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Ex.5 Report: Image Data Augmentation Using CNN and CIFAR-10

(a)

Objective

The objective of this exercise is to study the effect of image data augmentation techniques on image classification performance. A custom convolutional neural network (CNN) was constructed and trained using the CIFAR-10 dataset, and the impact of **horizontal** and **vertical flip** augmentations was evaluated on a test image (dog.jpg).

Methodology

A custom CNN was implemented using PyTorch and trained on the CIFAR-10 dataset. After training, a sample image (dog.jpg) was uploaded and resized to match the CIFAR-10 input size (32×32). Three versions of the image were tested: the original image, a horizontally flipped version, and a vertically flipped version. The trained model was then used to predict the class label and confidence for each version.

Results

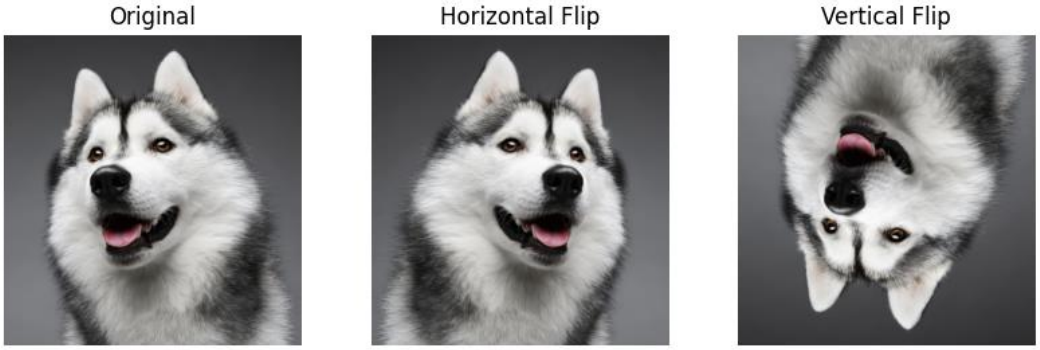
The model correctly classified the image as **dog** in all three cases. The prediction confidence for the original image was **0.5512**. After applying horizontal flip augmentation, the confidence increased to **0.6750**, indicating improved robustness to left–right transformations. The vertically flipped image was also classified as dog with a confidence of **0.5547**, which is comparable to the original image.

Conclusion

The results show that horizontal flip augmentation can improve classification confidence, while vertical flip does not significantly degrade performance in this case. This demonstrates that image data augmentation can enhance model robustness to geometric transformations without changing the predicted class.

```
Original: predicted=dog  confidence=0.5512
Horizontal Flip: predicted=dog  confidence=0.6750
Vertical Flip: predicted=dog  confidence=0.5547
```

```
plt.figure(figsize=(10,3))
for i, (name, im) in enumerate(zip(names, imgs), start=1):
    plt.subplot(1,3,i)
    plt.imshow(im)
    plt.title(name)
    plt.axis("off")
plt.show()
```



Part (b): Single Digit Image Classification

After training the convolutional neural network on the MNIST dataset, the model was tested on a single externally uploaded handwritten digit image. The network correctly classified the image as digit **6** with a confidence score of **0.8088**, demonstrating that the trained model is able to generalize unseen digit images outside the training dataset.

```
Predicted digit: 6
Confidence: 0.8088
```

```
plt.imshow(img, cmap="gray")
plt.title(f"Predicted digit: {pred}")
plt.axis("off")
plt.show()
```