AutoEncoders

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AutoEncoder

- It is a kind of self-supervised deep learning model since the output neurons tries to be like input neurons and the training of the model is done by comparing the output neurons to the input neurons.
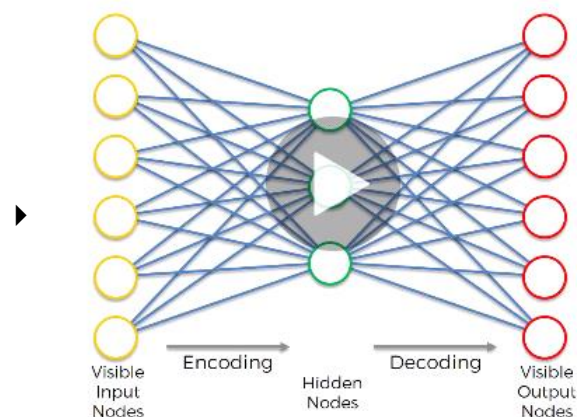
Steps involved in Auto Encoder

STEP 1: We start with an array where the lines (the observations) correspond to the users and the columns (the features) correspond to the movies. Each cell (u, i) contains the rating (from 1 to 5, 0 if no rating) of the movie i by the user u.

STEP 2: The first user goes into the network. The input vector $x = (r_1, r_2, ..., r_m)$ contains all its ratings for all the movie

STEP 3: The input vector x is encoded into a vector z of lower dimensions by a mapping function f (e.g: sigmoid function):

$$z = f(Wx + b) \text{ where W is the vector of input weights and b the bias}$$

STEP 4: z is then decoded into the output vector y of same dimensions as x, aiming to replicate the input vector x

STEP 5: The reconstruction error $d(x, y) = \|x-y\|$ is computed. The goal is to minimize it.

STEP 6: Back-Propagation: from right to left, the error is back-propagated. The weights are updated according to how much they are responsible for the error. The learning rate decides by how much we update the weights.

STEP 7: Repeat Steps 1 to 6 and update the weights after each observation (Reinforcement Learning). Or:
Repeat Steps 1 to 6 but update the weights only after a batch of observations (Batch Learning).

STEP 8: When the whole training set passed through the ANN, that makes an epoch. Redo more epochs.
passes through the neural network,

Overcomplete Hidden Layer

If the no of hidden nodes is equal to or greater than the number of input nodes.
Then the information would easily fly through the input node to output node and therefore the auto encoder would be useless.

Hidden nodes just copy the values to the output layer without finding any features from the inputs.
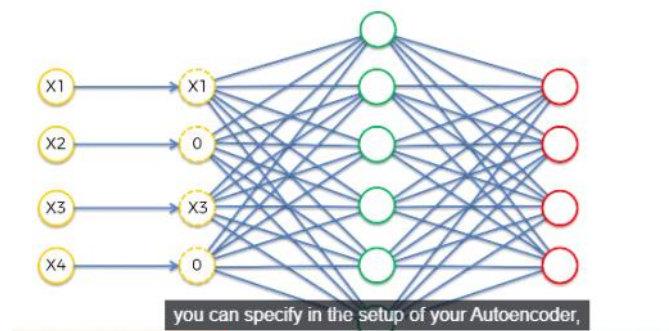
Techniques to prevent Overcomplete Hidden Layer:-

1)Sparse Auto Encoder

Sparse auto encoder is an auto encoder in which the number of hidden neurons are greater than the number of input neurons but has a regularization technique which introduces sparsity.
All the hidden neurons dont work at the same time. For every row , some of hidden neurons are significant and some of the neurons are significant.

2)Denoising Auto Encoder

Denoising Auto encoder generates a new version of input to avoid copying of data from input to output neurons.

you can specify in the setup of your Autoencoder,

3)Contractive Auto Encoder