4. Use Auto encoder to implement anomaly detection. Build the model by using:

a. Import required libraries

b. Upload / access the dataset

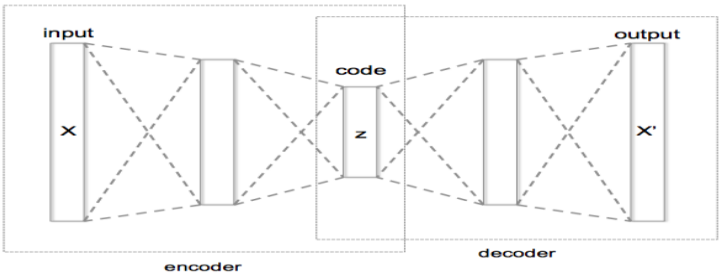
c. Encoder converts it into latent representation

d. Decoder networks convert it back to the original input

e. Compile the models with Optimizer, Loss, and Evaluation Metrics

Auto Encoder

Auto Encoder is an unsupervised Artificial Neural Network that attempts to encode the data by compressing it into the lower dimensions (bottleneck layer or code) and then decoding the data to reconstruct the original input. The bottleneck layer (or code) holds the compressed representation of the input data. The number of hidden units in the code is called code size.



Applications of Auto Encoders

- Dimensionality reduction
- Anomaly detection
- Image denoising
- Image compression
- Image generation

Dimensionality reduction

Dimension reduction methods are based on the assumption that dimension of data is artificially inflated and its intrinsic dimension is much lower. As we increase the number of layers in an auto encoder, the size of the hidden layer will have to decrease. If the size of the hidden layer becomes smaller than the intrinsic dimension of the data then it will result in loss of information.

Anomaly Detection

Anomaly detection is the process of finding abnormalities in data. Abnormal data is defined as the ones that deviate significantly from the general behavior of the data. Some of the applications

of anomaly detection include fraud detection, fault detection, and intrusion detection. Anomaly Detection is also referred to as outlier detection.

Image Denoising

Today, Auto encoders are very good at denoising of images.

What happens when rain drops are on our window glass?

Of course, we can't get a clear image of **"What is behind the scene?"** Here rain drops can be seen as noise. So,

When our image gets corrupted or there is a bit of noise in it, we call this image as a *noisy image*.

To obtain proper information about the content of image, we want **Image Denoising**.

We define our auto encoder to remove (if not all) most of the noise of the image.

Image Compression

Usually, Auto encoders are really not good for data compression. **For Image Compression, it is pretty difficult for an auto encoder to do better than basic algorithms, like JPEG** and by being only specific for a particular type of images, we can prove this statement wrong. Thus, this data-specific property of auto encoders makes it impractical for compression of real-world data. One can only use them for data on which they were trained, and therefore, generalization requires a lot of data.

Feature Extraction

Encoding part of Auto encoders helps to learn important hidden features present in the input data, in the process to reduce the reconstruction error. During encoding, a new set of combination of original features is generated.

Image Generation

There is a type of Auto encoder, named Variational Auto encoder (VAE), this type of auto encoders are **Generative Model**, used to generate images.

The idea is that given input images like images of face or scenery, the system will generate similar images. The use is to:

Generate new characters of animation

Generate fake human images

Conclusion:

Thus we have studied Auto encoder for anomaly detection.