A QoE driven Cell Selection Scheme based on the Attention Mechanism in 5G Networks

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5G 네트워크의 Attention 메커니즘 기반 QoE 기반 셀 선택 방식

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Abstract

In this paper, the attention-based deep learning architecture is considered for intelligent cell selection based on Quality of Experience (QoE) metrics. The attention mechanism is known for its better performance on popular benchmarks in other domains. Also, recently QoE driven handover schemes are being considered over traditional techniques, which mainly focused on Reference Signal Received Power (RSRP) measurements. This paper proposes an intelligent cell selection scheme for handover based on the attention mechanism using QoE data extracted from a protocol stack. The proposed architecture would improve the performance in predicting best neighboring cell that provides the least amount of file download time as it contains an attention head to capture the information in the entire input sequence. Since 5G networks are characterized by extremely dense deployments, precise prediction of a target cell that provides best QoE is essential.

Ⅰ. Introduction

In handover, due to periodic monitoring of the network, measurements regarding link quality can be organized sequentially. So, it is possible to acquire a dataset of instances with multiple features that are arranged in a sequential manner. For instance, Ali Z. [1] et.al proposed LSTM-based architecture to capture the temporal characteristics of the data extracted from the network, the model was able to improve the QoE of User Equipment (UE). However, some UEs exhibit marginally poor QoE as well compared to the benchmark scheme. In order to improve the performance further, This paper considers the attention mechanism which will enable the recurrent network to capture long term dependencies throughout the entire time steps.

Ⅱ. Method

Figure 1 shows the architecture of the proposed model. For input sequence $X = \{x_1, x_2, \cdots, x_m\}$, where x_i is a feature vector extracted from each layer of the protocol stack in a particular time interval. It contains features such as: throughput, cell ID of serving and neighbor cells, number of radio link failures and so on.

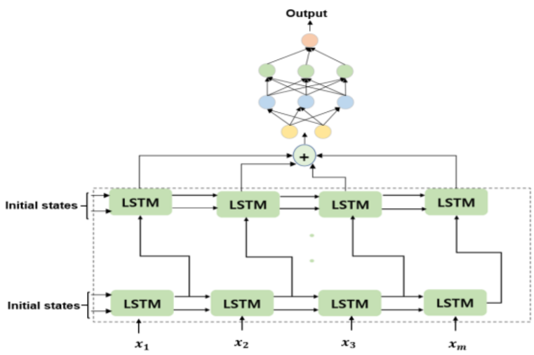

Figure 1. Multi-Layer attention-based architecture

As the series of time-steps increases, the hidden state of the last LSTM cell might not capture the information in the entire sequence well. The main idea of attention is to add new paths from each LSTM unit to the dense layers. The dense unit has direct access to the inputs in each time steps. The hidden state of each LSTM units is further connected to other units as an input for multi-layer connection. From the final layer, an extra path connecting each unit to the dense layer is added. Then, weighted average of the final states would be fed to a standard fully connected dense layer. Finally, the output unit predicts the file download time for each neighboring cells. The cell with least predicted download time would serve as a target cell.

Ⅲ. Conclusion

The main objective of this paper is to showcase the impact of attention mechanism on intelligent cell selection where the attention paths on the architecture would further improve the inference of the model for selection of the best target cell during handover decision.

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