

## **ARTIFICIAL NEURAL NETWORK**

### **INTRODUCTION**

Artificial Neural Network (ANN) also known as Neural Network is a branch of artificial intelligence where computer networks are trained to learn and process data which is influenced by the neural network of the brain. The brain consists of billions of cells called nerve cells or neurons and they communicate signals to one another (Van Gerven and Bohte, 2017). Likewise in ANN, neurons refer to collection of nodes which are connected to one another in the net. The neurons are closely intertwined and stacked into layers. There are two major layers which are the input and output layer. The input layer receives the data while the output layer depicts the target result. In between the input and output layer are the hidden layers, in which the weights are applied to the input and are directed through bias and an activation function (Balarkrishnan et al. 2019).

### **LITERATURE REVIEW**

ANN consists of four main ingredients which are;

- a. Data: This is an historical data which is preprocessed and passed into the network.
- b. Model: This is the method the network uses in conducting its task. The main goal of the model is to generate predictions from input data. The main models are regression and classification.
- c. Objective function: This is also known as the loss function. The aim of a model is to minimize the loss function of the training datasets so as to get an optimum result.
- d. Optimization algorithm: This is an algorithm used in machine learning for optimizing the objective function which can also be referred to as optimizers. Examples of optimizers are: Gradient descent, Stochastic gradient descent, Mini-batch gradient descent, Adagrad, Adam e.t.c.

ANN has been phenomenal in the present world and its applications are stated below;

- i. ANN is used in pattern recognition such as image recognition, speech recognition, image and text classification (Li et al. 2017).
- ii. It is also used in risk analysis systems, computer quality analysis, drug detection, e.t.c
- iii. ANN has been optimized to predict performance of wire electrical discharge machining of Inconel 718 Alloy (Lalwani et al, 2020).
- iv. It can be applied in signal processing systems (Cichocki et. al, 1993).
- v. In South Africa, ANN was used to develop water purification facilities (O'Reilly et al, 2018).
- vi. ANN has established its feet in the detection of noise in telecommunication (Kashi et al, 2017).
- vii. Neural networks are used in predicting stock prices fluctuation (Qui and Song, 2016).
- viii. In medicine, ANN is used to predict the presence of tumors (Nasser and Abu-Naser, 2019)

### **AIM AND OBJECTIVE**

The aim and objective of the report is to use neural network to predict whether a breast cancer patient is going to be benign or malignant.

### **METHODOLOGY**

The dataset is extracted from [https://archive.ics.uci.edu/ml/datasets/breast+cancer+wisconsin+\(original\)](https://archive.ics.uci.edu/ml/datasets/breast+cancer+wisconsin+(original)) and it describes breast cancer of 699 patients in University of Wisconsin hospital. The patients were analyzed based on nine attributes which are: clump thickness, uniformity of cell size, bare nuclei, bland chromatin, normal nucleoli and mitoses. The predicting class labels were either benign or malignant and they were indicated by the number 2 and 4 respectively.

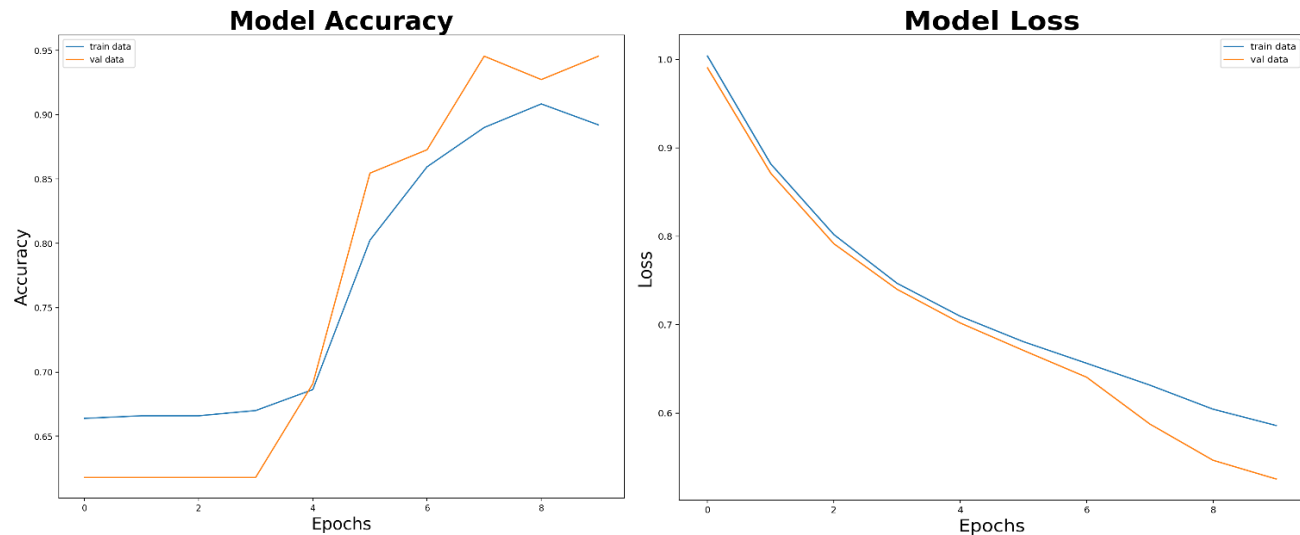
The modules used for the algorithm are pandas, numpy, matplotlib, sklearn and tensorflow. During the course of preprocessing, it was deduced that bare nuclei column had regular expressions in 16 rows and the data had to be cleaned which resulted in the reduction in the rows of the dataset from 699 to 683. The neural network was built on a single hidden layer of 5 units as the dataset was a simple one. The activation function used for the hidden layer was rectified linear unit (ReLU) while the output layer used sigmoid as the activation function. 'Adam' was used as the optimizer, while the objective function used was sparse categorical cross entropy and the metrics used was accuracy. The model was fit with 10 epochs and a validation split of 10% was performed on the training dataset.

