Image Classification of Cats Vs. Dogs

Kai Halpin, Shana Ibatuan, Parishi Jain, Justin Kim, Fumi Okutsu, Andres Perez, Alice Zhong and Dr. Horace Crogman
Physics Department, STEM Technological Adaptive Learning Program, California State University of Dominguez Hills

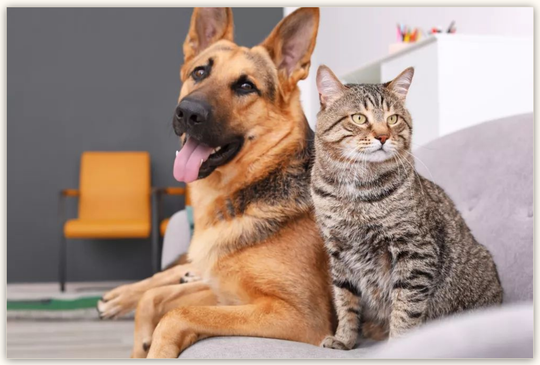
Abstract

Our group was tasked to build a machine learning model that has the ability to predict or differentiate images of cats and dogs referenced from a data set from Kaggle. Image classification was used, which was built upon machine learning and deep learning activities previously learned.

Different methods were tested to see which model would return the highest validation accuracy of classifying whether an image was a cat or dog.

Introduction

Over the past few years, in the digital age, there have been several advancements in deep learning and neural networks that have revolutionized computer vision as we know it. Image classification is just one of the advancements, and it is "the process of categorizing and labeling groups of pixels or vectors within an image based on specific rules."[1] Within image classification, Keras and Tensorflow was utilized to solve the task of determining whether the image was a cat or dog. By designing a convolutional neural network that is capable of learning, students were able to determine the differences. [7]



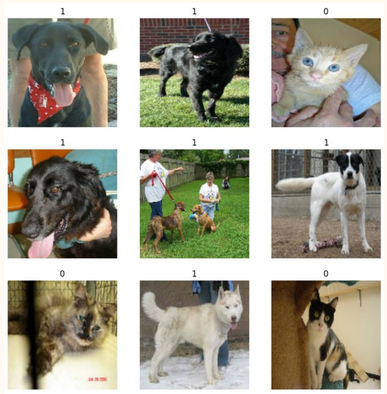
Methods

For our image classification project, we used the "Cats-vs-Dogs" dataset from Kaggle. In our first approach, we followed YouTube tutorials that utilized Keras image classification with a label system using decimals for image categorization.[2] Additionally, we implemented a function from another tutorial to identify displayed images as either cats or dogs.[4] During this stage, we experimented with different parameter values, such as batch size, validation split, and epochs, in an attempt to optimize the model's performance. In our second approach, inspired by a tutorial from the Keras website, we set up the model on Google Colab and gained a deeper understanding of the image classification process. Combining knowledge from both the YouTube tutorials and the Keras website tutorial, we created a third 'mixed' method of image categorization.

Results

The Keras Image classification, had the highest validation accuracy, returning an average model accuracy of 91% after running 10 epochs. Higher variability, allowed us to account for more parameters regarding the cat and dog data set. This allowed for a high model accuracy relative to other members methods. Furthermore, some of the libraries used and the tutorial were both from the Keras library.

Method	# of Epochs	Average Model Accuracy
Approach 1	5, 10	77% , 74%
Approach 1	25	79%
Approach 1	25	89%
Mixed Approach 1	42	76%
Keras' Tutorial 1	5,10	83%, 91%
Keras' Tutorial 1	5,10	85%, 85%
Mixed Approach 2	5, 10	72%, 82%



O is for images classified as CATS and 1 is for images classified as DOGS

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loss: 0.6542 - accuracy: 0.6387 - val_loss: 0.7178 - val_accuracy: 0.4957
loss: 0.5010 - accuracy: 0.7547 - val_loss: 0.9846 - val_accuracy: 0.4957
loss: 0.3917 - accuracy: 0.8242 - val_loss: 1.2963 - val_accuracy: 0.4957
loss: 0.3189 - accuracy: 0.8636 - val_loss: 0.4946 - val_accuracy: 0.7405
loss: 0.2570 - accuracy: 0.8918 - val_loss: 0.3366 - val_accuracy: 0.8518
loss: 0.2210 - accuracy: 0.9076 - val_loss: 0.3127 - val_accuracy: 0.8723
loss: 0.1990 - accuracy: 0.9173 - val_loss: 0.2557 - val_accuracy: 0.8864
loss: 0.1818 - accuracy: 0.9254 - val_loss: 0.6338 - val_accuracy: 0.7789
loss: 0.1767 - accuracy: 0.9258 - val_loss: 0.1990 - val_accuracy: 0.9203
loss: 0.1519 - accuracy: 0.9390 - val_loss: 0.2171 - val_accuracy: 0.9124
```

Model is trained for 10 epochs, returning a 93% accuracy

Conclusions

Through this process, we were able to determine that the Keras Image classification machine learning model yielded the highest validation accuracy in distinguishing between images of cats and dogs. Keras image was used to preprocess layers for image standardization and data augmentation. Different than the other methods tested, this deep learning model utilized more feature extraction to retrieve information and patterns from the raw images. This model takes inputs of images and uses separable convolutions, residual connections, and global average pooling to extract features and classify images into either a "Dog" or "Cat" category.

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References