CENG 506 - HW2

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Note: The implementation details such as number of epochs, configured network architectures and so on are described in the autoencoder.py file as comments.

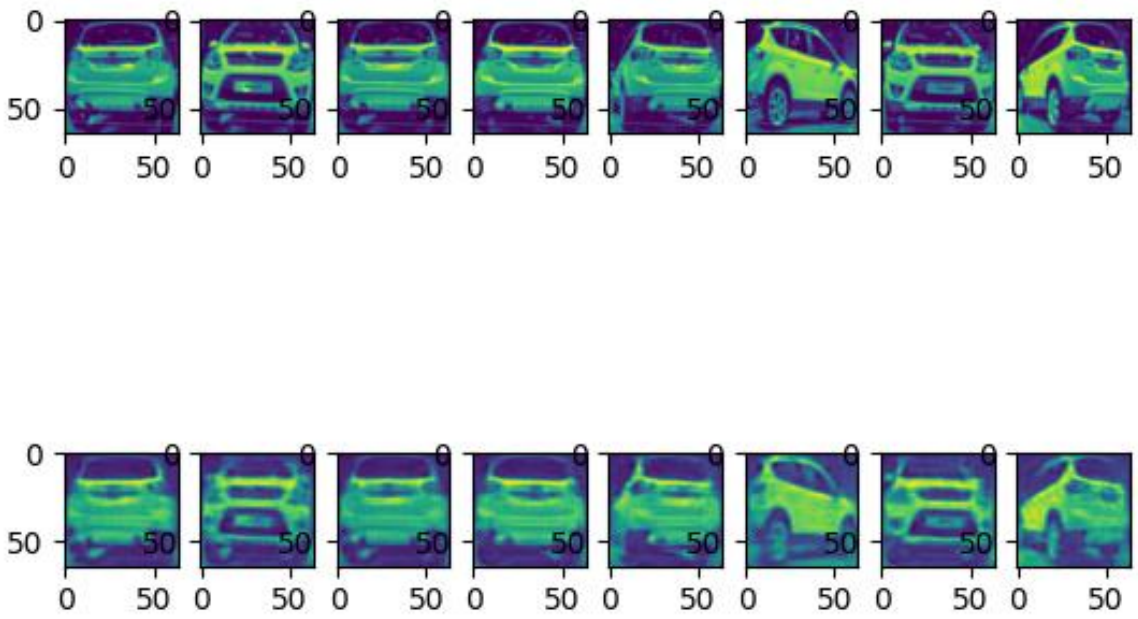
Experiment 1:

Best MSE results for each car sequence respectively:

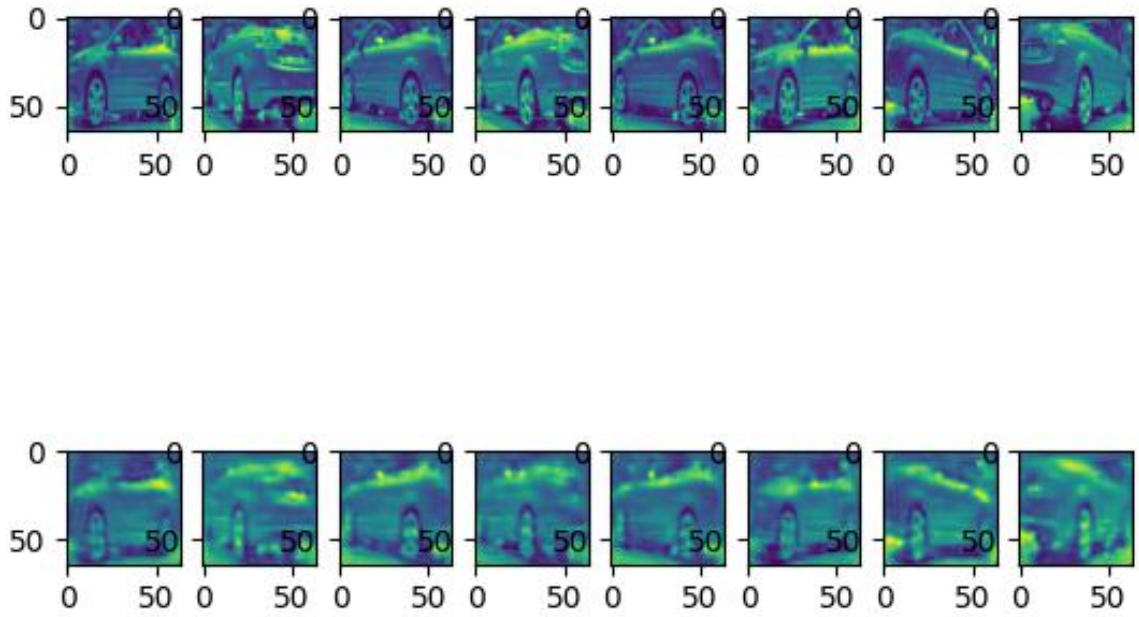
Sequence Number	Observed Best MSE Result
1	0.0069
2	0.0068
3	0.0085
4	0.0100
5	0.0038
6	0.0071
7	0.0041
8	0.0063
9	0.0087
10	0.0063
11	0.0079
12	0.0045
13	0.0074
14	0.0045
15	0.0092
16	0.0046
17	0.0046
18	0.0059
19	0.0042
20	0.0076

For the images shared in below, the above ones are the original ones, and the below ones are the encoded and decoded images. There are 8 experimental results for each of them and each decoded image are projected into 64*64 pixels range.

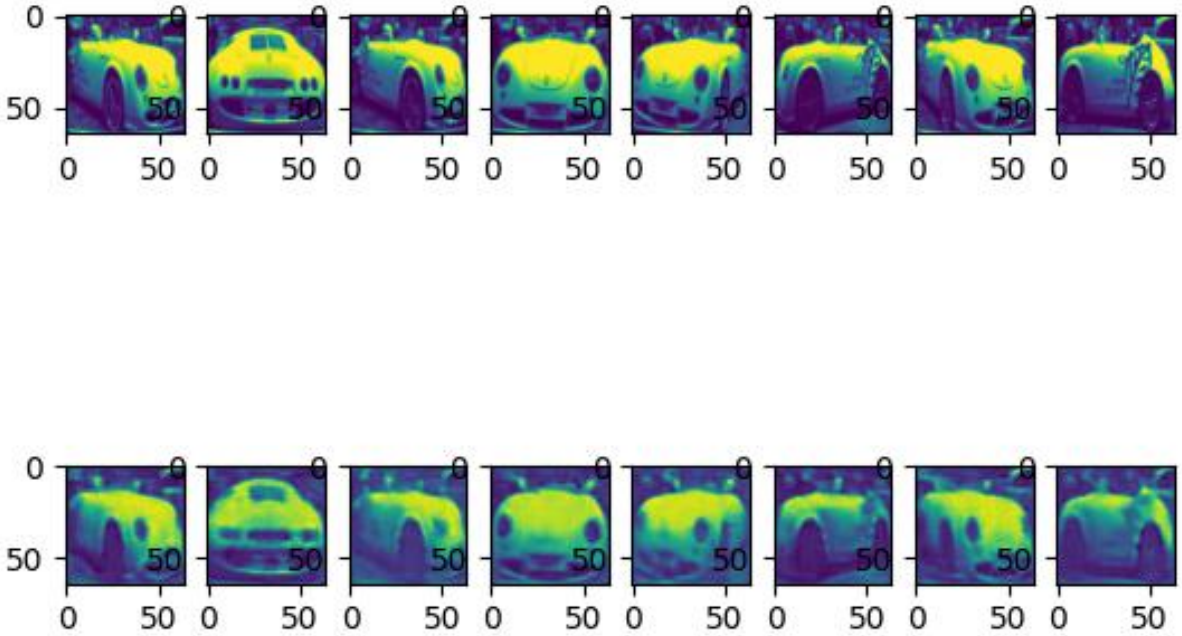
Sequence 1) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



