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COMPARATIVE ANALYSIS OF KERAS CNN MODELS FOR IMAGE CLASSIFICATION WITH TRANSFER LEARNING

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ABSTRACT

Over the past few years, Artificial Intelligence and Machine learning have been in the limelight and made great progress. Considering convolution neural networks as an example which showed excellent results in various fields like image recognition, pattern recognition, speech recognition etc. In recent years so many CNN architectures came into picture to improve the respective system performance. Some of the well-known CNN architectures are VGG16, ResNet50, VGG19, and MobileNetV2. So, in this paper, we want to do a comparative analysis between these pre-trained models in terms of their efficiency and accuracy when used for image classification.

Keywords: Transfer Learning, Convolution neural network, VGG16, VGG19, ResNet50, MobileNetV2.

INTRODUCTION

Nowadays, due to tremendous growth in computer technology and big data, CNN has shown substantial breakthroughs in various fields such as Image classification, Image recognition etc. Image classification using CNN is being used for various purposes and in various fields such as, Agriculture to find the disease of a plant, hospitals to identify the cancer cells etc. But the only problem is that training a model from scratch with a large dataset takes a lot of time and computation power. So, to avoid this we use a finely tuned pre-trained model which is a saved network that was trained on a large dataset of various categories. This is called Transfer Learning. By using Transfer Learning technique lot of computation power and time can be saved.

METHODOLOGY

Transfer Learning

Transferring the knowledge that was gained by solving a particular problem and using that knowledge to solve another related problem is called as Transfer Learning. For example, if we have trained a model to identify Cars, then by doing some finetuning to that model we can use it to identify Trucks and Buses as well, since the main features of Car like Doors, Wheels, Windshield, Headlights, Steering and Seats will also be there in Trucks and Buses. So, the feature weights of the Car will be used to identify Trucks and Buses. By doing this we can save lot of computation power and time too

Dataset

We have used flowers dataset from TensorFlow. The dataset contains 3670 flowers pictures belonging to five different classes (i.e., daisy, dandelion, roses, sunflowers, tulips). We have split entire dataset into two parts of 8:2 ratio. We have used 80% (i.e., 2936 flower pictures) for training and remaining 20% (i.e., 734 flower pictures) for validation purpose.

Model Architecture and Training

Except the last layer of the pre-trained model, we have kept all the remaining layers as it is with the same weights and then we have added a flatten layer followed by a dense layer which has 512 neurons with ReLU activation function and at last a dense layer with 5 neurons with SoftMax activation function. For every model we did 10 epochs and observed the results. We have done all the model training in a system with 8GB RAM with AMD Ryzen 5 3500U Processor with Radeon Vega Mobile Gfx (2.10 GHz)

MODELING AND ANALYSIS

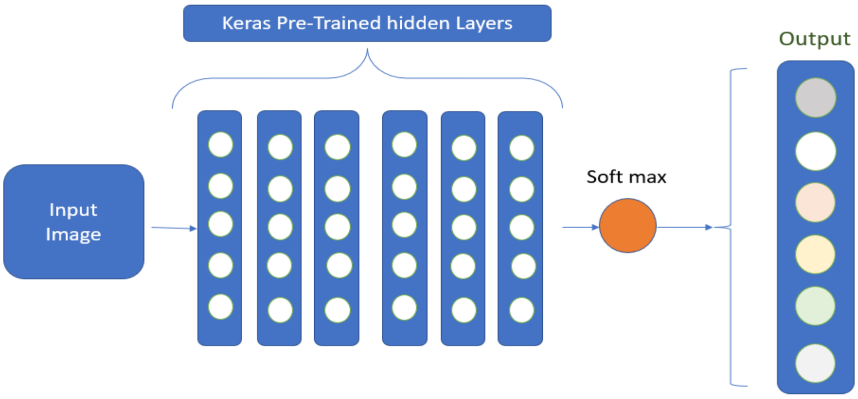

Fig – 1 Model Training Architecture

Model	Avg Time (Sec)	Avg Accuracy	Max Accuracy	Avg Validation Accuracy	Max Validation Accuracy
VGG16	852	0.977	1	0.841	0.852
VGG19	932	0.948	1	0.823	0.842
ResNet50	371	0.954	1	0.873	0.892
MobileNetV2	111	0.724	0.847	0.602	0.634

Table – 1 Observed result after model training

RESULTS AND DISCUSSION

For comparing model performance, the parameters which we considered are, time taken to train the model, model accuracy, model loss. Since we have trained all the models in the same system, so we are not considering any beta factor to normalize the values.

