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WQD190005

Background/Motivation:

The data science project was completed by Garrick Chu. He is an amateur data scientist. This project called “Who’s a good dog” was his second data science project and one of the purposes is familiar himself with convolution neural network.[1]

The motivation of this project is associated with the dog’s breed images classification to identify dog breeds. In this project, Garrick is likely to build a neural networking model with the performance exceeding average people. The inspiration for the project came from the experience that helps reunite lost dogs with its owner within 3 hours, because he came across a lost dog and then capture its photo to upload social media app with dog’s details. After that, Garrick decided to accomplish a project for improving the efficiency of looking for lost dogs. To achieve the goal, he created the model with better performance than humans to improve the accuracy of the dog breed’s identification.

Methodology:

The technique in the project includes two parts the convolutional neural network(CNN) and transfer learning. Garrick utilizes CNN for dog breed's image classification and transfer learning for improving model's accuracy.

- CNN

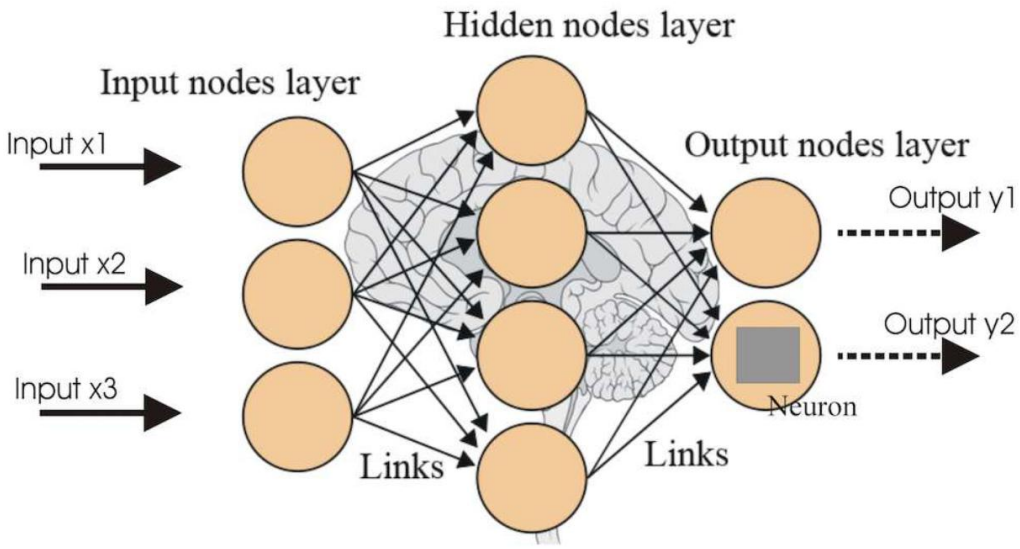

Figure 1: Neural Network

The neural composed of several layers includes the input layer, hidden layer, and output layer. It is like the human brain with amounts of neurons. The input layer connects input information, the hidden nodes layer represents neurons to filter and compress the images, and the output layer gives the results(Figure 1).[2]

Garrick uses CNN to classify the dog's breed images. Firstly, the neural network was fed with labeled dog's breed images and learn to classify them. After training, when inputting the unlabeled image, the neurons would extract shapes of images in the first layer and handle a more complex part of images in the subsequent layers. On the top layer, the neuron would compare the previous information to other different animals and then the output predicts the results that match the unlabeled input image to the most similar dog's breed images.