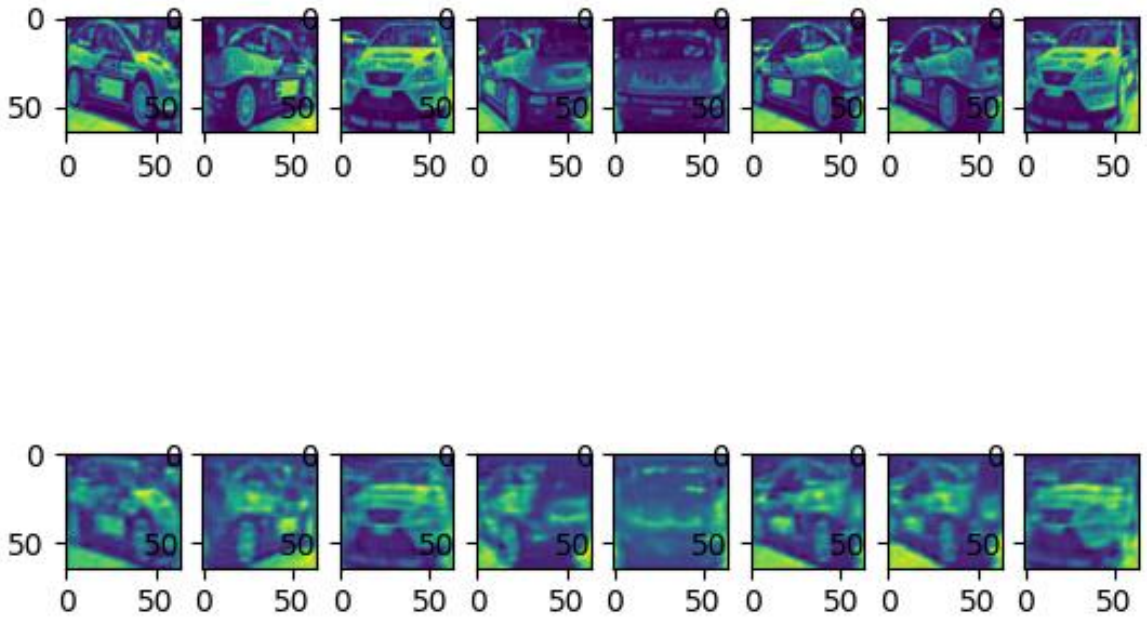
Sequence 2) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



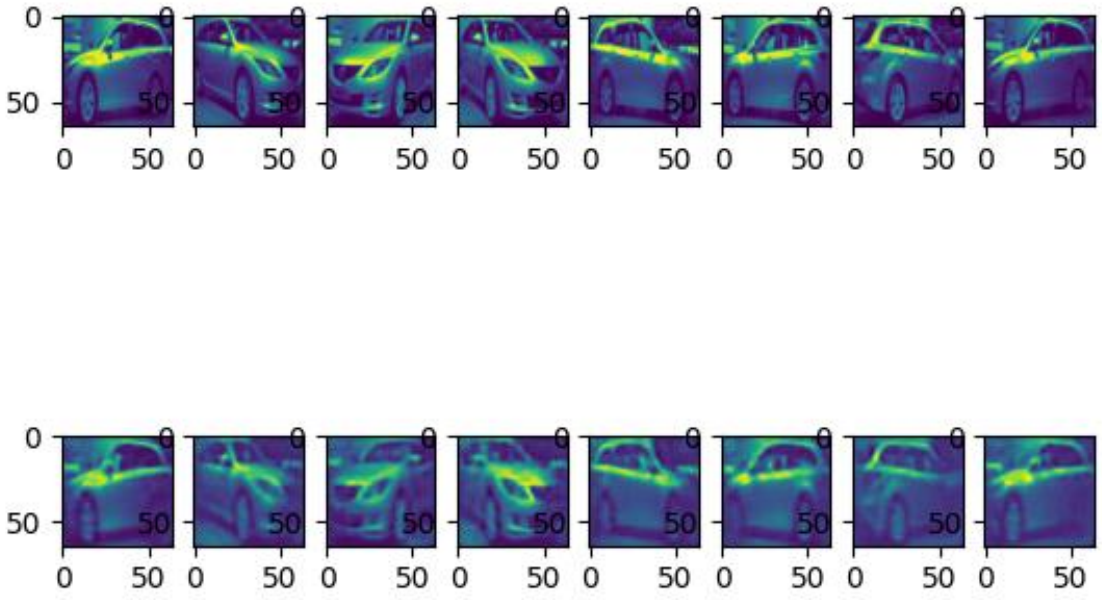
Sequence 3) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



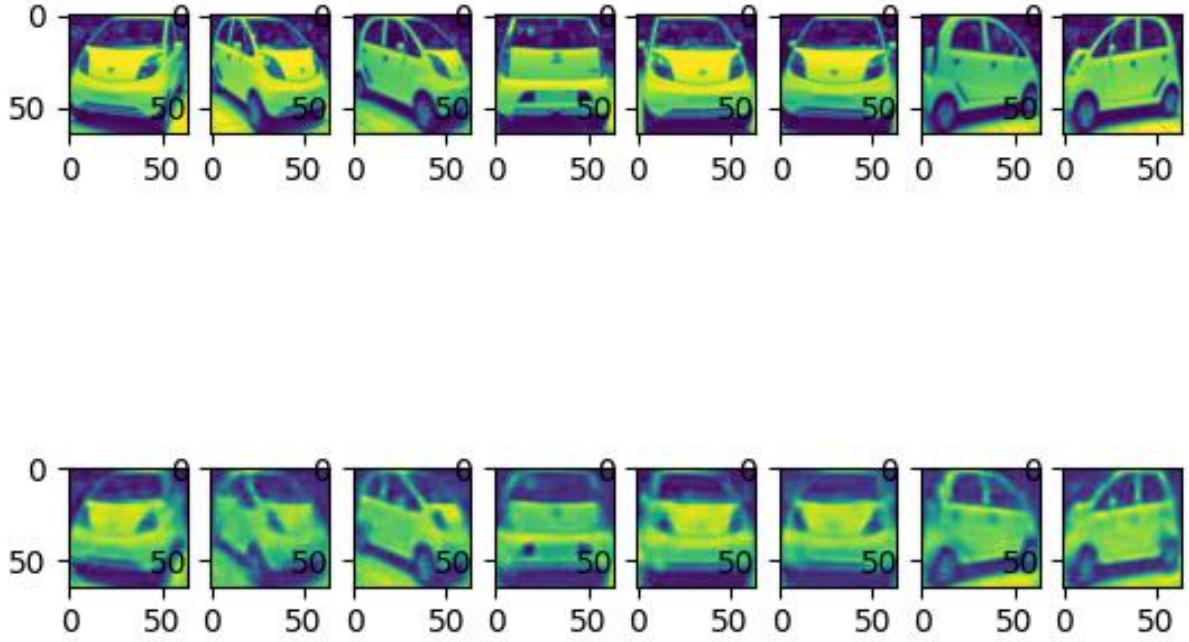
Sequence 4) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



