Comparative Analysis Of shortest Path Optimization Techniques in Packet Switching Network based on Neural Network

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ABSTRACT: The more effective neural network algorithm for optimization of routing in communication networks is proposed. As it was well known from literature, various optimization and very ill-defined problems may be solved using appropriately designed neural networks, because of their high computational speed and the possibility of working with uncertain data. Under some considerations, the routing in packet-switched communication networks may be considered as optimization issues, more precisely, as a shortest-path problem. Routing algorithm neural network is designed to find the optimal path, meaning, the shortest path (if possible), but considering the traffic conditions: the incoming traffic flow, routers occupancy, and link or connection capacities, preventing the packet loss due to the input buffer overflow. The performance of the proposed neural network is applicable in different traffic conditions and for different full-connected networks with both symmetrical and non-symmetrical links.

Keywords: Routing, shortest path, optimization, Rosenblatt algorithm, packet Switching network.

I. INTRODUCTION

In modern real communication networks, specifically in packet switched networks, routing is an important and prominent process that has a significant impact on the network’s performance. Ideal routing algorithm comprises finding the “optimal” path(s) between source and destination router, enabling very high-speed data transmission and avoiding a packet loss. Because modern communication traffic is characterized by huge amount of source-destination pairs, high variability, nonlinearity and unpredictability, the routing policy is a very difficult task. Under some assumptions the optimal routing can be considered as the shortest path (SP) computations that have to be carried out in real time. This creates neural networks very good can-didates for solving the issue, because of their high computational speed and the possibility of working with indefinite data.

II SHORTEST PATH OPTIMIZATION

2.1Basic Description: The shortest path problem can be defined for graphs whether undirected, directed, or mixed graph.

The problem is also sometimes called the single-pair shortest path issues, to distinguish it from the following variations:

- The single-source shortest path issue, in which we have to find shortest paths from a source vertex \( v \) to all other vertices in the graph.
- The single-destination shortest path issue, in which we have to find shortest paths from all vertices in the directed graph to a single goal vertex \( v \). This can be reduced to the single-source shortest path problem by reversing the arcs in the directed graph.
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- The all-pairs shortest path issue, in which we have to find shortest paths between every pair of vertices $v, v'$ in the graph.

2.2 Application of Shortest Path: Shortest path algorithms are applied to automatically find directions between physical status, such as driving directions on web mapping websites like Mapquest or Google Maps. For this approach fast specialized algorithms are available.

If one represents a nondeterministic abstract machine as a graph where vertices describe states and edges describe possible transitions, shortest path algorithms can be applied to find an optimal sequence of choices to reach a certain goal state, or to accomplish lower bounds on the time needed to reach a given state. For example, if vertices explore the states of a puzzle each directed edge corresponds to a single move, shortest path algorithms can be applied to find a solution that uses the minimum possible number of moves.

III. ALGORITHMS USED FOR SHORTEST PATH OPTIMIZATION

The most important algorithms for resolving this problem are:

**Rosenblatt Algorithm:** The Perceptron presented by Rosenblatt in 1959. The essential and important innovation was the introduction of numerical weights and a special interlinked pattern. In the original Rosenblatt model the computing domains are threshold elements and the connectivity is determined stochastically. Learning occurs by adapting the weights of the network with a numerical algorithm. Rosenblatt’s model or tool was refined and perfected in the 1960s and its computational properties were carefully discussed by Minsky and Papert [15]. In the following, Rosenblatt’s model will be named the classical Perceptron and the model discussed by Minsky and Papert the Perceptron.

The Perceptron forms a network with a single node and set of input links along with a dummy input which is always set to 1 and a single output lead. The input state which could be a set of numbers is applied to each of the connections to the node.

. Thus the preceptron equation for the class labels $c_k$

$$C_k = w_0 + w_1i_1 + w_2i_2 + \ldots + w_ni_n$$

b) **Algorithm description of Hebb:** Perceptron is the generic name given by the Frank Rosenblatt because it is a model of EYE. Perceptron was an attempt to understand human memory, learning & cognitive process. Training algorithm of perceptron is supervised learning.

It accept no. of inputs $x_i$ ($i=1, 2, 3\ldots n$) & compute a weighted sum of these inputs. The sum is then compared with a threshold 0 of an output Y (which is either 0 or 1)

$$y = 1 \quad \text{if} \quad \Sigma^{n}_{i=1} w_i x_i \geq 0$$

$$y = 0 \quad \text{if} \quad \Sigma^{n}_{i=1} w_i x_i \leq 0$$
The perceptron is the single transmission network consists of sensor modes, association unit & final output of response unit.

c) **Hopfield Neural Network**: A simple single layer recurrent neural network. The Hopfield neural network is accompanied with a special algorithm that defines it to learn to recognize schemes. A Hopfield network is a network of \( N \) such artificial neurons, which are fully connected. The connection weight from neuron \( j \) to neuron \( i \) is given by a number \( W_{ij} \). The collection of all such numbers is represented by the weight matrix \( W \), whose components are \( W_{ij} \).

### IV RESULT ANALYSIS & DISCUSSION

Three different Algorithms are taken for result analysis & discussion (shortest path distance and processing time). Rosenblatt Algorithm, Hebbian Algorithm and Hopfield Algorithm. We can see Rosenblatt Algorithm is superior to Hebbian and Hopfield Algorithms in terms of shortest path distance and processing time. The table form result analysis is depicted below:

<table>
<thead>
<tr>
<th>Nodes(N)</th>
<th>Network</th>
<th>Rosenblatt Algorithm</th>
<th>Hebb Algorithm</th>
<th>Hop Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=7</td>
<td>( \ell = 0.4 )</td>
<td>Source node(SN)=2</td>
<td>Destination node(DN)=1</td>
<td>Connecting paths(C)=9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shortest distance-2.350</td>
<td>Shortest distance-2.8875</td>
<td>Shortest Distance-2.9524</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Processing time-3.0115</td>
<td>Processing Time-3.3238</td>
<td>Processing Time-3.5338</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shortest distance-2.4387</td>
<td>Shortest distance-2.6550</td>
<td>Shortest distance-3.1513</td>
</tr>
</tbody>
</table>
V CONCLUSION

This study proposed an analysis and comparison of shortest path optimization using Rosenblatt and Dijkstra Algorithms.

- In Shortest path optimization using Rosenblatt Algorithm, various Algorithms are used for finding shortest path optimization.
- Shortest path optimization using Rosenblatt over other different algorithms has various advantage. In case of shortest path optimization using Rosenblatt Algorithm over Hebbian Algorithm and Hopfield Algorithm allows the best and least Processing time and shortest path distance covered from source node to destination node in neural network.

References:


