Image Enhancement Using Deep Learning

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Introduction

Image enhancement - Adjusting images to make them more suitable for display or analysis

Super-resolution - Artificially increasing the level of detail on blurry or low-quality images

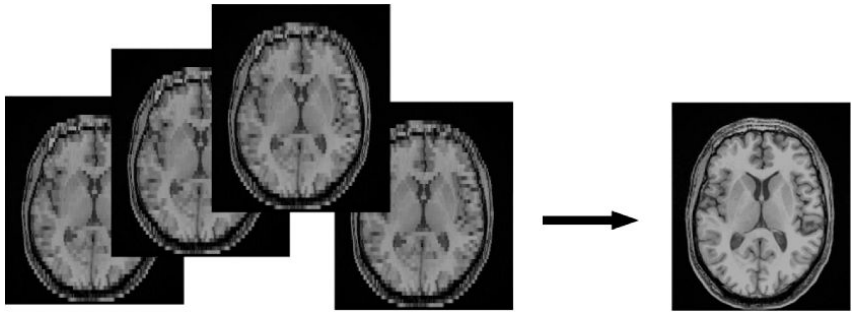
Applications

Face Recognition

Satellite Mapping

License Plate OCR

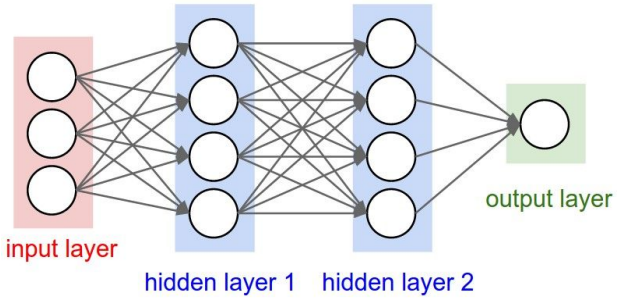
Medical Imaging



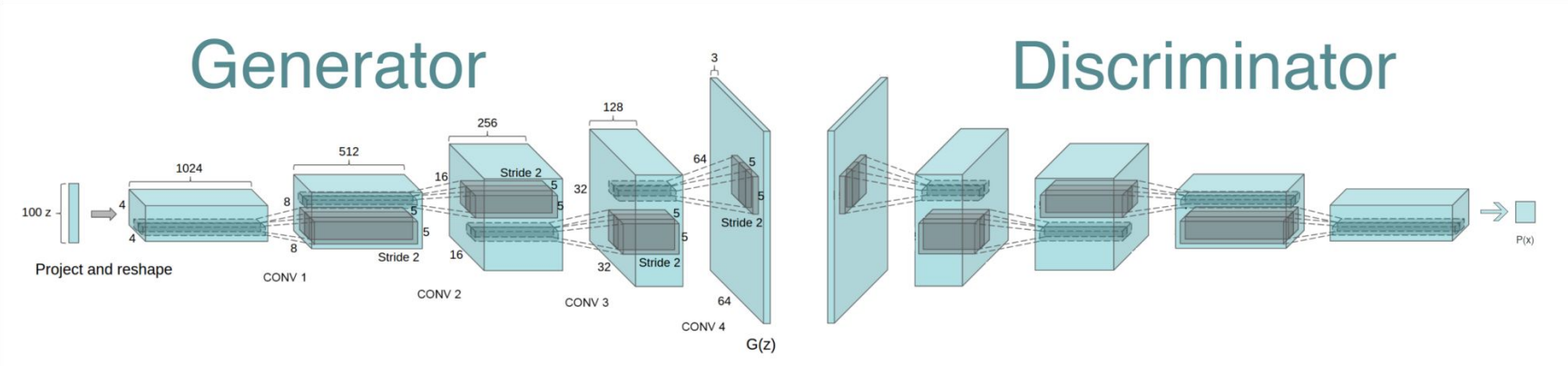
Methods

- Machine learning techniques
  - Maximum likelihood estimation with regularization
  - Nearest neighbors interpolation
  - Principal component analysis

- Deep learning techniques
  - Convolutional neural networks
  - Variational autoencoders
  - **Generative adversarial networks**



Generative Adversarial Networks (GAN)



Learns to create fake images that can fool the Discriminator

Learns to distinguish between real and fake images

Goal is to create super-resolution images that look as real as possible and similar to the original image

Dataset

MNIST Digits

60k images

Cropped to 16x16 pixels
Downsampled to 4x4

Celebrity Faces

200k images

Flowers

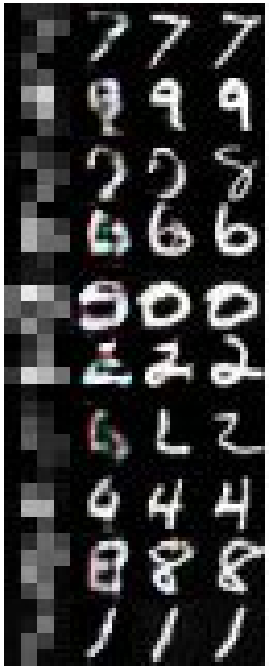
8k images

Cropped to 64x64 pixels
Downsampled to 16x16

Results

Digits

4x4 | 1k iterations | 20k iterations | Truth



Faces

16x16 | 1k iterations | 8k iterations | Truth

Flowers

16x16 | 1k iterations | 5k iterations | Truth

Future Work

- Fine-tune model
  - Delicate balance between generator and discriminator
- Upscale to higher resolutions
  - Harder and longer to train
- Collect real low-quality images for testing
  - As opposed to downsampling to artificially reduce quality
- Build a web app
  - Allows users to enhance images

References

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- A PCA-Based Super-Resolution Algorithm For Short Image Sequences - https://arxiv.org/ftp/arxiv/papers/1201/1201.3821.pdf
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