Deblurring Images with Neural Networks

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Deep Learning Course Project

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Autoencoder

An autoencoder is an artificial neural network that learns to copy its input to its output

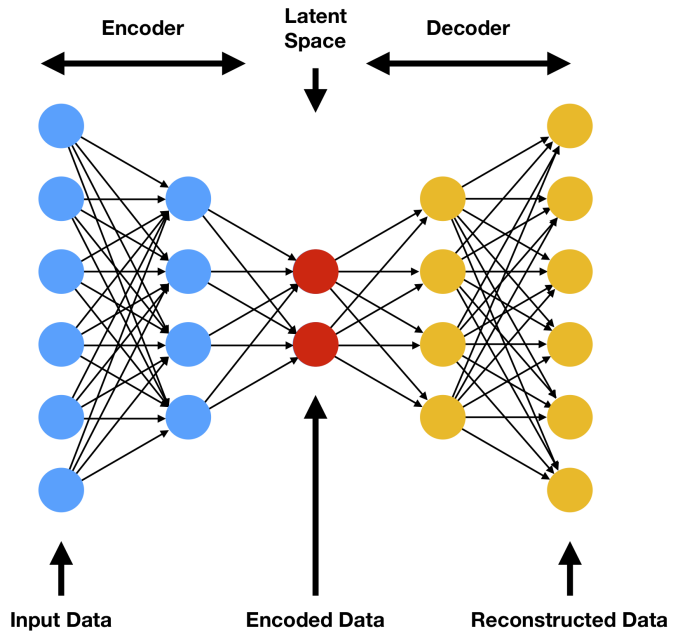


Figure: autoencoder model

Models:

- *Plain Network*
- *Skip Connections*
- *ResNet*

Plain Network

3 models:

$$C_{32}^{3,1} - C_{64}^{3,1} - C_{128}^{3,1} - D_{128}^{3,1} - D_{64}^{3,1} - D_{32}^{3,1} - D_{3,p}^{3,1} \quad (1)$$

$$5C_{8}^{3,1} - 5C_{16}^{3,1} - 5C_{32}^{3,1} - 5D_{32}^{3,1} - 5D_{16}^{3,1} - 5D_{8}^{3,1} - D_{3,p}^{3,1} \quad (2)$$

$$4C_{16}^{3,1} - 4C_{32}^{3,1} - 4C_{64}^{3,1} - 4D_{64}^{3,1} - 4D_{32}^{3,1} - 4D_{16}^{3,1} - D_{3,p}^{3,1} \quad (3)$$

	CNNBase_v1	CNNBase_v2	CNNBase_v3	SkipConnections_v1	SkipConnections_v2	ResNet_v1	ResNet_v2
Total Params.	333955	118499	375011	370833	130099	2187715	236227

Figure: Table of the toltal number of parameters in each network

Skip Connections

2 models:

$$C1_{32}^{3,1} - C2_{64}^{3,1} - C3_{64}^{3,1} - C4_{128}^{3,1} - D5_{128}^{3,1} - D6_{64}^{3,1} - S7_{C2} - D8_{32}^{3,1} - S9_X - D10_{3,p}^{3,1} \tag{4}$$

$$5C_{8}^{3,1} - 10C_{16}^{3,1} - 5C_{32}^{3,1} - 5D_{32}^{3,1} - 5D_{16}^{3,1} - S_{C6} - 2D_{8}^{3,1} - S_{C4} - 2D_{8}^{3,1} - S_{C2} - D_{8}^{3,1} - S8_X - D_{3,p}^{3,1} \tag{5}$$

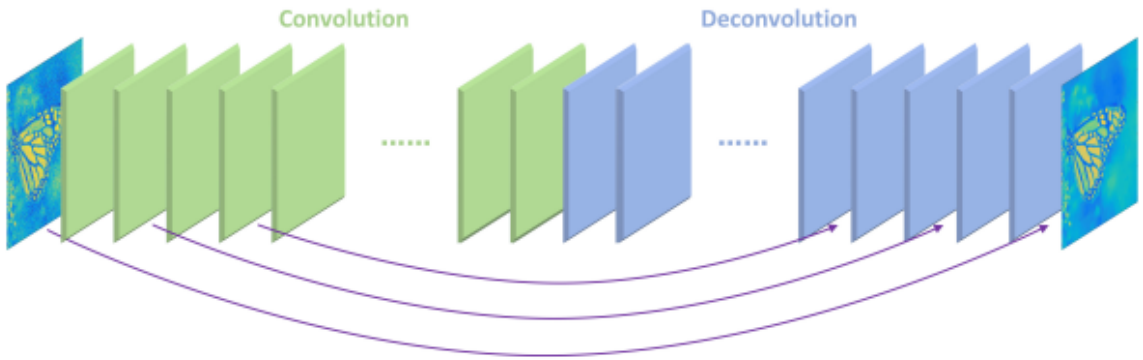


Figure: Skip Connections Model

Skip Connections

2 models:

