Journal of Research and Innovation in Technology, Commerce and Management
Vol. 3 Issue 4, April 2026, pp. 34100-34106
ISSN: 3049-3129(Online)

An overview on different Layers of Artificial Neural Network

Komal Bharti
Assistant Professor, FITCS,
Parul University, Vadodara, Gujarat.
Email: bhartikomal503@gmail.com

Hetanshu Ilaviya
Parul Institute of Technology
Parul University, Vadodara, Gujarat

Cite as: Komal Bharti, & Hetanshu Ilaviya. (2026). An overview on different Layers of Artificial Neural Network. Journal of Research and Innovation in Technology, Commerce and Management, Vol. 3(Issue 4), 34100–34106. https://doi.org/10.5281/zenodo.19703672

DOI: https://doi.org/10.5281/zenodo.19703672

Abstract **-** *We* know that human brain is the only part of human body that is responsible for the various activities that our body performs. When we decide to do a particular task our brain generates a concept first then it will create an algorithm about how we can perform it. But the bigger question is, "Can we use our brain to do multitask at the same time?" and the answer is no. If we take a closer look to a human brain we will get to know that our brain is made up of individual neuron units, which is a nerve cell which is the basic building block of our nervous system. So if we can replicate the behaviour of a neuron then we can build an Artificial Neural Network (ANN) that can replicate functionality of our human brain. Here I will give a brief idea how it works like we have many processes going in our brain e.g. watching, feeling air on our skin or feeling hungry etc. all these tasks are carried in our brain with the help or different neurons, just like that in ANN there are different nodes which carries different signals in this network with their respective weights, in ANN it calculates its weighted sum and then passes it to function which makes it perform different actions.

Keywords – Artificial Neural Network, Learning, Number Recognition, Pattern Recognition.

Introduction

Artificial Neural Network are based on the model of our human brain just like our brain have several neurons which together takes out a task, and by using that approach we can solve the problems like pattern recognition and classification, approximation, optimization and data clustering but for that we must first step

into the working of Biological Neural Network (BNN) and its working patterns.[1]

Biological Neural Network(BNN)

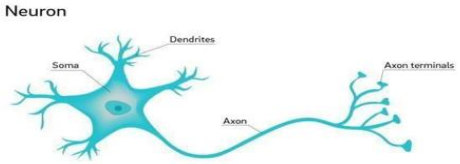


Fig. 1 A Biological Neuron

Human brain is nothing but the network of several individuals known as Neuron. In a biological neuron there are four parts.

i. Dendrites
ii. Soma
iii. Axon
iv. Axon terminals

Dendrites are the receiver of signals that are coming from other neurons in the form of electrical impulse via chemical process. Once we have received the information it moves to

the **Soma,** which takes all the information and processes it and sums it up and then transfer it to the **Axon** which transfer it to **Axon terminals** which are connected to other neuron's **Dendrites.[2]**

Our Artificial Neural Network inherits some of the properties of our BNN which are:

i. Our artificial neuron receives many signals.
ii. A signal gets modified when a weight gets attached to it.
iii. The artificial neuron do the summation of weighted inputs.
iv. Neuron transmits a single output in some special cases.
v. The output of one neuron may go to many neurons.
vi. The processing of information stays local.
vii. The strength of synapse may vary after some experience.

Artificial Neural Network (ANN)

Now with this information we can now move towards our ANN. [2]

Let's take a simple example of working of artificial neural network, for this we are taking example of handwritten number recognition like we have numeric ranging from 0 to 9 and we want our AI to recognize the number. So first step is to make AI learn about the numbers, for that we need to divide our problems into layers.

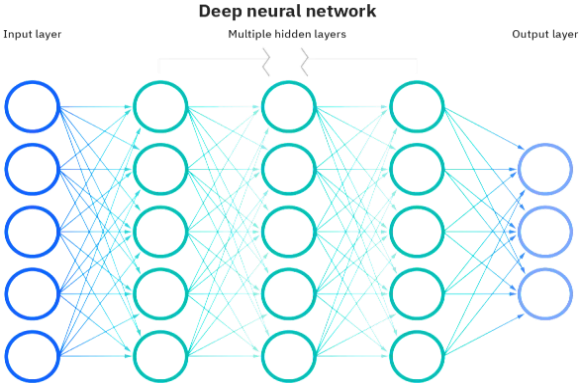


Fig. 2 Layers of neural network

Here in this picture we have an input layer and some hidden layers and an output layer,

before discussing the layers I want you to know that

here when we are taking neuron we take a variable that can hold a value from 0 to 1(ex 0.4, 1.0, 0.5) now the network starts with grid of 28 x 28 pixels which is 784 neurons for total inputs and every neuron holds a grey scale value of the pixel from 0 to 1 where 0 is the black pixel and 1 is the white pixel, this number can be called as the **Activation**. And when the activation is high the pixel will be more illuminated, and these pixel together makes up the first layer of our network called as Input Layer.