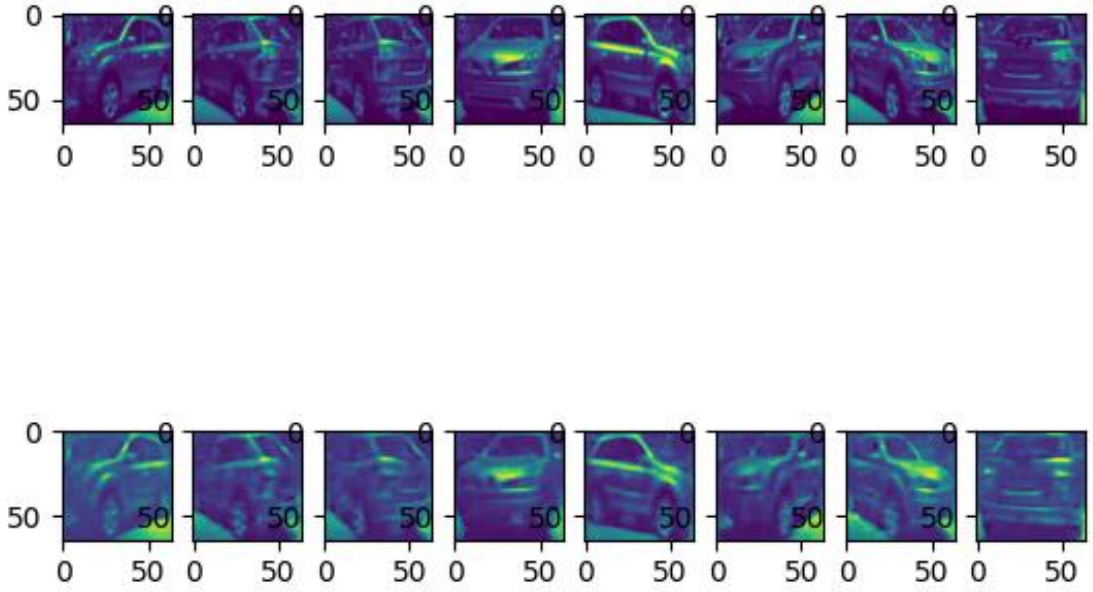
Sequence 5) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



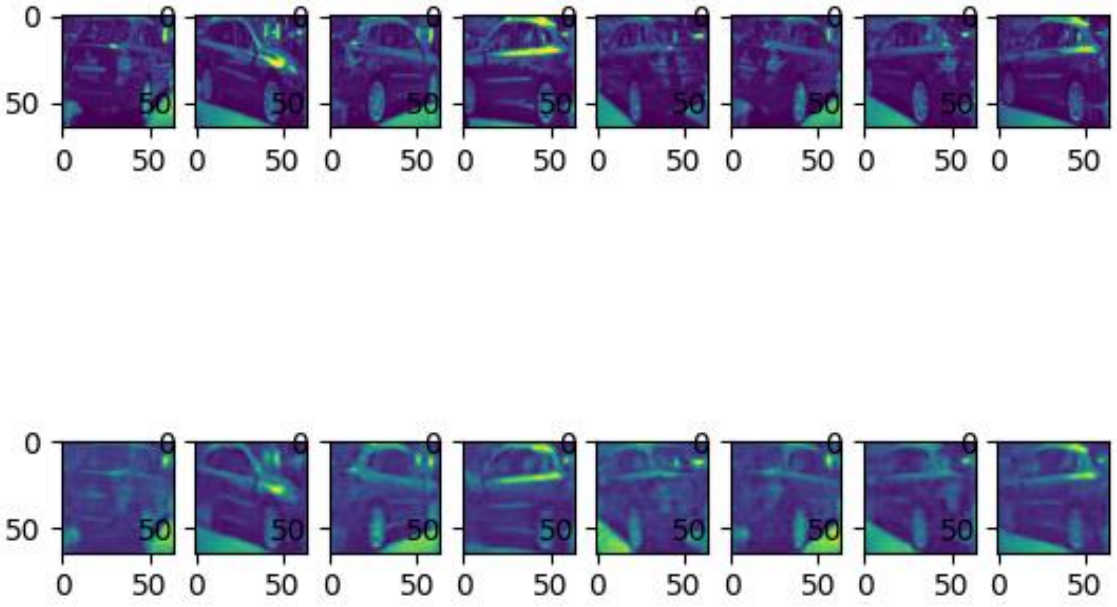
Sequence 6) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



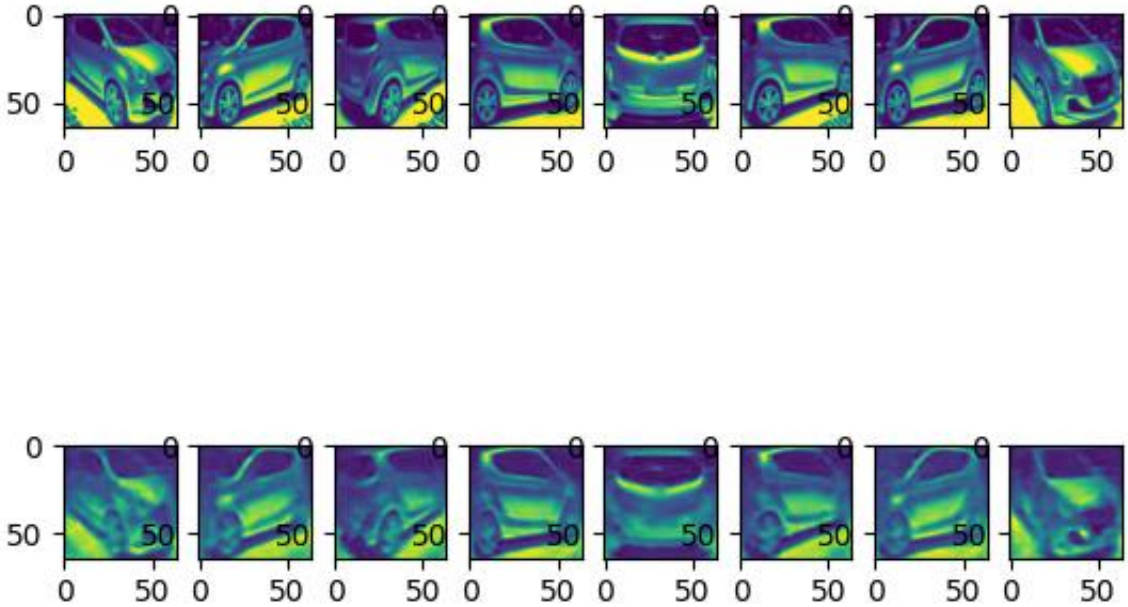
Sequence 7) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



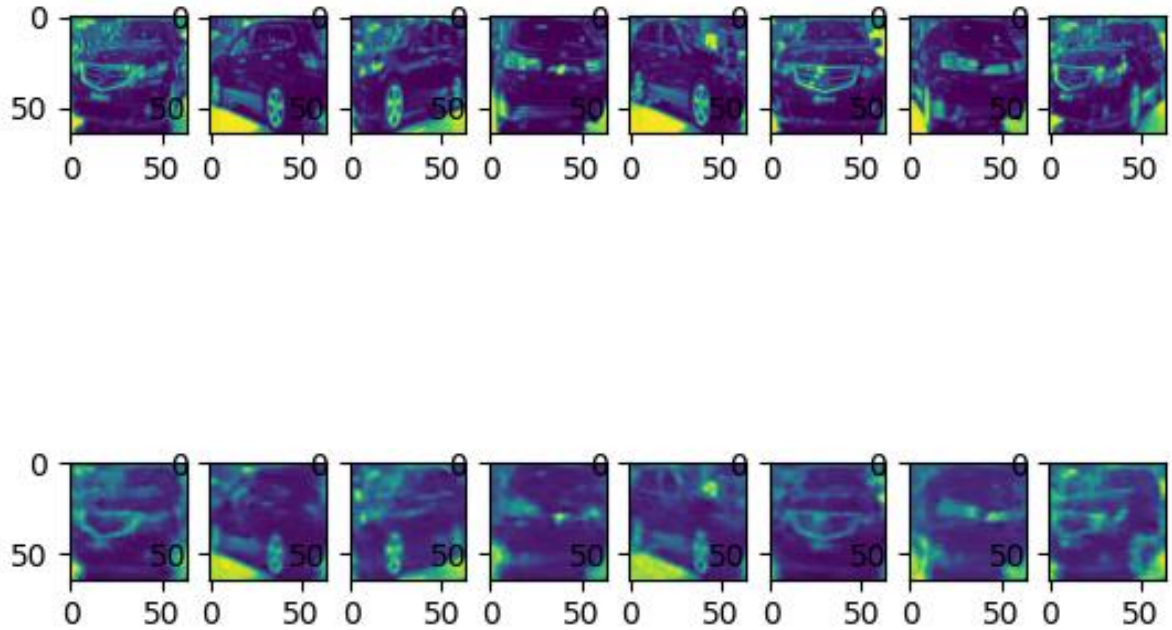
Sequence 8) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



