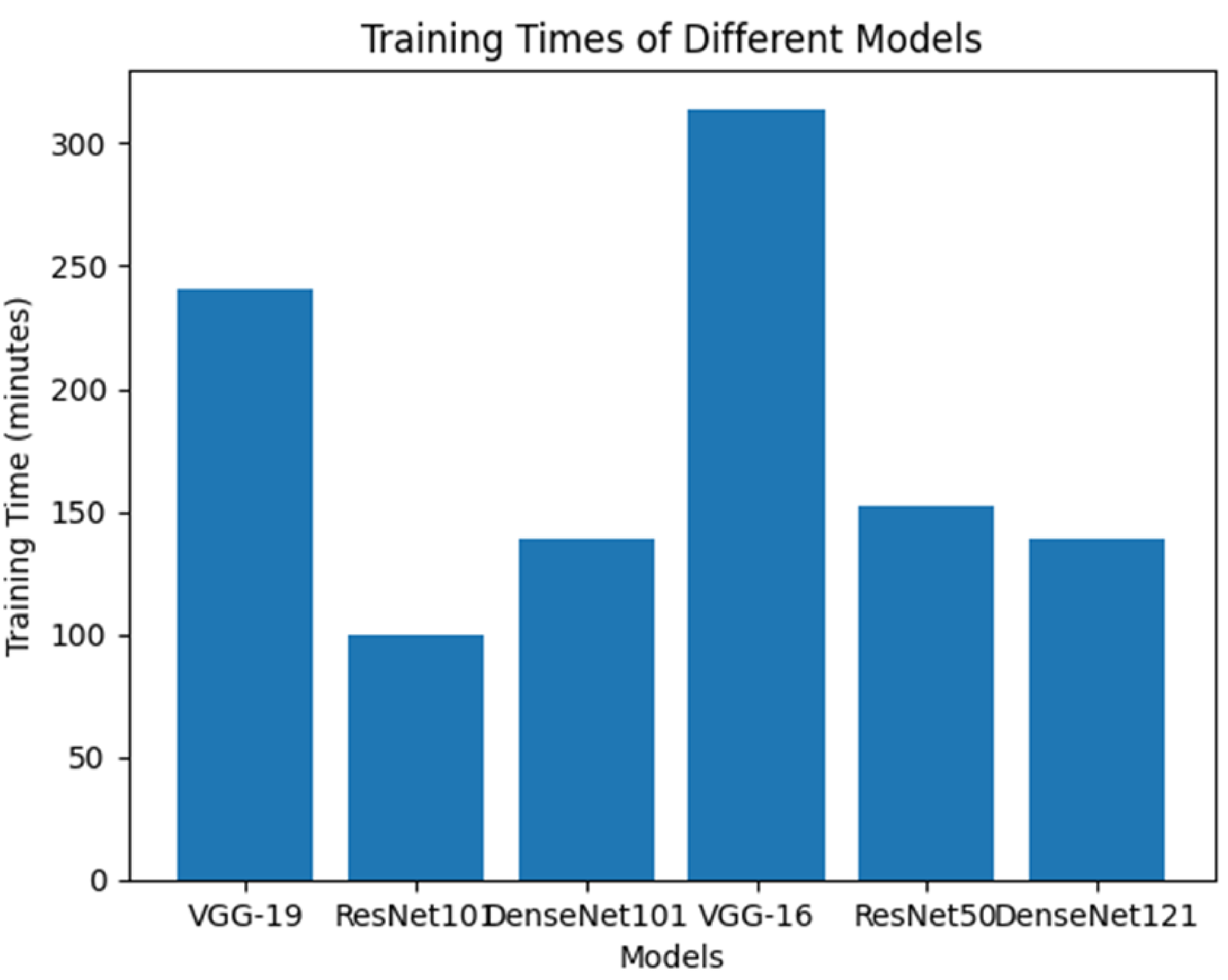
RESULTS IN VISUALIZATIONS:

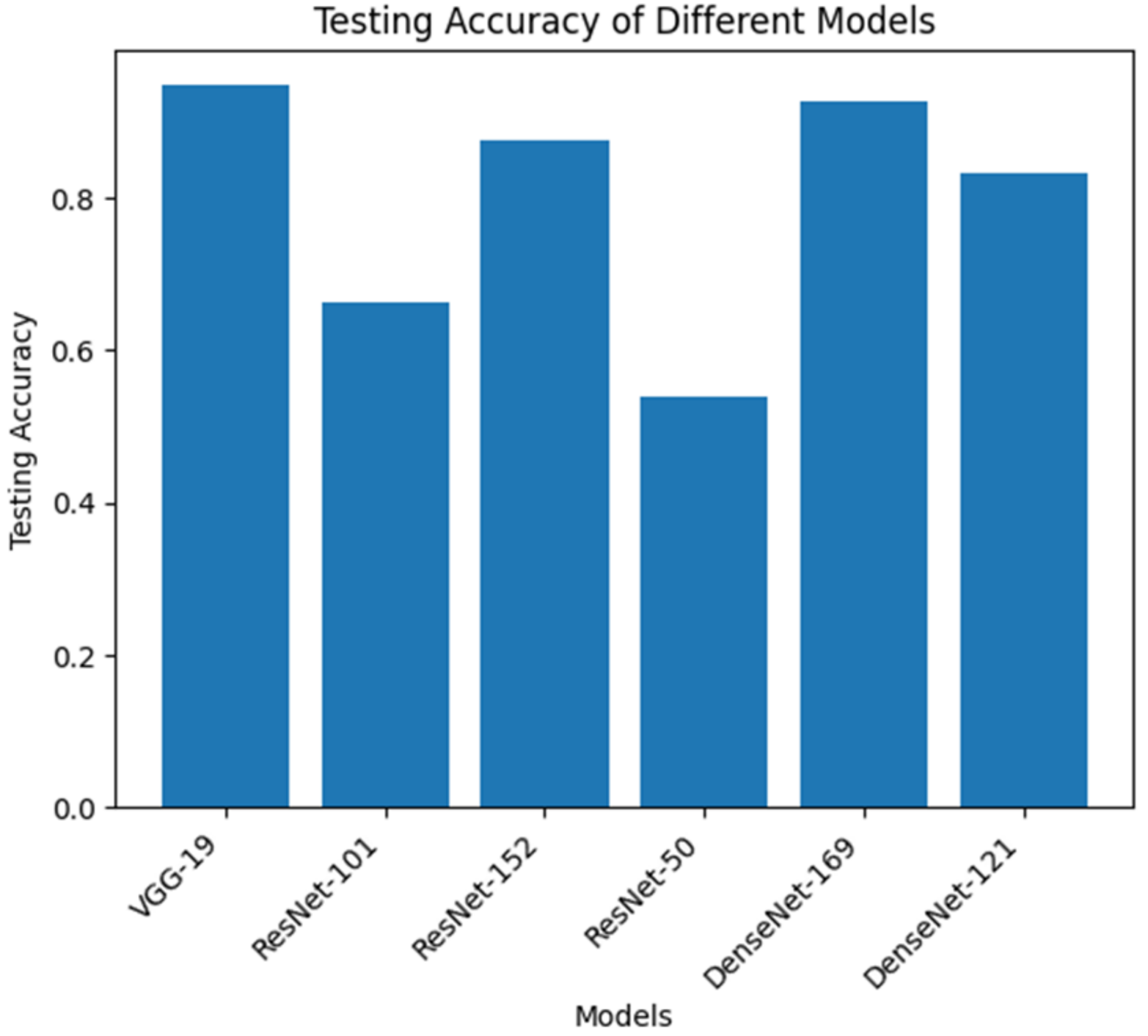

Precision Comparison for Each Model
Precision (Normal)
Precision (Cataract)
1.0
0.8
0.6
0.4
0.2
0.0
Precision
VGG-19
ResNet101
ResNet152
DenseNet169
ResNet50
DenseNet121
Models