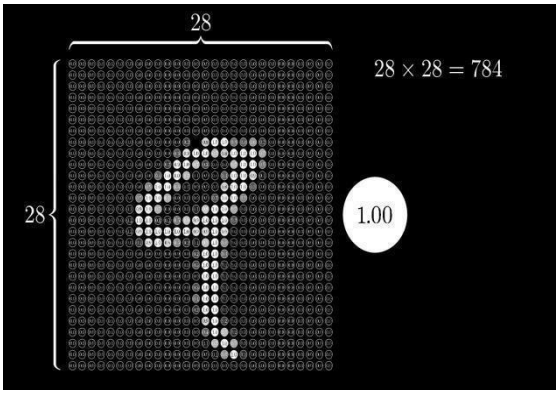


Fig. 3 28x28 grid of pixels

Once we have our first layer set up we can now start building our network and we can set our last layer as the numbers from 0 to 9.

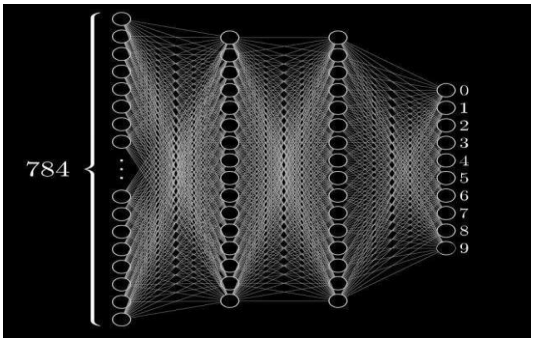


Fig. 4 layers with inputs and outputs

The layers in the middle is called as the hidden layers which is responsible for selecting the right choices and generating the outputs so that next layer can easily operate on it which is going to generate the result which is responsible for selecting the right choices and to generate the correct output for the user, to sum it up hidden layers are mainly the heart of

this neural network and this is responsible for taking the activation of one layer and determining of the activation of the next layers.

generating the outputs so that next layer can operate on it and

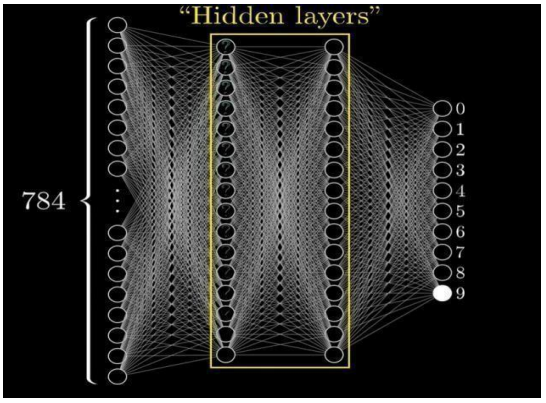


Fig. 5 Hidden Layers

So this means if we feed our network an image i.e. 784 neuron worth of data then according to it grey scale reading it can provide back the output in the form of the numeric.

Now when we know how this as a whole architecture works one might think why the layered structure and how this is more efficient.

Why layers?

Once we are done with the learning

how the above process works, now we can dive deep and now we can learn how **Hidden Layer**s works. Numeric that we read or write also have different pattern like:

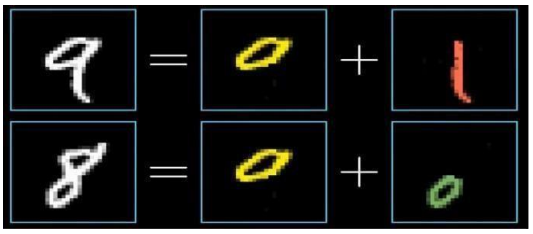


Fig 6 Pattern in numeric

Here in Fig. 6 we have two numbers 8 and 9 where in 8 there are two loops which are joint together to get a number whereas in 9 we also have loop but the loop of 9 is joint with a line that makes these two numbers different to scan.