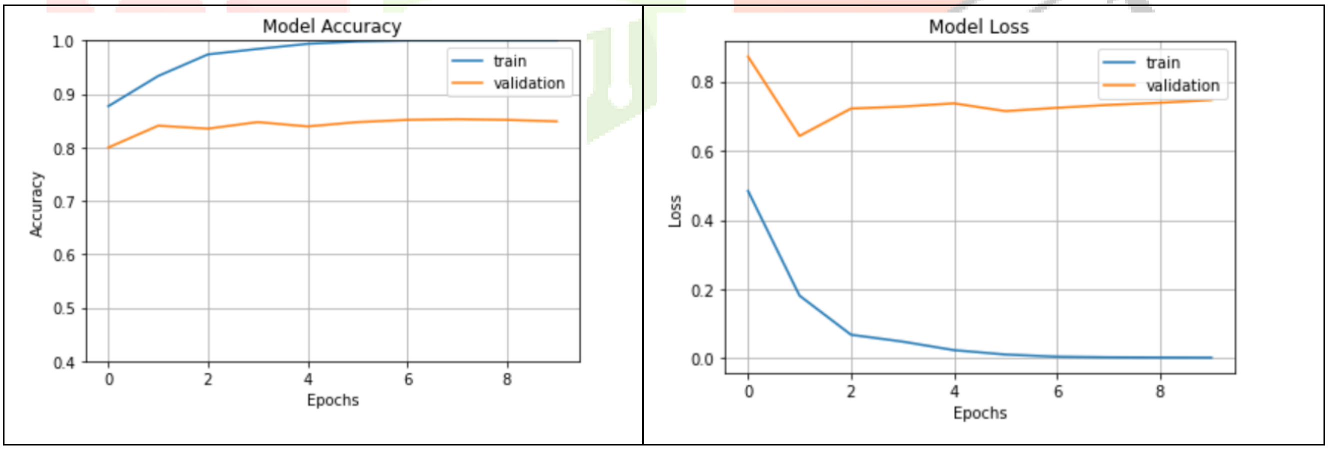

Fig – 2 Model Accuracy & Loss for VGG16

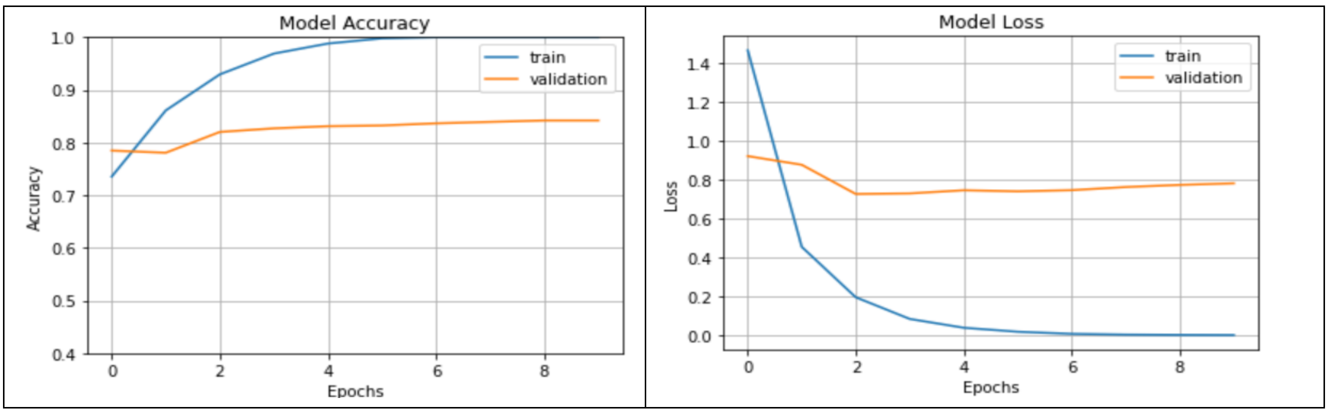

Fig – 3 Model Accuracy & Loss for VGG19

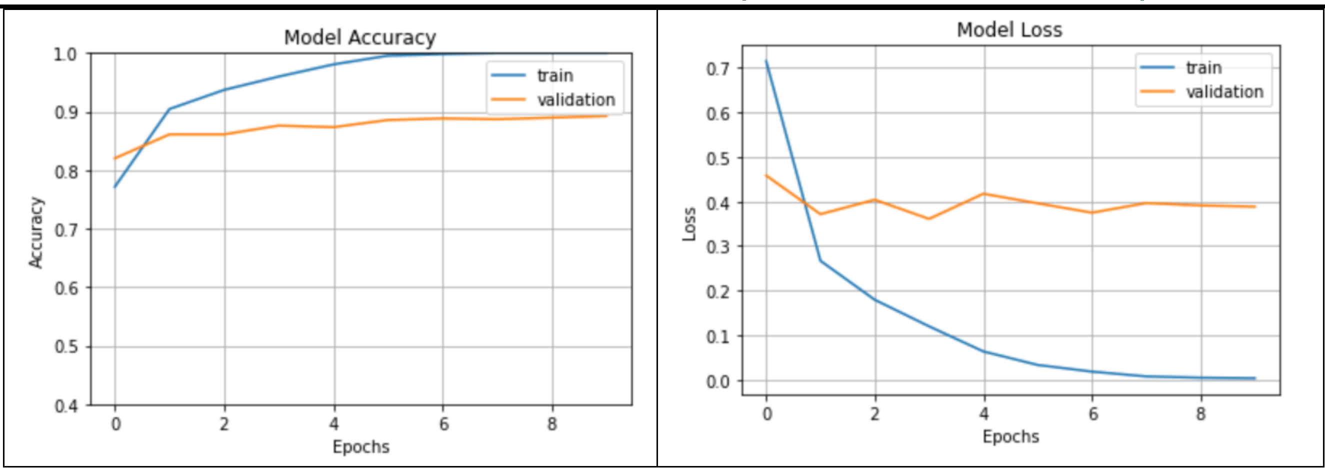

Fig – 4 Model Accuracy & Loss for ResNet50

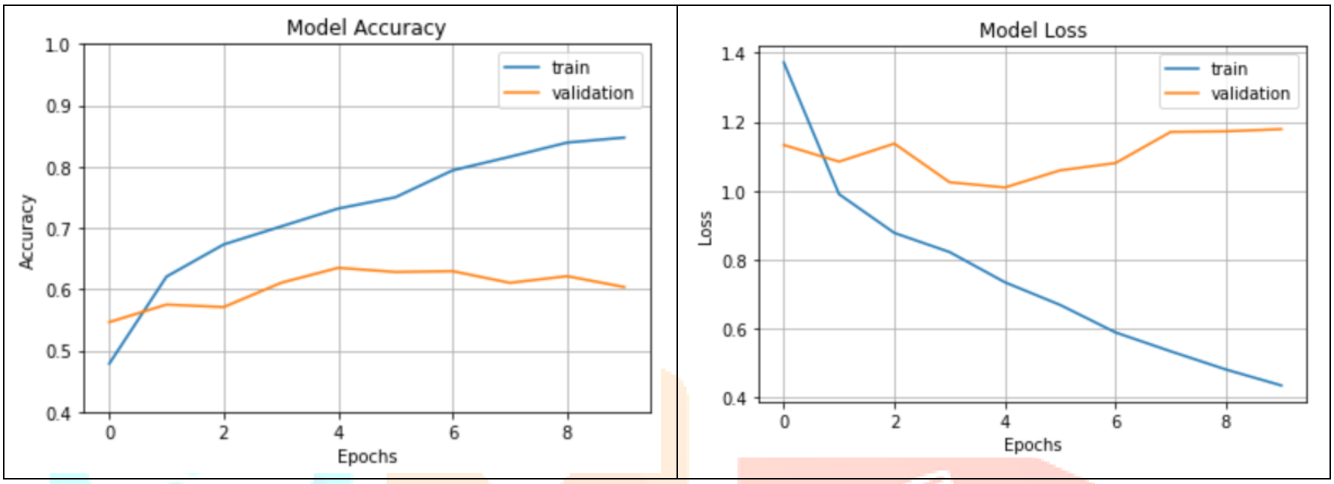

Fig – 5 Model Accuracy & Loss for MobileNetV2

From the above results we can see that, except MobileNetV2 all other models have reached the maximum value (i.e., 1) for training accuracy, the maximum training accuracy of MobileNetV2 is 0.847. Considering the validation accuracy (From Table – 1), its evident that ResNet50 outperforms remaining models. ResNet50 has the highest Avg validation accuracy and maximum validation accuracy too. And, the average time taken by ResNet50 is around 371 seconds per epochs, which is far lesser than VGG16 and VGG19.

CONCLUSION

The use of CNNs for image classification is investigated in this study. We provide our study and comparison of CNN models, we have analyzed that for Image classification ResNet50 is the most preferrable model. And the second preferred model is VGG16, followed by VGG19. And the least preferred model for Image Classification is MobileNetV2.

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