- Transfer Learning

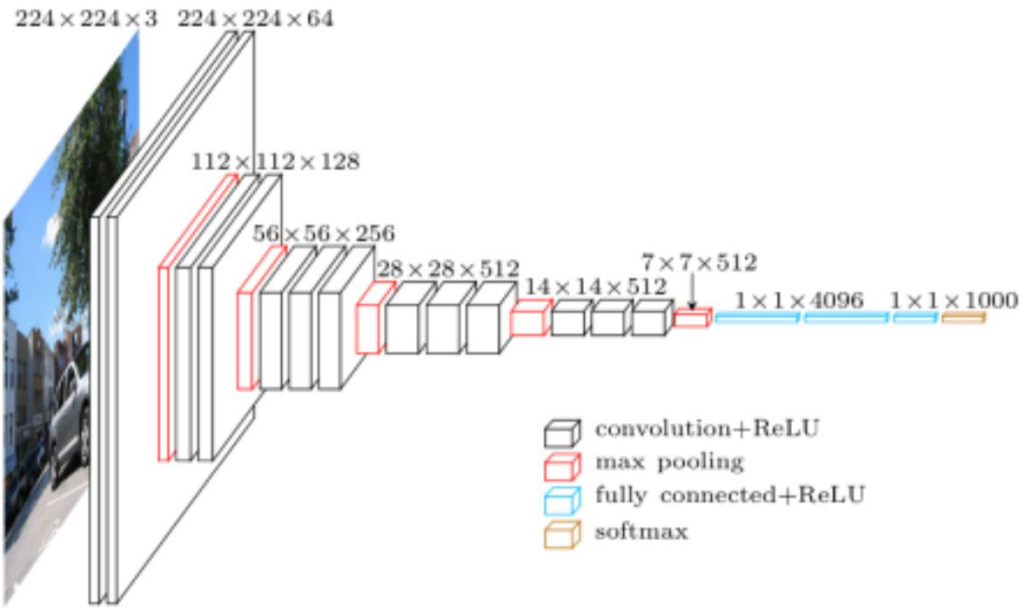

Figure 2: VGG16 network architecture

Garrick chose the VGG16 model to extract features from the previous trained model which trained by larger data set.[3]

Description of Dataset:

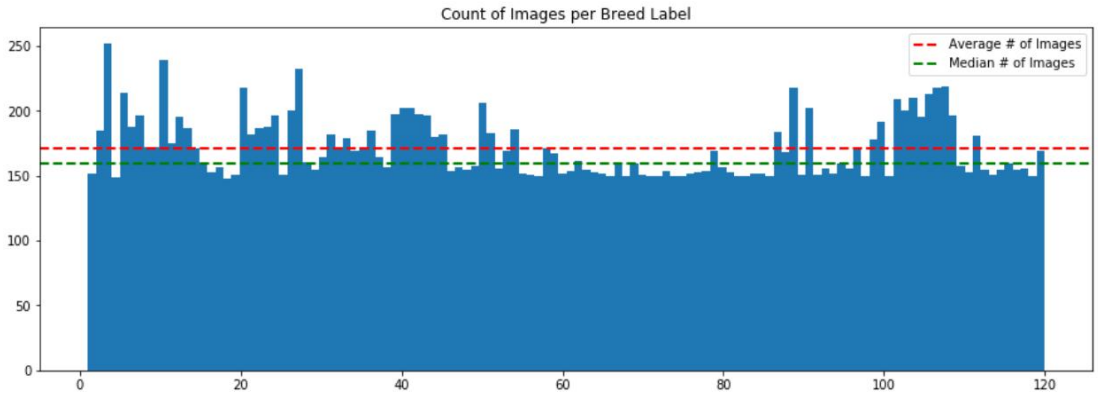

Figure 3: The dog's dataset

The dataset used in the project contains about 20,000 images across 120 categories of dog's breed. The bar chart shows the number of images per breed. The image dataset is balanced with about 160 images with fewest 160 images and most 250 images. Garrick divides each breed of dog into three partitions including 80 images for training, 20 images for validation and the rest images for test. The data comes from public dataset *Stanford Dogs Dataset.*[4] From the figure 3, we could find that the dataset is a little imbalance, but the algorithm would negate the effects of missing value.

Tools:

To accomplish the project task, Garrick mainly uses Jupyter notebook as his tool. It is an open-source software to help developers contribute and interact with Python code.