$$C_{32}^{5,2} - R_{32}^{5} - C_{64}^{5,2} - R_{64}^{5} - C_{128}^{3,2} - R_{128}^{3} - D_{128}^{3,2} - R_{128}^{5} - D_{64}^{5,2} - R_{64}^{5} - D_{32}^{8,2} - D_{3,p}^{3,1} \quad (6)$$

$$C_{8}^{5,2} - 2R_{8}^{5} - C_{16}^{5,2} - 2R_{16}^{5} - C_{32}^{3,1} - 2R_{32}^{3} - D_{32}^{3,1} - 2R_{32}^{5} - D_{16}^{3,1} - 2R_{16}^{5} - D_{8}^{8,1} - D_{3,p}^{3,1} \quad (7)$$

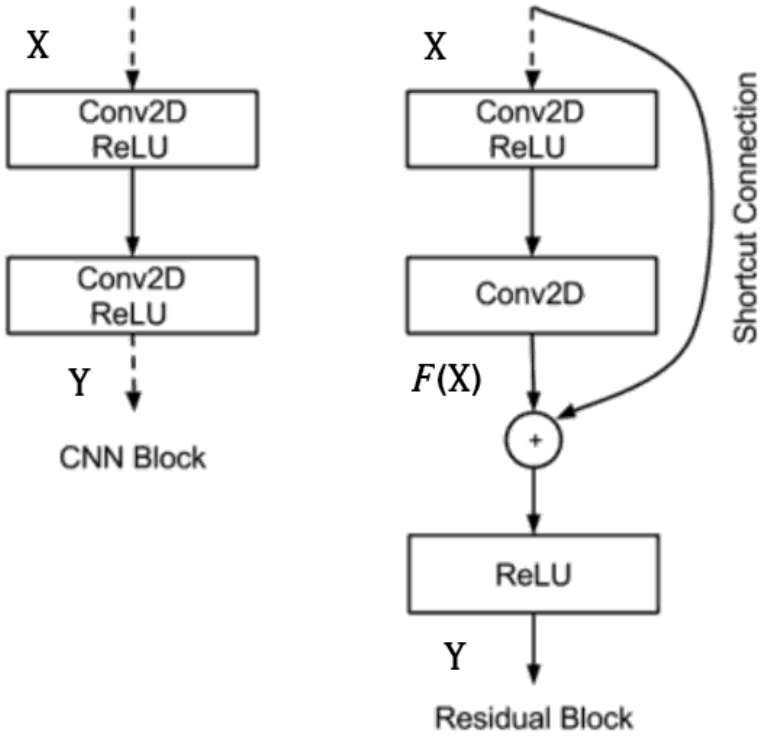


Figure: Residual block

CIFAR10 Results

