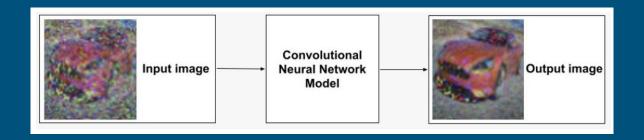# IMAGE DENOISING
USING
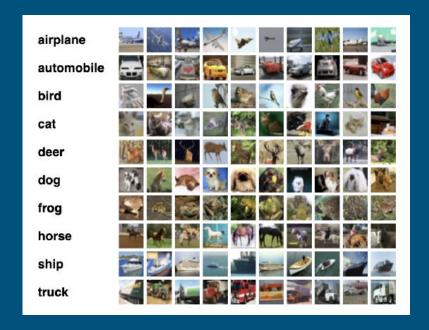# CONVOLUTIONAL NEURAL NETWORKS

Introduction & Motivation

- Use of ML techniques to improve image quality
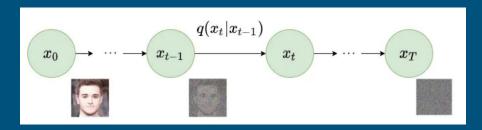- Focus images used in self-driving cars
- Generate Synthetic Images

Dataset

- CIFAR-10 dataset
- Image Size - 32*32 pixels
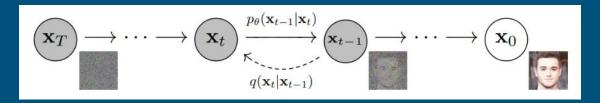- Colored Images
- 5000 training images
- 1000 testing images

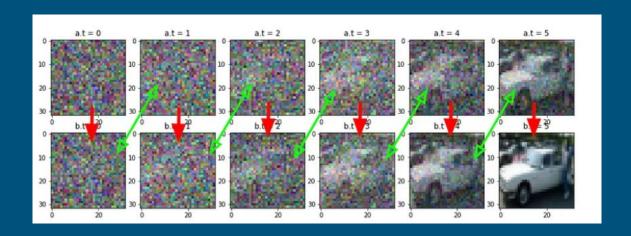# Diffusion Model

- Step 1 : Forward Diffusion - Adding Noise

$$q(x_t|x_{t-1})$$

$x_0 \rightarrow \cdots \rightarrow x_{t-1} \rightarrow x_t \rightarrow \cdots \rightarrow x_T$

- Step 2 : Reverse Diffusion - Recognising Noise Patterns & Training Model

$$p_\theta(\mathbf{x}_{t-1}|\mathbf{x}_t)$$

$\mathbf{x}_T \rightarrow \cdots \rightarrow \mathbf{x}_t \rightarrow \mathbf{x}_{t-1} \rightarrow \cdots \rightarrow \mathbf{x}_0$
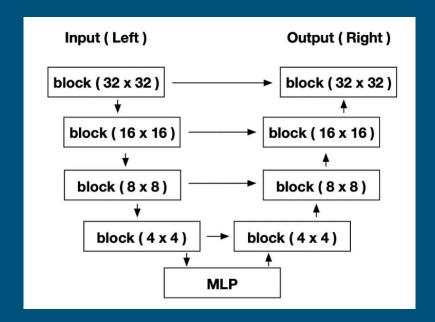
$$q(\mathbf{x}_t|\mathbf{x}_{t-1})$$

Training & Testing

- Noisy image gradually improves until the image becomes clear.
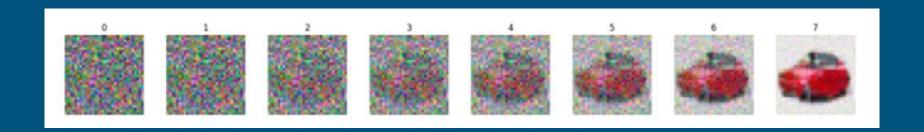- Use of U-Net Convolutional Neural Network

U-Net

- Contracting path and expansive path
- Break input images into parts
- Capture high level features

Results

- 30% improvement in image clarity over ResNet
- Stabilized results after 110 epochs
- Increase in efficiency of denoising process

Future Scope

- Optimization using Cosine Noise
- Developing image generation software
- Research Interest:
  - Simulation Data Enhancement
  - Photon Mapping
  - Electromagnetic Imaging

Learnings

- Project Planning & Execution
- Increased Conceptual Understanding
- Improving Problem Solving skills and develop interpersonal skills

Applications

- Medical Imaging
- Photography & Videography
- Remote Sensing
- Autonomous Vehicles

References

- https://www.superannotate.com/blog/diffusion-models#:~:text=Diffusion%20models%20are%20advanced%20machine,learning%20to%20reverse%20this%20process.
- https://www.deeplearning.ai/the-batch/a-new-class-of-diffusion-models-based-on-the-transformer-architecture/
- https://tree.rocks/make-diffusion-model-from-scratch-easy-way-to-implement-quick-diffusion-model-e60d18fd0f2e

THANK YOU