# Identifying Network Throughput Patterns with Deep Learning Techniques

Harun Ur Rashid and Seong Ho Jeong*
Hankuk University of Foreign Studies
harun@hufs.ac.kr, *shjeong@hufs.ac.kr

# 기계 학습 알고리즘을 사용한 네트워크 처리량 패턴 분류

하룬 우르 라시드, 정성호
한국외국어대학교

## Abstract

Throughput is a crucial metric influencing end-user perception and productivity, especially in assessing Quality of Service (QoS) for critical industrial services. In future network scenarios, insufficient throughput, particularly in vehicular networks, could halt the whole service. The current method for assessing network quality involves machine learning (ML) techniques for throughput prediction within the LTE and 5G network paradigm. This study introduces deep neural networks for precise throughput identification, utilizing LTE and 5G vehicular network parameters. Initial results reveal superior performance of ML model with a focus on network parameters, compared to recent studies.

## Ⅰ. Introduction

The progression of cellular networks from 1G to 5G, and the anticipated advent of 6G, introduces a diverse range of commercial services with distinct characteristics and demands. Services like virtual reality, augmented reality, and high-speed autonomous vehicles in 5G and future 6G networks necessitate the acquisition of network resources, specifically network slices, with a focus on top-tier QoS. These services have unique network requirements aligned with their objectives. For instance, communications among autonomous vehicles, including positioning, and warning messages, demands high throughput and low-latency network interfaces. This scenario calls for each vehicle to connect to multiple network slices concurrently, ensuring optimal and reliable performance. This study centers on the assessment of network quality, with a particular emphasis on throughput, in LTE and 5G networks. The objective is to develop a non-intrusive model for classifying throughput, situated within the framework of 6G, leveraging LTE and 5G as benchmark technologies.

## Ⅱ. Method

ML models play a key role in the identification of network throughput, utilizing a dataset derived from the LTE and 5G network scenario. This study proposes the application of a deep neural network model for discerning throughput labels categorized into three classes. The Lumos5G [1] dataset is employed as the basis for this investigation, comprising 65,119 samples. The selected network parameters for the LTE network include RSSI, RSRP, RSRQ, and RSSNR, while for the 5G network, RSRP, RSRQ, and SINR are considered. Model evaluation is conducted through various metrics, encompassing training-testing loss, confusion matrix analysis, Matthews Correlation Coefficient computation, and the Receiver Operating Characteristic (ROC) curve examination for individual throughput classes. To address potential imbalance issues in class labels, a sampling method is implemented.

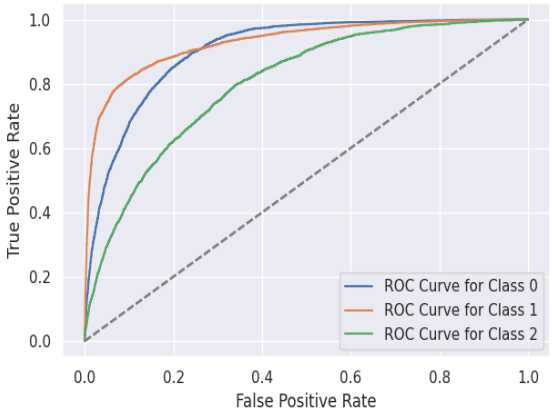


Fig. 1: AUC-ROC curve for testing dataset

## Ⅲ. Conclusion

The AUC-ROC curve underscores the model's excellence in accurately identifying medium throughput (Class 1), surpassing performance in other classes. With an AUC value of 0.84, the model demonstrates a good balance between precision and recall across all classes, indicating its overall effectiveness in throughput classification.

## ACKNOWLEDGMENT

This research was supported by the MSIT (Ministry of Science and ICT), Korea, under the ITRC (Information Technology Research Center) support program (IITP-2023-RS-2022-00156353) supervised by the IITP (Institute for Information & Communications Technology Planning & Evaluation).

## REFERENCES

[1] Arvind Narayanan, Eman Ramadan, Rishabh Mehta, Xinyue Hu, Qingxu Liu, Rostand A.K. Fezeu, Udhaya Kumar Dayalan, Saurabh Verma, Peiqi Ji, Tao Li, Feng Qian, Zhi-Li Zhang, February 11, 2021, "Lumos5G Dataset", IEEE Dataport, doi: https://dx.doi.org/10.1145/3419394.3423629.