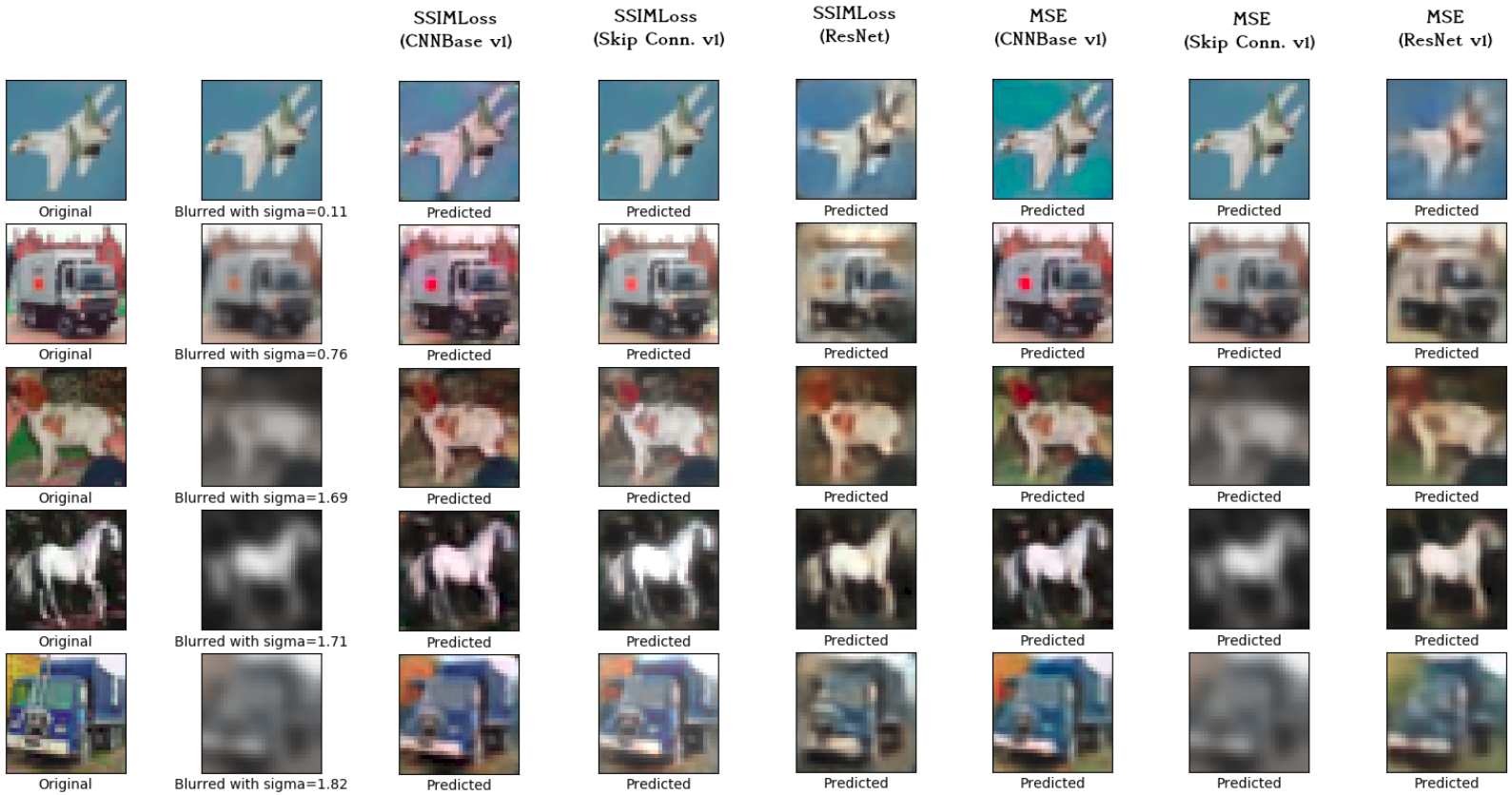


Figure: Output examples

CIFAR10 Results

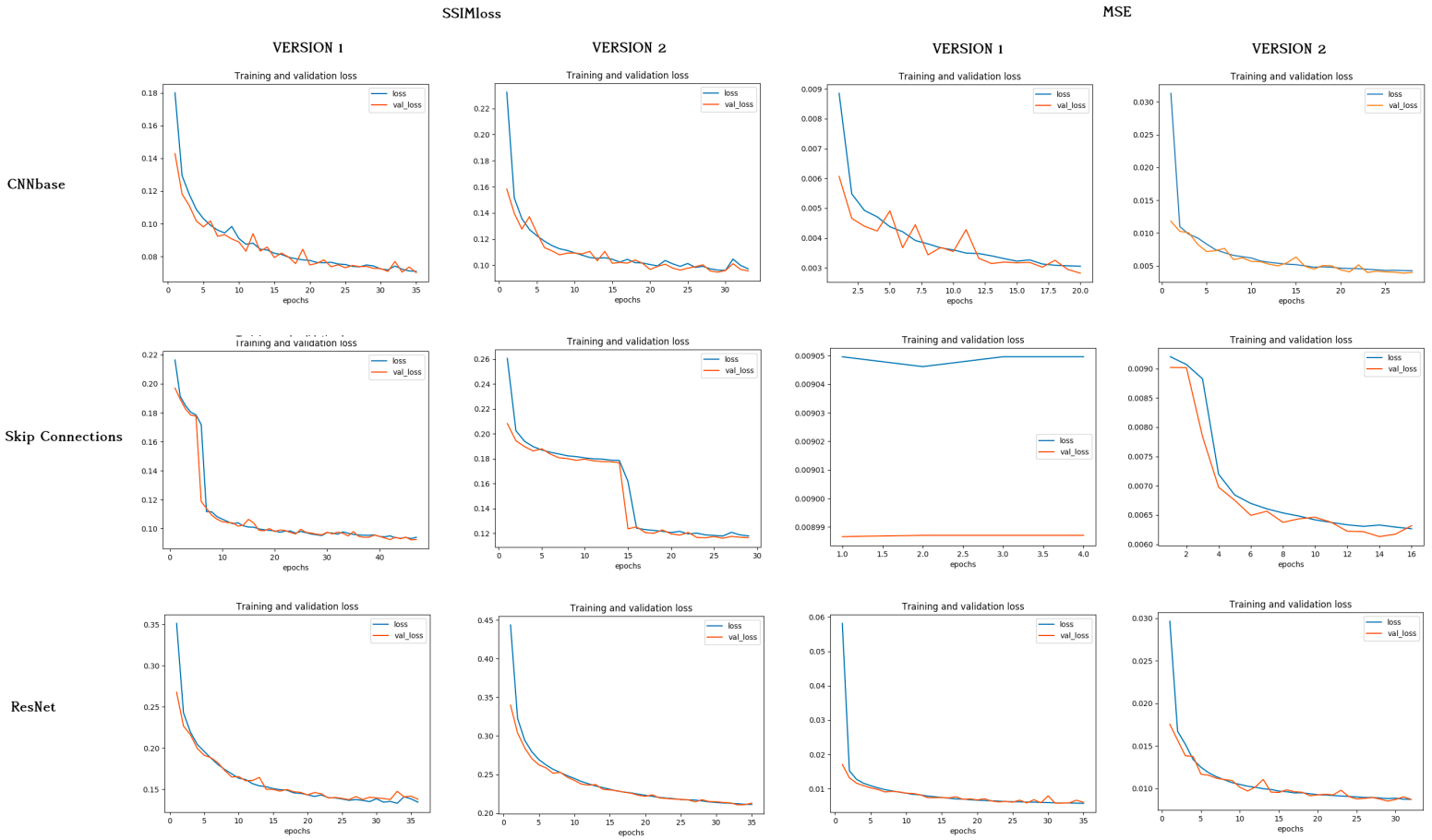


Figure: Loss Accuracy Comparison between different networks on CIFAR10

CIFAR10 Results

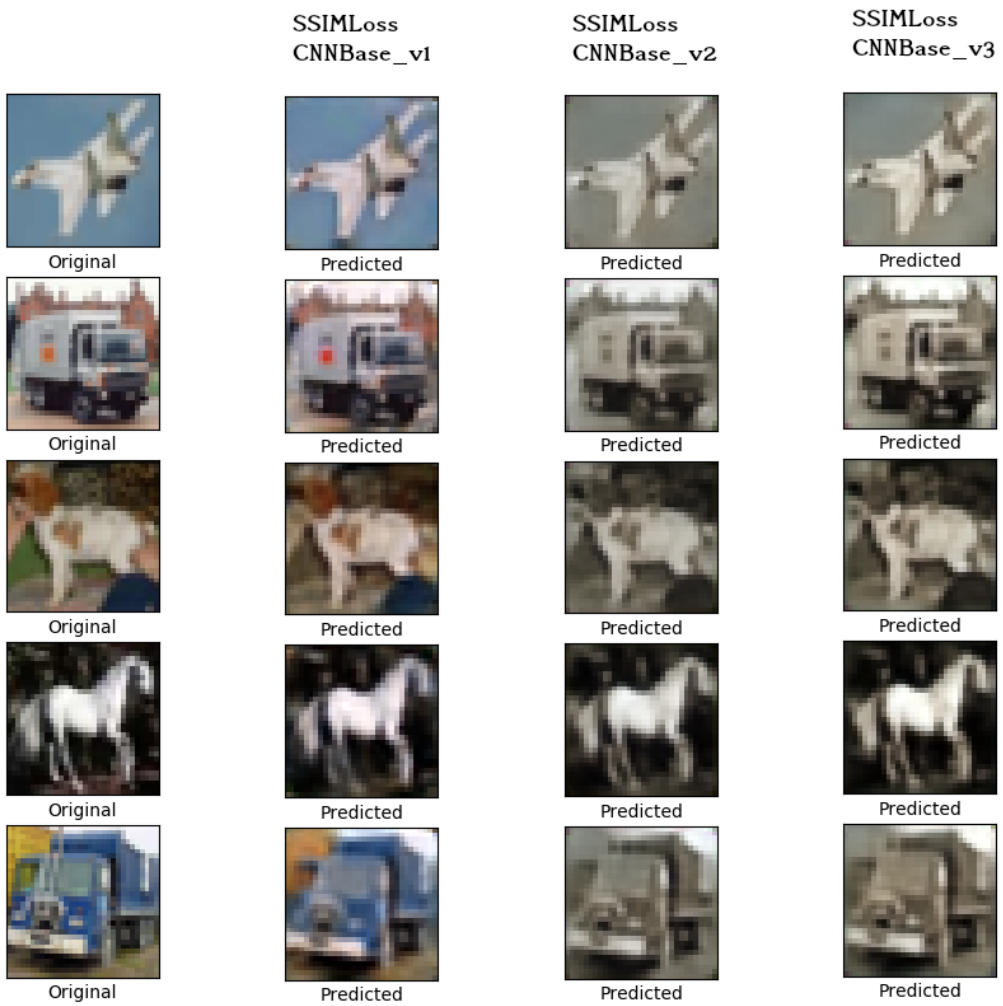


