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# Optimized Routing Approach using McCulloch-Pitts Neuron model

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**ABSTRACT:** With the amelioration of the promising research work in the sphere of mobile communication and cloud computing, the swift and seamless data transmission stands on congestion control of the network. However, many a routing method involves to easing the congestion in the mobile network. Mostly, the prime focus of any routing algorithm remains towards the approach to the selection of the route in which path data packets are being sent efficiently. But the short fall of this concept is it cannot deal with the congestion prevention and congestion avoidance scenario. Our optimized routing approach with the help of artificial neural network will ensure relatively more smooth data transmission between any mobile device and cloud nodes across the global network by reducing the chance of arising congestion situation.

**KEYWORDS:** Cloud computing, Mobile communication, Congestion, Active Scanning, Passive Scanning.

## 1 INTRODUCTION

Mobile devices are constrained by their processing power, battery life and storage. Cloud computing is a model which can enable ubiquitous network access to a shared pool of configurable computing resources. It provides an environment of infinite number of computing resources. However, mobile cloud computing is a new platform combining the mobile telephony and cloud computing together to create a new infrastructure which can run rich mobile application with a rich user experience, whereby cloud performs the heavy lifting of computing-intensive tasks and storing massive amounts of data. In this new architecture, data processing and data storage happen outside of the mobile devices.

The first formal definition of an artificial neuron model based on the highly simplified considerations of the biological model was formulated by Warren McCulloch and Walter Pitts in 1943. The McCulloch-Pitts model of a neuron is characterized by its simple and precise mathematical definition. This model only generates a binary output and also the weight and threshold values are fixed.

The McCulloch-Pitts neural model is also known as linear threshold gate. It is a neuron of a set of inputs $I_1, I_2, \ldots, I_N$ and one output $y$ .The linear threshold gate simply classifies the set of inputs into two different classes. Thus the output $y$ is binary. Such a function can be described mathematically using these equations:

$$Sum = \sum_{i=1}^{N} I_i W_i$$

$$y = f(Sum)$$

$W_1, W_2, \ldots, W_N$ are weight values normalized in the range of either $(0,1)$ or $(-1,1)$ and associated with each input line, $Sum$ is the weighted sum, and $T$ is a threshold constant. The function $f$ is a linear step function at threshold $T$ as shown in. The symbolic representation of the linear threshold gate is shown in figure.

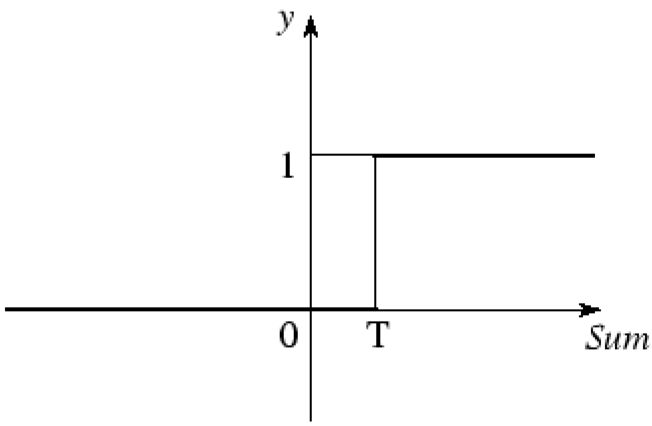


***Fig. 1. Linear Threshold Function***

Fig. 1 shows the representation of Linear Threshold Function.

