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GraphNPP: A Graphormer-Based Architecture for Network Performance Prediction in Software-Defined Networking

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Abstract : Network performance prediction (NPP) is essential for the management and optimization of software-defined networking (SDN) and contributes to improving the quality of service (QoS) in SDN to meet the requirements of users. Although current deep learning-based methods can achieve high effectiveness, they still suffer from some problems, such as difficulty in capturing global information of the network, inefficiency in modeling end-to-end network performance, and inadequate graph feature extraction. To cope with these issues, our proposed Graphormer-based architecture for NPP leverages the powerful graph representation ability of Graphormer to effectively model the graph structure data, and a node-edge transformation algorithm is designed to transfer the feature extraction object from nodes to edges, thereby effectively extracting the end-to-end performance characteristics of the network. Moreover, routing oriented centrality measure coefficient for nodes and edges is proposed respectively to assess their importance and influence within the graph. Based on this coefficient, an enhanced feature extraction method and an advanced centrality encoding strategy are derived to fully extract the structural information of the graph. Experimental results on three public datasets demonstrate that the proposed GraphNPP architecture can achieve state-of-the-art results compared to current NPP methods.

Keywords : software-defined networking, network performance prediction, Graphormer, graph neural network
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