And if we assign these patterns to one of the hidden layer which can match the pattern and then get to the number then our layered structure will look like:

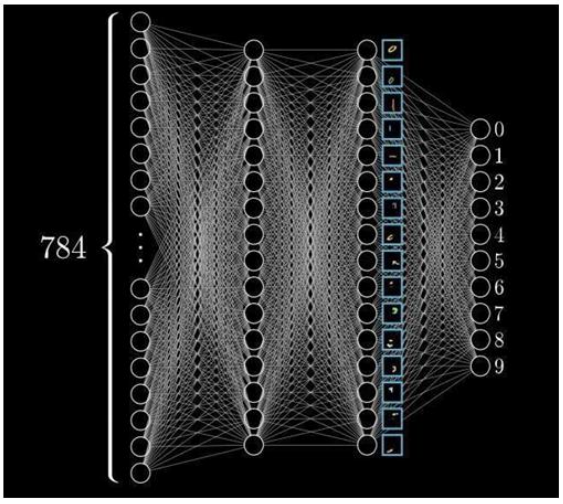


Fig. 7 pattern placing in hidden layer

Now if we take a closer look to these patterns which are nothing but just the combination of some small edges which comes together and makes up that pattern. Like we have loop which is there in 8, 9 and 6 we can break it into smaller parts like:

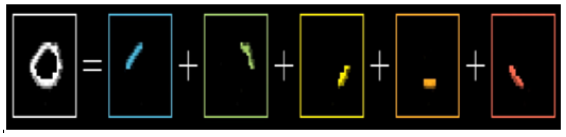


Fig 8 Small edges of a pattern

With the fragments of these edges in one hidden layer we can compute that what would be the fragments needed for forming the whole number and by combining all these fragments we will get the pattern which will match the desired number output we want it to recognize.

Till now we got the basic idea of how this neural network works. We can now further

proceed towards what parameters we need to use so that our ANN will know that it has that edge. For that we assign each connection from one neuron to the neurons of the previous layer a number that we call as **Weight,** and then we take all the activation from the previous layer and calculate their weighted sum according to these weights.

$$w_1 a_1 + w_2 a_2 + w_3 a_3 + w_4 a_4 + \cdots + w_n a_n$$

Fig 9 weighted sum equation

This weighted sum will match the illuminated pixels and add some negative weights around that area so that we will get the largest weighted sum of the illuminated area. Now the weighted sum from fig. 8 can be any

number but for this example here we want its activation to fall between 0 and 1, for that one thing we can do is to use a function that can wrap this thing in between the range of 0 to 1, which is our desired range, and the function that does this is called as the **Sigmoid function**, basically what this function does if it will get the negative inputs that will ends up to be 0 and any positive input will become 1and it will steadily increase between 0 and 1.

$$S(x) = \frac{1}{1 + e^{-x}}$$

Fig. 10 Sigmoid Function Equation

Fig10 is the sigmoid function equation and the curve we can plot with it is:

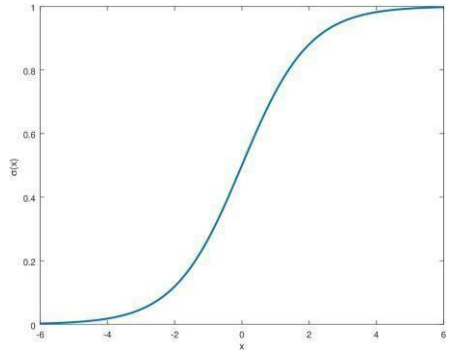


Fig 11 Sigmoid curve

Now let's say if we want our value to fall under some range so for that we can add or subtract the value into our Fig 9 weighted sum equation before putting it into sigmoid function(Fig 10), and we can all that value as **Bias.** And if we want to add the bias for a value then we need to add bias for all neurons of that layer just for instance let's say we have 2 hidden layers each with 16 neurons then weights for this whole network will be 784x16 + 16x16 + 16x10 which gives us 12960 and when we add the bias to it (i.e. 16+16+10 which is 42) we get 13002. This value 13002 is the combinations in which our neural network can work and behave.

Mathematical Notations of Neural Network

First of all we need to organize our activations from one layer into a column as a vector and then we can arrange our weights as the matrix so that each row of that matrix can respond particularly to one neuron present in the next layer.