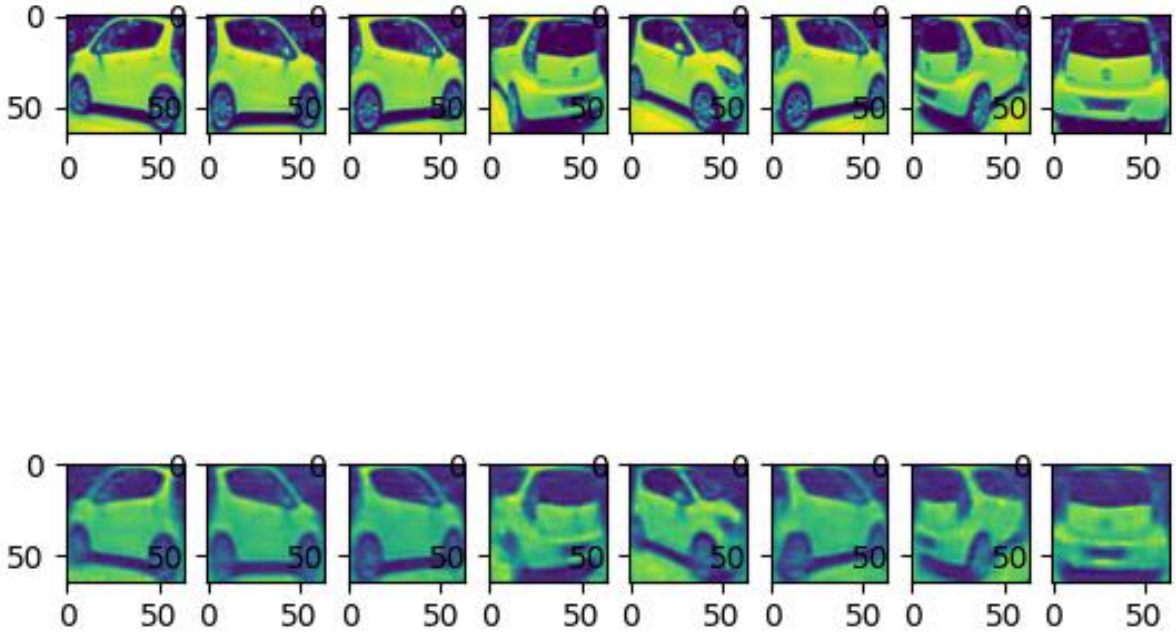
Sequence 9) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



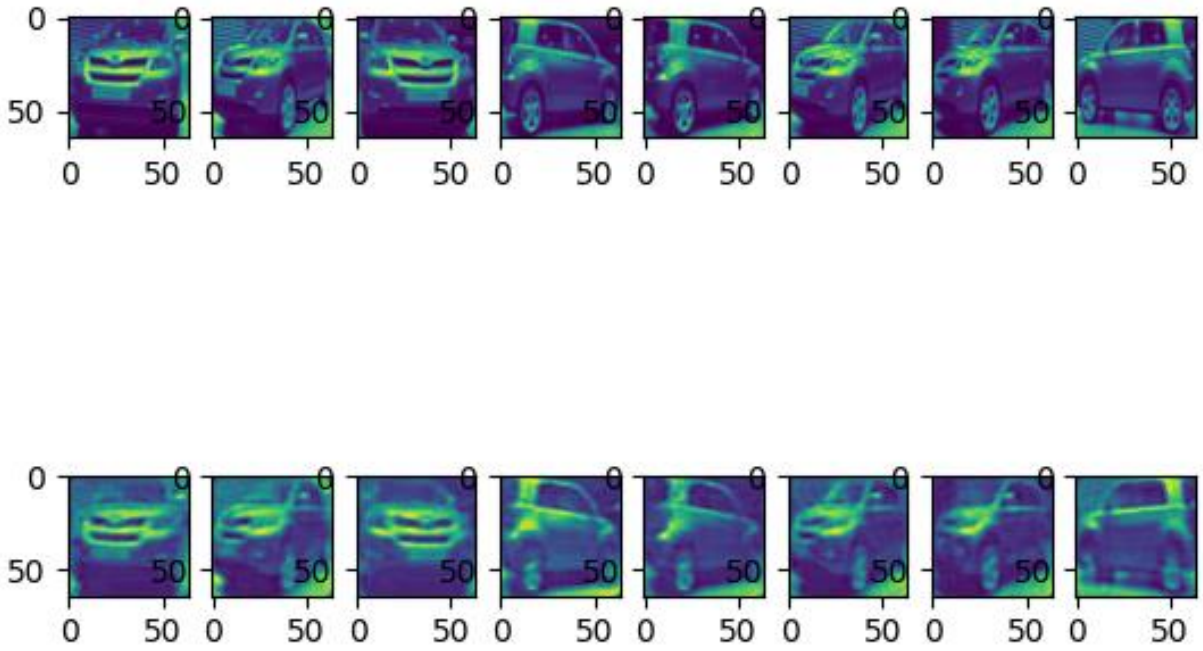
Sequence 10) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



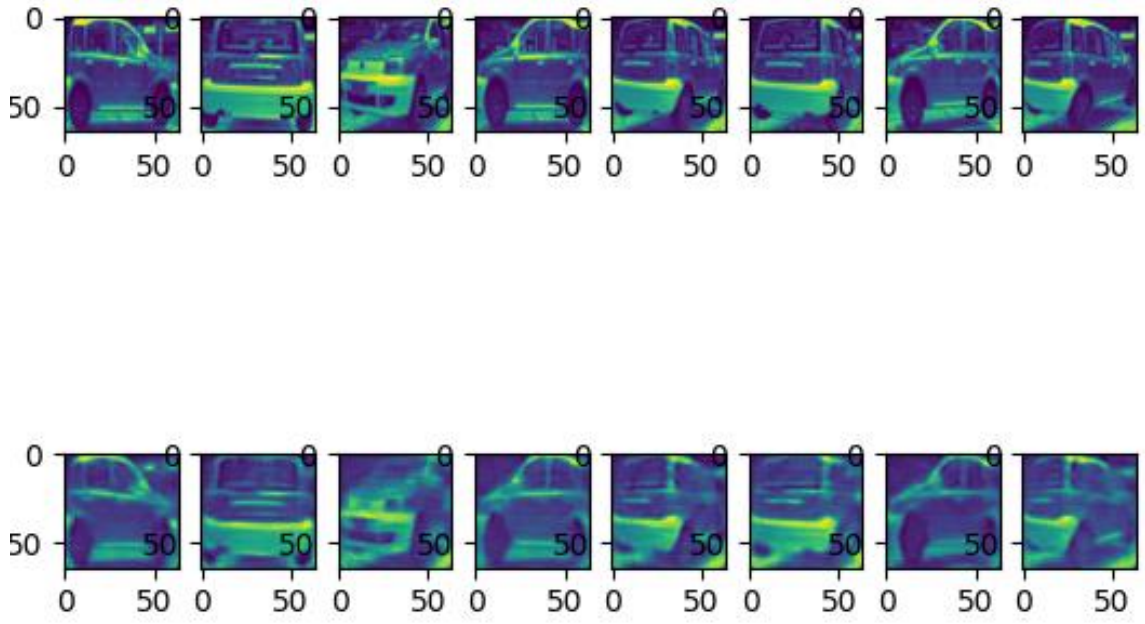
Sequence 11) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



