

# Cats vs. Dogs Classification Using Convolutional Neural Networks (CNNs)

## Introduction

This project implements a Convolutional Neural Network (CNN) to classify images of cats and dogs. The model is trained using the Cats and Dogs Filtered dataset from TensorFlow, which consists of labeled images for binary classification. The goal is to build an efficient deep learning model capable of distinguishing between the two classes.

## Dataset and Preprocessing

- The dataset is downloaded and extracted if not already present.
- It consists of training and validation sets, each containing images of cats and dogs.
- Data augmentation techniques, such as rotation, shifting, zooming, and flipping, are applied to increase model robustness.
- Pixel values are normalized to a range of [0,1] for improved learning.

## Model Architecture

The CNN consists of the following layers:

1. Conv2D (32 filters, 3x3, ReLU) + MaxPooling (2x2)
2. Conv2D (64 filters, 3x3, ReLU) + MaxPooling (2x2)
3. Conv2D (128 filters, 3x3, ReLU) + MaxPooling (2x2)
4. Conv2D (128 filters, 3x3, ReLU) + MaxPooling (2x2)
5. Flatten Layer: Converts feature maps into a 1D array.
6. Dense Layer (512 neurons, ReLU activation): Fully connected layer.
7. Output Layer (1 neuron, Sigmoid activation): Outputs probability of being a dog (binary classification).

## Training and Optimization

- The model is compiled using the Adam optimizer and binary cross-entropy loss function.
- It is trained for 10 epochs, with both training and validation data.
- The dataset is loaded using ImageDataGenerator for efficient batch processing.

## Evaluation and Results

- The final training and validation accuracy are displayed to assess model performance.
- A plot of training vs. validation accuracy is generated to visualize learning trends.

## Prediction on New Images

- A function is implemented to classify new images as either Cat or Dog, with confidence scores.

## Conclusion

**This project successfully classifies images of cats and dogs using a deep CNN. The model is trained with augmented data to improve generalization. The final model can predict new images with high accuracy and can be further fine-tuned for better performance.**