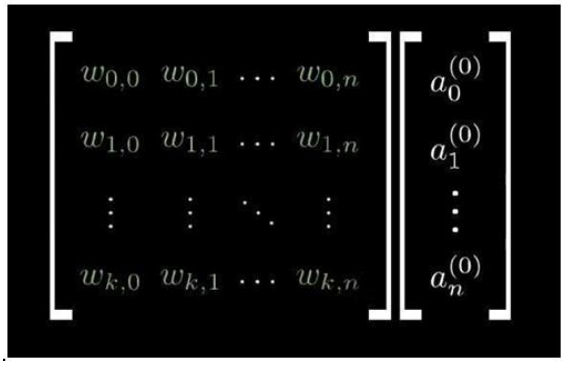
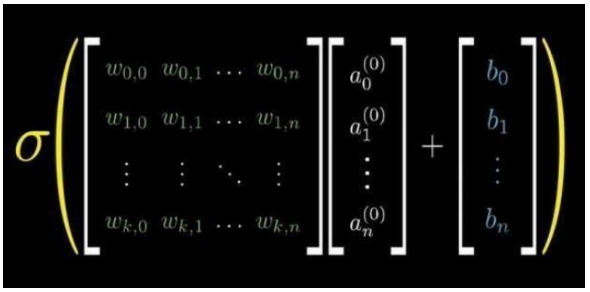


Fig 12 mathematical notation of weighted sum

Now with the help of matrix product we can get our desired output. For the function with some bias value this representation will become:



And with these functions we can communicate between the layers of the

network and we can even write a code that can evaluate the desired output.

Conclusion

In this paper we discussed about how an ANN works for that we first discussed about the Biological neural network (BNN) which consists of several individuals called as neurons, then we discussed about how a biological neuron takes the information from many neurons and process it and transmits its output to other neurons. With the help of this information we took an example of number recognition in ANN which starts with the grid of 28x28 pixels which is 784 pixels where each pixel act as a neuron which holds a piece of information called as grey scale value, this grey scale values tells us what kind of edges those pixels will make which will eventually forms the pattern and by combining these patterns we get our number which was initially handwritten by a human.

For the calculation part we talked about the sigmoid function which squishes the value in the desired range so that we can transmit that

relatable information to the neurons in the next layer, with these functions we can now create a vector and a matrix with which we can calculate the all combinations that are needed to perform such kind of operations.

References

[1] S.C. Shapiro, Artificial intelligence, in Encyclopedia of Artificial Intelligence, vol. 1, 2ndedn., ed. by S.C. Shapiro (Wiley, New York, 1992)

[2] C.B. Gokulnath, S.P. Shantharajah,An Optimized Feature Selection Based on GeneticApproach and Support Vector Machine for Heart Disease (Springer Nature, Iran, 2018)

[3] E.R.Q. Fernanded, A.C.P.L.F. de Carvalho, X. Yao, Ensemble of classifiers based onmultiobjective genetic sampling for imbalanced data. IEEE Trans. Knowl. Data Eng. 14(8)(2015)

[4] F. Babiˇc, J. Olejár, Z. Vantová, J. Paraliˇc, Predictive and descriptive analysis for heartdisease diagnosis, in FedCSIS, vol. 11 pp. 155–163, IEEE Catalog Number: CFP1785N- ARTc 2017, Slovakia, https://doi.org/10.15439/2017f219. ISSN 2300-5963.

[5] R. Pari, M. Sandhya, S. Sankar, A Multitier Stacked Ensemble Algorithm for ImprovingClassification Accuracy (IEEE, 2018)

[6] A. Agah, Introduction to medical applications of artificial intelligence, in MedicalApplications of Artificial Intelligence (CRC Press, 2013), pp. 19–26.

[7] Meenakshi, M. (2020, May). Machine learning algorithms and their real-life applications:A survey. In Proceedings of the International Conference on Innovative Computing &Communications (ICICC)

[8] C. Cortes, V. Vapnik, Support-vector networks. Mach. Learn. 20(3), 273–297 (1995)

[9] Meenakshi Malik, Rainu Nandal, Surjeet Dalal, Vivek Jalglan, Dac-Nhuong Le," DrivingPattern Profiling and Classification Using Deep Learning", Intelligent Automation & SoftComputing, Vol.28, No.3, 2021, pp.887-906

[10] J.H. John, Neural network and physical systems with emergent

collective computationalabilities. Proc. Natl. Acad. Sci.
U.S.A. 79, 2554–2558 (1982).
[11] A.N. Ramesh, C. Kambhampati, J.R. Monson, P.J. Drew, Artificial intelligence inmedicine. Ann. R. Coll. Surg. Engl. 86(5), 334 (2004)
[12] A. Yardimci, A survey on use of soft computing methods in medicine, in Proceedings ofthe 17th International Conference on Artificial Neural Networks, Porto, Portugal (2007), pp.69–79.