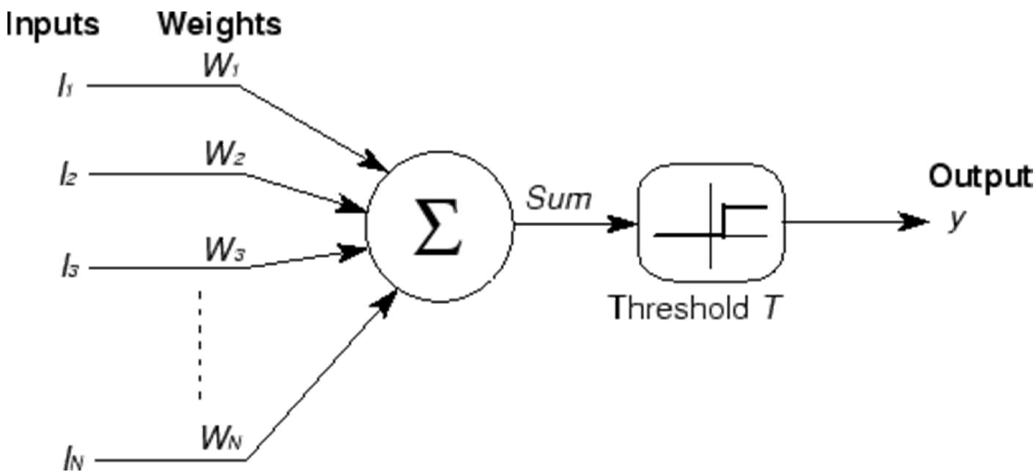


***Fig. 2. McCulloch-Pitts Neuron model***

Fig. 2 shows the McCulloch-Pitts Neuron model.

## 2 ACTIVE SCANNING & PASSIVE SCANNING

When a mobile station (MS) is moving away from its current Access Point (AP), it initiates the handoff process. Then the received signal strength and the signal-to-noise-ratio have decreased significantly. The mobile station (MS) scans the channels which the new base station (BS) uses. The station STA now begins MAC (Medium access control) layer scanning to find new Access Points.

- Active Scanning - The client actively searches for an Access Point. This process usually involves the client sending probe requests on each channel it is configured to use and waiting for probe responses from Access Points. Then the client determines which AP is the ideal one to roam.
- Passive Scanning - The client does not transmit any frames but rather listens for beacon frames on each channel. The client continues to change channels at a set interval, just as with active scanning, but the client does not send probe requests.

## 3 RELATED WORK

In their paper “A novel approach on weight based optimized routing for mobile cloud computing”, Sarddar et al. (2015) have proposed a weight-based route selection algorithm designed with two fundamental network properties i.e. cost of path and channel capacity of a link. Their proposed algorithm, also suggests the method of selection of the base station before routing calculation and implementation. Even their proposed algorithm significantly enhanced time and energy savings through load balancing while routing mobile network transmissions connected to a cloud environment.

In their paper “A Mobile Cloud Computing Architecture with Easy Resource Sharing”, Sarddar et al. (2014) have proposed a model which would allow mobile device users to use cloud-based applications. Through their research paper, they have demonstrated use of a resource manager that enables easy resource sharing. Not only does this translates into savings in terms of power consumption, but also shortens the time it takes for communications to take place.

In the paper "Green Cloud Computing using Artificial Neural Networks" by Twinkle Bedi (2014), we have seen the results of simulation work performed to enhance the effectiveness of Green Cloud Computing using Artificial Neural Networks.

In the paper “A Neural Networks-Based Hybrid Routing Protocol for Wireless Mesh Networks” by Nenad Kojić et al. (2012) a new hybrid routing protocol for wireless mesh networks is presented. They have created new routing metrics based on multi-criteria optimization. They have observed several network parameters in order to provide optimized usage of network resources and network stability. For this purpose they have started with Hopfield neural network and suggested its modification addressed to the improvements of the routing performances in real conditions. Intensive simulations confirm that the use of artificial intelligence can be very efficient in routing, even in the case of dynamical environment.

Kojić et al. have also shown the efficient neural network algorithm for optimization of routing in communication networks in the entitled paper “Neural Network for Optimization of Routing in Communication Networks” (2006).

Overall, the design of a neural network in cloud computing is briefly discussed in the paper “Neural Network Design in Cloud Computing” by B. Rajkumar et al. (2013).

