DLP Final Project

Group 14

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Generative Models as a Data Augmentation for Classification

Outline

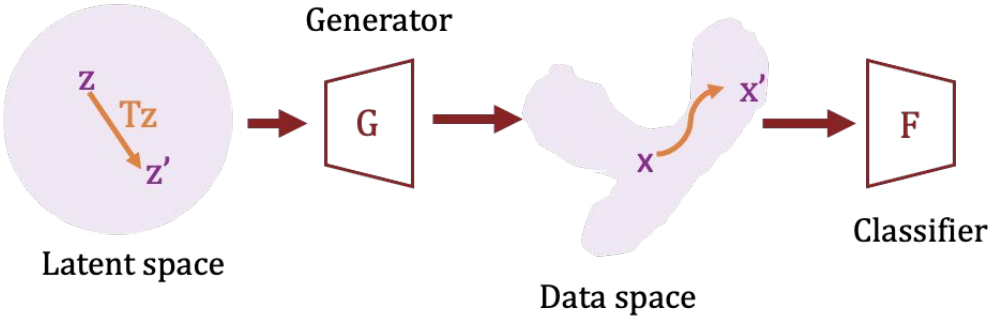
- Introduction
- Method
- Implementation Detail
- Experimental Results
- Conclusion

Introduction

- GAN is a widely used and powerful generative model.
- We use **GAN steerability** as an **data augmentation** technique.

Jahanian, A., Chai, L., & Isola, P. (2020). On the" steerability" of generative adversarial networks. *International Conference on Learning Representations (ICLR)*.

Method



- Transform is done in the latent space with magnitude α.
- Use the generator to generate the augmented image.
- At last we use a classifier/encoder to do classification.

Method

With a **generator G** and **magnitude α**, we try to learn **latent vectors W_{steer}**, which achieves the same effects of **transformation T** in image space.

Objective function: $\mathbf{w}_{\text{steer}} = \arg\min_{\mathbf{w}} \mathbb{E}_{\mathbf{z},\alpha}[||G(\mathbf{z}+\alpha\mathbf{w}) - T(G(\mathbf{z}),\alpha)||],$

G(z) G(z+αw) T(G(z),α)

As a consequence, we can manipulate the latent space to do transformation.

$$T_z(z) = z + w_{steer}$$

Method - Transform

The meaning of α differs in different transformations.

$$\mathbf{w}_{\texttt{steer}} = \arg\min_{\mathbf{w}} \mathbb{E}_{\mathbf{z},\alpha}[||G(\mathbf{z}+\alpha\mathbf{w}) - T(G(\mathbf{z}), \alpha)||],$$

- Rotation : How many degrees to rotate the image or axes
- Zoom & Shift : How much to zoom in or out, shift along x axis, shift along y axis.
- Color : How much pixel value to add according each channel.

Implementation Detail

- Dataset: ImageNet with only 25 classes
  - Training: 1300 images in each class (650 original + 650 generated)
  - Testing: 50 images in each class
- Generator: Biggan-deep-256
- Classifier: ResNet50

Deng, J., Dong, W., Socher, R., Li, L.-J., Li, K., & Fei-Fei, L. (2009). Imagenet: A large-scale hierarchical image database. I*EEE conference on computer vision and pattern recognition (CVPR).*

Pytorch-pretrained-BigGAN: https://github.com/huggingface/pytorch-pretrained-BigGAN

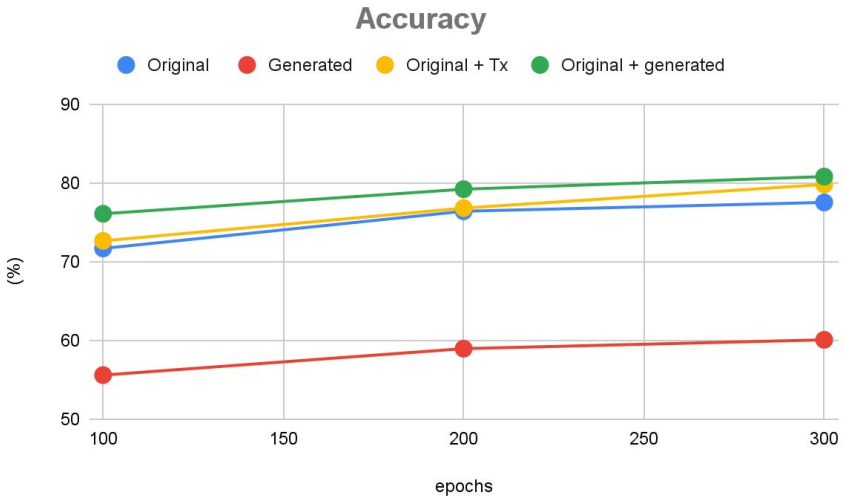
Experimental Results

Class	Generated1	Generated2	Generated3
			
			
			

Experimental Results

The hybrid of original and generated images performs best

	100(epochs)	200(epochs)	300(epochs)
Original	71.68	76.4	77.52
Original + Transform	72.64	76.8	79.8
Original + Generated	**76.08**	**79.2**	**80.8**
Generated	55.6	58.96	60.08



Conclusion

- We investigate image transformation by **exploring walks in the latent space of GAN.**

- We conclude that GAN steerability is a **better data augmentation technique** compare to transformation done in the data space.

Q&A