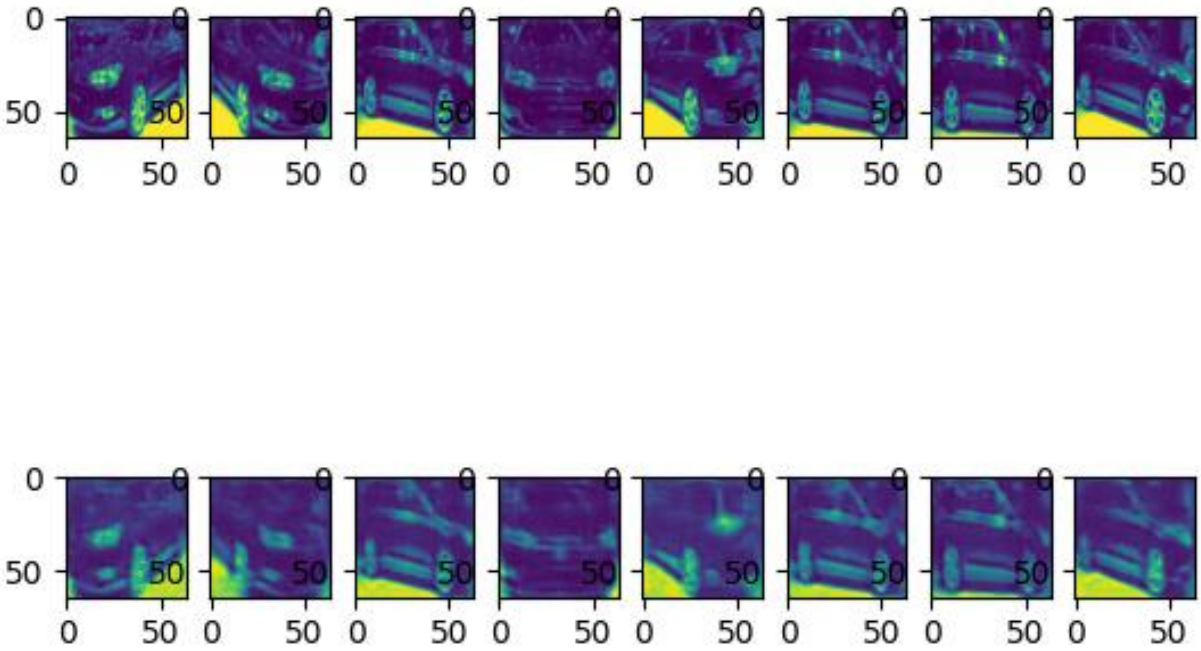
Sequence 12) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



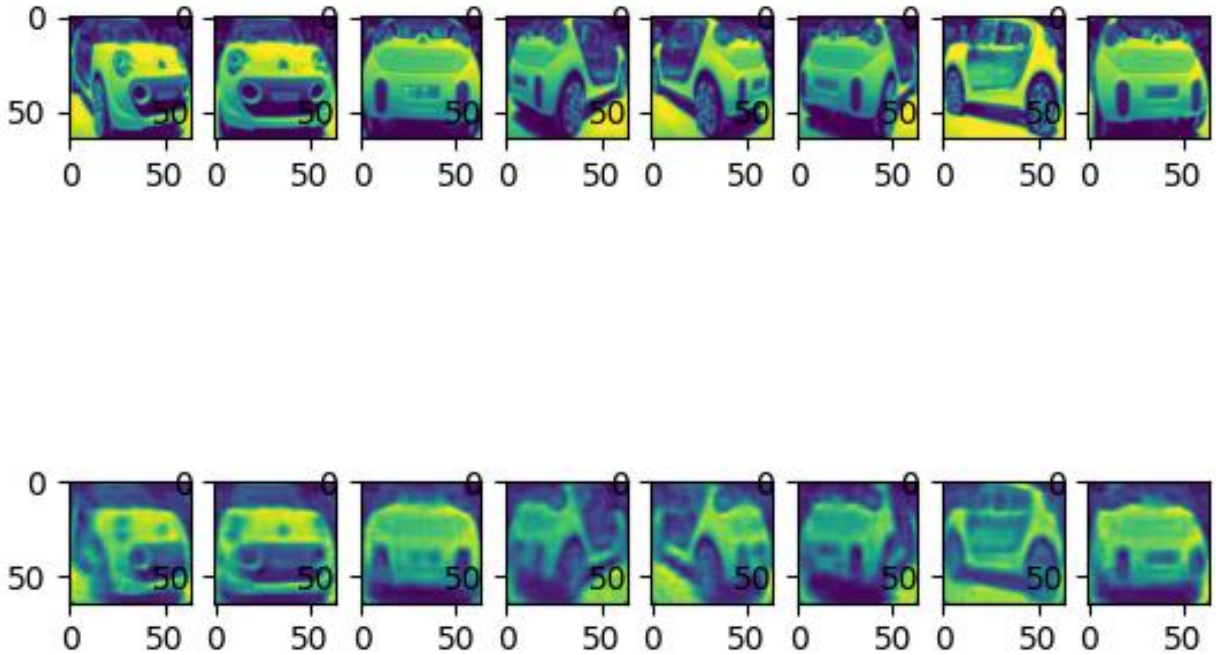
Sequence 13) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



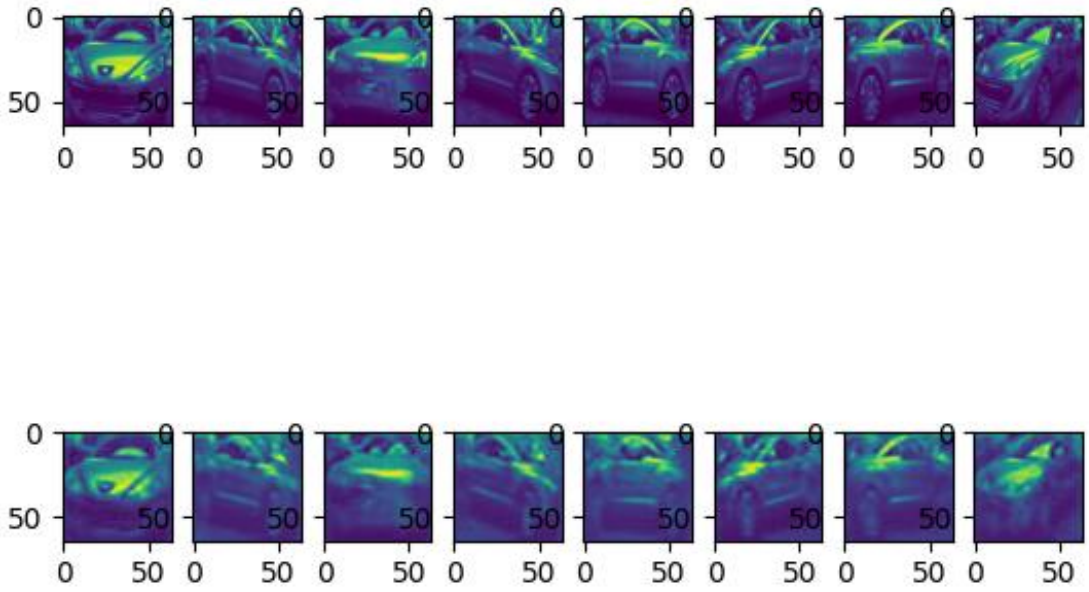
Sequence 14) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



