

Learning BP

Yuan An

May 1st, 2018

Backpropagation [1] is a method used in artificial neural networks to calculate a gradient that is needed in the calculation of the weights to be used in the network. It is usually applied to train deep neural networks¹ [2].

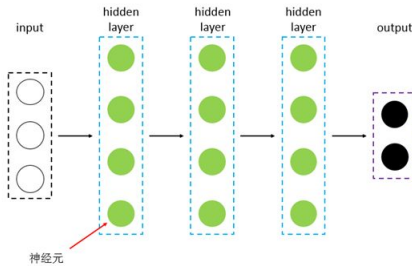


Figure 1: An example of DNN

Backpropagation is commonly used by the gradient descent² optimization algorithm to adjust the weight of neurons by calculating the gradient of the loss function.

Loss function is sometimes called cost function or error function. The loss function is a function that maps values of one or more variables onto a real number. For

¹a class of artificial neural network with multiple hidden layer between the input and output layers that can model complex non-linear relationships.

²a first-order iterative optimization algorithm for finding the minimum of a function

backpropagation, the loss function calculates the difference between the network output and its expected output after a case propagates through the network.

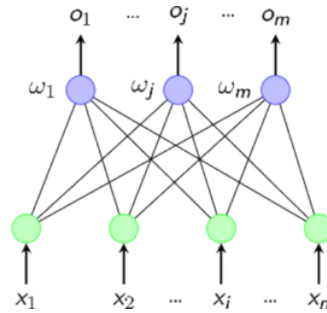


Figure 2: A model of BP

The limitations of BP are as follows:

- Gradient descent with BP is not guaranteed to find the global minimum of the loss function, but only a local minimum.
- Backpropagation learning doesn't require normalization of input vectors while normalization might improve performance.

Backpropagation is also a generalization of the delta rule³ to multi-layered feed-forward network, made possible by using

³a gradient descent learning rule for updating

the chain rule to iteratively compute gradients for each layer. It is closely related to the Gauss-Newton algorithm, and is part of continuing research in neural backpropagation.

References

- [1] Wikipedia.org. Backpropagation.
<https://en.wikipedia.org/wiki/Backpropagation>.
- [2] Wikipedia.org. Deep neural network.
https://en.wikipedia.org/wiki/Deep_neural_network.

the weights of the inputs to artificial neurons in a single-layer neural network.