Figure: Outputs comparison with different version of CNNBase scheme

Kernel Motion Approach

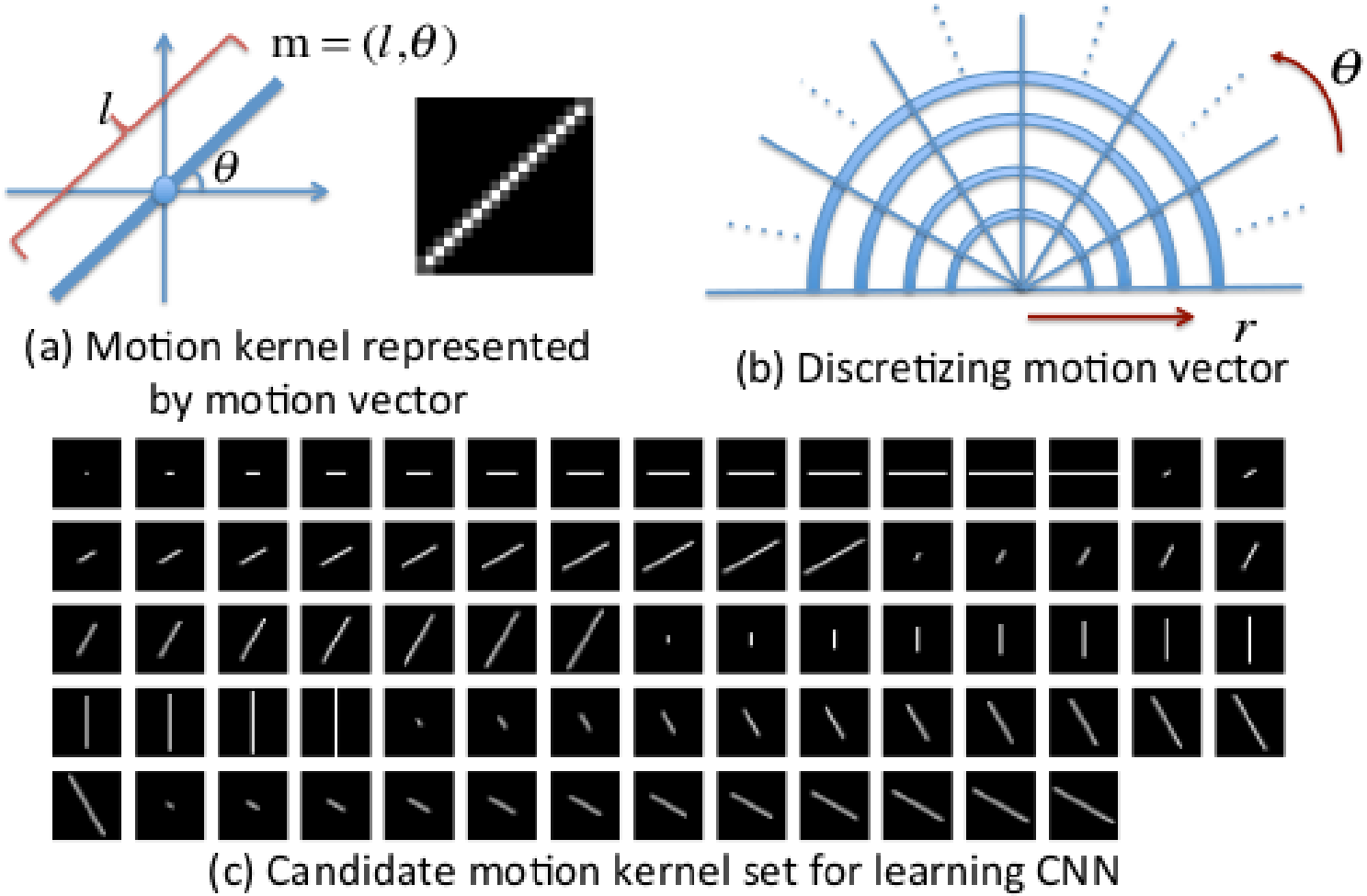
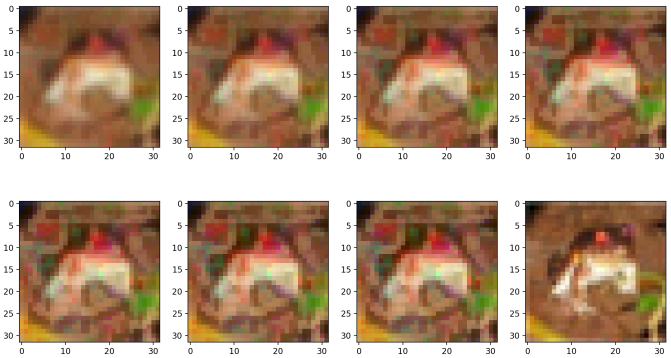
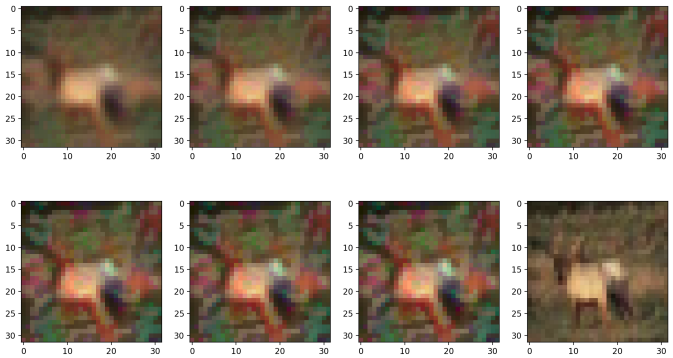


