



# Autoencoder Neural Networks and its Applications

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## DESCRIPTION

An autoencoder neural network is an unsupervised machine learning algorithm that applies backward propagation and adjusts the target value to match the input. Autoencoders are used to reduce the size of the input to a smaller representation. Anyone who needs the original data can reconstruct the original data from the compressed data. Autoencoders are a popular type of unsupervised artificial neural network that captures unlabeled data and learns efficient encodings of the structure of the data that can be used in different contexts. The autoencoder approximates a function that maps data from the entire input space to lower dimensional coordinates, further approximating the same dimension in the input space with minimal loss.

## TYPES OF AUTOENCODERS

### Convolution autoencoders

Traditionally formulated autoencoders do not take into account the fact that a signal can be considered the sum of other signals. The convolutional autoencoder takes advantage of this observation by using the convolution operator. They learn to encode the input into a series of simple signals and then reconstruct the input from it to change the geometry or reflectance of the image.

### Sparse autoencoders

Sparse autoencoders provide an alternative way to introduce information bottlenecks without reducing the number of hidden layer nodes. Instead, build a loss function that penalizes activation within the layer.

### Deep autoencoders

An extension of a simple autoencoder is the deep autoencoder. The first layer of the Deep Autoencoder is used for the primary function of the raw input. The second layer is used for the

secondary features that correspond to the pattern of appearance of the primary features. The deeper layers of deep autoencoders tend to learn even higher levels of functionality.

### Contractive autoencoders

The contractive autoencoder is an unsupervised deep learning technique that helps neural networks encode unlabeled training data. This is achieved by constructing a loss term that penalizes the large derivative of hidden layer activation for the input training example. Basically, it imposes a penalty if a small change in input results in a large change in coding space.

## APPLICATIONS

### Feature extraction

The autoencoder can be used as a feature extractor for classification or regression tasks. The autoencoder captures unlabeled data and learns an efficient encoding of the structure of the data that can be used for supervised learning tasks. After training the autoencoder network with a sample of training data, you can ignore the decoder part of the autoencoder and use the encoder to convert the raw high dimensional input data into a low dimensional encoded space. I can do it. This low data dimension can be used as a feature of monitored tasks.

### Image denoising

Raw real-world input data is often noisy, and you need clean, noise-free data to train a robust supervised model. You can use the autoencoder to eliminate noise in your data. Image denoising is one of the most common applications where autoencoders try to reconstruct a noise-free image from a noisy input image. The noisy input image is served as the input to the autoencoder, and the noisy output is reconstructed by minimizing the reconstruction loss from the original target (noisy) output. Once the autoencoder weights are trained, they can be used further to remove noise in raw images.

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### Anomaly detection

An anomaly detection version may be used to stumble on a fraudulent transaction or any particularly imbalanced supervised tasks. The concept is to educate autoencoders on most effective pattern statistics of elegance (majority elegance). This manner the community is able to re-building with precise or much less

reconstruction loss. Now, if a pattern statistics of any other goal elegance is exceeded *via* the autoencoder community, it outcomes in relatively large reconstruction loss. A threshold fee of reconstruction loss (anomaly score) may be decided, large than that may be taken into consideration an anomaly.