Image Classification of Cats and Dogs using Convolutional Neural Network

# 1. Introduction

Image classification is one of the most fundamental tasks in computer vision. In this project, we have implemented a Convolutional Neural Network (CNN) to classify images of cats and dogs. The goal is to build an intelligent system that can automatically distinguish between a cat and a dog using image data.

# 2. Objective

To develop a machine learning-based image classification system using CNN that can accurately classify input images as either 'Cat' or 'Dog'. The system should be user-friendly, provide high accuracy, and include a GUI interface for interaction.

# 3. Tools & Technologies Used

- Python  
- TensorFlow / Keras  
- OpenCV  
- PIL (Python Imaging Library)  
- Tkinter (for GUI)  
- Jupyter Notebook / VS Code (IDE)

# 4. Dataset Used

The dataset used in this project is the famous 'Dogs vs. Cats' dataset provided by Kaggle. It consists of 25,000 labeled images of dogs and cats. For simplicity and performance, we used a subset for training and validation.

# 5. Methodology

The following steps were taken to build the image classification system:  
1. Data preprocessing and augmentation  
2. Building a CNN architecture  
3. Training the model with binary cross-entropy loss  
4. Saving the trained model (.h5 file)  
5. Building a GUI using Tkinter for user input and prediction  
6. Predicting new images as Cat or Dog using the trained model

# 6. CNN Architecture

The CNN used in this project consists of the following layers:  
- Convolutional Layer (32 filters, 3x3 kernel)  
- MaxPooling Layer (2x2)  
- Convolutional Layer (64 filters, 3x3 kernel)  
- MaxPooling Layer (2x2)  
- Flatten Layer  
- Dense Layer (128 units, ReLU)  
- Output Layer (1 unit, Sigmoid)

# 7. GUI Functionality

The project includes a user-friendly graphical interface built using Tkinter. Users can upload any image from their local system, and the model will classify it as a Cat or Dog and display the prediction on the screen.

# 8. Results & Accuracy

The CNN model achieved an accuracy of approximately 85-90% on the validation set. It performs well in differentiating between cats and dogs in various real-world images.

# 9. Conclusion

This project demonstrates the application of deep learning in image classification tasks. By integrating a CNN with a GUI, we created a complete end-to-end system that can be used in real-world scenarios.

# 10. Future Enhancements

- Improve accuracy using transfer learning (e.g., VGG16, ResNet)  
- Extend the classification to include multiple pet types  
- Deploy the model on web or mobile platforms

# 11. Screenshots

Example Screenshots here from the GUI and prediction outputs.