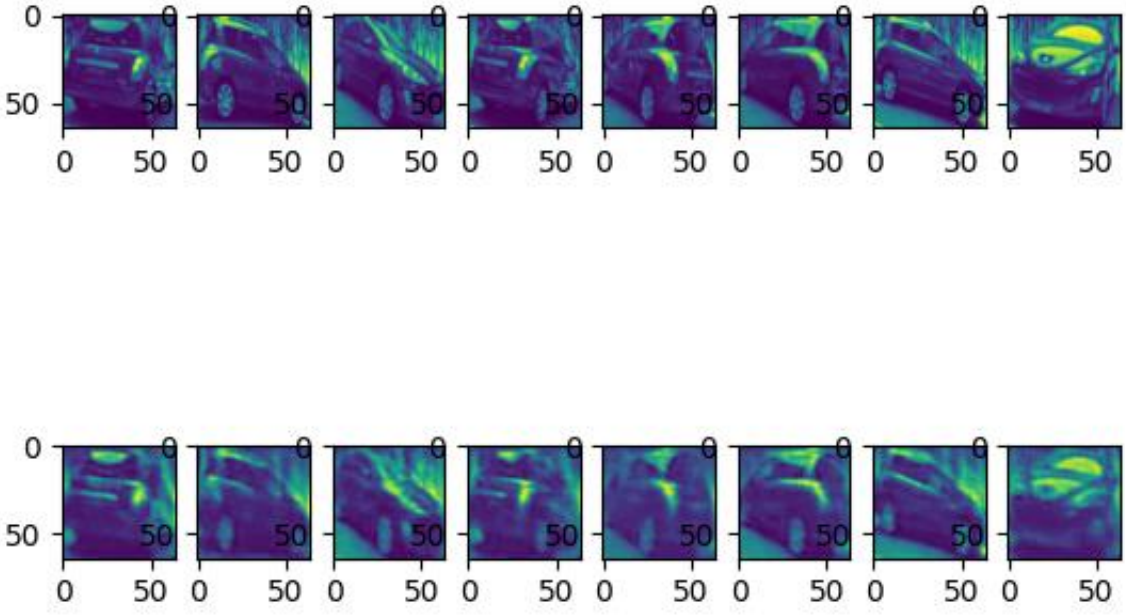
Sequence 15) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



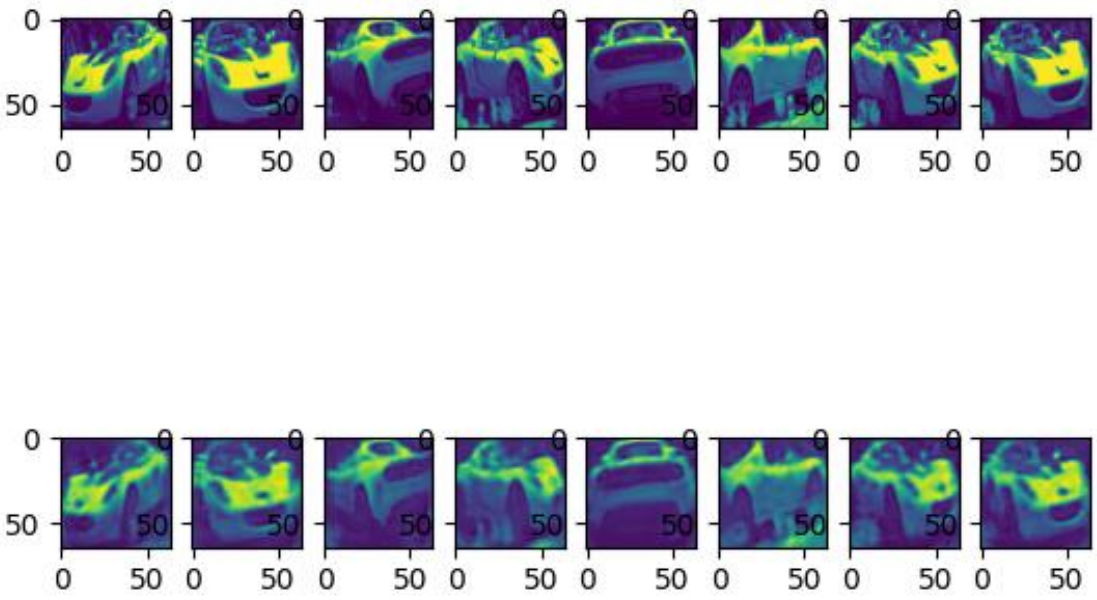
Sequence 16) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



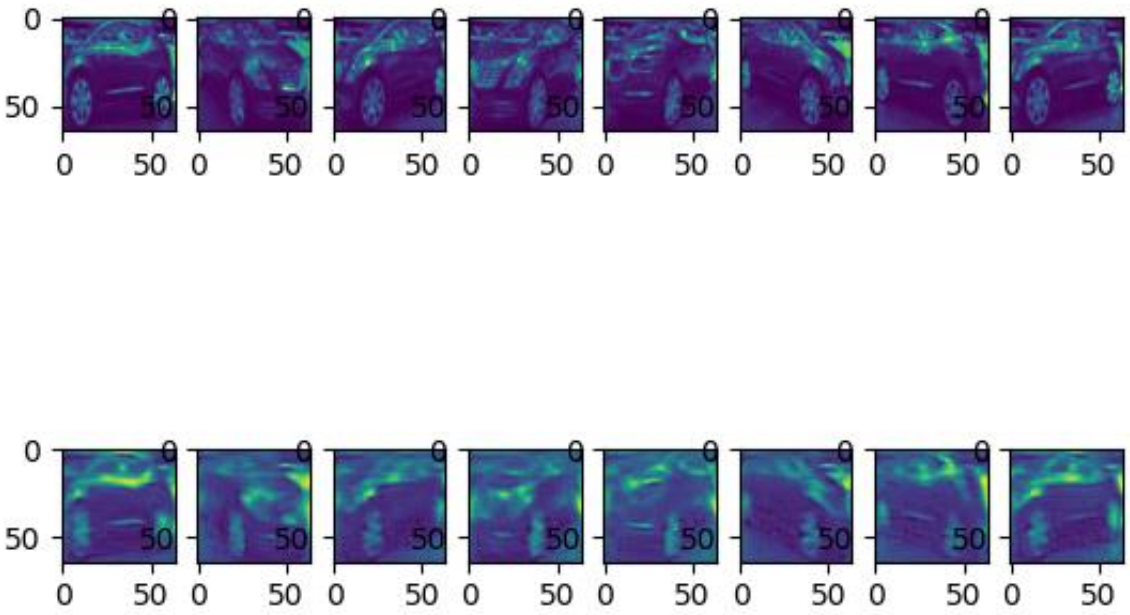
Sequence 17) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



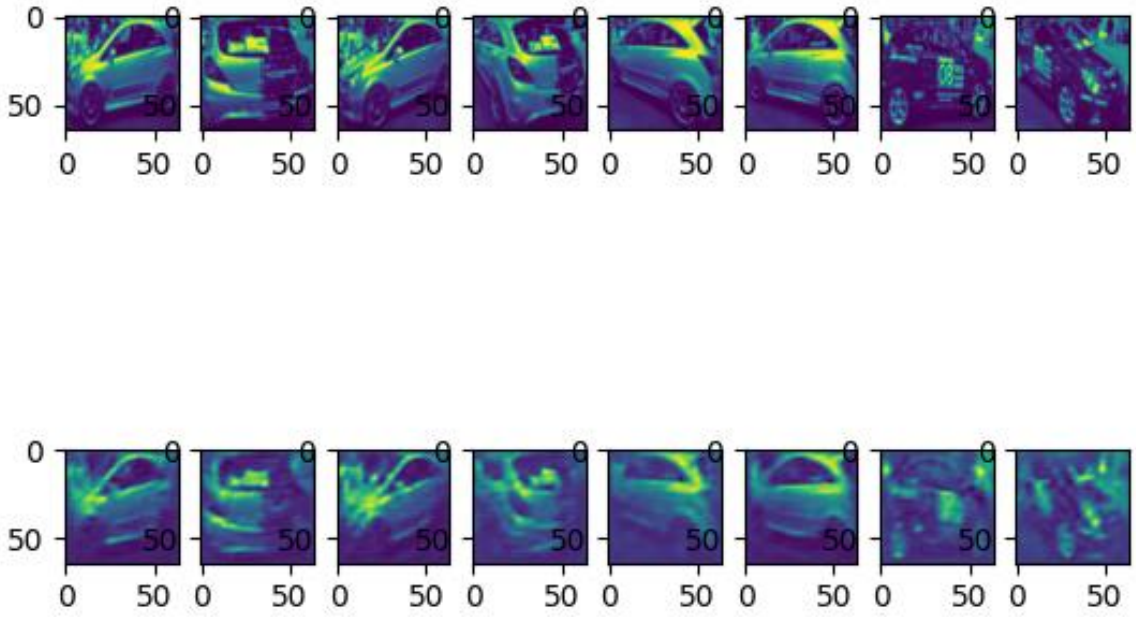
Sequence 18) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



Sequence 19) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



Sequence 20) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.

