**Dog vs. Cat Image Classification using Multiple Approaches**

**Motivation:**

The classification of images into categories of dogs and cats is a classic problem in computer vision and serves as an excellent introduction to machine learning algorithms. With the availability of large datasets containing images of dogs and cats, we aim to develop and compare multiple machine learning approaches for accurate image classification. By exploring different methodologies, we seek to gain insights into the strengths and weaknesses of each approach in solving this task.

**Method:**

We propose to use three distinct machine learning approaches for image classification:

1. **Convolutional Neural Networks (CNNs)**:
   * CNNs have demonstrated state-of-the-art performance in image classification tasks due to their ability to automatically learn hierarchical features from raw pixel data. We will design and train CNN architectures to classify images of dogs and cats.
2. **Support Vector Machines (SVMs)**:
   * SVMs are classical machine learning algorithms that can be effective for image classification tasks. We will explore both linear and non-linear SVM kernels to classify images of dogs and cats based on handcrafted features extracted from the images.
3. **Transfer Learning with Pre-trained Models**:
   * Transfer learning involves leveraging pre-trained deep learning models (e.g., VGG, ResNet) trained on large image datasets. We will fine-tune these pre-trained models on our dataset of dog and cat images to utilize the learned features for classification.
4. **Random Forest**

**Intended Experiments:**

Our proposed experiments will include the following steps:

1. **Data Preparation**:
   * Obtain a dataset containing a large number of images of dogs and cats. The dataset will be divided into training, validation, and testing sets.
   * Preprocess the images by resizing, normalizing, and augmenting the dataset to enhance model performance.
2. **Model Development**:
   * Implement CNN architectures using popular deep learning frameworks such as TensorFlow or PyTorch.
   * Train SVM models using handcrafted features extracted from the images.
   * Fine-tune pre-trained deep learning models for transfer learning on the task of dog vs. cat classification.
3. **Training and Evaluation**:
   * Train each model on the training dataset and evaluate their performance on the validation set.
   * Optimize hyperparameters for each approach using techniques like grid search or random search.
   * Evaluate the trained models on the testing set to assess their generalization ability and compare their performance.
4. **Comparison and Analysis**:
   * Compare the performance of CNNs, SVMs, and transfer learning approaches based on metrics such as accuracy, precision, recall, and F1-score.
   * Analyze the strengths and weaknesses of each approach in terms of computational efficiency, robustness to variations in data, and ease of implementation.

**Relevant Dataset:**

**Dataset**: We plan to use a publicly available dataset containing images of dogs and cats.

**Link:** https://paperswithcode.com/dataset/cats-vs-dogs