Results:

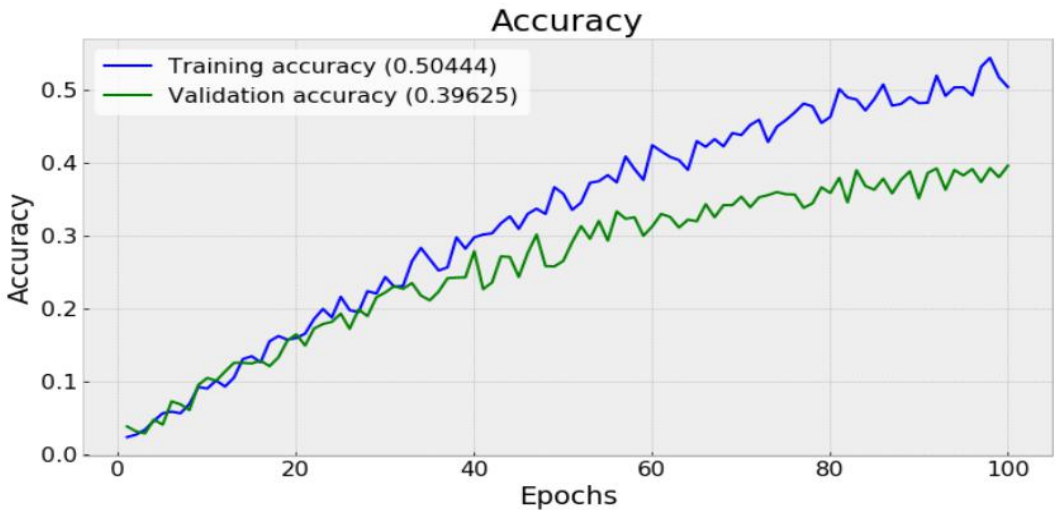

Figure 4: The Results of Simple CNN from scratch

Figure 4 shows the result of the CNN model. With the increasing of epochs, the accuracy of the output also grows. Garrick achieved the model with 100 epochs using a Batch Normalization. After the training, the accuracy hits 0.50444 and the validation accuracy arrives 0.39625.

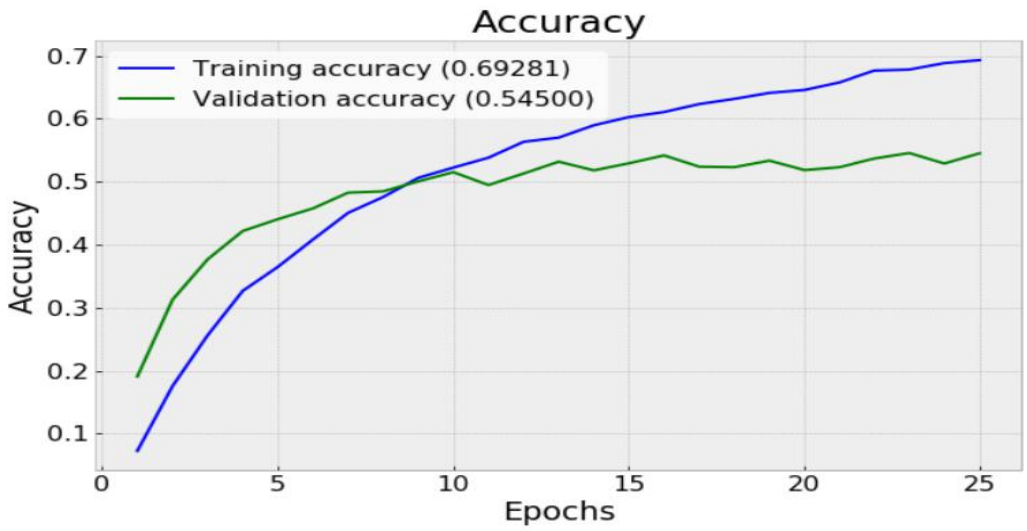

Figure 5: The Results of CNN using Transfer Learning

The figure 5 shows that the result of CNN using Transfer Learning has been improved. The validation accuracy increased from 0.39 to 0.54. The reason is that in the VGG16 model, there is a pre-trained model to improve its performance compared without that on the model CNN from scratch. Furthermore, it also helps prevent over-fitting means perform well on the current model, but it becomes detrimental to other new data.