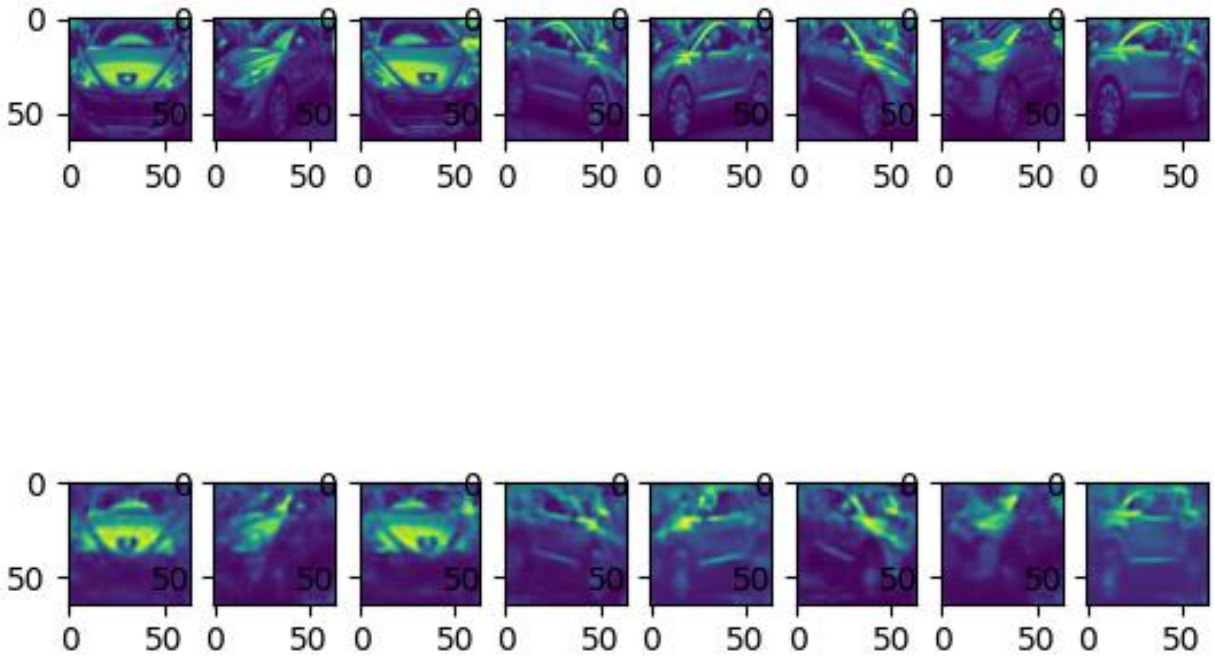


As shown from the above sequence results, while some of the decoded results is similar to the above original images in the corresponding column and the others are not that much similar to the corresponding original ones though the training module is the same for each sequence. There can be many reasons behind this such as illustrations, details on the cars, size of the cars. For example, the lamp of a car is more detailed than the other car's. The learning for this complicated car is hard which increase the error. Another example which is effective on the error is the size of the car. Transition between pixels for bigger cars can be learned easily compared to the smaller cars where the pixel transition of the car is sharper and hard to predict. These and other similar results affect the encode and decode precision for the images.

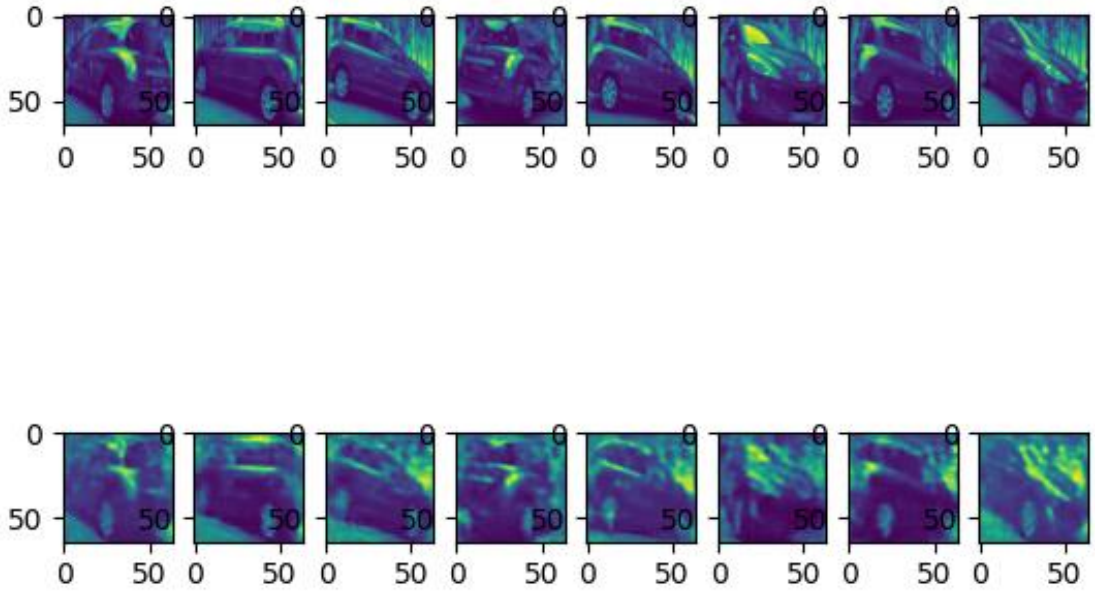
Experiment 2:

Sequence	Observed MSE Error
16	0.0085
17	0.0102
18	0.0139
19	0.0086
20	0.0090

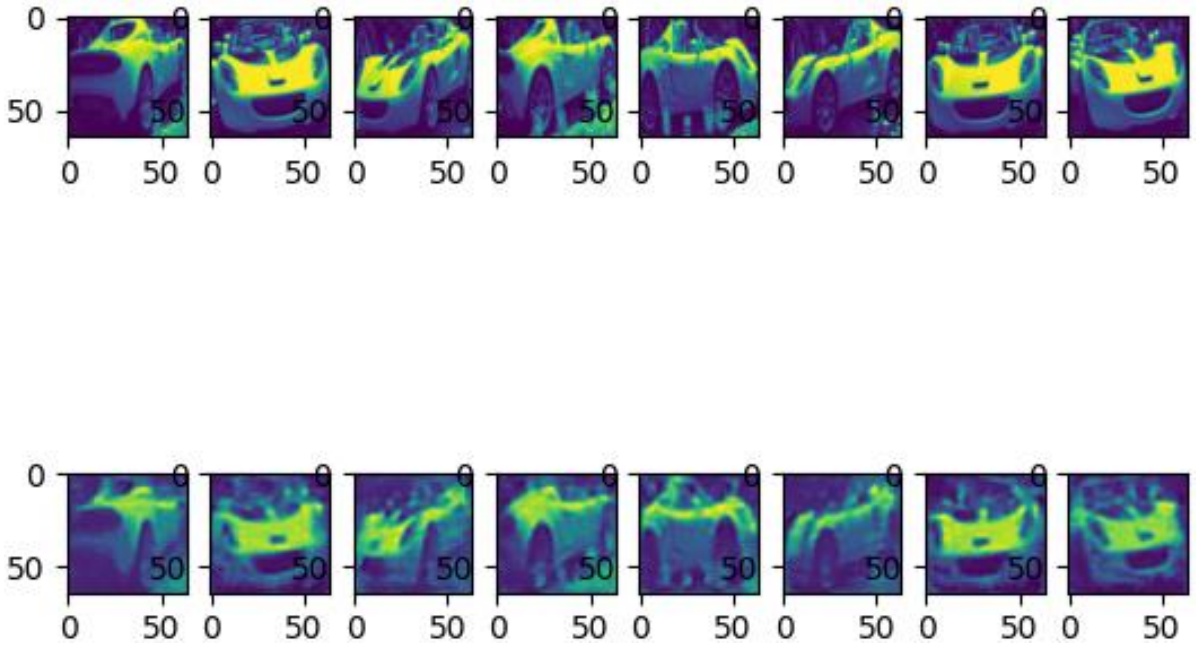
Sequence 16) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