We have studied the real life application and the historical back ground from the paper “Real – World Applications of Neural Network” by Nwankwo Nonso Prince (2011).

In the paper “Optimization of Routing Algorithm using Fuzzy Neural Network” (2012) Arun K. Patel has found the best route through a wide area network (WAN) and optimized the fuzzy reasoning and neural network based routing algorithm.

## 4 METHOD

Our proposed method aims at the proper route selection of any mobile network for message delivery. Improper routing can cause problems like packet dropping and packet delay. In this paper, we have proposed an optimized routing approach using McCulloch-Pitts Neuron model.

We already know,

Throughput = Maximum number of data packets sent / Unit time

And,

Efficiency = Throughput / Maximum capacity of the communication channel

Hence, ‘Efficiency’ could be the input parameter. Assume if calculated value of ‘Efficiency’ is greater than and equal to 0.5 then set input as binary ‘1’.

The weight factor ‘W’ can be obtained from the distance between two nodes. Using ‘ping’ command over the entire node’s IP address we can get the network latency time. Assume each and every network latency time as the weights of the constituent edges of the network.

In a complex network, data packets can be forwarded from the source to destination through several paths. The real complex network can be compared with the multilayer perceptron (MLP) which is truly a feed forward artificial neural network by its nature.

However, we can easily compute the $Sum$ value from McCulloch-Pitts Model equation for all the possible paths between source and destination.

Thus, from the following output activation function, we can simply take decisions on finding out the optimized routes in which paths data packets can be sent efficiently.

$$y = 0 \ \ if \ \ IW < 0$$

And,

$$y = 1 \ if \ \ IW \geq 0$$

## 5 RESULTS & DISCUSSION

By using 'Active Scanning' mechanism, we have determined the nodes in which data packets are being forwarded. Then we are optimizing the route selection process with the afore-said method.

The function that maps the net input value to the output signal, is known as activation function. Sigmoid functions can approximate the step function to the desired extent. Binary sigmoid or logistic sigmoid is defined by

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

Where $\theta$ is known as steepness parameter.

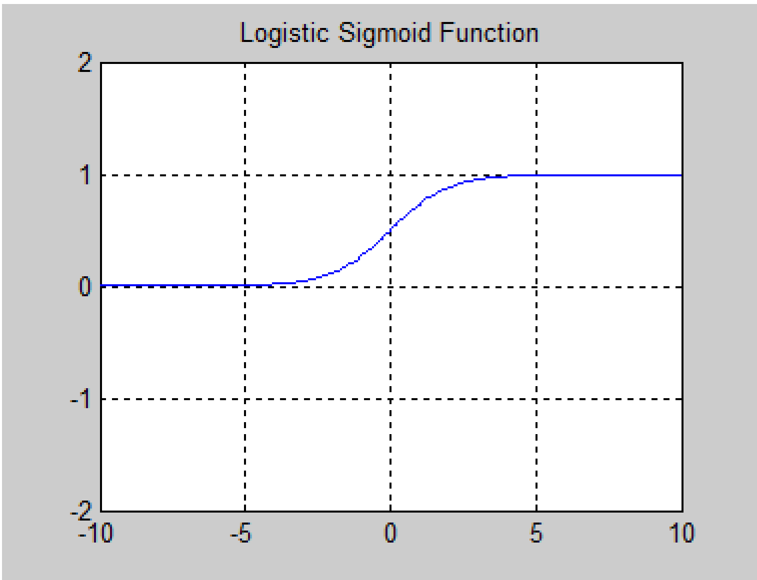


***Fig. 3. Sigmoid Function***

Fig. 3 shows the response of Sigmoid Function.

## 6 CONCLUSION

In this paper, we have presented our research work towards optimized route selection technique. This method can be used in irrespective of any wired or wireless network and even mobile or cloud network also. In future work, we plan to develop a new algorithm which might take care of more real time scenarios where the application of parallelism will enhance the performance improvement up to its apex level.

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