Figure: Representation of motion blur kernel by motion vector and generation of motion kernel candidates

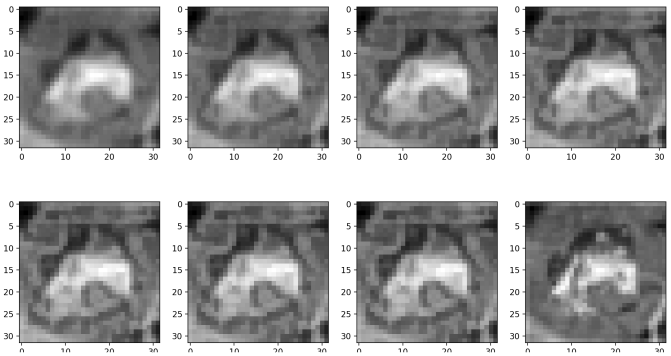
Style Transfer Approach



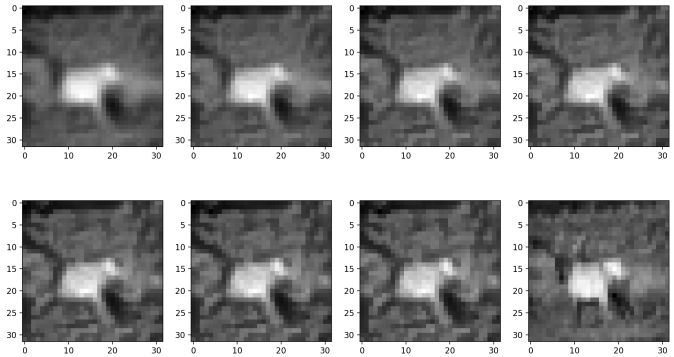
a) Frog Deblurring color version



c) Reindeer Deblurring color version



b) Frog Deblurring gray-scale conversion



d) Reindeer Deblurring gray-scale conversion

Figure: Style Transfer outputs on two images of CIFAR10. The last image in each group is the sharp image.