

## Cats vs. Dogs Image Classification Using VGG16 and Transfer Learning

This Cats vs. Dogs Image Classification project leverages Transfer Learning with the VGG16 model to classify images of cats and dogs. The approach ensures efficiency by using pretrained convolutional layers while training custom fully connected layers.

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### Project Highlights

- **Dataset:** The project automatically downloads and extracts the Cats & Dogs dataset from TensorFlow's repository.
  - **Model:** Uses VGG16 as a feature extractor while adding custom fully connected layers.
  - **Data Augmentation:** Enhances generalization by applying transformations like rotation, zoom, and horizontal flipping.
  - **Optimization:** Trained with SGD (Stochastic Gradient Descent) and a learning rate of 0.01.
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### Key Steps

#### 1. Dataset Handling

- Automatically downloads and extracts the dataset if it's missing.
- Prepares training and validation sets using ImageDataGenerator.

#### 2. Model Architecture

- Uses VGG16 pretrained layers (without the top layers).
- Freezes VGG16 layers to retain prelearned features.
- Adds custom layers:
  - Flatten Layer
  - 512 Dense Neurons (ReLU)
  - Dropout (0.5) to prevent overfitting
  - Final Output Layer (Sigmoid) for binary classification (Cat/Dog)

#### 3. Training & Evaluation

- Trained for 10 epochs (adjustable for better performance).
- Plots training & validation accuracy to observe learning trends.
- Final model is saved (cats\_dogs\_vgg16\_model.h5) for later use.

#### 4. Prediction on New Images

- Loads the saved model for inference.
- Preprocesses and predicts whether an image contains a cat or a dog, providing confidence scores.

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### **Future Improvements**

- **Unfreeze deeper VGG16 layers and fine-tune them on the dataset.**
- **Experiment with different optimizers (Adam, RMSprop) and learning rates.**
- **Use a deeper custom classifier (additional fully connected layers).**
- **Apply early stopping to avoid unnecessary epochs.**