Evaluation:

	Predicted class		
Actual Class		Class = Yes	Class = No
	Class = Yes	True Positive	False Negative
	Class = No	False Positive	True Negative

Figure 6: Confusion Metrics

Next, Garrick begins the evaluation of the training model using test data. There are three different metrics to evaluate the classification model, including precision, recall and F1-score. All the metrics could be calculated by confusion metrics(Figure 6).

Precision means the ratio of true predicted class to all positive classes. Recall means the ratio of true predicted class to all actual classes. While the F1 Score combines them as the metric.[5]

$$F1\ Score = 2*(Recall * Precision) / (Recall + Precision)$$

Garrick also completes another evaluation to compare the performance with human.

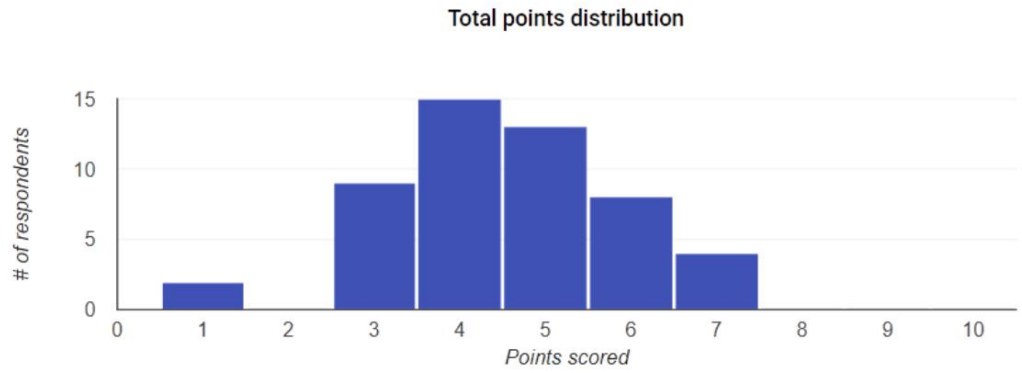

Figure 7: Point Distribution

In the survey, Garrick received 51 respondents. The data shows that the highest score is 7 of 10 correct answers. While the average score is 4.51 of 10 points and the median score is 4 of 10 points. By contrast, the neural model get around 80% accuracy and it behaves much better than human identification.

Data Products

The project results could be used in business companies. They could use the model to leverage the images of data from customers and automatically labeled these pictures for further demands. For example, the social media platform could use this information to do products advertisement targeting clients who have a passion for dog breed classification products and offer better services.

Conclusion

To improve the project work, Garrick decides to obtain more labeled data to improve identification accuracy. Because the convolutional neural network would use too many computing resources to classify the dog's breed images, Garrick is also likely to change the computing platform to accelerate the training.

References:

[1] T.J. DeGroat. (2019, May 30). Data science alum helps build springboard's community. [Blog post].

Retrieved from: https://www.springboard.com/blog/student-success-garrick-chu/

[2] Machine learning terms every manager should know. (n.d.). Retrieved October 14, 2019 from:

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[3] Garrick Chu. (2018). *Who's a good dog? : An exploration and assessment of using convolutional neural networks to classify dog breed from images.* Retrieved from:

https://github.com/thegarrickchu/Springboard-Dog_Breed_Classifier/blob/master/Springboard%20Capstone%20Project%202%20-%20Final%20Report.pdf

[4] Aditya Khosla, Nityananda Jayadevaprakash, Bangpeng Yao and Li Fei-Fei. Novel dataset for Fine-Grained Image Categorization. *First Workshop on Fine-Grained Visual Categorization (FGVC), IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2011.

[5]Renuka Joshi.(2016, September 9) Accuracy, precision, recall & f1 score:

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https://blog.exsilio.com/all/accuracy-precision-recall-f1-score-interpretation-of-performance-measures/