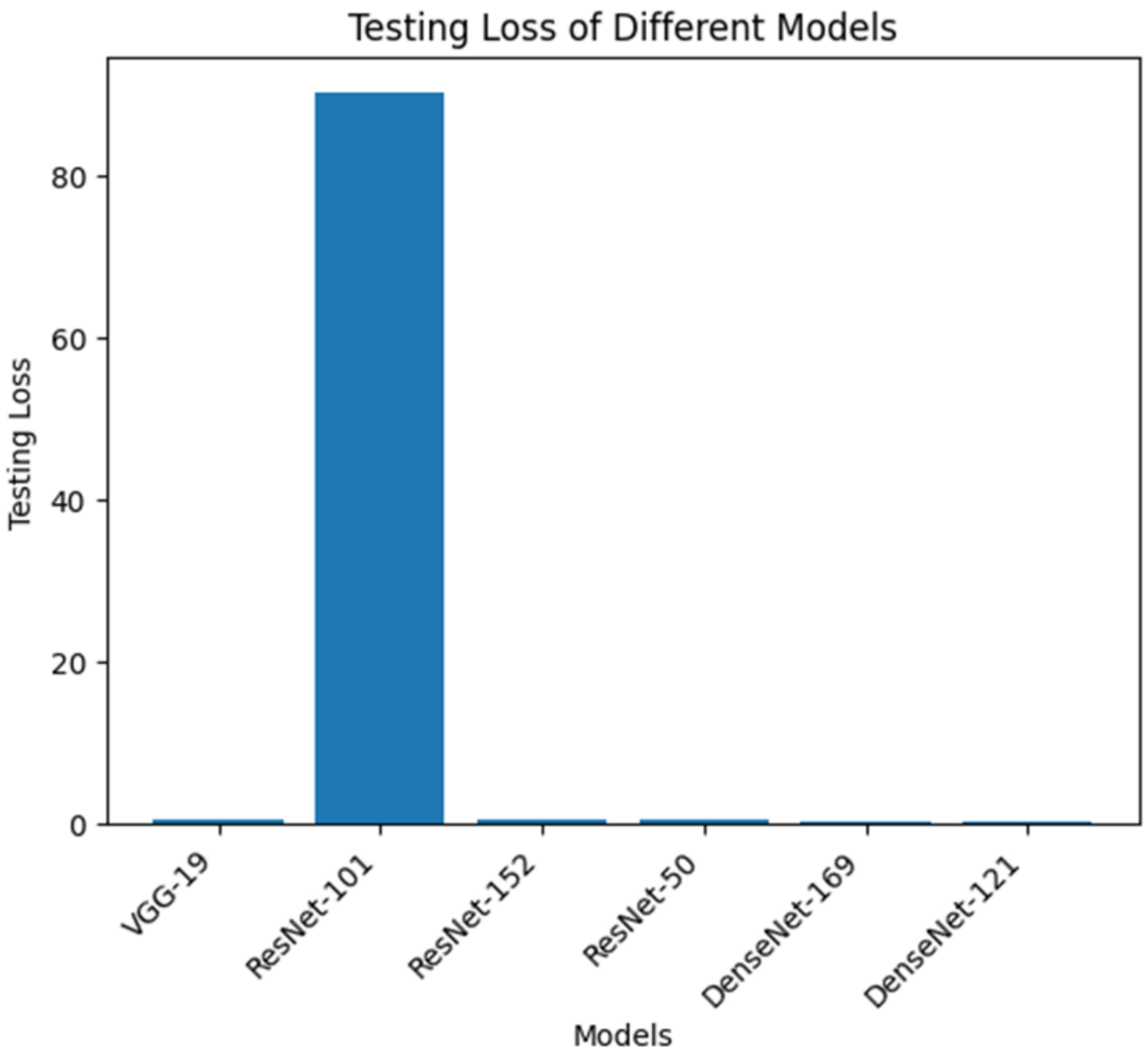

Recall Comparison for Each Model
Recall (Normal)
Recall (Cataract)
1.0
0.8
0.6
0.4
0.2
0.0
Recall
VGG-19
ResNet101
ResNet152
DenseNet169
ResNet50
DenseNet121
Models


F1-score Comparison for Each Model
F1-score (Normal)
F1-score (Cataract)
F1-score
0.0
0.2
0.4
0.6
0.8
VGG-19
ResNet101
ResNet152
DenseNet169
ResNet50
DenseNet121
Models


Accuracy Comparison for Each Model
Accuracy
0.0
0.2
0.4
0.6
0.8
VGG-19
ResNet101
ResNet152
DenseNet169
ResNet50
DenseNet121
Models


Training Times of Different Models
Training Time (minutes)
0
50
100
150
200
250
300
VGG-19
ResNet101
DenseNet101
VGG-16
ResNet50
DenseNet121
Models


Testing Accuracy of Different Models
Testing Accuracy
0.0
0.2
0.4
0.6
0.8
VGG-19
ResNet-101
ResNet-152
ResNet-50
DenseNet-169
DenseNet-121
Models


Testing Loss of Different Models
Testing Loss
0
20
40
60
80
VGG-19
ResNet-101
ResNet-152
ResNet-50
DenseNet-169
DenseNet-121
Models

CONCLUSION:

- The results provided include precision, recall, and F1-score values for the "Normal" and "Cataract" classes, as well as overall accuracy and additional metrics for the evaluation. The final conclusion can be summarized as follows:
- The model achieved an accuracy of 94.96% on the test dataset, indicating that it was able to correctly classify the majority of the images. The test loss, a measure of how well the model performed on the test set, was 1.4225.
- Considering the precision, recall, and F1-score for both the "Normal" and "Cataract" classes, the model achieved high scores for both classes, with values ranging from 0.92 to 0.98. This suggests that the model performed well in correctly identifying both normal and cataract cases.
- In conclusion, based on the provided results, the model appears to be effective in classifying normal and cataract cases with a high degree of accuracy.