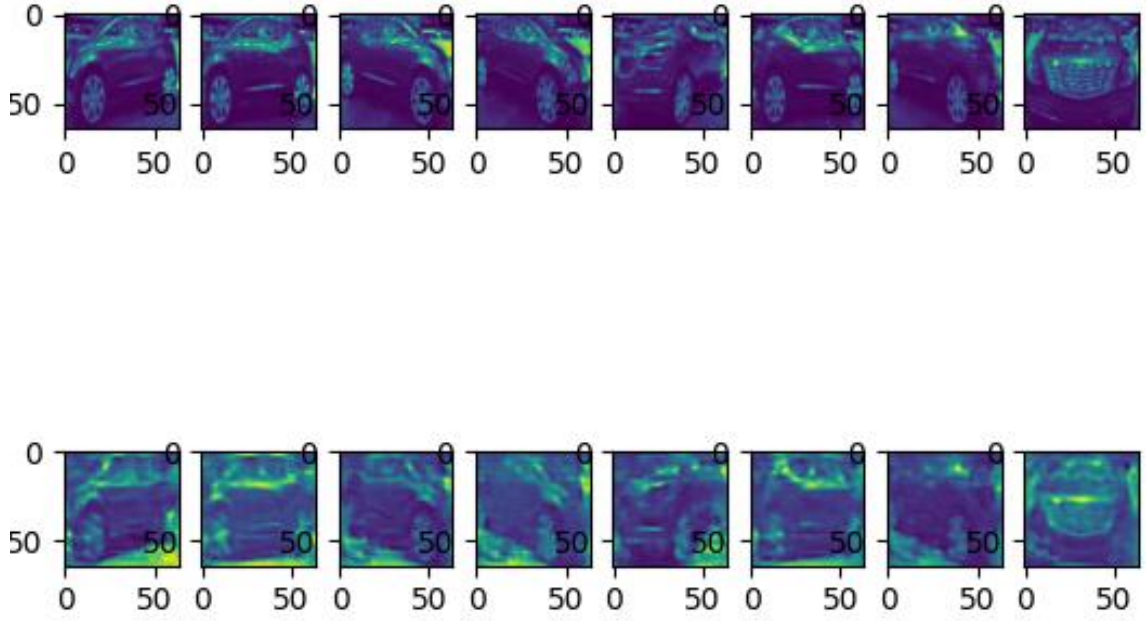
Sequence 17) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



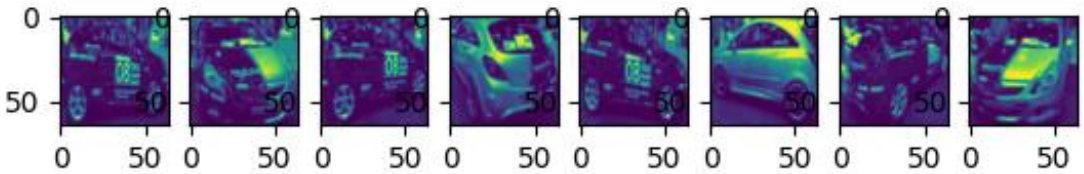
Sequence 18) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.

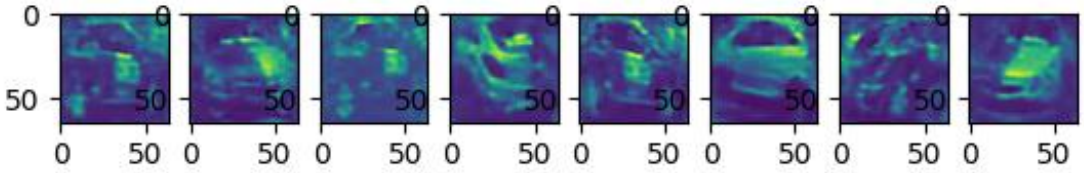


Sequence 19) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.



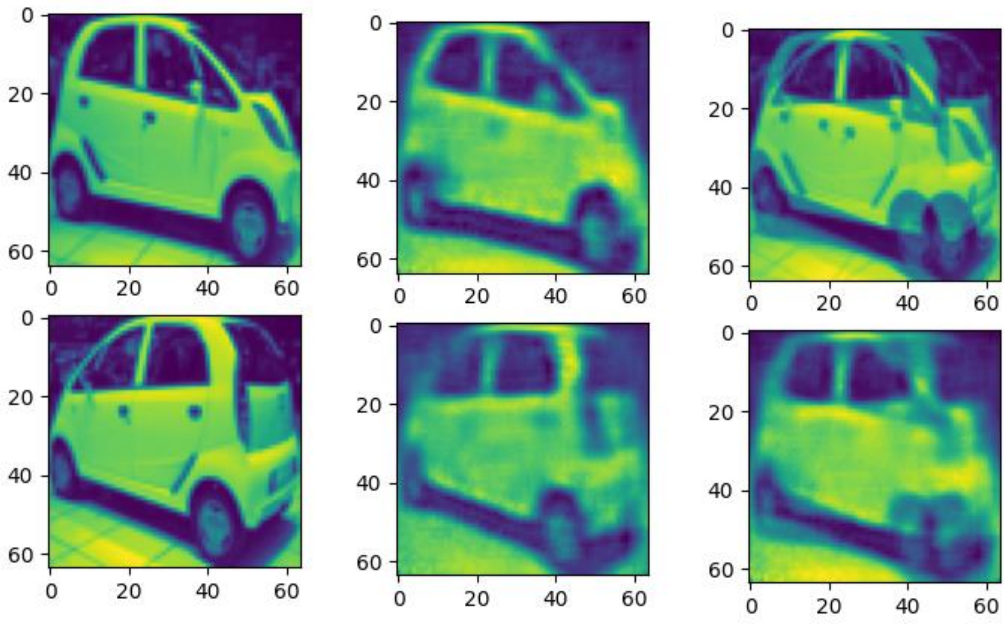
Sequence 20) Each column represents one sample of the corresponding sequence. The above images are the original ones, and the below ones are the encoded and decoded images.





In this training, sequences from 1 to 10 is used to train for model. While training, 11-15 sequences are used for validation to prevent overfitting of the model. To do so, I have tried to tune learning rate during training the model by computing the average loss obtained from the validation set and managing the learning rate after each epoch. The remaining 16-20 sequences are used for the test set, MSE for each sequence are computed separately and decoded outputs are shown above figures respectively.

Experiment 3:



The above figure shows 2 car images from sequence 5 such that the leftmost side is the original ones, the middle ones are the encoded and decoded ones, and the rightmost ones are the interpolated ones. For interpolation torchlerp function that implements linear interpolation with respect to the given weight is utilized. The rows represent original images, decoded images and interpolated image where the above one is the interpolation of the original images as specified in pixel domain and the below one the interpolation of the original images as specified in AutoEncoder latent domain respectively.