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Application of Artificial Neural Network in Environmental Engineering – A State of the Art Review

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Abstract:

In this research paper, a comprehensive review is conducted on the application of artificial neural network (ANN) in the various arena of environmental engineering correlated complications, however, the conservative methods are bulky and composite in the consideration of computational investigation. The process of Artificial neural networks is demonstrated through its application in water quality, waste-water treatment modelling, and application in air quality analysis. A decent corporeal sympathetic of the water quality index, wastewater treatment, and air quality prediction process is revived. The identification of the most influencing parameter (Input vector) is also systematically overviewed, and which can be considered in the design of a more efficient neural network model. This review delivers illustrations for the ANN model that offers sensible precision for environmental engineering problems, and an additional operative implementation for engineering applications.

Keywords: - Artificial Neural Network (ANN), Water Quality Index (WQI), waste-water treatment, Air quality, Prediction, etc.

1. INTRODUCTION

Artificial neural networks branch of Computer Science and principally inspired by a human biological neural system comprising of several interrelated neurons in the brain. The human brain neurology having huge advancement of the parallel information processing and disseminated storing properties. ANN adopts the same methodology for its application like classification of data, time series analysis, image processing, prediction, etc. requires pre-historical data sets for processing of information to generate the output. For the development of Neural network model, it requires the input data, training and validation process of the data, and then forecast the output for a new set of a case study. ANN can be designated as a scientific structure proficient in representing the uninformed, composite, and non-linear procedure relating to the input and output of any structure.

The basic structure of an artificial neural network contains an artificial neuron which is the processing element having an extremely unified network divided into three important groups of layers.

The most common ANN structure contains an input layer that collects the information along with weights and bias, one or more hidden layers to increase the accuracy of the network, and an output layer that generates output through the summation of all processed data and activation function. A simple mathematical model of an artificial neuron is shown in Fig.1.

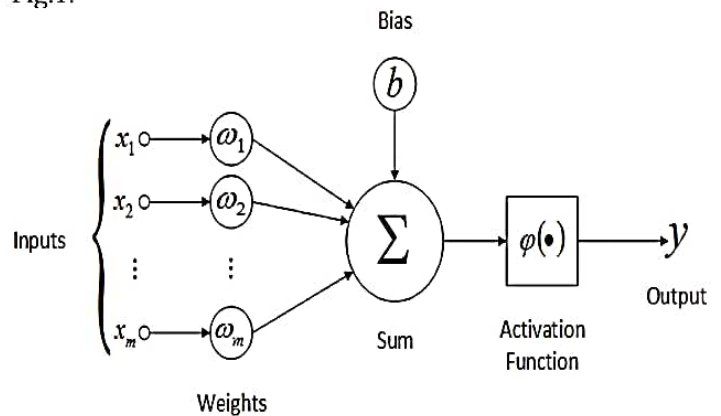


Fig. 1. Structure of Artificial Neural Network model.

In the above figure, the samples of input which are independent variables are taken as x_1, x_2, \dots, x_m to the network. The connection weight or synapse are assigned to each of these inputs by using Zero initialization and Random initialization methods. In the Zero initialization method, the biases are initialized with 0, and weights are initialized with random numbers, while in Random initialization maximum or minimum random values to weights are initialized and it is considered better than the Zero initialization method. The weights are represented as w_1, w_2, \dots, w_m and the neuron makes a summation of all the information it collects, with every set of information is being multiplied by its associated weights to form the products $w_1x_1, w_2x_2, \dots, w_mx_m$. The Activation