CAPSTONE REPORT

Problem Statement

First of all I would like to introduce my project. This project consists of image classification of 50 types of bark. The use case of classifying these pieces of bark is in order to do things such as Tree detection from range to predict landscape layout, tree detection to minimize forest fire damage and tree classification to optimize seasonal harvesting. All of these use cases could be used in order to create products for the private sector in order to enhance forestry and agricultural technology. However, since all the time in the world is not available in order to complete this project my main goal is to make a model that classifies tree bark correctly to a degree of 70%+ accuracy in both the accuracy set and the validation set and the difference in accuracy is not bigger than 5%. For an example an ideal score for the model would be 70% accuracy and validation accuracy of 75%. I chose this range because it. In conclusion the problem statement is the following; **How can we build a model that optimally optimizes the classification of tree bark across 50 different species?**

Subject Matter Background

The reason this is a good problem is because this model can serve as the foundation to a bigger project in the future that can contribute to the private sector, such as tree bark recognition from satellite imagery in order to minimize forest fire damage in the future. This subject area apart from being highly applicable to the real world it also serves as a purpose within the course seeing as neural networks are often regarded as one of the most useful models for classification. So what better model to use in order to classify 5578 different images other than a model which can optimize itself over enough cycles, or epochs as they are called more frequently . From my research into this area this problem has not been visited much in the past, which is one of the key reasons why it was so compelling to do it. Aside from the data on kaggle there were no mentions of any other users on the website who went ahead and used the methods that I used in order to classify the data set. Hence, by using various visualizations on the data in order to I was able to gain useful knowledge I wouldn't have otherwise gotten, thus allowing me to optimize the model to the best of my ability.

Data Source & Description

The data had been received from Kaggle.com, more specifically one can find the data at the following link https://www.kaggle.com/saurabhshahane/barkvn50. The data consists of 50 classes of tree species. There are 5578 images all of which are sized 303x404. When the data set is looked into there is a class imbalance of the amount of images in each class. The class with the most images has 250+ images while the class with the least images has 80+. The image sizes in one class are also imbalanced, so those will have to be resized.

Preprocessing Summary

The preprocessing of the data was not immense , however, when loading the images into the train and validation sets what had happened was the images were rescaled, horizontally flipped, vertically flipped, seared, zoomed in, among other techniques. These preprocessing techniques are what is called image augmentation and they help reinforce the strength of the detection of the model. Due to the augmented images the model can detect if an image belongs to a specific class even if the image is of bad quality because augmentation is basically distorting the imagery and making itself harder to classify.

Modelling Summary

As far as the modelling goes the the first model was a convolutional neural network and it was layers in the following fashion; Convolutional layer (relu), Max Pooling layer 25% dropout layer, then repeat the former 3 more times and the final two layers were two dense layers. Using this first model what was able to be achieved was not impressive to say the least with 2 epochs the model had an accuracy of 4%. Seeing the accuracy of the first model I decided to implement transfer learning. The first pretrained model that was used is VGG16 with the imagenet dataset along with a dense layer, dropout layer, dense layer and yet another drop layer that ended up composing the second model. After 10+ hours of training the model the results were sub par with an accuracy of 60% which is below my target. The results of the seconds left much to be desired, so a third model was constructed. This time the third model was the same as the second model except the neural net that was pre trained was the Renet50V2 model, using this model an accuracy of 70%+ was achieved and the time which it took to train the model was a third of the time the second model, thus achieving optimal results according to the criteria.

Findings and conclusions

Overall the findings were that the ResNet50V2 model was the best model to use for our reinforcement learning, compared to our initial goals I had actually achieved in terms of the accuracy and the validation accuracy. To be more specific the accuracies were 71 and 70 for the accuracy and the validation accuracy respectively. Seeing this it tells us that the specific problem for tree classification the ResNet50V2 network is the best network to use. My hypothesis previously was that the transfer learning techniques were going to be the best for this task, so in the end I was right.

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Final Summary

The final application of the project can be to use the tree bark classification to spot trees from a far in order to harvest various materials from these trees, these materials could range from sap to barriers to the bark itself. Not to mention that in the future what could happen is that this model could connect to a drone in order to scan vast swathes of land in order to examine a landscape for forrestfire susceptibility and if it is like a forest fire will occur firefighters can be called preemptively since that area will be innate more high risk. Finally the model can be deployed in order to monitor forestry health and formation to make sure resorts have the right quota of trees growing inside of them. Overall future steps that could be taken with the project is to automate it into a bash script that can feed images to it from the web.