

GAN-based Data Augmentation for Image Classification

Lab Overview: In this project, the student will explore the use of GANs to generate synthetic data for augmenting a dataset used in image classification tasks. Data augmentation is a common technique to increase the diversity of training data, which can improve the generalization of machine learning models. GANs, being generative models, can create realistic synthetic samples that can be used to supplement the original dataset.

Key Steps and Components:

1. Dataset Selection:

- Choose the data provided on ecampus: NewData

2. GAN Architecture:

- Implement a GAN architecture suitable for generating images similar to those in the chosen dataset.
- Experiment with different GAN architectures (e.g., DCGAN, WGAN, etc.) and hyperparameters to find the most effective model.

3. Training GAN:

- Train the GAN on the original dataset to generate synthetic images. The GAN should learn to produce realistic images that resemble the distribution of the original dataset.

4. Data Augmentation:

- Integrate the trained GAN into the data augmentation pipeline for the image classification task.
- Randomly select a subset of the training data and augment it with both real and synthetic images generated by the GAN.

5. Model Training:

- Train a convolutional neural network (CNN) or another suitable image classification model using the augmented dataset.
- Compare the performance of the model trained with and without synthetic data augmentation.

6. Evaluation:

- Evaluate the model on a separate validation or test set to assess its generalization performance.
- Compare the model's performance with and without GAN-based data augmentation to measure the impact of synthetic data.

7. Hyperparameter Tuning:

- Experiment with hyperparameter tuning for both the GAN and the classification model to optimize their performance.

8. Visualizations:

- Visualize the synthetic images generated by the GAN and compare them with real images to ensure they resemble the original dataset.

Deliverables:

- Codebase with the GAN implementation, data augmentation pipeline, and classification model.
- Report documenting the project, including dataset details, GAN architecture, training process, and evaluation results.
- Visualizations and comparisons showcasing the impact of GAN-based data augmentation.