**Connection between the Neural Networks and the concepts of Quantum Mechanics: Studying Neural Networks along with Quantum Mechanics**

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**Abstract**

The main objective of this liturature is to study the inner working of Neural Networks(NN) or a Deep Learning NN (DLNN) with respect to the concepts of Quantum Mechanics. The main objective of this study is to establish a working link between the NN and the Quantum Mechanics.

*Keywords: Neural Network, Deep learning, Quantum Mechanics, Physics*

**Quantum State <——-> Neuron Activation**

A quantum state denoted by , represents the system’s state in a superposition of possible outcomes. Mathematically it can be expressed as:

re basis states and are the complex coefficients representing the probability amplitudes. On the other hand a neuron’s activation , is the result of a weighted sum followed by a non-linear activation function:

Where, is the weight connecting input to neuron ,

is the input value,

is the bias term and

is the activation function.

In both the systems the state (quantum or neuron activation) is unobservable directly in its raw form but influences the system’s evolution.

**Super position <——-> Layer output**

In super position a quantum particle exists in all possible states until measured. For example, in two states system (qubit):

Where, and are complex amplitudes satisfying the condition,

Also in a neural network, a layer processes many neurons simultanously and their outputs collectively represents a high dimensional “super position” of information. For a layer with neurons, the output can be represented as

Where, is the vector of the activation,

is the weight matrix,

is the input vector and,

is the bias vector.

The layer outputs like the quantum superposition encode multiple possibilities before collapsing into the next layer’s input or the final output.