After fitting the model, the training accuracy, training loss, validation accuracy and validation loss were visualized using matplotlib functions. The multiple plots were plotted against the number of epochs. Finally, a predictive system was

built to predict whether the diagnosis of a breast cancer patient is going to be benign or malignant. The predictive system accepts a tuple which is first converted into a numpy array, and was reshaped because we are trying to predict a row of data points.

## RESULT

At the end of the model training, it was deduced that the training accuracy, training loss, validation accuracy and validation loss were 89.21%, 58.59%, 94.55% and 52.54% respectively. The model accuracy and model loss plots are shown below:



The model depicted a test accuracy of 83.94%. Also, the probability of each class for the test data was taken into account. In the course of prediction using the model, the first row from the test data was used and it predicted that the breast cancer patient's tumor is benign.

## DISCUSSION

Breast cancer is the major cause of death among women with cancer. Employing deep learning model in the field of medicine is very important due to the risk of the area. Although, an optimization algorithm (Adam) was used with feature weighting, a better algorithm could be used to better the model. Studies show that classifiers that made use of Genetic Algorithm (GA) in feature selection displayed a higher performance compared to those that did not utilize it, Mohan et al, 2020, made use of 3 machine learning models for the prediction of breast cancer with the infusion of GA and it was deduced that GA improved the performance of the algorithm. Additionally, Sakri et al, 2018, made use of GA to predict breast cancer using 198 patients with 34 attributes.

Moreover, the result gave a test accuracy of 83.94%, still other computational methods could give better accuracy because the dataset used was small. Neural network thrives on large dataset because it has not learnt on the training sets before being applied on the test data and fewer dataset does not give room for deep learning, hence the accuracy score.

## CONCLUSION

The proposed model used was able to predict whether a breast cancer patient's tumor would be benign or malignant and it shows how artificial neural network is a life saver and by bettering the model, patients can have the chance of detecting the cancerous cells at the early stage and prevent further risk of developing malignant tumors.

## REFERENCES

- Balakrishnan, Harikrishnan Nellippallil, Aditi Kathpalia, Snehanishu Saha, and Nithin Nagaraj. 2019. "ChaosNet: A chaos based artificial neural network architecture for classification." *Review of. Chaos: An Interdisciplinary Journal of Nonlinear Science* 29 (11):113125.
- Cichocki, Andrzej, Rolf Unbehauen, and Roman W Swiniarski. 1993. *Neural networks for optimization and signal processing*. Vol. 253: wiley New York.
- Kashi, AS, Q Zhuge, JC Cartledge, A Borowiec, D Charlton, C Laperle, and M O'Sullivan. 2017. Fiber nonlinear noise-to-signal ratio monitoring using artificial neural networks. Paper presented at the 2017 European Conference on Optical Communication (ECOC).
- Lalwani, Vishal, Priyaranjan Sharma, Catalin Iulian Pruncu, and Deepak Rajendra Unune. 2020. "Response Surface Methodology and Artificial Neural Network-Based Models for Predicting Performance of Wire Electrical Discharge Machining of Inconel 718 Alloy." *Review of. Journal of Manufacturing and Materials Processing* 4 (2):44.
- Li, Hao, Zhien Zhang, and Zhijian Liu. 2017. "Application of artificial neural networks for catalysis: a review." *Review of. Catalysts* 7 (10):306.
- Mohan S, Bhattacharya S, Kaluri R, Feng G, Tariq U. Multi-modal prediction of breast cancer using particle swarm optimization with non-dominating sorting. *International Journal of Distributed Sensor Networks*. 2020;16(11) doi: 10.1177/1550147720971505.
- Nasser, Ibrahim M, and Samy S Abu-Naser. 2019. "Predicting Tumor Category Using Artificial Neural Networks."
- O'Reilly, G, CC Bezuidenhout, and JJ Bezuidenhout. 2018. "Artificial neural networks: applications in the drinking water sector." *Review of. Water Supply* 18 (6):1869-87.
- Qiu, Mingyue, and Yu Song. 2016. "Predicting the direction of stock market index movement using an optimized artificial neural network model." *Review of. PloS one* 11 (5):e0155133.
- Sakri SB, Rashid NB, Zain ZM. Particle swarm optimization feature selection for breast cancer recurrence prediction. *IEEE Access*. 2018;6:29637–47. doi: 10.1109/ACCESS.2018.2843443.
- Van Gerven, Marcel, and Sander Bohte. 2017. "Artificial neural networks as models of neural information processing." *Review of. Frontiers in Computational Neuroscience* 11:114.